

**MANUAL WELL DRILLING PROJECT**

**MAY-JUNE 2007**

**PROJECT REPORT**

**Submitted to:**

**Ann Campana Judge Foundation  
3359 NW Poppy Drive  
Corvallis, OR 97330-3476**

**Submitted by:**

**Dr. Cathleen M. Fitzgerald, P.E.  
695 Oak Creek Drive  
Reno, NV 89511**

**August 30, 2007**

## **Kenya-Uganda Trip, May-June 2007**

### **Trip Leader**

- Dr. Cathleen Fitzgerald, P.E.

### **UNR Hydrology Grad Students**

- Breann Westfal
- Andie Gehlhausen
- Harmony Farnsworth
- Jeremy Rivord
- Marcy Kamerath

### **Others**

- Monika Winder – Post Doctoral Researcher, Tahoe Environmental Research Center
- Neema Scott – Graduate, Smith College
- Dr. David Kreamer – Professor of Hydrology, UNLV
- Terry Jones – Director, Sequoia Ministries
- Randy Coates – Missionary, Turkana, Kenya

### **Completed Project Tasks**

The following tasks were completed in 2007:

- Construction of the manual drill rig, using locally available supplies, in Kenya
- Completion of one water well in Turkana, Kenya, using the manual well drilling method
- Training of one water technician to oversee efforts to drill additional wells
- Construction of the manual drill rig and completion of one water well, using the manual well drilling method, in Kayoro, Uganda
- Training of local young men and women, who previously had experience drilling with the LS100 mud rotary drill rig, how to complete wells using the manual method

### **Manual Well Drilling**

Difficulties were encountered in 2004 and 2005 while drilling with the LS-100 mud rotary drill rig on previous SAIWI trips in Rabondo, Kenya (i.e., mechanical breakdowns, limited ability to purchase replacement parts in country, etc.). Each drilled well cost approximately \$2,000 because a vehicle was required to transport the rig to the drill site and oil and fuel were needed to operate the equipment. The cost of \$2,000 per well was beyond the means of the community to make this a self-sustaining project, and therefore, well drilling was only initiated twice a year when students and volunteers from the United States were able to travel to Kenya and assist the

community in their efforts both financially and with technical support. So the use of simpler drilling methods was investigated that would reduce the cost per well to levels that the community members could afford and would not require mechanical equipment.

In April 2005, Cathy Fitzgerald traveled to Bolivia to visit Terry Waller and learn the Water for All manual well drilling method that has been used to successfully drill over 1,500 wells in Bolivia to depths of up to 300 feet (see [www.waterrforallinternational.org](http://www.waterrforallinternational.org) for additional details). In May 2006, Mr. Terry Waller accompanied Cathy Fitzgerald and two SAIWI students to Rabondo, Kenya to determine the feasibility of using this drilling method in that area. Two wells were successfully completed using this method and the water technicians were trained in the use of this new technology.

The purpose of the 2007 SAIWI trip was to see if the Water for All manual drilling method would work in Turkana, Kenya (an arid desert environment) and in Kayoro, Uganda, where Cathy Fitzgerald had trained eight water technicians how to drill wells with the LS100 drill rig in 2001.

The first task was to purchase supplies to construct the manual drill rig, using local supplies, and to have a welder make the drill bits, using bolts, couplers, and the leaf springs from repaired cars. The technology is a simple manual hydraulic percussion technique that uses lightweight inexpensive 1 ¼-inch plastic PVC pipe. The PVC pipe is threaded onto a length of 1 ¼-inch galvanized metal pipe that is fitted with the homemade bit with an internal check valve that is pictured below.

Drill Bit  
Welded at  
Local Shop



The well is drilled with the borehole filled with a bentonite-water mud mixture. Cuttings are lifted out of the bottom of the hole by moving the drill pipe up and down. On the up and down stroke, the check valve on the bit closes and opens, which forces a discharge of fluid and cuttings up and out of the drill stem into a settling pit at the surface. The fluid is then recycled back into the hole via a small trench. Thus, the wells are made by the hydraulic action of the water plus physical striking (percussion) of the bit that pulverizes or dislodges pieces of the formation.

The top of the drill stem is attached to a rope, which goes over a pulley on the top of a tripod and a team of 4 to 8 people, depending on the depth of the borehole and weight of the drill stem, pull the rope and assist in the drilling process. Pictures of the process are shown below.



Photo of Water For All manual well drilling method – drilling well in Turkana, Kenya



Closeup of one of the local Turkana women drilling the water well

Difficulties were encountered when drilling the first borehole because the formation consisted primarily of fine to coarse sand. After drilling the hole to a depth of 42 feet, the upper portion of the borehole collapsed when trying to set the casing. Therefore, a second well was drilled to a depth of 46 feet. The well was completed, using 3-inch diameter casing that was manually cut with a hacksaw to create perforations (screen interval) within the saturated zone. The screened area was wrapped with a plastic flour sack and glued to serve as the filter pack. Due to a lack of time, the water technician who was trained on drilling and pump installation (Loray) was tasked with completing the well by backwashing the sediment out of the well and setting the Afridev hand pump. There are plans to drill an additional well this summer in the same area in Turkana through a grant obtained by Neema Scott from Smith College.

The second half of the trip involved drilling a borehole in Kayoro, Uganda, using the same manual well drilling method and training the water technicians who were familiar with mud rotary drilling on the use of the new technique. The water technicians and the US contingent involved in drilling the well in Uganda are shown in the following photograph:



Well drilling setup in June 2007 for the Kayoro community in eastern Uganda

Difficulties were also encountered in drilling this borehole. The first 10 feet of the borehole consisted of hard rock (laterite) which was difficult to penetrate. After breaking through the hard rock layer, there were fractures in the formation below the laterite, which resulted in a loss of water to the formation and difficulties in keeping water in the borehole for the drilling process. The borehole was completed to a depth of 22 feet and 4-inch casing with slotted screen was



installed. The well then was backwashed to remove the bentonite and sediment. Due to a lack of time, the water technicians were tasked with bailing the well on a daily basis until the water in the borehole was clear. At that time, the Afridev hand pump will be installed. A picture of the borehole with members of the community and water technicians is shown below.



Borehole and community members in Kayoro, Uganda

### **Budget**

A total of \$1,000 was obtained from the Ann Campana Judge Foundation for the water projects in Kenya and Uganda. A spreadsheet of expenditures for supplies and transportation for the Turkana, Kenya portion of the project is attached.

If you have any questions regarding this report, please contact the undersigned at 775-853-8503.

A handwritten signature in black ink that reads "Cathleen Fitzgerald". The signature is written in a cursive style.

Dr. Cathleen M. Fitzgerald, P.E.  
Senior Engineer  
The Planning Center

WELL DRILLING SUPPLIES

Partial List of Expense for Turkana, Kenya  
Portion of Project

	Quantity	Cost	Total - KS	Subtotal with VAT	US Dollars
Bentonite	10 bags	1293/bag	12931		
Afridev Pump	2	39,000	78000	93000	
3-inch Casing/Screen	12	569	6828		
Drill Pipe	12	241	2892		
Male Sockets	24	21	504		
Female Sockets	24	69	1656		
PVC Glue	1	345	345	14175	
				107175	1611.65
Transportation - to and from Nairobi to Turkana					2600
			TOTAL		4211.65
Money Advance – Ann Campana Judge Foundation					1000.00

Exchange rate = 66.5 Kenya Shillings = 1 US Dollar

VAT = Value Added Tax