SNEP Symposium – Science Bringing Solutions Delivering Environmental Improvement to Southeastern Coastal New England

Room 2, Morning Session 1

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Valerie: Okay so I'm going to introduce Timothy McCobb from U.S. Geological Survey. Tim is a hydrogeologist in USGS New England Water Science Center, Massachusetts office. He has more than 20 years of experience working on groundwater related projects in southeastern Massachusetts, including extensive experience in groundwater fuel techniques, groundwater flow modeling, and GIS to assess regional freshwater resources. And with that, I'll turn it over to Tim.

Timothy: Okay great, just give me a moment here to share. So hopefully you can see my full screen there and hear me okay?

Valerie: Yes.

Timothy: Great. So good morning and thanks for the opportunity today. Today I'm gonna be talking about work done by the USGS using river observations on Cape Cod as another approach to identify possible nitrogen reduction areas. So, this work is primarily funded by the by the SNEP program so I'm excited to present this work today.

So, we all know that excess nitrogen in the coastal environment is a major environmental problem. It's said to be the biggest existing and future threat to the cape's water quality in in southeastern New England, probably. And we know it's very expensive to remedy. This excess nitrogen stems from land applications as we know of storm water and fertilizer in wastewater. But the big one is septic systems. In fact on Cape Cod, 85% of all the homes on Cape Cod are served by on-site septic. So, the towns are making some difficult decisions and expensive decisions using the Cape 208 plan as a guidance to meet these total maximum daily loads or TMDLs to the sub-embayments. So, what I would call monumental work has been done by the by the MEP, the Mass Estuaries Project, to develop these TMDLs and by the Cape Cod Commission to develop tools like Watershed MVP. Those are very useful for scenario testing and planning. The TMDLs and available tools are generally scaled to large or fairly large recharge areas at the embayment or sub-embayment scale and those are based on delineations using the regional groundwater USGS groundwater model from back in the late 90s.

So today, I want to present an additional approach at getting at the question, "can we use river water quality to identify source areas in the groundwater watershed to prioritize actions for nitrogen reduction?" So on the cape, these rivers are generally gaining streams that are essentially drains to the groundwater system. In fact on Cape Cod, 30 to 35 or as much as 40 percent of all groundwater exits the system through these rivers. On the right here, I show an example of a groundwater contributing area. It's colorized here by time-of-travel, or groundwater travel time. This is work done by John Masterson in the early 2000s. And we can use our groundwater flow models to track water from its entry point from its entry point at the water table as recharge to its ultimate discharge location, whether it be a well or directly to a pond or to the river or ultimately all the way to the coast. So what you see here, this is the recharge area or groundwater contributing area that ultimately discharges to Coonamessett River, in this case under steady state in average conditions. So, today when I say contributing area, what I'm really talking about is the simulated recharge area from our particle tracking for average conditions. And so these contributing areas will vary over time with different pumping rates and recharge so what I'm talking about is an average condition. So, the thought here is that we can make a linkage between the river quality or river water quality observations to the modeled contributing areas.

So in September of 2019 and again in March of 2021 during the summer and winter period, we set out to measure stream flow and collect samples at multiple sites along 12 of the cape rivers, on the upper cape and the mid cape area. This method is referred to as a seepage run or also known as differential gauging. And so ultimately or essentially what this is, is by examining differences in adjacent sites, looking at differences in flow between upstream and downstream, we can determine groundwater inputs when it's a gaining stream reach or surface water outputs. In the case where it may be a losing stream reach. We can do that for each of these individual reaches throughout the area. By adding nitrogen samples to that, we can also calculate direct nitrogen load from groundwater. In this case where we have gaining streams, we can calculate the direct load from groundwater to these individual reaches. So for our two surveys, we focused on the freshwater sections of the 12 rivers here that you see here. A total of 62 stream locations which resulted in between 2 and 7 reaches per river. These surveys occurred over about a 4 to 5 day period, a dry period where we avoided precipitation and so we essentially were at groundwater base flow. Samples were collected for field parameters from all stream locations as well as the 12 headwater ponds in midstream ponds. We collected samples for field parameters like conductance dissolved oxygen temperature, inorganic nitrogen species, and the mainly the main focus here was looking at nitrate, which is the predominant form in groundwater.

So, what results from these seepage runs are these great river profiles. And so here's an example from the Santuit River in Mashpee, Massachusetts for the summer period. So on the x-axis here we have distance downstream and so in the red here we have discharge. This is in cubic feet per second. It starts at about four cfs at Santuit pond and increases gradually to about seven and a half or so cfs at the most downstream site. The gray line here is concentration. This is nitrate concentration coming out of the pond in the summer. It's zero and it slowly increases with distance downstream. Taking the product of those two, we can calculate a load and so this is nitrate load, the blue line here that you see, increases rapidly almost exponentially as you go downstream. But the real strength of this technique or that where this technique is most useful is that we can examine incremental nitrate loads or the loads that are attributed to the groundwater input here. And in this case of the Santuit River, we see that most of that input, these gray bars, is coming in the lower half, south of Route 28. So this is a very effective technique of looking at focused discharge of groundwater.

When I add the winter set here on the right, this is the plot that I just showed you on the left. The main difference between the summer in the winter is what the starting nitrate concentration is at the pond. In the summer months we see, when the pond is productive, we see nitrate is zero coming out of the pond. We look over to the winter, when the pond is less productive, it's coming out of the out of the pond at about .7 or .8 milligrams per liter as n and then it increases downstream at about the same rate as we see in the summer. So the difference here results in a shift of this overall nitrate loading, shifted from the summer to the most downstream site is now at about 18 kilograms per day in this in the winter months. But what most remarkable is that the incremental flux, what we care about, the input from the groundwater is very similar between the two sets in the summer and the winter, indicating that we have a pretty constant input from the groundwater to the river.

So the nitrate load, nitrate fluxes or loads, for each of the 62 reaches can be compared by scaling them to a common reach length. So in this case here, I used 100 meters as our reach length and I've plotted them from high to low here on the right and arbitrarily I've picked the top 12 to highlight here in red on the map as well as on this chart. And we see that three of the rivers have multiple reaches in the top 12, but overall we see these high reach fluxes are pretty well distributed on the west cape and they occur under conditions of both high stream flow and low concentration, high stream flow low nitrogen concentration, like the Mashpee and the Coonamessett River. But we also see the condition of very low stream flow, almost a trickle in the bps, with high concentrations that becomes the number one here, this Bps River, number one reach out of the whole area. So we see a variety of mixes between high and low: high flow, low flow, high concentration, and low concentration.

We can also look at these high fluxes and display them in terms of TMDL, or total maxim daily load, for the sub-embayments that they discharge to, or at least a component of the TMDL. So these are the measured reach flux as a percentage of the controllable watershed load, and this is from the MEP tech report. So this is the controllable watershed load to the sub-embayment that they discharge to. And controllable sources include wastewater, fertilizer, and stormwater runoff. But the bottom line here is these individual reaches, some of them quite short, pick up significant loads from groundwater in terms of the total TMDL for it for the sub-embayments that they discharge to.

So moving on, there are multiple tools we can use to explore the linkage between river observations and land use. Here I show example in these three panels for the Santuit River. There are eight locations and seven reaches on the Santuit that we've measured. And so, on the left here I show the USGS steady state groundwater regional groundwater flow model results. So here's the contributing area that's determined from particle tracking and I have it colorized here as groundwater travel time with the orange being less than 10 years and the red going up as much as 50 years. We can also use the Cape Cod Commission's WatershedMVP database. This is a beautiful tool that's based on parcel scale water use and from that they derive wastewater flows and nitrogen loads on a lot by lot basis so you can see all of these dots as input into the database. The orange here are septic loads, there's also there's also fertilizer that can be broken up into cranberry load, the maroon here, or golf courses and we can s up all of those over different land areas. And then also as well, we can use the Mass GIS land use data set which with that, we looked at percent developed versus undeveloped land.

So using particle tracking in the regional groundwater flow models, we can determine what I call the simulated groundwater reachsheds. So these are the groundwater recharge areas that are contributing directly to the individual river reaches.

Valerie: Tim, I'm sorry, I'm seeing people say that they can't hear you and that the main room audio is feeding into room two. Is that-

Cary: I just talked to Adam in main room and I think he fixed it.

Valerie: Okay, I'm sorry for interrupting

Timothy: Okay, so we're good. So you guys can hear me okay?

Cary: We can now.

Timothy: Alright good. So these reachsheds, simulated groundwater reachsheds, vary greatly in size and shape depending on the flow in the river, the size of the river, the reach length, and the river's orientation with the regional groundwater flow system. And so what this does is provides us the framework for the connection between recharge areas and river observations.

So the question becomes, do these river observations reflect what we see on land or land use characteristics? And it's apparent that they do. As an example, I show the Mashpee reachsheds, the 7 Mashpee MP 1 through MP 7 here on the left. Comparisons can be made between the reach observations what we see at in in the river and contributing area load factors, including the nitrogen yield the land application of nitrogen, land use and development, the wastewater flow, the number of septic systems, as well as the actual size of the contributing area or recharge area. So on the right here, we go back to a river profile, this is for the Mashpee river in the winter months. So this is distance downstream, the black line here represents observed nitrate reach flux. In general, it increases with distance downstream. This is in kilograms per of nitrogen per day. The blue vertical bars here represent the nitrogen load by type over the contributing area. And so what we can see, and so you see that predominantly the blue is septic load but we also see fertilizer storage, atmospheric as well as a landfill load, for this Mashpee, the most downstream most Mashpee contributing area. But what we can see visually is there's a good correlation between the river load and the contributing area factor here at least the nitrogen yield.

But in fact for all 62 reaches, based on spearmint correlations, we see moderate to strong positive correlation of most, of the moderate to strong positive correlation of the observed load to most of the contributing factors, the strongest being the recharge area the actual size of the recharge in wastewater flow that's applied over that contributing area. Still correlated but a little weaker are the number of septic systems in land development.

So given the linkage, there are ways we can rank or prioritize these reachsheds. Here are five examples that show on the right. We can rank our field measurements, these are the reach loads for the summer and the winter and I've listed them here from high to low, from 1 to 62 by name. We can also rank them by contributing area reach load, and so this is essentially the Watershed MVP approach, where we sum up everything in that contributing area, and or we can also put it in terms of TMDL, so these are the field measurements as percent controllable watershed load or field measurements as a percent controllable required reduction for the sub-embayment that it just discharges to. So however we rank these, we tend to see the same players, the same reaches come up to the top of the list. The Bumps and the Maststons Mills are usually at the top of the list. The lower Santuit and the lower Mashpee are also at the top of the list there as well. So what I show on the map here are the priority watersheds, this is the average of the ranks. The top 12 out of 62, so essentially what we can say is based on the river sampling these are the recharge areas that should be carefully examined as priorities for nitrogen reduction.

So some considerations for this approach, these are temporal snapshots, so we do expect variability in flow and concentrations over time. And so you know, that would argue for more long-term monitoring of not only river quality but also river flow so we can get more of a load sample. There are errors in differential flow measurements that increase with decreasing reach length. As these reaches get smaller, we do need to pay attention to error in our stream gauging measurements which runs at about five percent for the technique or method. So we can't get too small and short on these on these reach links. We are using the steady state regional flow model so these contributing areas are under for average conditions and there are associated errors with the regional grid size which is a 400 by 400 grid size, 400 foot by 400 foot. A couple other considerations, this is this is not a transport model. The benefit here is this is based on direct measurements of groundwater load to the rivers, so we don't need to make assumptions about attenuation or loss in the groundwater system or making a direct measurement. And then the other consideration that I want to list is we do need to consider nitrogen source history and how the land changes and how it relates to groundwater travel time, that lag from groundwater travel time, so that's just something else that we need to consider.

So in summary, the seepage run is an effective method for measuring loads to quantify groundwater inputs to rivers. On the cape, we see a clear linkage between river observations and these reachsheds, these groundwater contributing areas. So we can prioritize groundwater reachsheds by a variety of ranking methods and it is possible for maximizing nitrogen reduction efforts. This technique, the differential gauging, may be useful when coupled with sampling for citing alternative reduction approaches, such as permeable reactive barriers, innovative and alternative septic systems, especially in areas that are not slated for sewering or slated for sewering anytime soon. So with that, I will stop and I've left my contact information there if anyone needs more information.

Valerie: Great thank you very much, Tim. We will be taking some Q & A at the end of the session so just so everyone has an opportunity to present, we'll hold the questions until after the presentation. But thank you very much, Tim. So our next presenter is Nancy Leland. And Nancy received her Masters of Science in 2002, from the university of New Hampshire, where she studied the seasonal dynamics of cyanobacterial populations. Since 2014, she's been continuing the research, sharing insights into cyanobacteria population dynamics and exposure potential across a range of aquatic habitats. Currently, her research focuses on the biotic and abiotic variables that influence the structure of the cyanobacteria populations. With that, I'll turn it over to Nancy.

Nancy: Well thank you very much, Valerie, for that introduction. Good morning everyone. I'm Nancy Leland, I'm an affiliate researcher at the University of New Hampshire Center for Freshwater Biology where we are doing lots of research on cyanobacteria. And in particular, I'm focusing on how we take our monitoring methods that we do for our research and translate that into methods that can be used through citizen monitoring programs. So with that in mind, I'm going to pull up my presentation and we'll get started.

Valerie: Thank you, Nancy.

Nancy: Okay, so can you all see that?

Valerie: Yes.

Nancy: Okay great, thank you. So, before I get started, I would definitely like to make a shout out to those folks that collaborated with us on this project over the years. We've had many people collaborating with us to work on citizen monitoring, but for this particular project the lead collaborators were the Martha's Vineyard Commission so Sheri Caseau and then also the Martha's Vineyard Shellfish Group was really important in terms of getting us lab space for this program that we did last summer. And the title of my talk today is Picocyanobacteria as sensitive ecological indicators and looking at potential applications using this particular group of organisms in varying aquatic habitats.

So today I'm going to talk first about cyanobacteria just to familiarize anyone who hasn't worked with it yet. So we're going to look a little bit at population ecology and the ecotoxicology of the cyanobacteria. We are going to talk about the cyanocasting model and how we applied that on Martha's Vineyard with the Commission and the Shellfish folks and how we're using that to develop our ecological indicators, and then to get in more detail about the work that was done last summer out on the vineyard.

So some of the common cyanobacteria that we see within the SNEP region, we like to think of them as different populations, and they are distinct populations. We have picocyanobacteria which tend to be very small and you'll see them over here on the left-hand side of the screen, something like Synechococcus, less than two microns in size so very small, we have some what are called colonial picocyanobacteria which includes Aphanocapsa, and they tend to form colonies and up to 50 microns in size, something like Woronichinia is included in this group of the cyanobacteria and they're also colonial picocyanobacteria so they're up to about 50 microns. And then we go into the world of the bloom forming cyanobacteria, and we have different genus there as well. They tend to be larger colonies and group together so we have Aphanizomenon and Dolichospemum, and Microcystis. And for today's presentation, you'll see me referring to these different cyanobacteria for different reasons and we'll be going through that.

So in terms of their ecology, the picocyanobacterial, we typically associate that with transparency problems in our water resources and they are purely planktonic, so they are subject to wind and water. Where conversely, we have the bloom-forming cyanobacteria, which have this ability to be buoyant and to float and so they form the surface scums that we typically see in our water bodies. And that's a very important distinction between these two groups about how we see them manifesting themselves as we're looking at our water resources.

So like I said before there's difference in morphology between these different genus of cyanobacteria. They can range from single cells up to very large colonies and filaments, we have size distributions to consider when we're working with them, definitely have seasonal preferences for these different types of populations when you might tend to see them more commonly in different water resources in the spring versus the fall, and they for sure have their ecological niches. So they respond to things like light, temperature, nutrients, and salinity and typically we'll see them partitioning out based upon these ecological niches. Then they, excuse me, are also subject to different variables that influence their growth. So the biotic and abiotic variables can influence what we're seeing for these populations.

And the reason why we like to study cyanobacteria and why more people are paying attention to them now is that they produce the cyanotoxins and that's being regulated now and given advisory level concentrations by the local authorities and also state and federal level. So the eco-toxicology of these different genus is really important. You'll see here on the left, some of the commonly found cyanotoxins the b-methyl-l-alanine are called BMAA the Anatoxin-a which is ATX and then the microcystins which is MC. So the different cyanobacteria, there are definitely genus preferences for producing these toxins but multiple toxins are very commonplace that we see in our in our water bodies. So that's how we tend to group these things if someone comes to me and tells me that they have microcystis in their freshwater body, I automatically start thinking about microcystins because that's what microcystis likes to produce. If someone comes to me and says that they're dealing with what they think is picocyanobacterial, we tend to think about BMAA and Anatoxin-a so there's definitely a separation in terms of the types of cyanobacteria that you have and what you might expect to see for the cyanotoxins. And the cyanotoxins just in and of themselves are very interesting they're very water soluble, they have different modes of action whether they're a neurotoxin or hepatotoxin, they have different effects whether it's acute or chronic, they degrade differently some of them are very, very sensitive to degradation effects and can degrade within hours while others can last for weeks, they differ in their bioavailability in terms of the genus that is there and whether it's edible or inedible to going through the food web, and they have very different bioaccumulation profiles associated with them so whether they're undergoing biodilution or biomagnification. So given all of that that we know about cyanobacteria, there's a lot of things that we don't know and some of the more important things is that we really do not understand what's going on with human health and ecological risks that are associated with picocyanobacteria, and that's why we are studying them now. We still, after all of these years, do not understand what the actual triggers are for toxin production itself. You can have something that is toxigenic but not producing the toxins at that time when you're taking the sample, so that's still a question that remains very elusive to those of us that are doing research. And then of course there's always the question of what is the toxin produced for and I'm thinking in terms of, it must have some benefit to the organism that's producing it, whether it's a chemical defense, a nutrient scavenger, or nutrient source itself. And sometimes that can help us understand more about what we're trying to do with these cyanobacteria.

So the cyanoCasting model we've developed for after seven years of field research and verification, and basically what this model relies upon community composition and size structure first and foremost and I think I mentioned that earlier, that depending upon what you see there by genus will tend to put you in categories of thinking about what the cyanotoxins are that are being produced. So the first thing we'd like to know is about community composition, then we like to know how much is there so we want a measure of the biomass, and from that we start to understand what we have for cyanotoxins themselves. And what you'll see here in this chart is looking at the different genus that we have so Microcystis, Dolichospermum, Aphanocapsa, Synechococcus so that's our first level, that's community composition. Size structure down here whether they're the buoyant and scum-forming bloom-forming cyanobacteria or whether they're in the world of the picos and looking at very small forms. Looking at their ecology in terms of what we might expect to see in the system and then we get to how do we know what's there. How are we identifying these so that we can continue to do our evaluations? There are some very simple identification methods that we like to use for most of them for Microcystis, Dolichospermum, and Aphanocapsa, we can use light microscopes and pigment analysis to be able to do that. When you get into working with something like picocyanobacteria you basically are in a more expensive place of having to use something like epifluorescence and flow site cytometry and qPCR to be able to identify them. So the monitoring protocol that we have is that we use these ecological niches which suggest the use as indicator organisms. So our BFCs, they're very large but they're also very slow-growing and definitely have specialized niches that they like to stay in during their life history. The picocyanobacterial, in particular, they are very fast-growing they're incredibly adaptive and they are really, really good at niche diversification, which means if something changes in the environment, they will be the first ones to respond to those changes and basically be able to proliferate and grow under other conditions, when may perhaps the BFCs would not be able to respond as quickly. And that's what's making them a very sensitive indicator in our mind in

terms of being able to be adaptive, diversify, and change with the changing environmental conditions very quickly.

So when we look at our methods we as I mentioned earlier we have our light microscope, we can get composition and dominance and from information very quickly about our bloom-forming cyanobacteria. We can use a handheld fluorometry and it tells us something about what's going on with the sample in terms of the biomass and we can measure that using our accessory pigment which is phycocyanin. And then we can also fractionate the samples so that we are able to describe these different types of populations. So the indicators that we're able to get just from these simple methods of light microscope and fluorometry we can look at what's going on with the biomass. We've also been able to estimate toxin levels from the biomass concentrations and we've been able to validate and verify that at different sites over several years. And then we can look at trophic influences which, in some particular systems, become extremely important. For our picocyanobacterial, which is typically less than 5 microns, we also are starting to use another accessory pigment phycoerythrin, which is specific to picocyanobacterial biomass. And so that's really helping us focus in on what's happening with this part of the population. And the picocyanobacteria are really important to us as an indicator because they are the organisms that will be getting into the food webs and potentially bioaccumulating and they're also responsible for the cyanobacteria and the cyanotoxins themselves that are aerosolized.

So one of the underlying concepts that we're using right now is that we can look at community composition through the concept of pigment fingerprinting. And the reason why we've moved to this concept of pigment fingerprinting is that it's really difficult to be able to see what's going on with the pico population visually, unless you go to something like the flow cytometry or the epifluorescence or the qPCR analysis. So the fingerprinting is really easy to use. We're finding that it's, you know, it's low cost, it's reliable, it's repeatable. So we're getting these patterns of this pigment concentrations that we're seeing that can help us understand that without having to rely upon the light microscope. And that's where it becomes very important for our work with brackish systems where we could use this pigment fingerprinting to understand more about picocyanobacterial and looking at the food webs and the process and aerosolization of the cyanobacteria and the cyanotoxins.

So the Martha's Vineyard Experience, this is the work that was done in 2021, where we applied the cyanocasting model over 30 sites we surveyed last summer and we predominantly use the light microscope and fluorometry. And one of the major findings from last summer was that there was a community composition response to salinity. And what we saw was that at the low concentrations of salinity, we had our bloom forming cyanobacteria were present in all of the systems, and then as we increase salinity we came across some halotolerant BFCs at some of the sites. But once we got above about 15 parts per thousand for the cyanobacteria, that the picos were dominating the cyanobacterial biomass. And so these red stars are the sites where it became picocyanobacteria-only sites and they were dominating these obviously are our high salinity sites. And so what we were able to do last summer with the data that we had is that we were able to use our ecological indicators to describe what was going on with these populations. We could look at diversity and biomass and also toxin concentrations. So what I want to talk about now is to share with you the data that we got on the toxin concentrations from last summer.

The, and a little background on this, for toxin concentrations that there is a relationship between cyanobacterial biomass and the cyanotoxin concentrations. We've documented this in fresh water systems in New York, New Hampshire, and Massachusetts and we know that the community composition determines the toxin concentrations themselves, so it breaks out a long different genus of the cyanobacteria. And we've been able to verify this for microcystins. And in our preliminary studies we've also seen that there's this relationship for Anatoxin-a and for BMAA. So what we've done is we've applied this model to Martha's Vineyard as part of our assessment to look at brackish systems. And I want to share with you some of those results. So for Anatoxin-a, for our freshwater site, our freshwater study site, we were able to establish linear relationships between the phycocyanin and the phycoerythrin for

Anatoxin-a. At our brackish sites, we had more correlations than we did linear relationships. And so the question for us is whether more information about the picocyanobacterial populations will help us understand whether we have linear relationships and can confirm them for this biomass to toxin model that we're using.

So for BMAA at our freshwater site, we did have linear relationships between the phycocyanin and BMAA and also the phycoerythrin as well, which was very interesting. The brackish site, again, we had correlations. We'd like to see linear relationships if they're there, but we realize that we need more information about the picocyanobacteria and what role they are playing in production of these toxins. So picocyanobacteria as an ecological indicator of toxin concentration, in freshwater systems we're feeling that our interpretation could be enhanced by including the picocyanobacterial data within this analysis. But in brackish systems, we feel that our interpretation requires the inclusion of the picocyanobacterial, simply because they're just dominating the biomass in these brackish systems and we have to have that that data available to us. And by including the picocyanobacterial sample, we will open the door to other types of assessments like the food webs and also aerosols.

So what's ahead for the future? We are going to be collecting samples as part of the Green and Resilient Infrastructure program that's being undertaken out on the vineyard this summer. We are going to be using cyanobacteria as a response variable for stormwater control measures and in particular of course we're very, very interested in what's going on with the picocyanobacteria response. We expect that we will see that quite rapidly because I mentioned before, they are highly adaptive, highly responsive, and have very high growth rates, even under changing conditions. So we're really, really interested in what's going to happen there. We're going to continue to work with our cyanoCasting model and looking at diversity indices what's happening with the biomass, what those toxin concentrations are. So we will be reconfirming this correlation between cyanobacterial biomass and the cyanotoxins. And then we will also be able to start to gather more information about aerosols. At this point, we have some ideas about the metrics that we could use within our framework of our monitoring program to look at the potential for aerosolization from the water resource, so we will be sort of playing around with that concept as we continue to gather all of our information out on the vineyard. So these white stars that you see, these are the sites that we will be monitoring in detail as part of the Green and Resilient Infrastructure project going on this summer. And with that being said, I'd like to say thank you again, especially your time today especially, but also to support from the Center for Freshwater Biology, the Shellfish Group from last year, the Martha's Vineyard Commission who will be joining us this year again in collaboration, and then of course the Stormwater Center with Jamie Houle, who you'll be hearing from later on today. So thank you very much for your time.

Valerie: Thank you, Nancy. I don’t know why, the echo. If everybody could turn off their speakers, their mics. We will be having some Q & A at the end. Is it Qian or is it Rachel? I’m confused, I’m sorry.

Rachel: Oh, you can call me Rachel.

Valerie: Okay, thank you. Okay, so our next presenter is Rachel. She's a research associate at the University of Connecticut Center for Land Use Education and Research. She specializes in GIS remote sensing applications from natural resource management and her current role is to provide spatial/geospatial support for a variety of projects at CLEAR, relating to land cover water quality and other environmental issues. And with that, I’ll turn it over to Rachel.

Cary: Hi everyone, this is Cary Chadwick I’m a co-worker of Rachel's. I’m also helping to get us started today although Rachel's really the superstar of the spatial work that we'll be showing and highlighting later in the presentation. So, Rachel and I are both from the University of Connecticut Center for Land Use Education and Research. Excuse me. Rachel's advancing the slideshow.

Valerie: Oh, sorry. I’m sorry Cary, I just saw your bio so let me read that quickly. I’m sorry, let me just present- I didn't see that there was a second one.

Cary: It is fine, you don't have to. Let's just move forward, we're fine. I'll give you an introduction as we go.

Valerie: Okay, I apologize.

Cary: No worries. Go ahead Rachel, go on to the next slide.

Rachel and I are actually only a small part of a much larger team of partners and scientists working on this project. And my caveat is that Rachel and I are both geospatial specialists so our area of expertise is the mapping and the geographic information systems and not so much the water quality science. So when it comes to the question and answers, we'll do our best but we may have to get back to you on some if there's more technical questions. The project team includes some really smart people. UCONN partnered very closely on this work with the University of Rhode Island's Department of Natural Resource Science, both Art Gold and Q Kellogg, who some of you may know. And then some other project partners at UCONN CLEAR including Chet Arnold, who is another very smart water quality science scientist. And the work that I'm going to be showing today was funded by the EPA Office of Research and Development. But this is work that goes back over a decade, longer than my time on the project, and has, you know, has grown and has been funded by various sources and has changed over the course of that time. So it's a long a long time in the making.

And the work covers EPA Region 1 and we have a few partners there as well. So as an outline for- I don't know what happened to this slide, so you can't see some of our outline- but you can see our beautiful HUC-12 watersheds that cover the Connecticut and Rhode Island coast, and that's the study area for our N-sink tool. But I'll just kick this off with an introduction, talk a little bit about the background and methods, and then pass it off to Rachel who's going to showcase the mapping.

So in terms of, you know, why we're here talking about N-Sink, I don't think I need to go into great detail about you know the reason, the background, the problem of nitrogen pollution and why it's a threat to water quality. We know that, we've seen these slimy slides in the previous presentation and others. Nitrogen loading to coastal waters can spur these harmful algal blooms, hypoxia, eelgrass decline, destruction of critical spawning habitats, and other problems in coastal waters. Sources and sinks of nitrogen are closely linked to land use and management. And for N-Sink, in this particular project, our target audience were land use decision makers and managers that need tools to translate science into management relevant information. So the goals of N-Sink, you can go to the next slide Rachel.

The goal of the project team was to create a decision support tool that is easy to use and highlights areas within a watershed that are critical to nitrogen management. For us, the tool needed to be broadly applicable, easy to use, and accessible online. Go ahead, yeah. The focus and intended outcome of the N-Sink tool is to identify areas within a watershed that play an important role in nitrogen management. And it centers on this idea of landscape nitrogen sink areas. These are going to include wetlands, riparian areas, ponds, and lakes, where nitrogen cycling processes such as denitrification as well as plant and microbial uptake remove, bury, or sequester nitrogen and reduce downstream nitrogen transport. It also draws attention to areas where nitrogen flow paths do not interact with nitrogen removal sinks before reaching estuarine waters. So in other words, areas where high likelihood of efficient nitrogen transport to the estuaries is happening.

So some additional caveats, beyond the caveat that Rachel and I are not the science experts here, is that N-Sink was not intended to be a rigorous model and it seems like there are many rigorous models out there, you're hearing about them today. This is not meant to be one of those. Instead of estimating nitrogen loading from land use and runoff data it estimates nitrogen attenuation along a flow path from the source to receiving water. It is meant to be a prioritization and visualization tool enabling users to better understand how nitrogen moves in a given watershed and investigate nitrogen related impacts of various land use scenarios. It directs the focus of decision makers to landscapes that might be valuable to protect in the future and target source areas where flow paths do not interact with nitrogen removal sinks before

reaching the estuary. The tools in outputs are not intended for applications where the absolute quantity of nitrogen is being tracked. For example, in documenting compliance with a TMDL.

So what is N-Sink? N-Sink is an accessible R-package and an interactive web mapping tool, and it's taken us many years to get to that point so this is a huge success for our team. N-Sink uses particle tracking to estimate nitrogen removal based on the characteristics of the landscape sinks and attenuation along that flow path from a source anywhere within the watershed to the receiving water body. The extent of nitrogen removal within a sink is governed by retention time with longer times leading to more nitrogen removal. Retention time and removal estimates are based on a series of literature reviews that are described in detail in this 2010 paper that was published by the project team. N-Sink examines watersheds at the HUC-12 watershed level and uses widely available geospatial datasets as their input, which was really important to the project team because the idea is that we wanted to make it scalable and broadly applicable.

Currently, we have run N-Sink for 76 watersheds spanning the Connecticut and Rhode Island coastline. This slide shows the various input data sets for the N-Sink tool. Landscape sinks are identified and characterized using a number of nationally available geospatial data sources which you see here. Topography, hydrography, and watershed boundaries are derived from the NHD-Plus version 2 data set, which is an integrated data set that includes the national hydrography data set, the national elevation data set, and the watershed boundary data set. Soils were derived from the Soil Survey Geographic database. N-Sink identifies wetlands by locating hydric soils with areas of impervious surface that removed from those areas. And that impervious surface comes from the land cover, the 30 meter national land cover data set, which is also used as an input.

This image shows a static example of how particle tracking works within the watershed in N-Sink. N-Sink again focuses on retention time within a sink. A user selects a point within the watershed and the tool calculates the flow path to the outlet. The flow path typically intersects both terrestrial sinks like wetlands and surface water, ponds, lakes, and streams before reaching the outlet. At each interception, nitrogen removal is estimated culminating in a cumulative nitrogen removal at the outlet point. So this is just a static example of the tool, but I'm going to pass it off to Rachel now to explain the interactive portion and the three maps that are generated when you run the N-Sink tool.

Rachel: Thanks guys. As Cary mentioned, N-Sink creates three maps as outputs which we'll explain in detail in the next few slides. So you can also use the url link below here to visit our N-Sink website and then you'll see a couple of examples of N-Sink maps in PDF format and each those PDF documents have a color coded map, along with the descriptions on the map itself.

So the first N-Sink map is a removal efficiency map that estimates the percentage of nitrogen removal in landscape sinks within a watershed. The removal rate of the sinks measured in percentage are calculated based on the sinks characteristics and the research results from the literature. The map is color coded so the areas in the darker green color indicate that those areas have higher percentage of nitrogen removal. So for example, in this map of Palmer River Watershed in Rhode Island, if nitrogen encounter the areas in the darker green color along its pathway, up to 60% to 80% of nitrogen will be removed before reaching down to its downstream water. So this map, it can also be considered the map for sink areas. So removal efficiency map focuses on conservation priorities. This map could be shared with local wetland and watercourse commissions to help them guide, repair, and corridor protection and restoration. And it can also be used by land trust and others to help prioritize open space acquisitions.

And based on the removal efficiency map, we created the second map, transport index map. This map shows the leaky areas within a watershed, which are the areas where nitrogen inputs will most likely make their ways to the receiving water. If nitrogen enters the watershed from any given location in this map, we use particle tracking analysis to calculate the cumulative nitrogen removal along its pathway, originating at that location. This map is also color coded, so the area is in the warmer color, which is in the red and orange shade here, and have higher nitrogen likeness. So for example, at the southern part

of Palmer River Watershed, if nitrogen enters this watershed from these areas, nitrogen are less likely to be removed and more likely to reach down to the coast. So this map is also considered the map for leaky areas. So this map focuses on the areas to prevent future nitrogen inputs and can also help reduce the current inputs. So for instance, if the leaky areas identified in this map have little or no current development they could be considered a priority for conservation and then if the leaky areas identified in this map have future development plan then zoning regulations could be reviewed to see what uses and at what intensity are currently planned for these areas. You can also use this map to reveal current land uses in leaky areas and identify hot spots of concern and determine whether we need more strict nitrogen controls and removal practices.

And then based on the transport index map, we created the third map, delivery index map. Delivery index map estimates the percentage of nitrogen being transported from a given location within a watershed to its receiving water, based on the current land use condition. So to calculate the delivery index, first we'll estimate a nitrogen loading rate based on the 2016 national land cover data set. Note that the loading rate calculated here is not an actual loading value. It is a normalized index measured in percentage and it's estimated based on the land cover classes in NLCD data set. And then we multiply the nitrogen loading rate by the transport index, derived from the transport index map, from the previous map to calculate the delivery index. In this map, the areas in the darker red color indicates those area have higher level of nitrogen delivery based on its current land cover condition. Since this map is a combination of current land cover with the transport information, this delivery index map helps to pinpoint the areas that are likely to deliver high nitrogen loading to the receiving water. This area might be prioritized for source controls and best practices and they might also be the focus of nitrogen monitoring and the efforts to estimate nitrogen loads. So you can also think about the delivery index map as the map for aerial concerns.

And then let's take a quick look at of the workflow for N-Sink so when we specify a HUC-12 ID for a HUC-12 watershed of interest, so N-Sink R-package, will download the corresponding data on the fly based on the HUC-12 ID, including the hydrographic data from NHD+, soil data from SSURGO, and the land cover data from National Land Cover data set. And then the R-package will create those three N-Sink maps for watershed as we discussed before, and then also creates a particle tracking tool that estimates the nitrogen removal along its pathway from any given starting location within that watershed. However, N-Sink R-package can only run in R-environment, which can be difficult for non-R-users or non-programmers. So in order for land use managers and stakeholders to use N-Sink, so we clear, we use ArcGIS platform and R-Bridge to transform N-Sink R-package into a web-based interactive web tool that can be easily accessed through a web browser.

So where is N-Sink? So you can click on the link above here to visit our N-Sink website, then you can find the access to both N-Sink R-package and the N-Sink web app. So first the N-Sink R-package is written in R- computer language and can only be run in R-environment so if you're an R user, you can directly download the N-Sink R-package through the GitHub link here, and then you can run the N-Sink analysis for any HUC-12 watershed on your own computer, for free. And although N-Sink was initially designing for HUC-12 watershed the R-package can actually also be used for a larger HUC extent, such as 8-digit HUCs. But if you're not familiar with R- or R-language or programming, you can also use the N-Sink web app to explore N-Sink through an internet browser. So the N-Sink web app is an interactive decision support tool to visualize, explore, and analyze N-Sink maps online, and it includes 76 HUC-12 watersheds along the Connecticut and the Rhode Island shorelines.

So given the time limit today, we'll probably not be able to do a live demo to showcase the web app but please use this url link here: s.uconn.edu/nsink to explore the web map and let us know what you think. To give you a quick walkthrough of the app, so the N-Sink web app includes different sections, so you can click on the tab on the top here to switch between different sections. So when you open the app, the first you see this welcome section that includes an overview of N-Sink and also a brief description for each section of the app. And then if you click on the tab of watershed maps, then you can download all

the three N-Sink maps in both TIFF and PDF formats for any one of the 76 watersheds along the Connecticut and Rhode Island coastline.

And if you click on the watershed analysis tab, and this section includes an interactive dashboard that summarize the three N-Sink maps information and also the land cover composition for any one of the 76 watersheds in a graphical chart format. And then we also have an N tracker tool that, in that tool you can track nitrogen from any user-specified location which is showing to the map in here and then it will draw you the nitrogen pathway from that location and summarize the nitrogen removal information in a table along this pathway using the particle tracking analysis in the N-Sink R-package.

So here is our presentation today and we look forward to your feedback and happy to show a live demo on the app if anyone is interested. And then we can answer any questions during the Q & A session.

Valerie: Thank you great thank you thank you so much that was a great presentation by everyone.

SNEP Symposium – Science Bringing Solutions Delivering Environmental Improvement to Southeastern Coastal New England

Room 2, Morning Session 2

May 18, 2022

Nora: Okay, so to keep us on schedule, let me get us started. Danica, I see that you're on as our note taker, thank you very much. My name is Nora Conlon, I am an EPA Region 1 Quality Assurance Chemist, and I'll be the facilitator for this session. I'm sure most of you, if not all of you, attended the first session so you know how this is going. But what we're going to do is have our three presentations and we'll hold questions until the end. I encourage you to put your questions into the chat and if you could identify who the question is for, that would help. And I'll try and look to see what we have here and bundle them as we get to the end. We have about 25 minutes at the end, so we should have time to address quite a few questions or have some conversation. So for the presenters, Jason if you want to get ready to share your screen, I will introduce you. One thing I'll do for the presenters is I'll go off camera but when there's about five more minutes left in your session, I'll turn my camera on as just a little visual clue that you're getting close to the end of your time slot to keep us on track today. And with that, let's get started. I think that's all I wanted to say. Yep, we have three great presentations in this session and we will start with Jason Steiding, Did I say your last name right, Jason?

Jason: Steiding.

Nora: Steiding, okay thank you. From the Mashpee Wampanoag Tribe and Jason has 11 years of experience serving as the director of the Mashpee Wampanoag Tribe's Public Works Department and recently took over as the tribe's Natural Resource Director in April 2021. As the tribe's Natural Resource Director, Jason manages the tribe's 12-acre shellfish aquaculture farm and is tasked with overseeing and implementing sustainability and conservation strategies to preserve tribal ancestral lands and to be a steward of the land as his ancestors were thousands of years before him. And with that, Jason if you'd like to get your presentation started, that would be great.

Jason: Okay, thank you. Can you see my slide now?

Nora: Not yet.

Jason: Okay, I have it up for my end. I'm not sure why it's not saving.

Nora: Danica, is there something we might be able to help with?

Danica: Let's see, so you're sharing your screen or sharing a window? Right now I do see the presentation as being up I'm just not sure if you folks are able to see it.

Nora: Hi Jason, so it doesn't look like we are seeing your screen yet.

Jason: Okay.

Nora: Alright can I just ask, are you using the Teams app? You are, okay. So did you already click the share button?

Jason: I did, let me see.

Danica: Hi Jason, it's Danica. If you want me to, if you're not able to share it, then I can pull it up on my screen and click through it for you and just share it through me.

Jason: Okay, yeah I'm sorry. I did a run through the other day and it worked I don't know why it's not working now.

Nora: I have the same thing happened to me too many times, it's a mystery.

Jason: Okay, that would be much appreciated, thank you. I don't want to hold this up. Just let me know when you're all set.

Danica: Are you able to see my screen?

Nora: Not yet. Still nothing. There we go.

Danica: Are you guys able to see my screen?

Nora: Yes.

Danica: Okay, I'll unpin myself. Jason you can see it as well?

Jason: Yes.

Danica: Okay, great. Okay just let me know when to click through the next.

Jason: Okay, thanks folks. Sorry about that. So much for the run through. Again my name is Jason Steiding, I'm the Mashpee Wampanoag Tribe's Natural Resources Director. Today, I'm going to be talking about partnerships and planning to address water quality in a Mashpee Wampanoag tribal ancestral pond. That pond specifically being Santuit pond. We can head over to the next slide.

So, you know, these are some of the partners that we have had in this project and then in projects past. There's a ton to name but obviously we've worked closely with the with the town of Mashpee Army Corps of Engineers. Specifically for this project, we've gotten great contributions and technical assistance from the SNEP network. We partner and get a ton of our funding from EPA and Fuss & O'Neil has done a lot of work on this project as well and I'll get into detail about these partnerships the more that we continue this discussion. Next slide please.

So some of the agenda items that we'll be talking about today. I'll give you a little brief history about the tribe and our tribal lands, talk about some of the issues that we're having specifically on Santuit pond and some of our other waterways in town, the relationship with the tribe, the town, and the SNEP network, some key facts about the watershed base plan, and then we'll talk about some of the things that we're looking forward to in the future as far as water quality is concerned. The next slide please.

So the Mashpee Wampanoag tribe, some might know, are we're referred to as the people of the first light. We've been stewards of this land and the waters for you know 12,000 years time millennia. You know, our land and our water are obviously very sacred to us. It's a natural resource that we hold dearly. We're, you know, we're basically as a tribe, feel as one with water, with land, with the wind, with the skies. So water and water quality is very important to us, not only as a tribe, but really as a community as well. You know, we're looking to tackle resources here that don't just have significance to us but to the community as a whole. We have limited control of our ancestral lands. We, right now, we have trust lands over, actually that might be a typo there, I believe it's 12 parcels in Mashpee and then a couple of off Cape. I'll show some maps in a little bit to kind of give you an idea of what it looks like. And one of the issues that we do have, and some of the maps that come up are pretty telling, is that we don't have really much control of our ancestral lands. You'll see there are little pockets here and there but there's really no contiguous pieces that we call ours, and that's what some of the obstacles are when we when we go to tackle some of these issues. Next slide please.

This is just an image of Santuit pond. I'll get into a little bit more detail obviously about some of the things that are going on in there, but some of the fish that are at risk in this waterway and then in some of the waterways in town include the American Eel, that Brook Trout is on the right top corner that's a Sea-run

Brook Trout and obviously the Herring which are very significant to the tribe, and I'll get into that again in a in a little bit of detail as well. Next slide.

So as mentioned earlier, this is sort of a snapshot of some of the trust parcels that we have. This is on the Cape side of things so there are additional parcels off cape but you can see these are 12 parcels located over about 321 acres. So the you know the issues that we have, when I talked earlier about you know getting funding to combat pollution and to you know get grant studies for your waterways, is that a lot of the grant opportunities have to be waterways or lands that are held in trust or run through your reservation, and as you can see there we don't control much. So in order for us to be successful and to, you know, apply for grants and to receive grants we have to partner. Sometimes it's the only way that we can do things, especially with the town of Mashpee because they control most of the land. And then you've got folks like the SNEP network who come in and give you the technical assistance as needed, but that's probably our biggest issue right now and it really is the reason why partnerships are so key for the tribe to get things done on our native lands and why it's so important to us. Next slide please.

So this map, I use in quite a lot of my presentations. I think it's very telling map. So we just saw the trust lands on that previous map that were located in the Mashpee area and on Cape. This map here will show you now, as you zoom out, just how insignificant that amount of land is. You can see the red areas in the lower right-hand corner those are the locations in Mashpee. We do have some trust land further up northwest, which is our trust land location in Taunton. So you can see this is a pretty telling map about just how little of our ancestral land that we do control and why it's very, very difficult for us to have an impact on any type of work that's being done in our community on our waterways because oftentimes we're just not eligible because we can't lay claim to land where we don't have much of a land base. I think the number is we control one-tenth of one percent of what was once our ancestral lands. Next slide please.

So again I mentioned Santuit pond. That's the pond right now that we're specifically working on with the town and with SNEP network as well. The top diagram there, that circle, that's where the pond is located in Mashpee. The pond is just a mess, so it's very significant to us. Obviously it's a cultural resource, but it was also the location where our Indian church was, our meeting house, it's the oldest Indian church in the country. The word Santuit itself means place of the Sachin so that is an area where our Sachins, who are our spiritual leaders, met to gather, to practice cultural beliefs, religion, for trading. So it's a very important river, I'm sorry, pond and river system, and it's totally impaired right now. It's infecting the herring spawning habitat, very minimal amounts of quality habitat left in the pond for the herring to spawn. Again, herring are a huge, huge piece to our culture. They're running right now. We use them for sustenance, for food, we use them to catch larger fish, we use them to put into lobster traps, we eat the herring raw. So, very, very important to us. As you move down from the river, now you're talking about, I'm sorry from the pond, now you're looking at Santuit river which runs in the Popponesset Bay. Santuit river also is impaired. I had shown you the picture of the Brook Trout earlier on. We're doing a study right now, speaking of partnerships, with US Fish and Wildlife. It's a tribal wildlife grant to study the decline of Sea-run Brook Trout in Santuit River. There are none left. We're still not quite sure yet whether it's pollutants, warming waters, we're not sure. But the river is actually devoid of these fish. So that's another grant that we have, another partnership, and another example of, you know, being able to work with an agency to identify issues that are that are in our backyard. And then the river spills out into Popponesset Bay. You can see the data there. Total nitrogen it's, I mean the bay itself is a mess. The tribe does have a 20-acre sorry, a 12-acre, shellfish grant in Popponesset Bay, where we grow oysters and quahogs, so it's an issue of sustenance as well for us. You know, we sell these fish and we also leave locations open for family areas for travel members, and oftentimes these areas are closed in summer months for algae blooms or what have you. So, you know, we're being affected in in many different ways and it affects our sustenance and it affects our cultural identity. So, you know, these are some of the issues that we're up against in this particular area. Next slide, please.

So Santuit Pond again, getting back to it, frequently there are, you know, no swimming advisories which, you know, I can remember being on this pond when I was a kid and you had sandy shores, sandy bottoms and you could swim all summer long. It's listed as impaired for fish passage, abnormal fish deformities, you can see everything that's listed there. I mean, the pond really is a mess and I do remember this pond being relatively pristine when I was growing up. We had looked at doing a dredging project on this farm with the Army Corps of Engineer a few years back and as of recently based on their own studies, they took core samples, there's eight feet of sediment in that pond and most of it is metals and it's basically considered toxic waste. You wouldn't even really want to disrupt the bottom for fear of you know dispersing that that waste even more throughout the pond and there's no way to take it because again it would be considered toxic waste so there's no way to bring it. So the pond's in really, really tough shape. Next slide, please.

You know, some of the issues with the pond and some of the reasons why the pond has is having issues is over development, you know, among many other things. And this map does a great job, I think, of showing just how much that area has become developed over the years. You can see the maps from 1952 all the way to 2002, which will show you the amount of development around that pond and what comes with the development. Homes, septic systems, fertilizers, runoff, and that's probably one of the biggest pollutants to that pond right now. I think that map does a great job of showing that. Next slide please.

So again, I won't get into the to the details, but this is just an idea of some of the issues that are going on in the pond and where some of these nutrients are coming from. And, you know again, you got the septic systems, you got some cranberry bogs in that area, you've got storm runoff and especially as we deal with climate change, we get more severe and frequent storms which do lead to that as well. Next slide.

So I mean, some of the things that we're doing right now, again, the town has some Solarbees in the pond, those have proven to be to be ineffective. They do have an enforcement of septic systems in the town, which hasn't really done much as well. They did apply, and this is what we're working on right now with the town along with SNEP, this is one of the partnerships that we're working on, is an MVP Action Grant which, so far, has been a great opportunity and really, I think, solicited a lot of interest in town from the people who live around the pond. So we're hoping for some really good results there. The SNEP feasibility study of interim measures to address water column phosphorus and all the work that we've done with SNEP. So we've done, I know myself in the town of Mashpee have gone through the stormwater training series with UNH, and so we're actually learning as we go along on this. We're not scientists, we're just trying to do the best that we can from our end. So all this help that we can get has certainly made a difference for us. And some of the long-term plans, the town does plan to shore the area but that, again we'll be lucky if we saw that in 10 years. So there's a lot of things going on right now. The pond needs a lot of work, but we're hopeful that we can get there. Next slide.

So I just talked about, you know, a lot of the collaborations that are going on right now. Some of the other partnerships that we do have, we water sample with the town, take water sampling in the summer, we also do that with the water. We're quite a big collaborative, I'm sorry. We have an Aquaculture Grant which is, the oysters that we propagate out in Popponesset Bay, which I spoke to. And then again, we work with USGS and the town of Mashpee, who have sondes in some of our rivers to address water quality. Next slide, please.

So again, the goal is to manage 91% of the phosphorus in the in the pond. We are currently working with the town and, again, the assistance of the SNEP network to provide an alum treatment to the pond. The MVP Grant has identified 10 to 20 retrofit locations. I think the first grant opportunity we have will address 5 of those to help combat some of the storm runoff. Again as I mentioned, there's been a lot of public engagement and a lot of education that has gone on as well. So again, we're very hopeful of how this will turn out. Next slide.

And so again, you know this this isn't the only area or the only pond in town. There are many other waterways including recent algae blooms in Mashpee Pond, which is an absolutely huge pond and lake system, for anyone who's familiar with this area. So for it to get algae blooms is very concerning. Some of the funding opportunities that we're looking at to address Santuit pond and some of these other locations in the future is a second round of MVP funding. The tribe was recently recognized with a TIS certification through EPA, which will allow us more capacity building to test for water quality ourselves and to implement our own water quality standards. And then again, just continued partnerships with a lot of the organizations who I've already mentioned. Next slide.

So again, we've received technical assistance through a SNEP MOA, which is a, you know, really educated. The tribal staff, again, we're not scientists here. So you know the things that we've learned through SNEP have been invaluable to us and hopefully we'll be moving forward. We've been allowed capacity building to plan and manage water quality-based issues to storm water on a watershed scale through this work that we've done. Again, the stormwater planning training sessions have helped the tribe to develop conceptual designs for stormwater. So you know part of that MOA has been, they've really wanted us to be involved and to put our input and to provide our input, which has been invaluable to us as well. We've assisted in creating the Draft Watershed Based plan. And, you know, it's also given us a voice. You know again, we came into this not really knowing the technical side of things or the science of all of this, and working with, you know, the town and SBEP and UNH has really emboldened us. And it's, you know, allowed us to almost feel like we're, excuse me, you know partners with some of these folks that we're dealing with and that gives you the confidence that you need when you're when you're searching out grant opportunities and asking for funding. So you know, that's been very, very invaluable to us as well. And, the next slide.

So this is just some of our contact information if you ever want to get a hold of any of us and some of the people who have been involved with this project including my Assistant Director Dale Oakley, Ashley Fisher, who is the town of Mashpee's Natural Resources Director, and of course Kim Groff from SNEP Network, who's been a huge asset to the tribe. And that is that, and I apologize for the technical difficulties.

Nora: It was a microsecond of a technical difficulty. I'm glad we have the backup plan. And I want to remind people, we'll be gathering the questions to talk at the end of the three presentations. And thank you very much, Jason, to share this. I think it's really important that the people who live somewhere have a say in in what's happening there and these partnerships are awesome. So thank you very much.

Jason: Thank you.

Nora: So, we're gonna move on to the next presentation and so, Kimberly if you'd like to get ready to share your screen and let me introduce you for our next session. And I apologize again, I didn't get a chance to talk to anyone beforehand to get pronunciations on names. So Kimberly Korioth.

Kimberly: Yes, you did pretty good.

Nora: Okay, thank you. She is the Stormwater and Resilience Analyst at Rhode Island Infrastructure Bank, and program manage the Municipal Resilience Program and Lead Stormwater and Resilience initiatives across the bank. Before joining the bank, Kimberly completed work as a fellow with the Rhode Island Coastal Resource Management Council, assisting with implementation of CRMC's Shoreline Adaptation Inventory and Design project. Kimberly holds a Master of Landscape Architecture, specializing in Ecological Design from SUNY College of Environmental Science and Forestry, and a B.A. from Boston University. So Kimberly, take it away.

Kimberly: Thank you so much, and can you see my screen okay?

Nora: Yes.

Kimberly: Ah perfect, okay. Awesome. Well thank you all so much and thank you for the introduction. So happy to be here today. As was mentioned, Kim Korioth here, Stormwater and Resilience Analyst at the Infrastructure Bank. My main work here is on the Municipal Resilience Program and that's what I'll be chatting with you all today.

So before we jump in, I wanted to provide kind of a broader overview on Rhode Island Infrastructure Bank as a whole. We are a quasi-public organization and we function as Rhode Island's kind of central hub for local infrastructure and investment, with strong focus on green infrastructure and clean energy solutions. You can see to the right, some of our focus areas. Kind of our bread and butter is the water and sewer, but we also focus very strongly on Brownfield remediation, of course climate resilience through our stormwater project accelerator through the Municipal Resilience Program, also on clean energy through our Efficient Buildings fund and our Commercial Property Assessed Clean Energy Program and road and bridge, as well.

But of course, the Bank has grown over the years. So the bank was actually initially established as the Clean Water Finance Agency back in 1989. And really functioning with a couple of key programs, and you can actually see back in 2016, we kind of had four key focus areas: clean water, drinking water, road and bridge, and also sewer as well, septic and sewer. But in the past five years, we've really, really grown to incorporate a number of new programs. You can see a number of the ones I've already mentioned. C-PACE, there's also a water quality protection program or stormwater accelerator, and of course the Municipal Resilience Program as well. And this graphic does depict the programs as of 2020, but going into 2022 here, we actually have some new programs too that we're starting off. And I'll make a quick plug for our Municipal Infrastructure Grant Program which just is starting up. And you can actually find the request for proposals for that on our website. And the deadline for that is May 27th. But that is a brand new program with a million dollars available there. So I will leave that since our focus is the Resilience Program, but continuing to grow.

Onwards and upwards here. So focusing back on the municipalities, yeah focusing the municipal resilience program, the MRP was really born out of Resilient Rhody, which was the state's first climate resilience strategy. It was brought up by Governor Raimondo in 2018, that's when it was called for. The bank led the development process of this document. A number of resilient roundtables gathering statewide stakeholders informed this document.

And ultimately, the main key things that came out of this document were some key climate resilience focus areas, which you can see over to the left. Some of the core ones mentioned natural systems, community health and resilience emergency preparedness, critical infrastructure and utilities. And within each of these focus areas listed here but also beyond this, there were 61 established key goals for how the state could be more resilient to climate changes. And one thing that was noticed across the development of this process was there was a specific need to support municipalities in prioritizing their local resilience actions. Often we would ask municipalities well, "what do you need from us? What would help you guys to improve your resilience?" And the top answer was always you know "we need more funding to push this forward." And you know when we kind of came back and asked well, "what do you need funding for? How can we help specifically? How can we structure a program to be most supportive of you and your resilience needs?", it got a little bit muddier. So in going into establishing the Municipal Resilience Program, we wanted to develop a program that could help municipalities identify and prioritize local resilience actions, but also advance them forward. And that kind of leads into our first primary objective here, but the second one is we wanted a program that was open to all 39 municipalities across the state and that all 39 municipalities could be involved with.

So what do we need to start this program? We had three key components. We needed a workshop partner which we found in the Nature Conservancy. We needed, you know, beyond general project or general program management of the MRP, we needed someone to lead the Action Grant process, that's where we, the Rhode Island Infrastructure Bank stepped in as well, and we needed 2.5 million or a

specific amount of money to launch the Action Grant project and 2.5 million is what the Infrastructure Bank put forward to initially kick off these action grants. That was from the bank's own capital.

And the program that was developed is outlined here. The first component was this workshop component, which in initial years the Nature Conservancy has been leading. The key focus there was to identify community hazards, strengths, vulnerabilities, and priority resilience actions, and then to follow up with the development of a local resilience strategy taking the form of almost a summary of findings report, kind of reporting back on what came out of the workshop. From there, the next kind of step of the program is the Action Grants. So once priority resilience actions have been identified, we looked to fund construction of shovel-ready capital projects with resilience benefits, with strong focus on green infrastructure and nature-based solutions. The third key part of this program is the MRP project pipeline. So of course you know, we go through these workshops, we're coming up with a ton of projects, a ton of priority resilience actions, there's only so many that we can fund through Action Grants with the capital we have available. So one thing that we've been keeping in mind is that you know, how do we get municipalities further support for the actions that have been identified through workshops? And that's something that we've been regularly working on and trying to provide support towards. I'll detail this more in a minute but this is also probably the biggest growth area of our program in the biggest development area.

So as I mentioned, there's these three core stages to the MRP: the workshops, the action grants, and the project pipeline. And I wanted to delve a little bit more in detail about what these look like and specifically how the workshop information is utilized. So I mentioned those summary of findings reports coming out of the workshops and really, the actions that come out of the workshops are kind of divided into three major categories. First being capacity building actions, the second being board capital construction projects, and the third being any planning preparedness studies and outreach that needs to be done. And really, you know, we try to separate these into these categories to align with potential other funding opportunities for these different actions. Where we go from there is, in terms of the action grants, the bank follows up with each MRP municipality after the workshop to do kind of a more narrowed project identification meeting, where we go through all of the capital project actions that came out of the workshop and just delve for a bit more detail, see what's most eligible for MRP Action Grants, and help them set up their application process for pursuing those action grants. Generally, and I've written here, about $200,000 per grant is available. That's been expanded. So I mentioned that 2.5 million of startup capital that funded a million dollar grant rounds in year one of the program and a 1.5 million dollar grant round in year two of the program. But since then, we've actually received 7 million from the state green bond to support this grant program, so we're look starting to look at some larger grant awards. In this past round, we've seen up to $500,000, $600,000 for some of these awards, which is very exciting. The last bit, as I mentioned, was this project pipeline component where we do our best to notify MRP municipality as a state federal grant opportunities, specifically keeping in mind, you know, that there are broader resilience actions than just the capital projects. There's capacity building actions, there's those P/P/S/O actions, as I've abbreviated there. So beyond also notifying municipalities of opportunities say like the FEMA Building Resilient Infrastructure and Communities Program or the National Fish and Wildlife Foundation grants, we also do do some direct connections between municipalities and state agencies who have programs as well, and try to, you know, have these conversations with state agencies to highlight projects that have come out of the MRP process and put them on other state agencies radars so that they we can hopefully get these projects funded and moving forward, as well as to broaden technical assistance within the MRP itself which I'll be speaking to a little bit later in this presentation.

So this is the overarching timeline of the MRP, and there's a lot of information here but I like to think of it seasonally. So things kind of kick off in the winter months. We have a call for participation which usually is released late fall and applications come in January or so to participate in the Municipal Resilience Program. Municipalities are then selected in the spring months and both the bank and our workshop consultant work with municipalities in the spring months to schedule their MRP workshop, get agreements signed, everything that we need to do to prepare. The summer is really focused on the workshop delivery. Getting all those municipal staff and community leaders in the room to have this conversation about

priority resilience actions. And then fall we get into post MRP workshop steps. Our workshop consultant gets a summary of finding report to the municipality for their ongoing reference. The bank steps in and has that project identification meeting, as I mentioned, to kind of narrow in on specific action grant projects. And then aligned with when that call for participation in the program goes out in that kind of late fall period, we also have our call for action grant proposals go out which is due January/February or so the following year. So if you kind of look at the overarching arc, you have the first year being the workshop portion of the program, with the end of that first year being when action grants are kind of pushed forward. And then year two being, well years two and three really, being the action grant proposal or action grant award period where projects are conducted.

I'll go through this briefly here, but we do I did want to list some of our requirements for the MRP program. For the participation, we're mainly looking for support from town leadership and municipal stakeholders. We also want to hear about need areas specific to climate change, vulnerable communities and how they're being impacted, but also how the municipality anticipates how they'll use the results of this MRP process. And on the action grant front, first and foremost, to date we've been looking at shovel-ready capital projects that fall under what the bank can do, essentially what our regulation allows. There's been some discussion of kind of expanding that eligibility, which I'll get to later in this presentation. But that's kind of first and foremost, with our other focus areas being, as I've mentioned, that focus on nature-based solutions, focus on community outreach and engagement, general feasibility and transferability of the idea, and of course the overarching need for climate change adaptation as well.

So the program has experienced a lot of success to date. In the first round of the program, we identified 52 projects, and speaking here specifically to, like, those capital construction-based projects with resilience focus in the workshop components, totaling about 14 million in need. Coming out of year two of the program, we had identified 151 projects in that rounds, totaling 80 million in need. In this most recent round in 2021, we identified 158 projects and we're still totaling the total need on there, but you can see that the program has just generally been growing and we've been identifying further and further need as we go. To date the bank has committed 7.4 million in MRP action grant funds to resilience projects. That covers about 28 grant awards, but a number of these grant awards do contain multiple different projects, if that makes sense. But as you can see, this is where the pipeline also becomes important because, you know, we're making a dent in this total number of resilience projects needed but there's still a lot of work to do. Along that line, the MRP has also catalyzed over 6 million in external funding sources for MRP identified projects, and this is a number that continues to grow. We always see the value in the workshop component as an opportunity through the findings reports to highlight certain resilience needs and certain resilience projects. These are things that, as I mentioned, we can bring up in conversations with other state agencies and say "hey, you know, these municipalities really need to get this particular type of work done, can we work together to make that happen?" And I think that's what drives a lot of this additional external funding. Additional program funding received: we have received, as I mentioned, $7 million from the Beaches Clean Water and Green Economy Bonds to support action grants, very excited about that. We've also received, and I'll get into this further later in the presentation, about $650k in federal and charitable funding for program continuity, expanding our assistant services, piloting new regional efforts. And we're looking to have $16 million potentially in this next green bond for action grants as well, which is really exciting.

You can see municipalities currently participating to date. We've covered a lot of the coastal components but we're really excited to get more of these inland communities involved and really excited in this 2022 round to have Burrillville, Gloucester, Lincoln joining us as well, and Richmond. I'm excited to work with those inland communities too.

In terms of MRP project needs, we've seen top need that comes back across the board is stormwater management. You can see a number of different other focus areas too, with coastal erosion, infrastructure upgrades, one other that I'll mention here too is, although it doesn't make the top five, vegetation management is often mentioned as a key focus area.

But the key challenges, or key needs that we notice across the program ongoing is, as I mentioned that need for further support of inland municipalities who are also experiencing hazards: intense rainfall, snowfall, flooding, invasive species. We need increased local staff capacity that's something that's mentioned in almost every MRP workshop, and increased support for other types of projects, as I mentioned: planning, design and engineering actions, policy-based actions. One thing we recognize is that coming out of the resilience workshop process, the ideas that come forward aren't always shovel-ready or aren't even necessarily construction based. We want to be providing more support for municipalities across these other need areas.

Which kind of leads to the future vision of the program. The three areas of growth we've identified are one, you know, we we've said this from the beginning, but we'd like to expand to all 39 municipalities. We want to get those inland municipalities involved as well. We just think there's such a great need area and being able to, you know, work statewide as well and maybe work in some regional sectors I think is just going to increase our efficiency. The second is that increased technical assistance, which we've been looking very specifically into increasing our design and engineering assistance, funding and financing to support that. And finally, an increase in local capacity, which we're specifically looking to pursue through regional resilience. And we've actually just hired our Aquidneck Island Regional Resilience Coordinator. I'll speak to this more in just a second, but we're looking to continue expanding these regional resilience efforts to provide more local capacity for advancing resilience forward.

So to achieve this vision for each of these key areas, we have a key funding source. For kind of continuing the program, expanding to all 39 municipalities, we've been working with FEMA through a Building Resilient Infrastructure and Communities Grant. For expanding that technical assistance, we've been working with National Fish and Wildlife Foundation through a grant with them. And for our Regional Resilience Coordinators, we have a pilot grant or grant forpilot dot process through a local charitable foundation.

I'll walk through each of these very briefly. The first one I mentioned is that FEMA grant to expand to all 39 municipalities is pretty straightforward, but we did apply and were awarded a grant with them to support workshops for the remaining 19 municipalities. We have 26 municipalities in the program to date, 20 have completed their workshops. So the 19 is the remaining who need their workshops. As well as to increase the technical assistance. As I mentioned, this speaks to the project pipeline portion of the MRP.

For this NFWF technical assistance component, the key goal here is to create a centralized nature-based resilience program for Rhode Island, meaning that we would bring into the MRP additional services including site visioning, design and engineering, permitting assistance for nature-based solution resilience projects. This actually builds off of the Shoreline Adaptation Inventory and Design program, which was launched through RI CRMC. And we've actually been working with a number of the partners who worked on this initial set program and will be collaborating with them on this process of bringing this kind of service area into the MRP. This will also include a capacity building component for nature-based solutions as well.

This is a general structure of that, kind of, adding that said component into the MRP. You'll see it kind of fit between the workshop component in the action grant component, but we want to have this kind of middle design and engineering assistance component, which will increase support broadly for resilience efforts.

And the last mention here is for our capacity building and regional resilience efforts. As I mentioned, we hired on our Aquidneck Island Regional Resilience Coordinator. It's two-year position which launched in April. And through this position, we're looking to provide assistance for the advancement of intra- and inter-municipal resilience actions and projects. We're working with municipalities now to kind of have some individual intro meetings where we'll be conducting, essentially as a outcome of that, we'll be conducting a resilience update, putting together a technical assistance package for them. And through

this position, we're aiming to generate a model for regional resilience coordination within the MRP and hopefully to explains this regional resilience coordination effort.

Thank you so much, and this is my contact information here and contact information as well for our managing director Shaun O'Rourke.

Nora: Thank you so much, Kimberly. And I see the questions that have been added to the chat, which I appreciate, and we will address those after our third presentation. So if both Tess Clark and Katelyn Gonyer, correct me if I'm wrong on the pronunciation. We have two speakers in this last group and let me introduce Tess first. She is a program manager at the Syracuse University Environmental Finance Center, working on resiliency and water infrastructure programs. Tess received her M.S. from SUNY College of Environmental Science and Forestry in Environmental Policy, with a research focus on New York state timber sales and forest economics. She has worked with the New York state Department of Environmental Conservation and SUNY Research Foundation and Brooklyn-based non-profit, the Human Impacts Institute. She graduated with a B.A. in Environmental Studies from New York University. And also with us is Katelyn Gonyer, who is a Conservation and Environmental Planner at the town of Mansfield, Massachusetts. Katelyn facilitates the town's open space planning and recreation activities, conservation planning, and interfaces with residents' businesses and the town's conservation committee select board and the town manager on land use, planning, and decision making. So with that, Tess I see I can see your slides on there so it looks like we are good to go.

Tess: Okay great. Can you also hear me?

Nora: Yes.

Tess: Okay great. Okay thanks so much for the introduction. We are really excited to be spending the day with you at the symposium. My name is Tess Clark I'm a Program Manager at the Syracuse University Environmental Finance Center and like was said I'm here with my colleague Katelyn from the town of Mansfield. Our presentation is called Making Space for Resilience: A Capacity Assessment Framework for the Town of Mansfield. The project is one of several capacity building efforts spearheaded by the southeast New England network. As some of you know, the SNEP network is a partnership of 16 organizations and we all collaborate on stormwater and watershed planning. Syracuse University is one of the partners, and we bring some expertise in public administration among other things and so that's how we got in touch with Mansfield and got to work on this project, which we're really honored to be doing.

So today we'll be quickly covering the need for the project and Mansfield's goals. We're going to discuss project methods and process some of our preliminary findings and some reflection on how this work can add value to local planning. And as we go through this, I'd love to encourage everyone here to think about the type of activities that have helped you. Whether it's like say learning how to use Microsoft Teams or something different like acquiring project funding or getting a grant. We think you can just save this for the Q & A and think about it on your own. And at this time, I'd like to turn things over to my colleague Katelyn who's going to talk about the need for the assessment in the first place.

Katelyn: Excellent, can everyone hear me okay?

Tess: Yes.

Katelyn: Okay, so thank you so much for the introduction. My name is Katelyn Gonyer I'm the Environmental Planner for the town of Mansfield. And I kind of want to give you the perspective of the town through this whole process of understanding, you know, what was an organizational capacity assessment, how does it fit into Mansfield, why it's such a valuable tool for us right now, and where do we go after the assessment process. The first slide really to outline the complex climate change impacts within our inland community in Mansfield. We're not coastal, we're all inland. You have to kind of understand the general hydrology of the town. So Tess if you could go back or forward to the map.

There we go. So all the way over on the right side is the Canoe river, which is was part of Kim Groff's Canoe River Aquifer Resiliency Project talk earlier on today. Mansfield was a part of that project and I'll speak to that in a second. But so we definitely have the Canoe River, we have the Rumford River which runs right through downtown, and then we have the Wading River that runs through west Mansfield. So we are a very river and rich wet town, so we definitely are seeing the impacts of climate change. And also, now looking back to, kind of, Mansfield and what it's gone through in the past decade. We've seen a really- thank you, Tess- we have seen a really big change in development pressure. We have 495, we have 95, with the connection of route 140, we had the Xfinity Center, now we have an expanded MBTA Station with a lot of brand-new residential developments that cater to commuters. So we've seen a huge demographic change in the past five to ten years. We've seen a lot more younger couples with kids, a really educated society, not to say any others weren't. But this group tends to be very educated in climate change and wants to know what is their town doing and what are we doing to look forward. And for a while, we didn't have many answers to that until the MVP project came along.

So and if we can go down to the-

I think that's a good segue into the next slide. Which, along with the MVP program, which I'll get into in a second, this new kind of demographic and all this development, it really put a lot of pressure on the municipality's resources and the responsibilities on the Conservation Department. New programs which you all might be able to understand or relate to, but programs like the MVP program, the MS4 permit, the open- we have a brand new open space committee that was established in 2019, we have brand new stormwater management regulations where we are now, the Conservation Commission is now listed as the stormwater authority, and also a lot of brand new regional collaborations, which are the best part of this whole responsibility expansion has been the collaborations. And to kind of circle back to the MVP program which is, Mansfield did do our planning grant with Easton and Norton, so we were already working on a regional level. And the SNEP recognized that and we created some relationships with the SNEP network. And the town started getting involved with the Canoe River Aquifer Resiliency Project which then led to some conversations about needs of the program with SNEP. Which, in those conversations with Kim Groff, the idea of a capacity assessment is what came out of this whole process that the town could go through this process and I had no clue what it was. So Tess can now kind of, I can quickly kind of go through just the fact that, like I was saying before, that Mansfield needed some ground work, we needed some help planning our future, the town's role. We started getting to regional more networking collaborations which was had a lot of pressure from residents wanting to see the town get involved in some climate change resiliency. So then the town has been working with SNEP and was able to do the call for participants and establish an MOA for their capacity assessment and we're still working through the process. So Tess will take it from here and we'll wrap it up at the end, thank you.

Tess: Awesome, thanks Katelyn. Yeah so you can hear, from what you just heard from Katelyn, that there was real need for some strategic thinking and really some need for some next steps, given that all of thes changes had taken place without really a grounding framework.

So when we got involved at Syracuse University and we came in through the SNEP network, we wanted to make sure that we had a shared understanding of capacity and what about it we wanted to assess. And I'll qualify this quickly by saying that capacity assessments focus on all kinds of things and some of them focus on things like looking at staff skills regarding technology or the ability of the organization to handle large sums of money or human resources policies for conflict resolution. That's not what we did, that wasn't really the goal here. We wanted to get next steps for resiliency planning and we wanted to get to that point. So we wanted to assess a really specific slice of the town's work as it relates to climate change. We wanted to focus on how the town's activities and processes contribute or do not contribute to the town's ability to adapt, respond to stress, and opportunities. And so that's really an adaptive capacity framework. So you'll see that adaptive, you know, adaptive capacity really runs through this entire analysis.

This led us to putting together a plan for a limited scope assessment of the town's climate-related work. Our goal was very basic: identify some next steps to advance resiliency planning at the town. But as Katelyn has said to me a few times, what even is resiliency planning? What is it? It's becoming really common to see resiliency plans but more for New York and Boston and larger cities and it's not as common to see it at a smaller municipal level. But what these plans essentially do is consider major risks and whether it's flooding or heat emergencies and identify actions that help communities successfully respond and thrive under their own shared vision. So Mansfield doesn't have one of these, but they do have four major planning documents that were aligned with statewide funding mechanisms for proactive planning and that described actions that were intended to address long-term sustainability. So based on those things we made some judgment calls about what to include. The plans on the left here of this slide are what we opted to include in our analysis and you heard Katelyn talk a little bit about that MVP process, the Massachusetts Vulnerability and Preparedness process, which does look at risks. We also heard a little bit about their open space planning work and their stormwater management. So we looked at all of these things and bounded our analysis around those four plans. What we didn't look at was they didn't have a climate adaptation or resiliency plan and Mansfield also doesn't have a hazard mitigation plan at the moment. They are pursuing one, their current plan expired in 2014, but they are pursuing a new one and that's really important for our process as well, is knowing that they're working towards a hazard mitigation plan which is something that is recognized by FEMA and it's a plan that contains risk-based analysis of hazards and priority actions. It's sort of the gateway for proactive resiliency planning to a lot of us practitioners.

So taking everything apart and then putting it back together. Together with Katelyn and others at the town, we assessed these four planning documents, looking at their major building blocks. We asked a suite of questions about each initiative like: what actions and strategies pose a major challenge? What do you anticipate being a challenge in the future? And what do you think represents a high priority for climate preparedness? We engaged as many people as we could. They're listed below, it includes folks like the Town Manager, Katelyn, the Conservation Department, the Department of Public Works, the Town's stormwater consulting firm, the Planning Department. Katelyn worked on her own with multiple individuals throughout this process. We needed to be efficient but we also wanted to engage the talent to the best of our ability. This quote I think is a nice metaphor for this process. It says that essentially the reason you take something apart is to understand it and put it together in a better way than you had before. And that's really what we're what we're trying to do here is to break down this slice of actions that the town has and reorganize them in a way that makes more sense, and that gives us what we need to do next. Where do we go next? If we look at them differently and break them down we'll know where we need to go.

So now on to some of our preliminary findings. For today, we're just going to go over a snapshot due to time constraints. And Katelyn, feel free to jump in at any point. We found that there were over 145 climate protective strategies and actions across these plans. And this isn't really surprising to us. We already knew that the town really cared about this and that they were doing everything they could to start preparing for climate change. The master plan especially is very forward-thinking and had a really strong emphasis on long-term sustainability. Because Mansfield is taking a lot of initiative already and working hard on their own, the majority of these actions are complete or on schedule or have a long-term planning horizon. So what you can see on this slide is that we've created an interactive dashboard that if I were to click on, it would take you to a page that's actively being updated based on progress the town makes and it shows you, it walks you through what kind of departments share responsibility for different actions, the progress and status of current initiatives, and more. So this is how we wanted to base our recommendations on, is how the town is already doing well. What are the small handful of things where they think we can improve?

So we asked the town staff to red flag actions for us that might pose a challenge or that they felt were difficulty, you know, some difficulty complete. And there was just a small handful of these. Tthere were 7 total and what's important to note here is that many of these are outreach related. Things like developing signage and doing education. Another common theme here is that some red flags related to regional

efforts, so the complexity of working on regional initiatives where things are quickly evolving, there's other major actors, that can be very time consuming and so that is also something the town wants to be strategic about.

So moving quickly through here. Where are we going? What are some of our notable recommendations? And I'll just note here that this is an ongoing dialogue with the town. We're still working and ironing some of this out, but we wanted to just mention a small handful of things that we've started in our dialogue to share with you all. So one major next step for the town is continuing to pursue hazard mitigation planning. This would fill some basic needs by linking some actions to risks in a more comprehensive way and it can take into account some of the technical challenges that we identified, especially aligning with regional efforts and problem solving some of the difficulties with participating in regional efforts that are changing. And it's also a great opportunity through this process to communicate the town's interest and commitment to preparing for climate change which, as you heard from Katelyn, is something that the residents really, really care about. So it's both an outreach opportunity and an opportunity for better resiliency planning. We're also recommending that the town do and outreach blitz. There is existing expertise for this in the town and a strong social media presence and there's also some outside resources available for technical assistance here. A short-term push for outreach can have a really long-term impact, so things like Facebook posts, Resilient Mansfield, Mansfield is Preparing, these are things that can have a long-term impact after communicating to residents the value and need for some of this work. And lastly, well not lastly second to last, the town's growing climate efforts are substantial. As you saw, there's 145 protective actions that are already in place. So long-term financing is a good idea for the town to consider. The town has an opportunity to keep this dialogue ongoing, to look at what they were doing next, and to think about what kind of conversation or what might look what kind of financing plan would work for them. So we have an opportunity to continue that discussion with the town as they prepare their HMP. And finally, we are recommending some expanded staffing within the next five years. We looked at the town's master plan and looked at where the master plan suggested some change and expansion and aligned our responses to that with the master plan, so we have some potential roles that we think the town could continue to expand upon as they grow and as they do more of this work.

Okay, and now we want to spend the next five minutes of our presentation really talking about the value of this process and reflecting on it with all of you. And I think I'm going to let Katelyn start and I will chime in as we go.

Katelyn: So once again, you did a great job of summarizing a lot of information, which is exactly what the whole process was. And as you guys saw, our biggest kind of wow factor was the amount, the way that they took so much of our initiatives, organized them, and then were able to so quickly go through and categorize and really pull out the outliers in such a very like presentable way. And as you saw, the recommendations aren't too complicated, they're not, they're very doable, they're very attainable goals, so that was really valuable. But just going through the whole process as a town, I can tell that they're going to build it towards your needs. It may not look like Mansfield's assessment, but they will come in and even develop the right process that should be implemented during the assessment. So I'm trying to see where else we need to go, I've lost my train of thought here. And then also, the fact that now we've got these recommendations, where do we go from here? That's one of our, you know, we don't want to just put this plan on the shelf. We want to implement it. So knowing that you know Tess will stick around and help me through these next steps, because I have learned so much about this process. And it really is something that the town's going to be able to use and it's legible to all and residents will be able to read it and understand and really get an idea that the town really is taking these actions. It gave so much guidance in such a small time with minimal input. I really didn't have to do much and that's huge for me right now especially since I'm maxed out. So the process was amazing and I invite anyone in any town that feels like you need a little bit more guidance, a little bit more direction in your resiliency planning to definitely look into this process.

Tess: And what I think is really valuable here is that, so you know, think going back to like what is capacity building? Reflecting is capacity building and it's something that can generate excitement and dialogue and what Katelyn has said is also confidence. Sometimes having these discussions gives you confidence with what you need to do next and gets you to the point where you're willing to take that next step to a bigger plan. In this case, the town is pursuing an HMP, and that is going to be, doing so with this framework in mind will give some immediate consideration, rather than just starting from a blank slate. You have some things you know you want to consider. And what's been really great about working with Katelyn is that we've been able to talk a little bit about just the nature of capacity, and it's given us some pause. You know, I talked to my partner recently who's a biologist and I was like “what does capacity mean to you?” and he was like "it's the load. It is the carrying capacity, it's the load.” And the way we look at it is really more process-based. It's a process and an outcome. It's how you grow it's how you change your thinking and it can be done in small everyday tasks and it can be done in larger chunks. So I think we're right getting up to the time, so I want to I want to conclude here and we have our contact information listed. And Katelyn, do you have any closing comments or thoughts?

Katelyn: One of the biggest things was I wanted to make sure that my contact information got up there because if, I’m serious about it, if you have any questions at all about the process, please feel free to email me or you know the technical side of things or Tess. It was phenomenal to work with them and I have to say that even though COVID put us all through the ringer, it did create these venues to have these relationships, you know, with Syracuse and you know connect make these collaborations so much richer. So I do invite anyone to reach out and ask questions and think about it for your community.

Tess: Yeah, this is an offering of the SNEP Network, so municipal folks on the call please feel free to check out the SNEP Network. They do great work; we love participating in their project. Okay I think that's it for us, I’m going to close out my PowerPoint.

Nora: Well thank you. Tess and Katelyn. Thank you to all the presenters who were right on time all the way across the board. I really appreciate that.

SNEP Symposium – Science Bringing Solutions Delivering Environmental Improvement to Southeastern Coastal New England

Room 2, Afternoon Session

May 18, 2022

Nora: Alright, so, welcome everyone to the second session for community capacity building and for our first presentation this afternoon, we have Elizabeth Scott from the SNEP Network. Elizabeth has over 30 years of experience in water resource management in Rhode Island, formerly serving as deputy chief in Rydem's office of water resources. Currently, Elizabeth serves as the Rhode Island liaison for the SNEP Network and as a member of the SNEP Network's management team, she assists, advises the New England environmental finance center staff on the network's administration and management and provides training and technical assistance to communities in the SNEP region, including serving as project manager for the SNEP Network's Maidford River restoration pilot project. With Elizabeth, is Joshua Wilson from Fuss & O'Neill. Joshua is an experienced field scientist in the disciplines of soil science, botany, wildlife biology and wetland ecology with over 20 years of experience. He serves as Fuss & O'Neill's senior wetland ecologist and certified soil scientist. He is responsible for assisting clients identifying opportunities to address climate change through nature-based solutions. He is also responsible for performing and overseeing staff and projects as it relates to natural resource restoration and enhancement, wetland and water course delineations, vegetation surveys and ecological surveys, all in accordance with applicable state and federal regulations and guidelines. He prepares and manages local, state and federal permitting for various projects throughout New England for a wide range of projects, including climate resiliency, linear utilities, site development and ecological restoration. And with that, I will pass it over to Elizabeth for the presentation, which I can see very well.

Elizabeth: Great, very good. Hi, good afternoon everyone, Josh and I are really happy to be here to present on the Maidford project. I'm going to be providing background and context for the project and then Josh will take over and present a snapshot on how we have used site assessment and hydrologic and hydraulic modeling to inform the design of the river and floodplain restoration project.

So this project is possible with the support of the Southeast New England Program Network. The town of Middletown and its partners are advancing plans to restore the major river to reduce flooding and improve water quality and habitat. In this map you can see the Maidford River it flows in north to south direction, at the very bottom here where my cursor is, there is a water diversion that is owned by the Newport water supply and they divert flow into these two reservoirs, Nelson and Gardiner Ponds, that are two of the nine reservoirs in the system. Water that doesn't flow into those ponds flows over the diversion structure and then along the south of the ponds into Sachuest Marsh which is located here and then eventually out to Sakonnet River.

So the Southeast New England Program network is providing support for this project with funding made possible by grant from EPA to New England Environmental Finance Center, but the town of Middletown is the project sponsor, but however without each of the town's locally trusted partners who have played a really critical role in scoping the project, it wouldn't have been possible to advance this project through to the 30% design stage that we've achieved to date. It's really important to point out that the river and floodplain restoration project that you'll be learning about, is proposed to take place entirely on private property, engaging with these effective property owners has been an essential component of the project, from the initial steps of conceiving the project and obtaining their consent, to undertake field assessments, to their agreeing to advance the project each milestone step along the way.

You can see on these photographs that the watershed has seen considerable residential development between the early 70’s and today, though agricultural remains the predominant land use cover in the

watershed making up about 40 percent of its land cover, while residential makes up about 27 percent. Well, this shift in land use has contributed to the watershed's water quality and flooding problems, other significant factors are, the straightening of the river that likely occurred in colonial times and the encroachment of agricultural and residential uses in its flood plain that likely began in colonial times and continued into more modern times.

As depicted in these photos, The Maidford River flows beyond its river channel and floods into adjacent farm fields and lawns and onto local roads with some regularity. Frequent flooding at Berkeley Avenue, creates a public health hazard, not only for the area residents, but for the emergency responders that are headquartered at the intersection of Berkeley Avenue and Wyatt, which is located right here. This flooding has resulted in this portion of the watershed to be recognized in the town's hazard mitigation plan as a FEMA flood zone and it's this green shaded area that in essence is our project area.

In addition to flooding issues, the Maidford River is also identified by DEM as being impaired by bacteria nutrients and suspended solids. It contributes to degraded water quality in Nelson and Gardiner's Pond, which are two of the drinking water supply reservoirs that I've mentioned previously, both of which experience cyanobacteria blooms. It also contributes to degraded habitat of Sachuest Marsh which is home to the salt marsh sparrow and it threatens recreational and shellfishing uses in near coastal waters of Sakonnet River, including third beach.

This project really builds upon ongoing watershed protection and stormwater management efforts by equinic land trust and the town of Middletown. You can see in the map on the left all that hatched area is actually land that is held in conservation easement of some sort and the image on the right is in essence the design concept which we began with for this project, which was first proposed in the Maidford river conservation plan that was prepared for a equinic land trust by Fuss and O'Neill.

So without this background, our project objectives are to restore natural stream and flood plain processes and habitats, reduce the frequency of magnitude of flooding, improve stormwater quality. And with the project team, with support from Fuss & O'Neil, has utilized modeling results to evaluate flood mitigation alternatives in our first phase and then on our second phase to evaluate the benefits of the selected alternative. Our project partner, Save the Bay, has mapped wetlands boundaries to initiate permitting and dialogue with DEM's office of water resources. And Inter-fluve, who is a subcontractor to Fuss & O'Neill, conducted geomorphological reconnaissance survey to develop detailed design plans to meet water quality and habitat improvement goals. And with that, I'm going to turn it over to Josh to take you through the some of our findings.

Josh: Thank you Elizabeth. So I'll tell you next slide since you're in control here, oh yeah and not yet though, but not yet, I'll go back to the previous one which is, so yeah Fuss & O'Neil was brought on, we've been working on the Maidford River for quite some time, 2017, obviously when we helped with the watershed plan, but for this particular project we were brought on board to assist the design partners with the flood design of the floodplain restoration and that included restoring it as though it said destroy the natural stream flood clean conditions to reduce local flooding on Berkeley avenue which is the main thoroughfare running north to south, as well as a smaller road called Berkeley Avenue extension. It will overall improve the water quality of Maidford River was also an important aspect of this project, so all these design issues that we were trying to accomplish. So to get to this point we, you know, we've done quite a bit of site investigations, inspections to assess the existing conditions such as the soils and the wetlands, we've reviewed historical mapping and aerial imagery to evaluate any changes or any information that we could garner in order to develop a successful design and then also develop hydrologic and hydraulic models. I'll often refer to it as an H&H model, so it's less of a mouthful, of the project area so from this we were able to understand the critical design elements and really identify alternatives going forward. So next slide, please.

Elizabeth: Why isn't it advancing? There we go.

Josh: So, really the first phase was really to understand the system and early on we developed a basically a one-dimensional model for the site and really we're looking at trying to determine what the critical issues for the design would be and from that what we determined was, that really the critical issues were the culverts, first at Berkeley Avenue and then secondarily at Berkeley Avenue Extension. So Berkeley avenue was identified as a constriction in the flow of the Maidford River, the constriction resulted in water backing up during even moderate storms and I think a few of those photos that Elizabeth shared indicate that and then flooding was exacerbated and then it would but we would basically hit that at that point overflow and then flood onto Berkeley Avenue and then it was exacerbated by limited capacity from the Berkeley Avenue Extension culvert. One of the things we sort of stepped out of the one-dimensional model into a two-dimensional HECRAS model and identified that, that really what was going on is shown in that that center picture that center image where you're showing where the Berkeley Avenue culvert is located and the blue is the flooding the flood water during 100 year storm and really what happens is, it hits that, it flows to the east southeast and really flows and then ultimately it flows on top of Berkeley Avenue and flows down below that's then you can sort of see it bubble out at the bottom of the picture where Berkeley Avenue Extension sort of holds back the water as well, so initially at the phase one we realized that that was going to be, you know, a way to go forward, another thing that modeling indicated was that while moving the river to the west away from Berkeley Avenue from its current position, we added we were able to add floodplain storage but the floodplain storage really wasn't providing a significant amount of improvement to the mitigating flood conditions but it was providing a substantial amount of habitat benefits as well, as well as water quality improvements, so next slide please.

So that outcome sort of gave us the framework for this conceptual design that you see here and really, it became a situation where the property we're working with, the property you'll hear me refer to Sweetberry Farm, which is north of Windham Mill Road, it's that green bob there, that area working on that parcel and then providing sinuosity on the further downstream parcels, so that moves us to the next slide, which is phase two.

And really we wanted to evaluate several project objectives. The first objective was to determine the feasible solutions that provide flood benefits overall to the site. The next was to really provide the flood protection up to the current hundred-year storm return interval so we wanted to be able to provide the best protection to the infrastructure as well as to develop portions of the parcels of the land up to that. The next was then, then we wanted to continue to focus on improving ecological and water quality benefits across the entire project reach and lastly we wanted to ensure that there was no net increase in flooding for the hundred-year storm, as I said previously, on existing developed areas. One factor we did consider too that we added in, was we really wanted to try to make this as climate resilient as we could and so part of the development was maybe not to reach the hundred-year based upon projections, but to really look at it from, look at how much can we get for protection can we get for climate change and for additional storm events in the future. So those are what we were considering as we moved as our objectives. So in the next slide.

At that point we started to, we were starting to look at the alternatives and develop all our alternatives and really get to a place where we could have a design that would, that would both accomplish all those objectives, and some of the key features that we had here design factors that we had to consider are listed on the page. And the first was to enlarge the culverts at Berkeley Avenue Extension and rather Berkeley Avenue and Berkeley Avenue Extension, so those two culvert, increasing those two culvert sizes would clearly allow water to pass more readily through the system and not create the backup problem, however that wasn't enough, so we began to talk about installing a flood control berm on the Sweetberry Farm parcel to the east, so that was considered. The next was to raise Berkeley Avenue itself and then a fourth item was to consider adding flood storage and investigate whether or not adding flood storage in the form of a pond or a large, larger wetland complex to the Sweetberry Farm parcel and really what it became was, what it became is, if you want to go to the next slide please.

It became an iterative process where we were looking at the design, you know, and whether or not how each of those factors would play into the design in order to make it successfully accomplish the objectives. So really, I'm going to, as we proceed through this portion of the presentation, I wanted to take a just a quick moment to provide a key map. This is sort of just an overview of what you'll see going forward in a few additional figures. So what you see here is, you'll see Berkeley Avenue which runs roughly northwest to southeast on this particular image and then you have the Mainford River which more or less runs north and south or up top to bottom on this image and then we have two, two blue areas, the first dark blue line is existing flood inundation, that is the FEMA flood indication area which we, which we verified using our we or we correlated with our 2d HECRAS model and so that's the limit of flooding as it exists today. The second is the lighter blue shaded area which is the proposed inundation and that using the same model is the extent to which the hundred year flood or any of the floods where we were modeling would extend to and it shows, you know, that we were able to show graphically show the difference in changes in flood elevation so and that all these incorporate into the key design factors that were discussed in the in the previous slide, so you can go to the next slide please.

So basically it was an iterative process and this and then this jumps ahead a couple slides too I'm going to say this, is that we worked with Inter-fluve on this one because it was, it was, we want to accomplish X, how do we design that, so we would say okay we're going to put the berm in and we're going to raise the road but we're going to do different elevations for those what does that mean for the design further downstream for in terms of adding sinuosity to the river and additional or more defined flood storage. So by iterating through the design factors in the model this is the preferred alternative that was identified that would manage flows from the hundred year recurring storm event and the design elements included raising Berkeley Avenue to about two and two and a half feet and then tying it into any feeder streets to it, it also meant constructing a flood control berm on Sweetberry Farm of about two to three feet in an elevation above grade, excuse me, then we also would increase culvert capacity and we discussed a number of different widths, and this thing along and so I, to different widths so that we could then the water would pass and that was a 35 foot width and then also providing flood plain restoration and modification, so if we go to the next slide.

Really what we ended up seeing is that a lot of that flooding no longer occurs, this is the hundred year flow, this no longer occurs on Berkeley Avenue instead it's all contained within, either on the east side before it crosses or on the west side when it crosses Berkeley Avenue and then within in the defined flood plain. What we see in the next slide.

We show a cross section, is that we see a reduction of about three feet in water surface elevation by providing the storage behind Berkeley Avenue, on Sweetberry and then also providing a wider floodplain area. Next slide please.

So our intermediate conclusions basically identified that culverts needs to be increased, sizes need to be increased on Berkeley Avenue and Berkeley Avenue extension to provide additional back water flooding and then installing the berm which would then control and slowly meter out flow. Storage, we did determine that storage on Sweetberry Farm did not provide any significant additional flood benefits, it was really very minuscule in that sense, so we didn't pursue that and then we also have to evaluate the floodway further upstream for regulatory purposes so we're that's sort of the next step process. Again, our decision was the hundred year storm event and increase culvert sizes and then try to anticipate some climate changes due to precipitation. Next slide please.

So let me get to the design aspects and really was a combination again, it was iterative working with working LiDAR as well as site-specific topography and really designing something that based upon soil conditions as well as that Inter-fluve did their good geomorphological assessment, but also their experience in designing rivers and restoring rivers to the site. So we go to the next slide.

So this is the existing condition of the site and what we did was, we then took the proposed condition which would be the next slide.

and overlaid it with the aerial imagery and this is the southern portion of it, but essentially what you see is a primary channel that flows through the center of a flood plain area. We also proposed some smaller wetland pockets within that area that would stay flooded or stay wet longer than, wetter than a flood, than a normal flood event. So the next slide.

Depicts the various treatments that are proposed and these different treatments we have some photos of those just to give you a flavor of what those would look like. So on the next slide.

We have things like, the meanders that we would propose, so adding sinuosity which provides not only habitat, but also an ability for the channel to move around and create habitat in a natural sort of way. Next slide please.

We also have woody debris and root wads placed on the outer banks in order to reduce the amount of bank corrosion on those outer banks.

We provide, we're looking to provide some bank floodplain and backwater wetland areas where we can, again like I said, provide some storage of water but also long-term habitat, wetland habitat in those areas. The next slide please.

The design will also incorporate fabric encapsulated soil lifts, which are a way to stabilize more straighter banks and also allow them to vegetate and then adding riffles into those areas. Next slide.

Grade control riffles will also be considered, although this is a relatively flat area or a steady slope through this area, but some grade control rifles are being considered in order to minimize the likelihood of down cutting or head cutting, when the stream is created.

And then lastly, the variety of different types of wetland habitats that we're looking at, we're considering, as we do the design and really incorporating microtopography, side channels and natural levees through the system. Next slide

So the towns, I don't know if this is me or you, Elizabeth, but

Elizabeth: You can go ahead, you're doing just fine.

Josh: So the town's working with property owners to secure approval, that's for the next phase. I think that, you know, the challenge of these projects is working with the property owners and I think it's in that you have a lot of people that you have to basically talk to and make sure they're on board and understand what's going on so the town's working with them. One of the issues that we do have to consider is that there's quite a bit of soil movement and because of the historical agricultural use, we need to consider what's going to be the impact or the management of those soils, so the town's received a grant from Restore America's Estuaries to advance the project to 60% design and is seeking other sources for funds to advance the project and also the Eastern Rhode Island Conservation District is managing part of the RCPP grant and has a one million dollars from that grant program to implement restoration initiatives on farm properties or farmland properties.

And so I think that was the end of it. I will say that this is a very abridged version of a presentation that we've given a couple other times and I tried to bridge it, but there's a lot there and we have, we will be, if it's not posted, it'll be posted on the on the website for people, the presentation that we had given to the towns, the town and the property owners, I guess, it was maybe four months ago, I think, at this point, will be available for review and if you have any questions about any of this, you know, obviously you can reach out to me and Elizabeth. So I don't know if you want to say anything else Elizabeth.

Elizabeth: No, great job. I think we are at time.

Nora: Nice job, so thank you very much Elizabeth and Joshua. I'm going to ask Jesse, if he would like to get ready to share his slides as we move on and to remind people if you have questions for Elizabeth and

Josh, if you could pop them in the chat or hold them for at the end, and we'll do questions all together. So, I'd like to introduce Jesse, Dr. Jesse Sayles, who is an ORISE fellow appointed with the U.S. Environmental Protection Agency, Office of Research and Development, Center for Environmental Measurement and Modeling, Atlantic Coast Environmental Sciences Division. That's a long pedigree there. He is collaborating with colleagues through the Stewardship Mapping and Assessment Project of Southeast New England, StewMAP SNE, and his project colleagues and co-authors include Bryce Dubois, Lynn Carlson, Casey Merkel, Curt Spalding, Ben Myers and Shreya Kaipa, and I apologize if I misspoke anyone's name. So, with that, Jesse, are you ready to go?

Jesse: Yeah and let me just ask you, well, do you hear me?

Nora: I can hear you and I can see your slides.

Jesse: That was question number two! Okay. So let's get to it. Alright. So, yeah, thank you everyone for attending our talk. I'm really happy to be reporting on the work that my colleagues and I have been doing on Stewardship Mapping in the Southeast New England region. So, I want to just introduce you to the team, because this is really a team effort, even though you'll be hearing my voice. And that did not advance, there we go. So as just mentioned, I'm working with Bryce Dubois at the Rhode Island School of Design, Lynn Carlson Compass Cartographic. Casey Merkel also at Rhode Island School of Design. Curt Spalding, Brown University at the time and we had previous assistance from Shreya Kaipa, Ben Myers and we're also collaborating with folks at the U.S Forest Service and the New York urban field station and I'll talk a little bit more about that in a moment.

And there, it's advancing, okay. So, in the next oh say 20 minutes, I want to introduce you to StewMAP what it is and why we're doing it and then go through some of the preliminary results of our stewardship mapping and through that I'm going to talk about three types of data that we've been collecting and so you can keep this in your mind. Attribute data, this is information about organizations that responded to our survey. Spatial data that we collected, this is about the areas where they work, we call this oftentimes their turf, a coin turned by the stewardship mapping community and we also collected network data, who they turn to for knowledge, for funding and several other things, as I'll make clear. I'm going to talk a little bit about how our work can support environmental justice collaborations and work in the region, as well as some next steps. And at the end of the presentation we actually have a small user feedback survey so we'll put a link into that and I'll explain what that survey is aiming to capture as we get along in the presentation. Okay.

So Stewardship Mapping is a project that was started by the U.S forest service to understand the generally civic society groups that are involved with doing stewardship in a region and intended to focus primarily in cities, recognizing that many of these groups were often less visible than some of the known characters working on environmental stewardship and so this StewMAP protocol of conducting the survey to understand what groups are doing, their capacity, where they're working, who their partners are, etc. has been carried out now in a number of cities across North America and actually a few internationally, as you see on this map here. This is a map of where various StewMAP projects have taken place. Now, our StewMAP effort is a little bit different, in that we've set out to not just focus on a city, but on a much larger geographic scope, the SNEP region, this goes beyond urban boundaries, looking at both urban and rural areas, has for essentially a watershed focus, we're using the SNEP boundary, which focuses on those three major estuary watersheds, Buzzards Bay, Narragansett and Cape Cod and the Islands and of course, embedded with a collaborative effort to support stormwater and green infrastructure projects.

And on the left here, you can see a map of the SNEP region, in case anybody wanted a refresher. The three major watersheds that I just mentioned are color-coded there in the map and when we talk about stewardship, we have a very broad definition of what this means, and it's organizations that are working on conserving, managing, monitoring, transforming, caring for specific living things, building partnerships, engaging in place-based traditional gathering of resources, that are working on restoring native habitat, that are preparing for environmental disturbances, that fund or provide in-kind material support, that

educate or advocate for the environment across a given region, in this case, the SNEP region. So there's a very large encompassing concept of what environmental stewardship is, we're really looking to collect a large swath of groups that identify as doing environmental stewardship and so we set out to do this, a survey, to understand who they were, understand about their organizations, where they work and their partners. And we conducted that survey from November 2020 through to June 2021, much of that during the covid pandemic, so that does maybe play into some of the results that we collected and so let me get on with telling you a little bit about actually how we did that. Okay

The key challenges here, we didn't know who the groups were to begin with, this is in essence an unknown population and so we had a targeted recruitment approach to try and recruit groups by phone or email to explain to them the nature of the StewMAP survey and ask them if they identified with environmental stewardship and to opt-in and we had an initial list of 390 organizations that we collected from coalition websites and from SNEP outreach documents. When we asked people to participate, they listed additional groups that they went to for knowledge, funding, other key partners, as well as desired relationships and we contacted them as well. A total of three rounds. There's a lot of manual validation and cleaning of all this information that came back. And just to emphasize, that we ended up focusing primarily on civic society-like groups, mostly citizen groups, non-profit groups, etc. We did not focus on municipal groups, state or federal. We did include and reach out to the tribes, because we know that that is an important group in the region and we wanted to gain their responses in the StewMAP effort, but it's important to keep in mind what the survey is currently representing. So from that original 390, we actually identified 718 groups, now we had 170 responses and now that doesn't mean that, that's a very, it sounds like a very low response rate, but not all of those 718 groups ended up identifying as doing stewardship, even though someone listed them as a partner, they themselves may have said no we don't really do environmental stewardship or we don't really work in that region even though we provide knowledge to someone there and so they were not included in the survey. After some cleaning of the data for quality control and removing a few initial responses from some municipal organizations before we decided to pull back and really just focus on civic groups, nonprofit groups, we had 149 responses. Some people asked not to be in a public-facing database and so 143 are included in a public-facing database that I will introduce you later on. Okay.

So let me talk a little bit about the organizational attribute data that we collected and give you an idea of these groups working in the SNEP region.

In terms of their primary stewardship activities, we asked everybody what they're doing. You can see here on the graph on the left, that there's a lot of people that are working on advocacy, on conservation, on education, but we also recognize that groups do multiple things and so in addition to just asking them for one primary activity we allow them to pick everything that they're involved with, and what we're showing you here on the right is just the fact that some of these activities are highly correlated. We're not showing you the graph of what everybody suggested, but essentially people that tend to do caring, also tended to do conservation, were involved with managing, monitoring and restoring, so that those activities tended to coincide with each other.

In terms of the types of sites or green infrastructure activities that they were working on, we allowed people to pick again multiple choice, from a whole host of different types of areas, of systems, some people maybe had a systems perspective, like, they worked on atmospheric systems or coastal shoreline systems, as well as green infrastructure items and so these three bar graphs show the results of those multiple choice options and you can see, you know, conservation of public of, sorry, conservation lands working on conservation lands is very common, working on parks, you can see in the bottom here, a lot of people commenting that they worked on forests and wetlands, a lot of people working on restoring natural features, but then when we asked them to list just one, kind of when push came to shove, you can see a large focus on, here in the pie chart, on watersheds and on conservation, working on conservation lands and so it's just interesting to see, you know, like the for example, forests were very common when

allowed to pick multiple choice, but when, really push came to shove, people really have this sort of watershed focus and conservation lands.

In terms of organizations, their size and their budgets, these are some descriptive statistics on the left here. There's certainly some very large groups working in the region that responded to our survey, but most groups were actually moderately sized or quite small. You can see both full-time and part-time staff, volunteers, their budgets, and in terms of understanding where their funding was actually coming from, most groups commented that they received funding from donations and then you can see a number of groups preferring not to respond, but it helps you just get an idea of where these civic society-like groups are actually getting their funding from.

We asked people in terms of the services that they were providing and services that they might be seeking and it's interesting to see where there is alignment in providing and seeking and where there is not, and so we just quickly look at this for example, we see a lot of people providing services such as, research or educational trainings, a certain amount of labor being provided, but what people responding to the survey were really seeking is grants. Now the labor provided and the labor seeking, there may be a chance to match people up there. Research provided and research seeking, there may be a chance to match people up. Again, the caveat being, this is sort of civic society-like groups where we didn't get responses from federal, state agencies, which you know, might change the services provided in terms of something like funding and we will talk about that later on because we have data on who people's funding network is. Okay.

So in terms of mapping where organizations work, I just want to give you a quick overview and then I'll actually show you the map of those turf areas. So here we've just looked at the count of organizations working in each of the three major estuary watersheds, but of course, many organizations span multiple watersheds, so we've indicated that here. So we have Narragansett Bay 62, Buzzards 7, Cape Cod 18, Narragansett and Buzzards 28, Buzzards Bay and Cape Cod 7 and then all three 21 groups, and that's the 143 in the public database and these turf sizes really range from being incredibly small, we're reporting in hectares here and if anybody doesn't know what a hectare is, it's 2.47 football fields, some really small groups representing things like community, school, garden groups or something like that to some very massive groups that are spanning well beyond the SNEP area, sort of the entire northeastern seaboard for example.

And so this is a map of those, all those turfs in the SNEP area and this is not just a map but actually a dashboard and it's interactive and let me show you what that looks like. See, the goal here is to be able to make this, is ultimately that this data will be a public facing, a public resource that people can look at and so all these groups and all that attribute information that I just listed are all accessible here. This is currently a draft where we're finishing it and eventually it will be published on the U.S forest service website and so what you're seeing is the ability to select by different watershed areas, so now it's going to pick a small watershed, let's see where it goes, I know it's going to the blackstone river and so we've zoomed into the blackstone river and it's identified the groups in the blackstone river and then you can pick out one group by its turf and see the attribute information about that group, and so right now we have it set up to select by the three major watersheds. Now it's looking at buzzards bay. Now it's looking at Cape Cod and the islands and you just saw some of the small watersheds. So we are going to provide a survey link to you where we want to get some feedback from you about what you might like to see in this dashboard and how you might like to select organizations whether it be by watershed, by municipalities, etc. We want to know how this can be more useful to you. Okay.

Now let's move on to the network data. This next slide is going to be a little intense, but bear with me, I'll explain. This is the network results of who people are working with and so let me explain to you what's going on here. We had 149 respondents to the survey, now they report working with many people that did not reply to the survey and so we have red was the survey respondent and blue is not. And people, these were open-ended replies, people could report all kinds of things, some people reported small sub organizations of a larger group and so that's a total of 740 groups that people reported as working with for

knowledge sources, funding sources or other key collaborators and if we aggregate that up to sort of their parent organization, it's 638 groups, so you know, there's different ways to slice this data and so here you can see that the knowledge network on the left is the largest network, 466 organizations in that network, 245 in the funding network, 214 in the key collaborator. On the bottom here, I've listed the top mentions, so you can see across the board our Rhode Island DEM is often a top collaborator in these different types of networks, as is TNC and Mass Audubon, you see SNEP network as a top funding source. And I recognize that can be very difficult to understand these types of graphs and so up in the top right here, just some statistics to help us understand. These graphs are very, have a very low density, which means that the number of possible relationships out of the total number possible. Sorry, the number in the network out of the total number possible are quite low. These networks are very decentralized meaning that there's no single individual holding it together and that has a lot of theoretical implications, but one is that it can just be very difficult to get information from one side to the other or to communicate something to all members of the network and I can talk to you more if you have questions about what these numbers might theorize. We also kind of looked at whether or not there was reciprocity, so I say I should go to you for knowledge, do you go for me and this is only among respondents, so there was about 15 percent of the relationships were reciprocal in the knowledge network and not in the funding and zero in the funding network and that makes sense, people get money from funders, they don't give it back.

We asked people also who they might like to work with, but had been unable to and we didn't have a huge number of responses to this question but we did get a fair number. You can see what that network looks like here and again some of these were replies to specific groups, 78 people mentioned specific groups sorry, 78 mentions were to specific groups, whereas 28 were kind of general categories, 10 people were just to say no, none, we're working kind of with everyone that we would like to, some people just kind of said we want to work with everybody, maybe everybody in a specific region or people commented that they'd like to work more with SNEP and if we look at the reasons why people were trying to seek out these collaborations, a lot of them were specific projects or goals, knowledge or expertise, funding, but what I find very fascinating is to see a small number of people that were talking about wanting to reach out to incorporate diverse voices, often in the context of reaching out to some of the tribes in the regions and you can see here on the bottom graph, this is just showing the group type that people were seeking out, so a lot of non-profits, some university partners but again, I highlight the fact that there's some people who would like to reach out to the tribes which we recognized as an important stakeholder in the region.

Now that dashboard I showed you earlier on, works very well with the GIS data, but it doesn't really allow you to integrate with the network data and so I've been trying to develop something here that links the geospatial information on the left here to the network information and so what this is doing is it's allowing you to select an area. You can select an area by location, you can even select by watershed and it pulls up the network in that area. Here's the network on the right, it's interactive, that's fun. You can view attribute information about those individuals in the network and then you can also select on a specific organization and see their immediate neighbors, their immediate network and that's what you just saw and I just want to point out this is all fake data in this tool right here because it's still very much under development and we're going to ask you for some feedback in the survey, If, how you might want to use something like this. Okay so with my, I'm almost out of time here.

With my last few minutes, I just want to mention a few things. A lot of the things I've talked about really feed into issues of environmental justice and supporting environmental justice work in the region and we are working with the SNEP network environmental justice initiative strategy team to think how our data can help with that and it touches upon issues of justice in several ways. We have information about groups missions and their needs and their focus and we can start to pull out who is working on environmental justice issues or who might be wanting to learn more about it, we can identify people in in the network who are very central and who are not very central and what that might mean for access or representation, we've saw some, but in the desired relationships people wanting to work with groups that have not always had an important voice in the region and we are trying to do some things as well as

developing, looking at stewardship capacity in specific areas, we also have a database of over 700 groups that are linked to this region and so we know a lot about that. There's some limitations here, we did not set out to study environmental justice issues explicitly from the beginning, but our data certainly lends to it and our survey responses are limited largely to civic society groups and tribes, but we don't have information from the towns, the state or federal groups in the region and so that, of course, is a limitation.

So, as my last slide, we are going to be continuing to get our data ready to be distributed and published. We are looking to maybe do some summaries of the data at smaller geographic scales. We're also really interested in analyzing the network among different sub-regions in the SNEP network like, between the three major basins, something I'm personally very interested in. The GIS dashboard, will be reviewed and hosted by the U.S. forest service, we're working on several reports and we will be presenting some webinars in June. So, please be in touch, if you have specific questions or interests, we'd love to just hear more about your thoughts on this StewMAP project. Thank you.

Nora: Thank you, Jesse and you said you'll be posting in the chat?

Jesse: Yeah, I'm gonna post this link in the chat as soon as I figure out how to highlight it, you can go to this QR code as well.

Nora: Thank you, so, with that Joanne, I'm gonna ask you to get ready to share your screen, okay, and as you do that let me introduce you. So our third presentation for this session is from Joanne Throwe, is that correct, that's right Throwe, thank you, and she is the president of Throwe Environmental as well as senior fellow at the University of Maryland school of public policy center for global sustainability. Joanne's work focuses on helping governments and organizations find innovative ways to finance environmental and natural resource improvements, especially as it relates to climate change. Joanne currently serves as a technical assistance provider for the SNEP network and is a field liaison for the national fish and wildlife foundation's national coastal resilience fund and the Long Island sound futures fund. Prior to work at Throwe Environmental, Joanne was deputy secretary for the Maryland department of natural resources and before that Joanne was director of the University of Maryland environmental finance centers, serving the mid-atlantic region and with that … Joanne.

Joanne: Thanks Nora. Hi everybody, glad to be here today. I know you heard about the SNEP network and what I'm going to talk to you about this afternoon is a little bit on sustainable financing but we're moving towards resilience financing. I'm going to talk a little bit about the framework, but I want to recognize you've heard from Elizabeth and others who are part of the SNEP network, doing amazing work across the region

And Throwe Environmental is part of that network, so we're happy to provide technical assistance through that network. We are located, we work nationally, but we are located here in Bristol Rhode Island, so very happy to be in Rhode Island.

What I'm going to talk to you and I know we're a little bit late on time, so hopefully Nora won't cut me off too much. I'll get my time in here.

Nora: We have buffered Joanne with the question session, so you get your whole 20 minutes.

Joanne: Oh wonderful, thank you, okay Nora, I'm watching the clock. So what I'm going to talk to you about in the next 20 minutes is, you know, looking at financing, it seems a little overwhelming to many people and I'm trying to simplify it here. I'm going to mention the planning to action climate toolkit and how we develop that to make it more simple. We're going to bring some examples of funding and financing mechanisms close to home with Portsmouth in Massachusetts. We've got Portsmouth and Borne in Massachusetts. We've got Newport, Rhode Island examples and we also have a tribe example. Jesse mentioned tribes before me.

So let's talk about this and first of all, I want you to understand a little bit of the resilience financing framework, it was interesting about two weeks ago, somebody, a federal employee sort of blurted out to my colleague and I you know here's a particular problem, how do you pay for it how, do you finance this, which we found afterwards very amusing because it can be simple, but it can be very complicated, there's no one answer that fits when we're talking about financing, especially when it comes to developing sustainable financing and thinking about natural resources, protection or investment in capital improvements.

So when we look at financing and you know, I don't want anybody's eyes to glaze over, but what I want to do is make it very simple, if that's even possible, but it is, you know, look at this pyramid you see in front of you and it's broken up into four parts. I'm going to start at the bottom, obviously, which is the foundation. When you're looking at financing and I know there's different ways to approach it, but I've been doing this a long time. Yes, I'm that old and honestly this process works, it seems to be any time I've ever had success in any work I do, this is the process I've used. And you know, you're starting at the basis where you need that community and leadership engagement, you have to ensure that buy-in is there, the community you're working with or you're part of really needs to be receptive to the idea of financing. Most of my work has been in the Mid-Atlantic and more recently here in New England, you know, some big differences here, but not so much, we all are dealing with the same types of issues and honestly, if you're not seeing leadership, be it your town council, your board of selectmen, whoever it is, if they're not open to talking about financing recommendations, it's very difficult to move forward, so getting that community commitment starting with the idea of understanding what it takes to build the community support and leadership support is essential. And then next, you have, you know, and honestly you can interchange this when we're talking about financing, environmental finance in particular there, you can take this and not necessarily everything falls under climate. I tend to see that there's so many connections we can make to climate resilience financing, but you know, this process works in other areas of financing as well. So the next thing you need to do, once you know leadership is, at least you know, going to be supportive, to listen, to be open to recommendations, to move forward, you've got the assessment of, you know, what are you financing, how do you know what you're prioritizing, where are your investments that are needed to make a difference in your community and this is something that, it's a process and what I like about the SNEP network and the work we've done that you'll hear about shortly, it's not a big investment to get communities to this point and you start with assessing your climate hazards, you identify those key assets and understand the impacts, you're analyzing, what the risk is you're doing, that vulnerability analysis and I'm going to walk you through a couple examples so it'll make sense as we move forward, but this is important, again you know, it's what are you financing and once you know that, then you move to that third step which is that part of the pyramid here you see under number three, which is your prioritization, your project portfolio. You know, once you've been able to maybe in Rhode Island you're doing an MRP or an MVP in Massachusetts, it gets you to the point where you're starting to move forward and think about where you need to prioritize your investments, but now you're thinking through what specific action, who's taking responsibility, where are the potential funding and financing options that you could consider for that particular project, that asset, to protect that asset or that particular project you want to implement. You need to be able to I identify that and start thinking about estimating implementation costs, so then that final piece when it comes together you've done that assessment and honestly it's some communities are so far along they have so many documents, so much information, it's not as hard to get to that fourth part, which is the top of the pyramid, getting to that sustainable funding and financing and thinking through how to establish either some type of dedicated revenue stream that is, you know, that can help generate and build investments in your community. So I tried to make it simple and how we approach it, but let's go through a couple of examples.

You know, Jesse just spoke about grants, we all know grants and coming to, you know, work in New England the last few years, it's interesting how little conversation had been happening about finance certainly in certain pockets of the Southeast New England area, but not in general, it's mostly about grants and what I would love to be able to, at least, share with you today, what you know grants are one way to fund projects, they're not everything and you're just spending so much time chasing after various

grants, but when you figure out a system that could, a financing system, that could help to augment what you need to have happen, it goes a long way. So I'm not, I have no time to go into bonds, TIF's, fees, special purpose funds.

Or looking at P3's, which are really starting to move forward these days. Performance-based contracting is, you know, becoming pretty widespread, very exciting, you know, turnkey delivery services, very, very exciting times in this. A special tax assessments, tax exemptions, loans, insurance, those are all taking place, many of you already know about them, their options, potential financing mechanisms you can explore, they're not the only thing. What's exciting though are things that are happening, for example, new legislation in Connecticut, moving towards stormwater and resilience together and resilience authorities that are taking place in other parts of the country. I'm involved with setting up the first few resilience authorities in the mid-Atlantic and you know, it's just one that is brand new starting up and already the state said how can we funnel my goal, our goal is to set up 50 million to start with, but that would be from other revenue that we can generate to the authority and what's interesting, the first meeting with the state, they said we have 10 million we'd like to invest in this project through the authority, well that's going to make my job a lot easier.

So different things happening around the country, it's very exciting. Financing is not a bad word and it's something that could be moving forward here in New England. To include examples of what I'm going to share now. So this is part of the SNEP network projects, I'm giving you different examples of how they approached it and I'm going to take that pyramid approach and so looking at, and everybody on this call I know you know Portsmouth, Rhode Island, Aquidneck Island, Borne and Cape Cod and then of course Newport Rhode Island, so all three of these have, you know, obviously smaller populations so most of the time people say ah towns I can't do this, no, I don't care what size you are, I've heard it all, I've seen it all and I've seen communities very much smaller than these who have really moved forward on financing and that we've looked at their vulnerabilities, but what I want to talk to you about now.

Is how we took, first of all, each aspect of the leadership, starting with leadership, right, the first thing we did is made sure for example Portsmouth, they had a very engaged leadership to the point where, you know, it just became one of those communities where you can pick up the phone get somebody anytime in leadership, they were all in, we also backed it up with a resilience work group, we had a larger stakeholder work group so we didn't want town counsel to later to say we didn't vet this, nobody was involved, that's not the case, and Portsmouth we did, and with some of the others, we did a capacity review, they allowed us to go into their programs and really they exposed some of their gaps in the areas that where they needed improvement in order to get to understand the financing, funding and financing, same with Bourne leadership, you have to be prepared when managing, you know, aspects of an expectations with leadership, that people change, you know, town leaders come and go, that was the case for Borne, we had a transition, but that was okay, because we made sure we were constantly working with the board of selectmen and other senior staff within the town, so it moved forward and also Newport Rhode Island, a very engaged community, various stakeholders, very involved and we took it and made sure that was there.

The next step on your pyramid is that vulnerability analysis and risk, risk assessment, so slightly different approaches with each and one of the things I would say is the goal is, back to that description, looking at those hazards, identifying what their priorities are and I'll give you a little tip here, sometimes you're reading hazard mitigation plans or your their MRP or MVP or comp plans, any documents they have and for example Newport had so many, and you know, it's not the full story, you really need to engage stakeholders to find out more information and detail around various projects and how you would get to prioritize and do that asset inventory, so we did that using a prioritization tool, the climate assessment toolkit, many of you might know about, and we happen to have on our staff, somebody who really loves coding and so we really tried to take that and redevelop the toolkit to be more user-friendly and we developed the toolkit so it would start to prioritize hazards, be able to show priority projects, start putting in costs and we don't have time to run through a video or anything like that here

But, we were able to start refining priorities, capital needs for Portsmouth, for example, looking at a resilience CIP that we helped set up, we started to move Borne towards that climate action plan, looking at all the vulnerabilities that will, they can anticipate and Newport's not finished yet, we are still in that project, but looking at incorporating a lot of the information from those existing plans with the work group and we have regular meetings with the town.

So that gets us to and I'm mindful of my time, the last piece which is, how do you get to climate finance and I like to include the word, usually I say funding, financing and investment because they are so interconnected, so example, Portsmouth, I'm looking at a long-term resilience financing strategy that they were able to set, recommending that they establish a climate resilience fund set aside dedicated funding that they could use towards even BIL project, BIL projects or other Rhode Island Infrastructure Bank funding, I know that they were presenting today. We were able to show, sit down with Rhode Island Infrastructure Bank and show a list of all these prioritized projects where Rhode Island Infrastructure Bank had funding, so what a great way to advance their resilience CIP, a resilience CIP that's not competing with schools and other priority needs of a community. Same with Borne, they were able to establish a climate resilience and infrastructure stabilization fund, where they can leverage and grow over time, that one's very interesting and I'm very excited about both of these examples and now as we move towards Newport and our check-in call today when we're going through, getting ready for our next meeting and what was interesting was Newport mentioned a climate leadership exchange event that we had right before SNEP began and they actually used a quote that they learned from other communities down in the Chesapeake Bay and I thought that was fascinating and the idea of they had mentioned why don't we bring all that together so many communities are doing so much more, let's start sharing information, so again back to connecting to the climate leadership and how important it is to share information and learn from each other.

So I'm going to end with a comment on something that's a little different and Jesse had mentioned working on tribes and engaging with tribes and we have this exciting project with the Wampanoag Tribe of Gay Head Aquinnah and you know, they're a small population, only 11 hundred of enrolled members, 580 acres on Martha's Vineyard, which is made up of 57% wetlands, 29% unimproved upland, which is a lot, it's a high percentage and 7% in conservation. We went and we have been working on a climate adaptation plan with a little bit of a twist.

Because so many climate adaptation plans or climate resilience plans don't include financing, it's a plan, how are you going to pay for it, what's really exciting for the tribe is how can we leverage that piece where I mentioned funding, financing, investment. I see you Nora, I'm wrapping up, so what I want to just say is, you know, we recently had a leadership exchange thanks to EPA and a workshop they were doing there, they allowed us to come in.

Collect some great information, we were able to get barriers and opportunities and solutions, great information that we're collecting, we're also turning a podcast series together of private interviews we held, that were just, are so powerful and I'm hoping very soon within a month or two, we're going to share all of them, they're just so powerful and it's part of SNEP network deliverable.

So we're really excited with all of these wonderful opportunities here in the southeast region on financing, it's not so scary, the opportunities are there and I thank you for your time. Nora, I did it, there you go, 20 minutes.

Nora: Excellent, thank you so much Joanne.