**Chris Montague-Breakwell**
Good afternoon and welcome to this webinar in EPA's Stormwater Pollution Prevention Webinar Series. This webinar will cover the topic of road salt. We are going to wait just a few minutes, two or three, to give registrants a few more minutes to come in. We had a tremendous amount of interest in this so we are going to wait and give those attendees who are just a few minutes late coming back from lunch a chance to phone in. Stand by.

For those who just joined, this is EPA's Stormwater Pollution Prevention Webinar Series. Today we will cover the topic of road salt. We are waiting just a few minutes after 1:00 p.m. to allow registrants who are just a minute or two late to call in. And we will be starting in a matter of minutes. Thank you for calling in.

Good afternoon and welcome to this webinar in EPA's Stormwater Pollution Prevention webinar series. This webinar will cover the topic of road salt. The application and storage of deicing materials, most commonly salt such as sodium chloride, can lead to water quality problems for surrounding areas. The webinar will present information on the impacts of road salt on the environment, implementation of TMDLs involving road salt, successful reduction strategies used by states, and possible groundwater impacts. The webinar will cover actions taken to address road salt by Minnesota and New Hampshire, as well as an EPA study on potential groundwater impacts. This webinar is sponsored by EPA's Office of Wastewater Management, 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 speaker's organizations are their own and do not necessarily reflect those of the EPA. The mention of any commercial enterprise, product or publications 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 the listen only mode. By default, all attendees entered using microphone and speakers. Please make sure that you have selected the correct audio settings in the Go-To Webinar audio control panel, either telephone or microphone and speakers. We encourage you to submit questions to our speakers during the webinar. To ask a question, simply type in the questions pane in the attendee control panel and click send. If your control panel is not showing, simply click on the small orange box with the white arrow to expand it. And you should be able to do that on your screen right now. Each speaker will give a roughly half-hour presentation followed by around 10 minutes of questions after presentations. If we have good Q&A, a good discussion going, we of course, can extend that. And, again that is a Q&A after each

presentation, each of our three presentations. As a moderator, I will read the questions allowed so that everyone on the line can hear it. And the speaker can answer. If you've any technical questions, you can let us know by entering in the questions pane and 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 could access it in the next few weeks after today's live presentation. The archived webinar will be posted on EPA's NPDES, that is National Pollutant Discharge Elimination System, training page, which is available at www.EPA.gov/NPDES/training. And all registrants will receive an e-mail with that link at the end of the webinar.

It is now my pleasure to welcome and introduce our speakers. First, we will be hearing from Philip Trowbridge and Eric Williams from New Hampshire Department of Environmental Services. Their presentation is entitled, “Road Salt TMDLs and Road Salt Reduction Strategies in New Hampshire.” Next is Doug Heath from EPA's Region 1 up in New England. And he will be presenting, “Road Salt Transport at Two Municipal Wellfields in Wilmington Massachusetts.” And finally, Brooke Asleson from the Minnesota Pollution Control Agency, Mark Fischbach and Kathleen Schaefer from Minnesota's Department of Transportation will be presenting, “Sharing the Road and the Environment.”

One final note before we get started with our first speaker, we will try to address as many questions as possible throughout this webinar however, due to the high number of participants, we have almost 1,000, not all questions may be answered. If you have unanswered questions, please e-mail the presenters directly or myself. We will provide you with the presenters and EPA's contact information at the end of the webinar.

So without further ado, our first speakers are New Hampshire Department of Environmental Services Philip Trowbridge and Eric Williams. Phil and Eric, I'm handing you presenter powers.

**Philip Trowbridge**

So good morning or good afternoon depending on what time zone you are in. For this presentation, Eric Williams and I will be sharing our experiences with road salt TMDLs and reduction strategies in New Hampshire. I will be doing the first part of the presentation and Eric will do the second.

This graph by Keith Robinson of USGS is useful for setting the stage. As you can see, starting in the 1940s, road salt began to be heavily used for deicing. Road salt was more effective then sand and it also had the added benefit that it would “melt away” at the end of the season. In response to this change in

practice, we have seen changes in our chloride concentration in New England streams shown by the symbols on this graph.

As a mountainous state in northern New England, New Hampshire uses a lot of salt. We also have a fair number of chloride impaired waters as a result. The number of impaired waters seems to be increasing and that may have something to do with our improved ability to detect these impairments. It's an important factor to recall that in the 1920s the baseline concentration of chloride was 1.3 milligrams per liter in our state. Now, when we monitor our chloride impaired waters, we are seeing concentrations that average 100 milligrams per liter. So we are talking about a major shift in the geochemistry due to this change in salting.

The state of New Hampshire has adopted the EPA recommendation for chloride water quality criteria. In particular, the four-day average of 230 million grams per liter and the one-hour average of 860 milligrams per liter. But road salt can also affect other things besides aquatic life. It can affect human health, infrastructure and aesthetics. Another important thing to consider when we talk about road salt is that treatment of chloride enriched waters is nearly impossible. Traditional BMPs do not remove chloride and one of the only effective techniques is reverse osmosis. So source reduction is really the only effective strategy.

The New Hampshire Department of Environmental Services became involved with this road salt issue when plans were made to expand Interstate 93.

Monitoring by DES and EPA had already shown that there were chloride impairments in some of the watersheds along the highway. A TMDL was needed to figure out allocations for the new highway lanes and the other sources that already existed in order to remove the impairments. After the TMDL was completed in 2008, the DES has continued to monitor the watersheds to track improvement and to gather more information.

I'll just direct you now to our study area. The watersheds we studied were in the southern part of New Hampshire just on the border with Massachusetts. This is our watersheds here. This is the Policy Brook watershed. It is about 40 miles from Boston in this direction [southeast]. And Manchester, New Hampshire [Northwest of the watershed] is the largest city in New Hampshire.

The rest of the talk I will be just talking about the Policy Brook watershed here in the interest of time.

Now Policy Brook is a stream that only a mother can love. The Policy Brook by the numbers. It is the watershed drainage Policy Brook is 10 square miles. It

adds 10 square miles. It contains 100,000 people. 98% of this watershed is urbanized area, according to the MS4 program. 36% is highly developed or transportation/land use. There is not one, but two, shopping malls in the watershed and one large uncovered salt pile as well. And I will just draw your attention to the bag of rock salt in the stream. We did not stage this photo. I can assure you that. It's the way it is.

For the TMDL monitoring that we did in FY 07, we measured temperature specific conductance, streamflow every 15 minutes using programmable data loggers. We also collected grab samples of chloride every few weeks to be analyzed in the lab to confirm our relationship between specific conductance and chloride. And then we plotted these yearly time periods.

Just expanding here, the plan series for chloride concentration, and what you can see here is in the blue lines is the record from the data loggers and the red dots are the confirmatory samples of chloride taken every few weeks. And what we noticed is that we had high concentrations of chloride here in the winter season. That was expected. What was unexpected was that we also had high concentrations. And in fact, the worst period of time for high chloride was the summer. On average, the concentration was 103 milligrams per liter and I take this time to remind you that the baseline used to be 1.3, so more than two orders of magnitude difference. And we were in violation of our water quality standard about 25% of the year.

As it turns out a better way to analyze the data was to use concentration or calibration curve like this one. So this graph plots the daily average concentration versus the flow exceedance percentage for that same day. You can see that regardless of season, chloride concentrations were high during the low flow periods. This indicates a groundwater pathway as the source of chlorides to the stream and not the surface water source, as we had previously suspected.

For the TMDL we also gathered data on salt forces in the watershed. And besides the obvious source of highway deicing and roadway deicing, we looked at parking lots, water softeners, septic systems, and salt pile runoff as contributors. Overall, as you can see for this watershed, more than half the salt was from parking lot maintenance. And this is not a universally applicable finding but it was important in our case here. It did highlight the importance of parking lots for implementation.

Our official TMDL for this watershed was expressed as a low flow duration curve. There are lots of advantages to that approach from a legal perspective because TMDLs must show that a water quality standard will be met under all conditions.

And as we showed earlier, the concentration of chloride in the stream depends heavily on stream flow. So a low duration curve had to account for that. But we had to translate that as an abstract concept into a more traditional tons per year or percent reduction terms to guide implementation, and also to divvy up the loads between the different sources. This became the starting point for negotiations between the different parties to set the final allocations.

After the TMDL was complete, we've collected five more years of data using the same method and our goal for this continued implementation monitoring was to document changes due to any salt reduction strategies that were put in place and to better understand the dynamics of chloride in these watersheds.

This graph is showing now the average chloride concentrations in the watershed changed between 2007 and 2012. The graph on the bottom is the Weather Severity Index which is an index used by DES and our Department of Transportation as a measure of how harsh the winter was. This WSI, which has been shown to be well correlated with total salt use. So you can see during the colder winters that occurred in FY 08 and FY 11, the chloride concentrations -- the chloride concentrations were higher. And obviously, during the more mild winters the concentrations were lower.

This slide takes the data and shows it in a different way. What we are showing on the top graph is the number of days in the year in which we had violations of our water quality standard at each of the stations that we were monitoring. And you can see again, this large spike in violations during the colder years and that there is some variation between the three different watersheds we were studying in terms of their severity of impairment.

Based on the data we collected for the TMDL in 2007, we observed something that we thought had potential for making TMDL simpler. And on the left part of this slide you will see a graph that we pulled out of this paper and I've given the citation here. And what we had noticed is that the number of exceedances of our standard seemed to be related to the average concentration of chloride at the station during the whole year. So each of the points on this graph represent a whole year of data and it shows the average concentration that was measured for that whole year and then how many days of the year were we in violation of our standard. And we had observed there was a threshold around 100 milligrams per liter as an annual average below which violations of the standard did not occur.

As we've collected more data, we have added more points to this graph and that is what is shown in the right-hand slide. And you can see that this pattern, this empirical relationship, continues to be followed. That, at approximately

100 milligrams per liter as an annual average, below there we do not typically see any violations of our water quality standard at a station. And above it, the risk or the incidence of violations increases.

The implications of this relationship are important. In the first case, it would greatly simplify TMDLs for road salt if we could avoid the low flow statistics and use a simple mass balanced approach. And one of the other things is that it generally, is very helpful for planning and screening purposes. So however this is an empirical relationship and it needs to be confirmed for other areas. It's only been confirmed in areas of southern New Hampshire. So we are hoping by sharing this today that it will inspire others who are doing this type of monitoring to try and generate these same graphs and see if this relationship can be universally applied or somehow be applicable in other areas. And it should also be recognized that the legal water quality standard cannot be replaced by an empirical relationship so right now it is limited to just planning purposes.

Another important observation that we made over the years is that grab sample measurements of chlorides can be used to accurately measure annual average concentrations. What this graph is showing is just a comparison of the annual average chloride concentration and a station measured by two different methods. On the bottom, we have the measurements from the average of the grab samples, which would be about 10-12 samples in a year. And on the vertical axis, we have the average concentration from the data loggers, which are a measurement that typically are the average of 30,000 measurements during the year. And you can see that they correspond pretty well. This is important because many watershed groups and local governments do not have data loggers that collect 15-minute data on chlorides, but handheld meters are common. So in conjunction with the empirical relationships that we were just talking about, we have just a pattern we are seeing here and we have a start of a simplified method for chloride TMDLs in planning.

So now, I'm getting ready to handle this presentation over to Eric and let me just conclude by saying in summary we in New Hampshire we've used the whole range of methods for road salt study. We have used the sophisticated methods with data loggers and low flow statistics which are important for official TMDLs and enforcement actions. We have also found that simpler screening level assessments can be done with handheld meters to make quick assessments and preliminary calculations of salt reduction targets.

And we hope this information is helpful and that we certainly would like to hear from you all if you have any information to share with us and our contact information will be available at the end.

**Eric Williams**
Okay, thank you, Phil. I'm going to talk about what we did in response to all of that work that Phil did clearly outlining the magnitude of a chloride problem in these streams in southern New Hampshire. And by the way, that is Phil living the dream collecting chloride data in a polluted stream.

So what do we do to try and take this message out to people and begin to take action to implement the TMDL? The first thing we did is we formed an I-93 Salt Reduction Work Group made up of representatives from the Department of Transportation, from the municipalities in those watersheds, from the federal agencies, from environmental groups and also from private sector property owners and salt applicators.

And what we found fairly quickly is that people responded to this problem in a similar way to that which people respond to many problems by going through the five stages of grief. The first one and with the Salt Reduction Work Group this lasted probably about a year through our meetings, this state of denial. There is not a problem. We have to do this. What are you talking about?

After that we move into the anger phase and this one probably also took about a year. There was a lot of anger at many of these meetings mainly because people that were applying salt and maintaining the roads, saving people's lives which is not a stretch of the imagination, felt that that should not be jeopardized because of a fish.

Moving from that, you start to see bargaining. Where the people that are involved in these operations start to think about the problem a little bit and realization slowly starts to sink in that there is something to all of this data that Phil meticulously collected. But they try to find other ways. Well, can't we just treat the stormwater? Can't we just use an alternative? And when we talk through all of those things, we generally get to depression because those other solutions won't really solve the problem and then there is a realization that there are just so many variables that factor into this, many of which are out of the control of the winter maintenance operator.

From there, and again, we are about five years into the work group's activities. We move to acceptance. We feel that generally now there is acceptance that everyone has to use less salt. And that is really where we want to be. Once you get here, it becomes more feasible to try and implement the various solutions that we have for salt reduction. And we wanted to take it a step further here and create a program that could work on many levels in a positive way to the winter maintenance industry. Working with the University of New Hampshire's Technology Transfer Center, we created a certification and training program

called Green SnowPro. For this program, we have three major audiences and again you saw these appear in the pie chart that Phil showed. Each one of these has a significant contribution to the chloride loading to these impaired streams and we found that in other areas with impaired streams these are the primary audiences as well. Often in varying proportions but each one remains significant in each watershed where there is a chloride impairment.

So we wanted to design a program that could reach all of those audiences and really just talk about BMPs. And some of these obviously take equipment changes. However, we did not want to predicate the program on the need to upgrade equipment because we knew that would be impractical especially in a watershed where there are probably hundreds of different people in the private sector doing maintenance on parking lots and private roads as well as foreign municipalities in the state of New Hampshire.

So we focused on things that everyone can do like calibrating whatever equipment you have and we weren't all that surprised to find that many of the people that are operating out there, particularly in the private sector, did not really have a handle on how much material that their equipment was putting down. And through this training program, we found that people were able to learn quite a bit about their own operations that they did not know before.

And for those in the municipal and state maintenance fields it was I think somewhat comforting to them to know that we are really not talking about things that are all that much different from what has historically happened with winter maintenance. As Phil mentioned, New Hampshire was the first state to use salt regularly on its highways in 1941. And you can see from these photos that we've had some of this equipment and these techniques in place from the very beginning. In the photo on the right, those two gentlemen would have 50-pound bags of salt, burlap sacks of salt that they would slice open with a knife and send the salt down that shoot and the driver of the truck would honk his horn every mile on the odometer. The guys in the back knew that they were supposed to unload six bags of salt every mile for an application rate of 300 pounds per lane mile, which is not all too different than what we are using today depending on the weather conditions.

And so the Green SnowPro program spent a half a day with operators in the classroom talking about a lot of the basics of winter maintenance operations. And a lot of that is simply about how salt works. And the difference between air temperature and pavement temperature and why that is important and how the effectiveness of salt is reduced the lower the temperature gets. Things like that that many in the business do know but many in the business also do not know. Particularly in the diversity of private sector operators. Following the classroom

training there is a hands-on segment where we go out into the parking lot of whatever facility that we are at and we actually calibrate a piece of equipment with the group. And in this photo, they are capturing, after they set the settings on the gauge, and on the auger they are capturing the salt discharge from the hopper and they will weigh that to show how much salt is coming out of the truck at whatever setting that they calibrated.

Another aspect of the training program is a salt accounting system. And this is something we knew we were going to need to do early on for those I-93 watersheds and any watershed where we do a TMDL and implement it. We have to know over time how we are doing on chloride loading in that watershed. And with such a large presence of private-sector applicators that is a challenging thing to do. The state DOT and the municipalities do a nice job keeping track of how much salt they use and we have a pretty good handle on their application rates. And the state Department of Transportation, by the way, has reduced their salt loading by 20% so far and they continue to implement changes to their operation.

So mainly for the private sector, UNH developed this online salt accounting database and I’ve got the website there if you want to check it out. This is open and available to anyone to use. And there are two options in the database. If an operation just wanted to track their use annually, they could do that. Obviously, that's much simpler. If they know how much salt they use over the course of the winter and they know either how many miles of roads or how many acres of parking lots that they maintain, we can then calculate their overall loading rate by watershed because there is a geographic function in here to state the location of the places where the salt is being applied.

If they would like more detail than that, they can choose the log book function which allows the operator to record what they have applied event to event. Many of the private operators particularly the larger ones are already doing that in some form or other. Many of them do that for purposes of liability protection. And that issue of liability protection was something that was raised from the very beginning when we first got the Salt Reduction Work Group together. That fear of a lawsuit is one of the major drivers behind operators applying more salt and that fear of liability was a motivator for them to apply more salt rather than less salt and in some instances that is really the driver behind how much salt is being put down. And given that the premise of all of our programs and all of our BMPs is to maintain the current level of service, whatever that may be, and to focus on efficiency and salt use, we felt that tackling that liability question is something that we probably need to do over the long term if we are going to accomplish real salt reduction in the private sector.

One of the things that we are trying to do is provide that liability protection through legislation. We have had bills in the last three sessions of the Legislature that have met with limited success. Last year one did pass the Senate but did not pass the House. And this year we do have another one House Bill 523 that in fact has a public hearing coming up next week on Tuesday where liability protection would be given to operators who choose to get certified under the program. And if they commit to using best management practices and keeping a log of their winter maintenance activities. So we will see how those hearings go in the coming weeks and months and have gathered more and more support as we talk about this each legislative session and we are hoping for better results this time.

In addition to certification and training, where we are tackling the aspect of the problem that is in the control of the winter maintenance operators, there's a big part of this that's not in their control and that is driver expectations and driver behaviors. And so we are working on trying to identify the drivers behind those behaviors, what motivates people to do the things that they do, what are some of the barriers to changing that behavior and then using that information that we hope to gather through focus groups and similar techniques to develop more messaging although this one was not done by us. Someone sent us this photo. For those of you outside of New England I probably need to give you a New England dictionary definition, alternate definition of word wicked. It is an adverb that means very. So anyway, we need – we know we need to work on messaging, winter messaging for drivers and the state Department of Transportation has started to do this through the message boards along I-93 and other highways in the state where they are putting forecast information on there. They are posting advisory -- winter advisories with lower speed limits and things of that nature. But we know we also need to do more to reach mainly on I-93 the commuting drivers and also on the weekends the skier traffic that comes up on Friday nights and goes home on Sunday afternoons. Those are the busiest times on the highway. And those are the prime audiences that we need to reach with messaging about taking precautions about winter driving because it is an inherently dangerous activity. And maybe reducing those expectations that you can continue to drive 75 miles per hour regardless of the day or the weather.

And if that does not work, one of our staff has this idea. There's a sign when you enter the state of New Hampshire with our state motto, “live free or die”. Our colleague Barbara McMillan suggested maybe we change that and put this sign on the highway entering this state, if all else fails.

So we thank you very much for the opportunity to give this presentation. And as Chris mentioned, we are available for questions or follow-up via e-mail afterwards. Thank you.

**Chris Montague-Breakwell**
Thank you, Eric and Phil. Now we are going to go into our Q&A for our first presentation. So listeners, if you would type into the "Question" box your question. I see many of you have submitted them already. I'm going to go through and will answer as many questions as possible. We may not be able to get to all questions because we already have a list of about 100, most of them dealing with audio issues. But let me dive in right now. And please keep asking questions and other presenters, Minnesota and Doug for EPA, if you want to jump in and help answer a question, feel free.

So our first question is and I see many people are asking this, this is for Eric. Were you able to explain the summer peaks when there was more salt use in the winter? There seems to be a lot of questions about that summer peak of salt. Eric.

**Philip Trowbridge**
This is Phil. I'll handle that question. Yeah, we explained it by the fact that the salt was not running off immediately into the stream. The salt was going into the groundwater and then it was slowly bleeding out into the stream and so you can think of it as having a large reservoir of salt that is slowly coming out and that as your stream flows go down your concentrations in the stream get closer to your ground water concentrations. So really, it's more a case of the salt not being diluted during the low summer streamflow then anything else.

**Chris Montague-Breakwell**
Okay. Thank you. Next question, on this note you mentioned the source of chlorides was mostly from groundwater and not surface water, have there been any studies related to how the typography and/or hydrogeology impact the amount of chlorides that you have measured already planned?

**Eric Williams**
Yeah, we actually did a groundwater study with the USGS and it was really very helpful because we could look at some of these pathways in the subsurface environment. And we did that in one location where we had a particular salt pile source. In the other watersheds, it just appears to be the case of groundwater saturation and so the groundwater model or the simplistic groundwater model is used to explain it.

**Chris Montague-Breakwell**
Okay, thank you. Next question, it is my understanding that roadway departments use different salt types than residential or parking lot owners. Have you conducted a test to indicate the difference?

**Eric Williams**
No, it's just different types of salt. We did not -- this was not a big factor for us. I think when you are dealing with the roadway with some of the CPW's and the state you have to account for the salt/sand mix appropriately in terms of their salt load. But they normally do that for us because you know, that is something they are – they doing the mix themselves. I think we did not get into accounting for any of the sort of non-salt deicing products that may be used by private entities because that was generally a much smaller piece of the pie than the typical rock salt that is used.

**Chris Montague-Breakwell**
Okay. Next question, what type of sensor was used to monitor the chloride concentration in streams? For example, the data shown with the 15 minute intervals and how many grab samples per year were needed?

**Eric Williams**
We used a variety of different loggers. We used in-situ TROLL 9500 with a specific conductance meter and a temperature sensor on it for most of our measurements. We also used YSI 6600 data loggers and for our grab samples of chlorides we collected them every 2-3 weeks during the year. So we had somewhere between 12 and 15 samples during the year. We found that since then the relationship between chloride and conductivity is very stable so we've backed off and we only collect chloride samples every six weeks.

**Chris Montague-Breakwell**
Next question. Does the 26% reduction in salt used by the state DOT account for the milder winters we've been having in the Northeast?

**Eric Williams**
Those numbers are adjusted for whether severity based on the index that Phil described so they do take into account the different weather conditions year to year.

**Chris Montague-Breakwell**
Great. The next question, how does brine compare with the traditional rock salt in terms of concentration and mobility in the watershed?

**Speaker**
The brine that they use is a solution of 23% salt in the water. And that is put down by -- mainly it's used by the state highway department and they use that on I-93 when there is a storm in the forecast and they apply that before the storm hits. So when you drive those roads after the brine is applied and before the

storm, you will see actually a grayish colored striping down the highway where the brine from the nozzles hits the highway and it sits there until the weather hits and what it does is it allows the salt to work right away because it is brought immediately into the solution is what salt needs to be to work. Another benefit of it is with the application of liquid brine, you don't have the bounce and scatter that you have with rock salt so there is some immediate savings there in terms of getting all of the material that you want in the place that you want it without losing it to the roadside or to the ditches. And I have seen some studies of trying to manage that and the amount of loss from bounce and scatter can be significant, up to 30-35% of the supply. So you don't have that with the use of liquid brine. Now with the liquid brine, it does not eliminate the need for salt applications during and at the conclusion of a storm event. However, I think the Department of Transportation has found that by using those practices in combination that has helped them to achieve that 25% reduction in overall salt use.

**Chris Montague-Breakwell**
Okay. Next question, did the rate of accidents go up with the decreased use of salt? Was there any demonstration that there was an increase in road accidents?

**Speaker**
No, there is no evidence for that. And again, it's because the goal of – the level of service goal remains the same as it was before these changes to the practices were made. So road conditions really aren't any different than they were before this started. So therefore, we would not expect to see a difference in the number of accidents.

**Chris Montague-Breakwell**
Next question, what BMPs were most effective for the DOT's 20% salt reduction?

**Speaker**
I don't think you can point to any one BMP, but I think it's a combination of use of liquid brine for anti-icing use, of automated weather systems, whether information systems, use of underbody plows that gets you a cleaner scrape from the pavement, more instruction for drivers, more attention to the issues, make people pay more attention to what they are doing with salt spreading. And you know, they continue to find -- to look for ways to make improvements. They are experimenting with GPS technology to more precisely measure how much salt is put where. So I don't think there is any one BMP that you can point to as being the primary reason that those reductions were achieved.

**Chris Montague-Breakwell**
Okay. Next question is magnesium chloride any environmentally friendlier than

salt for ice control?

**Speaker**
Not, not really. And not for the reasons that most of our water bodies are impaired in New Hampshire, which is for chloride. It still has a chloride ion in it, which is completely soluble, and once it's applied, it's in the watershed until it gets flushed out. So perhaps the only difference is if you do have a concern over sodium levels in a drinking water supply, mag chloride obviously would take sodium out of the picture.

**Chris Montague-Breakwell**
Okay. Next question, prime applicators have told me they have to apply manufactures application rate in order to avoid liability. Is there anything being done in your program to try and get producers of salt to try and reduce the high application rates they recommend in their instructions on the salt bag itself?

**Speaker**
We have not heard that concern from private applicators in New Hampshire. And most of them are purchasing their salt in bulk from wholesale suppliers and those people do not provide instructions on application rates. I think you might be referring to what is available in say the hardware store if a homeowner goes into buy a bag of salt. It might have a rate on there. But in our experience that generally is not what happens with our private applicators here.

**Chris Montague-Breakwell**
Okay. Can you go a bit more into detail about the -- what is offered exactly in limited liability provisions in the House Bill 523?

**Speaker**
Sure. Basically, it's modeled after liability protection provisions that are in New Hampshire law for ski areas. And what that law says is that skiing is an inherently dangerous activity. Therefore, absent gross negligence, if somebody has a crash on a ski area and say hits their head on a tree, the ski area owner or operator is not liable for damages. And so the parallel here is that walking on snow and ice or driving on snow and ice is an inherently dangerous activity and so if an applicator gets certified and follows best management practices, absent gross negligent the applicator would not be liable for damages for any incident that occurs due to snow and ice.

**Chris Montague-Breakwell**
Okay. Phil and Eric, thank you so much for your presentation. This will conclude our Q&A for Phil and Eric's New Hampshire presentation and we are going to move to our next presentation.

For the many people who had questions about groundwater or drinking water contamination, save them for our next presenter, Doug Heath from EPA who will discuss groundwater contamination by road salt. Doug, I'm handing you presenter powers.

**Doug Heath**
Okay, does that show up alright, Chris?

**Chris Montague-Breakwell**
Yes.

**Doug Heath**
Okay, great. Good afternoon. My name is Doug Heath and I work with the Drinking Water Protection Branch of the EPA in Boston. For the last say 28 years we've been in involved with all kinds of drinking water protection efforts in New England. And looking at road salt has been one of the more recent issues of concern that we've been grappling with. And it's a widespread issue that occurs as you know, not only in the Northeast but also the rust belt and also the Rocky Mountain areas where ever salt is applied for winter and highway maintenance.

This study in Wilmington grew out of a larger one looking at the impacts of I-93 widening on water resources in three towns known as Andover, Tewsbury and Wilmington just north of Boston. A full report about today's talk will be published in the March issue of the New England Waterworks Association Journal.

As you know, there are many sources of sodium and chloride that can affect drinking water quality. And the most common ones are listed here. For this study, we will focus on the last two as they have the greatest potential for impacting surface water and aquifers in developed areas.

The wellfields that I will be describing this afternoon are located in Eastern Massachusetts, 16 miles north of Boston. Interstate 93, shown here in the town of Wilmington is the major source of road salt in the area. Wilmington is a residential community of about 25,000 people. The two wellfields are Browns Crossing and Barrows Wellfield which lies 2,800 feet respectively down gradient of this major transportation corridor. The surface and groundwater flows from left to right in this figure. Also note the network of smaller town roads that are important secondary source of sodium chloride to the wells.

This graph shows historical concentrations of chloride measured in wellfield raw waters since 1950. Before I-93 opened in 1960, the chloride averaged about

5-milligram per liter in the surrounding aquifers. Since then chloride levels have increased 40 times due to deicing salt practices by both the state and local town entities.

More recent sampling of raw water in 2009-2012 shows that chloride concentrations range from about 180 to 320 milligrams per liter at Browns Crossing shown here in red and sodium which is shown here in the blue colors. Sodium averages seven times state advisory levels for people on salt reduced diets.

This is a photograph of I-93 just west of Browns Crossing Wellfield. There are eight travel lanes and two breakdown lanes. Each lane mile of pavement is equivalent to about 1 1/2 acres in size. There are also two interchanges in the wellfield recharge area.

This is a photograph of what many highway catch basins look like. Most are connected to storm drain piping that discharge directly to streams, wetlands and groundwater.

Here is a typical stormwater outfall that is highly effective in channeling water from paved surfaces but affords no treatment of water quality to sensitive water resources.

In addition to road and pavement areas, there are 40 acres of parking areas in the Browns Crossing Source Water Protection Area or SWPA. A SWPA is equivalent to the total recharge area of both surface and groundwater that supplies water to a wellfield.

All of the parking areas are treated by private landscaping companies hired by property owners. Over the last two winters, reported loading have averaged approximately 1 ton of chlorine per acre. This rate is far lower than for highways where car and truck velocities are far greater.

This map shows that nearly 90 outfalls discharge saline stormwater to the wells recharge areas shown here by dashed lines. Those belonging to Massachusetts Department of Transportation are shown as squares, while those for Wilmington are triangles. And parking lots are designated as circles.

Our GIS program was used to measure the total lane miles salted within each recharge area. About 2/3 are those maintained by Massachusetts DOT, shown here in magenta. Parking areas are shown in blue. And town roads, both secondary and primary, are shown as green and blue colors. Measuring pavement areas is critical to understanding the percentages of salt loadings by

responsible agencies.

This 3-foot diameter storm drain channels runoff from 1,000 feet of I-93 pavement into a brook that flows directly to the Browns Crossing Wellfield. This was one of the key sites for stormwater monitoring during the winter months.

Up to 13 datasondes were installed in wells and streams to continuously measure changes of specific conductances and temperature. These data loggers are similar to ones described by Phil and Eric in their presentation and this is a YSI 600 XLM that was used extensively in the I-93 area as the TMDL program was being established.

Some datasondes, such as this, were employed in monitoring wells in both wellfields to detect changes in groundwater over time.

And this figure shows the path of the stormwater from the I-93 culvert to Browns Crossing Wellfield. Water flow directions in this figure are shown by the arrows. The red line on the right is part of the Source Water Protection Area boundary. Over 1,000 feet of eight lanes of I-93 highway contribute stormwater to this one culvert. Data loggers show that stormwater travels to the wellfields from just 2-6.25 hours.

This graph shows the correlation of chloride to specific conductivity based on 68 laboratory samples of well water and surface water in Wilmington. As you can see, the correlation coefficient is quite good, above 99%.

This correlation graph allows for the calculation of specific conductivity measured by the data loggers to chloride concentration in streams and raw well water. This graph shows peaks of chloride in surface water and Browns Crossing Wellfield from November 2010 through July of 2011. Base chloride levels in the stream averaged about 250 milligrams per liter, which is the secondary MCL for drinking water.

Now to introduce the wellfields themselves in more detail. Browns Crossing Wellfield is an old wellfield. It is the largest in the town of Wilmington. It was built in 1928. It started out with a design capacity about 1.5 million gallons per day and consisted of tubular wellfields in wetland ranging from 53-83 feet in depth. The geology is overburden consisting of 3 feet of peat, of 66 feet of coarse sand that overlies 14 feet of fine to coarse gravel, which is the main water bearing unit over fractured metamorphic bedrock.

The new Browns Crossing Wellfield was built and began operations in March of 2011. It has a slightly lower capacity but the maintenance benefits are far

greater because they are not submerged in wetlands. Because of the liquid, there are various difficulties in well maintenance and restoration. 16 wells were installed on dry land and these are screened from 61 to 83 feet depth in that key water bearing unit.

This is the plan view of the wellfield showing the supply wells in red next to the monitoring wells in yellow. Some of these monitoring wells were used for our data loggers to measure changes in their conductivity and temperature overtime in groundwater itself during pumping operations.

This is a plan view of Barrows Wellfield showing its Source Water Protection Area in red, wellfield in yellow and also the roads that were mapped by GIS and the lane miles described in each. Approximately 54% of the highways are made up of state roads and then the town roads were 46%.

Barrows Wellfield is more recent. It was built after World War II to handle the increased demand from post-World War development. Built in 1955, it is now connected to the Sargent Water Treatment Plant in 1989 because of bacterial issues and the wellfield is now pumping at about 1/3 of a million gallons a day with 45 wells. This geology is similar to that of Browns Crossing but it's more shallow. Its overburden is peat underlaying by fine and course sand and gravel followed by bedrock only 24 to 34 feet in depth. So it’s roughly half the depth of Browns Crossing Wellfield. And this has consequences with regard to its impacts from ailing surface water.

This shows the plan view of the Barrows Wellfield. As you can see, it's a tubular wellfield. These are small diameter tubes inserted into the geologic matrix and then all linked by common suction manifolds, which then pumps water to the treatment plant for treatment.

Now just 800 feet upstream from the Barrows Wellfield is this very large culvert which drains stormwater directly from I-93. This was built in 1960 to officially drain water from the highway surface into the wetlands surrounding the wellfield.

This is the plan view of the Barrows Wellfield showing the extent of I-93 pavement that contributes to this culvert. Approximately 3,000 feet of eight lanes of highway all drain to this one culvert. Water then drains to small channels which was built in 1960 in order to officially remove water from the pavement. Unfortunately this drains into wetlands and it goes right passed the tubular wellfield, which was there before I-93 was built. The measurement of surface water and time of travel during the winter months with data zones show it takes 1.5 to 22 hours for stormwater flow from I93 to the wellfield itself.

This is a graph that shows an example storm for April 1st, 2011 of the datasondes measurements for I93 shown in red and the culvert and then downstream the datasondes was installed in the Barrows Wellfield itself showing a more muted, a more deluded response. It took 4 1/2 hours for this failing pulse to move from I93 to the wellfield itself. It was during that process it underwent about 61% dilution. This was done for about 23 different storm events for the winter months 2010-2012. It showed how effective datasondes were in measuring the time of travel using salient pulseless as indicators.

This is a graph of raw water in the Barrows Wellfield itself using a flow cell right in the pump station. And it shows the impact of saline water on chloride concentrations especially during February 2011. The dips in chloride water quality were due to linkage with MWRA during periods of system cleaning and also restoration. But in general, the elevated levels were all due to saline water flowing from this culvert and channel from I-93 passing directly over the wellfield and then introduced into the tubular wellfield network. As you can see, it is many cases well above the 250 secondary MCL for chloride.

In calculating wellfield road salt budgets here are a few easy steps to remember. First, if you don't have one already, it's important to delineate the Source Water Protection Area of the wellfield in question. Then map all the roads and parking areas within that area. You separate out the state, local and private roads, and parking areas depending on who maintains what. The length of highway. Then you map the number of lane miles or acres for each category. Following that, you determine the salt loadings and tons per lane mile or acre per season which in some cases can be quite easy if you're dealing with a state agency, as they inevitably keep track of the amount of salt applications done and tons per lane mile for large interstate systems. Some towns also maintain these statistics. You can use those for those highways in the Source Water Protection Area. One of the harder challenges we had was finding how much salt was put down by private contractors. And we had to contact a number of them, some cases repeatedly to get that information. It may have been considered proprietary. From that, from step five, you then multiply the lane acres or lane miles by application rate and then you can create a pie chart showing sector percentage.

So we will go through that process now as an example. The Wilmington DPW was very cooperative in allowing us information about who maintained what portions of highways within the Source Water Protection Areas. This was the one for Browns Crossing Wellfield. You can see the Source Water Protection Area shown in red. The town roads are in blue and green and MASSDOT treated highways are shown in magenta.

After that is determined, we can then calculate the amount of tons of chloride that

can be assigned to each responsible agency. For example, in this table we had a loading rate during the winter of 2010 and 2011 of nearly 25 tons per lane mile along I-93. And within that, there were nearly 17 lane miles of highway. This translated into 416 tons of road salt or an equivalent of about 250 tons of chloride. Chloride typically makes up about 61% in straight rock salt. In the Barrows Wellfield we had the same loading rate but fewer number of lane miles, 5.63, and ended up with 140 tons of road salt or 84 tons of chloride. And we did the similar process for the town roads in Wilmington and also the parking areas. So in all, for both wellfields nearly 500 tons of chloride had been applied during that one winter.

This is a pie chart showing the breakdown by sector of chloride loadings for Browns Crossing Source Water Protection Area during the winter of 2010-2011. It shows that over 2/3 of the salt likely came from MASSDOT applications, about 250 tons, 21% from the town of Wilmington, and about 10% from parking areas in the northern part of the protection area.

For Barrows Wellfield, this is a breakdown shown in blue we have 64% from MASSDOT and 36% for town roads. There were virtually no parking areas in the Barrows Wellfield to factor in.

I'm just waiting for the slides to advance. There we go.

So in summary, nearly 500 tons of chloride were applied during the winter of 2010-2012 on roads and parking lots in the Browns Crossing Barrows Wellfield. As you can see the percentages listed there. Since the highway opened in 1960, the chloride levels in raw water have increased more than 40 times from less than 10 milligrams per liter to as much as 400 milligrams per liter, which is far above the secondary MCL of 250 milligrams per liter. Chloride at the Barrows Wellfield also increased from 250 to over 400 milligrams per liter during the February 2011 winter, which was one of more of severe ones we've had recently due to likely induced infiltration of saline stormwater into the wellfield itself. On February 28th, 2011, Barrows raw water sodium reached a calculated maximum of 240 milligrams per liter or 12 times the state's advisory level of 20 milligrams per liter. Datasondes show that saline I-93 stormwater averaged about 3.6 hours to reach Browns Crossing and about 10.6 hours to reach the Barrows Wellfield during the winter months.

This brings us to potential remediation strategies. What do you do when you have this kind of situation? One thing that could be done was that MASSDOT could declare a reduced salt application zone for the portion of I-93 within the wellfield recharge areas. MASSDOT has about 29 or so reduced salt zones throughout the commonwealth and this one would help reduce chloride

applications or [indiscernible] applications from 300 pounds per lane mile down to 250 pounds per lane mile during each winter event. State and local best management practices can be implemented and Eric and Phil went over a number of those. Stormwater could be diverted beyond the wells. This would be expensive and involve major plumbing, especially for that portion of stormwater channel that goes through 2000 feet, the Browns Crossing Wellfield. The town could connect to an alternative supply, either in total or in part, to blend this water supply to reduce the chloride levels. In fact, the town does have a connection with the Massachusetts Water Resources Authority and that may be an alternative. However, that is also going to be costly. Then followed by drinking water treatment itself on-site. And this would consist largely of reverse osmosis or similar technologies to reduce chloride levels in [indiscernible] water to help protect the health of citizens.

And that is it. I'd be happy to answer any questions.

**Chris Montague-Breakwell**
Great, thank you so much, Doug. This is Chris Montague-Breakwell, the moderator. And again if people want to submit questions, I encourage you to submit them via text on your GoTo Webinar panel on the right-hand side. And I will read the questions aloud and then Doug or anyone that wants can answer any of them. First question, how do you identify Source Water Protection Area topography to metric measurements of flows?

**Doug Heath**
Source Water Protection Area is usually defined by using the number of key steps. One is to consider the aerial topography. This would help take care of the surface water flows toward a wellfield. It should also consider the stormwater infrastructure in the area. For example, for both these wellfields we had to look at how water is channeled from various catch basins which collect water in catchment areas on different portions of the pavement and then into streams or groundwater that flow eventually to the well. Massachusetts Department of Environmental Protection also defines the down – the zone 1 for tubular wellfields as they are rated to 250 feet. So in this case, we use that to length to define the down gradient portion of the Source Water Protection Area. I also did a lot of work tramping around during the winter months looking at how water flows throughout the watershed. And especially how water flows in different portions of pavement as this was far more detailed then could be shown in topographic map. The other great tool that we had available was a very extensive map of systems of how stormwater is channeled throughout the Wilmington area and this identified every catch basin, every stormwater outfall. And this was invaluable in determining the overall Source Water Protection Area with a lot more confidence. And then finally, you look at actual characteristics,

you look at the pumping rates, you exam the likely transfercifity (ph) of the aquifer materials to come up with some capture zones that in this case all proves to be well within the Source Water Protection Area. So there are a number of techniques that have to bring to bear. Most of the drinking water systems in New England unfortunately are defined as circles or protection areas. Since many of them are bedrock wells and these are far more – too complex to do refined delineations until more information is available.

**Chris Montague-Breakwell**
Next question, what types of treatments or BMPs could you put on a stormwater outfall to capture the sodium or chloride? Is that even a feasible approach?

**Doug Heath**
It's very difficult to do since chloride, as Eric and Phil mentioned, is totally absorbed into the water. It's very conservative and flows with the water and it's very hard to remove without high energy reverse osmosis treatments or desalinization. You can remove debris, you can factor out various nutrients with existing stormwater systems, you can reduce the amount of sand of course, but chloride is highly conservative and it tends to go with the flow and I don't think it's feasible given the number and small size of the stormwater outfalls that we have today.

**Chris Montague-Breakwell**
Next question. We are being required to put in many infiltration features along our highways, how concerned should we be about potential impacts to groundwater from these practices?

**Doug Heath**
I think we should be concerned considering where they are. I think that in some cases more attention should be given to drinking water systems, likely receptors including private wells, and to try to reduce the number of these infiltration systems close to the wells and have more of them outside of their zones of contribution. I realize this is quite difficult to do with existing highways who have already been grandfathered in to the systems as they are, and in many cases they were installed back in the days when little consideration was given to drinking water quality. Sort of out of sight, out of mind. Nowadays we know a little better and I think some aspects of some stormwater treatment like detention basins may help a little bit but in the end the chloride gets into the environment, it's absorbed into the aquifers and makes its way to water systems eventually. The key thing is reducing the amount of salt and reducing any excess amounts and trying to optimize the application rates depending on the road and water conditions. This is the real challenge but the technology exists to do this.

**Chris Montague-Breakwell**
Next question, did DOT implement any pavement modifications to increase friction and therefore reduce salt application? And New Hampshire or even Minnesota folks if you want to jump in and talk about this as well, feel free.

**Doug Heath**
They have not in this case. We hope that there will be steps taken to do some of the potential remediation strategies that I outlined at the end of the talk. But to date, I don't think that reduced salt application zones have been done as yet although these issues may be under consideration. But as far as I know, nothing regarding friction has been done.

**Chris Montague-Breakwell**
What about something looking at porous pavements or permeable pavers? That's another question that has come up.

**Doug Heath**
Porous pavement is an attractive new approach. It has been tried in a number of parking areas and subdivisions as part of the LID approach to stormwater mitigation. And it has shown through the University of New Hampshire's Stormwater Center to largely reduce the amount of salt required to maintain a dry pavement. So it has a lot of promise. However, as far as I know it's not been tried yet on interstate highways or high velocity systems. And there is some questions I guess on durability and wear. But it's certainly an attractive technology that should be used a lot more.

**Speaker**
Hi. This is Minnesota and we have a little experience with trying out impervious pavement.

**Mark Fischback**
The Minnesota Department of Transportation in the Metro District, we do have some raw – have an open weave pavement on the top surface to allow the liquids to pull away from the driving lanes. And that's been working well for us.

**Chris Montague-Breakwell**
Oh my goodness!

**Doug Heath**
Are there any more questions?

**Chris Montague-Breakwell**
Doug, this is the moderator. My audio connection just dropped out. Can you

hear me okay?

**Doug Heath**
I can hear you fine. Welcome back.

**Chris Montague-Breakwell**
Sorry about that. My next question is about the soil remediation and extensive feasibility of doing that. Do you have any further comments about that?

**Doug Heath**
I'm not sure what soil remediation means in this context of drinking water quality.

**Chris Montague-Breakwell**
I think in this case they were looking – or asking a question about soil remediation particularly under stored salt piles.

**Doug Heath**
Oh, I see. Well, first removing the piles is the first step and then allowing sufficient flushing through cleaner water to occur which gradually reduces the salt issues. As you know, there is some problem with the cation exchange of sodium for calcium in soils which can have potential releasing of various aluminum complexes. But in general, just removing the source of salt I think would be the key thing to do. But I am not an expert in soil remediation in this case.

**Chris Montague-Breakwell**
Okay, next question a lot of people have interest in how much rock salt cost per ton and if New Hampshire or Minnesota folks want to jump in and answer, feel free.

**Speaker**
It's about $55-$60 per ton in New Hampshire.

**Mark Fischbach**
In Minnesota, we're paying an average of $62 per ton in the Metro District.

**Doug Heath**
I think most of the rock salt that we have in New England comes from Chile or Mexico and comes by ship. So prices largely depend on shipping cost as well as demand here for salt. Once it is off loaded off the ships into several key depots it's then trucked to DPWs and other storage areas throughout the region. So fuel costs I think are another key factor in overall cost per ton.

**Chris Montague-Breakwell**
Next question. Have there been other form of deicing chemicals or organic forms of deicing that have been found to be effective? What comes up a lot is beet juice.

**Doug Heath**
Yes, there are a number of hybrid add mixtures that basically also contain chloride. And Ice-Be-Gone as a number of molasses or yeast compounds and this is to increase adhesions to pavement services. But in the end, they still release a lot of chloride into the environment. There may be some reductions in the sodium levels in these, which is also the good. But chloride is still the key melting agent in these compounds.

**Chris Montague-Breakwell**
Okay. Next question, are there prohibitions against allowing gas well brine from being used on roadways in Massachusetts?

**Doug Heath**
I have no idea. I've never heard of that subject.

**Chris Montague-Breakwell**
Okay. I saw a number of questions come up talking about gas well brines so I thought I would throw it out there.

**Doug Heath**
What kind of brine?

**Chris Montague-Breakwell**
Gas well brine.

**Doug Heath**
Oh, I see. Well, we don't have any fracking here in New England and we don't have any gas wells. As far as I know, it's not being brought in from other areas. That would be certainly a subject worthy of investigation. Most brine used here is made by the Department of Transportation for their own facilities, as Phil and Eric described in the New Hampshire program. It's been fairly successful in reducing salt levels for the large interstate systems.

**Chris Montague-Breakwell**
Okay. Thank you, Doug, for that great presentation. We are now going to go to our next and final presentation. Brooke Asleson from Minnesota Pollution Control Agency, Mark Fischbach and Kathleen Schafer from Minnesota's DOT will present "Sharing the Road with the Environment". Minnesota, I'm going to

hand over presentation powers to you.

**Brooke Asleson**
All right, thank you. I first just wanted to thank EPA for hosting this event on a very important topic that is very near and dear to our heart here in Minnesota. And, of course, thank all of you for participating. It was really great to see the amount of interest in the topic for this webinar so that's very encouraging to know that there are so many folks out there looking into this topic and doing things to try to solve this very challenging problem.

So really the main issue is finding that balance between safe roads and as you heard in some of the previous presentations, both are critically important. We do need to provide safe roads and save driving conditions but we also need to protect our water resources. And so we really have in Minnesota been putting a lot of emphasis on that equal balance that they are both equally important.

So, you know, essentially chloride is toxic to aquatic life and once it's in our waters there's no way to remove it. So it is a permanent pollutant that will be in the water system for life. In the Twin Cities area, which I will show you a map next exactly showing you what that location, 75% of the chloride is from road salt with the remaining 25% from other sources such as wastewater treatment plants that primarily are discharging water softening salts.

The University of Minnesota did a study recently that did a map balance of the amount of road salt applied in the seven county metro area and found that about 78% of that chloride is being retained in the metropolitan area. And we also some estimates that are based on purchasing records of approximately 365,000 tons of road salt applied to the Twin Cities Metro Area every year. And so the public does expect and needs safe roads and parking lots and sidewalks. And so this is a real challenge before us.

So here is the great state of Minnesota for those of you not familiar with our state. The darkened in counties in this area here, this is the seven county metro area. Throughout the presentation you will hear me refer to the Twin Cities Metro Area and in the presentation itself it will say TCMA. This is the area that we are referring to. And so this is the focus of kind of our project and a lot of the efforts that we have underway.

Just a little bit of information about the Twin Cities. It is seven counties. It includes hundreds of cities and it is about 60% of the state's population lives in the Twin Cities metro area. So that's about 3 million residents or so living in this area. So it's a very large area that we are trying to work with here and make an impact.

So we have come up with an overall plan of how are we going to achieve this very challenging and difficult balance of providing safe roads and protecting our water resources. And our first component is really to fully understand the water quality conditions that we have today and what the impact of road salt has on the environment. And then the next is to really fully understand what are the road safety needs as well as the limitations. You know, where we do have flexibility when it comes to road safety and the products we use and the methods we apply versus where we really don't have flexibility. And then the next stage we have been really working hard to create a shared vision. And we want this shared vision to be the Minnesota Pollution Control Agency with the State Environmental Agency but as well as our DOT, a lot of our local partners, we have several cities and counties and watershed organizations that we have been working very closely with so that we are all working towards the same goal kind of collectively. The next component is to develop some shared goals and some strategies on how to meet those goals. And then finally is to implement. And hopefully make some great progress on decreasing the amount of chloride entering our water.

And so we have hit on most of these aspects. We have done some implementation already. So I'm going to talk in a little bit more detail about where we are at with these various components.

So the first step of kind of what are we doing here in Minnesota is understanding the water quality conditions. And Eric and Philip went over this in their presentation from New Hampshire. I just wanted to remind everybody that in Minnesota we have the same federal water quality standards of 230 milligrams per liter for the chronic and 860 milligrams a leader for acute. When we translate those two our general public, we like to say that equals about 1 teaspoon of salt will pollute about 5 gallons of water.

We went through a fairly extensive process to evaluate all of the existing information and data that we had for the seven county metro area. And here are some of the key things that we learned from that process. The main one is that 75% of the data points collected occurred during non-winter months. And we were finding that most of those exceedances of that either the chronic and/or the acute standard were happening in the winter months. So really only 20% of the existing data that we had available was during the winter months which is what we found to be in Minnesota the most critical time period to be collecting information.

We also -- we’re noting some general increases in our base low chloride levels in a lot of our streams. Were gradually over time those base flow conditions are increasing in chloride indicating that we are having some groundwater

contributions to these streams involved. Currently, we have 51 monitoring stations on streams within the metro area that are exceeding the chloride standard. So even though we do have a significant amount of chloride data available in the metro, only 20% of that data is really giving us the full story of what is going on in relation to chloride.

And this graph is just an example to show you that the winter months is really the critical time period. So for this particular stream, it is 230 here about that chronic value. A lot of the spring and summer conditions are showing that it is below or somewhat hovering that standard. But when you look at these peaks, they are always often happening in the wintertime. So if we did not have that winter data we would really not have the full story of how the road salt is impacting the system.

And this is a second graph to illustrate that increase in base flow concentrations that I had mentioned. This is Eagle Creek. This is actually a trout stream in our metro area that is primarily groundwater sensitive. As you can see over time there is a significant trend of increasing chloride concentrations indicating that the groundwater is now providing a source of chloride for this system.

And then we looked at our lakes. In the metro area, we have about 950 lakes. So lakes are a critical aspect of our recreation and, in general, kind of our daily life revolve greatly around our lakes. And so we looked at the information, there was not nearly the amount of data available on lakes. And what we did find is that the concentrations of chloride are often the highest in the deepest part of the lake versus the surface. And we had only about 100 or so lakes where we had both the surface and that deep water sample. And almost in every case, the deepest part of the lake had the higher concentrations.

Currently we have about 28 lakes that are exceeding the chloride standards. Now again, that is based on the limited information and data that we do have. But in the lakes that we are sampling we are seeing increased concentrations of chloride. But really the main point is that without getting those samples from the deepest part of the lake, you are really missing the full picture of what is happening in the system.

And here I have some graphs that kind of demonstrate that. Here in the darker blue, this is the surface water values. As you can see they are hovering near the standard, but mostly they are below it. Now the pink dots here are the data points that were collected from the deepest part of this lake. And, as you can see, we have some significant increase in chloride concentrations that are exceeding the water quality standards. And again, this would be a lake, a typical metropolitan lake here showing if you just looked at the surface sample,

and now when you add in that deep water sample you get quite a different story that the data is telling you. And so the main point here is that, you know, the way that we collect our chloride samples, the timing of it is really important for chloride. It needs to be treated a little differently than a lot of our other pollutants.

This is just to kind of give you that overall picture of we have about 950 lakes in the Twin Cities metro area. 807 of those lakes have no chloride data available to us. Of the 142 lakes that we do have data, 74 of those lakes we have enough data to get the full picture. And we have got 28 exceedances at this point for those lakes. But the main message is that there is still a lot here we don't know. But we feel that this is enough information to know that this is a widespread problem that we need to do something about. We can't wait for all the 950 lakes to be monitored before we make some progress.

The next thing that we have been doing is a huge effort and emphasis on developing partnerships to create kind of that shared vision and create common goals. So our main goal is to really understand the public safety needs and limitations as well as the environmental conditions. And we need to evaluate those conditions against the desired water quality goals. And we are committed to studying realistic and achievable goals and develop a collaborative strategy with our local partners to meet those goals.

The third bullet I will talk about is a certification program that we have had underway for several years now. New Hampshire sounds like they have another great training program. So this is one step that we have already taken. In 2005, the Minnesota Pollution Control, Fortin Consulting, MnDOT, and the Minnesota Local Technical Assistance Program put together kind of a pilot project on what would a training and certification program look like.

The certification does involve a test and once those individuals pass the test they are considered to be certified and they go on a list that is kept by the Pollution Control Agency of here is a list of certified contractors. And the goal of this training is really to teach the best practices to reduce chloride impact. And it is targeted to private applicators and local governments and it is a highly successful program. We have seen some great successes come out of this training. And one of those is the Dakota County. They were able to decrease their application rate from 405 tons per storm event to 355 tons per storm event. So they had a considerable reduction which they attribute to a lot of what they learned at this training. And I'm sure my MnDOT partners here will probably talk a little bit more about that as they are really the experts in what are the best practices in winter maintenance.

The fourth component I will talk about is called the Twin Cities Metro Area Chlorate Management Plan Project. This is a project that began with a feasibility study in 2008 and the full project began in 2010. And the goal of this project is really to assist our local partners to better manage the balance between clean water and road safety by developing a management plan that will complete TMDLs for all of the impaired waters, set goals for all the remaining surface waters, and lay out some implementation strategies to achieve those goals. And I think the key here is the process of developing the plan and going through this project, the partnerships that are developed, the shared vision and goals that we will all come up with together is really the key in that will get all of us working together on this same page in the same direction.

Here is just an overview of some of the activities that we have underway through this project. As I mentioned, we have a very comprehensive stakeholder process where we are really emphasizing developing some partnerships and some true collaboration on this. We have had the last three years of some targeted chloride monitoring. We will then also evaluate the waters to determine if they are impaired or if they are meeting the standards so that we can set the appropriate goals. We do need to identify more specifically the sources of chloride in the seven county metro area. We then plan to develop protection goals as well as complete of the TMDLs. And finally, develop implementation strategies to help meet all of those goals. And we have a schedule to be completed with the project in 2014.

Here is an example of our stakeholder process that we have developed. We have several various workgroups that we've pulled together to work on this project. We have this monitoring subgroup which consists of nine various local partners that have been working with us to collect the monitoring information that we need in support of the project. We also have a technical advisory committee that is really guiding a lot of the decisions that are made in this project as far as the type of modeling we are going to do, the approach we will take for addressing the goal, how we will set the goals for really letting this technical advisory committee guide those decisions. We also have an education outreach committee. That's a huge challenge trying to inform and educate the public about safe roads and trying to lower those expectations that have been mentioned in some previous presentations. And then we have an implementation plan committee as well that really is a lot of our local winter maintenance experts that are helping us decide what are the appropriate practices and tools and things that we can use to reach our water quality goals.

And here is just a map to show a little bit of some of the monitoring we are doing. You can see here this is the seven county metro area. And the blue is the road density. So as you are moving closer towards where Minneapolis and St. Paul

are, that is kind of our most urbanized part of the seven counties. And as you move out of it gets a little more rural and kind of the outer ring of the metro actually still has some pretty active agriculture practices happening. So we do have a very diversified land use situation in the metro area. And we have 74 lakes, as I mentioned, and 27 stream sites that are being monitored right now for this targeted chloride monitoring. The green dots are the lakes and the orange dots are the stream sites. And as you see, we tried to get a mix of the inter-core metro as well as a few sites throughout in the urban, more rural area of the seven county metro area.

The next steps for the TCMA chloride project is we will be conducting a formal water quality assessment in this June of 2013 to kind of finally establish which waters are, in fact, impaired versus not. We are working with the stakeholders to select the appropriate modeling approach for the project. And we will also be working with the stakeholders to set some protection goals and determine what should those goals look like. And right now we are considering it could be numeric targets but we are really looking more towards some performance-based goals. Since these are voluntary-based goals we feel that for this particular pollutant, some BMP type of goals may be a better approach to and a more realistic approach to solving this problem.

And then the last component is we are developing a Best Management Practices Winter Maintenance Tool that will lay out implementation options. And the plan is we will automate this tool. It will be available on our website to all of our local partners to utilize. We will walk them through a series of questions to help them understand what are the current practices they are using today and then we will kind of pour each BMP as an excellent practice, a good practice, or a poor practice. And so then everybody can see and do kind of a little report card of where they are at compared to others, compared to themselves, and then lay out a plan for the next five years on where do they have opportunities within their organization to change the BMPs and to reduce the amount of salt they are putting down.

The last two components that I will just briefly mention is that we also have included some new language in our draft MS4 permit requirements that we now require that salt storage be covered. And we also are now implementing a requirement for our salty discharger's to start monitoring their waste for chloride concentrations and this is typically going to be industrial and municipal waste waters that have processes like reverse osmosis where we suspect an increased level of chloride coming from those facilities where we will now start requiring them to actually monitor their chloride outflow.

Some resources that we have created throughout the last couple of years over

this project. We have developed some draft guidance on monitoring for chloride as we've learned a lot about the appropriate techniques and timing and locations of where we should be collecting chloride data to get the best information. So we have shared this and we will refine this once we have all of the final data analysis complete. It is available for everyone and anyone to utilize and use. We also have created a website. This is a new website that is really focused for the general public. And we have kind of this general tips on what can homeowners do to reduce their impact. And then we have several resources. We've pulled together all of the various training and resources available throughout the state for education outreach purposes and compile that into one kind of easy to find location where we encourage all of our local partners and others to utilize this and utilize these videos and brochures and clips and training events to inform and educate their constituents.

Another thing that PCA is trying to assist our MnDOT partners with is helping to get the word out about the negative impacts that road salt has on the environment. And so a few of the things we've done recently is we have created a YouTube video that talks a little bit about the water quality monitoring reviewing, why it's important, and how road salt is impacting our waters as well as we try to put out press releases pretty regularly during the winter times to kind of help raise awareness about the issues that road salt can pose to the environment and some great tips and things that people can do to reduce their impact.

And another resource that we recently created was a display for the Minnesota State Fair that we now are loaning out to any of our partners who want to use it at their own events. This is really to help inform and generate some discussion with the general public about the water quality concerns of road salt.

And that is what I have for the kind of the Minnesota pollution control portion of it. And now I'm going to hand it over to my MnDOT partners for their part.

**Kathleen Schaefer**
Okay, thank you, Brooke. Well Brooke asked Mark and I to come here and talk about some of these practices and trainings that are provided to our state and local agencies snow plow operators as it relates to our MnDOT and MPCA partnership. So Mark and I are going to be tag teaming on this next segment here.

**Mark Fischbach**
Good afternoon, everyone. My name is Mark Fischbach. I'm the clear roadway superintendent for the metro district. It is my responsibility to deliver the snow and ice plan throughout the metro district on the state trunk highway system. In

the metro district we cover 5,500 route miles with 237 plow trucks with salt applicators on them. We are a 24/7 operation. The materials that we use throughout the district and the state is salt, liquid magnesium chloride, salt brine, and liquid corn salt. Our population, like Brooke stated before, is approximately 3 million people in an eight county metro area that MnDOT covers. We have an annual economic output of $141 billion so you can see why it's important that we provide safe passable roadways for the driving public throughout the metro area.

We have a service level on our super commuter routes which is routes that have a greater than 30,000 average daily traffic flow on them. Our service level is to reach bare lane in three hours after the event has ended. And I will turn it over to Kathy.

**Kathleen Schaefer**

Okay, thanks, Mark. I'm Kathleen Schafer and I am a former snow plow operator here in the metro area. And I am now the circuit trainer which I have been doing for the past 10 years. So I'm employed by MnDOT, but I also work for our Minnesota LTAP. There. So I work for the Minnesota LTAP or Local Technical Assistance Program. And this is another partnership between MnDOT and the University. And through this program, I provide training to state and local agencies public works employees throughout Minnesota. I also work very closely with our salt solutions coordinators and assist with the training that they provide to the DOT snow plow operators. Both of these programs have been operating for many years and have similar objectives. And that is to provide training to our maintenance forces on current and timely topics as they relate to winter maintenance and chemical application. So because of that background I was in pretty good position so that I was asked to be part of the education and outreach team within our partnership between MnDOT and the MPCA. And this partnership, I think, provides a great opportunity for our two agencies to have a dialogue and address some of the issues that concern safety on our roads, which, of course, is a huge issue for everybody and we have so many adverse conditions to deal with in our Minnesota winters. So that is a big one. Mobility, as Mark said, we are a major metropolitan area and we have to make sure that we keep traffic moving. And both our agencies are highly invested in the use of sustainable practices that will help to protect the environment.

**Mark Fischbach**

Part of MnDOT's responsibility to this group is to provide technical support on what are the best management practices among the state and municipalities in our training programs and our equipment usage and future technology. So we are a strong supporter in looking at new technology that can help us reduce our chloride levels into the environment.

**Kathleen Schaefer**
Okay, so some of the training that we are providing, we have our snow plow operators training also known as SPOT. So our MnDOT operators receive this two weeks of training before they ever get into a snow plow truck. And it provides consistent statewide training for operators with a combination of classroom and behind the wheel training. And you can see on the photo on the left, that is an aerial shot of some of the obstacle courses that our snow plow operators would be driving through. And while they are doing this, they have the full plow and wing on the truck as they are going through these courses. And then on the right you can see there is a group of new employees being trained on the components and the operations of the sander.

**Mark Fischbach**
We meet annually with the snow plow operators in the metropolitan area and refresh each operator that has gone through this SPOT training on standard calibration application rates, timely manner of application and so forth. We train approximately 500 plus operators each fall before we go into the snow and ice season.

**Kathleen Schaefer**
So as Mark said, it's not just a one-time training, it's an ongoing training. One of the tools that we use for this ongoing training is this Minnesota Snow and Ice Control Handbook that we wrote back in 2005 and it was just revised this last year in 2012. And so this handbook provides a lot of information on steps to take before winter, before a storm, during a storm, and afterwards. There is application rate charts. There is all kinds of useful information to help make our operations run efficiently and smoothly. And throughout this handbook we have these little fish symbols that provide tips to operators and managers on things and methods they can use to help reduce environmental impact.

So we understand that it's vital for operators to know how salt works. And without a clear understanding of how salt works and when to use it we see a real over application of salt.

**Mark Fischbach**
In the metro district and statewide it's good to have a good program in place for training, equipment that is being used for salt application, calibration of the equipment, application rate guidelines, application guidelines, and experience. All of them combined make a good program for applying sodium chloride to the roadways.

**Kathleen Schaefer**

So we focused on the three R's. And we don't always call it that but this is really when it comes down to so often is the right material, and the right amount at the right time.

And we use graphs like this to explain to operators that salt loses its effectiveness as the temperature drops. And this graph shows that at 30 degrees a pound of salt will melt roughly 45 pounds of ice in just a few minutes. And as that temperature drops just to 15 degrees, and we are always talking pavement here, pavement temps, at 15 degrees that same 1 pound of salt will only melt a little over 6 pounds of ice and it takes nearly an hour.

**Mark Fischbach**
And this is not only directed at our plow operators, it's also a good information tool to get out to the public so they understand how salt works and especially at colder temperatures it takes longer to de-ice the roadways.

**Kathleen Schaefer**
So Mark mentioned earlier some of the other training we do,extensive calibration training. We want to make sure that our operators understand how to calibrate their trucks and that they are confident that their trucks are applying the material that they are calling for. So we also developed these calibration guidelines or guides, they are little booklets through both MnDOT and the Minnesota Local Road Research Board. And these guides have easy to understand step-by-step instructions with pictures on how to calibrate both electronic and manual sander controls. And you see the pictures of the fellas all talking there. And we have people from different agencies coming together to learn how to calibrate sanders and we find that it's a really good networking tool also. So these folks are exchanging some of their best practices just in these informal discussions.

**Mark Fischbach**
It's very important to have our standards calibrated annually so we can keep track of the volume of sodium chloride that is applied to the roadways. So annually we calibrate our sanders and anytime there is major work done on the sander and the controllers we re-calibrate throughout the season.

**Kathleen Schaefer**
So when we are using liquids whether it's on board pre-wetting or treating the stockpile, we realize that training is also needed in that area. So operators need to know first of all, why we are using the liquids, what the application rates should be, what the wetting agent is, and to what temperature that will work. So all of this -- all aspects of this type of training are provided through our Circuit Training Program and our Salt Solutions Program.

**Mark Fischbach**
Two reasons we use pre-wetting and stockpile treatment is one, it reduces the scatter on the roadway surface. We try to keep 100% of the material in the driving lanes where it works the best. Once it scatters out onto the shoulders, we consider that wasted material that contributes to the hazards into the environment. And then also by wetting the material it jump starts the melting action to give us an advantage in the melting process.

**Kathleen Schaefer**
We are also starting to use a supersaturated salt application also known as our slurry application. And within these trucks we have these big tanks that hold a lot of liquid. I think it's 400 gallons each. And so we are getting a higher liquid to granular ratio where it's about 20 gallons of brine per ton.

**Mark Fischbach**
And again, this assists in the melting process and also it greatly reduces the scatter onto the shoulders and it also helps when the traffic passes through the application area keeping it in the driving lanes and it sticks or adheres to the lanes better.

**Kathleen Schaefer**
MnDOT also utilizes our own mobile salt stockpile treatment unit. This unit travels throughout the state treating stockpiles with various de-icing liquids such as mag chloride, calcium chloride, liquid corn salt just to name a few.

**Mark Fischbach**
And again, this is just another area where we can keep the salt wet and also to jumpstart the activation and the melting process.

**Kathleen Schaefer**
And this unit we share it not only throughout MnDOT but local agencies have taken advantage of this as well.

So anytime we introduce new techniques, materials, equipment we realize training is required in these areas. So we also provide training in anti-icing. And the anti-ice just about everywhere MnDOT goes throughout the state. And many of our local agencies are beginning to or using anti-icing as well. So we developed this anti-icing guideline booklet. And you can see the cover of it here is shown. It's sort of serves as the index and it has information as to why we anti-ice, when and where it is most effective, how to blend some of these various chemicals and materials, there is even experts who volunteer to have their contact information in here so people can contact them and get advice.

**Mark Fischbach**
By using an anti-icing program it helps us reduce solid sodium chloride being applied to the roadway. By using the liquid, you can place the product into areas that you would like to de-ice. And once it dries to the surface, the liquid chemical will activate when precipitation starts to fall and it will do some melting of a small amount of snow or ice that helps prevent the bonding from taking place with snow and ice which assists in removing the snow and ice with mechanical means in turn uses less sodium chloride.

**Kathleen Schaefer**
And throughout the state we have many bridges and underpasses and overpasses where we have fixed anti-icing systems that are automatically triggered when sensors indicate ice on the bridge deck. And these systems use often, not always, but often use potassium acetate which is a non-chloride product that we found to be very effective in cold temperatures.

And there is also a technology transfer aspect to our training where we share new ideas and inventions and technology. Through the Minnesota LTAP we have what is called the Opera Program and this is for cities and counties to research either new equipment that comes from a manufacturer or homespun inventions. And this is really some fun information to share. On the left you see a picture of an airfoil. An air coil that was fabricated by a crew in Stearns County. In the center is a salt chute which helps to deliver the salt closer to the ground reducing that bounce and scatter. And that was fabricated by crews in Washington County. And on the right we see what is called a Snow Walker. And this is a trip mechanism to prevent a snow blower that is going that is going along a sidewalk. It helps that walk over uneven surfaces on the different slabs of the sidewalk. And that is an invention that came out of Glenwood, Minnesota.

**Mark Fischbach**
MnDOT encourages all our employees to submit any type of ideas for new technology to our central office for review as an implementation into our research project. And many times these research projects have been very successful, probably the majority of times. And it is assists not just MnDOT but other agencies in Minnesota in moving their snow and ice program into a more effective program with these new technologies.

**Kathleen Schaefer**
So some of the programs that we have within MnDOT that Mark was talking about, we have the MOR program which is Maintenance Operations Research and also the NTREC which is the New Technology Research Equipment Committee. So as Mark said, it helps promote new ideas.

**Mark Fischbach**
MnDOT -- we want to be stewards of the environment. We want to be part of the solution and not part of the problem. So we are moving forward with best management practices to reduce our contribution to the chloride levels.

**Kathleen Schaefer**
Okay, and then that concludes the Minnesota presentation.

**Chris Montague-Breakwell**
Thank you so much, Minnesota. We have a number of questions asking if yourtraining manual is going to be available online. The *Minnesota Snow and Ice Handbook* is available online. And several people have expressed willingness to even pay if need be.

**Kathleen Schaefer**
Yes, it is available online. I just switched to one more slide here that shows the various resources. It is available on the Minnesota LTAP website and also on our DOT maintenance training website.

**Brooke Asleson**
It's also available on the Minnesota Pollution Control Agency's website. So if you go to pollution control agency and type in road salt and water quality, that main page that I covered in my presentation will show up and under that we have the actual link to a lot of these resources and the trainings themselves, the list of certified contractors. So all that information can also be found at the pollution control agency website.

**Chris Montague-Breakwell**
Is that training information free?

**Brooke Asleson**
Yes.

**Chris Montague-Breakwell**
Great. Next question. Are there any state mechanisms or funding to help communities apply or reduce road salt pollution?

**Brooke Asleson**
Yes, there currently is. We are very fortunate in the state of Minnesota that they passed some legislation that gave some increased taxes dedicated to the environment. And so those funds are called our Clean Water Legacy Funds and various state agencies have been given those funds to give out as grants to local partners. And so our goal is once we get this final management plan in place

then everybody in the seven county metro area will be eligible to apply for those grant funds to upgrade their equipment and try out some of these different products and technologies so that we do require that they have a plan in place. So some folks may already have a plan but at the end of this project there will be a metro-wide plan that will allow everyone eligibility for grants.

**Chris Montague-Breakwell**
Next question. There have been a number of people who have asked a question about the use of cyanide to reduce clumping of road salt when it's applied on potential detrimental impacts to water quality when it runs off. Minnesota or New Hampshire or Doug do you want to jump in and address this if you can?

**Brooke Asleson**
We have not done our own research or monitoring in Minnesota yet. But as part of that feasibility study we did a literature search of all of the available research and information regarding chloride in the environment. And there is some research indicating that ferrocyanide does disassociate in the daylight into free cyanide which is very, you know, hazardous. So there is research out there indicating that ferrocyanide that is added is problematic.

**Chris Montague-Breakwell**
Next question. Are there any recommendations for street sweeping after storms to pick up the extra salt, particularly storms that it did not melt in a day or two?

**Mark Fischbach**
The Minnesota Department of Transportation Metro District, we do have an extensive street sweeping program and we pick up an average of 22,000 tons of sweeping sand each spring. And in the metropolitan area MnDOT puts out less than 2,000 tons of street sweeping sand. So you can see that a lot of the debris is carried in from city streets, county streets, from the trucking industry, and so forth. And we do recycle that product. We screen it, take all the debris out and then we use it in fill areas in our construction sites.

**Chris Montague-Breakwell**
Next question. Is the degree of connected impervious a factor for chloride concentrations to receiving waters especially during the winter season? For an example, impervious surfaces drain directly to a stream pipe versus sheet sloped vegetation?

**Brooke Asleson**
Yeah, in our evaluation of all the available data we were able to develop some very strong and statistically significant relationship between road density and the

chloride concentration in stream or in lakes. So as a road density increases the concentration of chloride in the water bodies also increases. That was a very significant relationship that came out of that analysis.

**Chris Montague-Breakwell**
Next question. And this is kind of a technical question but field it if you can. Can you go through the steps involved in retrofitting the existing salt application to allow for pre-wetting application of brine mixture?

**Mark Fischbach**
It is a very simple process. Basically you need some type of a storage tank attached to the dump truck that you are using and we use a free flow system. Basically it is gravity fed where you have an on and off switch and you turn it on when you are applying the salt. And we are shooting for 9 gallons to a ton for pre-wetting ratio.

**Chris Montague-Breakwell**
Great. Next question. Have you had experience protecting the environment from large-scale salt source sites that typically requires outdoor store over 100,000 tons of salt?

**Mark Fischbach**
In Minnesota we don't have any facilities that size. Basically at our vendor's stockpiles that are large like the majority of them tarp their stockpiles as they get the salt in. The majority of our salt is delivered to the vendor by barges.

**Chris Montague-Breakwell**
Okay, the next question is again addressed to you, Mark. Can you describe the difference in effectiveness and use areas for make mag chloride versus corn salt that you use and how that compares to road salt effectiveness?

**Mark Fischbach**
When we reach temperatures of 5 degrees or lower then we switch to a mag chloride which works at lower temperatures up to approximately 15-20 below and that assists in the melting action. Again, that helps us reach our service level and also helps reduce the sodium chloride that is applied at that lower temperatures because it makes it more effective.

**Chris Montague-Breakwell**
Okay. Next question. Next question is: has Minnesota conducted any focus groups or other social marketing tools to better understand the public and craft their messages? This could go to New Hampshire presenters as well.

**Brooke Asleson**
Well I think our main efforts have been with our stakeholder groups and so we have been relying on a lot of our local educators. We have a lot of watershed organizations that have educators, full-time educators and those and they really been the ones doing the work within their watersheds to better understand the needs of their particular community and providing some educational information and resources. And we have compiled some of the work that they have been doing on our website as well. And, for instance, the Mississippi Watershed Management Organization put together a short video for homeowners that was to be aired on cable TV giving them some tips and guidance on how to use less salt and some tips to deal with winter maintenance issues. So that has really been the extent of it as our local partners have been doing more of the research and focus on the needs of their public and how to deliver those messages. But we have been working collaboratively with them as well as our own internal communications and MnDOT communications folks to get some good messaging out there that is understandable and meets the needs of the general public.

**Chris Montague-Breakwell**
Okay. And I'm actually hearing directly from Jessica who works for MnDOT communications and she tells me that yes, they do work with group of 600 Minnesotans through an online community and have feedback from them on their expectations and needs.

One question I have seen come up a fair amount is to please explain why abrasives are not a good solution?

**Kathleen Schaefer**
Well they just don't melt. They don't melt ice, they don't melt snow. Abrasives can provide a very little bit of limited traction but they tend to blow off the roads so quickly that they just don't do much and they cost a lot to recover that and then to figure out a way to, as Mark was describing, to screen it and then dispose of it. So when we think about it in that respective it just does not work very well for us. When we do use it is in freezing rain events and we will use maybe a 50/50 mix of sand and salt and pre-wet as it's applied to the roadway. Sort of stick it to the ice and act as sort of like sandpaper. But that is about the most that we use the abrasives within MnDOT.

**Mark Fischbach**
Minnesota went from using hundreds of thousands of tons of abrasives to very little.

**Doug Heath**
Chris, this is Doug Heath.

**Chris Montague-Breakwell**
Go ahead, Doug.

**Doug Heath**
There are three other reasons why abrasives don't always work. One is that on high velocity highways it will create aerosols and fine particulate solutions which can affect human health. The second one is that they can tend to clog up stormwater outflow systems. And then the third, sediment will affect fish quite adversely and surface waters. So at least in New England, sand is used sparingly. And typically on hilly areas and it falls within shadows. Not generally on highways where you have fast moving traffic.

**Chris Montague-Breakwell**
Okay. Thank you so much for your presentations. That 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 shown on your screen now. I also want to remind you to fill out the webinar evaluation survey. It should soon appear on your screen window as soon as you exit the webinar. Please consider completing this webinar survey and let us know your thoughts. We do appreciate your feedback and 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 hearing your feedback on what other topics you would like to hear about. Thank you for your participation and we hope that you'll join us for future EPA stormwater pollution prevention webinars.