

[GRAPHIC] Reclaiming Our Resources, City of Santa Rosa.

[VOICEOVER] The city of Santa Rosa owns and operates the Laguna Subregional Wastewater Reclamation Facility. Located on Llano Road, near Highway 116, it treats wastewater from Santa Rosa, Rohnert Park, Cotati, Sebastopol, Sonoma State University and the South Park Sanitation District. The service area has an estimated population of 220,000 and the plant treats an average dry weather flow of nearly 18 million gallons per day.

[GRAPHIC] A Tour of Santa Rosa's Laguna Treatment Plant.

[DENISE CADMAN, NATURAL RESOURCE SPECIALIST] What does 18 million gallons a day look like, the flow we're receiving right now? And if you can visualize a football field. Everybody kind of has an idea of how large a football field is. Imagine that 50 feet deep in raw sewage and that would be one day's worth coming into the plant.

Here's an aerial of the Laguna Treatment Plant and a couple things I can point out here that we won't be able to see easily from the ground, that across the street, there are these large holding ponds. So, when the water is treated, it initially goes across the street into a storage system and then it can be distributed from there to a series of other holding ponds that you would see as you moved north and south along the Santa Rosa Plain. The other thing I can point out in the aerial photograph is our proximity to the Laguna de Santa Rosa. So, it flows right by the treatment plant and heads north and west along the Santa Rosa Plain. Laguna de Santa Rosa, for those of you who aren't familiar with it, it's a wetland complex 14 miles in length that spans

from Cotati to its confluence with the Russian River in Forestville. And it has many different types of wetlands - open water, fresh water marsh, riparian. In the upland of the Laguna, there are seasonal wetlands such as Vernal Pools and it serves as a flood plain to absorb water during storm events and then slowly release it downstream to the Russian River. So, it plays a critical role in what we do here. And of course, we named this facility after the Laguna de Santa Rosa.

I'd like to spend the time now to discuss what do you do with 18 million gallons of highly treated water, wastewater, every day? Because anything you chose to do with it could have potentially negative impacts on the natural environment. This particular farm is called Brown Farm and it's owned by the city of Santa Rosa, leased out to farmers. So, what we do in the summertime is irrigate the water that's treated here at this facility. And it replaces what would have been ground water being pumped out of wells to irrigate what, on this farm, are hay crops. So, the farmers here are able to get two or three cuttings of hay instead of just the one cutting they would get from winter rainfall. In addition to the city owned farms, we have privately owned farms like this one across the street that are irrigated with reclaimed water as well. So, farmers are able to keep pasture green for their livestock. They're able to grow hay crops. They're able to provide drinking water for their animals and use the water to flush out dairy barns for cleaning. In addition to those agricultural uses, we also have grapes, organic vegetables, aquaculture. And in addition to agricultural irrigation, we have recreational irrigation, so we can go to golf courses and ball parks and soccer fields with the water and again, we can replace what would have been drinking water, wasted essentially, on turf, replace it with the water that's been treated at this facility. Now, the other option that we have is to discharge water. And we can only do that in the wintertime. So, here again, Laguna de Santa Rosa, we discharge at a number of

points along the Laguna or its tributaries. So, out of Brown Pond is Little Windmill Creek and we can release water and it travels and meets the Laguna just out of this photograph and heads to the Russian River and then out to the Pacific Ocean. So, we're allowed by the permit, which is set for us by the regional water quality control board, to discharge as early as October and as late as May. And then we're allowed to discharge up to 5 percent of the volume of the river. So, in other words, we're allowed to discharge when water is moving quickly downstream and there's a large volume of water to dilute the additions that we make with our treated water.

So, these were the only 2 options prior to this year - summer irrigation and winter discharge. But now we have a third means of recycling this water back into the environment. A pipeline was constructed. It leaves this facility. It travels over 40 miles up the Santa Rosa Plain, up this very rugged mountain range, and you can see that they're laying out pipe that'll be put into the ground. And we now, as of January, have been pumping water to the geysers. We send the water from this treatment facility up to the geysers and we will send them anywhere from 8 million a day to 14 million a day. So, more in the wintertime, less in the summer when we're using water for irrigation. They inject that water into the steam field and are able to produce then more electricity.

This lab supports the treatment plant by obviously testing the water in every stage of its treatment process. The first sample is taken in the raw sewage. So, we want to see what's in the raw sewage coming into the plant. And the reason for that is because we're a biological treatment plant here, which means we use living organisms to remove the solids and organic material from the water. And if something toxic were to come in, it could poison our work force.

This particular room that we're in is called the bacti room for bacteria or the micro

room and we look for microorganisms in here. In addition to checking the water that is coming through the treatment plant, this lab also services the city of Santa Rosa for its drinking water. So, random samples are taken every day to make sure there's not bacteria in our drinking water sources.

The other thing I want to show you in this room is a little snippet of video to look at the work force, the microorganisms, who are found at the treatment plant. They fall into one of two categories. They either make food, which is what plants and algae do; that's called autotrophic. Or they consume food like we do and that's heterotrophic. Well, we want heterotrophs here. We want organisms that break down food, that eat food, not make it. Just know that bacteria are our number one organism here. They help us to break down and then clean up both the water and the solids that come into this facility, but in addition, we have a whole spectrum of organisms that are the same ones you'd find in any fresh water creek or stream or marsh anywhere in Sonoma County. Okay, so we've done what nature does. We've just concentrated it to speed up the process. What we'll do now is just walk across the lab and you can look as you go across.

The lab is set up in long benches. Each bench is going to be testing for different constituents. So, the first bench that we'll pass with those fume hoods is for identifying metals. We have benches for nutrients. So, looking for phosphates and nitrogen molecules. We have a little room on the side, which is for organics.

Okay, so what you see here is a tank. It has rainbow trout in it. And the reason rainbow trout are at this facility is because we use them for a water quality test. They're what we call a bio assay which means test the quality of the water on a living organism. Rainbow trout, as you probably know, are highly sensitive to pollution. So, they're a good indicator as to whether or not the water that we've treated here is clean

enough to go into the creek.

The building we just passed here, houses our mill rights for fabrication of parts, our electricians and our instrument techs. So, they fix things that break and keep this plant running.

Up ahead looms the primary building where the sewer comes in. Okay, so the sewer is on a slight decline to come to this point. It mostly gravity feeds down to us at this location. It comes in about 3 stories underground. So, the first thing that we need to do is pump the raw sewage up into the primary tanks. On the way in, it goes through a bar screen to screen out the largest objects that might have somehow gotten in the sewer; things like paper towels and latex gloves. And then we want the really heavy stuff to settle out. So, sand and grit that gets into the system as well as things that people put down their garbage disposals, that's removed when the water moves through what's called the grit free air tanks where the water is rolled with air. It helps the heaviest things settle out quickly. And that grit is removed and that goes to landfill.

It's too large for us to treat here. From there, water is piped into the primary holding tanks and the solids start to settle out. As the solids settle to the bottom, they are removed by a conveyer belt that scrapes along the bottom, pushes the solids into a pipe. Floating solids are also removed by sprayers that push them down to one end where they can be skimmed off the surface. So, the solids are removed from the water. They pass through the gravity belt thickeners on the way just to remove even more water, because water adds a lot of weight and volume, increases the time it takes to treat the solids.

And then the solids end up in these big round buildings. These round buildings are called anaerobic digesters. Anaerobic means without oxygen. So, the organisms, all bacteria, that live in these tanks don't require oxygen as part of their metabolic

pathway. Well, methane is generated when anaerobic organisms exhale. You find it at wastewater treatment plants and landfills and livestock feed lots. So, we capture that methane gas and we use it to power our generators and that provides one-third of the energy used by the plant. In addition to that, these cogenerators, as they're called, produce a lot of heat. And we use that heat to heat up the anaerobic digesters. Those organisms are like the ones that live in our gut. They like it nice and warm. So, we can use the heat from the generators to heat the anaerobic digesters and other buildings. So, we've closed our loop. When you take a product, an industry, and you reuse it in that industry, that's called cogeneration. So, we have cogeneration of methane gas. And that's really significant because we use a lot of energy at this treatment plant. I wouldn't want you leaving with the impression that hey, you can use as much water as you want to, flush your toilet 20 times a day because we can get the water nice and clean here, but remember it comes at a cost and that cost is a tremendous amount of burning of fossil fuels, which we know has detrimental impacts to the environment. So, if you look at our monthly PG&E bill, it's over \$100,000 dollars a month. Remember that's with 30 percent recapture from methane gas; that gives you an indication of just how much energy this process requires. And the reason is because water is heavy. It weighs 8 pounds per gallon. We're pumping around 18 million gallons a day right now and the energy costs of course, go up any time you have to lift water.

We let the solids remain in the anaerobic digesters up to 30 days. And the bacteria are just going crazy in there taking those solids and breaking them down, just like we digest food in our stomachs to obtain energy and nutrients. And what we'll do is leave the solids sitting in the anaerobic digesters and I'll keep you in suspense as to what happens to them until the end of the tour. So, from here on out, we'll just be following

the water through the treatment process, which again is over 99 percent of what we do here by volume. And at the end of the tour, we'll find out the fate of the solids.

[They tour group follows the water through primary.]

So, we've come out of primary. We've all survived. And we've left the majority of solids behind. Between primary and these secondary aeration basins, we can temporarily divert the water. If you look over here, those are called the flow equalization basins. And if we are receiving more water, like say during the peak flow of each day or a big storm, than we can immediately treat, we can divert that water and then just feed it gradually back into the system. Because the system works best when we get a steady flow of water through it.

Once the water enters these tanks, again called aeration basins, this is where that whole collection of microorganisms reside. We're providing them with everything they need to be happy - food, water and oxygen. You'll see, as we pass by an empty tank, that these tanks are quite deep. And along the bottom are pipes and periodically along the pipes you'll see these disks. Well, those are like air stones in an aquarium.

So, the building at the end of this tank houses two big blowers that are creating the oxygen in these tanks and that again comes out in energy costs to us, it's expensive, and that also indicates our dependence on energy.

I'll point out from here we've got the building up ahead, that houses our emergency diesel generators so that if we ever did have a power outage here for any length of time, we could continue on. We run 7 days a week, 24 hours a day. People never stop flushing their toilets or sending us water.

It turns out we've got the whole nitrogen cycle happening right here at the treatment

plant. You might have noticed there was a bit of an odor in primary. Well, as waste travels to us in the sewers, bacteria are already at work breaking down those nutrients. And one of the things that they produce as a byproduct is ammonia. Ammonia is really smelly. It's also toxic. So, when the water enters these tanks, it's high in ammonia, but not for long. Because then we have another group of bacteria, which are called nitrifying bacteria, that are going to convert the ammonia to nitrite and then to nitrate. So, we'll end up with our nitrogen in the form of nitrate, which is  $\text{NO}_3$ . Nitrate is non-toxic. It's a plant friendly form of nitrogen. Problem is, even too much of a good thing can be bad. And if we were to release water, say in the wintertime, into the Laguna and have our water high in nitrate, that could stimulate the growth of algae. And then when that algae itself dies, the bacteria that decompose it, they're aerobic like us, which means they'll be removing oxygen from the system. So, you can get a crash in your system. Low oxygen can lead to the death of fish and other aquatic organisms. So, to further reduce the nitrate level, we use the quiet zone at the end of this tank. That's called the anoxic zone. And what we do is deprive microorganisms of oxygen so that they become so desperate for it they'll rip it right off the  $\text{NO}_3$  molecule. That's called denitrification where we had  $\text{N}_2$  gas now evolving to the atmosphere and we've reduced our levels of nitrate. So, the whole nitrogen cycle happening right here at the treatment plant.

These tanks are set up in 3s so the water serpentine through a series of 3 tanks. This is the longest portion of the treatment process, probably taking on average 6 or maybe a little more hours in time. Now, you might say, this water doesn't look too clean. Well, the reason for that is because it is just dirty, just filthy with microorganisms. So, the microorganisms, once they've done their job, need to be removed from this water. So, secondary is really 2 parts. One, add the water to tanks

with microorganisms, let them do their job. And then the second part of secondary is remove the microorganisms. And we do that in tanks called clarifiers. So, we'll walk there now.

[The tour walks to the clarifiers.]

Now we need to remove the microorganisms. We do that in tanks called clarifiers. And it's a little easier to describe how clarifiers work when we look at an empty tank. So, if you look at the inner most ring of this tank and we'll walk across one that's working in a moment, that's where the water from the aeration basins comes in. You'll see it's very brown in color, but that if you look, you'll see that that brown color is actually kind of cloudy. So, that there's clear water in between these clouds of brown, which are the microorganisms. That water comes through the trap doors at the inner most ring, hits the second ring. The second ring, you'll observe, is a skirt. It doesn't go all the way down to the bottom. So, that encourages settling of the microorganisms. To further increase that settling, we add a coagulant that makes the microorganisms stick together in little groups that encourage them to settle. Once they're at the bottom, we have the boom arm with these hoses mounted on it. They siphon the microorganisms off the bottom and return them back to the secondary tanks. Okay, so microorganisms, like the ones that are here in abundance, are all primarily unicellular. They reproduce by dividing in two. And they do that every 12 to 18 hours. So, they're always restocking our supply of microorganisms. They're a self-sustaining population. And by the time we remove them from the clarifying, they've reproduced and they're hungry and ready to go again. So, back to the aeration basins we send them. The water just slips down under that skirt and rises to the surface.

But see the water at the surface on the outer most part of the tank is pretty clear. And it flows into those V notches of this weir and that's water that's now finished with its secondary treatment and is ready to go to the filters. I'll just add one more thing, the volume of this tank, which is 1.4 million gallons. So again, that'll help you to visualize if we're talking about 20 million gallons, let's say, that would be about 14 tanks of raw sewage on a daily basis coming into this treatment facility. Now, obviously, we never store water here. We're moving it through our system always. So, what comes in every day, the same amount has to go out.

[The tour walks some more.]

We've finished with secondary and now we're ready to go to the filters. These 4 green pumps behind me are going to lift the water up to the top of the filter building. And I'll describe to you now what you'll see up there because it's very noisy up there. There's a lot of water rushing. So, it would be difficult for me to describe what you'll see which is actually not much; a series of tanks, where water is going to be diverted into each of these tanks. And then it'll enter the tank through one of several weirs and then it's just allowed to trickle out of the weirs. And that's about all you'll see. Below the surface of the water is where the action is, that's where we have a bed of anthracite coal. It's about 4, 4-1/2 feet deep, just small black granular coal that provides lots of little nooks and crannies to trap fine suspended solids and parasites in the water column. What you'll observe when you get up there is that tanks have varying levels of water in them. Some of them, the water level is low, the water is trickling out of the weirs. Other tanks, the water is backing up towards the top of the weirs, sometimes even over the weirs. What's happening there is we've got a filter that's now plugged with all these

fine suspended solids. That will initiate a back flush that'll blow air back through that bed and loosen it all up, remove that water. It'll re-enter the treatment process at the beginning and it will, the filter will resume working, will trickle water down through it again.

[The tour walks some more.]

Let's talk about what we've achieved so far in the process. In primary, we removed the majority of solids. In secondary, we removed more solids, nutrients and metals. In tertiary, we removed fine suspended solids and parasites from the water. Now what's left is to remove the rest of the microorganisms. So, this is kind of tricky because up until this point in the treatment process, the microorganisms have been our best friends and helpers. They've done the job of digesting the solids and reducing waste in the water. And so, most microorganisms fill those kind of ecological roles for us. They're busy decomposing and recycling nutrients. But we know that some microorganisms can make us sick. So, because people will come in contact with this water, we need to remove all microorganisms, both good and bad, to make sure that those potential pathogens are not present in the water. What we used to use, prior to 1998, was chlorine. So, these are the old chlorine contact tanks. We would bring the water in, bring them in contact with chlorine gas, and that would disinfect the water. Now, if we were discharging during the winter, we'd have to treat with a second chemical, sulphur dioxide, but even so, we'd often find tiny trace amounts of residual chlorine that could kill aquatic organisms. So, we switched from chlorine to an ultraviolet system. And we'll go take a look at that now.

This is our ultraviolet light system. We use it for disinfection and we've moved away

from then a chemical approach using chlorine, just like this plant in general has moved away from using chemicals. Very few are used now. And again, we mimic what happens in the natural world, condensed and speeded up the process here at the treatment plant. So, water will pass through these banks and what they've done is raised up just one of these metal casings with the high-energy UV light bulbs. So, as water moves through, it has to pass in between layers of these light bulbs. That means it has to come in very close proximity to high-energy ultraviolet light. Now, ultraviolet light is part of the natural light spectrum that's coming from the sun. It's a very high-energy, short wavelength light that can damage cells. So, what it does to bacteria is, it scrambles the DNA and RNA of bacteria and viruses so that they are no longer able to divide in two to reproduce. Now, we're using a very high intensity. The bacteria have to come in very close proximity. And to get the reduction in bacteria that we require here at the plant, we couldn't do it without going through our tertiary filtration system. So, we need crystal clear water so that a bacterium can't hide behind a little piece of suspended solid in the water column and avoid getting their full dose of ultraviolet light. Okay, so no protection for the bacteria. Water passes through. They get a full dose of ultraviolet light- scrambles the DNA so that they are no longer able to divide and reproduce. That effectively kills them. Now, that we've finished with our 3 steps plus the disinfection, let's take a look and see what the final product looks like.

Okay, so here is water that's been through the full treatment process plus disinfection. This is water that then could have been in your toilet less than 24 hours ago. The average time of the process is about 16 hours. And there's some time in the sewer for the water to get to us. Now we have water that is passing under our feet and we've just diverted a little bit of it here at the fountain so you can take a look at it,

on the way to those big holding ponds across the street.

All the water that's here today is all the water that's ever been here. It's all the water that ever will be here. And it just keeps getting reused again and again. Water conservation is always important. And thinking about the chemicals you use in your day-to-day lives is as well. And the water agency, which is the county agency that brings our water, they harvest it from an aquifer under the Russian River, they tell us that each one of us uses 80 gallons of water per day in our household alone. Okay, that doesn't even include water for outdoor irrigation. That's just primarily flushing the toilet followed by bathing. So, 80 gallons a day is a lot of water for each of us to use. So, cutting back again and rethinking the type of chemicals you use is essential. That makes you part of the solution instead of part of problem.

I've kept you in suspense all this time about the fate of the solids. What happened to the solids? We left them behind in the anaerobic digesters. They've been there for 25 or 30 days. So, let's find out now the fate of the solids. Okay, so we left the solids behind in the anaerobic digesters, anaerobic bacteria are going to be digesting those solids. It turns out those solids really aren't all that solid. There's still a lot of liquid in them. So, they come to this building, the belt press building, and they go through a series of belts that remove water — water is going to add volume. We're going to remove the water. We're going to send that back to primary. And then we have to do something with the solids. They've further diversified their approach to include a compost facility, which has been built across the street. At the compost facility, we use the curbside green waste recycling program as well as tree trimming companies and sawdust from saw mills. We layer that in long beds with our nitrogen source, which is human manure, the bio solids from this facility. Now, these beds are controlled for temperature and for moisture and they are mechanically agitated. So,

we use again microorganisms to break down organic matter and we have a compost that is used as a soil amendment, primarily by landscapers, although...

[VOICEOVER] The city of Santa Rosa is committed to integrating water reclamation and conservation into future supply and demand solutions, for both the water system and the wastewater treatment and reuse system. The Laguna Wastewater Reclamation Facility is one vital part in that process, treating wastewater to the high standards required to maximize reuse opportunities throughout the region.

[GRAPHIC]

City of Santa Rosa. City of Santa Rosa. 2004.

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[END OF VIDEOTAPE.]