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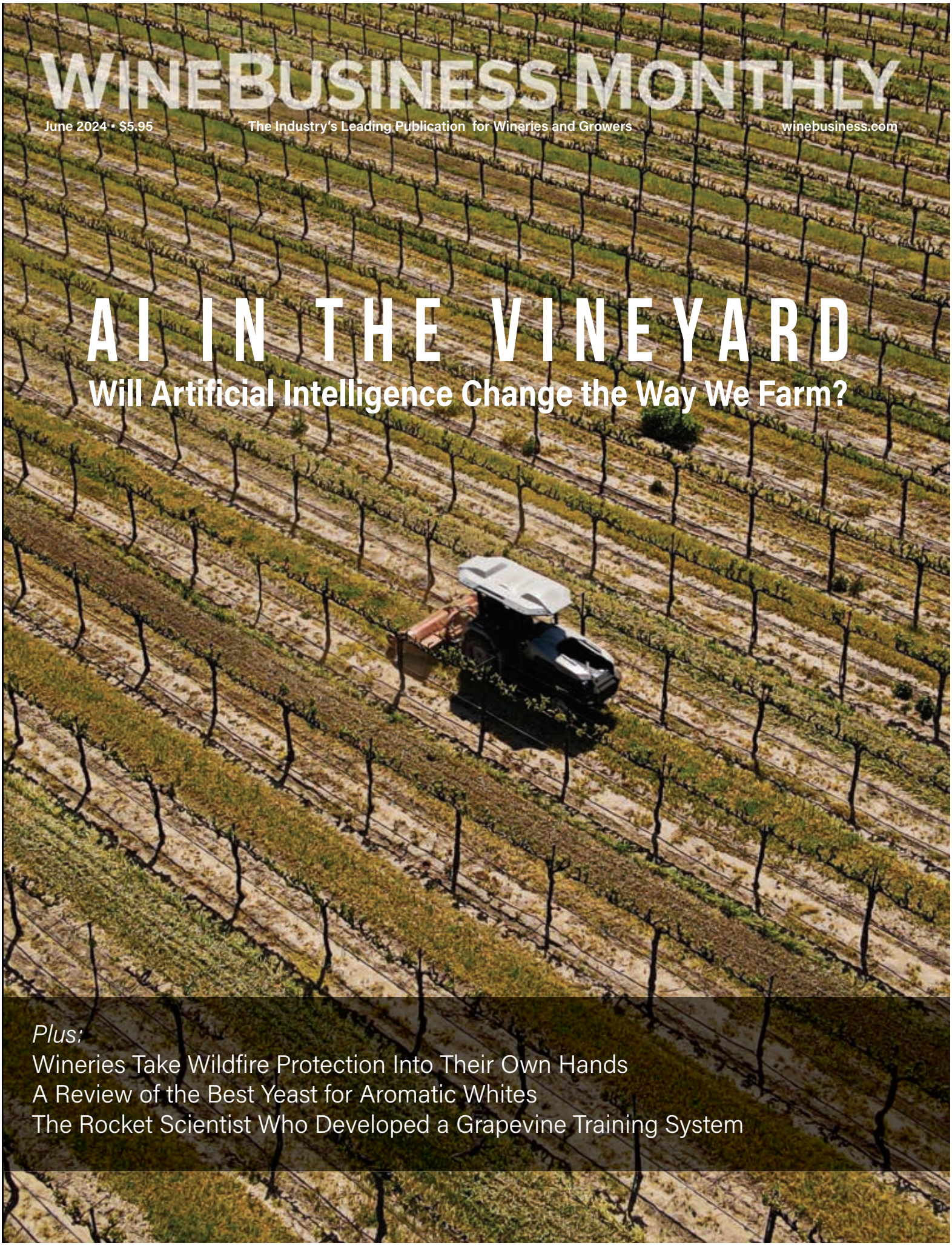

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TRIALS & TROUBLESHOOTS

Sutter Home Winery Levels Up Wastewater Use with Reverse Osmosis Technology

Looks to Exceed Regulatory Compliance and Reduce Dependence on Groundwater

Bryan Avila

Meet the Author: **Bryan Avila** is a formally-trained enologist, seasoned commercial winemaker, ACUE-credentialed educator and co-founder of the Vintners Institute. The Vintners Institute is a grassroots, next-gen effort to bring wine industry producers and allies together, on-line and in-person, to innovate with nature, educate the workforce and inspire good leaders. A freelance writer for *WineBusiness Monthly*'s Winemaker Trials, Bryan would love to hear what you are doing in your vineyard and winery to overcome challenges, grow better grapes and make better wine. Contact: *bryan@vintnersinstitute.com*

Trial Lead: Dave Sneed, utilities manager, Trinchero Family Estates Winery

Dave Sneed graduated from Napa High School and worked for five years at Napa Electric before he enlisted in the United States Navy Submarine Force to operate and maintain advanced sonar systems. After serving eight years in the Navy, he spent five years with Nestle Corp. at Calistoga Mineral Water as their facility electrician and maintenance manager. Later, Sneed was hired by Sutter Home as an electrician and moved into maintenance management where he became involved in process waste and drinking water. Twenty-six years later, he manages the utilities department for all of Trinchero Family Estate wineries within the Napa Valley.

BACKGROUND:

To head off desperate water conditions[1], the California State Water Board introduced new wastewater discharge requirements for wineries in 2021. The goal was to protect groundwater from contamination by wastewater discharged to land. These new laws significantly affect how wineries manage their process water. The regulation, known as the General Waste Discharge Requirements (WDR) for Winery Process Water (aka Winery Order[2]), was adopted on Jan. 20, 2021. Affecting more than 2,000 wineries in California, the winery order introduced a tiered system based on the volume of process water they produce. Each tier provides specific discharge specifications and protocols for monitoring and reporting. Larger facilities face stricter regulations, ensuring that the environmental impact is mitigated as production scales. The Winery Order targets aspects of waste process water that could negatively affect groundwater, such as nitrogen, biochemical oxygen demand (BOD) and salinity. This regulation has raised concerns among winery owners about a significant cost of compliance for larger operations. These facilities were required to submit a Notice of Intent (NOI) by Jan. 20, 2024, and achieve compliance within five years. Despite these challenges, the winery order is seen as a crucial step towards safeguarding California's water resources amid the wine industry's growth.

FIGURE 1 Sutter Home Winery ran trials at its wastewater treatment facility. The green star shows Recovered Water Solutions' trial space.

The Trinchero Family's Sutter Home Winery is a Tier 4 facility. The Trinchero Family, winners of the California Sustainable Winegrowing Alliance's Green Medal for leadership in sustainability in 2021, is leading the way in efficiency once again.

California is expected to pass a Direct Potable Reuse (DPR)[3] bill which details standards for recycled water to be blended into public drinking water systems. This is part of legislative mandates meant to develop uniform water recycling criteria for DPR, ensuring public health protection. To achieve this level of purity, filtration technology plays an important role.

Reverse osmosis filtration has been an exceptionally versatile processing technology in the wine industry. Adopted from the water treatment industry for use in wine, this equipment has been a vital tool in the winemaker's toolbox for decades.

Sutter Home Winery Levels Up Wastewater Use with Reverse Osmosis Technology

Stage	Unit Process	Function
1	Waste Water Ponds and bioreactor system upgraded to an MBR System by adding an ultrafilter	Removal of BOD and insoluble solids
2	Water Softener (Ion Exchange = IX)	Reduces RO fouling for improved water recovery
3	Low Efficiency RO	High flow filtration step
4	High Efficiency RO (HERO)	The pH of the brine is raised above 9.5 to keep silica in solution and prevent it from precipitating on the membrane

Reverse Osmosis (RO) water filtration systems permeate water with purity so high that even minerals in the water are retained by the membrane. While it is easy enough to produce clean water via RO, the retentate contains salts and impurities that will need to be trucked off-site to either a large municipal wastewater plant, like East Bay Municipal Utility District (EBMUD), or to an up-cycler that can use these concentrated salts (aka brine) for their products. In this scenario at Sutter Home, the higher the wastewater recovery percentage permeated through the RO membranes, the less water pumped from the aquifer and less trucks required to ship away the brine.

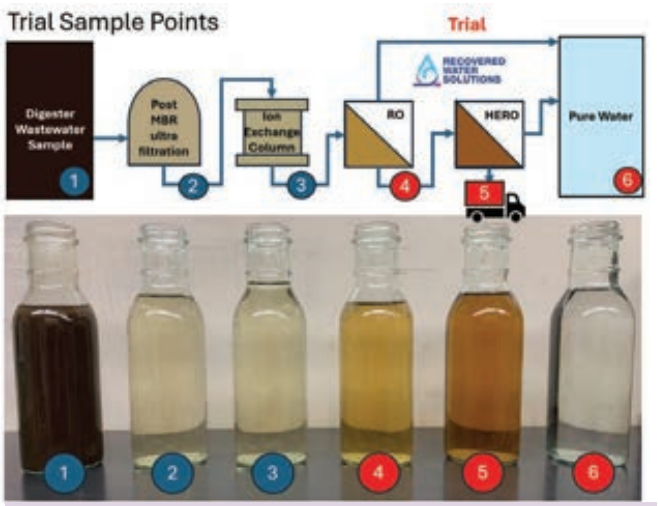

FIGURE 2 Block flow diagram of basic process with actual samples, which were labeled by number according to when each was taken in the process.

TRIAL OBJECTIVE:

Trinchero's Sutter Home Winery ran trials with Recovered Water Solutions to exceed regulatory compliance and reduce dependence on groundwater.

TRIAL DESCRIPTION:

The engineering team at the Sutter Home Winery wastewater treatment facility in St. Helena is evaluating the feasibility of a financially sustainable

upgrade to their wastewater processing system. This new system is said to recycle water while complying with new wastewater discharge standards. This trial added two types of RO systems provided by Recovered Water Solutions (RWS), a Winesecrets company, to an existing wastewater treatment system, which also included a Membrane Bioreactor System (MBR) with ion exchange for removing metal salts.

The first reverse osmosis membrane permeates pure water from a weak brine solution while its retentate is further concentrated by high efficiency reverse osmosis (HERO). The final HERO filtration captures more water from the concentrated brine before it is hauled off as waste or sold as an upcycled raw material for industrial use. This new system would allow reuse of a significant portion of that water for industrial use at a purity level that will enable readiness for Direct Potable Reuse—which will significantly decrease continuous demand for domestic water.

Reuse of the water in the Sutter Home system presents a significant shift in the way that the winery currently operates. Purifying wastewater into ultra-pure water has a myriad of upsides, but at the end of the day, the ionic solutes that will be filtered out will have to go somewhere else. This bench trial set out to check feasibility in two major areas: First, to confirm whether the goal of 97% treatment efficiency was possible, and second, to identify and characterize in the laboratory, the types of challenges that would arise. This will aid the decision whether to take the next step up in scale.

EXPERIMENTAL MILESTONES

- Process Demonstration Phase 2023
- Proof of Concept 2024
- Initial implementation 2025
- Process implementation 2026

CONCLUSIONS:

Once the DPR regulation passes, every gallon of water processed into potable-grade water will save one gallon of water pumped from the well through reuse, minus evaporation. One of the important factors in achieving a high rate of recovery is to send the trucks out with as little water as possible to make the economics feasible from a business standpoint. At 20-million cases per year, the difference between 92% and 97% water recovery is a lot more truckloads to ship the same dry weight quantity of salt off-site. In other words, performance of the RO technology is one link in the wastewater treatment chain of processes that impacts overall performance and viability of the program. The following flow diagram in **FIGURE 2** highlights the basic process being tested.

The Sutter Home/RWS Wastewater treatment trial samples are described as follows:

1. Raw process waste
2. Bioreactor (MBR) permeate, filtered at 0.4 micron
3. Ion exchanged to remove salts
4. First pass RO filtration on low brine concentration
5. Second pass HERO filtration on high brine concentration
6. Water purified to direct potable reuse standards

Feasibility trials seek to determine the ability to do something that has not been done before, and this trial is no different. These trials tend to be a blend of science and expert-level troubleshooting to get things to work for the site. While this is not the first time an RO-based wastewater treatment system has been put together, it is the first time that it has been done at this place of business, this location, at this scale and with this wastewater chemical matrix.

This type of process trial eventually comes down to plugging everything in, running the system, measuring the outputs and troubleshooting the system until a desired performance is achieved or not. Once the system has reached

FIGURE 3 Eric Dahlberg (left), Rich Martin (left center), Dave Sneed (right center), Aaron McDaniel (right) in the RO/HERO trial area.

peak performance, operations protocols will be drafted. These protocols note critical process control points and serve as a framework to scale to the next level by further refining and validating these protocols for proper functionality.

These initial trial goals only set out to achieve specific water recovery efficiencies, which entail pushing a lot of dirty water through a molecular sieve. This means sending the wastewater of a dynamic matrix through a tight sieve and learning how to mitigate the impact of fouling through engineering and chemistry.

While this trial did not achieve a sustainable rate of 97% degree of efficiency at the bench, achieving 92% was significant. It proved that this level was possible with more study. Eric Dahlberg, president of Winesecrets and RWS, a veteran provider of tangential flow filtration solutions for both wine and water, said, "This level of recovery represents a noteworthy advance over conventional RO, where recoveries of 50-70% are common."

Trinchero technical staff agreed that this level of recovery is feasible. More work into investigating methods to reduce fouling in this trial will be continued for the next scale of testing.

Post-Mort Q&A

What was the motivation to study additional wastewater treatment technology? How did you decide on RO and HERO technology, as a solution, to treat your wastewater?

Sneed: Being able to reuse our wastewater and treat our process waste is a big deal. If new Direct Potable Reuse laws pass, this opens a whole array of other ways to save water. This incoming regulation aims at creating uniform standards for recycled water usage, which allow wastewater to be used at the domestic level. This State Water Board law has been 10 years in the making. These standards will make it much easier for regional municipalities to follow suit. While this is just the regulatory compliance response, it's just the tip of the iceberg of the benefits of water reuse:

- Using less water means pumping less fresh water out of the ground.
- Brine-free RO water leaves less scale on cooling towers.
- Easier compliance with the Groundwater Sustainability Act by protecting aquifers from being sucked dry.
- Compliance and improvement for our sustainability certifications.
- Our wine customers appreciate that we are doing our part for the environment.
- Taking care of the environment is important to the Trinchero family.

Which facilities will test this technology? Where will it go after treatment?

Sneed: We are trialing this technology at our Sutter Home Winery here in St. Helena. We hope to use this technology at the production scale once we work out all the kinks.

How did you evaluate the treatment processing technology? What parameters/data did you measure?

Sneed: Ninety-seven percent recovery was our goal. To build a sustainable process, it has to pencil out financially sustainable first. Otherwise, the system could be doomed from the start, and we want to avoid a situation like that. We first looked at the potential ROI before we moved forward. After all, if you don't think that there will be a return on investment, why take the first step? If we can return 97% of our wastewater back into the system, we will save money doing this. When you have a company like RWS that specializes in water recovery, we can run trials to determine if it is feasible. Once we know that it's doable, we can work on treatment and operational milestones by tackling the little things, like flux and membrane fouling, that get us closer to our recovery target.

Who else worked with you on this trial?

Sneed: Given the coming regulations, we were evaluating our potential costs of water treatment. That's when we engaged Eric's team at Winesecrets, and Eric Dahlberg's RWS group came to us with some suggestions. He sent us some general ideas at us for bench- and pilot-scale testing, and we liked his approach. I've had the pleasure of working with Eric Dahlberg when I was at a previous company, so we had already built a working relationship, and it was easy to get started. We bring some things to the table in terms of how we currently process our wastewater. We already have a 200,000-gallon-per-day activated sludge system which already breaks down the big solids and BOD. Most importantly, though, the family has bought in to sustainability. Mario Trinchero is a big supporter of the wastewater initiative. This is important because the family is spending money on R&D because it's good for the company, our environment, our community, and our customers. The family walks the talk.

What were you hoping to achieve with this first trial?

Sneed: We process our wastewater like a municipality to meet the standards for wastewater. Treating our pond water (PW) is something we have dialed in, but this is for a process that discharges the water versus reusing it. Now, this trial aims to find a method that reuses this water. The target was 97% recovery, and we achieved that...but not sustainably. On average, we achieved 92%, but it did not start out that way. Looking to find the pinch point of why we couldn't get there, little by little, we were able to make some adjustments which got us closer to ending phase one. We proved that 97% was attainable in the bench phase; now we are hoping that we can fix some of the fouling issues to make that number more repeatable. Once you get to such a high concentration of brine, it takes a bit of tinkering with the process and chemistry to prevent them from precipitating and building up on the membrane.

Did you encounter any difficulties during the trial? If so, how did you address these complications?

Sneed: One of the first things that happened to us early on was that we had a bio-sliming of the prefilters going in. (We) found the cause and eliminated it with no issues. Later, we had some precipitation issues that were overcome by injection of anti-scalants. Certain constituents in the salt can raise the pH to

keep that precipitate from falling out. We can make acid/base adjustments to keep the salts from falling out as a precipitate.

What was the most important outcome of the trial that winemakers can use?

Sneed: It takes so much water for uses, such as cooling and sanitation, to make quality wine. Reusing water will help us minimize the amount of water used per gallon of wine produced. We set a target for 97% RO efficiency of recovery, and it showed us that we could reach that level, and it gave us insights into how and why it would slow to about 92% over time to date. We have a pretty good idea how we will achieve the profitable level of 97%, making the same type of adjustments as we did at the bench but now in a more useful phase II, pilot scale. The higher the RO efficiency, the more concentrated the salts are, so the more important it is to address the scaling potential. Even with the problems we had, this technology was 100% successful because we feel very strong with the progress that we have made to date.

Were the results as you predicted or did anything unexpected occur?

Sneed: We did achieve 97%, but we learned that it was not sustainable. We may be able to run for four hours, but efficiency declines, and (the machine) has to be cleaned. That's not going to work in a large system where you are constantly having to break down and clean the machine or adding to the carbon footprint and expense and operations burden of having to haul a more diluted brine using more trucks. We are confident that we can flesh out these systems at the next scale up.

What were your impressions of the resulting water quality?

Sneed: I'd drink it. RO water filtration technology is the same type that is used in homes and offices for drinking water. That's why an investment in this type of system lends itself to direct potable reuse which adds lots of value to the recovered water way beyond the cooling tower.

Do you plan to conduct any follow-up trials? What will you be looking into next?

Sneed: We spent phase 1 tuning this instrument. Phase 2 is focused around running it continuously. It's more about operations efficiency. Bench top is currently just under 5 gallons per minute. During phase 2, we plan to achieve 97% treatment efficiency sustainably throughout the duration of the run, and phase 2 will be operating at the equivalent of about 5,000 gallons per day. The opportunity to work at a large scale brings us closer to understanding what and if there will be new hurdles due to scale alone. Once phase 2 is complete, hopefully, we will be able to build a phase 3 system by building on our learnings from phase 2. **WBM**

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