

# Water Distribution System Design

La Peñita, Panama



December 10, 2019  
International Senior Design Project  
Samantha Cepeda, Grace Kluchka, and Kendall Welling



# Outline

Project Overview

Data Collection & Analysis

Proposed Design

Conclusion

# Community Background

- Location
  - Eastern Panama
  - Chucunaque River
    - Refugees
- Community Members
  - Water Committee



Source: Google Maps [1]



Source: MiDiario [2]

# Project Overview: Problem

- No community-wide water distribution system



Source: Photos by authors

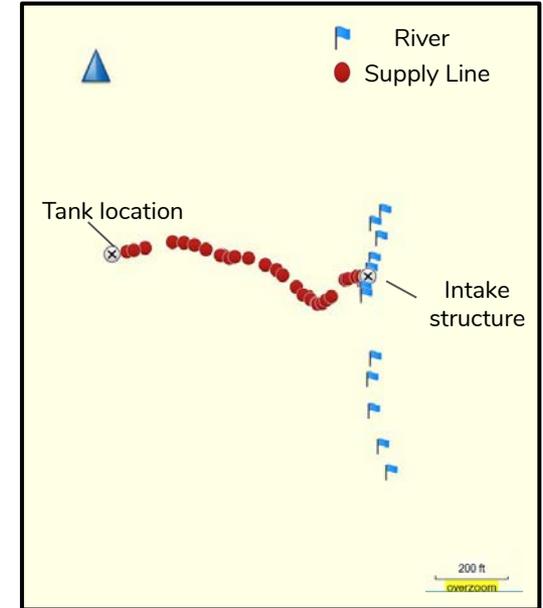
# Project Overview: Existing Infrastructure



Intake Structure



Tank Platform Location

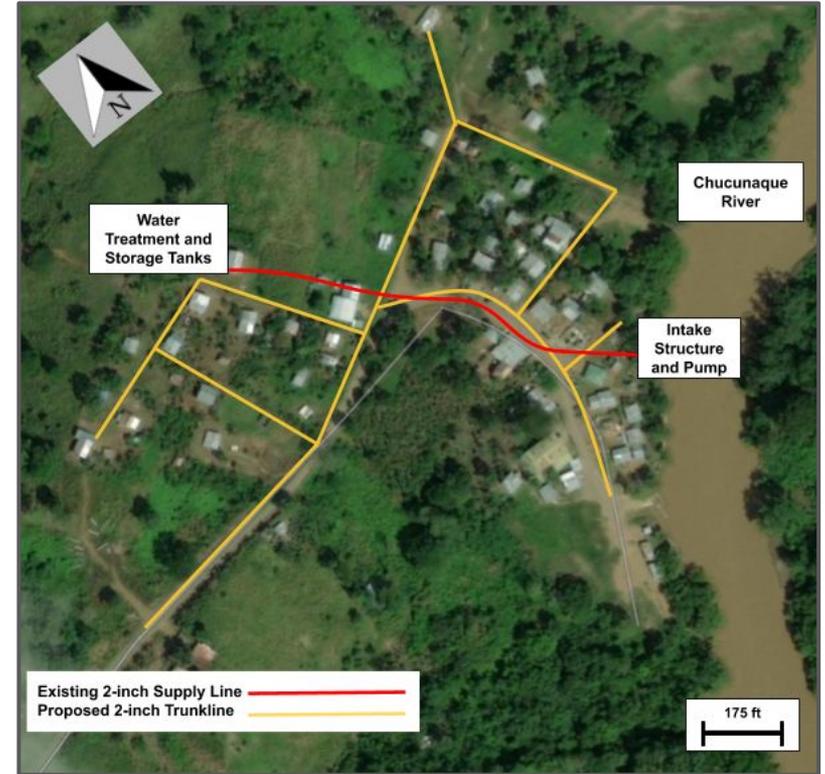


Map of Existing Infrastructure

Source: Photos by authors

# Project Overview: Solution

- System Components:
  - River Water Source
    - Intake Structure
      - Pump
  - Water Treatment
    - Filtration
    - Chlorination
  - Water Storage Tanks
  - Distribution Network
    - Trunklines
    - Branchlines



Source: Apple Maps [3]

# Project Overview: Partners

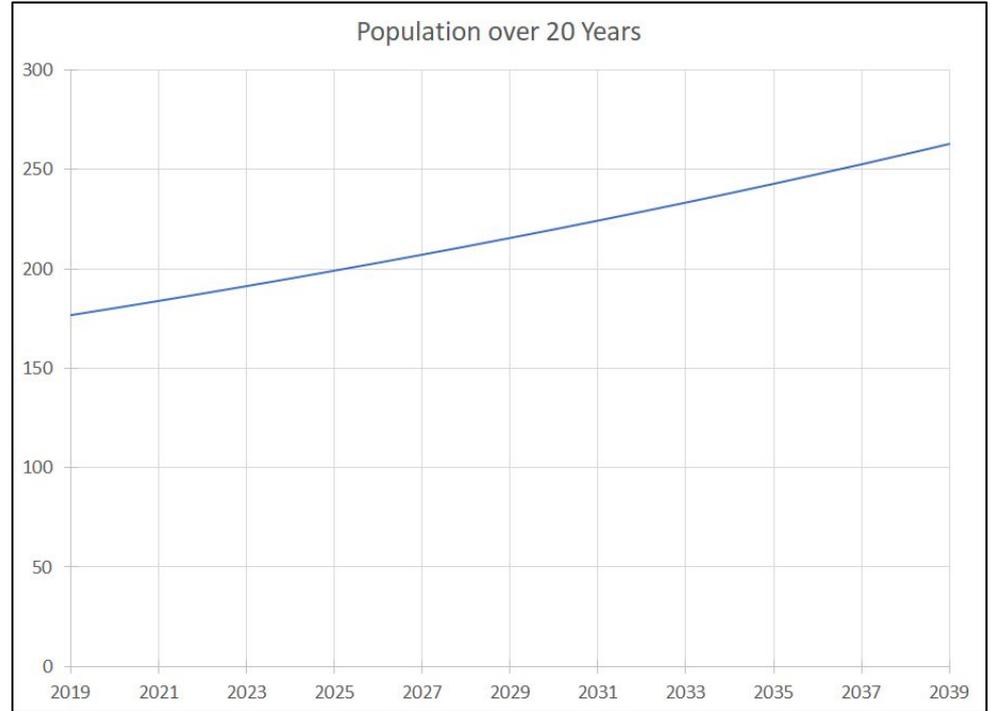
- Footprint Possibilities Inc.
- Global Brigades-Panama



Source: Photo by authors

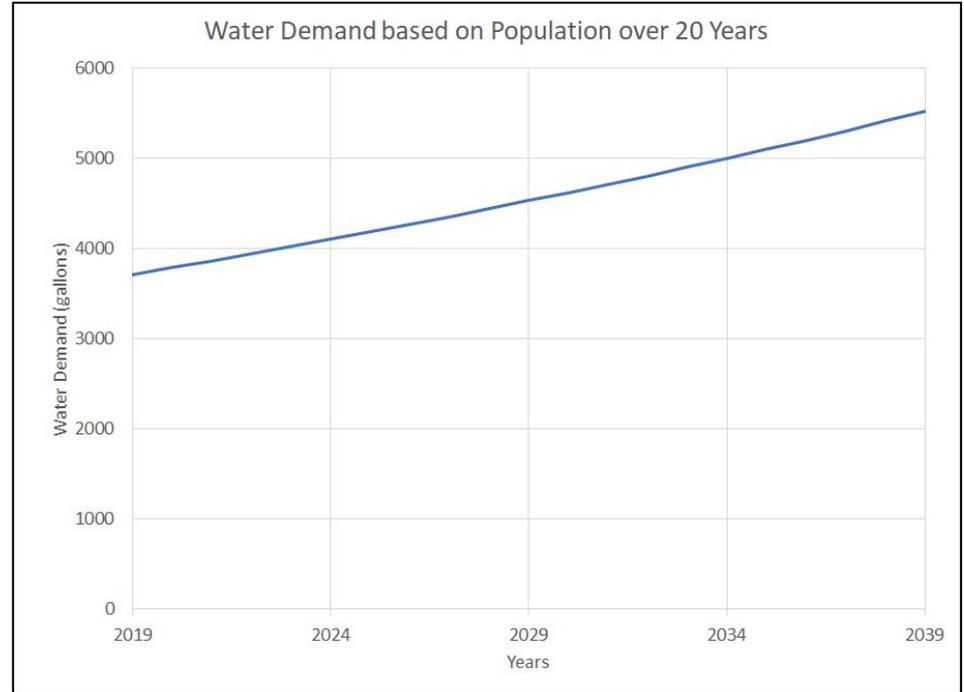
# Data Collection: Demography

- Current Population: 177 people
- 20-Year Population
  - 2% Annual Growth Rate
  - 263 people



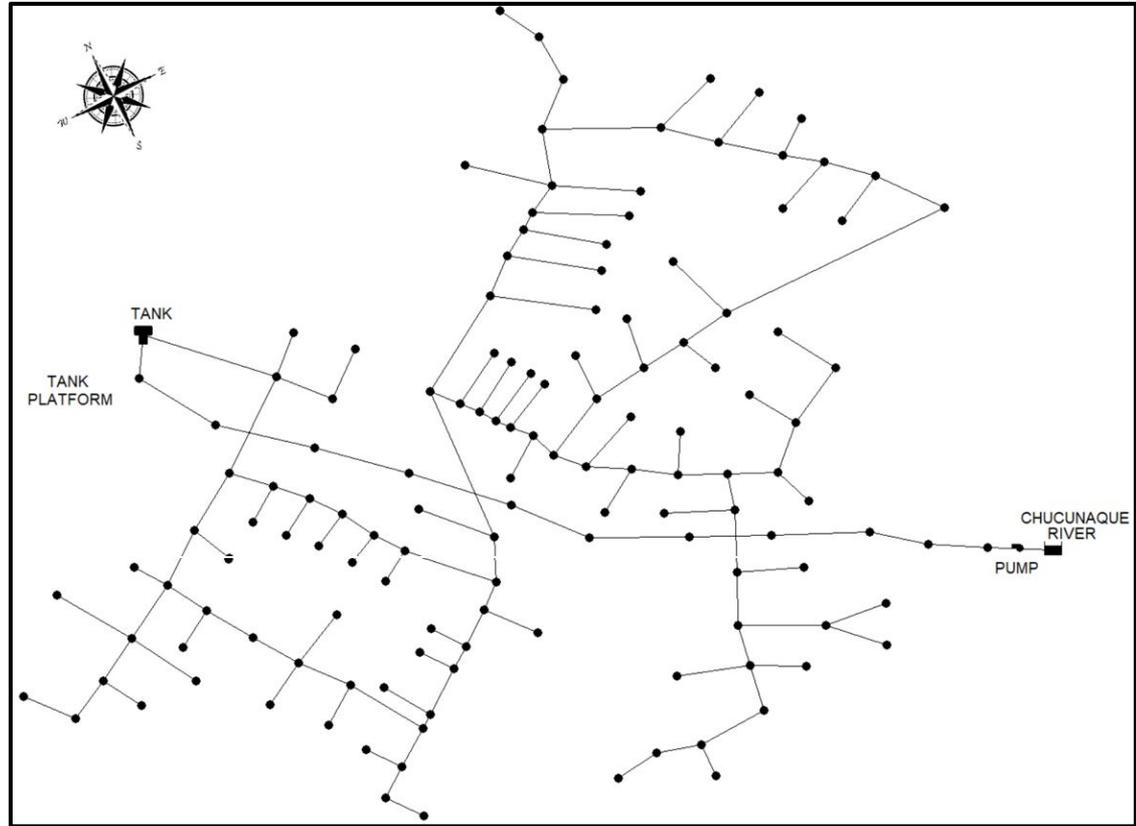
# Data Collection: Water Demand

- World Health Organization recommends 21 gallons pcpd [4]
- System Demand: 5,500 gallons/day



# Hydraulic Model

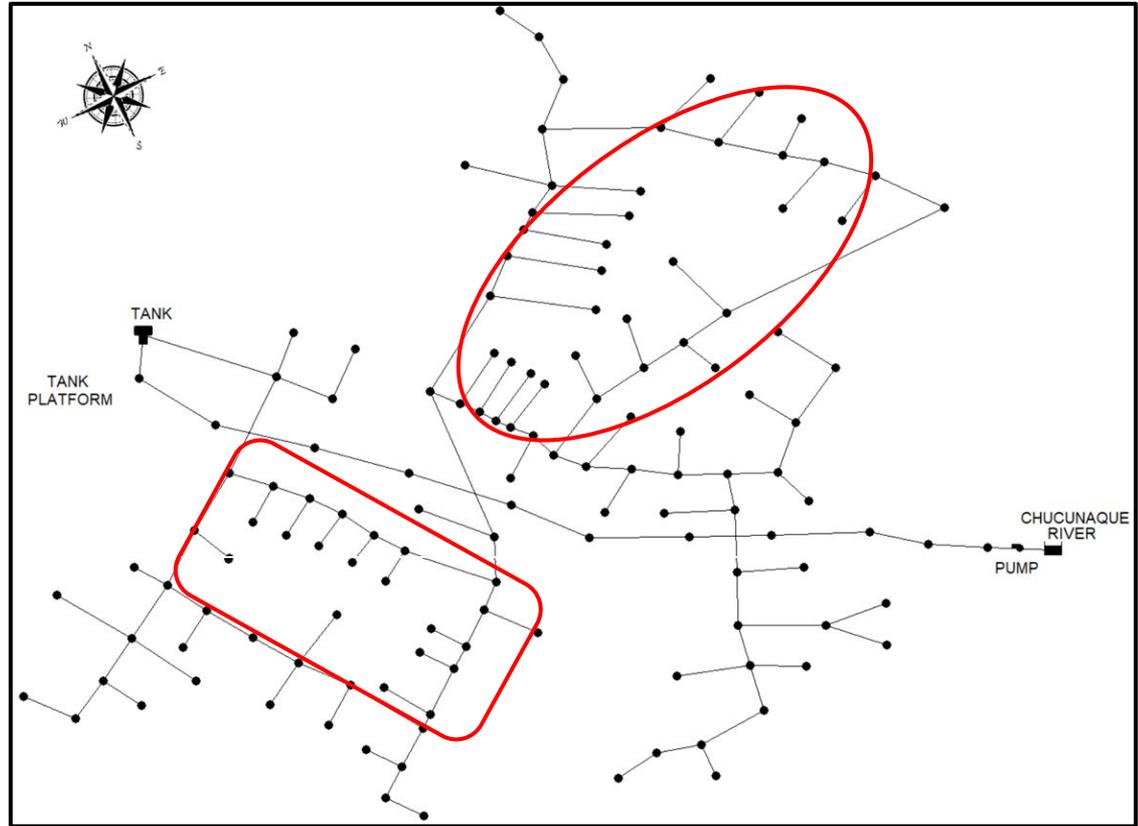
- EPANet
  - Supply Line
    - 2-inch
  - Trunk Lines
    - 2-inch
  - Branch Lines
    - 1/2 inch
  - Loops for redundancy



EPANet Schematic

# Hydraulic Model

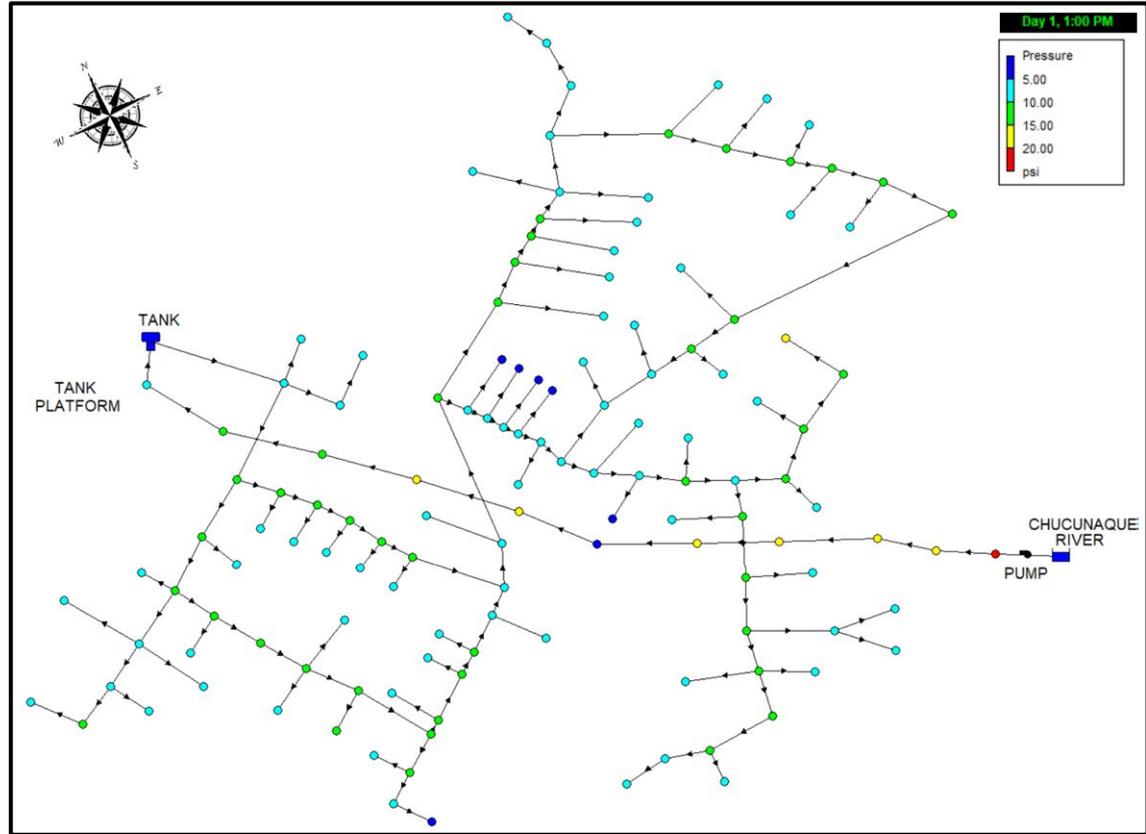
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EPANet Schematic

# Hydraulic Model

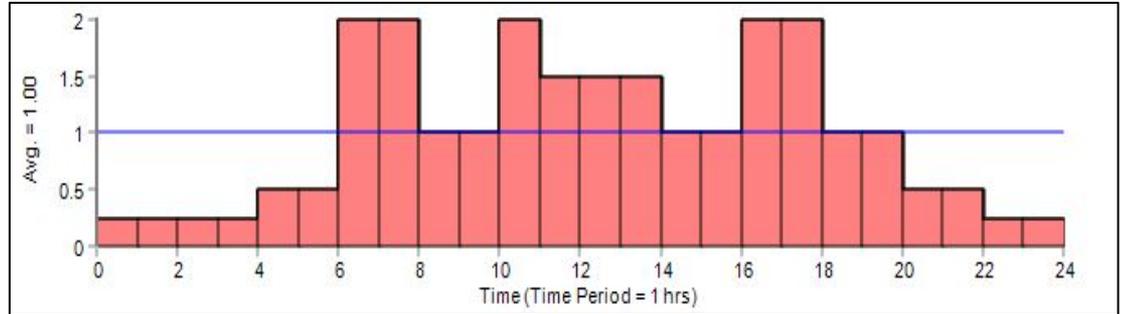
- EPANet Analysis
  - Min. Pressure 4 psi
  - Max. Pressure 15 psi



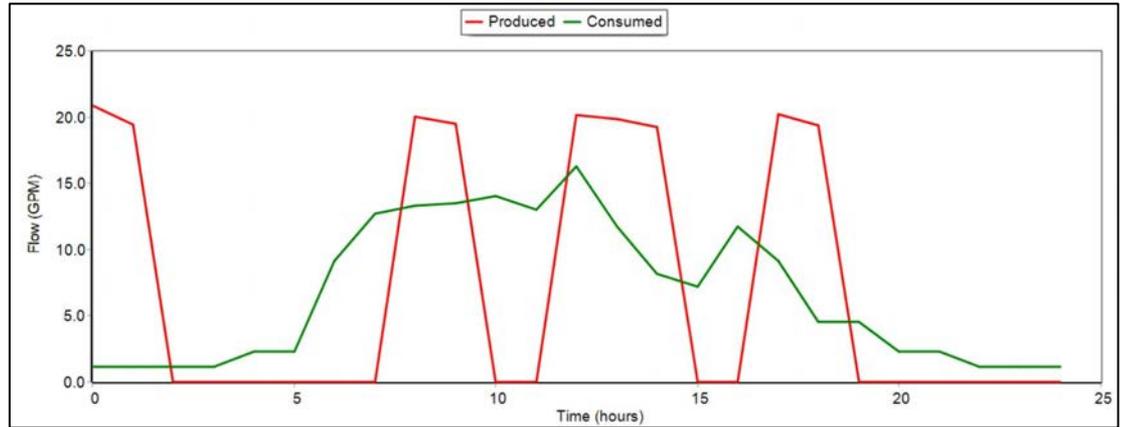
EPANet Schematic

# Hydraulic Model

- Five different water demand patterns
- Three water usage spikes



Water demand pattern for homes



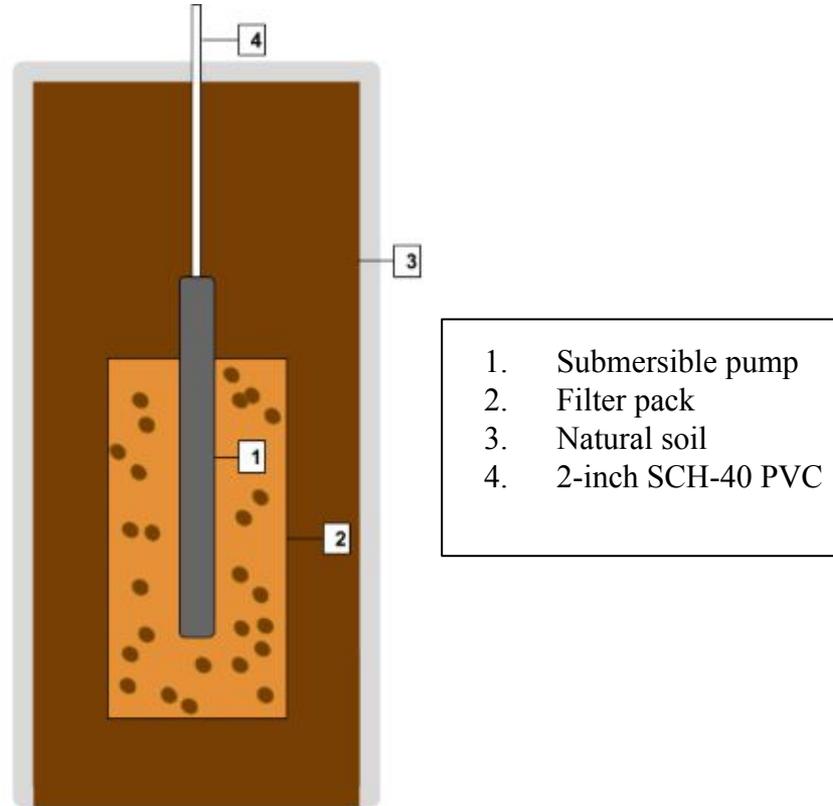
System Flow Balance

# System Components

1. River Source: Intake Structure and Pump
2. Water Treatment: Filtration and Chlorination
3. Water Storage Tanks
4. Distribution Network

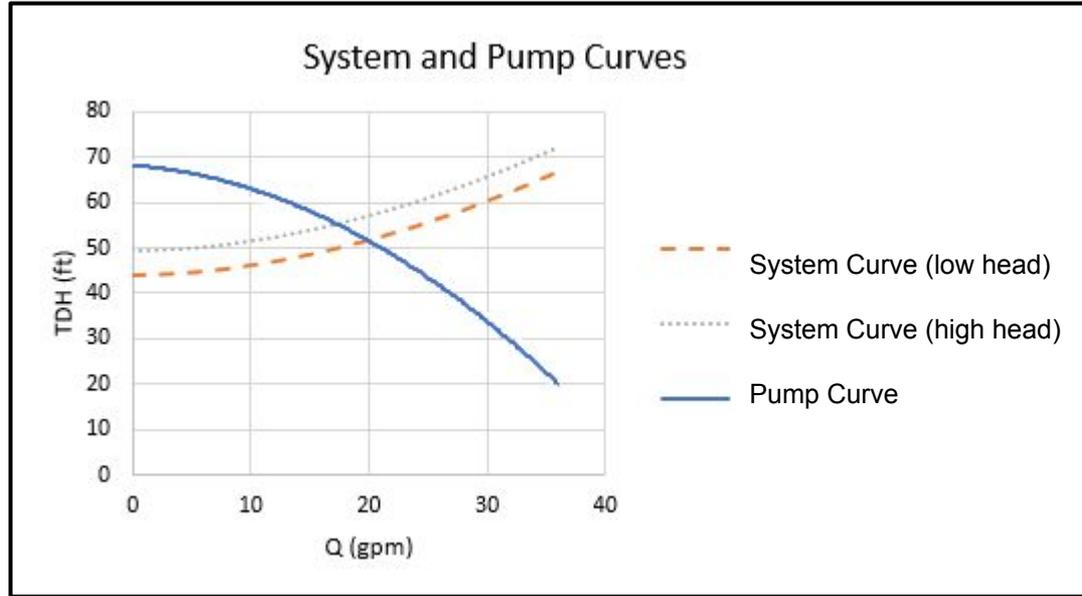
# Wet Well

- Filter pack will ensure low turbidity of water entering pump



Wet Well Profile View

# Pump Specifications



# Automatic Pump Shut-Off

1. Insufficient water in wet well
2. Sufficient water in tanks

```
RULE 1
IF TANK tank LEVEL ABOVE 5.25
THEN PUMP pump STATUS IS CLOSED
RULE 2
IF TANK tank LEVEL BELOW 2
THEN PUMP pump STATUS IS OPEN
```

Pump Shut-Off Implementation in Hydraulic Model

# Water Quality Testing

- *E.coli* and Coliforms Present
  - Health Hazards
- High Turbidity



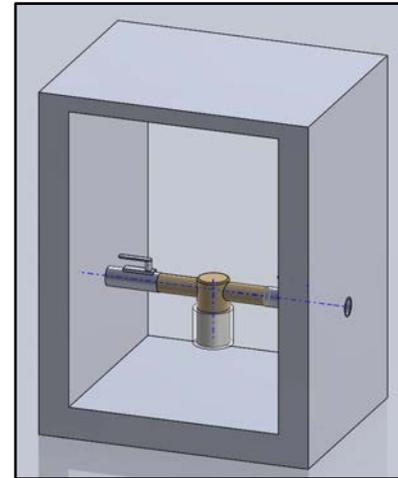
Upstream Intake Structure  
Water Quality Sample

Intake Structure  
Water Quality Sample

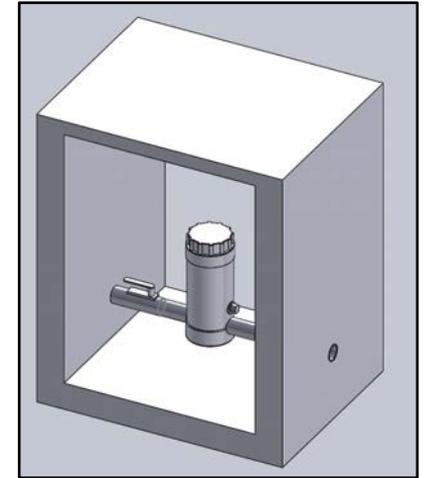
School Tap  
Water Quality Sample

# Water Treatment Plan

- T-screen backwash filter
  - 120 mesh screen
  - Stainless steel screen
- In-line Chlorinator
  - 3 chlorine tablets every 1-2 weeks
  - Contact time of 30 min
  - Residuals may be depleted
- Both are located before the storage tank



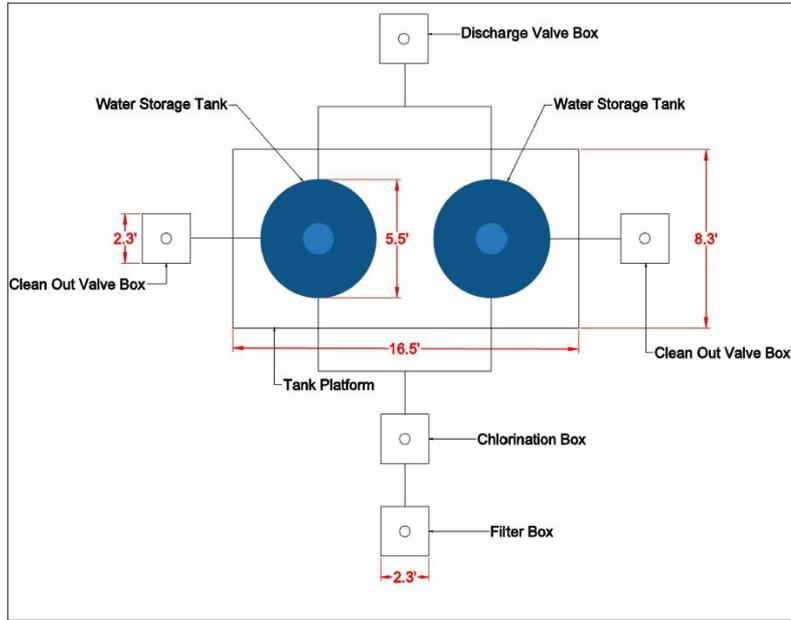
Backwash Filter



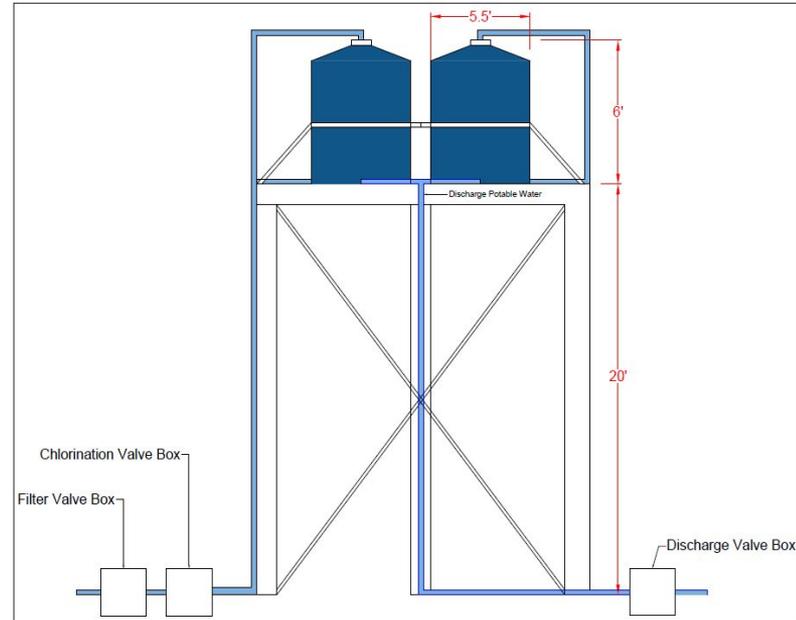
Chlorinator

# Tank Specifications

## Plan View



## Side View



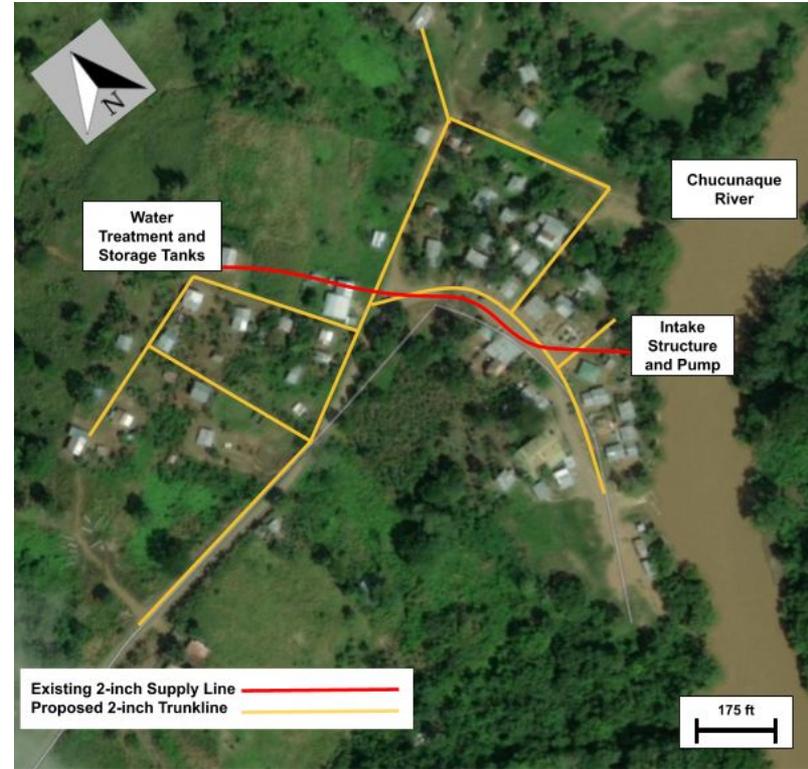
# Tank Roof

- Platform existing
- Mono-pitched
- Serviceability consideration
  - Height
- Gravel for erosion control



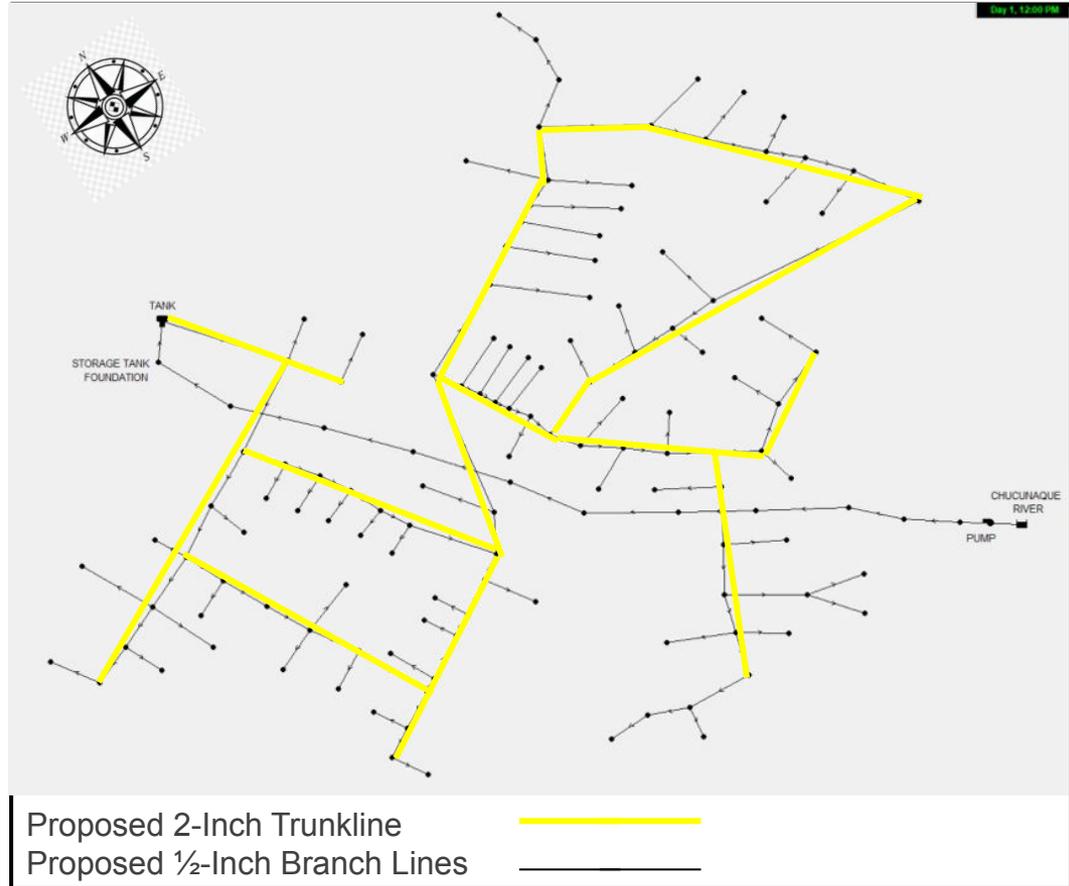
# Distribution Network

- Trunk Lines
  - 2-Inch
- Branch Lines
  - 1/2-Inch



# Distribution Network

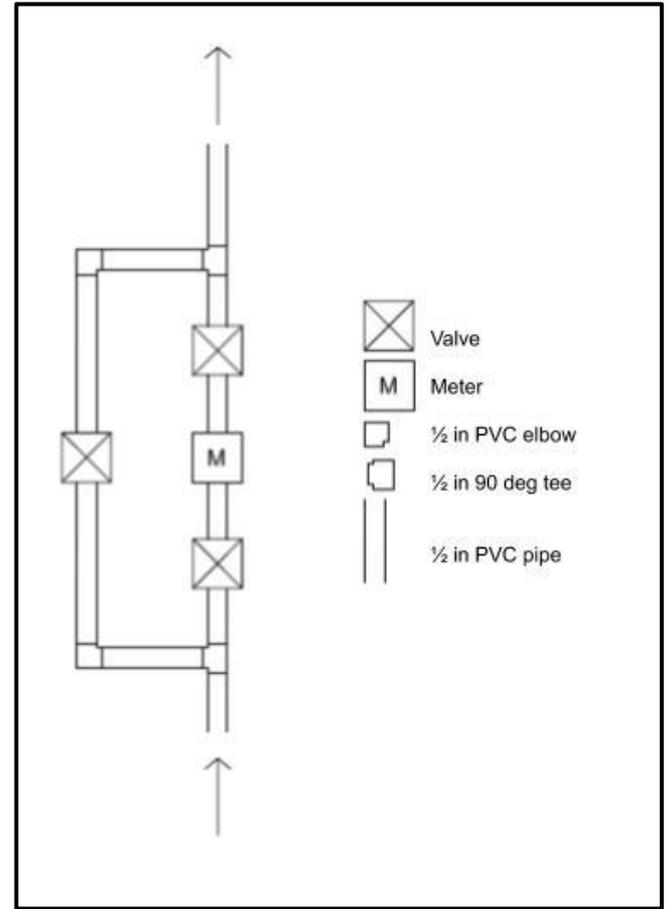
- Trunk Lines
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  - 1/2-Inch



Source: Apple Maps [3]

# Metering

- Meters at each outlet location
  - Protection
  - Redundancy



Source: Flows.com [5]

# Vertical Pipe Support

- Materials:
  - 0.5 inch PVC pipe
  - Wood
    - Metal Pipe Straps
    - Galvanized Steel Nails
  - Concrete
    - Zip Ties



Source: Photo by authors

# Construction Schedule

1. Mobilization
  - a. Transportation
  - b. Safety and Training
2. Construction
  - a. Piping Network
    - i. Trunklines
    - ii. Branchlines
    - iii. Meter Installation
  - b. Tank Roof
3. Flush and Test

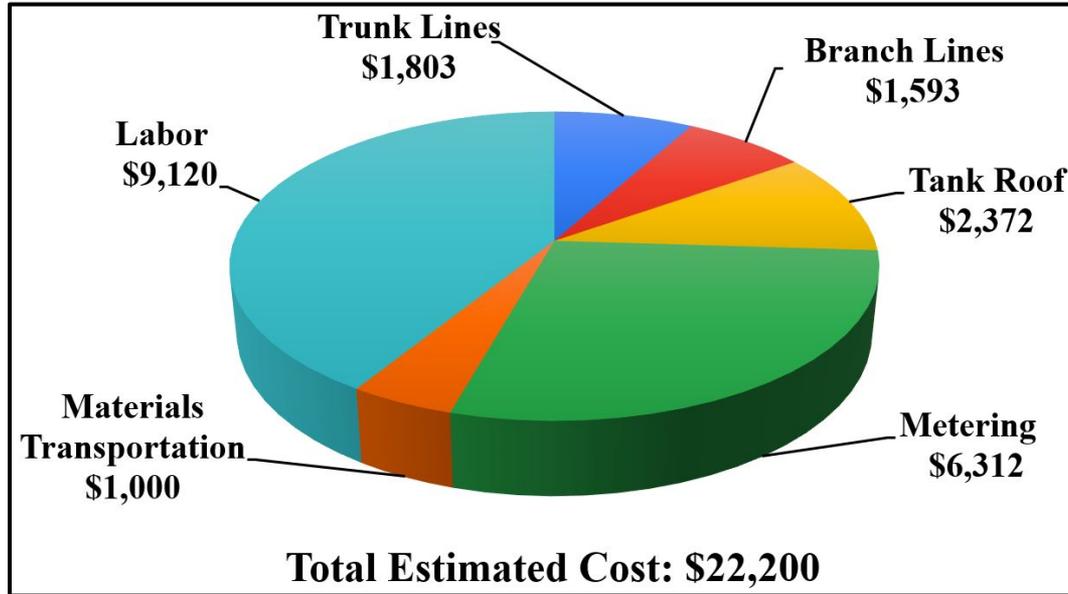


Source: Photo by authors

# Construction Schedule

- Project Duration: 18 Weeks
  - Contingency Days Included

# Cost Estimate



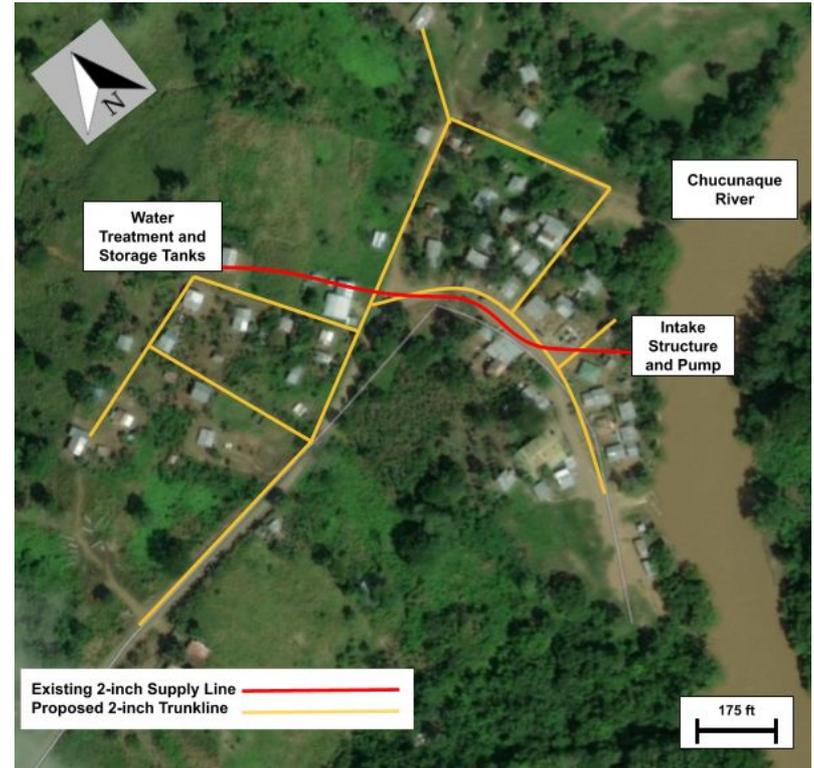
# Annual Operating Costs

- Chlorine Tablets
  - \$110
- Pumping
  - \$640
- Maintenance



# Recommendations and Conclusions

- Sustainable water distribution system for the La Peñita, Panama
- Next Steps
  - Send report to project partners
  - Implementation



Source: Apple Maps [3]

# Thank You



Source: Photo by authors

Acknowledgements: Dr. Watkins, Mike Drewyor, Kiko de Melo e Silva, Footprint Possibilities, and Global Brigades

# References

- [1] “Google Maps.” *Panama*. Accessed 1 December 2019. Retrieved from <https://goo.gl/maps/2hT9PP6AfjCpAQe6A>.
- [2] “Pasar La Selva Del Darién Es Un Suicidio,” *Inicio*. 30 May 2019. Accessed 20 November 2019. Retrieved from <https://www.midiario.com/mundo/pasar-la-selva-del-darien-es-un-suicidio/>
- [3] “Panama Map,” *Map of the World, Apple Maps*. Accessed 15 October 2019. Retrieved from [satellites.pro/Panama\\_map#8.360415,-77.791448,18](https://satellites.pro/Panama_map#8.360415,-77.791448,18)
- [4] *World Health Organization*, [www.who.int/](http://www.who.int/)
- [5] “Economy Plastic Water Meter - WM-PC Series,” *Flows.com*. Accessed 20 November 2019. Retrieved from <https://www.flows.com/economy-plastic-water-meter-wm-pc-series/>