Rain Gardens: From Ecosystem Services to Landscape Amenities

BOB SIMMONS: Greetings, everyone, from my living room. I'm really glad to be here with you this evening. I really was excited when I was contacted and able to share some of my expertise and knowledge with you all.

I have been with the WSU Extension for 28 years now. And I don't know if you're familiar with WSU Extension, but WSU has offices in every county of the state. And some of you may be familiar with our youth program called 4H and the master gardener programs that we have in every county.

But in the agricultural areas, we have specials in different fields of agriculture, whether it's wheat or apples or grapes. And over here in the Puget Sound area, where I am, we have a few water resource specialists looking at water quality and looking at ways to better improve our management of water, so it stays clean before it goes into Puget Sound. So I've been working in stormwater issues for about the past 20 years.

All right, so I'm going to go through, a lot of this is the background of why we put in rain gardens. And then we'll talk about them as a tool for helping improve water quality. My thing is not advancing. There we go.

So here are some rain gardens in Port Townsend, Washington, up on the Olympic peninsula. And to the left, there's a large area of pavement. And this rain garden that you see intercepts that runoff. The water is able to flow into it in certain locations. And that water is soaked into the ground at the rain garden and is treated by the rain garden, the soils in the rain garden before it soaks all the way in. So thus, we have less contaminated runoff running right into Port Townsend Bay, which is in the background.

And here's another more established rain garden that we see nest directly adjacent to a parking lot at the Thurston County Fairgrounds. The water kind comes in the bottom on the right there, the bottom right. There's some gravel. And that's coming right off of a paved parking area and flowing into there.

And here's a series of rain gardens along a street in Puyallup. And this gets runoff coming off the street just directly. There's no curb there. And it just runs right into that rain garden. So any contaminants on that roadway comes into that rain garden and soaks into the ground and gets treated as it soaks in.

And here's another rain garden in another nearby neighborhood in Puyallup there. And this one just gets runoff from that downspout. You can see that black pipe going into the ground. And this really just takes the runoff off that roof and soaks it into the ground instead of adding to all the runoff that's coming down the street. So it doesn't really treat any of the street contaminants, but it just reduces the amount of runoff.

So before I go any further on rain gardens, I want to talk a bit about just the general water cycle. So here's a schematic put out by the US Geological Service. And it talks about precipitation in the upper left that comes down as either rainfall or snow. And so it builds up in the mountains and across the landscape.

But the snow builds up up in the mountains. And when that melts, it'll either soak into the ground, or it will run off into streams. And the precipitation as rainfall comes down. It filters down all the way through the forest and reaches the streams. It'll run off into the streams, or it'll soak into the ground but adding to the groundwater.

That groundwater goes somewhere. It's continually moving through the cycle and eventually discharges at lakes or into Puget Sound or local bays or streams or the ocean. And then again, all points along the way, it can evaporate or transpire back into the atmosphere, thus creating clouds again.

So I'll go through that a little bit in a more forested situation, where we'll see the water cycle starts at the sky. And it comes down as rainfall. And it hits those roofs that you see at the bottom or the tops of the trees.

But when you're in a forested situation, there's a lot of layers. So if it just starts raining, it may hit here. And if it stops, the water will never see the ground. It may just evaporate off the tops of those trees.

Those needles on those fir trees you see can hold a lot of water. If it does keep raining, it may hit those understory leaves, the chokecherry or the slough or the evergreen huckleberry bushes that are in the understory of our west side mountain forests. And there again, if it stops raining, that water may never see the ground. So there's a lot of water-holding capacity there.

So if it keeps raining, it may hit that herbaceous layer down near the ground, where there might be kinnikinnick or ferns or some trailing blackberry that you can see here or some moss. So there again, if it doesn't keep raining, that water may just evaporate and never get into the ground or run off into a stream. And below that, we have that duff layer of decaying vegetation.

So there again, it may just get held there and evaporate eventually. Or if it keeps raining, it may get down into the root zone. And in that root zone, the roots may take it up and transpire it through the plants, whether they're shrubs, herbaceous layer, or those trees. So there again, that whole water cycle is a lot slower when it happens in a forested situation. You get much less water runoff.

So here's a schematic that was developed based in the hydrology that we find here on the western side of the mountains with a rainfall event coming down as precipitation. And you can see, as it makes it down through the trees, we have only about 1% surface runoff. That's because that duff layer is course. It doesn't allow water to flow quickly. And the water is really slowed down as it drips down through. So it's able to soak into the ground much more easily.

So in this situation, we have the trees transpiring a lot of it and also a lot of evaporation. So these estimates are 40% to 50% of evaporation or transpiration through the vegetation and then the rest slowly trickling into the ground. So we have a lot of good groundwater recharge, recharge our groundwater aquifers with, again, very little surface runoff.

So this slide, after we develop an area to suit our needs, we put a house in and some lawn going down to that little pond. And then you can see we're getting a lot more runoff. Here, the estimate is about 30% of the rainfall is coming. It comes down, goes off as runoff, the rest being transpired by whatever trees that are there, whatever lawn is there, and much less groundwater recharge. The estimate there is less than 15%.

So that's the evapotranspiration. That's the interflow. So sometimes there is layers of clay or really compacted soils that don't let water soak all the way down to the water table, kind of intercepts it. And it moves underground towards a water body downhill. So there again, we see a surface runoff of about 30%.

And so here's what that might look like in real life. You can see water flowing off that cleared area to the right because that water hasn't been slowed down by all that forest vegetation that's further back. And so it's creating ponding in that street area that's being developed. So a lot more runoff happening in that situation.

And we engineer ways to get rid of that, so we're not walking in these big puddles and driving through them. So that water goes somewhere and, often, the nearest water body through a discharge pipe. And so that adds a lot of burden to our waterways that evolved under a forested situation.

And so now we have much more water, more quickly gushing down our waterways, and that causes a lot of problems. Here, you can see it's not the greatest picture. But after the water subsided, some of that erosion that happened and the undercutting of the existing banks. And so that tree and the banks are going to fall into that stream and bring all that soil downstream.

So that's the problem with that excess volume. And also, with all that sediment, you can clog up the bottom of the stream beds. They can bury the salmon eggs that are buried in those gravels that are in the stream.

There's salmon lay their eggs in those stream beds in the gravels, as well as a lot of other fish. And other aquatic insects and organisms live in those gravels. And they depend on water flowing through the gravel for the oxygen in the water to sustain their lives. And they get smothered when sediment is built up upon them from all that's built up in those streams.

So this is a lot of the situations we have. This is over on the Kitsap Peninsula in the Puget Sound area of Washington state. But it's a very common theme because people like to live and develop near water bodies of this Sinclair Inlet here.

But you can see all the water running off these parking lots. Where do you think it's going? I know you can't answer, but it's pretty obvious that it goes right into the inlet there, bringing whatever contaminants are on those roadways and parking lots and whatever pesticides might have been used in those little green areas.

So further up on the Olympic peninsula, we have a town called Quilcene. And there's a bay there. And you can tell that the water going in there is probably a lot cleaner than the water going in Silverdale.

So it's estimated that 75% of the toxics in Puget Sound are carried there by stormwater runoff. The State Department of Ecology commissioned a study. And that was the estimate they came up with. Not from big pipes coming out of industrial plants but just from water running off of our roadways in the streams.

And so here's some of the common sources, excess fertilizers that people use on their farms, as well as pesticides. And homeowners are particularly poor managers of fertilizers and pesticides because they often figure, oh, a little more would be better. Or I still have a quarter of a bag, but I don't want to store it anymore. So I'll throw that out there too. It couldn't hurt. And when in fact, it actually could hurt if it does run off, or it can contaminate the groundwater, which isn't good either.

So failing septic systems, that's when the septic effluent isn't perking into the ground in an on-site sewage system. And it's coming to the surface and becoming runoff. When wastes aren't managed well on a farm, so cattle or horses are allowed to be too close to the stream, and it rains, that manure can runoff into a stream. Or if they pile up the manure, it builds up in their paddocks too close to a stream and don't cover that manure with a covered structure, that, of course, can wash into streams and waterways. And also, the water falling onto those paddocks, those confined areas where people keep horses or cows, if they're not properly buffered by trees and vegetation to soak up some of the water running off them before that water runs into streams, then they can contaminate streams.

There's also pet waste. So people sometimes don't pick up after their pets as they take them for their walks. And that is also shown to be contaminating our waterways. There's been research done looking at DNA tracers of what animal wastes are found in water. And they're finding farm waste. They're finding dog waste. They're finding human waste. Pointing to septic systems failing, farm waste, and pet waste are sources.

All right, so here is a stormwater outfall in the Montlake Cut off in Seattle. So down in the bottom left, you can see the stormwater discharge pipe coming into that waterway, which we often find. We're just trying to get that water off the road, out of the neighborhood, and into a water body. So it's kind of out of sight, out of mind.

And it looks bad enough there. But when you actually analyze the water and figure out what's in it, you'd be horrified. And so these are some of the things that they're finding in stormwater runoff. And they scratch their heads in terms of figuring out exactly the sources. But they're finding it in the stormwater runoff.

And think of yourself. As a person, you can choose whether or not to swim there. But as a fish, you had no choice. This is where you live. And so you're being exposed to these contaminants.

And some of these can have immediate lethal effects, or some can just permanently brain damage you. Such as, copper can fry some of the neural transmitters in their brains. Those neural transmitters don't grow back.

So once exposed to the stormwater, a lot of aquatic organisms can't rebound. They're permanently brain damaged. And so salmon, in particular, lose their sense to home back to their native stream to swim back to where there was spawn. And that's where they were going back to lay their eggs. Or they lose their ability to swim in a straight line. They lose their ability to smell. They lose their olfactory senses. So anyways, kind of some very depressing effects.

So a lot of [AUDIO CUT OUT] especially dead coho that are pregnant-- and you can see that picture there-- full of eggs, going upstream to lay those eggs after their four-year lifecycle of being spawned in the stream, living in the stream for a year or so, going up to Alaska and swimming in the open ocean, and growing to five, six, seven, eight, nine pounds, and coming back to lay their eggs and going back up the streams where they were spawned to lay their eggs. And we're finding a lot of them are dying before they can even lay their eggs.

So here is some research that was done over the years. So Longfellow Creek in 2003, in the upper left, they found a 67% mortality. And that area, that stream's in a pretty urban area. So it's getting a lot of stormwater runoff.

But the one below is a few years later and had 72%. And the one in the bottom right is 84% in 2012. So the numbers are going up as development increases in that area. So not a good picture.

They did sample a number of other creeks. Here's some of the others. And Longfellow's the one down near the bottom. I'm not sure if you can quite see the bottom of slide. Actually, I can't in mine. But down the bottom is where Longfellow Creek is.

They actually did sampling in 51 different creeks going from very rural areas such as in the upper right-- that Fortson Creek is a very rural area-- then areas that are more and more developed to see if there was a difference in terms of salmon mortality and the amount of development around them. And so this team was developed as the collaboration of WSU and some of our researchers that are WSU research station, US Fish and Wildlife, NOAA, and Suquamish tribe.

And so looking at those 51 sites, I mentioned they went from very rural areas to very urban areas. You can see in this graph on the right, they associated traffic intensity with mortality. So those areas that had a big road network had higher mortality. And those areas that had busier roads, so principal arterials, interstate highways had higher mortality as opposed to those areas that had less roads and just more localized, residential roads.

So their major findings, they noted that these spawners are consistently dying every fall and that it was widespread through those 51 different areas and that it correlated with development. So those mortality rates were high, especially in the higher developed areas. So they published some research on this, a lot of research on this.

So to further oil down and answer some questions about stormwater runoff, they collected the stormwater runoff coming off this bridge. So they figured this would just be water coming off of a roadway, not coming from any of the other lawns or anything else. They figured the runoff here is really water that's hitting that roadway and pavement and coming off it.

And fortunately, there's a NOAA laboratory facility underneath where those buses are. There is a research facility there and a parking lot right down there. You can see that arrow and the NOAA thing.

And so that's the bottom of that arrow where that pipe comes from the stormwater grate up above down this pipe. And it really just flowed in this parking lot, across the parking lot. And it flowed into Lake Washington. So that research facility is right on Lake Washington. And the bridge goes across portions of Lake Washington.

But one of the WSU researchers, Jen McIntyre, collected some of that stormwater runoff and exposed fish to that runoff. So she looked at adult coho salmon, as well as adult chum salmon, so two different species to see if there is difference and see if they had any effect at all. So she set them up in these tanks.

She put the adult fish into these tubes. And you can see the labels on them. And so she did two of each and duplicated that, so total of four coho in the clean well water and four coho in the runoff.

And see polluted that runoff like it would be just after it's discharged into Lake Washington. So with this, she ran that experiment to see what would happen after exposing these fish to those contaminants. And she put the fish in the tubes because those salmon are very sensitive to what they can see out of the water. And they didn't actually want to give the fish heart attacks or any other lethal effects based on all the movement around the lab. So kind of like putting blinders on a horse, they put them in these tubes.

And so here is a picture of a coho exposed to stormwater after two hours. And it's not looking very healthy. And here's a chum salmon after four hours. And that is looking pretty healthy.

So here's kind of a chart of what they look like after four hours. And the chum had severe symptoms after four hours. And chum hardly had any. So it's good for the chum. But it's still not really acceptable to have some of our salmon dying, a whole species dying. And also think that these are just kind of bellwether indicators, that there are other aquatic organisms that are probably sensitive that may be dying as well.

So then they look at the juvenile salmon. So what if these coho did make it out, those that did and lay their eggs? Well, the juvenile ones die. And they found, after 96 hours of exposure, the juvenile coho died, 100% of them. And these juvenile coho tend to live in the stream systems for about a year before they migrate out. Chum salmon actually only live for six weeks in the stream systems and then tend to swim out.

So they also looked at chinook. And that had a moderate amount of mortality. And they even had some mortality with the control, which does happen.

So then they looked at some other species. On the bottom of your screen, I'm not sure if you can see it well. But at the bottom left, we have some zebrafish. This was them. The next one is a mayfly. So that's an aquatic insect. That actually has an adult stage out of the water. Some water Daphnia that live in the streams, as well as a developing salmon egg on the right.

They found some acute lethality, developmental effects in some of these species, and cardiovascular toxicity. So all of them were affected to some degree or another. So it's not just salmon.

So what is it that causes mortality? Some obvious things are petroleum products and other toxics running off. So there is a chemical pet waste picture and lawn fertilizers. That bottom right is actually a failing septic system, where septic effluent and drain field is associated with a home on-site sewage system isn't soaking in. It's bubbling up at the surface. And of course when it rains a lot, that's going to runoff into the local street and into a waterway eventually.

Heavy metals which can come from brakes. So brake pads on cars have a certain amount of copper in them. So naturally, every time you push on the brakes, those brake pads are wearing down.

There's also galvanized parts on your car and other parts that contribute lead and zinc to the roadway. And even galvanized fences, when it rains, that galvanized material comes off. And it can get, especially if it's along a street, get right into the runoff along a street.

So pesticides and herbicides, polycyclic aromatic hydrocarbons, which come out of exhaust pipes. Actually comes out from wood-burning and from oil-burning and propane-burning furnaces. So all that combustion of hydrocarbons causes these polycyclic aromatic hydrocarbons, which are very toxic to fish and aquatic species.

And also tire compounds, tires are formulated with a number of compounds, heavy metals being part of their formulation, plasticizers. So there is a whole range of things in tires that can be toxic. And actually, Jen McIntyre with WSU is actually doing some research focused just on different tire compounds and their toxicity to salmon.

So now to hopefully some brighter things are some of the solutions that we're looking at and that do work. And the idea is to-- I have a bunch of big words here. But you try to create a hydrologically functional landscape. So it's kind of taking in the water as opposed to letting it all run off. That prevents harm to the streams, so it's not as contaminated. And there's not as much of it. It's not eroding the streams or causing too much sediment to build up in the streams or putting toxins in the streams and lakes and wetlands.

And we go back to utilizing our vegetation, our forest layers to help with that. Because we know trees can really help manage stormwater with their leaf canopy as well as their extensive root systems that allow water to soak into the ground more easily. They make the soils more permeable. And then once water gets in, they soak up the water and transpire it.

And there's a lot going on in that root ecosystem, the rhizosphere, we call it. That's the soils underneath the vegetation is the rhizo-- the living part of the soil. And here, we see those white fibers are mycorrhizal fungi in between those roots. So those brown and gold color things, those are roots or pine seedlings.

And you can see there's tiny micro roots. And there's these mycorrhizal fungus formations, as well as a whole host of other microorganisms living in the soil. So those all can help absorb water as well as take out some of the contaminants and degrade some of the contaminants.

So some of the principles we look at with low impact development is if someone does one develop in an area, which, of course, we all want to have a nice house in the forest, trying to leave as much forest there as possible, enough of the natural soils and the soil structure as possible. So leave as much in place and just only expose the amount around your house as you need to protect from fire and to have a workable yard for your needs. And build up instead of outward. So a second story maybe to accommodate extra bedrooms as opposed to outward.

And so here is just a schematic of different strategies, such as having a pervious deck, which you see in the middle of the slide. Water can filter through the deck and soak into the ground. Or towards the bottom of the slide, there is some rain gardens getting water off the roadway or taking the water from the gutters off of the house and soaking it in the ground in a rain garden.

So here are some other ideas. I'll kind of go through them a little more slowly here. You can just build up the soils with compost. So augmenting your gardens as well as your lawn with extra compost is good for the soils, for the health of the plant, and acts as a sponge to soak up some of that stormwater runoff. And also using good layers of mulch in gardens. And when you do plant out a landscape that has been cleared, try to plant in layers. So we have an upper overstory and understory and a lower layer and some mulch.

And of course, stop contaminates at their source. So use safer alternatives to pesticides, such as beneficial insects on the left. Or on the right, that's a weed ranch. But that just signifies manually removing weeds. This is a way to pull scotch broom out, which is a tenacious weed here in western Washington that people like to get rid of. And this is a good way to pull them out.

Those in areas that might be paved, you may think of free-draining walkways and patios. So on the left, between those big slabs of slate is some gravel, so water can just soak right in where it runs off that slate. And to the right, there's some thyme plants planted in between those rocks. And so that water can soak right in.

And here, these pavers are spaced at about-- you can see the 1/2 inch spaces between the pavers. So water doesn't soak right into the pavers. But those spaces are filled with gravel. And underneath those pavers is a couple of inches of gravel that allows the water to soak right in underneath this parking area. So they're not going to get any runoff from this because it's going to soak into that gravel and slowly into the ground underneath this parking area.

They're also making concretes and asphalts that are pervious. So here, we have some pervious concrete at the bottom butted right up to some just traditional asphalt. And you can see the pervious concrete is soaking up the water. It's not ponding at all. The conventional asphalt is letting water run off.

And here, there is a vegetated roof. And this one's in Portland. On the right, that's actually a rooftop six or seven stories above the ground. And that's actually providing a little bit of habitat for insects and wildlife, as well as some carbon sequestration, as well as managing the water. So water can lay on those leaves and on the blades of grasses there and evaporate or transpire through the roots back up into the atmosphere and never see the pavement below. So thus reducing the amount of runoff as well as those other beneficial things I mentioned.

And there's other strategies to reduce stormwater toxicity. So I'll talk about some of the research into bioretention. So here, I'm not sure if you can see a label down on the bottom. But in these big 55-gallon containers, we fill them with a bioretention soil mixture.

And so bioretention is just a fancy term for soil that's 60% sand and 40% compost. And so those soils are mixed and placed to a depth of about 18 inches in this and then collected at the bottom. And stormwater was filtered through.

And the idea with this mixture is the compost has a lot of biological activity and a lot of ability to soak up and remove contaminants. And the sand is mixed in to allow the water to flow through. Because if it was pure compost, water wouldn't flow through it so well. So the sand allows it to flow through fast enough. The compost takes out the contaminants as it goes through.

And to see, to demonstrate whether or not how well it works, they did the same thing with the coho salmon. There's coho salmon in each of these tubes. The clean well water on the left, there's coho salmon in those tubes.

In the middle one, you can't see the tubes, but they're there. And on the right, that's water that have run through that soil column, kind of depicted in the middle bottom there that we just looked at, and then placed in that tank of water. And that water was circulated for a number of hours.

And then with the well water, here is after four hours. This is looking pretty healthy. And the unfiltered stormwater after four hours, not looking very healthy.

It should be noted that all four of those fish, after four hours, had died. And with well water, after 24 hours, they were all still [AUDIO CUT OUT] And then with the filtered stormwater, you can see here that all four fish were alive at four hours. And this one's looking pretty healthy. And they were all still alive at 24 hours. So it seems like that might be a good solution, filtering water through this bioretention soil mix.

So we do have some other research questions of, how long will those soils last and continue to clean the water? And how big-- how much soils do we need to filter water from how big of a runoff area? So how big do we make the rain gardens or areas that we're using the bioretention soils to clean the water?

So here is kind of an aerial shot of our WSU Puyallup Research facility. And we put in demonstration and research sites with permeable asphalt, as well as mesocosms. So you can see these mesocosms down here. Those are actually like those tanks that had the soils in them, same idea.

They're getting real stormwater runoff coming off of the paved area that they see up here. And then we're seeing how well different soil mixtures of different percentages of sand and compost as well as other things. So we're trying biochar mixed with sand or other like water waste, treatment residuals, other minerals and chemicals that may take out contaminants and seeing how well they work. And then here, this is an older picture.

This is 16 different rain gardens that we set up with different plants, some with bigger plants and smaller plants and different varieties of plants, and some with no plants with just the bioretention soils. They all have the bioretention soils. And we're collecting the water underneath the rain gardens. So these are all these rain gardens. Each one is a different rain garden is lined with plastic. And that water is captured at the very end of the rain garden and analyzed for contaminants.

So that was kind of an overview of some of the ongoing research, also looking at the contaminants that soak in through those asphalt areas of our research station. So seeing how much water soaking in after rainfall and then seeing how much of the contaminants are actually being removed by the gravel underneath the parking area, underneath that permeable asphalt. So on to rain gardens, here's one in a neighborhood in Port Townsend.

And you can see it's getting the runoff from the street and these yards. And in the middle of the street there, I put some of the contaminants that might be flowing in the runoff that would be flowing down that street and off the street and off the lawns. So heavy metals, pet waste, pesticides, fertilizers, all come would come into the rain garden here. It comes in, and hopefully it soaks in, and it gets treated by the soils that are put in the bottom of the rain garden and soaks in the ground.

And if it keeps raining and it's an excessive event, we have an area here where water can flow out of the rain garden. But really, we'll get about six to eight inches of ponding here before it overflows. So that gives it time to soak into the ground. Here, we have a little demonstration sign explaining what that rain garden is and what it does.

So here is a quick little schematic of what rain gardens do. They also provide habitat for insects and birds and pollinators. Those flowers are good sources of honey for local bees as well as other pollination.

And they manage the excess water coming off of rooftops, off a driveway. They filter pollution coming off the driveway, off the roadway through the soils that you can see down on the bottom right. They clean up the water before it soaks into the groundwater.

Here's kind of the basic anatomy of a rain garden. So I'll kind of go through it slowly. We excavate, typically, about two feet deep, take out that native soil. And then we put back in that rain garden mix, which is really that bioretention soil, 60% sand and 40% compost, into here and then a layer of mulch on top. So that's that mix here.

And then so then we're allowing maybe six to eight inches of ponding there. But for water to go anywhere, it's got to rain a lot and then overflow. But anyways, this water will pond. And it will soak into the ground. So this area with the compost and sand acts like a big sponge and cleans up the water before it soaks into the ground.

So here, we have the different zones of a rain garden. So we're looking from a sky view looking down. We have kind of the flat bottom area of the rain garden. We call that zone one. And that's where the water ponds.

It's flat on the bottom. The bottom of a rain garden should be fairly flat. And then there we put our plants that can really tolerate getting very wet and, also, during the dry season, can also tolerate the dryness. But they definitely have to be tolerant to being wet for a week or two at a time.

And then there's zone two, where that's that layer from the bottom of the rain garden up to where it can overflow. So that sees a variety of wetness, depending on how deep the water is in the rain garden. We hope that rain garden is soaking it in pretty quickly. It will hold some water. So those plants have to be tolerant to getting exposed to the water for a period of time. And then zone three are those drier species that are really above getting saturated at all by what's coming into the rain garden. It's kind of a perimeter planting.

So I'm going to talk about some of the resources. We have this rain garden manual for western Washington. And it's available at this website. And so this will be online. So this presentation will be online. So you can go back to this.

Here's a picture of a rain garden before we put the plants in. And you can see that bottom area that's flat that's getting the ponding. And then you can see, on the upper left, that's the overflow area. So it'll pond up to there. Then it'll overflow.

So you can kind of really see zone one is where that water is. Zone two is that waterfall flow area. And then zone three is above that. And that's what it looked like after we got done planting. It's kind of a winter picture, so those plants aren't very big yet. But that's what it looked like after it was done. It's a little different angle. I took the picture from a different spot. The overflow is right towards the bottom left of the screen.

And here's another rain garden in Port Townsend after a rain fall. You see the water ponding there. And when it gets very deep, it'll go into that storm drain. But here, you can see it's holding that amount of rainfall and soaking it in.

So here's some of our resources. We have a whole deal in the upper right. It's about 32 minutes long. That goes through all the steps that's outlined in that rain garden handbook that I mentioned.

And if you really want technical guidance, there is a low impact development manual with the State Department of Ecology. That's all linked off of this website here. So I'm missing that again. So there's that how-to video, the handbook. We have different fact sheets there.

And this other website I listed to is something we collaborated with stewardship partners. That has a whole host of actually other resources. So anyways, those are some great resources for you.

Other resources are different municipalities that are listed here. So that's a rain garden that someone put in their yard shaped like Puget Sound. And so here's the Kitsap Peninsula. And they offer a $1,000 rebate to people who put in rain gardens. And up here on the Olympic Peninsula, the city of Port Angeles offers a $750 rebate. The city of Seattle offers a whopping $5,000 for people to put in rain gardens. So they reimburse people for their expenses.

So each city kind of has its own program. But some cities don't. Like see, Port Townsend doesn't actually have a program. So it depends on the city. And it depends on the county whether or not they offer a program and offer any assistance at all.

So coming up, we realize that this is not a forest. Things are a lot different now than they were. And you can take this to eastern Washington. Things are a lot different. There are more developed areas. All right, well, thanks you all.