At the Kenyan waterworks, a man loads donkeys with water for home delivery.

MAKING WATER SAFE

An all-Java mobile app documents Safe Water Kenya's efforts to provide clean water to rural families in remote East Africa. **BY PHILIP J. GILL**

PHOTOGRAPH COURTESY OF SAFE WATER KENYA

Cloud Computing

Clean, safe drinking water is something that people in the developed world take for granted every time they turn on a faucet. But for more than 1 billion people living in the developing world, the lack of clean, safe drinking water poses a major health threat and a significant barrier to education and economic development.

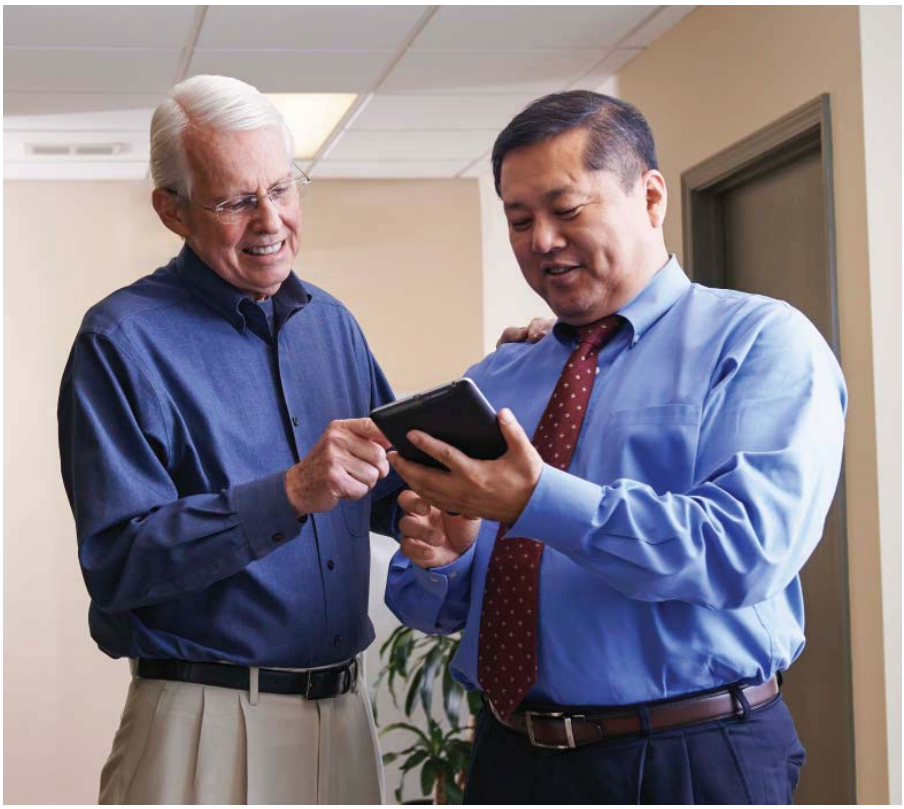
The World Health Organization (WHO) says that more than 2 million people—95 percent of whom are children—die from the consequences of a variety of waterborne illnesses each year. Indeed, WHO, a United Nations agency based in Geneva, Switzerland, reported outbreaks of cholera, the age-old waterborne scourge that causes debilitating and potentially fatal diarrhea, in more than 50 countries around the world last year.

SAFE WATER KENYA
(a project of the Safe Water Team)
safewaterteam.org

Headquarters:
Grand Rapids, Michigan

Industry:
Nongovernmental organization (NGO)

Oracle technologies used:
JDK, Oracle Database 12c, Oracle WebLogic Server 12c, Oracle Database Mobile Server, Oracle Berkeley DB Transactional Data Store



Safe Water Kenya's Don Arnold (left) takes a look at the latest Survey App, developed by mFrontiers' Daniel Pahng (right).

BIG PROBLEM
More than 1 billion people lack access to clean, safe drinking water, according to the Water Project.

PHOTOGRAPH BY ANDREA MANDEL

"It's not just a matter of illness; there's an economic factor as well," explains Don Arnold, executive director and founder of Safe Water Kenya (SWK), a project of the Safe Water Team (SWT). A nonprofit based in Grand Rapids, Michigan, SWT works to improve water quality in the developing world.

"There are not too many people in Africa with salaries," says Arnold, a veteran plumbing industry consultant with more than 30 plumbing patents to his name. "So if they get sick, they don't work, and they don't get paid for that day. If the children are sick, mommy has to stay home to care for them, and she doesn't get paid that day, and the children don't go to school."

To address these critical water issues in rural Kenya, an East African republic, SWK began installing Hydraid BioSand Water Filters—based on the low-tech, slow sand filtration process—more than a year ago. "We have installed 2,500 [filtration systems] so far," says Arnold. "We figure the average family has seven people, so that in just a matter of a year or so, we have affected 17,000 lives."

Those filters don't come for free. "To document the installations to our donors, we have to fill out an extensive survey that includes photos, GPS coordinates, and a signature from the

Arnold (in red shirt) with Safe Water Kenya warehouse workers and installation team members

PHOTOGRAPH COURTESY OF SAFE WATER KENYA

receiving party," says Arnold.

SWK meets these requirements using a decidedly high-tech solution: an all-Java "Survey App" that runs on handheld Android tablets developed specifically for SWK by mFrontiers, a Libertyville, Illinois–based enterprise software house and Oracle partner. The app earned mFrontiers a 2014 Oracle Excellence Award for Sustainability Innovations.

CARBON FOR CLEAN WATER

Arnold was inspired to start SWK while on a church mission to Africa six years ago. "I was in Uganda riding in a car with a local leader, and he stopped alongside the road and pointed down to a river where people were filling plastic containers with filthy brown water," Arnold recalls. "He told me that the people would take that water home, drink it and cook with it, and get sick. In a lot of cases, he said, they really didn't understand where waterborne diseases came from."

To get started, SWK shipped 2,250 Hydraid filters to Kenya, expecting them to last 18 months. But thanks to an energetic ground operation led by SWK local country manager Vivian Akinyi, who works through rural village health clinics to find needy families, SWK passed that mark in nine months and has not looked back since. "Today we install 15 filters on a typical day," says Arnold.

Initially, major funding for the water filters and installations came from carbon credits certified by the nonprofit Gold Standard Foundation, also based in Geneva. "Our current credits are granted on the basis that we use a device or technology that reduces carbon emissions," explains Arnold. "In our case, we are replacing burning wood or charcoal to boil water to make it safe to drink. Every time we put a filter in a home where they were boiling water, we're reducing emissions by that much."

Originally, the SWK surveys were completed manually, using pen, paper, camera, and a GPS device in the field, and the data was then re-entered into a computer system back in SWK's distribution office for transmission back to SWK headquarters in the US. But that process was time-consuming and potentially error-prone. Today, the SWK Survey App collects and stores data on an Android tablet running in offline mode, automating the process and reducing errors. mFrontiers developed the Survey App, written entirely in Java and deployed on an all-Oracle product stack, based on its mFinity Enterprise Mobility Management Platform.

Low-Tech Clean Water

The Hydraid BioSand Water Filter that Safe Water Kenya (SWK) uses is a low-tech, sustainable device designed to provide clean, safe water for drinking, cooking, and sanitation. Created by David Manz, a professor at the University of Calgary, in Alberta, Canada, the Hydraid filter builds on the slow sand water filtration process originally developed in Scotland in the early 1800s and used to provide the first public clean-water system in London in 1829.

Slow sand filters use naturally occurring biological processes to clean water; a gelatinous layer or biofilm that grows naturally on the surface of a few millimeters of sand eliminates contaminants from any water source, from lakes and streams to rainwater. "The good bacteria eats the bad bacteria," explains SWK Executive Director and Founder Don Arnold.

"There are a lot of technologies that will work to provide clean water, but few are as practical as the Hydraid filter because it doesn't require replacing elements such as cartridges or adding chemicals such as chlorine," Arnold adds. "The Hydraid filter eliminates 95 percent of bacteria, viruses, and parasites in the water. Even chlorine can't remove parasites."

Manz' second innovation in slow sand filters was to replace the large, heavy concrete containers traditionally used with a lightweight, easy-to-install, FDA-approved plastic container. That container measures 30.5 inches tall and 16.5 inches in diameter, and weighs 8 pounds empty and 140 pounds when filled. Installation takes 30 minutes, and the filter produces up to 47 liters per hour, enough for a family of 8 to 10 people. The biological layer is triggered when the first water is poured on top, and it takes about two weeks to fully form. It uses no electricity and provides clean, safe water for 10 years with little maintenance (simply removing the solids that collect at the top from time to time).

PHOTOGRAPH COURTESY OF SAFE WATER KENYA

Arnold and Safe Water Kenya local country manager Vivian Akinyi (left) visit a cooperating health clinic.

After installing the water filter, the SWK worker fills out the survey. "The survey consists of seven or eight pages on an Android tablet, each of which has five or six questions," says mFrontiers President Daniel Pahng, who wrote the Survey App himself using jQuery, an open source JavaScript library for client-side apps. "Using the tablet, they [SWK workers] also take photos of the family to add GPS coordinates because there are no street addresses."

As a final step, the installer records the recipient's signature and the serial number of the Hydraid water filter on the tablet form and moves on to the next home.

Because there are no internet connections in these remote locations, the data is stored on the Android tablet in a light-footprint Oracle Berkeley DB datastore. "When they return to the distribution office," says Pahng, "the Oracle Database Mobile Server sync agent, running on the Android tablet, automatically uploads survey information to an Oracle database hosted on a cloud-based Oracle WebLogic

Left: A Hydraid BioSand Water Filter is installed using sand and gravel. Right: A Safe Water Kenya graduation ceremony for trained health workers.

PHOTOGRAPHS COURTESY OF SAFE WATER KENYA

Server, from which the information may be accessed using a browser back at Safe Water Kenya's headquarters."

Pahng notes that the mFinity platform was originally written in Microsoft .NET. "However, when the company decided to expand globally, we realized that Microsoft was not a leader in the mobile world," he explains. "For most enterprise-level customers, we needed Java."

UNPRECEDENTED TRANSPARENCY

Not only does the Survey App speed the installation process; it also creates a level of transparency that few nonprofits can match, says SWK's Arnold. "Many nonprofit organizations really don't give their donors more than general information," he explains. "In other words, if they were installing filters like we are, maybe in a once-in-a-while newsletter or maybe the annual report they could say they were pleased to report that 'last year we installed X number of filters.'

"Well, that's good, but it isn't as good as what we can do," Arnold continues. "The very night that the filters are installed, the survey is uploaded to our system and people all over the world, our staff and our donors, can see what we did. They see pictures of the families and all sorts of information about them. I don't know any other organization that has a tool like that."

In addition to quickly informing staff and donors, Arnold expects the app and tablet computers to help SWK accelerate its work. "We're trying to be practical about what we can take on," says Arnold, "but we're planning on doubling this year to about 5,000 filters."

"We're very grateful to mFrontiers and Oracle," adds Arnold. "The system is beyond anything that we were smart enough to ask for." `</article>`

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