POST IMPLEMENTATION REPORT

CHAPTER: Oregon State University
COUNTRY: Kenya
COMMUNITY: Lela
PROJECT: Lela Community Water Project

PREPARED BY
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Kristina Milaj
Jordan Machtelinckx
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October 14, 2012

ENGINEERS WITHOUT BORDERS-USA
www.ewb-usa.org
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<th>Section</th>
<th>Title</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td>14.7</td>
<td>Rainwater Harvesting Maintenance Manual</td>
<td>53</td>
</tr>
<tr>
<td>14.8</td>
<td>LWWC Appreciation and Request to EWB-OSU</td>
<td>61</td>
</tr>
<tr>
<td>14.9</td>
<td>Lela Primary School Board Request for Partnership</td>
<td>67</td>
</tr>
</tbody>
</table>
Post Implementation Report Part 1 – Administrative Information

1.0 Contact Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
<th>Chapter or Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Lead</td>
<td>Zachary Dunn</td>
<td><a href="mailto:kenya@ewb-osu.org">kenya@ewb-osu.org</a></td>
<td>EWB-OSU</td>
</tr>
<tr>
<td>President</td>
<td>Sean Gertz</td>
<td><a href="mailto:president@ewb-osu.org">president@ewb-osu.org</a></td>
<td>EWB-OSU</td>
</tr>
<tr>
<td>Mentor #1</td>
<td>Jeff Randall</td>
<td></td>
<td>CH2M Hill</td>
</tr>
<tr>
<td>Mentor #2</td>
<td>Paul Berg</td>
<td></td>
<td>CH2M Hill</td>
</tr>
<tr>
<td>Faculty Advisor</td>
<td>Arturo Leon</td>
<td></td>
<td>OSU</td>
</tr>
<tr>
<td>Health and Safety Officer</td>
<td>Zachary Dunn</td>
<td></td>
<td>EWB-OSU</td>
</tr>
<tr>
<td>Assistant Health and Safety Officer</td>
<td>Jessica Cawley</td>
<td></td>
<td>EWB-OSU</td>
</tr>
<tr>
<td>Education Lead</td>
<td>Kristina Milaj</td>
<td></td>
<td>EWB-OSU</td>
</tr>
<tr>
<td>Community Contact</td>
<td>Charles Olang’o</td>
<td></td>
<td>Lela, Kenya</td>
</tr>
<tr>
<td>Community Contact</td>
<td>Paul Olang’o</td>
<td></td>
<td>Nairobi, Kenya</td>
</tr>
</tbody>
</table>

2.0 Travel History

<table>
<thead>
<tr>
<th>Dates of Travel</th>
<th>Assessment or Implementation</th>
<th>Description of Trip</th>
</tr>
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<tbody>
<tr>
<td>December 14-29, 2009</td>
<td>Assessment</td>
<td>Initial Community and Health Assessment</td>
</tr>
<tr>
<td>June 8-26, 2011</td>
<td>Assessment</td>
<td>Technical Assessment for Water Source Development</td>
</tr>
<tr>
<td>July 9 - August 3, 2012</td>
<td>Implementation</td>
<td>Construction of drilled well, rainwater catchment system</td>
</tr>
</tbody>
</table>

3.0 Travel Team

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>E-mail</th>
<th>Phone</th>
<th>Chapter or Organization</th>
<th>Student or Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zachary Dunn</td>
<td><a href="mailto:kenya@ewb-osu.org">kenya@ewb-osu.org</a></td>
<td></td>
<td>EWB-OSU</td>
<td>Student</td>
</tr>
<tr>
<td>2</td>
<td>Jordan Machtelinckx</td>
<td></td>
<td></td>
<td>EWB-OSU</td>
<td>Student</td>
</tr>
<tr>
<td>3</td>
<td>Jessica Cawley</td>
<td></td>
<td></td>
<td>EWB-OSU</td>
<td>Student</td>
</tr>
<tr>
<td>4</td>
<td>Kristina Milaj</td>
<td></td>
<td></td>
<td>EWB-OSU</td>
<td>Student</td>
</tr>
</tbody>
</table>
4.0 Health and Safety

4.1 Incident Reports

Did any health or safety incidents occur during this trip? __ Yes __X__ No

5.0 Monitoring - Current Status of all Past-Implemented Projects in Program

There are no past-implemented projects in this program.

6.0 Budget

6.1 Project Budget

Project ID: 5091
Type of Trip: Implementation

<table>
<thead>
<tr>
<th>Trip Expense Category</th>
<th>Estimated Expenses</th>
<th>Actual Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airfare (donated by Emirates)</td>
<td>$15,000</td>
<td>$15,575</td>
</tr>
<tr>
<td>Gas</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Rental Vehicle</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Taxis/Drivers</td>
<td>$660</td>
<td>$581</td>
</tr>
<tr>
<td>Misc.</td>
<td>$75</td>
<td>$100</td>
</tr>
<tr>
<td><strong>Travel Sub-Total</strong></td>
<td>$15,735</td>
<td>$16,256</td>
</tr>
<tr>
<td><strong>Travel Logistics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exit Fees/ Visas</td>
<td>$150</td>
<td>$150</td>
</tr>
<tr>
<td>Inoculations</td>
<td>$274</td>
<td>$274</td>
</tr>
<tr>
<td>Insurance</td>
<td>$400</td>
<td>$333</td>
</tr>
<tr>
<td>Licenses &amp; Fees</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Medical Exams</td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>Passport Issuance</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Misc. (phone minutes, cash advance fees)</td>
<td>$100</td>
<td>$777.15</td>
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<tr>
<td><strong>Travel Logistics Sub-Total</strong></td>
<td>$1,924</td>
<td>$2,534</td>
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## Food & Lodging

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lodging</td>
<td>$250</td>
<td>$245</td>
</tr>
<tr>
<td>Food &amp; Beverage (Non-alcoholic)</td>
<td>$750</td>
<td>$714</td>
</tr>
<tr>
<td>Misc.</td>
<td>$0</td>
<td>$0</td>
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<tr>
<td><strong>Food &amp; Lodging Sub-Total</strong></td>
<td>$1,000</td>
<td>$959</td>
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</tbody>
</table>

## Labor

<table>
<thead>
<tr>
<th>Item</th>
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<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Country logistical support</td>
<td>$300</td>
<td>$354</td>
</tr>
<tr>
<td>Local Skilled labor</td>
<td>$228</td>
<td>$625</td>
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<tr>
<td>Misc.</td>
<td>$0</td>
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<tr>
<td><strong>Labor Sub-Total</strong></td>
<td>$528</td>
<td>$979</td>
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## EWB-USA

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Program QA/QC</td>
<td>$3,675</td>
<td>$3,675</td>
</tr>
<tr>
<td><strong>EWB-USA Sub-Total</strong></td>
<td>$3,675</td>
<td>$3,675</td>
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## Project Materials & Equipment (Major Category Summary)

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Well drilling &amp; construction (includes drilling, casing, well pump, concrete pad)</td>
<td>$15,000</td>
<td>$13,019</td>
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<tr>
<td>Rainwater catchment system (storage tanks, gutters &amp; piping, tools)</td>
<td>$5,908</td>
<td>$3,350</td>
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<tr>
<td>Surveying</td>
<td>$150</td>
<td>$0</td>
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<tr>
<td>Water quality testing</td>
<td>$600</td>
<td>$230</td>
</tr>
<tr>
<td><strong>Project Materials &amp; Equipment Sub-Total</strong></td>
<td>$21,658</td>
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## Misc. (Major Category Summary)

<table>
<thead>
<tr>
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</thead>
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<tr>
<td>Report Preparation</td>
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<td>Advertising &amp; Marketing</td>
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<tr>
<td>Postage &amp; Delivery</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Misc. Other</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Misc. Sub-Total</strong></td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$44,520</td>
<td>$41,002</td>
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**EWB-USA National office use:**

<table>
<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>Indirect Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EWB-USA</td>
<td></td>
<td></td>
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<tr>
<td>Program Infrastructure</td>
<td>$1,225</td>
<td>$1,225</td>
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<tr>
<td><strong>EWB-USA Sub-Total</strong></td>
<td>$1,225</td>
<td>$1,225</td>
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</tbody>
</table>
## TRIP GRAND TOTAL (Does not include Non-Budget Items)

<table>
<thead>
<tr>
<th></th>
<th>Revised 09/01/2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$45,745</td>
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<tr>
<td></td>
<td>$42,227</td>
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</table>

## Non-Budget Items:

### Additional Contributions to Project Costs

<table>
<thead>
<tr>
<th>Community</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>$100 $100</td>
</tr>
<tr>
<td>Materials</td>
<td>$0 $0</td>
</tr>
<tr>
<td>Logistics</td>
<td>$150 $150</td>
</tr>
<tr>
<td>Cash</td>
<td>$200 $0</td>
</tr>
<tr>
<td>Other</td>
<td>$0 $0</td>
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<tr>
<td><strong>Community Sub-Total</strong></td>
<td>$450 $250</td>
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</table>

### EWB-USA Professional Service In-Kind

<table>
<thead>
<tr>
<th>Professional Service Hours</th>
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</tr>
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<tbody>
<tr>
<td>550</td>
<td>550</td>
</tr>
<tr>
<td><strong>Hours converted to $ (1 hour = $100)</strong></td>
<td>$55,000 $55,000</td>
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</table>

### Professional Service In-Kind Sub-Total

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td></td>
<td>$55,000</td>
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<tr>
<td></td>
<td>$55,000</td>
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### TRIP GRAND TOTAL (Includes Non-Budget Items)

<table>
<thead>
<tr>
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<tr>
<td></td>
<td>$101,195</td>
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<tr>
<td></td>
<td>$97,447</td>
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## Chapter Revenue

<table>
<thead>
<tr>
<th>Funds Raised for Project by Source</th>
<th>Revised 09/01/2012</th>
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</thead>
<tbody>
<tr>
<td>Source and Amount</td>
<td>Raised Before Trip</td>
</tr>
<tr>
<td>Corporations</td>
<td>$15,000</td>
</tr>
<tr>
<td>University</td>
<td>$1,500</td>
</tr>
<tr>
<td>Grants - EWB-USA program</td>
<td>$5,000</td>
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<tr>
<td>Individuals</td>
<td>$8,684</td>
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<tr>
<td>Special Events</td>
<td>$2,127</td>
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<tr>
<td>EWB-USA Program QA/QC Discount Amount</td>
<td>$0 $0</td>
</tr>
<tr>
<td>EWB-USA Program Infrastructure Discount Amount</td>
<td>$0 $0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$32,311</td>
</tr>
<tr>
<td><strong>Actual Raised by end of Trip</strong></td>
<td>$32,311</td>
</tr>
</tbody>
</table>
6.2 Professional Mentor/Technical Lead Hours

<table>
<thead>
<tr>
<th>Name of Professional Mentor</th>
<th>Pre-trip hours</th>
<th>During trip hours</th>
<th>Post-trip hours</th>
<th>Total Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeff Randall</td>
<td>40</td>
<td>208</td>
<td>12</td>
<td>260</td>
</tr>
</tbody>
</table>

7.0 Project Disciplines:

**Water Supply**

- **X** Source Development
- **X** Water Storage
- **X** Water Distribution
- **X** Water Treatment
- **X** Water Pump

**Structures**

- Bridge
- Building

**Civil Works**

- Roads
- Drainage
- Dams

**Sanitation**

- Latrine
- Gray Water System
- Black Water System

**Agriculture**

- Irrigation Pump
- Irrigation Line
- Water Storage
- Soil Improvement
- Fish Farm
- Crop Processing
- Equipment

**Structures**

- **X** Bridge
- **X** Building

**Energy**

- Fuel
- Electricity

**Information Systems**

- Computer Service

8.0 Project Location

- **Latitude:** 34.398536
- **Longitude:** -1.123123

9.0 Acronym Definitions

- EAFW – East African Foundry Works
- EIS – Environmental Impact Statement
- KSH – Kenyan Shilling (local currency); all prices are in USD unless stated as KSH
- lpcd – liters per capita per day
- lps/lpm/lph/lpd/lpy – liters per second/minute/hour/day/year
- LWWC – Lela Women’s Water Committee
- MMW – Migori Ministry of Water
- MOU – Memorandum of Understanding
- NGO – Non-Governmental Organization
- OSU – Oregon State University
- WHO – World Health Organization
- WRMA – Water Resources Management Authority
Post Implementation Report Part 2 – Technical Information

1.0 EXECUTIVE SUMMARY

From July 9th to August 3rd 2012, the Oregon State University chapter of Engineers Without Borders USA (EWB-OSU) traveled to Lela, Kenya for the first implementation of the Lela Community Water Project (LCWP), recognized by EWB-USA as project number 5091.

The LCWP was started in 2008 by the Lela Women’s Water Committee (LWWC) to address the lack of reliable safe water for residents of Lela. The goal of the project is to meet the World Health Organization’s recommendations for water quantity, quality, and accessibility for all residents of Lela. This translates to a total supply of 100,000 liters per day (lpd) for the entire community, with safe quality for the intended purpose.

Located in southwest Kenya, Lela is an agrarian community of approximately 2,000 people. EWB-OSU is currently working with Operation H2O, an NGO that focuses on well drilling and community capacity building in Kenya, to help meet Lela’s need for clean water. During the July 2012 trip, the LWWC signed a memorandum of understanding with EWB-OSU and Operation H2O, affirming their commitment to managing Lela’s new water sources (see Appendix 14.1).

The LCWP began in 2008 when the LWWC submitted a project application to EWB-USA. EWB-OSU adopted the LCWP in 2009, and has committed to partnering with Lela through 2014. Currently the LCWP is the only project within EWB-OSU’s Kenya program. The first assessment trip was completed in December 2009 (health assessment and community needs survey) which was followed by a second assessment in June 2011 (technical water source assessment). As a result of these assessments, an alternatives analysis was completed which concluded that the best options for implementation were drilled community water wells and rainwater catchment systems.

During the trip, a well was drilled to approximately 200 feet and fitted with an Afridev hand pump. This well is providing water at approximately 20 liters per minute (lpm). In addition, a rainwater catchment system was expanded at the Lela Primary School. The capacity of the system was increased to 40,000 liters by installing three HDPE 10,000 liter water tanks on reinforced concrete foundations. The existing 10,000 liter water tank was implemented in June 2011 by an NGO not related to EWB-OSU. All four tanks were fitted with first flush and overflow pipes, flush valves, and taps. Only minor deviations were made from the systems as designed. These deviations are summarized in section 6.3. Drawings of each system as-built are provided in section 6.4.

The first implementation trip of the project was considered a success. The systems were complete as designed at the time that EWB-OSU’s travel team left Lela. Portions of construction that the Lela community was responsible for (e.g. the fence surrounding the well) have progressed according to EWB-OSU’s contacts in Lela. Both implemented facilities are considered fully functional at this time.
2.0 INTRODUCTION

The purpose of EWB-OSU’s first implementation trip to Lela was to drill a community water-well and to expand a rainwater catchment system at the Lela Primary School. The purpose of this report is to explain how the trip contributed to the goals of the LCWP, and to characterize the future of EWB-OSU’s partnership with the Lela community. The report is divided into several sections including program background, community information, project summary, and monitoring. The report also includes copies of official documents and agreements made with the Lela community and Kenyan government.
3.0 PROGRAM BACKGROUND

EWB-OSU took on the LCWP in 2009. Two assessment trips were completed that included community needs and health surveying, technical water source assessment, and GPS mapping. Based on the information gained, an alternatives analysis was carried out in 2011. Several options were considered: drilling a borehole and installing a hand pump or diesel/solar powered electric pump; rainwater collection on various available roof configurations; or surface water treatment and distribution from a marsh. The high cost of diesel was considered prohibitive for Lela, while the potential for theft of solar panels ruled out a solar-electric system. Water quality testing has shown that surface water sources are highly contaminated with bacteria and would require substantial operating costs for treatment. Ultimately, EWB-OSU determined the best option for implementation was to drill a community water-well fitted with a hand pump and build a rainwater catchment system at the Lela Primary School.

The goal of the LCWP is to meet World Health Organization (WHO) standards for water quality, quantity, and access for all 2,000 residents of Lela. The WHO recommends 40 liters per capita per day (lpcd) for the purposes of drinking, cooking, basic personal washing, and clothes washing, with ten liters per category. In the context of a school, WHO recommends 2 liters per student per day. By comparison, the Migori Ministry of Water (MMW) design criteria call for 20 lpcd for members of rural households and 5 lpcd for students. EWB-OSU has chosen to defer to the WHO standards, on the basis that those guidelines are widely accepted and the water usage is not directly indicated in the local standards. Also, aiming for the greater of the two benchmarks in the general sense will ensure both are satisfied upon successful project completion. The WHO standards are the ultimate goal for the community, while the MMW criteria standards can be considered as a benchmark of progress. Note that quantity of water is not the only pertinent aspect of this project; adequate access should also incorporate time spent collecting water and water quality. Because of this, the WHO also provides recommendations to address these factors. Following is the stated goal of this project, based on WHO recommendations:

- Provide 2 lpcd for students at the Lela Primary School for the purposes of drinking & hygiene
- Provide 40 lpcd for the purposes of drinking, cooking, hygiene, and laundry
  o During all seasons/months
  o Meeting or exceeding WHO recommendations
    ■ Access less than 500 meters away for all households
    ■ At least one water point for every 250 people
    ■ Flow rate of at least 7.5 lpm at each access point
    ■ Safe water quality for the intended purpose

For the 2,000 people in Lela, the total water required to meet the minimum value of 40 lpcd is 80,000 lpd. This includes the 2 lpcd that students require during school hours, but does not account for population growth. The current population growth in Kenya is 2.444% (CIA World Factbook). Assuming that the average population growth in Kenya is representative of Lela, the projected population of Lela in 2020 is approximately 2,500 people, increasing the estimated daily water demand to 100,000 lpd. The possibility that, by virtue of securing an improved water source, the population of Lela could increase at a higher rate is not accounted for. However, given these considerations, the team still concludes that 100,000 lpd is an appropriate goal. The initial focus of this project is water supply quantity; potential treatment systems will be considered as a secondary objective in the future.
4.0 TRIP DESCRIPTION

From July 11th to August 1st, EWB-OSU worked in Lela. Five student travelers, on professional mentor, and a videographer stayed with a host family. The primary objectives of the trip were as follows:

- Expanding the existing rainwater catchment system at the Lela Primary School
- Supervising the drilling and installation of a new hand pumped well
- Participating in community building activities
- Promoting and coordinating education and training opportunities regarding the new systems

Three 10,000 liter rainwater catchment tanks and the necessary gutters and piping to expand the existing rainwater catchment system at the Lela Primary School were successfully installed. Minor tasks were incomplete at departure but were scheduled to be completed by a local technician shortly after the team’s departure. A well was drilled and constructed successfully and the community agreed to build a fence around the well pad to keep livestock away. Both systems are discussed in detail in section 6.

Additional tasks which included mapping the western border of Lela using GPS and installing a weather station at the Lela Primary School were completed (the latter as part of EWB-OSU’s partnership with John Selker and the TAHMO project). EWB-OSU now has detailed GPS information regarding the entire perimeter of Lela (see Appendix 14.6). The weather station was sponsored by a research professor at Oregon State University and will provide the team with remotely-updated data including wind speed, temperature, rainfall, and depth of water in one of the 10,000 liter water storage tanks. This is beneficial for determining usage rates and the efficiency of the system.

In addition to the physical systems implemented by the EWB-OSU team, education and training events were also organized to give all community members the opportunity to learn about the systems. These community and capacity building workshops were sponsored by the local ministries of Water, Public Health, and Gender and Social Development. Each party used its respective background to communicate the importance of the use, operation, maintenance, and management of both water systems.
5.0  COMMUNITY INFORMATION

5.1  Description of Community

Lela is a community in the Migori district of the Nyanza province in southwestern Kenya, about 50 kilometers from Lake Victoria. It is home to an estimated 2,000 people. The majority of community members are subsistence farmers and business people in neighboring markets. Diets consist of foods such as kale, maize, potatoes, mangos, oranges, avocado, papaya, guava and cassava, as well as traditional foods and plants that were unrecognized by the travelers. Dholuo is the mother tongue of those born in Lela. Community members who have moved into the area generally speak to one another in Kiswahili, the lingua franca of the area. The children learn English and Kiswahili in school though elders tend to speak limited English in favor of Kiswahili.

Lela currently relies on a variety of methods to obtain water, varying seasonally. The community experiences two wet seasons and two dry seasons each year (see Figure 5.1.1). During the wet seasons, various surface water sources are available including surface pits, two hand dug wells, the Ore River, and a marsh area. These sources are often highly contaminated and reportedly dry up during Lela’s driest seasons, with the exception of the Ore River, which is perennial. Some community members have tin roofs and use them to collect rainwater by installing small sections of gutters leading to collection buckets.

![Lela, Kenya Rainfall by Data Source](image)

*Figure 5.1.1 – Lela annual precipitation pattern*

During the dry seasons, residents have historically had two main options for obtaining water: walk as far as five kilometers one-way to a well located in the town of Bondo, or walk several kilometers to a river south of Lela, near the Tanzanian border. Bondo has two borehole supplies. The first, located at the northwest end, is fitted with a hand pump. The second, located at the northeast end, is fitted with a diesel
pump and storage tank. This pump is the main supply for the town as it has a higher capacity, but Lela does not claim to use this source. The community of Lela has made efforts to improve local water availability and quality through the creation of the Lela Woman’s Water Committee (LWWC). It was this committee that initially contacted EWB-USA to request assistance. The LWWC made it clear to EWB-OSU that their desired solution was a community well, due to their familiarity with the success of such wells in neighboring communities.

As a result of the July 2012 implementation, Lela now has access to an improved water source. Lela’s new community well, located near the center of the community, is pumped by hand using an Afridev hand pump. An expanded rainwater catchment at the Lela Primary School is providing water to students via four 10,000 liter water storage tanks. Both systems are described in detail in section 5 of this report.

5.2 Community Relations

The relationship between EWB-OSU and the Lela community has been positive and constructive throughout the life of the program. EWB-OSU maintains regular contact with the Lela community via weekly phone calls between the project coordinator and Lela’s elected village elder, Charles Olang’o, and his son Paul Olang’o. The July 2012 implementation built upon previous relationships, as EWB-OSU sought local participation and ownership. Some of the key partners during this implementation and their contributions are listed below:

- Operation H2O (represented by Mr. Okello) managed all aspects of well construction including drilling and pump installation
- Mr. Johnston (former chairman of Lela Primary School) and his team of local construction workers carried out construction of the rainwater catchment designed by EWB-OSU
- The LWWC facilitated meetings and committed to managing Lela’s new community water well
- The Olang’o family hosted the travel team, prepared meals, arranged transportation, and provided space for meetings with the LWWC
- Paul Olang’o served as guide and translator to the travel team during their stay in Kenya

At the start of the July 2012 trip, EWB-OSU signed a Memorandum of Understanding (see Appendix 14.1) with the LWWC. This document outlines the commitment made between these two organizations and with Operation H2O. The document was signed by all parties and copies were left with Charles Olang’o. All commitments outlined in the document were met, with the exception of the cash contribution the LWWC agreed to make towards the cost of the well. After agreeing in principle, the LWWC later reported that they were having trouble fundraising the money (they had raised 7,000 of the 17,000 KSH needed). However, they were optimistic that fundraising would be more successful post-implementation, once people were able to benefit from the well. The LWWC agreed to wire the funds to EWB-OSU once available. As of the date of submission of this report, no funds have been collected by EWB-OSU. This topic will require further discussion by EWB-OSU.

Overall, the community has demonstrated a strong commitment to managing their new infrastructure. The fence which the LWWC agreed to build around the well pad is nearing completion. In addition, they have developed a schedule for using the well. A chain and lock were purchased to secure the lever on the hand pump to the well pad when it is not in use. It is unlocked every day from 10am to 12pm and from 4pm to 6pm. This allows for the committee to monitor who is using the well and thus who owes fees. The LWWC has also committed to working with the Migori Ministry of Gender & Social Development to develop a formal constitution which details the policies that will be put in place to manage Lela’s new community well. These developments are encouraging to EWB-OSU.
6.0 PROJECT SUMMARY

6.1 Project Description

To continue striving towards the LCWP’s goal of clean, accessible water for all community members, this implementation trip’s focus was to implement a drilled well, fitted with an Afridev hand pump, for all community members to use for domestic purposes. Secondly, EWB-OSU sought to expand the rainwater catchment system at the Lela Primary School to utilize the entire roof area and increase storage capacity by adding three 10,000 liter tanks, for a total capacity of 40,000 liters. Community and capacity building were key objectives that were carried out in parallel to these implementations to ensure community ownership and sustainability.

Other objectives of the trip were to complete further GPS mapping of the boundaries of Lela, as well as the installation of an independent weather station at the Lela Primary School to monitor local weather conditions and monitor the water level in one of the 10,000 liter storage tanks. All objectives were completed during this implementation trip.

6.2 Summary

The drilling and construction of the well and installation of the hand pump was managed by Operation H2O, who sub-contracted with Serve In Love Africa Trust (SILA Trust) for the drilling and Sparkle Geologic Services for the drawdown test. The pump installation was carried out by Operation H2O. A permit to drill was obtained from the Water Resources Management Authority in Kenya prior to the start of construction (see Appendix 14.2) The well was drilled to a depth of approximately 195 feet with a yield of about 50 liters per minute during a one-hour pump test (which unfortunately lasted only 40 minutes before the electric pump failed). This is a sufficient yield for the Afridev hand pump that was installed, as its maximum yield is 20 liters per minute. As expected, the initial yield of the hand pump was somewhat turbid as the well was developed and suspended cuttings were flushed out. Unfortunately, Operation H2O was unable to source a reliable pump to perform a 24 hour pump test, which would have given the travel team more information about the nature of the local groundwater resources. It also would have helped develop and clean the well. Fortunately, the information from the one-hour pump test was enough to give the travel team (including the professional mentor) enough confidence that the aquifer would be sufficient for the Afridev hand pump. As a result, the well had to be cleaned out using the hand pump, which meant that the turbidity would decrease slowly over time. Based on EWB-OSU’s weekly communication with the community, this has in fact occurred and the well water has become quite clear.

Three additional 10,000 liter water tanks were placed at the Lela Primary school to capture water from the roof. This project was completed under the supervision of a local technician named Johnston who had a team of workers with him to implement the project. The tanks, gutters, pipes, and the materials for the foundations were purchased in Migori and delivered to Lela. Johnston and his team first dug the ground at the specified location for the tanks and then put in the sub-base. The concrete mixing was done manually and cured for five days following the pour. The tanks were then placed on the foundations and anchored. First flush, overflow, and drainage pipes were added. In addition, the gutters were connected to the roof at the determined slope points. Lastly, a hydrostatic pressure gauge (one of the sensors on the weather station installed at the school) was put in one of the tanks to remotely monitor the water level throughout the year.

Water samples collected from the newly drilled well following disinfection and installation of the hand pump were sent to the Catholic Diocese of Nakuru (CDN) water quality laboratory. The results (see Table
6.2.1, Appendix 14.3) showed that the water met WHO standards for all parameters with the exception of turbidity and concentration of manganese. However, initially high levels of turbidity are normal for new wells. Following the travel team’s departure, EWB-OSU’s community contacts in Lela reported that the water had cleared considerably since the time of collection. In the case of manganese contamination, it was discovered that CDN’s reported WHO standard was incorrectly reported as 0.1 mg/l. The actual standard is 0.4 mg/l (WHO Guidelines for Drinking Water Quality, 2008, p. 398), above the measured value of 0.3 mg/l.

Table 6.2.1 – CDN water quality results (results of concern are highlighted in grey)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Hand-dug well</th>
<th>Rainwater</th>
<th>Drilled well</th>
<th>Units</th>
<th>KEBS/WHO limits*</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.3</td>
<td>7.8</td>
<td>6.9</td>
<td>KEBS/WHO</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>Turbidity</td>
<td>78</td>
<td>1</td>
<td>117</td>
<td>NTU</td>
<td>5</td>
</tr>
<tr>
<td>Alkalinity total (pH=4.5)</td>
<td>230</td>
<td>35</td>
<td>236</td>
<td>mg CaCO₃/l</td>
<td>1000</td>
</tr>
<tr>
<td>Hardness total</td>
<td>138</td>
<td>16</td>
<td>185</td>
<td>mg CaCO₃/l</td>
<td>500</td>
</tr>
<tr>
<td>Total Dissolved Solids (residue dried at 180°C)</td>
<td>62</td>
<td>34</td>
<td>70</td>
<td>mg/l</td>
<td>1500</td>
</tr>
<tr>
<td>Calcium (Ca²⁺)</td>
<td>66</td>
<td>3</td>
<td>33</td>
<td>mg/l</td>
<td>250</td>
</tr>
<tr>
<td>Iron (Fe²⁺)</td>
<td>0.5</td>
<td>0.1</td>
<td>0.1</td>
<td>mg/l</td>
<td>0.3</td>
</tr>
<tr>
<td>Magnesium (Mg²⁺)</td>
<td>14</td>
<td>1</td>
<td>24</td>
<td>mg/l</td>
<td>100</td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>µg/l</td>
<td>10</td>
</tr>
<tr>
<td>Manganese (Mn²⁺)</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
<td>mg/l</td>
<td>0.1</td>
</tr>
<tr>
<td>Nitrate + Nitrite (NO₃⁻-N)</td>
<td>0.3</td>
<td>1</td>
<td>3</td>
<td>mg/l</td>
<td>10</td>
</tr>
<tr>
<td>Total Reactive Phosphorous (P)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>mg/l</td>
<td>-</td>
</tr>
<tr>
<td>Chloride (Cl⁻)</td>
<td>5</td>
<td>0.5</td>
<td>24</td>
<td>mg/l</td>
<td>250</td>
</tr>
<tr>
<td>Fluoride (F)</td>
<td>1.7</td>
<td>0.1</td>
<td>0.5</td>
<td>mg/l</td>
<td>1.5</td>
</tr>
</tbody>
</table>

*WHO standards are listed as reported by CDN and were found to be inaccurate in some cases

Official water quality results for Lela’s new well were obtained from the Ministry of Public Health and Sanitation. The results (see Table 6.2.2, Appendix 14.4) show high levels of bacterial contamination in the well. This contradicts field testing conducted by the travel team, which indicated the absence of coliform bacteria. Mr. Okello has agreed to return to Lela to repeat the disinfection process and submit a second sample for analysis. This second test will clarify the results obtained in the first test and will also help determine the degree to which the initial turbidity has subsided.
Table 6.2. – Official water quality results (results of concern are highlighted in grey)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Results (Drilled well)</th>
<th>KEBS/WHO limits*</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.8</td>
<td>6.9 – 9.2</td>
</tr>
<tr>
<td>Turbidity</td>
<td>107 NTU</td>
<td>10 NTU</td>
</tr>
<tr>
<td>Magnesium (Mg(^{2+}))</td>
<td>6.8 mg/l Mg</td>
<td>250 mg/l Mg</td>
</tr>
<tr>
<td>Calcium (Ca(^{2+}))</td>
<td>36.8 mg/l Ca</td>
<td>250 mg/l Ca</td>
</tr>
<tr>
<td>Chloride (Cl(^{-}))</td>
<td>40.0 mg/l Cl</td>
<td>600 mg/l Ca</td>
</tr>
<tr>
<td>Nitrate (NO(_3)(^{-}))</td>
<td>4.4 mg/l NO(_3)</td>
<td>45 mg/l NO(_3)</td>
</tr>
<tr>
<td>Nitrite (NO(_2)(^{-}))</td>
<td>0.82 mg/l NO(_2)</td>
<td>0.1 mg/l NO(_2)</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>0.1 mg/l Fe</td>
<td>0.1 mg/l Fe</td>
</tr>
<tr>
<td>Fluoride (F(^{-}))</td>
<td>0.24 mg/l F</td>
<td>1.0 mg/l F</td>
</tr>
<tr>
<td>Manganese (Mn(^{2+}))</td>
<td>0.01 mg/l Mn</td>
<td>0.05 mg/l Mn</td>
</tr>
<tr>
<td>Phosphate (PO(_4)(^{3+}))</td>
<td>0.01 mg/l PO(_4)</td>
<td>0.05 mg/l PO(_4)</td>
</tr>
<tr>
<td>Total Alkalinity (CaCO(_3))</td>
<td>220 mg/l CaCO(_3)</td>
<td>500 mg/l CaCO(_3)</td>
</tr>
<tr>
<td>Total Hardness (CaCO(_3))</td>
<td>120 mg/l CaCO(_3)</td>
<td>500 mg/l CaCO(_3)</td>
</tr>
<tr>
<td>Conductivity</td>
<td>210 μS/cm</td>
<td>2500 μS/cm</td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>106 mg/l</td>
<td>1500 mg/l</td>
</tr>
</tbody>
</table>

*WHO standards are listed as reported and were found to be inaccurate in some cases*

The results obtained from the CDN lab and from the Ministry of Public Health and Sanitation are at times contradictory and difficult to interpret. There are also discrepancies between the WHO standards reported. For example, the official water quality results list nitrite concentrations as 0.82 mg/l, above the standard of 0.1 mg/l. However, the CDN results list nitrate + nitrite as 3 mg/l, and the WHO standard as 10 mg/l. The project team will continue to monitor water quality on future trips. At this time, there is no conclusive evidence that the well water is unsafe for human consumption.

Additional field testing was done within Lela to quantify water quality from other sources including the marsh, Lela’s hand-dug well, and rainwater from the water tank installed in 2011. The results are available in Appendix 14.5. GPS data were taken to determine the complete boundaries of the Lela community and were added to the map which is included in Appendix 14.6. The updated map shows the locations of churches, survey points, the Lela Primary School, the Olang’o home, hand dug wells, and the new well.
6.3 Difference Between Planned and Actual Implementation

The rainwater catchment system retained most of the original design. However, some modifications were put in place as necessary to improve the constructability and functionality of the system. As described previously in section 4.0, three rainwater catchment tanks and attached gutters were constructed as an addition to the existing rainwater catchment system. The construction process of the system was slightly altered with a greater emphasis on a more experienced skill set. Originally, the system was to be built by volunteers from the community, as well as travel members. This plan was in place to engage the community through hands-on involvement. Upon arrival to Lela, a local technician (and former chairman of the Lela Primary School) named Johnston suggested the most appropriate and effective way to build the system would be to hire local labor. Hired labor was chosen over volunteers given relative experience in constructing similar systems with familiar techniques.

This decision not only changed composition of the personnel actually involved in construction, but it also changed some of the construction practices. For instance, due to the preference of the fundi, concrete was mixed by hand on the ground, rather than in a drum mixer because that was the technique most familiar to the fundi and his crew, allowing them to work quickly. The direction of the fundi led to the addition of flush valves on the bottom of the rainwater catchment tanks to enable members of the community to clean the insides of the tanks. The overflow system on the rainwater catchment was originally designed to have an underground drainage feature which would dissipate the effect of the water on the surrounding soils. The design changed when the team and the fundi determined that the overflow system would only consist of a surface pipe overflow that opened up onto the ground. The community would add to the overflow if necessary. The pipe diameter for the overflow was also reduced from 4 inches in diameter to 3 inches for reasons of constructability and availability of materials. Figure 6.3.1 depicts the orientation of the tanks that was chosen by Johnston as the most efficient layout.

![Figure 6.3.1 – As-built orientation of water storage tanks at the Lela Primary School](image-url)
The well construction stayed true to the planned procedure and design with the exception that completion was delayed due to a faulty electric pump used to complete the drawdown test. The pre-implementation report called for a 24-hour drawdown test on the well to establish the capacity of the well to pump water. During the trip, the team was unable to complete the drawdown test due to complications in locating the appropriate rental pump. It was determined by the travel team, under the guidance of the travel mentor, that the drawdown test, although highly important, was not necessary to complete construction of the well. The travel team had to leave before the correct pump could arrive, so that portion of the well testing was skipped, and the well was completed by the conclusion of the trip.

The land surveying task was minimized to GPS mapping prior to the departure of the travel team. There were two main contributing factors that lead to this decision. The first was the purpose and usefulness of the resulting land survey data compared to the time and effort commitment required from the travel team. The data would have been used to design a water storage and distribution system. However, concerns regarding the feasibility and sustainability of such a system resulted in land surveying being dismissed as a goal of the trip. The second contributing factor was the difficulty associated with the allocation of appropriate land surveying equipment and high cost and reliability issues the equipment accompanied. Overall, EWB-OSU concluded that it was appropriate for the land survey task to be minimized to GPS mapping to conserve the limited time resource of the travel team.

6.4 Drawings

![Figure 6.4.1 – As-built rainwater catchment tank/foundation schematic](image-url)
6.5 Operation and Maintenance

Operation and maintenance training was addressed in multiple ways. The travel team’s direct influence was during meetings held with the community, the LWWC and Mr. Okello. Further content included organizing how the community would regulate who uses the well water and rainwater catchment water from the primary school, how to collect monthly fees from users, as well as how much the charge for these fees. It was decided by the committee that each family that uses the well would pay 50 shillings per month, and that names and payment records would be kept by the committee. Water from the primary school’s rainwater catchment tanks was decided to be used for the students and teachers at the school, and that the students could bring home up to two liters per day for consumption. A maintenance manual was later produced and will be sent to Paul in Nairobi to be delivered to Lela (see Appendix 14.7). Mr. Okello will return to Lela as the community gets used to the well to hold more workshops to ensure the community heeds the lessons and stays committed to their agreement. Additionally, the local ministries of Public Health, Water, and Gender and Social Development held workshops in the community which included, among other topics, correct operations and maintenance procedures to ensure the longevity and sustainability of the systems.

6.6 Education

The travel team held multiple meetings throughout the trip with the LWWC and other community members, during which the importance of operations and maintenance and usage regulation of the systems was discussed. The team made it clear that the community’s ongoing participation was vital to the long term success of the projects, and that it was in their best interest, not only that of the EWB-OSU team. The team discussed the logistics behind the usage of the rainwater catchment system at the school to ensure maximum efficiency (e.g. using all four tanks simultaneously rather than using one until it is
empty, then moving on to the next one) as well as that for the hand pump. Technical details were also included to better convey the significance of maintenance duties, such as cleaning out the first flush systems on the rainwater catchment tanks after each significant rain event, and the inner workings of the hand pump’s rods and valves.

To more successfully reiterate these points, the EWB-OSU team arranged for the local ministries of Public Health, Water, and Gender and Social Development to come to Lela to perform workshops with community members. Some of the ministries’ representatives plan to return Lela to continue the education process during the weeks and months following the implementation in July. The representatives from each ministry addressed the importance of implementation of each of the systems using approaches relevant to their background; the Ministry of Health discussed the need for clean water and how to most efficiently use the water from the new well to help prevent waterborne diseases as well as educate the community about sanitation and food quality control; the Ministry of Water addressed topics related to water sources and sanitation, as well as the technical operation of the Afridev pump and the rainwater catchment system and the maintenance requirements that will prolong the life of the implemented systems; the Ministry of Gender and Social Development is providing trainings and support for the LWWC to come up with a constitution that will be relevant for the group dynamics and reflect the management and fee structure of the systems.

EWB-OSU considered it to be much more effective for community members to hear lessons from fellow Kenyans (especially from people who reside in the same district) than to listen to members of a foreign NGO. The ministries have extensive experience working with locals regarding public health, maintenance of water systems, and gender and social development. In addition, they were pleased to have the chance to offer their public services to rural areas of the Migori District.
7.0 MONITORING APPROACH

7.1 Current project monitoring

Both the rainwater catchment system and the water well were functioning as designed at the time the team left. The only real problem which occurred during construction was the failure of the pump during the drawdown test. This failure led to high turbidity, since the well was not developed during the pump test. Rather, it had to be developed using the hand pump.

Regarding the rainwater catchment system, a few small tasks associated with the tanks remained upon the travel team’s departure. These included finishing the concrete curbs around the base of the storage tanks, as well as an overflow channel dug in the dirt surrounding the tanks to avoid any overflowing water to erode the smooth ground directly around the school and in the schoolyard. Recent telephone conversations with Lela community contacts informed EWB-OSU that these tasks have now been completed.

For the well, all components were installed but the lack of a 24-hour pump test had not yet flushed out the suspended cuttings from the drilling. Significant decreases in turbidity occurred in one day of hand pumping prior to the team’s departure. The community has recently indicated that the turbidity is significantly minimized and is now no longer an issue. The community also agreed to the construction of a fence surrounding the well pad to keep livestock away from the pump, which has been completed, with the exception of a gate (which is nearly completed).

The EWB-OSU project team can monitor the information recorded by the weather station installed at the primary school via the internet, making regular analysis of rainfall data and water levels in one of the storage tanks possible. Questions or concerns can be brought up with community contacts via weekly phone calls.

7.2 Monitoring of past-implemented projects

There are no past-implemented projects in this program.
8.0 COMMUNITY AGREEMENT/CONTRACT

The official means of agreement between the Lela Community and EWB-OSU is a Memorandum of Understanding (MOU). The travel team brought a copy of the MOU to Lela and held a signing ceremony with the LWWC at the beginning of the trip, on July 13, 2012. A signed copy is included in Appendix 14.1.
9.0 PHOTO DOCUMENTATION

Figure 9.0.1 – LWWC with EWB-OSU travelers

Figure 9.0.2 – Community meeting place
Figure 9.0.3 – Rachael (left) and Rose (right), hosts of the EWB-OSU travel team

Figure 9.0.4 – Paul Olang’o, translator and guide to the EWB-OSU travel team
Figure 9.0.5 – Roped off drilling area

Figure 9.0.6 – Travel team with videographer overseeing construction
Figure 9.0.7 – Well casing with hand-cut slots

Figure 9.0.8 – Gravel pack
Figure 9.0.9 – Afridev plunger

Figure 9.0.10 – Drilling underway

Figure 9.0.11 – Completed well with Afridev hand pump and concrete pad
Figure 9.0.12 – Water quality testing

Figure 9.0.13 – Marsh

Figure 9.0.14 – Collecting water sample at marsh
Figure 9.0.15 – Construction of concrete foundations

Figure 9.0.16 – Gutter and first flush connection

Figure 9.0.17 – Local workers mixing concrete
Figure 9.0.18 – Installation of weather station

Figure 9.0.19 – Rainwater catchment system and automated weather station
Figure 9.0.20 – Solar charging battery
10.0 LESSONS LEARNED

- The travel team experienced difficulty receiving cash advances from the Barclays bank in Migori. A great deal of time was wasted at the bank which should be avoided in the future. Pursuing alternative forms of payment is highly recommended, such as money orders or cashier’s checks. Also, cash advances carried heavy fees (~$200) which could be avoided by using alternative payment methods.

- The travel team expected to do most of the construction work for the rainwater catchment system. However, a team of skilled laborers from the community were ready and willing to carry out implementation. Changes to the budget reflect this. Hiring local skilled labor was more appropriate and increased community ownership.

- The 525 report called for renting a concrete mixer to pour foundations for the rainwater catchment tanks. Local laborers laughed at this idea as they have plenty of experience mixing concrete by hand using the volcano method (see Figure 9.0.17).

- The Ministries of Water, Public Health, and Gender & Social Development are very willing to conduct educational programs within the community, although they require small fees for transportation, lunch, and supplies (if applicable). The ministries also like to be informed concerning project development, meetings, system implementation, etc.

- The Ministry of Gender and Social Development is actively involved in aiding communities with management strategies and training leaders.

- Wear closed toe shoes and avoid getting blisters. Avoid spandex clothing if you are bathing in semi-dirty water and rash easily.

- Boreholes drilled in this area are typically 7 inches in diameter. Casings are typically 5 inches in diameter. The 4 inch casing used in Lela’s well made it difficult to perform a drawdown test. The majority of electric pumps available in the area are larger than 4 inches.

- Two shallow wells, built within the last 10 to 15 years in Lela, were broken down and left unreppaired. One hand-dug well in Lela was not repaired by the LWWWC allegedly because of a controversy where the family nearest the well claimed it as personal property.

- The rainwater catchment system storage tank previously installed at the school by the organization Concern Worldwide was locked and leaking. The tank water was used despite this leak and it was eventually repaired during the trip. Teachers at the Lela Primary School have keys to the locks on all four tanks and ultimately have control over the system.

- During the trip, the travel team learned new information regarding Jerry Ochieng, corroborating previous suspicions about his intentions within Lela and his potential for corrupt behavior. In addition, EWB-OSU has reason to believe that the new chairman of the Lela Primary School is a friend of Jerry who was elected in a questionable manner. He is not popular among community members and is likely to be removed from his position after next year’s election.

- Johnston, the previous chairman, is well liked among parents, teachers, and students alike. He is a technician who built the Lela Primary School himself and oversaw construction of the rainwater catchment during EWB-OSU’s trip. He announced his intention to seek his former position as chairman of the school, following objections from community members regarding the new chairman.

- Meetings generally start several hours after they are scheduled to begin.
11.0 PROJECT STATUS

<table>
<thead>
<tr>
<th>Implementation Continues</th>
<th>Monitoring</th>
<th>Cancelled</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
12.0 NEXT PHASE OF THE PROGRAM

Before leaving Lela, the EWB-OSU travel team met with the LWWC to discuss the future of the LCWP. During this meeting, the LWWC expressed their desire for further water source development within Lela, specifically more wells. This request was formally made through a document submitted to EWB-OSU which expressed the LWWC’s appreciation for the work done thus far and their desire for further partnership (see Appendix 14.8). Though Lela’s new well is producing water at approximately 20 liters per minute, it serves only a portion of Lela’s residents since many people live more than a kilometer away. Therefore, future wells developed in other parts of Lela will be needed to meet the accessibility goal of 500 meters for all households. The next phase of the program will focus on identifying plausible locations for future wells. This will include using maps of the community to identify areas not served by Lela’s new well and conducting a new hydrogeological survey as a prerequisite to applying for another permit to drill.

EWB-OSU had an extremely positive experience working with Operation H20 and their lead hydrogeologist Melchizedeck Okello and would be open to working with them again in the future. Mr. Okello has also expressed interest in working with EWB-OSU again, as well as assisting with government permitting and other required steps prior to travel. The most likely travel dates for the next trip are June 2013, though they would be subject to Mr. Okello’s availability. If funding permits, additional rainwater catchment systems could be developed at other public buildings within Lela.

In addition to the need for clean water in the community, the Lela Primary School is in need of improvements and expansion to accommodate the growing student population in Lela. The Primary School Board made a formal request to EWB-OSU for assistance with this work (see Appendix 14.9). To take on this work would require a second project within the program.
13.0 PROFESSIONAL MENTOR/TECHNICAL LEAD ASSESSMENT

13.1 Professional Mentor/Technical Lead Name (who provided the assessment)

Jeff Randall

13.2 Professional Mentor/Technical Lead Assessment

Many factors contribute to the success of a project. The following is a brief annotated list of the keys to success for the EWB-OSU Lela, Kenya project that I observed as professional mentor. Although these keys are not applicable to all projects, I’ve included them here to at least spark project planning thought by future EWB project teams.

Key Individuals

- Zachary Dunn, project manager. His management and leadership skills were perfectly suited to international projects. He was organized, thorough, detailed, focused on not only the technical details but on the team and on the community before, during and after the work. These attributes are critical even eclipsing strong technical capabilities.

- Mr. Okello, in-country well system installation general contractor. Having a trustworthy and honest and local (southwestern Kenya) in-country team member who coordinated the drilling, aquifer testing, well head completion, and pump installation removed a large burden from the project team and overall resulted in a superior well system. Moreover, he will likely provide advice to the community regarding future maintenance. The modest payment for his services was paid back many times over.

- Paul Olang’o, in-country “guide, interpreter, protector”. Having a trustworthy and honest local team member involved 24/7 with the project during our stay in Kenya allowed the rest of the team to focus on the work at hand. Paul’s presence and local knowledge (he is well known and respected by the community) greatly increased productivity. The tiny stipend paid to Paul by the project was an investment with an incredible return.

- Charles and Rachael Olang’o, host family. Having a host family to take primary care of the team’s safety, housing, and basic cooking needs also greatly increased productivity by allowing the team to focus more time and energy on the project. Both Paul Olang’o and his parents Charles and Rachael also acted as active community liaisons and greatly increased the team’s access to the many dimensions of the community.

- Johnston, construction fundi (journeyman). The project team had anticipated, and in fact practiced construction of the rainwater collection system foundations and overall system installation prior to leaving for Kenya. The intent was to supply EWB team labor supplemented with unskilled local community members to do the work (and thus building a stronger community buy-in for the project). It is my opinion that without the use of Johnston and his team of local journeymen and skilled labors that the rainwater collection system could not have been completed by the end of the trip. The work and coordination were difficult even for a local contractor and the work was not finish until the last day. Moreover, it is my opinion, that the use of Johnston, who is well known and highly respected by the local community, and his use of other locals to construct the rainwater collection system likely increased community support and interest in the
success of the project. The very modest cost of hiring skilled labor rather than supplying “free”
EWB project labor was well worth the price as well as reducing potential EWB team and general
community Health and Safety issues.

Key Project Principles and Processes

- A strong focus by the EWB-OSU team from the initial project assessment through post
  implementation on the Lela community’s specific ability (culturally and monetarily) to operated
  and maintain the built infrastructure. Moreover, the team’s focus when dealing with the
  Community was always to stress the fact that the infrastructure was the community’s and that
  they were totally responsible for the future success of the systems EWB provided.

- The EWB-OSU team’s relentless pursuit of community participation at every step and obtaining
  approval and buy-in both verbally and ultimately in writing. The signing ceremony of the
  Memorandum of Understanding where it was read in the communities dialect and signatures of
  all the Woman’s Water Committee (the responsible community group) was very effective in
  making it clear that the community was now responsible.

- Obtaining the necessary permits (with completed hard copies) before the implementation team
  left the States, especially regulatory agency well drilling permits and related paperwork and local
  community or property owner access agreements and rights-of-way, etc. This is a critical project
  milestone because permits and permit revisions, and local permissions can take a great deal of
  time and often extra money that is typically not included in the project team’s travel schedule or
  budget.

- The EWB-OSU team showed a great deal of what I call “design vs reality” flexibility during the
  installation of the well and rainwater collection systems. Many unanticipated things including
  differing equipment, materials, construction techniques than were planned or assumed for design
  (especially the well drilling) cropped up during construction as often happens during overseas
  projects in relatively remote areas. The team was quick to play the cards that were dealt calmly
  and wisely in a way that did not compromise the utility or safety of the finished product, but
  conformed to local reality.

13.3 Professional Mentor Technical Lead Affirmation

I endorse this report as written and acknowledge my participation in the implementation of the project as
described.
14.0 Appendices

14.1 Memorandum of Understanding

Memorandum of Understanding
for the
Lela Community Water Project - First Implementation
7/15/2011 – 8/2/2011

Date: 13 July 2012
Signed by:

[Signatures]

[Names]

[Names]
Lela Community Copy

This agreement is between the community of Lela and the EWB-USA Oregon State University Chapter for the purpose of specifying guidelines for the Lela Community Water Project.

The EWB-USA Oregon State University Chapter agrees to

- Work with Lela to design and develop improvements to their water supply through 2014.
- Finance material purchases not obtainable by the community for project implementations as approved by EWB-USA.
- Ensure training is provided for community members to learn how to maintain water systems implemented in collaboration with EWB-USA.
- Seek input from community members and professional mentors during the design phase, but will not submit plans for approval by a third party.
- Provide as-built drawings to Lela and/or any other necessary authority after project completion if requested.
- Assist the community with the following processes for EWB-USA related implementations:
  - Frame and pour concrete foundations
  - Install gutter system(s) for rainwater catchment system(s)
  - Install piping and connections
- Assess and monitor water quality in Lela, including
  - Rainwater systems
  - Groundwater from new community borehole
  - Existing hand-dug wells (2)
  - Relevant surface waters
- Oversee borehole drilling, well-pad construction, and hand-pump installation for EWB-USA related implementations
- Ensure necessary community training and education occurs regarding
  - Maintenance of hand pump and rainwater catchment systems
  - Fee scheduling and community responsibilities
  - Community mapping and resource planning
  - Water and hygiene education

The following are not the responsibility of EWB-USA Oregon State University Chapter

- Maintenance of the water systems
- Ultimate quality of the water
- Provide funding for maintenance costs
- Governance or oversight of systems

Operation H2O will

- Drill, construct and develop borehole and water well in Lela
- Construct a well-pad
• Install a hand pump
• Provide contacts for ongoing maintenance beyond the technical training of local community members.

The Lela Women’s Water Committee, as representative of the Lela Community, agree to
• Allow the EWB-USA Oregon State University Chapter to work on the Lela Community Water Project.
• Participate in the work of constructing the systems as approved by EWB-USA.
• Provide available resources for the completion of the project (raw materials, basic tools, water, etc.).
• Fund $200 toward implementation costs of a new community water well.
• Establish a financial plan for operation, maintenance, and replacement expenses.
• Designate and oversee a responsible party for water system maintenance and repair.
• Determine the appropriate owner and manager of rainwater catchment systems.
• Plan and oversee the construction of a fence around the well-pad.
• Ensure equitable and sustainable management of the water systems.
• Agree that the goal of the Lela Community Water Project is to improve the quality of life of everyone in the community, not just those who can afford to pay a tax/fee. Therefore,
  o Lela residents will strive to find ways to provide clean water to everyone.
  o Acknowledge the land on which water systems are constructed is publicly owned.
  o Continue to hold elections for water board positions.
Mkataba wa Maelewano
dwa
Mradi wa Maji katika Jamii ya Lela – Utekelezaji wa Kwanza
15/07/2011 – 02/08/2011

Tarehe: 13 July 2012
Hisia:

[Handwritten list of names]

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Nakala ya Jamii ya Lela

Makubaliano hava ni kuti ya Jamii ya Lela na EWB-USA, Mlango wa Chuo Kikuu cha Jimbo la Oregon (EWB-USA, Oregon State University Chapter) kwa madhumuni ya kufanana miongozo katika Mradi wa Maji katika Jamii ya Lela.

EWB-USA, Oregon State University Chapter inakubali

- Kushirikiana na Lela katika kubuni na kuendeleza uboshaji wa maji hadi 2014.
- Kuchangia ununuzi wa vifaa vya utekelazaji wa mradi visivyopatikana katika jamii, kama iliyoruhusuwa na EWB-USA.
- Kuelimisha jamii jinsi ya kudumisha mifumo ya maji itakayotekelezwa pamoja na EWB-USA.
- Kutafuta mchango na mawazo kutoka watu wa Lela na washauri kitaalamu katika hatua ya kubuni; lakin mipango hatupatikana kwa mtu/kundi la tatuu.
- Kama kuna ombi, kupea Lela michoro ya ujenzi na au mamlaka nyingine muhimu baada ya kukanilisha mradi.
- Kusaidia jamii kutekeleza taratibu za EWB-USA zifuatazo:
  - Kumwaga saruji na simiti ya pedi ya kisima.
  - Kuweka michirizi ya paa ya kuteka maji ya mvua.
  - Kuweka mabomba ya maji.
- Kuthamini na kufuatilia ubora wa maji katika Lela, pamoja na
  - Mifumo ya maji ya mvua
  - Maji kutoka kisima kipya
  - Visima vilivyochimbwa na mikono tayari (2)
  - Milili ya maji yanayohusika
- Kusimamia uchimbaji wa visima, pedi ya kisima na kuweka pampu ya mkono kwa ajili ya EWB-USA.
- Kuhakikisha elimu muhimu ya jamii kuhusu
  - Kudumisha pampu ya mkono na mifumo ya kuteka maji ya mvua
  - Ratiba ya ada na wajibu wa jamii
  - Kuweka jamii katika ramani na mipango ya rasimali
  - Elimu ya maji na usafi

Yafuatayo sio wajibu wa EWB-USA Oregon State University Chapter

- Kudumisha mifumo ya maji
- Ubora wa maji mwishowe
- Kuchangia pesa za kudumisha
- Kusimamia na kutawala mifumo

Operation H20

- Itachimba, itajeng aita endeleza kisima katika Lela
- Itujenga pedi ya kisima
- Itaweza pampu ya mkono
- Itatoa mawasiliano kwa ajili ya udumisho unaendelea zaidi ya mafunzo ya kuifundu
Kamati ya Maji ya Wanawake wa Lela, kama wakili wa Jamii ya Lela, wamekubali
  - Kuruhusu EWB-USA Oregon State University Chapter kutekeleza Mradi wa Maji katika Jamii ya Lela.
  - Kushiriki katika kazi ya ujenzi wa mifumo kama iliivyodhinishwa na EWB-USA.
  - Kutoa rasilimali za kutosha kwa ajili ya kukamilisha mradi (malighafi, zana ya msingi, maji, n.k.).
  - Kuchanga $200 kwa ajili ya utekelezaji wa kisima kipya.
  - Kuanzisha mpango wa kifedha kwa gharuma za uendeshaji, matengenezo, na badala.
  - Kuteua na kusimamia mtu/kundi lenye wajibu wa kudumisha na kutengeneza mifumo ya maji.
  - Kuamua mmiliki sahihi na meneja wa mifumo ya kuteka maji ya mvua.
  - Kupanga na kusimamia ujenzi wa uwa litakalozunguka pedi ya kisima.
  - Kuhakikisha usawa na uendelevu wa ya usimamizi wa mifumo ya maji.
  - Kubali ya kwamba lengo la Mradi wa Maji wa Jamii ya Lela ni kuboresha hali ya maisha ya kilo mtu katika Lela, sio tu ya wanaoweza kulipa kodi/ada. Kwa hiyo,
    - Wakazi wa Lela watajitaahidi kumpa kilo mtu maji safi.
    - Kukiri ya kwamba ardhi itakayojengwa mifumo ya maji ni mali ya umma.
    - Kuendelea kupiga kura kwa nafasi za bodi ya maji.
14.2 Water Resources Management Authority Permit to Drill

Water Resources Management Authority
AUTHERISATION TO CONSTRUCT WORKS
FOR THE USE OF WATER

Dear Sir/Madam;

I have the honour to inform you that the Water Resources Management Authority has given you approval to construct the proposed works based on your application dated 22-June-2012 for a Water Permit.

<table>
<thead>
<tr>
<th>Authorization No.</th>
<th>WRMA</th>
<th>WRMA/12/KSU/1K/C/10250/G</th>
<th>Dated</th>
<th>14-June-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type Of Water use</td>
<td>Surface water</td>
<td>Ground water</td>
<td>Effluent discharge</td>
<td>Swamp Drainage</td>
</tr>
<tr>
<td>Diversion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instream Works</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Searage</td>
<td>Shallow Well</td>
<td>Borehole</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARTICULARS OF APPLICANT</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Full name of applicant(s) (In Block letters)</td>
<td>LELA PRIMARY SCHOOL</td>
</tr>
<tr>
<td>2. Category of Applicant - Individual, Group [Association, Society], Company, Institution</td>
<td></td>
</tr>
<tr>
<td>3. ID Number of Applicant (Individual) or Certificate of Incorporation or Registration for Groups or Companies</td>
<td>854997</td>
</tr>
<tr>
<td>4. PIN Number (where available)</td>
<td>A/N</td>
</tr>
<tr>
<td>5. Physical Address where water is to be used</td>
<td>Contact of Applicant</td>
</tr>
<tr>
<td>6. L/R Number(s)</td>
<td>792</td>
</tr>
<tr>
<td>7. Box Number</td>
<td>P.O. Box 102</td>
</tr>
<tr>
<td>8. Village(s)/Ward(s)</td>
<td>Nasilwata</td>
</tr>
<tr>
<td>9. Town</td>
<td>AIGORI</td>
</tr>
<tr>
<td>10. Sub-location(s)</td>
<td>Nasilwata</td>
</tr>
<tr>
<td>11. Post Code</td>
<td>40360</td>
</tr>
<tr>
<td>12. Location(s)</td>
<td>SUNA CENTRAL</td>
</tr>
<tr>
<td>13. Telephone Contact (Landline)</td>
<td>0722364879</td>
</tr>
<tr>
<td>14. Division(s)</td>
<td>SUNA CENTRAL</td>
</tr>
<tr>
<td>15. Telephone Contact (Mobile)</td>
<td>0722364879</td>
</tr>
<tr>
<td>16. District(s)</td>
<td>MEGIRI</td>
</tr>
<tr>
<td>17. Email Contact</td>
<td></td>
</tr>
</tbody>
</table>

WATER RESOURCE DETAILS:

| 16. Name of Body of Water or Aquifer where water is to be diverted, abstracted or stored | Report |
| 17. Is point of abstraction or storage in a Protected Area or a Groundwater Conservation Area? (yes/no) | N/G |
| 18. Sub-catchment Number | 1RC |
| 19. Class of Water Resource | |
| 20. Name of Body of Water or Aquifer where effluent is to be discharged | |
| 21. Sub-catchment Number (Effluent) | EPWU |
| 22. Class of Water Resource (Effluent) | |
| 23. Category of Application (Class of Permit) | B1 |
SUPPLEMENT TO PERMIT/AUTHORIZATION

26. Are there any supplements approved under Section 21 of WRMA Rules (yes/no)
   NO

27. Supplement No.

28. Brief Description of Project and Intended Use for Water Type of Water Use
    FOR DOMESTIC USE

<table>
<thead>
<tr>
<th>Type of Water Use</th>
<th>Groundwater (m³/day)</th>
<th>Surface Water (m³/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>River - Normal Condition</td>
</tr>
<tr>
<td>29. Public</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Domestic</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>31. Livestock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32. Subsistence Irrigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33. Commercial Irrigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34. Industry/Commercial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35. Hydropower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36. Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37. Sub-total</td>
<td>20.00</td>
<td></td>
</tr>
<tr>
<td>38. Quantity Returned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39. Water Abstracted (row 34 - row 35)</td>
<td>20.00</td>
<td></td>
</tr>
<tr>
<td>40. Effluent Discharge</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Having filed the necessary application, maps and plans, and having complied with the provisions of the Water Act 2002, and the rules there under relating to the applications for Water Permits are hereby authorized to construct, subject to the acquisition of the necessary rights of way or easements therefore, if any, the works shown by the said applications, maps and plans in accordance with provisions of the Water Act 2002, the rules there under, and the following conditions:

1. The construction of the works hereby authorized shall commence within a period of 0 days and shall be completed within a period of 5 months from the date of this authorization.

2. (a) Any person who erects or constructs temporary works shall be entitled to divert, abstract, impound, obstruct, store or use water to such extent only as may be necessary for the construction or erection of the works, and whenever it shall be necessary to divert, abstract or impound water during the erection or construction of the works authorized, such diversion, abstraction, obstruction, impounding, or use of water shall be made at such time and in such manner that the works of other operators are interfered with as little as possible and that no damage will be caused to property of another landholder. Provided that if any damage is caused it shall, failing agreement between the parties concerned, be settled by arbitration under the Arbitration Act.

(b) Unless empowered thereto by the Water Resources Management Authority in writing, all temporary works shall be removed within a period of three months from the date of completion of the works authorized or from the date of determination of the authorization (whichever be the earlier) and where any temporary works exist, such as quarries, borrow-pits, excavations, cuttings, tunnels or things of a like nature which cannot be economically removed, efficient precautions to the satisfaction of the Water Resources Management Authority shall be taken, by the person named in the authorization, to render and to maintain all such temporary works safe in the interest of life and property. The Water Resources Management Authority reserves the right to inspect the works authorized by this authorization, and attention is drawn to section 90 of the Act.

3. Any changes between the original proposed design and final as-constructed arrangement has been documented and such documentation submitted to the Authority.
<table>
<thead>
<tr>
<th>CONDITIONS OF AUTHORISATION</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring device</td>
<td>ABSTRACTOR TO INSTALL A METER AT ABSTRACTION POINT</td>
</tr>
<tr>
<td>Controller device</td>
<td>ABSTRACTOR TO INSTALL A SLICE GATE OR VALVE AT ABSTRACTION POINT</td>
</tr>
<tr>
<td>Water Quality Report</td>
<td>ABSTRACTOR TO SUBMIT PHYSICAL, CHEMICAL, AND BACTERIOLOGICAL ANALYSIS REPORT OF WATER USED</td>
</tr>
<tr>
<td>Evidence of DMA Compliance</td>
<td></td>
</tr>
<tr>
<td>Soil and Water Conservation Plan</td>
<td></td>
</tr>
<tr>
<td>Compensation Flow (m³/day)</td>
<td></td>
</tr>
<tr>
<td>Inspection Milestones</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Notification Requirements</td>
<td>CONTRACTED LICENSED BOREHOLE DRILLING CONTRACTOR MUST INFORM THE REGIONAL MANAGER WHEN DRILLING COMMENCES IN ORDER TO SUPERVISE THE DRILLING</td>
</tr>
<tr>
<td>2</td>
<td>PROPOSED BOREHOLE MUST BE DRILLED AT THE SELECTED SITE AND TO THE RECOMMENDED MAXIMUM DEPTH AS CONTAINED IN THE HYDROGEOLOGICAL SURVEY REPORT</td>
</tr>
<tr>
<td>3</td>
<td>MAXIMUM GROUNDWATER ABSTRACTION SHALL BE LIMITED TO 20M³/DAY SUBJECT TO AVAILABILITY FROM 60% FROM THE TESTED YIELD FOR A MAXIMUM PERIOD NOT EXCEEDING 10 HOURS PER DAY</td>
</tr>
<tr>
<td>Storage</td>
<td></td>
</tr>
<tr>
<td>Abribe</td>
<td>ABSTRACTOR MUST INSTALL AIRLINE AND PIEZOMETER AT ABSTRACTION POINT</td>
</tr>
<tr>
<td>Test pumping</td>
<td>ABSTRACTOR TO SUBMIT A TEST PUMPING REPORT</td>
</tr>
<tr>
<td>Other Technical Details</td>
<td></td>
</tr>
<tr>
<td>Effluent Discharge Requirements</td>
<td></td>
</tr>
</tbody>
</table>
The Chief Executive Officer,
Water Resources Management Authority,
P.O.Box 45250-00100,
Nairobi.

4. This Authorization will be automatically cancelled, when the authorized period expires, without any further reference to you unless extension of time limit is applied for prior to date of expiry.

5. The following details/documents/fees are required to complete your application before a Permit may be issued:
   (a) FORM WRMA 008 MUST BE RETURNED DULLY SIGNED WHEN WORKS HAVE BEEN COMPLETED
   (b) 
   (c) 
   (d) 

SIGNATURE

I am faithfully,

Signature of WRMA Officer

<table>
<thead>
<tr>
<th>Name of Officer</th>
<th>W.R.O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>W.R.O</td>
</tr>
<tr>
<td>Date of Signature</td>
<td>19th July 2012</td>
</tr>
</tbody>
</table>
### Catholic Diocese of Nakuru Laboratory Test Report

Bottle 1 = hand-dug well, bottle 2 = rainwater, bottle 3 = drilled well.

#### Table

<table>
<thead>
<tr>
<th>Physical and Aggregate Properties</th>
<th>Bottle 1</th>
<th>Bottle 2</th>
<th>Bottle 3</th>
<th>KES/WHO Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>7.3</td>
<td>7.8</td>
<td>6.9</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td><strong>Turbidity</strong></td>
<td>78</td>
<td>7</td>
<td>112</td>
<td>5</td>
</tr>
<tr>
<td><strong>Alkalinity total (pH=4.5)</strong></td>
<td>210</td>
<td>35</td>
<td>236</td>
<td>1100</td>
</tr>
<tr>
<td><strong>Hardness total</strong></td>
<td>138</td>
<td>16</td>
<td>185</td>
<td>596</td>
</tr>
<tr>
<td><strong>Total dissolved solids (residue dried at 180°C)</strong></td>
<td>62</td>
<td>34</td>
<td>79</td>
<td>150</td>
</tr>
<tr>
<td><strong>Minerals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (Ca²⁺)</td>
<td>66</td>
<td>3</td>
<td>33</td>
<td>250</td>
</tr>
<tr>
<td>Iron (Fe⁺⁺)</td>
<td>0.5</td>
<td>0.1</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Magnesium (Mg²⁺)</td>
<td>14</td>
<td>1</td>
<td>24</td>
<td>100</td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Manganese (Mn²⁺)</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Inorganic Nonmetallic constituents</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate + Nitrite (NO₃⁻ + N)</td>
<td>0.3</td>
<td>1</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Total Resistant Phosphorous (P)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Chloride (Cl⁻)</td>
<td>5</td>
<td>0.5</td>
<td>24</td>
<td>250</td>
</tr>
<tr>
<td>Fluoride (F⁻)</td>
<td>1.7</td>
<td>0.1</td>
<td>6.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

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14.4 Lela Community Well - Official Water Quality Results

MINISTRY OF PUBLIC HEALTH AND SANITATION

GOVERNMENT CHEMIST’S DEPARTMENT
P. O. BOX 2006,
TEL. 057-2022985
KISUMU.

CERTIFICATE OF ANALYSIS

Report Reference No.: P/WATER/WQ/VOL 1/2012
Sender: M. Okello
Report No.: 038/2012
Date Received: 03/08/2012
Sender’s Reference: --

Description of Sample: LELA Pr. Sch. BORE HOLE (WASWETA).

Examination Required: PHYSICO-CHEMICAL

Analytical Report:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>RESULTS</th>
<th>WHO/KEBS STDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. pH (at 26.2°C)</td>
<td>7.8</td>
<td>6.9 – 9.2</td>
</tr>
<tr>
<td>2. Turbidity</td>
<td>107NTU</td>
<td>10NTU</td>
</tr>
<tr>
<td>3. Magnesium (Mg²⁺)</td>
<td>6.8mg/L Mg</td>
<td>250mg/L Mg</td>
</tr>
<tr>
<td>4. Calcium (Ca²⁺)</td>
<td>36.8mg/L Ca</td>
<td>250mg/L Ca</td>
</tr>
<tr>
<td>5. Chloride (Cl⁻)</td>
<td>40.0mg/L Cl</td>
<td>600 mg/L Cl</td>
</tr>
<tr>
<td>7. Nitrates (NO₃⁻)</td>
<td>4.4mg/L NO₃</td>
<td>45mg/L NO₃</td>
</tr>
<tr>
<td>8. Nitrites (NO₂⁻)</td>
<td>0.82 mg/L NO₂</td>
<td>0.1mg/L NO₂</td>
</tr>
<tr>
<td>9. Iron (Fe)</td>
<td>0.1mg/L Fe</td>
<td>0.1mg/L Fe</td>
</tr>
<tr>
<td>10. Fluorides (F)</td>
<td>0.24mg/L F</td>
<td>1.0mg/L F</td>
</tr>
<tr>
<td>12. Manganese (Mn²⁺)</td>
<td>0.01mg/L Mn</td>
<td>0.05 mg/L Mn</td>
</tr>
<tr>
<td>13. Phosphates (PO₄³⁻)</td>
<td>0.01mg/L PO₄</td>
<td>0.05mg/L PO₄</td>
</tr>
<tr>
<td>14. Total Alkalinity (CaCO₃)</td>
<td>220mg/LCaCO₃</td>
<td>500mg/L CaCO₃</td>
</tr>
<tr>
<td>15. Total Hardness (CaCO₃)</td>
<td>120mg/LCaCO₃</td>
<td>500mg/L CaCO₃</td>
</tr>
<tr>
<td>16. Conductivity</td>
<td>210μS/cm</td>
<td>2500 μS/cm</td>
</tr>
<tr>
<td>17. Total Dissolved Solids (TDS)</td>
<td>105mg/L</td>
<td>1500mg/L</td>
</tr>
</tbody>
</table>

Remark: A turbid but relatively soft water of significant organic content. Should be clarified and disinfected before domestic use.

Date: 07/08/2012

Boniface B. Achuma
for: Government Analyst
BACTERIOLOGICAL EXAMINATION OF WATER

Sample No. 055/2012

Time and date sample taken: 02-08-2012

Time and date sample examined: 03-08-2012

Taken by: M. OKELLO

Authority: M. OKELLO

Reason for sampling: Quality Check

Is it protected? Yes

If so, how? Completely covered

Is there a pump? Yes

Has it been overhauled recently? No

Exact site sample taken from: LELA PR. SCH. BORE HOLE (WASWETA)

(i.e. tap in kitchen, through cistern or direct from mains)

Are there any latrines or other sources of pollution? No

If so, where? No

Is it a chlorinated supply? No

Report:

TOTAL COLIFORM COUNT (MF, 37°C) * c.f.u/100mL

FEACAL COLIFORM COUNT (MF, 44°C) * c.f.u/100mL

*TNCC - Too Numerous To Count

Copies to: Boniface Achuma

Government Chemist/Analyst
### 14.5 Water Quality Field Testing

<table>
<thead>
<tr>
<th>Source type</th>
<th>Marsh</th>
<th>Hand-dug well</th>
<th>Rainwater tank</th>
<th>Drilled well</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>8</td>
<td>7.8</td>
<td>6.4</td>
<td>8</td>
</tr>
<tr>
<td>Hardness (ppm)</td>
<td>120</td>
<td>200</td>
<td>0</td>
<td>250</td>
</tr>
<tr>
<td>Alkalinity (ppm)</td>
<td>80</td>
<td>150</td>
<td>0</td>
<td>240</td>
</tr>
<tr>
<td>Nitrate (ppm)</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Nitrite (ppm)</td>
<td>0.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Turbidity</td>
<td>-</td>
<td>20%</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>E. coli (per 100 ml)</td>
<td>120</td>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Coliform (per 100 ml)</td>
<td>TNTC</td>
<td>TNTC</td>
<td>240</td>
<td>0</td>
</tr>
</tbody>
</table>
14.6 Map of Lela

Download original high-resolution map [PDF].
14.7 Rainwater Harvesting Maintenance Manual

Rainwater Harvesting Maintenance Manual
For the Lela Primary School (Lela, Kenya)

Prepared by:
Jessica Cawley (EWB-OSU)
Updated October 2012

Contact:
kenya@ewb-osu.org
www.ewb-osu.org
Rainwater Harvesting Maintenance Manual

BACKGROUND

The community of Lela worked to install a rainwater harvesting system at Lela Primary School with the help of Engineers Without Borders – Oregon State University (EWB-OSU) in July 2012. The total system capacity of the system is 40,000 liters (four 10,000 liter tanks).

MAINTENANCE OF THE ROOF & GUTTERS

- DO NOT THROW OBJECTS ONTO THE ROOF OR INTO GUTTERS
- KEEP GUTTERS CLEAN
- MESH AT THE ENTRANCE TO THE TANK MAY NEED TO BE CLEANED

Gutters should be clean (as shown above) to keep water clean within the storage tanks.

Lela Community & EWB–OSU
July 2012
OPERATION OF THE TANK: FIRST FLUSH

The first flush pipe diverts polluted water from the storage tank, as shown in the diagram below:
Empty water from all four first-flush pipes after every major rainstorm. Make sure gutters are clear to prevent pipes from clogging.
OPERATION OF THE TANK: MESH

To prevent mosquitoes from accessing the water tanks, no entry point to the tank should be open.

- REPLACE BROKEN MESH

The overflow must also have a mesh filter to prevent mosquitoes from entering the tank.
OPERATION OF THE TANK: DRAINAGE

PREVENT STANDING WATER and protect the foundation of the tank and the adjacent building.

- The tap should have a drainage field.
- The overflow should lead into a drainage field.
- Should the drainage field start pooling with water, it should be dug out and the gravel should be cleaned of sediment and replaced.

A GOOD DRAINAGE FIELD:

- 1-2 feet deep
- Filled with rocks
- Allows water to drain

EXAMPLE OF GOOD DRAINAGE FIELD

EXAMPLE OF BAD DRAINAGE FIELD
WATER USAGE

- Use all tanks simultaneously – do not use one tank at a time.
- As a general rule, use the tank with the most amount of water. This will allow all tanks to refill during rainstorms.

SUMMARY: Rainwater Tank Maintenance

The rainwater tank can provide clean and safe drinking water but only when the following activities are carried out thoroughly each season!

To do every year before the rainy season:

- Clean the tank
- Clean the roof
- Clean the gutters
- Clean the mesh filters
- Clean the downpipe

At the start of the rainy season:

The first minutes of each rain will wash away any remaining dirt on the roof and gutters. This dirty water fills the downpipe. Once the downpipe is full then clean water will flow into the tank. As rains continue, the downpipe will require emptying after every storm to ensure that the dirty “first flush” water of each rain doesn’t enter the tank.

To do regularly during the rainy season:

- Empty the first flush pipe after each rain
- Check and clean roof
- Check and clean gutters
- Check and clean mesh filters
- Check and clean the downpipe

To do always when the tank is full:

- Make sure the hatch is closed properly
Rainwater Harvesting Maintenance Manual

- Make sure no animals, mosquitos or light can enter the tank, because this can decrease the water quality! (repair any damaged mesh)

The tank and associated guttering and pipework should be kept in good general repair. Any damage or faults should be rectified as soon as possible.
14.8 LWWC Appreciation and Request to EWB-OSU

To
GROUP LEADER,
ENGINERS WITHOUT BORDERS

Art. MR. ZACHARY ONN.

APPRECIATION.

On behalf of LELA Community member and LELA Water Project Women Group, I wish to extend my sincere and heartfelt appreciation to your team for the work well done.

We are aware as a group, the difficulties you are undergoing, but all the same, you have managed to overcome them.

It is not easy considering the current economic situation all over the world for a group of young professionals to take their valuable time to come to Africa up to Lela village, Kenya using your resources to please come be install 3 (three) 1000 liters each water tanks for our school and a water borehole depth of over 200 ft. Surely one volunteer is better than 10 (ten) pressed men, and willing hands make light work.

It is our hope that the School Manager in collaboration with other other stake holders will manage the project efficiently for the benefit of pupils, residents to enjoy and drink clean water.

May God help us to appreciate this gift.
The group photo and other details is attached. Attached for each of reference.

Wish you well.

Thank you.

Chairperson, Secretary, Treasurer.
LELA WATER PROJECT WOMEN GROUP

INTRODUCTION

LELA WATER PROJECT WOMEN GROUP was started in 2006 and is a registered group with the Ministry of Culture, Sports and Social Services. Reg. No. 103850/2007. Twenty members initially registered but membership has steadily increased to twenty-five.

The group was registered to undertake activities ranging from assisting members in cases of trouble through many go round to socially improving economic activities in the community. Since its inception members have been engaged in various activities ranging from selling milk, vegetables, fish to enable members to earn their livelihood individually and make reasonable contributions to finance group projects.

LIST OF MEMBERS

1. Enice Awuor 1978
2. Phoebe Atieno 1978
3. Mary Atieno 1976
4. Elizabeth Magana 1972
5. Trephina Aoko 1978
6. Susan Auma 1976
7. Caroline Owuor 1973
8. Mereza Achieng 1979
9. Phyllista Aoko 1978
10. Millicent Mwangi 1973
11. Agnes Atieno 1972
12. Anna Akoth 1972
13. Mereza Atieno 1972
14. Doris Okello 1972
15. Cypria Jangaj 1970
16. Margaret Akeyo 1972
17. Reina Ams 1973
18. Enice Atieno 1975
19. Mary Achieng 1972
20. Juliana Atite 1973
21. Christine Atieno 1972
22. Elsa Atieno 1972
List of members cont'd

23. Roseline Okuku  Re
24. Rhoda Mejia  Mrs
25. Mary Atumamba  Ms

Among the members, we have the following:

Widows:
1. Truphosa Akot
2. Elizabeth Magana
3. Anna Akot, Omima
4. Mary A Otieno
5. Truphosa Alo
6. Margaret Achiyo Magana
7. Agnes Atieno Kimira

Orphans in school:
1. Felix Odhiambo
2. Spencer Marione
3. Elija Ongango
4. Vocarsis Akot
5. Walter Ouma
6. Rekema Magana
7. John Otieno
8. Evelyne A Odoyo

The needy:
1. Tedla Anyango (who is blind)
2. Luckina Sigiria
3. Carina Akeyo

Office Bearers:
1. Chairperson - Mary Akoth Oburato
2. Secretary - Mereza Achieng Okello
3. Treasurer - Truphosa Akot Sigiria
4. Project Co-ordinator - Charles Olongo Omweno
SUSTAINABILITY OF THE GROUP.

1. Members monthly contributions
2. Well owners contributions
3. Community members contributions
4. Entrance Fees from willing applicants
5. IGA - ie Sand harvesting, Small scale farming, poultry keeping, Biftees making, etc
6. Sales of Vegetables, Onions, Tomatoes, fish
7. External Donors (if any)

GOAL

1. To improve the knowledge, attitude, practice and welfare of its members to be self reliant economically
2. To educate members on how to reduce poverty and improve on food production & security
3. To dig wells for members because water is life
4. To reduce illiteracy amongst its members
5. To stabilize its members economically

AREA OF OPERATION

The group is based at Lela village and operates within Musrata & Sublocation - Suna South Location.

BENEFICIARIES

1. Group members
2. Community
3. Widows, Orphans, & the Needy.
BANK ACCOUNT

The group has got Bank Account with Co-operative Bank of Kenya - Migori Branch
A/C No. 01100017257000

CONTACT PERSON
MARY AKOTH Obento - P.O. Box 245
TEL(MOBILE) No. 0717184395
E-MAIL - Ambroseakoth@Yahoo.com

REQUEST

The group is kindly requesting you for any kind of assistance because as a group we have also few projects to be undertaken. ie we have a plot at Lela Centre which we want to develop. We have a strong feeling that if the plot is completed it will improve the welfare of our members.

WATER is LIFE - we still need more water tanks to be installed within the reach of members. Community water is a very problem facing the community. The community.

COMMUNICATION

As communication is the backbone of development, we would like to communicate with you directly through the E-Mail already indicated above. In case of any problem please don’t hesitate to contact us for further clarification.

We wish you well, May God Bless you.
14.9 Lela Primary School Board Request for Partnership

LELA PRIMARY SCHOOL
P. O. BOX 1021 - 40400
SUNA - MIGORI
30/7/2012

To The Group Leader,
Engineer Without Borders.
EWB – OSU
MEMORIAL UNION
OREGON STATE UNIVERSITY
CORVALLIS, OREGON 97330 U.S.A.

ATT: MR ZACHARY DUNN

The entire school management committee stake holders, teachers, pupils and other beneficiaries wish to sincerely thank you and your team for the excellent work done to us. We are all aware of the economic hardship facing you as young professionals but you have managed to complete this project as per your schedule. We do appreciate the achievement as school considers the limited resources and the cost involved. You have made us proud even a small child in class one is proud of your gift because they are sure of drinking fresh, clean water in near future.

You have been in this school many times and I presume you can see how the school looks like although its a new school the government and stake holders have tried to put six classrooms.

These classrooms have not yet been plastered, windows not yet fixed, all are still temporary structures we are still lacking two more classrooms for standard seven and eight and administration block you can see class one are learning under the tree.

It is our humble request that you take this school as one of your projects and include requirements in your development programmes.

Head teacher

Parent's Representative