

## Operations & Maintenance Plan – Nigerian Water Project

<b>Equipment &amp; Labor</b>		
Solar-powered borehole well and pump		
Borehole Well Water Tank		
Purification System		
Clean Water Tank		
Taps and piping system		
Bottle cleaning station	Purchase 20 * 20-liter bottles (20*\$35.00)	\$700.00/month
<b>1 skilled labor operator</b>	\$65/day * 20 days/month	\$1,300/month
1 operator in training	\$32/day * 20 days/month	\$640/month
1 bookkeeper	\$65/day* 20 days/month	\$1,300/month
Monthly Total		\$3,940/month
<b>Yearly Cost</b>		<b>\$47,280/year</b>

<b>Maintenance (5-year basis)</b>		
Solar-powered borehole well and pump	Panel and pump repairs	\$500/year
Borehole Well Water Tank	Monthly tank cleaning	\$100/year
Purification System	Contractor, membranes, softener maintenance	\$2,000/year
Clean Water Tank	Monthly tank cleaning	\$100/year
Taps and piping system	Inspection and repairs	\$100/year
Bottle cleaning station	Inspection and repairs	\$100/year
Electrical service	Electrical repairs	\$200/year
Supplies – salt, carbon, resin, etc.		\$500/year
Funds for spare parts – pumps, panels, filters, membranes, resin, etc.	Estimate 7-year life for pumps, 3 years for resin, and membranes	\$1,720/year
<b>Total</b>		<b>\$5,320/year</b>

<b>Operations Cost</b>		
Equipment and Labor		\$47,280/year
Maintenance		\$5,320/year
<b>Total</b>		<b>\$52,600/year</b>
<b>Revenue</b>		
Sales of bottles @ \$15.00 per 20-liter bottle with bottle exchange. \$50.00 per bottle with no exchange.	55 bottles/week (8/day) 2,860 bottles/year 57,200 liters/year 1,100 liters/week 157 liters/day	2,860 * \$15.00 =  <b>\$42,900/year</b>
Subscription customers \$5.00 per bottle with bottle exchange program	100 families * 1 bottle/week 5,200 bottles/year (14/day) 104,000 liters/year	5,200 * \$5.00 =  <b>\$26,000/year</b>
Cell phone charging revenue (\$0.13/phone) 10 phones/day	10*365*0.13=\$474.50	\$500/year
<b>Total</b>		<b>\$69,400/year</b>
<b>Estimated surplus</b>		<b>\$16,800/year</b>

## Operating Assumptions

### Borehole well operation

24 liters/min \* 60 min/hr \* 6 hrs/day \* 7 days/wk \* 52 wks/yr = 3,144,960 liters/year  
8,616 liters/day  
430 bottles/day

### Purification System operation

12 liters/min \* 60 min/hr \* 4 hrs/day \* 7 days/wk \* 52 wks/yr = 1,048,320 liters/year  
2,872 liters/day  
52,416 bottles/year  
143 bottles/day

**Note:** A Reverse Osmosis and Softening (ROS) purification system was used as a worst-case purification scenario. Depending on the quality of the borehole well water, ROS may not be needed. Other purification systems technology will cost less than ROS technology.

ROS Purification produces a salty wastewater stream about equal to production volume. This water is not suitable for drinking by humans, animals, or using for agricultural purposes. This water can be used for flushing toilets and other sanitation purposes.

1,048,320 liters/year wastewater

2,872 liters/day wastewater

School Taps open – 5 days/wk \* 40 wks/year \* 4 hrs/day \* 60 min/hr \* 1 liter/min (flow) =

48,000 liters/year

2,400 bottles/year

6 bottles/day

Church Taps open – 3 days/wk \* 52 wks/year \* 2 hrs/day \* 60 mins/hr \* 1 liter/min (flow) =

18,720 liters/year

936 bottles/year

2.5 bottles/day

Subscribers for water

14 bottles/day

Outside Sales of water

8 bottles/day

Well capacity = 430 bottles/day versus demand 30 bottles/day = 14.3 times the demand

Purification capacity = 143 bottles/day versus demand 30 bottles/day = 4.7 times demand

### **Routine System Operation**

1. Inspect both the borehole well water and purified water storage tanks for contamination.
2. Inspect solar panels and equipment for problems.
3. Turn on the borehole well pump to fill borehole well water tank.
4. Inspect ROS purification system equipment. Regenerate softener if hardness greater than 34 ppm (2 drops Hach test)
5. Start operating ROS purification system to fill Clean Water Tank.
6. Inspect water taps in school and church. Open supply valves to taps.
7. Disinfect the taps with chlorine bleach water.
8. Once there is water in the purified Water Tank, flush each tap for 1 minute.
9. Inspect the water bottling station and equipment. Disinfect the bottling station with chlorine bleach water. Save chlorine bleach water for cleaning returned bottles.
10. Start cleaning returned bottles with chlorine bleach water. Allow them to sit for 10 minutes. After 10 minutes, rinse the returned bottles with clean water.
11. Fill the cleaned bottles with purified water. Put on the caps. Label the bottles and shrink wrap the caps. Store on the shelves for customer exchanges.
12. Continue with routine jobs to keep the area and equipment clean. Work with the bookkeeper on records for system operation.