

Eleventh Annual School of Science, Engineering, and Health Symposium

May 2, 2014

# Village Water Ozonation System (VWOS)

*Amanda Schneider*

*Amy Heindel*



DEPARTMENT  
OF  
ENGINEERING

the Collaboratory  
for strategic partnerships and applied research



MESSIAH  
COLLEGE



# Purpose

- Provide access to clean water where its lack is a matter of justice.
- Partners
  - *Forward Edge International*
  - *Villa Esperanza, Managua, Nicaragua*
- Summer site team trip - installation





# What is VWOS?

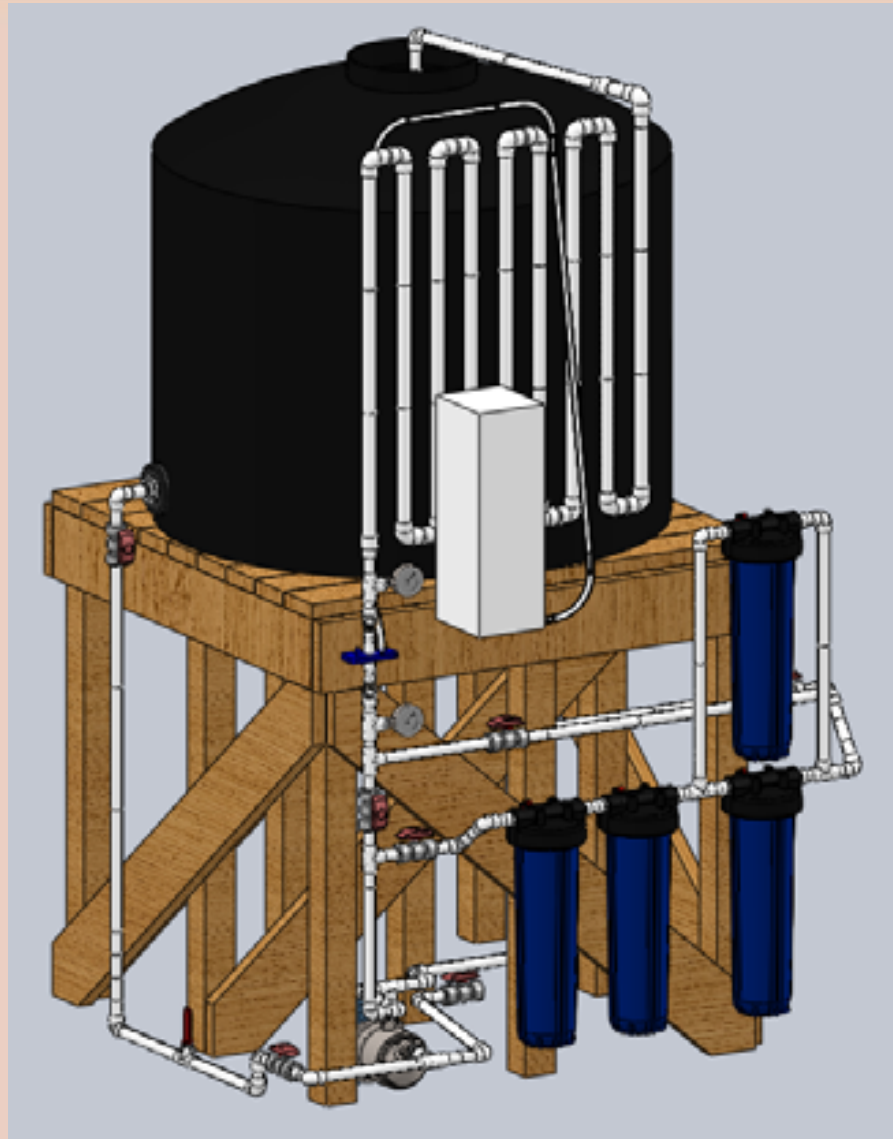
Village Water Ozonation System

- **Small-scale water treatment system**
  - *Batch System*
  - *Ozone*
- **Design Constraints:**
  - *Economic/Cost*
  - *Infrastructure*
  - *Culture*



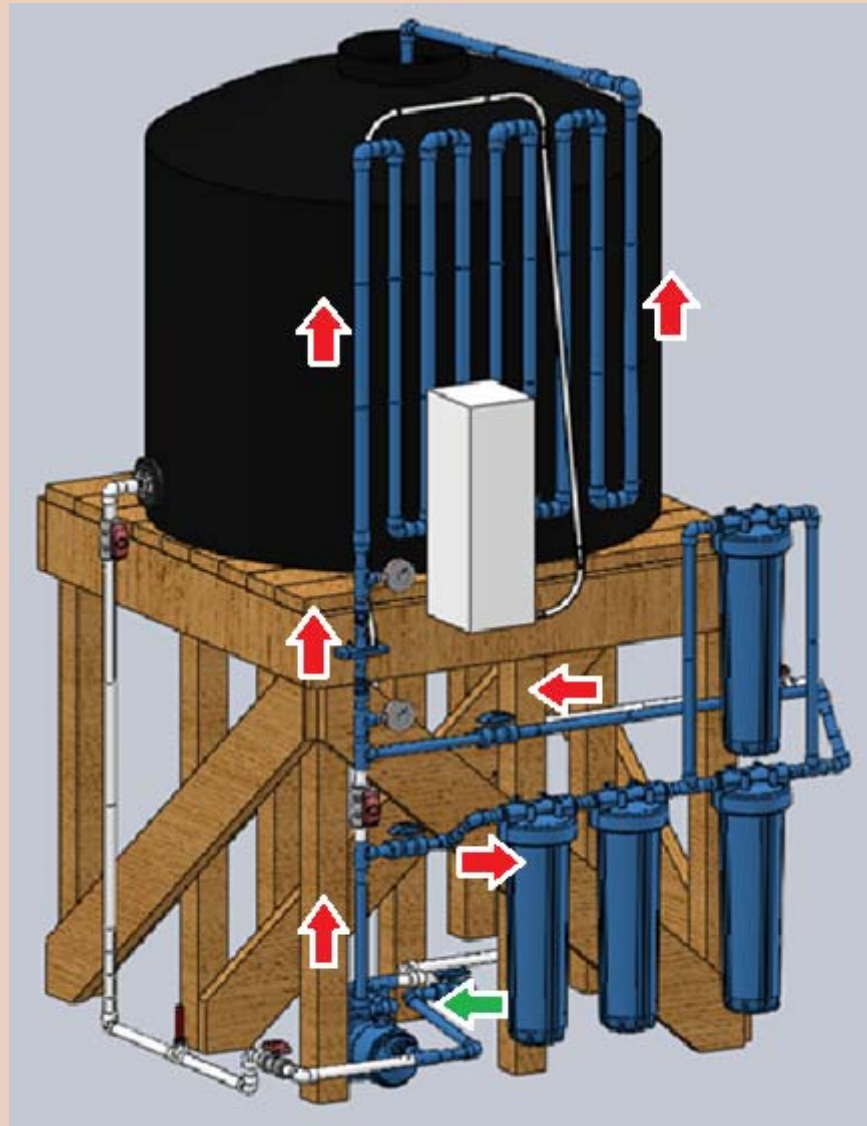


# VWOS



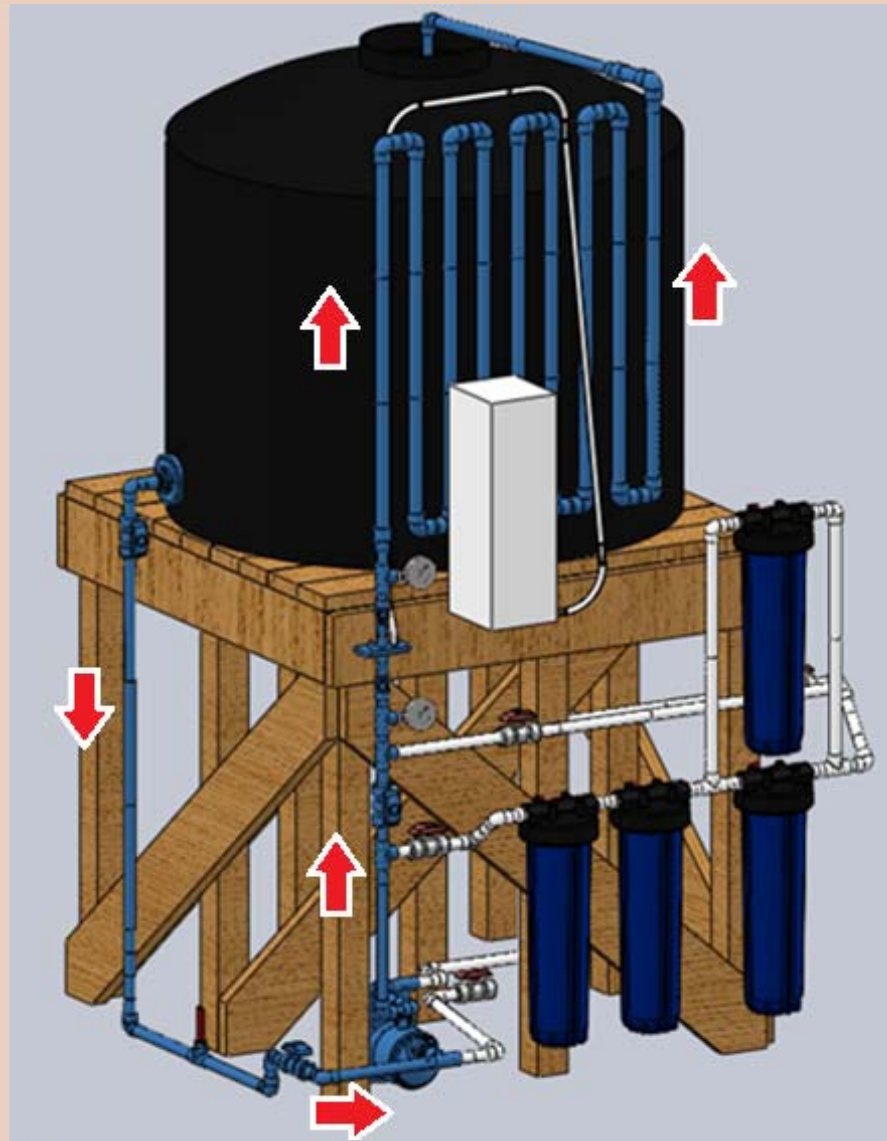


# VWOS



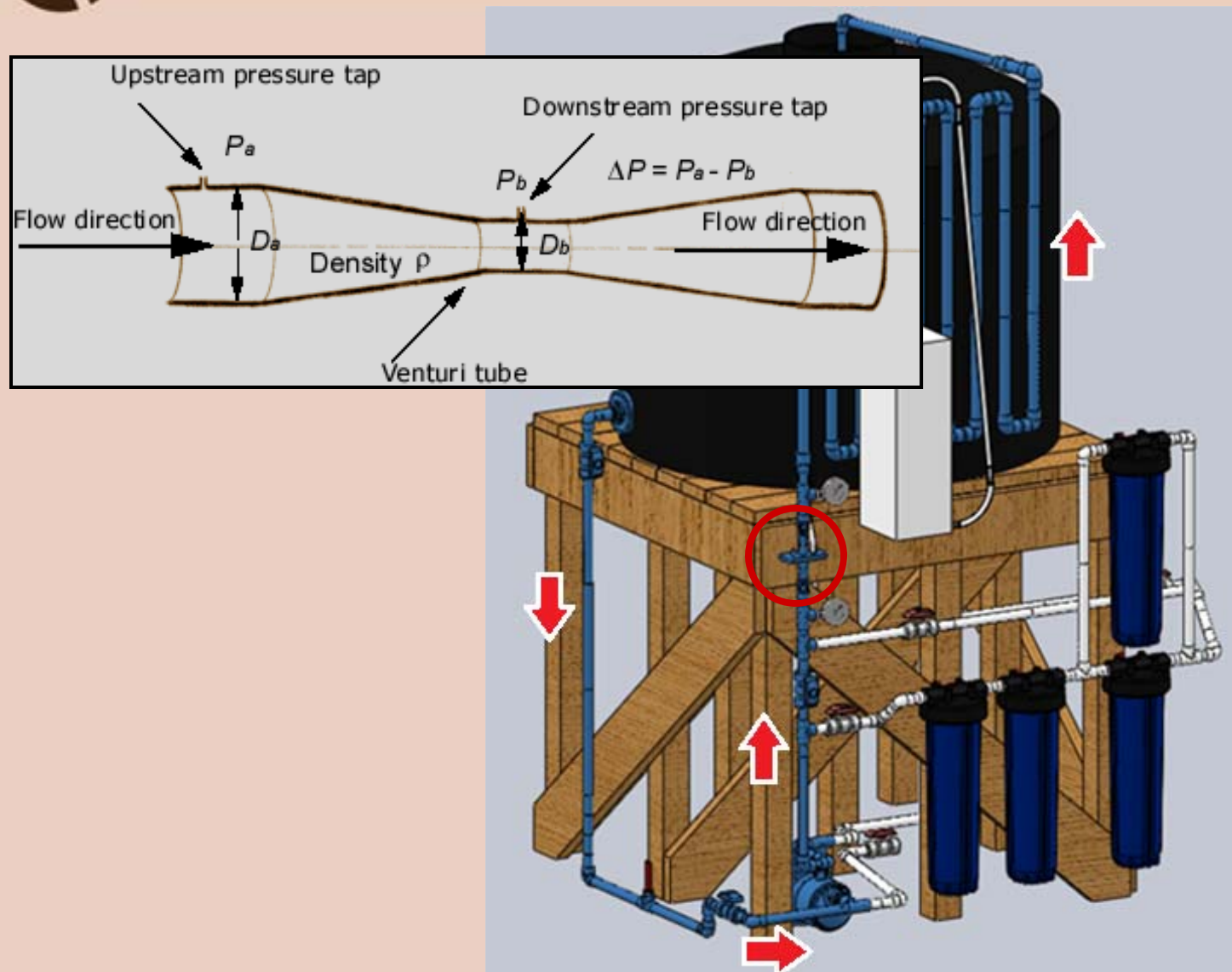


# VWOS



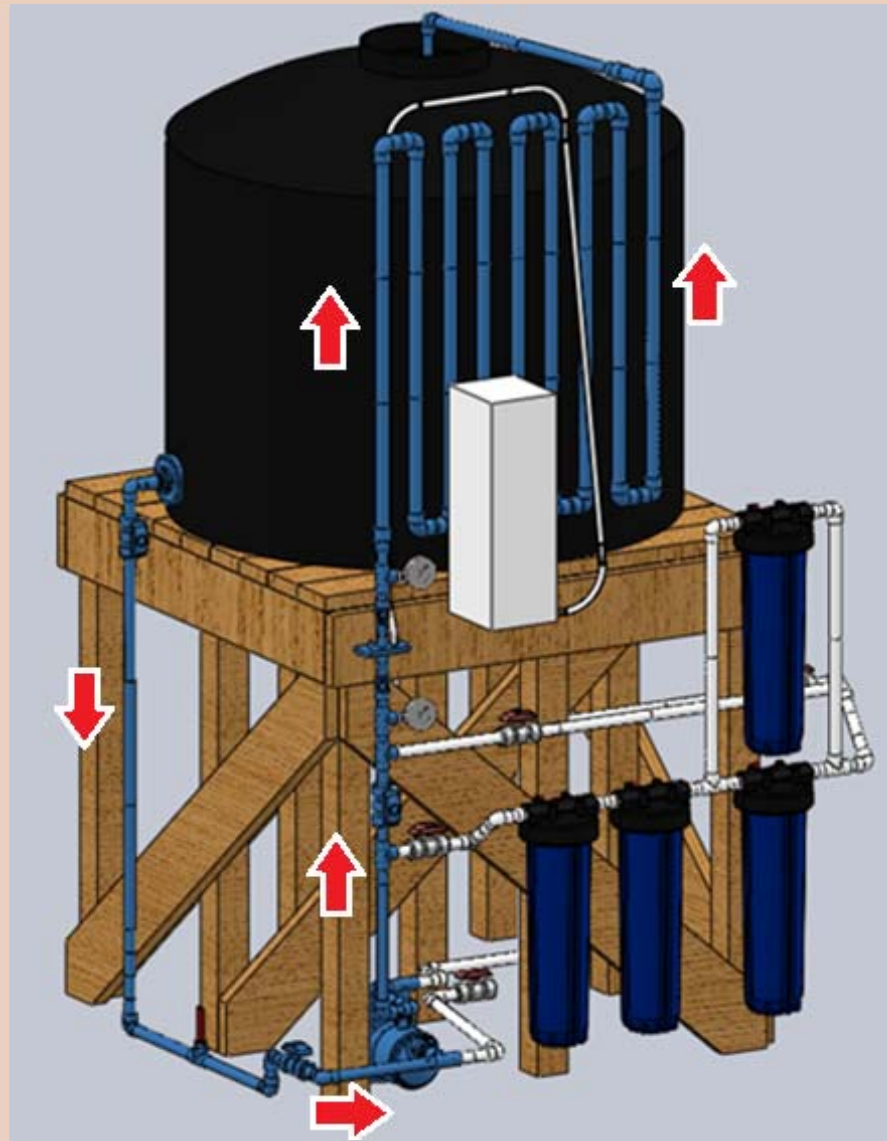


# VWOS





# VWOS

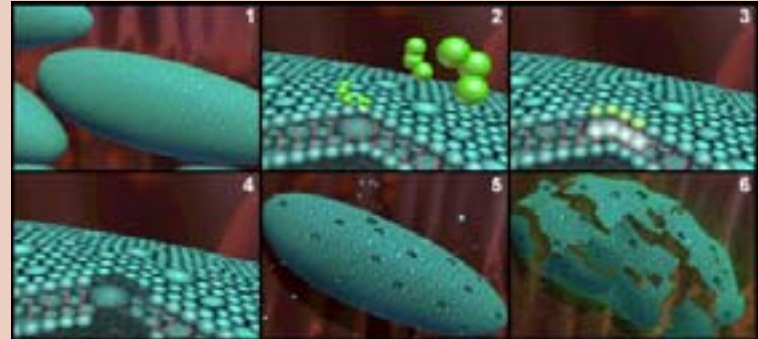






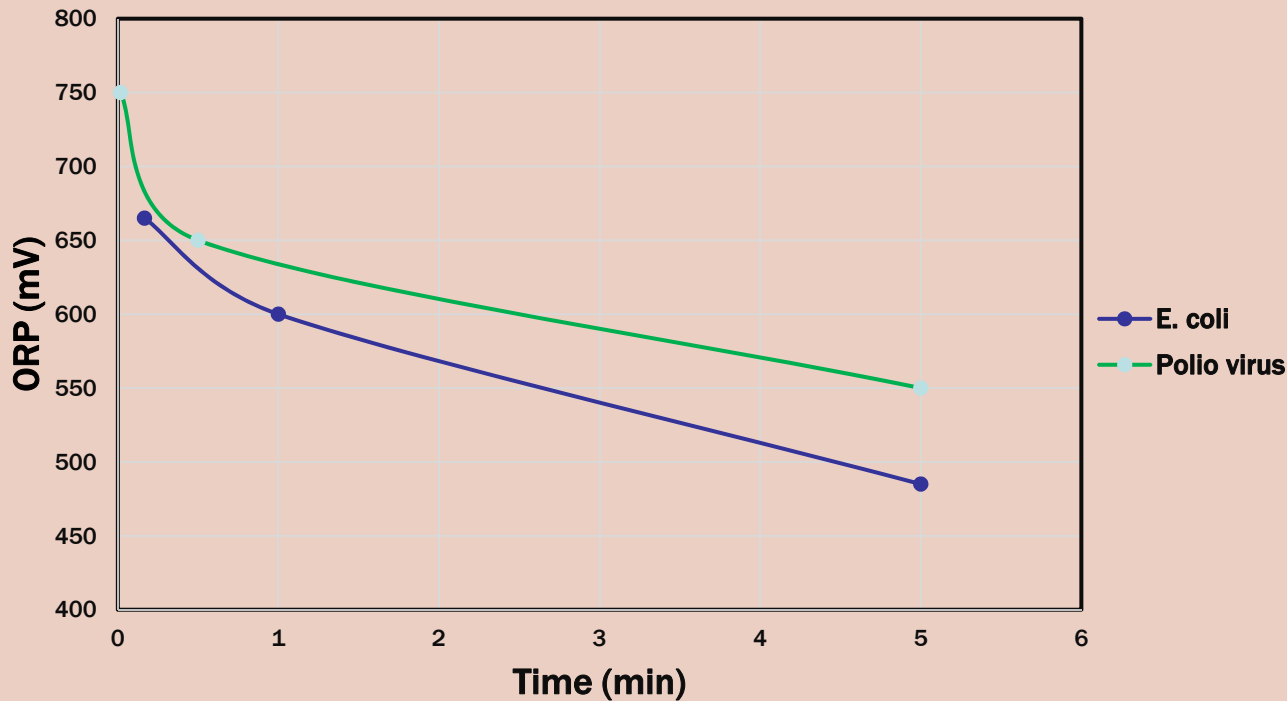
# Oxidation Reduction Potential (ORP)

- Old Goal: 600 mV
- New Goal: 750 mV



[http://www.ozoneapplications.com/info/bacteria\\_destruction.htm](http://www.ozoneapplications.com/info/bacteria_destruction.htm)

## ORP Levels and Kill Time





# Efficiency

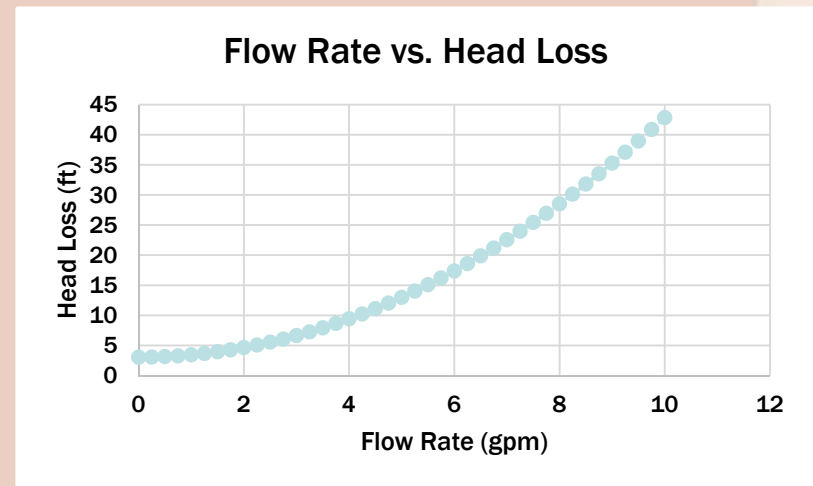
- **Quantifying Efficiency**
  - *Cost Per Liter of Water Produced*
  - *Shorter Run Time = Less Energy Used*
- **Improving Efficiency**
  - *Increase Surface Area*
    - Smaller bubbles
    - More bubbles
  - *Increase Contact Time*





# Bench-Top System

- Optimization for more sustainable, cost-efficient process
- Understanding the system
  - *Head loss evaluation*
  - *Flow meters*
- Finalized to begin testing
  - *pH, temperature, venturi position and orientation, static mixer*





# Serpentine Loop Modification

Same contact time, higher velocity



Before



After



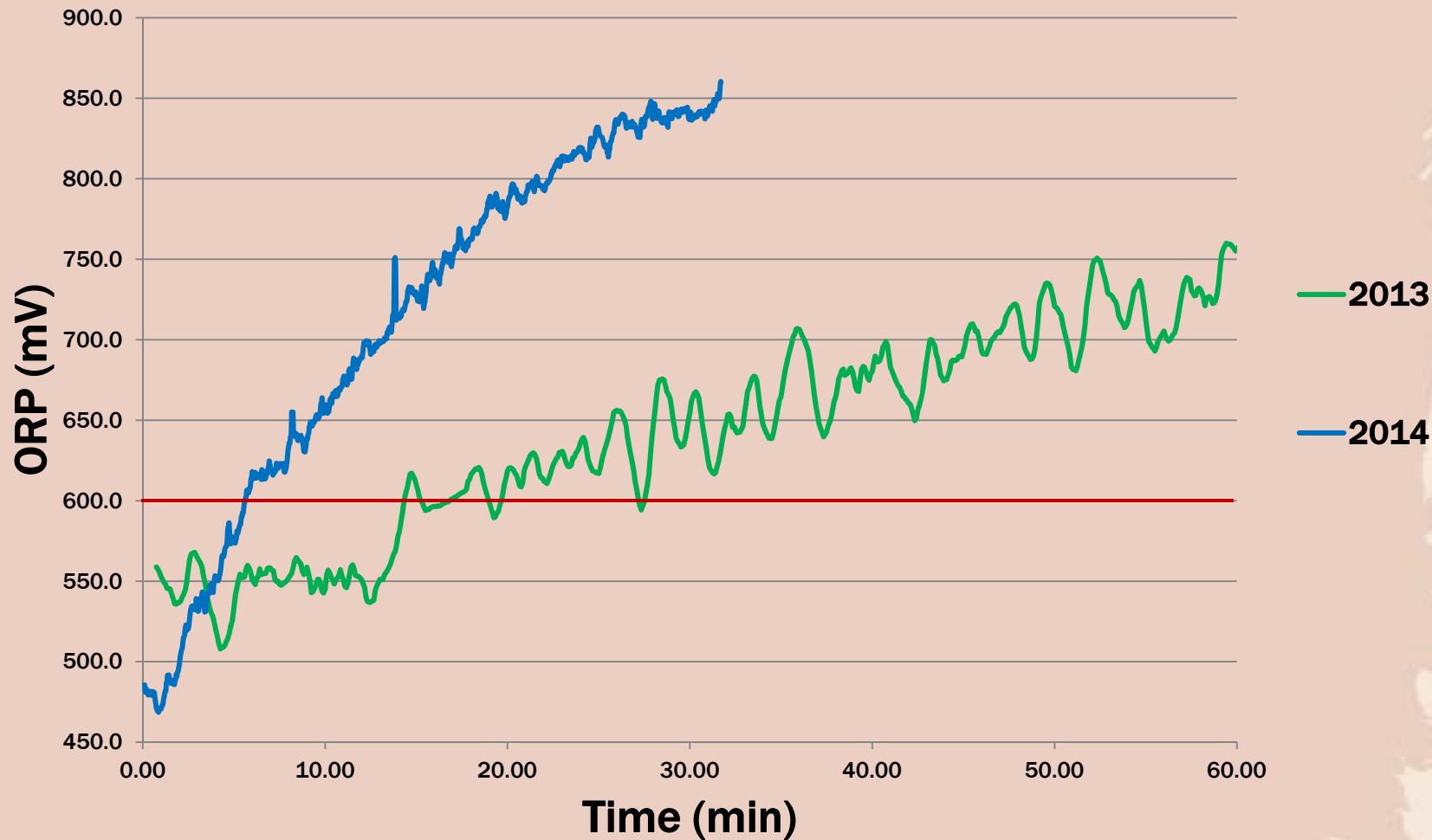
# New Ozone Generator

- Discovered no ozone production
  - *Check valve failure*
  - *Ozone generator damaged*
- Replaced ozone generator



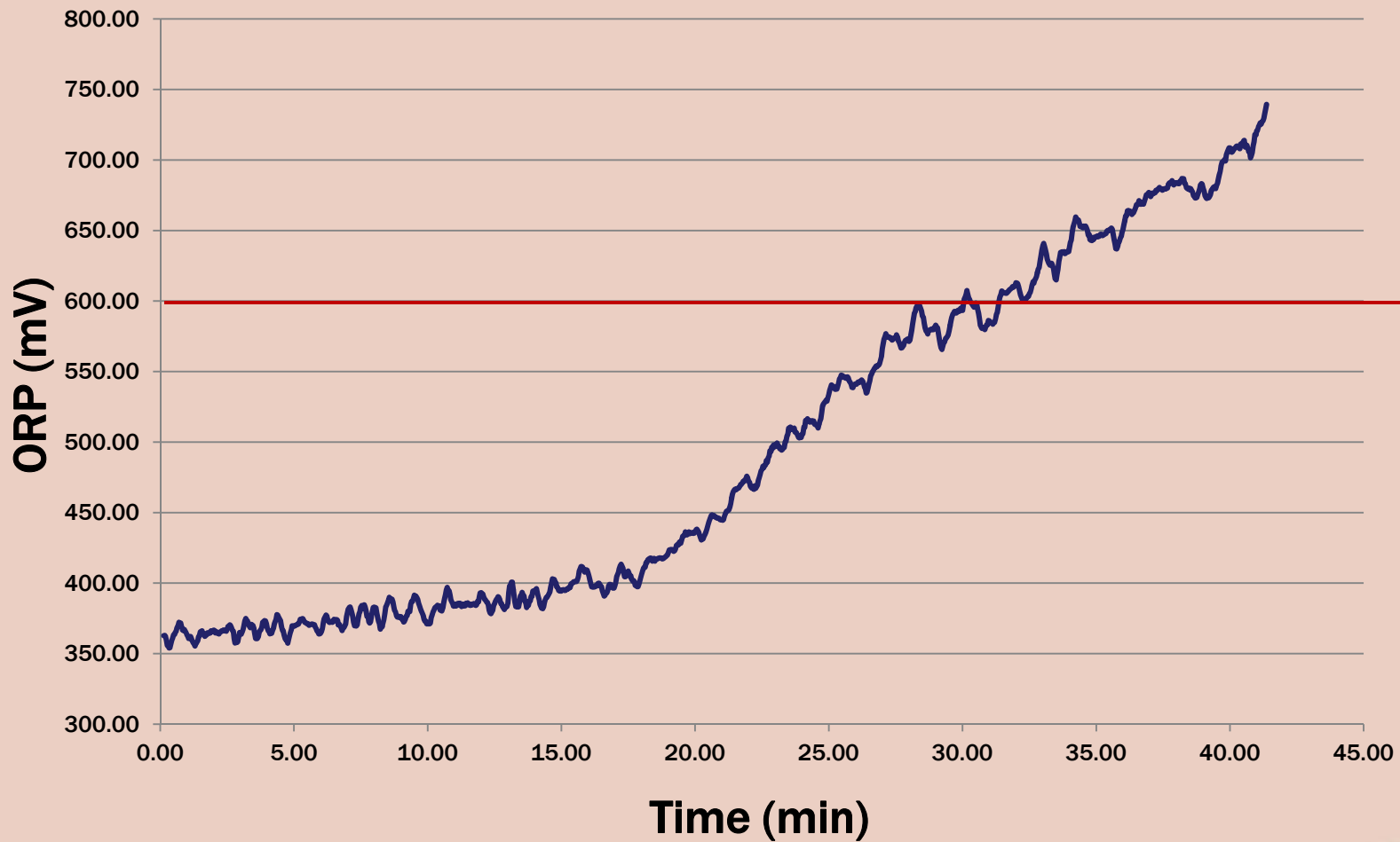


# Clean Water Test





# Creek Water Test





# Water Testing Team Results

- In collaboration with testing team
- Samples while running test
- PathoScreen tests
- Coliform Colony Count tests
- Results



- *Bacteria concentration decreased as ORP increased*
- *Unidentified bacteria*





# User Manual

- For installation in Nicaragua
  - *Operation Procedure*
  - *Parts List*
- Translation to Spanish



**Parts List**

Part	Description	Quantity
1	...	...
2	...	...
3	...	...
4	...	...
5	...	...
6	...	...
7	...	...
8	...	...
9	...	...
10	...	...
11	...	...
12	...	...
13	...	...
14	...	...
15	...	...
16	...	...
17	...	...
18	...	...
19	...	...
20	...	...
21	...	...
22	...	...
23	...	...
24	...	...
25	...	...
26	...	...
27	...	...
28	...	...
29	...	...
30	...	...
31	...	...
32	...	...
33	...	...
34	...	...
35	...	...
36	...	...
37	...	...
38	...	...
39	...	...
40	...	...
41	...	...
42	...	...
43	...	...
44	...	...
45	...	...
46	...	...
47	...	...
48	...	...
49	...	...
50	...	...
51	...	...
52	...	...
53	...	...
54	...	...
55	...	...
56	...	...
57	...	...
58	...	...
59	...	...
60	...	...
61	...	...
62	...	...
63	...	...
64	...	...
65	...	...
66	...	...
67	...	...
68	...	...
69	...	...
70	...	...
71	...	...
72	...	...
73	...	...
74	...	...
75	...	...
76	...	...
77	...	...
78	...	...
79	...	...
80	...	...
81	...	...
82	...	...
83	...	...
84	...	...
85	...	...
86	...	...
87	...	...
88	...	...
89	...	...
90	...	...
91	...	...
92	...	...
93	...	...
94	...	...
95	...	...
96	...	...
97	...	...
98	...	...
99	...	...
100	...	...



# Future Work for VWOS

- **Installation in Managua, Nicaragua**
  - **May 2014**
  - **Receive feedback from client**
- **System Optimization**
  - **Temperature Testing**
  - **pH Testing**
  - **Static Mixer**



# Acknowledgements

**Katy Howell– Project II / Collaboratory**

**Laura Penwell– Project II / Collaboratory**

**Gavin Stobie– Group Orientation / Collaboratory**

**Gabby Clapper– Group Orientation / Collaboratory**

**Lizzy Chang- Collaboratory**

**Mr. Ray Knepper – Volunteer Advisor**

**Dr. Vader – Project Advisor**

**Dr. Soerens – Project Advisor**

**The Collaboratory Water Testing Team**

**Mr. Jeff Thompson – Forward Edge contact**



**Questions?**