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Student **A**ssociation for **I**nternational **W**ater **I**ssues **(SAIWI)**

Ann Campana Judge Foundation Project Report

Phase II Rabondo, Kenya Well Drilling and Hygiene Education Project

In June 2005, five members from the Student Association for International Water Issues (SAIWI), along with Ron Petersen of International Development Mission (IDM) and Cathy Fitzgerald from Lifewater International, journeyed to Rabondo, Kenya to complete Phase II of the Well Drilling and Hygiene Education Project. The community of Rabondo is located in the heavily populated area of southwest Kenya where subsistence farming is the main means of economic support. Like many communities in rural Kenya, Rabondo has a limited access to uncontaminated drinking water. The major water source for the community is polluted surface water that has been contaminated by livestock. Water quality testing indicates unsafe levels of fecal coliform bacteria in the untreated surface water. The groundwater in the area is the cleanest source of drinking water, but access is limited to two drilled wells and a few hand-dug wells (Figure 1).

In June 2004, Phase I of the Well Drilling and Hygiene Education Project was completed. Members of SAIWI, in corporation with IDM and Lifewater International, completed the first community water well using the LS-100 drill rig (Figure 2), taught water hygiene classes at the local schools, and helped to engineer a rain water harvesting system on the roof top of the secondary school (Figure 3). The goal of Phase II of the Well Drilling and Hygiene Education Project was to drill the second community water well with the LS-100 drill rig, conduct a geophysical survey for potential future well sites, and bring supplies needed to complete the rain harvesting project at the local primary school.

Tasks Accomplished

Completion of Water Well with the LS- 100 Drill Rig

The second community water well was completed at the AIDS orphanage to a depth of 10.6 m (35 ft) over a two-week period, using the LS-100 drill rig (Figures 4 and 5). The LS-100 is a mud-rotary drill rig designed especially for drilling shallow groundwater wells in developing countries. It is small and portable and parts on the rig should, in theory, be easily replaceable. On the first day of drilling, the 6-inch borehole was completed to a depth of 6 m (20 ft). However, because of mechanical difficulties and hard rock, it took almost 10 days to drill the the final 4.5 m (15 ft) to complete the borehole.

One of the first mechanical issues we encountered was stripped threads on the head of the grease gun that made it nearly impossible to properly lubricate the seals on LS-100. A replacement

grease gun was not available, and as a result, nearly every seal on the drill rig had to be replaced at least once. After using up all the replacement seals, new seals had to be improvised, using available materials like cardboard, rubber and lithium grease. Another problem we faced was the mud pump used to circulate the drilling fluid burned out. This required a day-long trip to Kisumu to purchase a replacement pump in order to complete the well (Figure 6). This was an unexpected cost of $213.00.

With a little ingenuity and perseverance, SAIWI members and the Rabondo water technicians were able to install an India Mark II hand pump on the new water well on the final day of the project (Figure 7). A sanitary seal and cement pad were placed on the well by the Rabando water technicians shortly after our return home. The well is currently supplying water to the orphanage.

Supplies for the Rain Harvesting System

SAIWI was able to purchase an additional larger (5,000 gallon) bladder tank for the rain harvesting system at the secondary school. Because the secondary school is undergoing additional construction that will include the area where the rainwater collection system is currently located, the plan is to relocate the rainwater harvesting system (gutters and tank) to the dining hall, which is located approximately 100 meters above the secondary school. The rainwater collected in the bladder tank then can be piped by gravity flow to the school kitchen, the laboratory, and the medical clinic. Measurements were taken of the roof area of the dining hall during our visit and all materials necessary to complete the system were left at the secondary school. The Rabondo community has reported that the system has been installed and is currently in operation.

The smaller (3,000 gallon) bladder tank was transferred to the primary school, and $500 in funding from Rotary International was used to purchase gutters and supplies to complete a rainwater harvesting system at this location. Reports from the Rabondo community are that this system has also been completed.

Geological and Geophysical Surveys

The SAIWI students also participated in a geological reconnaissance of the area and performed a total of seven vertical electrical soundings (VES) and one short profile. The purpose of these two activities was to develop a rudimentary hydrogeologic model of the area that could help guide drilling. Additionally, the geophysical soundings were used to help prioritize potential drill sites for the LS-100. The seven geophysical soundings carried out in 2005 were in addition to the 12 soundings that were done in previous years. For the most part, they were located at proposed drill sites that had been selected by the communities. A handful of soundings were located at existing hand-dug sites for calibration purposes. With one minor exception, there was no consistent attempt to map the geology. However, some of the students had good geologic backgrounds, so those talents were utilized. The observations below come primarily from a composite of catch-as-catch-can observations, plus a single half-day attempt to assess the geology in the vicinity of the clans of Kiugu and Kadero to locate a suitable well site.

Much of the area is underlain by relatively hard rock, generally too hard for the LS-100 to penetrate effectively. Locally, there are some weathered zones that could be more favorable to drilling, but even these could be problematic. Figure 8 shows a saprolite (well-weathered granite) that has been removed from a hand-dug well to a depth of approximately 8 meters. However, the boulder seen at the far right of the picture was removed during excavation. Such boulders were

observed in a number of surface outcrops around the area. Discussions with the "driller," coupled with our own cursory observations, suggest that these are mostly surface float, with little depth extent, probably no more than a couple of meters. Never the less, these are a clear deterrent to drilling with the LS-100. A weathered rhyolite was observed in the one hand-dug well that was under construction at the time of the visit. Large granitic outcrops were also observed at several locations within a distance of one kilometer (see Figure 9).

The geophysical data were helpful in providing a general indication of variations in subsurface configuration. However, they proved to not be a particularly good method for screening LS-100 sites, as had been originally hoped. There are numerous reasons for this, both geological and socio/political. The boulders were essentially undetectable in the geophysical data. At several sites where the low resistivities would typically be good indicators of a favorable drill site (soft rock), a large number of boulders were also observed, rendering the site unfavorable for drilling.

Lessons Learned

The LS-100 is probably not the best option for obtaining water at Rabondo. Generally, the rock is too hard. Furthermore, within the previous year, members of the community have developed a thriving business constructing hand-dug wells, which are a more appropriate technology for this area. Several reasons are that 1) the technology is available year around, not just when we are there, 2) hand-dug technology does not depend on expensive materials such as bentonite, or expensive replacement parts for the rig, which was damaged frequently by drilling in hard rock, and 3) it provides jobs within the community. While the community has designated a drill team, they are not currently proficient enough with the LS-100 to drill on their own.

Another factor was the insistence that LS-100 wells be attempted at sites which were the most desirable culturally, but were clearly not the best technical sites, based on geological and geophysical data. A prime example was the community "mandate" that the 2005 team drill the well at the AIDS orphanage, even though this was clearly not the best technical site.

The upcoming trip in May-June 2006 with two SAIWI students and Cathy Fitzgerald will focus on determining whether the Waller Baptist manual well drilling technique will be effective in the Rabondo area.

Budget

Item	Individual cost	#	Total cost	ACJF funds	SAIWI funds	Personal funds
Individual costs						
Immunizations	$60.00	5	$300.00			$300.00
Airfare	$1,487.00	5	$7,435.00		$7,435.00	
Visa	$50.00	5	$250.00			$250.00
Food, lodging, & misc.	$500.00	5	$2,500.00			$3,000.00
Group costs						
In country travel [(1)]			$2,290.00	**$2,290.00**		
Material costs						
Bentonite	$13.30	10	$133.00	**$133.00**		
Well casing	$26.66	3	$86.00	**$86.00**		
Well screen	$54.00	1	$54.00	**$54.00**		
India Mark II pump	$360.00	1	$360.00	**$360.00**		
Bladder tank	$533.00	1	$533.00	**$533.00**		
Mud pump	$213.00	1	$213.00	**$213.00**		
Well pad #1	$81.00	1	$81.00	**$81.00**		
Well pad #2	$107.00	1	$107.00	**$107.00**		
Misc.			$25.00	**$25.00**		
Petroleum			$132.00	**$132.00**		
Total cost			**$14,499.00**	**$4,014.00**	**$7,435.00**	**$3,550.00**

[(1)] Cost of rented vehicle to transport students and supplies from Nairobi to Rabondo and daily cost of vehicle in Rabondo for three weeks

Trip Participants

Andrew Knust (SAIWI)
Jason Assam (SAIWI)
Anna Makowski (SAIWI)
Ben Rau (SAIWI)
Joan Otahal (SAIWI)
Ron Petersen (International Development Missions)
Cathy Fitzgerald (Lifewater International)

Figures

Figure 1 – One of Rabando's hand-dug wells

Figure 2 – Community members at the completed 2004 SAIWI well

Figure 3 - The rain harvesting system at the secondary school

Figure 4 – Rabondo water technicians at the finished 2005 SAIWI well

Figure 5 - Drilling with LS-100

Figure 6 - The new mud pump

Figure 7 - Installation of the India Mark II hand-pump

Figure 8 – Geophysical survey at one of the hand-dug well sites. Note the saprolite (well-weathered granite) material surrounding the well.

Figure 9 – One of the large granitic outcrops located in the area.