ENGINEERS WITHOUT BORDERS USA
Boston Professional Chapter

Spring 2022 Newsletter

International Projects

Chamhawi Water Supply Project

The village of Chamhawi will soon receive the benefits of an improved drinking water system! Since the Chapter drilled a borehole and installed a hand pump in October 2020, the community has been drawing water from the borehole, providing the community with a safe and sanitary drinking water supply. The Chapter is now prepared to implement the second phase of the Chamhawi water supply project, which is slated for construction this June. The improvements will include installation of a solar pump and controls, solar panel, and water storage tank. The project team worked diligently through the fall of 2021 to complete the design and the Implementation/Phase 3 Assessment Report, which was submitted to EWB-USA in November and approved in February. The design required close coordination with Energy & Technologies, Structures and Water Supply groups to successfully develop a comprehensive plan set. The Chapter received the following feedback from EWB-USA: "Great job on the plan! It has been added to the 'good example spreadsheet' for other teams to use as a model for a well prepared set of documents." The Chapter solicited bids for the project and has recently awarded the contract to New Hope Tanzania (NEHOTA), which is the same contractor that provided the Community-Based Water Supply Organization (CBWSO) training for the Village of Chamhawi in November 2020. NEHOTA will initiate construction in June, and has scheduled the construction of the most critical aspects of the project (tanks stand construction, solar installation) while the project team is on site during the second week of June. In addition to providing construction management and oversight, the team will also be busy during the site visit to meet with the community of Chamhawi, village leadership, and the CBWSO to ensure the sustainable operation and maintenance of the facilities constructed. The team will also conduct an assessment to determine whether a third phase of the project will be considered in the future. The team is very excited to see the results of many months of hard work come to fruition in the construction of this second phase, and to improve village member access to a safe drinking water supply!

Chamhawi hand pump

Mkutani Water Supply Project

Installing the 4 kilometer long pipeline in Mkutani has greatly decreased the time it takes to fetch water and hence the demand for clean water has greatly increased. We are hopeful this will lead to both better health and more time for other income-producing activities for the women in the village.
Additional training of the Mkutani CBWSO (Community Based Water Supply Organization), facilitated by Leon Balige of NEHOTA, took place in November 2021. This was necessary as the country requirements for CBWSOs have changed and the training also served to ensure the CBWSO would be able to properly care for the expanded water supply system for the village.

We also coordinated WASH (Water, Sanitation and Hygiene) and SWASH (School based WASH) workshops in Mkutani in January 2022. This was facilitated by Augustine Rukeha and was well received by the health workers, teachers, students and other village residents.

The June implementations and assessments trip will allow us to evaluate the new pipeline and to meet in person with the Mkutani CBWSO and other stakeholders to discuss the possibility of incorporating an additional existing but uncharacterized borehole well into the Mkutani water supply as the next phase.

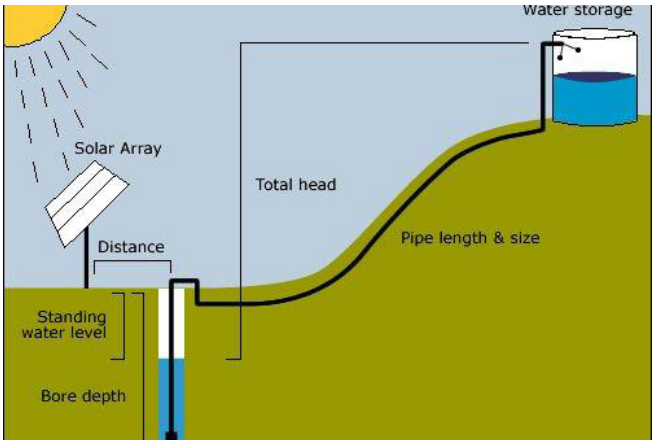
Above
Distribution line in Mkutani

Mkutani School Girls' Latrine Project

The team responsible for the design of the latrine block for the more than 300 girls attending Mkutani Primary School has continued collaborating with in-country engineers and contractors to ensure the sanitary block can be built in keeping with Tanzanian standards at an affordable cost. Construction will take place in June 2022 with members of our travel team overseeing the project in-person.

Left
Current latrines at Mkutani Primary School

What Goes Into The Engineering



Left
Well drilling in Mkutani

Right
Elevated tank and solar pump diagram

Despite the name of our organization, we are not all engineers. We come from a variety of backgrounds, differing areas of expertise and varying years of experience. This diversity within the chapter contributes greatly to the success of the work that we do, as each of us brings our individual skills, passion, and ideas into every facet of what we do. And when we bring all of our collective talent to bear, we create a project, we implement a solution, and we improve the lives of the communities that we serve.

We may not fully comprehend what is involved in each other's contributions to a particular project. Engineers with a particular area of expertise that are focused on a singular aspect of a project may not have a grasp of what is involved in another project component. For instance, those of us who are not environmental engineers may not have a full understanding of how water from a well is delivered through a system of treatment, storage, and distribution to the end point – a faucet from which a village member fills a container.

Take, for instance, a water supply project. The first step in such a project is securing a safe source of water sufficient to meet the water demand of the community. In most of our projects, this involves installing a well. But is this simply drilling a deep hole in the ground with the hope that water is encountered? Not at all – when drilling a well, considerations need to be made such as first determining where the best chances of encountering water may be. In many instances, a method called seismic refraction is employed – which measures the velocity of sound in different types of formations – saturated and unsaturated – at different depths, to determine if water may be present, in what type of formation (sand, gravel, bedrock) and at what depth. This expertise is usually provided by a hydrogeologist. We may also look at mapped geological formations and for the depth of other successful wells in the region. Once the type of expected formation and depth

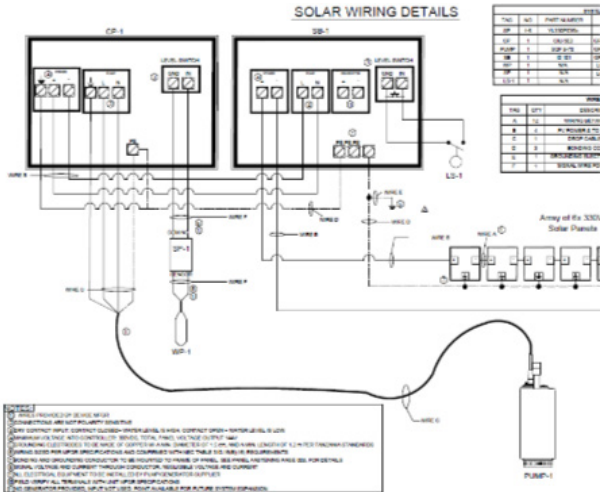
is determined, then the well is designed using civil engineering principles. Decisions need to be made as to the type and size of well casing, whether a screen will be installed or not in the water-bearing zones, and what depth to drill the well.

Once a well is drilled, it needs to be tested to be sure that they yield is adequate to meet the community's needs and that the water quality is suitable for consumption. The next step, pump design involves the combined expertise of civil, mechanical, and electrical engineering.

The civil engineer determines what flow rate from the well is necessary to supply with community with enough water, making sure not to exceed the capacity of the well, and what "head" the pump will need to overcome in order to deliver that quantity of water. But what does this mean? This can be likened to the effort it takes to ride a bike up to the top of a hill. Imagine the bicyclist is the pump, and the top of the hill is the tank. The effort it takes to get to the top of the hill is a function of several factors. There is the actual elevation from the bottom to the top of the hill. There is the friction of the tires on the road. There is the efficiency of the bicyclist in performing the ride. There could be resistance from wind. Similarly, sizing of a pump incorporates the elevation to the tank, the friction "losses" in the pipe through which the water flows – the smoothness of the pipe type (plastic vs iron), and the velocity (the higher the water velocity, the greater the friction), among other considerations.

Once the civil engineers determine the general pump conditions, then the civil and mechanical engineers decide on the optimal type of pump to be used. In our applications, we typically install a submersible pump in the wells we drill – which is a long, narrow pump (usually 4-inch diameter) that fits into the well casing (usually 6-inch diameter), set near the bottom of the well, and then pumps up though the piping to the water storage tank.

When the pump is selected, then electrical engineering is needed to provide the necessary power to the well pump. In our solar-powered applications, the power is provided by solar panels that harness the solar energy from the sun and delivers that energy to the pump to operate. Our EWB electrical engineers "size" the panels to



Left
Solar panel wiring schematic

Right
Solar panel in Kmutani

Left
Mkutani Tank Stand

Right
Mashpee Wampanoag Tribe

provide enough power during the hours of sunlight each day so that the pump will deliver enough water during that time to supply the daily "demand" of the community. Batteries could be used to increase the yield by allowing for pumping during cloudy conditions and In the evening, however they are typically not used due to the expense. Consequently, the pump can only operate when the sun is shining – when the solar radiation is strong enough to meet the minimum power requirements of the pump. The water storage tank is designed by the EWB civil engineers to be large enough to store water to meet each daily demand and "buffer" the time when there is little or no solar radiation to the pump. Water is delivered by gravity from the tank through the distribution piping to the water taps.

Lastly, the EWB structural engineers play a key role in such a system. In many designs, the water tank sits atop a structure that we call a tank stand. There are a number of factors that are considered in the tank stand design, which is usually a square enclosed structure comprised of concrete beams and slabs with block walls. First, the structure must support the weight of the tank filled with water. For a typical 10,000-liter (2,642-gallon) tank, this amounts to about 22,000 pounds. But that does not account for everything! The EWB structural engineers must take into account the potential for seismic (earthquake) activity, wind loads, and in colder climate, snow and ice loads a well as frost penetration. The soil type dictates how wide and deep the foundation needs to be. All of this translates into how much and what size of steel reinforcement ("rebar") is necessary, what "strength" of concrete is required (ratio of cement to sand and gravel), and the dimensions of the load-bearing components (columns, beams, and slabs) necessary for overcoming the anticipated loads. Most importantly, the selected design must be affordable and constructable by local contractors with the available materials and expertise.

Just like the adage, "it takes a village to raise a child" so too it takes a team of EWB members - dedicated engineers and other volunteers from a variety of disciplines – to successfully design and implement an EWB-BPC project!

Domestic Projects

Mashpee Wampanoag Food Sovereignty Project

Mashpee Wampanoag Irrigation Project Greenhouse

The Mashpee Wampanoag Tribe were successful in obtaining a cost-share agreement with the USDA-Natural Resources Conservation Service to pay for two additional greenhouses and the installation of a new water supply well and other related infrastructure. Following that success, the tribe reached out to EWB-BPC and requested that we partner with them in the design and implementation of the water supply components of the project. We've hit the ground running, bringing in technical specialists, Thomas Sexton and Gregory McNeal of GZA and Peter Newton of Bristol Engineering Associates to lead the design effort. This will be run as a Community Engineering Corps (CECorps) project. CECorps is essentially the sister organization of EWB-USA, dedicated to domestic projects. The Work Plan is nearing completion and more to come this summer as we begin to carry out the initial design efforts.

Member Experience: Richard Martorana

Above
Mature Moringa tree

Richard Martorana is our Small Business Development Team Lead

Facing retirement after (only) 47-years at Draper Laboratory, my daughter Kate who taught English in Namibia suggested that I actually make myself useful and through EWB. To quote her, "... if I catch you reading the AARP Newsletter, or watching daytime TV which will lower your IQ by at least 20% which you cannot afford, I promise to never give you grandchildren" I knew it was time to do some serious planning/commitment. With one eye gazing out my office window at the Cambridge Brewery and the other at the EWB Boston website, I discovered that the Professional Chapter was having a social event right there that evening. Now, I'm not especially religious but a coincidence like that could make one a Believer. After being treated to a few cold ones, I figured this was the outfit for me.

At the next meeting, the task assignment interview went smoothly. There was an opening for someone to help the villagers develop small businesses. The president asked what I had been doing at Draper, I confessed that I was responsible for temperature control of the Trident missile guidance system. When he responded, "Close enough", I knew it was a world-class organization and immediately got a copy of Muhammed Yunus' classic book on the history of microfinance in Bangladesh. Yunus was indeed a genius, got a Nobel, and probably qualified for sainthood. I thought a Nobel would impress my friends back in Brooklyn but not having been to confession in at least 25-years, sainthood would be a longer shot.

The goal of my first trip to Tanzania in 2015 was to attempt to understand the villagers' ambitions and capabilities. My first move was to organize a meeting where I simply asked for ideas from people who would like to start new businesses or expand existing ones. Turnout was good and recalling that my only takeaway from my MBA was "money is a good thing", my faithful interpreter Macmillan and I set out to make cold calls at local banks for small loans for the villagers. Microloans were not nearly as fashionable as they are today with the mainstream banking industry so we were given (as we say in Brooklyn), the "bum's rush." Finally, we got a positive response from one banker who actually agreed to

go out to Mkutani to train clients about business banking, which they did in good faith. The bad news was that the interest rate was the equivalent of 24%, common at that time for such projects but it was a start. We were thrilled. Surely I would get a Nobel. And then, I discovered the Moringa plant.

Moringa is a scruffy looking tree that does very well in semi-arid climates and most of Tanzania is pretty dry most of the year. The leaves are extremely nutritious to the point where it has been designated a "go-to" food by the World Health Organization for famine relief. Kids bounce right back from near starvation. It also grows wild around Mkutani! To boot, oil from the seed pods is highly valued by multiple industries for applications from face creams and soap (high Vitamin B) to lubrication of precision instruments. Retail vitamin companies swear that it will cure everything from bunions to heart disease. If I could get villagers trained in growing moringa and harvesting the oil, surely I would get that Nobel.

Our next move was to find (and fund) a trainer who really knew moringa agriculture and business dynamics. After a nearly disastrous start with one company that turned out to be dishonest, we found one that would not only train the community members but also buy their seeds thus giving them a market outlet. Given Mkutani's isolation, this was a big advantage. The following year we raised about $2,400, and contracted for the training program and first planting. We were off and running. Everything went according to plan. The trainer followed through even to the point of providing seedlings, shovels, written instructions, and multiple check-up visits to the village. Over 1,800 trees were planted. I had my tux cleaned for the Nobel ceremony. However, two years later, of the dozen or so villagers in the program, only one followed through with a permanent crop. The others dropped out because they felt more comfortable with the low-risk traditional crops. Later we learned that one self-trained village entrepreneur in nearby Mapinduzi was making a killing selling moringa seeds to Chinese privateers from local China-financed infrastructure projects. The other shoe to drop was that all of the villagers in Mkutani defaulted on their loans for other small businesses but our similar program in Mapinduzi was more successful.

Lesson learned: The villagers will usually say yes to help but taking rish is something else. Tradition will dominate.

Left

Communcity members planting small crop during trip to Tanzania in 2015

Right

Richard's Granddaugter Emma Jane (21 months old)

Events

Habitat for Humanity

On August 13th, members of the Engineers Without Borders Boston Professional Chapter will join hands with Essex County Habitat for Humanity in a volunteer service day to literally raise the roof for a 6-family home in Salisbury, Mass. In addition to doing something really important for your community, it's fun and a great learning experience if you ever wanted to know how to build a frame, install siding, or pour concrete. Also, a good way to get to know other EWB-BPC volunteers.

Get Involved

Here are a few tips on what to do if you are new to EWB-BPC or if you want to be more involved:

- Join our Slack channel! We use Slack for project and fundraising discussions, in addition to general announcements and meeting reminders. It is the easiest way to stay up to date on EWB-BPC activities. Email president@ewbboston.org if you would like to be added, or scan the QR code!
- Join our mailing list! You can subscribe to our mailing list via our website, on the "Subscribe" page. This will ensure that you will receive our monthly bulletins that are sent out on the 1st of each month. Email bulletins include monthly up-to-date project information, groups that need assistance and EWB-BPC meeting/event information.
- Come to our meetings and events! If you are not on our Slack or mailing list, our meeting information is listed on the calendar located in the "Events" page of our website.

Thank you to our generous sponsors

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- Photo updates of the project(s) your donation is funding

Silver
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- Three tickets to the annual fundraising event
- Logo or name on signage at fundraising events, in newsletter, and on website
- Photo updates of the project(s) your donation is funding

Gold
$10,000+

- Pictures of travel team in Tanzania wearing your logo
- Six tickets to the annual fundraising event
- Logo or name on signage at fundraising events, in newsletter, and on website
- Photo updates of the project(s) your donation is funding