

## Relief for a Parched World

As unprecedented drought torments the American West, Maurice Hall and his team are using science and forging partnerships to create a whole new approach to water management — one that can revitalize rivers and aquifers and share water more equitably.

*By Tom Clynes*



Maurice Hall, EDF Vice President for Climate Resilient Water Systems

The U.S. West is experiencing its most severe drought in 1,200 years, with millions of people lacking a reliable source of drinking water and once-verdant farm fields turning to dust. Without major water savings, dwindling reservoir levels could compromise water delivery on the Colorado River by the end of this year. Under that scenario, the river could cease to flow through Grand Canyon National Park, a catastrophe for ecosystems and the tens of millions of people downstream who rely on the river.

For Maurice Hall, who oversees EDF's work to manage water more sustainably, decades of experience with water issues in the West have given him a deep understanding of what has led to this dire situation — as well as a conviction that the current crisis offers unprecedented opportunities to create long-term solutions.

Hall makes the case that it's possible to revitalize rivers and aquifers, and their ability to provide a resilient water supply, using a combination of robust science and collaborative management approaches. Under his direction, EDF's Resilient Water Systems team is working with farmers, corporations, irrigation districts, communities, policymakers and peer environmental organizations, bringing once-dueling

stakeholders together to make the tough decisions needed to redesign water systems so that they work for everyone.

Recently, Hall took time out to talk about how a more holistic and inclusive approach to water management can benefit the entire country — and how exciting new tools, developed by EDF and partners, are helping farmers and water managers to save and use water more effectively.

### **Nothing is as essential to life as water, which is what you've spent most of your professional life thinking about. How did you get interested in water systems as a career?**

The most memorable parts of my youth were on the water, fishing and canoeing on the rivers of East Tennessee. When I moved to New Jersey for my first job, as a chemical engineer, I was shocked by what all that urbanization was doing to the water. That's when I started thinking about working in water. I moved to Colorado for my doctorate, and very quickly fell in love with the West and its open landscapes.

I spent a lot of time in northeastern Colorado trudging through fields, measuring the moisture content of corn and nutrients in the soil. It was there, and during my later work as a water engineer and consultant, that I started to realize how many decisions about water are made in isolation, without a consideration for how they link together. And that's really the driving theme of how I think about water systems, this question of how to create the right decision-making structures to manage water holistically.

**“ EDF's scientific and policy expertise, along with its ability to bring diverse parties together to find common ground and agreement, is helping us prepare for a drier future by reimagining how we use and share water in the West.**

**— Karen Ross, Secretary, California Department of Food and Agriculture**



Lake Mead is at its lowest water levels since the 1930s, threatening water supplies to millions of people living on tribal lands and farms, and in major cities.

### **Anyone who's followed the news lately knows that water is incredibly scarce right now in the American West. How did we get into this situation?**

It began with the idea that we have all this land in the West. One obvious way to use it was to farm it, and in most places in the West, that required irrigation. People were encouraged to divert water to convert prairies and deserts into verdant fields. Under the prior appropriation system that developed, if you got to the water first and put it to good use, you got the right to use it in perpetuity. People built dams and channels and drilled lots of wells to pump it up from groundwater basins. No one considered whether it was sustainable in the long term.

Now, agriculture is by far the biggest consumer of water in western states, and at the same time, water use in our cities has grown dramatically. In California, for instance, irrigated agriculture uses 80 percent of the managed water supply. Our climate and our society have changed, but in many places our water allocation system continues to encourage the overuse of the past to continue. As a result, our reservoirs and wells are running dry.

### **And yet, farmers have greatly improved irrigation efficiency in recent years. Hasn't that helped?**

We've invested hundreds of millions of dollars in drip irrigation infrastructure with the single-minded view that more efficient irrigation is good. Farmers have certainly

made great strides, but improved irrigation efficiency has had some unintended consequences.

While flood irrigation may seem wasteful, much of the water that crops don't soak up filters into the ground and recharges the aquifers. Flood irrigation also benefits wildlife, particularly migrating birds. With the transition to drip irrigation, which very efficiently waters high-value crops, very little water reaches the aquifers. As farmers got more efficient, they saw that they could grow more crops with only a fraction of their water right. So, the most obvious thing was to use that leftover water to expand the irrigated acreage and grow more crops — which increases the total water use. Field by field and farm by farm, that pattern has extended. The end result is that we are now using even more water to grow crops, and with improved irrigation systems, much of that water goes to grow crops like walnuts and almonds that can't skip water for a year. As a consequence, we're seeing groundwater levels dropping dramatically.



OpenET gives Nevada farmer Denise Moyle accurate information that she uses to better manage her water use.

## For those of us who live outside the West, why should we worry about this situation?

To some degree, we are all in this together. Last year, 22 percent of the nation's crop acres were in a severe drought. In the Midwest, the problem was the opposite, with farms soaked all spring and planting season weeks behind. These climate-driven water issues reduce farm-related income and increase food prices, rippling through the whole economy.



EDF's Vanessa Puig-Williams meets with Charlie Flatten of the Hays Trinity Groundwater Conservation District at Jacob's Well in the Texas Hill Country.

We've historically considered the hundredth meridian, which roughly divides the humid eastern United States and the arid western plains, as the border between where you can farm with just rainwater and where you need to supplement with irrigation. Well, that line is marching east. Even the giant aquifer that's directly under the Mississippi River is stressed, primarily because farmers are pumping out huge amounts of water for rice and soybeans and corn in eastern Arkansas. In parts of the Southeast, the sandy soils dry out quickly after rains, so farmers are turning to irrigation to improve their yields. And we're now beginning to see more of the impacts from over-pumping that are familiar in the West.

One thing that makes the groundwater issue challenging is that you don't see the impacts of overpumping at first. It's not obvious until it compounds over years, and then all of a sudden you have land sinking and wells going dry. By that time, expectations are entrenched. It's difficult to change directions once farms and cities have done the same thing for generations; they're much more resistant to change.

## You're painting a fairly dire picture. Does the current moment offer opportunities to create positive change?

Absolutely. The most severe drought in at least 1,200 years in the West has brought us to a point where the failures in our system are blatantly obvious. People see the need to create a system that actually does what we need. We are forced to ask the

hard questions: What are the benefits we want to preserve? What are the trade-offs? How much should go to supporting particular economic interests? To supporting ecosystems? To protecting disadvantaged communities that depend on water?

Now we have a chance to sit down and think about these issues in a transparent way, to engage every group that has a stake in water management, and reimagine processes that balance those different needs. EDF is taking an extremely active role in this, bringing people together to find ways to redesign these systems so they benefit everyone, not just a small part of the population.

### Why is EDF so well suited for this role of bringing diverse stakeholders together to find solutions?

For starters, we have a solid vision of where we want to go, based on decades of scientific and policy expertise. That vision is clear, but it's also flexible. That flexibility allows us to work with some unusual bedfellows, and talk about how to move things in the same direction.



Arizona Gov. Doug Ducey (front, right) meets with Gila River Indian Community Gov. Stephen Roe Lewis and Lt. Gov. Robert Stone at a managed aquifer recharge site where a portion of the Gila River is flowing again, after running dry for several years. ROBERTO A. JACKSON/GRIN

For example, we often hear voices that are adamantly saying, “We shouldn’t be growing alfalfa in the desert, or rice or almonds.” We’ve taken the position that irrigated agriculture is not the bad guy. More than a third of the country’s vegetables and two-thirds of our fruits and nuts are grown in irrigated fields in California. We need this food, and we need the farmers who grow it. They need a seat at the table. At the same time, their influence shouldn’t continue to outweigh the needs of farm



Homes in Rancho Mirage, Calif., in the Coachella Valley. Although agriculture uses 80 percent of the state’s managed water, wasteful practices on non-farm properties continue to contribute to water shortages. DAMON WINTER/THE NEW YORK TIMES

workers or tribes or rural communities that also have livelihoods and cultures that they want to protect. By involving everyone, and using the best available science, we can balance the water budget and shape a sustainable future.

### What would be an example of that process in action?

The Multibenefit Land Repurposing Program in California’s Central Valley is a good example. To begin to get groundwater back in balance, between a half-million and a million acres of irrigated crops will need to come out. But you can’t allow that to happen in a willy-nilly way, or you’re going to have a patchwork of fields just kicking up dust, becoming invasive plant havens and providing no benefits to their communities.

With that in mind, EDF began working about five years ago in irrigation districts in the Kaweah area of the Central Valley. We initiated a dialogue with a few somewhat receptive but reluctant stakeholders to figure out how to put a programmatic lens on this and develop something that they could live with. We were all a bit uncomfortable at first, but we pulled in the right expertise and sat down with them and explored how to find common ground. We let them know that we think we have some good ideas, based on good data, but we don’t have it all figured out yet; we have a fairly open view to what the end product might look like.

Together, we developed a concept we call multibenefit land repurposing. The basic idea is to give farmers the flexibility to make decisions that make sense for them,

while providing incentives so that they manage their lands in ways that benefit the community and are consistent with a regional program.

In the spring of last year, California dedicated \$50 million to launch a strategic land repurposing program statewide, based primarily on the EDF Kaweah design. In September, they added another \$40 million in grants to help landowners begin to transition irrigated farmland to habitat for wildlife, recreational spaces and other uses that require less water. EDF, in partnership with Self-Help Enterprises, proposed and was selected to help support and guide the program's implementation statewide.

### **You also presided over the development of OpenET, an online platform co-developed by EDF that uses satellites to help measure water consumed by crops. How did that come about?**

For the most part, management decisions about irrigated agriculture have been made using rough guesses of how much water is actually being consumed. We really didn't know how much was being lost to evapotranspiration (ET), which is evaporation from the land's surface and water vapor that is breathed out by plants. That was a huge gap in our knowledge.



Alfalfa farmer Mark Owens is using OpenET data to reduce applied irrigation water while sustaining crop yields and quality.

About six years ago, shortly after I joined EDF, we put together a team to see if we could apply satellite-based methods to make scientifically credible, reliable estimates of evapotranspiration. We brought in scientists from NASA, the Desert Research Institute and others, and took advantage of cloud computing capacity through Google's Earth Engine. The result was OpenET, which launched last year in

17 western states. It's now being used by farmers and water managers every day to better manage their water and test conservation strategies that will build resilience to drought and climate change. Now we're close to launching an application that makes it easy to bring OpenET data into other software programs that inform decisions about irrigation and water planning.

### **It sounds like OpenET could be incredibly valuable to people in some of the other 33 states, not to mention arid regions elsewhere in the world. Are there plans to expand its reach?**

Yes, now the OpenET team is working to provide scientifically robust water data outside the western U.S., beginning in Mississippi's Alluvial Plain and Mexico's Mexicali Valley. Also, our science partner from Brazil has been asked by the Brazilian Water Agency to begin developing an OpenET product for Brazil. There's huge demand, and we're engaged in finding the right local partners, including researchers and agricultural experts. How quickly we can expand access to OpenET is largely dependent on willing local partners, and funding. We need partners who know the climate and agriculture of their regions, and we need secure funding commitments to allow us to continue to support the existing OpenET enterprise as well as development in new locations.



Silt deposited by the Colorado River dries and cracks during severe drought in Glen Canyon National Recreation Area. MOMATIUK - EASTCOTT/CORBIS

OpenET also opens up innumerable opportunities for understanding the water supply in non-irrigated rangelands and even forests. When we understand how much water is left in a system, it can help us understand how forest management

affects water supply and fire risk, and open the door to more holistic water management. We had big wildfires this year in New Mexico, where many nearby families had their lives turned upside down. That's one reason why I'm really excited about the possibilities of applying OpenET to help with fire management. We'll be catalyzing research to further our understanding of how OpenET can inform fire-risk mitigation practices in our forests, and make those practices easier to finance and support.

**Last summer, you testified at a Senate hearing during which Bureau of Reclamation Commissioner Camille Touton reported that we will need to save 2 to 4 million acre-feet per year to keep the dams at Lake Powell and Lake Mead from reaching critically low levels that would jeopardize water supplies. That's a lot of water. Where are those reductions going to come from?**

The idea of not having enough water to flow through the Grand Canyon or reach the tens of millions of people who rely on it downstream is a pretty austere prospect to consider. But it's now a very real possibility. To prevent that, we're going to need to change how this river is managed basin-wide, so that we are not taking out more water than the river provides. All users in every state must be a part of a collective plan to reduce water use equitably across the basin. The magnitude of the problem is so large, it can only be solved with broad participation.



Low water levels at the Hoover Dam and Lake Mead, the largest reservoir in the United States.

Unfortunately, the level of agreement on how to proceed between the seven Colorado River Basin states is not where it needs to be to avert a crisis. We are strategizing ways to influence and accelerate actions and shape new rules and agreements, to reflect a broader set of public and environmental values beyond just the large water users that typically exert outsized influence. We still have a long way to go, but recently, four states in the Upper Colorado River Basin — which provides water to 40 million people — agreed to use satellite data to enable more collaborative and responsive decision-making across state lines as the river's reservoirs plummet to dangerously low levels.

**In the U.S. and elsewhere, access to water is often an environmental justice issue. What can we do to create more equity around water issues?**

Right now in California's Central Valley, more than a million people are without a reliable source of drinking water. In some cases, you might have a family or a small community water district whose well goes dry or is pumping contaminated groundwater, because of the collective actions of many comparatively well-resourced farmers who can afford to drill deeper and lower the water table for everyone else. This is a side effect of water decisions that have been dominated by a fairly small number of entities. For a long time, the guiding principle has been, "He with the deepest well wins."



EDF-led workshops equip rural water board leaders to more effectively shape local water management decisions.

Before I joined EDF, my job at The Nature Conservancy was to make the case that we need groundwater reform in California. We were able to push for the passage of the

Sustainable Groundwater Management Act in 2014. The act considers water to be a shared asset and imposes rules on its use, and requires irrigation districts to consider the interests of disadvantaged communities served by private wells and small community water systems.

At EDF, we've teamed up with partners to develop a program to assist disadvantaged communities' water districts and provide them with tools and understanding about how they can self-advocate and engage in water decisions. We've also been a fierce advocate of the renegotiation process in the Colorado River Basin, insisting on a place at the table for tribes and affected communities. They shouldn't be just responding to the proposals; they should be in the room helping to design those solutions.

## **You've spoken eloquently about our shared responsibility to improve our communities. Can you share your thoughts on some of the ways that people can do this?**

I have a strong belief that those of us who are comparatively well-off have a responsibility to contribute to our communities in ways that raise the community's overall health, and particularly the disadvantaged parts of the community who are living with the impacts of our collective actions.

Some of us, like me, are working to change systems. And some of us, like my wife, are working in a person-to-person context. She teaches English as a second language, for the school district in Sacramento. Many of her students are refugees who came from Afghanistan and elsewhere with almost nothing. It's a huge step forward for them if they are able to look at a job application form and understand it and fill it out.

And then there are those who are supporting efforts like these through their donations. Whether we're helping people one-on-one, or working to change policies and systems, or generously supporting positive change through our donations, it's going to take a lot of effort to get the world heading in the direction we need to go to survive as a species and certainly as a civilization.

*We thank you for your support for EDF's efforts to find environmental solutions that work. To contribute or to learn more about climate-resilient water systems or our other work to preserve the Earth's natural systems, please visit [www.edf.org](http://www.edf.org).*

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