

# Valle Escondido

iDesign 2015

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# Outline

- Assessment Trip
  - Community Background
  - Problem Description
  - Data Collection
- Design Proposals
  - Rainwater Catchment
  - Spring box
  - Aqueduct Development
  - Storage & treatment
- Cost Estimation
- Questions



# Assessment Trip

# Community Background

- Valle Escondido
  - Isla San Cristobal, Province of Bocas del Toro
- Indigenous Ngöbe community
- Population of ~300 people
- Income: Agriculture
  - Cacao, yucca, banana, dasheen, etc.
- 4th Peace Corps Volunteer







# Community Background

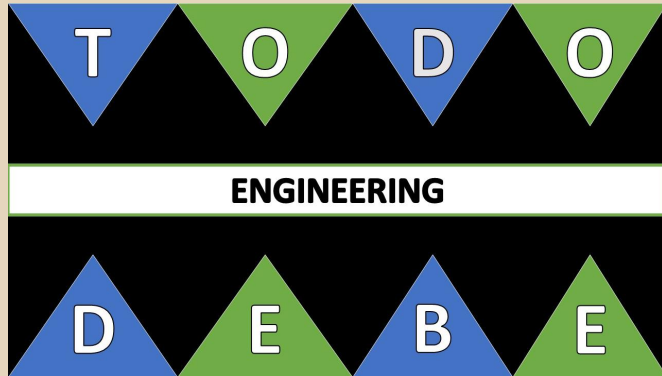
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# Problem Description

- Illness due to contaminated water
  - Open defecation
- Spring-fed aqueduct system in place
- Alternative water sources for families not connected:
  - Open wells
  - Rainwater

# Mission Statement



Diversification and enhancement of water resource systems, considering public health and sanitation.



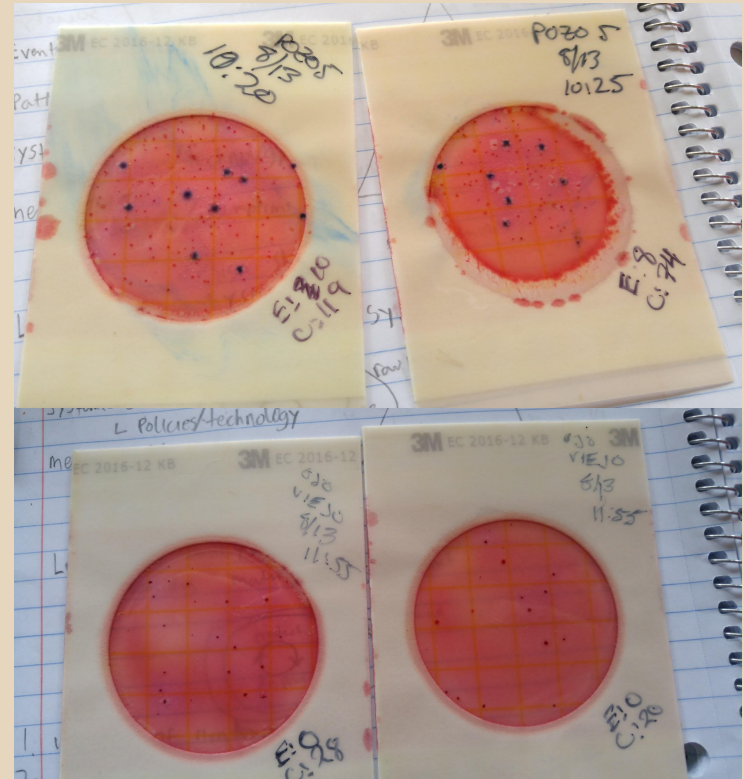
# Data Collection

- 5 wells serving 1-2 families each
  - Stagnant
- 1 main bathing area for community
- 2 existing springs for aqueduct
  - Turbidity



# Data Collection

- Wells
  - Average ~5/ml E.coli
  - TMTCColiforms
- Spring Water
  - No E.coli
  - Average ~10/ml coliforms
- Contamination
  - Exposed well's
  - Broken or unburied pipes
- Presented results to community



# Data Collection

## Nitrate tests

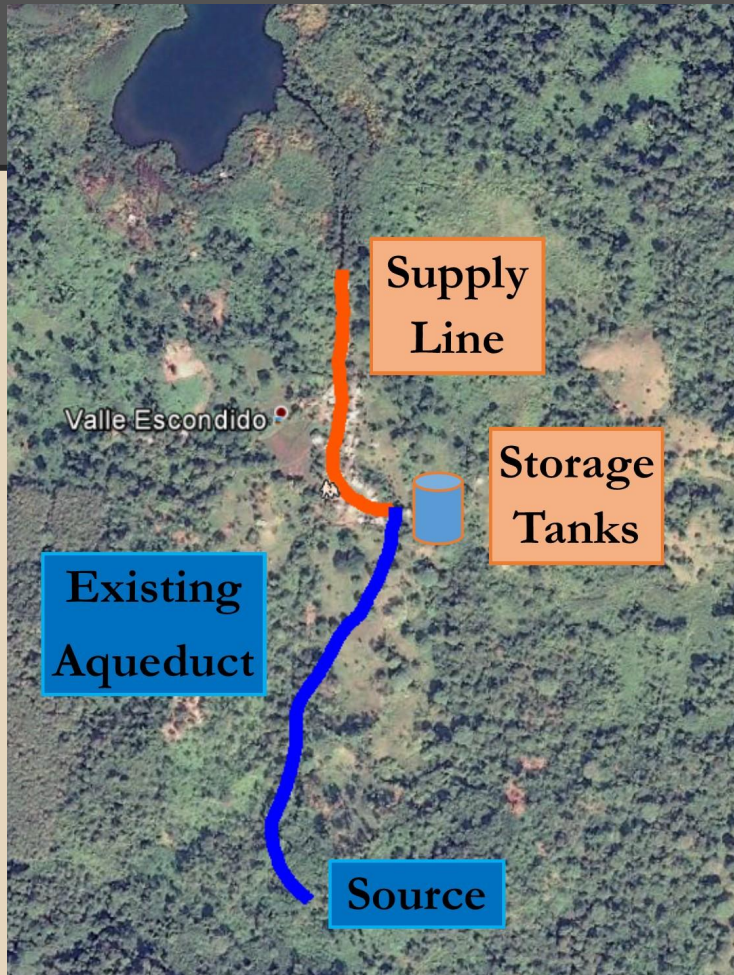
- Wells
  - All results  $<1$  ppm
  - Determined nitrate not a problem





# Data Collection

- 6100 feet of pipe spanning 1.08 miles
- 187 feet of elevation change from spring to community





# Design Objectives

- Source Protection
- Aqueduct Expansion
- Rainwater Harvesting

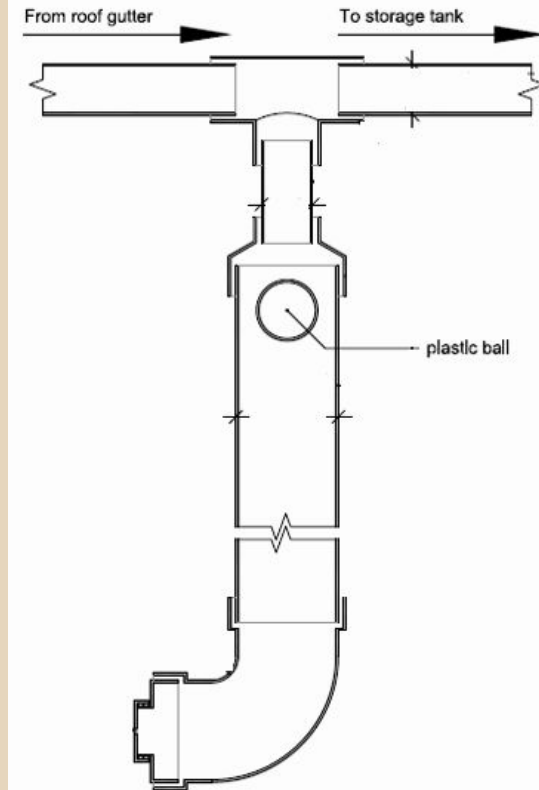


# Design Components

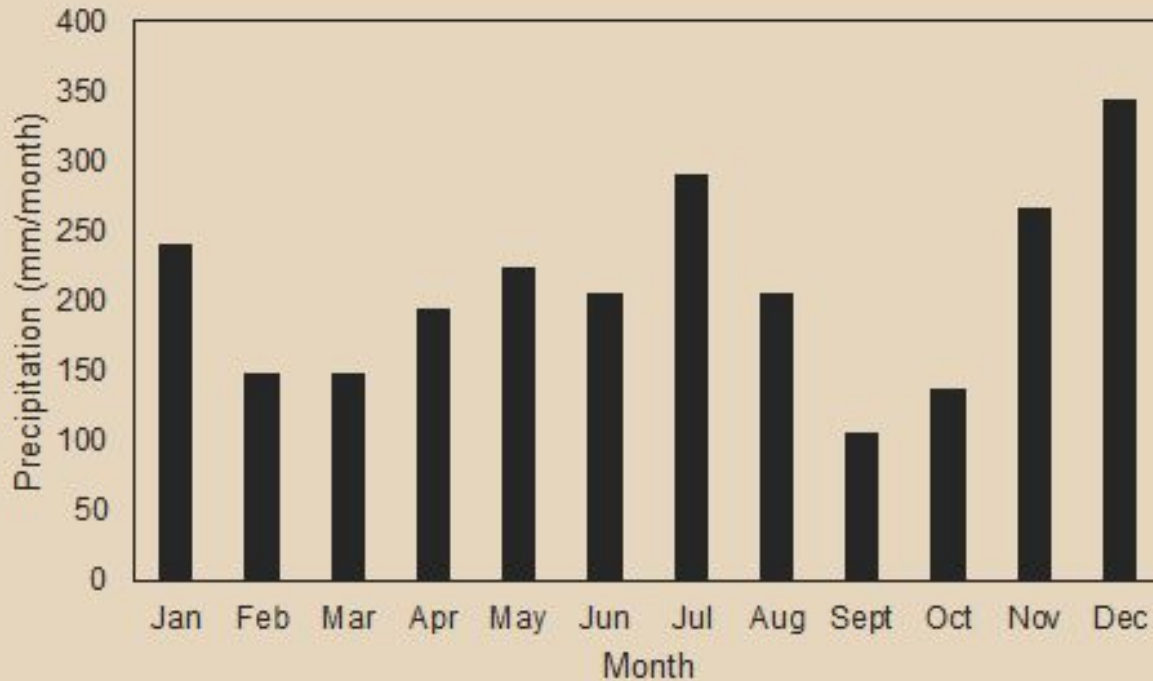
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# Rainwater Catchment System

- PVC gutter
- Filtration
  - Mesh screen
  - First flush system
- 85 gallon tank
- Wooden stand



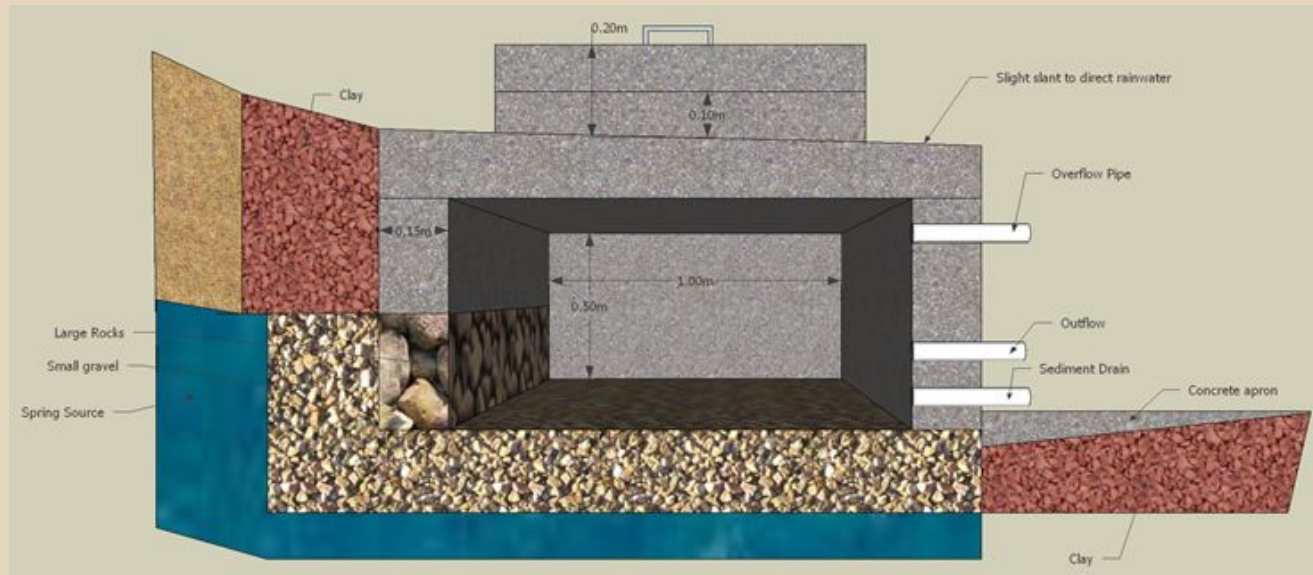
# Monthly Precipitation Averages





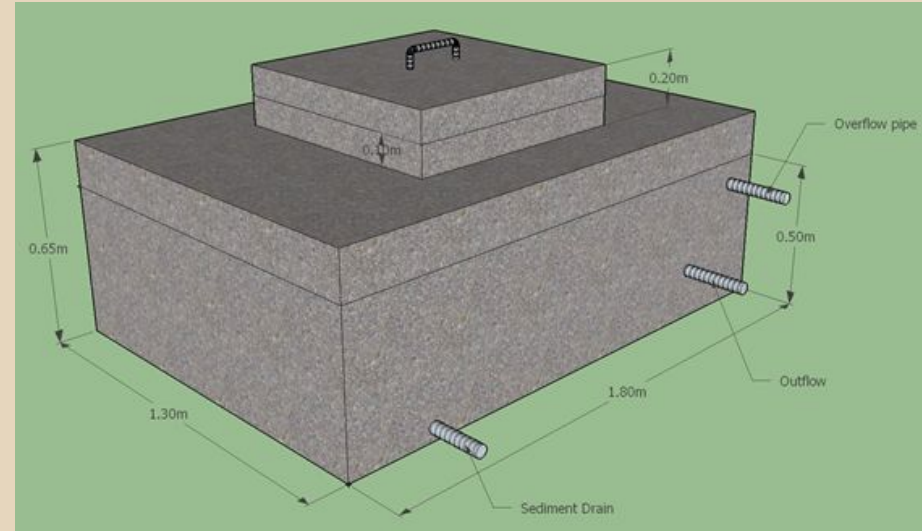
# Springbox Design

- Integrated open side and bottom design
  - *Gravel/stones* - filter sediment
  - *Clay* - prevent infiltration
  - *Concrete apron* - prevent erosion



# Springbox Design

- Visual estimates for size
- Design Specifications
  - Rebar reinforced concrete
    - 5:1 sand/gravel to cement
  - Outflow, overflow, and sediment drain
  - Ridge around opening to prevent seepage



# Springbox Design

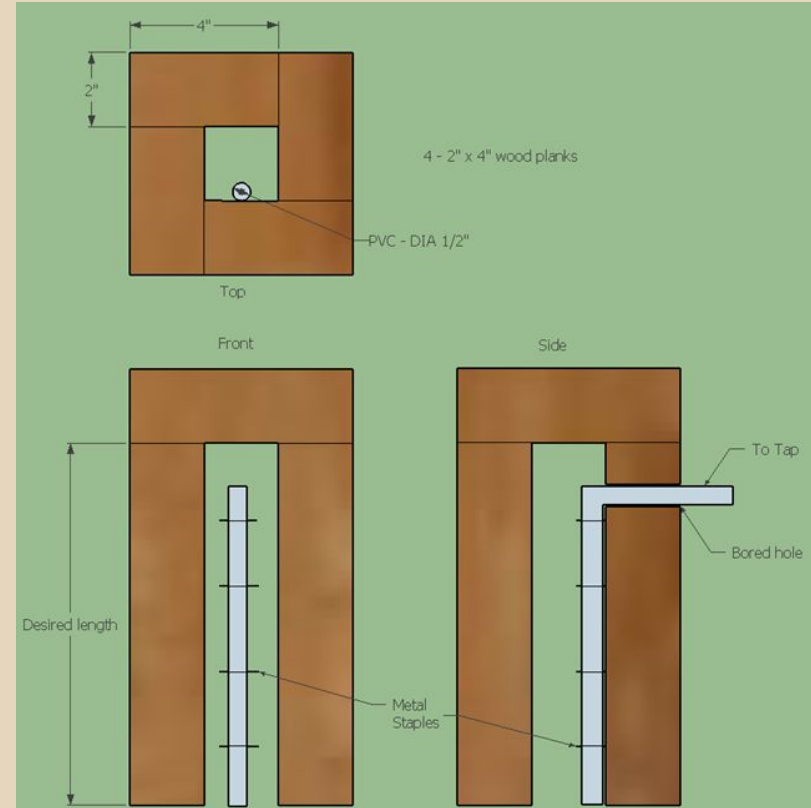
- Maintenance

Maintenance Schedule

Occurrence	Activity
Monthly or more	Cleaning around site (i.e. removing leaves and debris from spring box and drainage canal, clearing brush from trail, etc.)
Every six months (or when water is not clean)	Open spring box and clean walls and floor, wash with bleach. Clear any debris or sediment accumulation.
Unexpected maintenance	Replace broken pipes, repair cracks and leaks.

# Tapstand

- Reinforce 1/2" piping to house
- Wood
  - Readily available



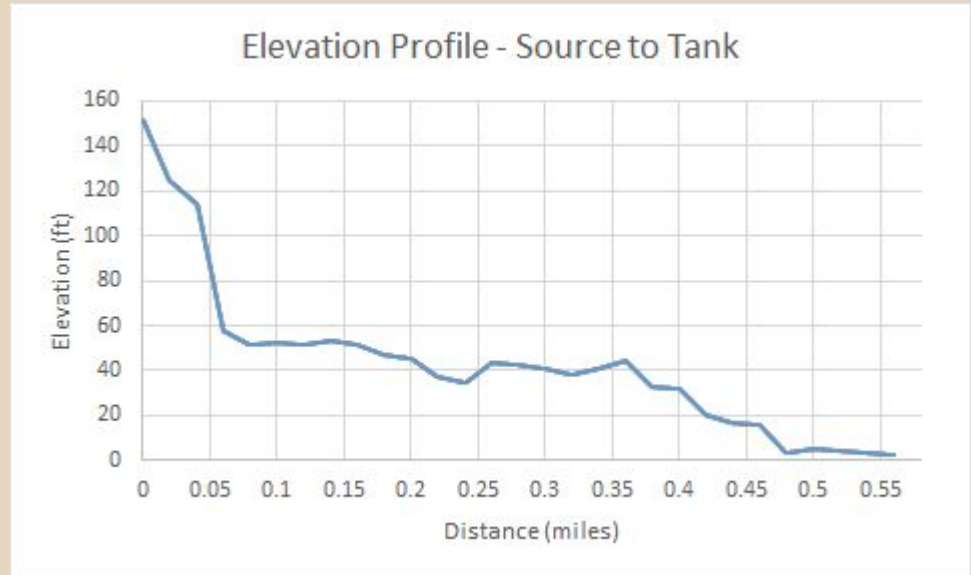


# Aqueduct: Source to Tank

Distance: 0.52 miles

Elevation Change: 147 ft

Average Grade: 6.1%

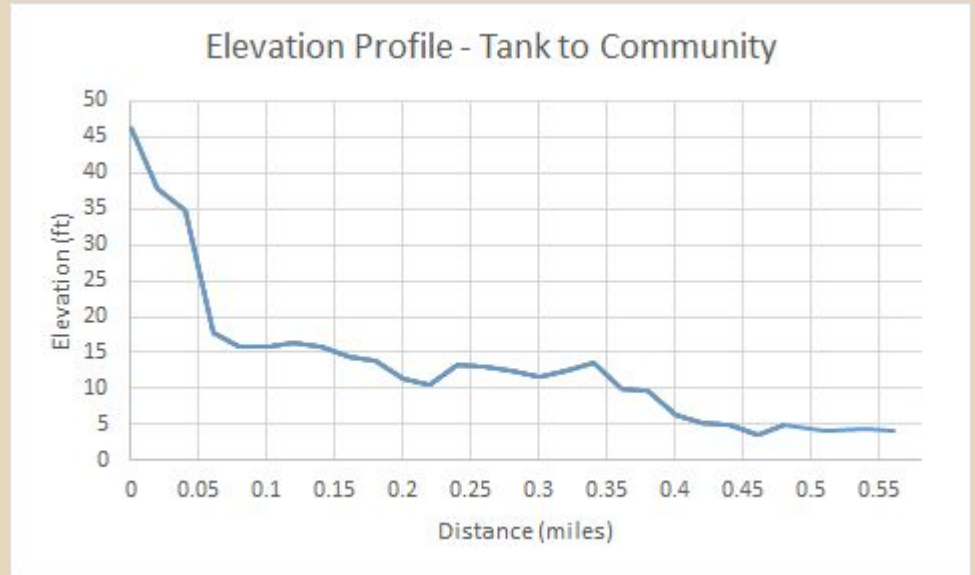


# Aqueduct: Tank to Community

Distance: 0.56 miles

Elevation Change: 42 ft

Average Slope: 2.6%



# EPANET

- Mapped general layout of water network
- Input elevation and pipe lengths based on survey data
- 2 models: existing, proposed



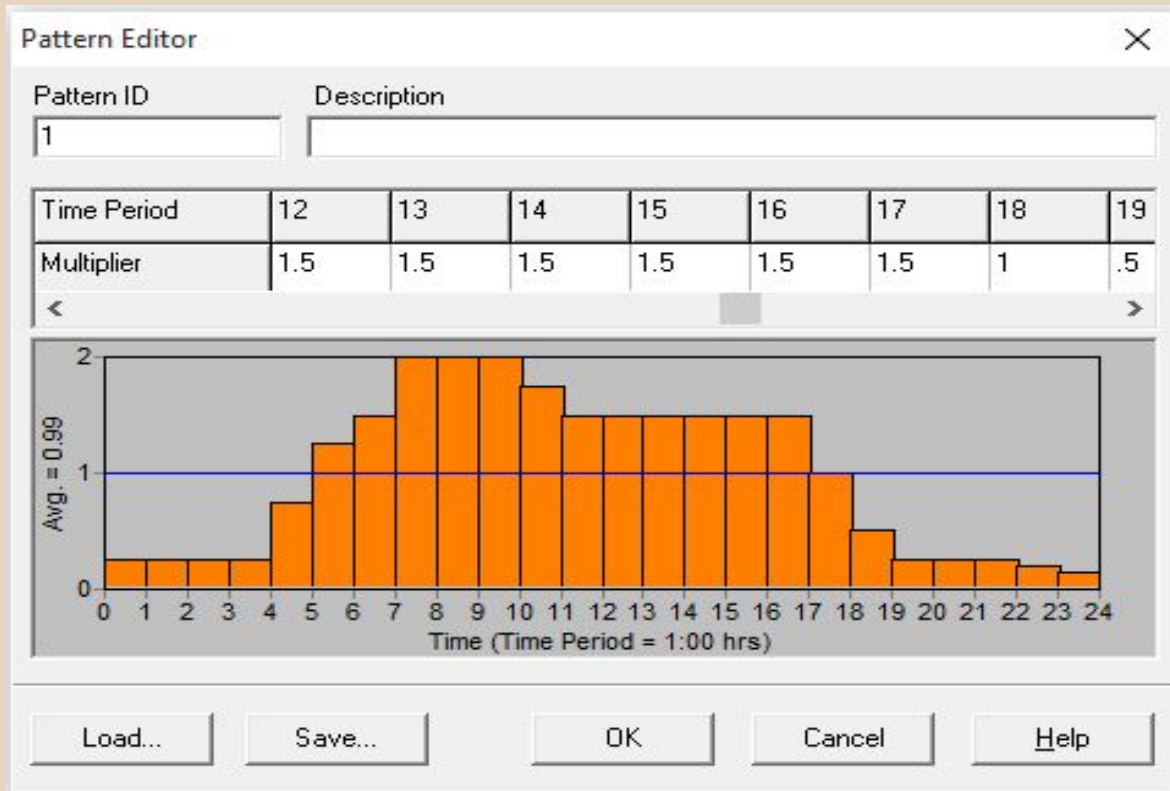
# EPANET: Water Demand

- Used to optimize flow to community
- Water demand of 30 gallons per day per person used

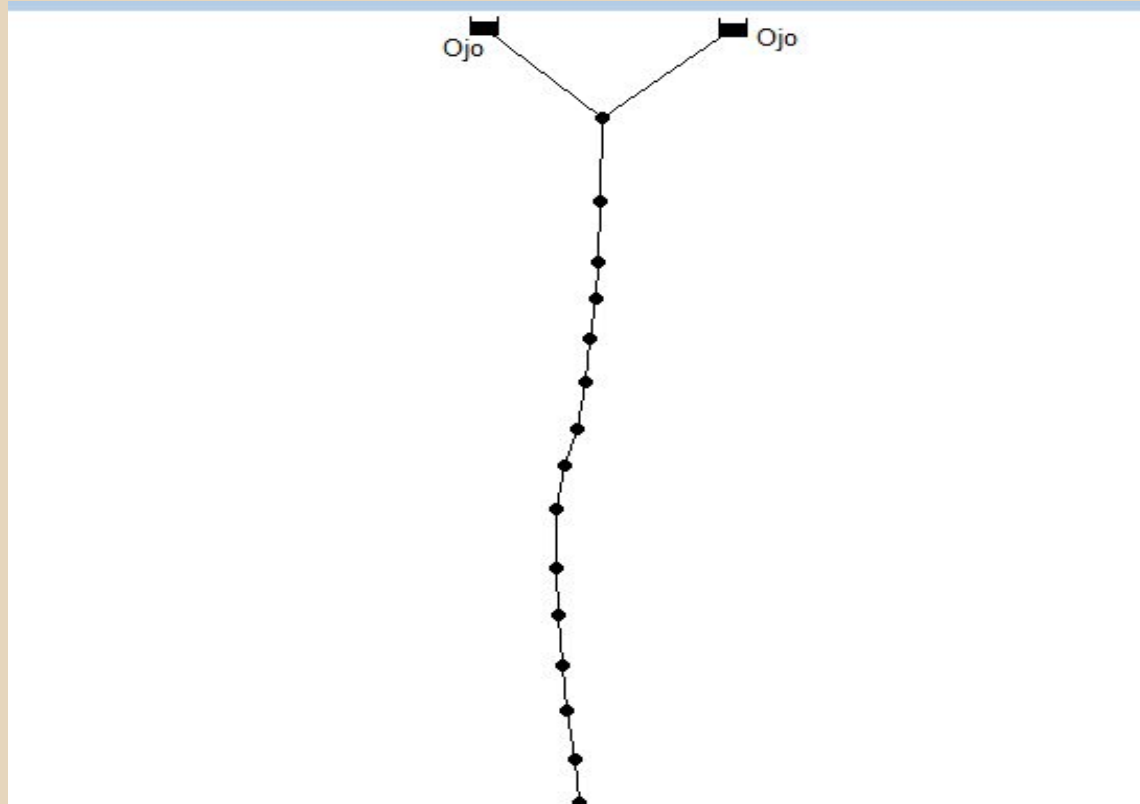




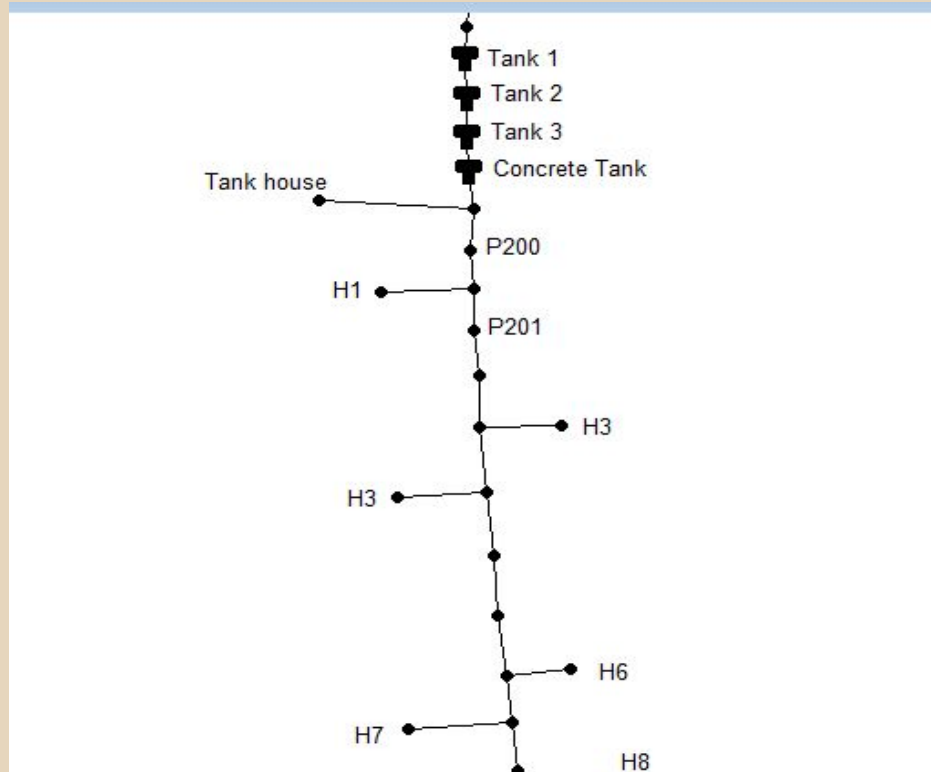
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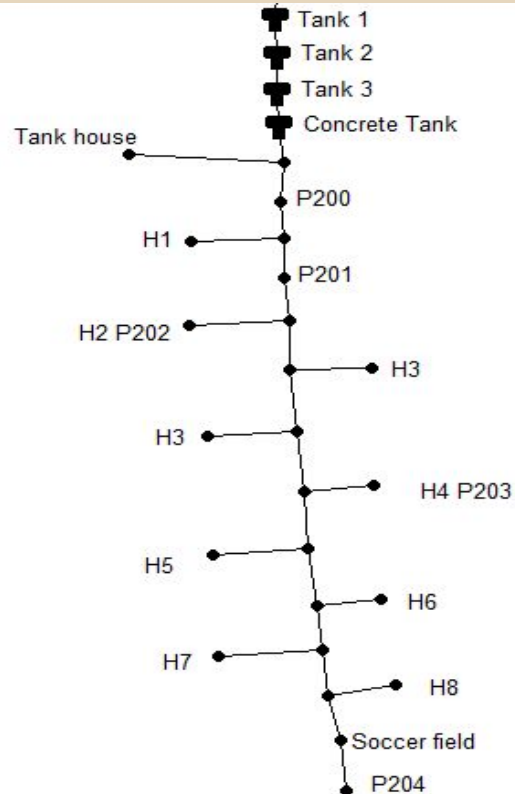
# EPANET: Existing Model



# EPANET: Existing Model



# EPANET: Proposed Model





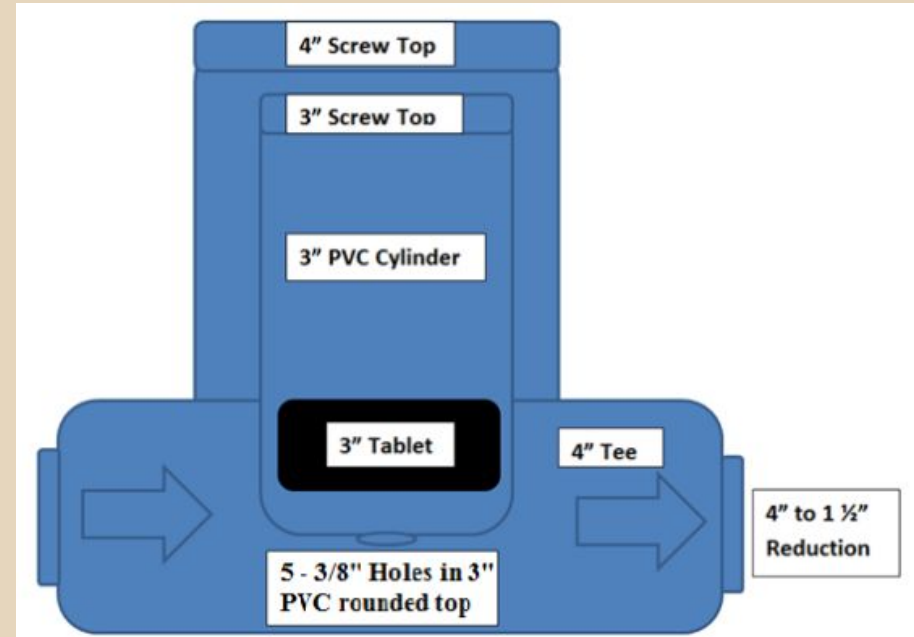
# Storage Optimization

- Current Tanks
  - 4,250 Gallons
  - Recommendations
    - Full Usage
    - Treatment



# Water Treatment

- Chlorinator
  - In-Line
    - Before Tanks
  - Treatment Tablets
    - Contact Time
    - Frequency
  - Ease of Use
    - Weekly



# Scheduling

# Rainwater Tank Schedule

- Flexible time frames
  - No hired labor
  - Yellow indicates strict times
    - Concrete curing
- Variation due to weather
- Maintenance
  - Bi-annual bleach washout
  - Filter cleanout when appropriate

Rainwater Tank Construction Schedule

Task	Time (days)	
	Min	Max
Boat transport	1	1
Construct & cure rainwater tank	8	10
Construct wooden stand	1	2
Install PVC gutters	1	3
Connect first flush & mesh between gutters & tank	1	2
Totals	11	16



# Springbox Schedules

- Construction Schedule
  - Approximately 1 month
- Maintenance Schedule
  - Frequency of cleaning
    - Site
    - Box
  - Frequency of replacement

Construction Schedule

Task	Time (days)	
	Min	Max
Boat Transport	1	1
Build forms	2	4
Place, brace, and oil forms	2	3
Dig Trenches	1	2
Prepare rebar	3	5
Carry Materials to site	1	2
Mix and pour concrete	1	1
Curing and wetting	7	8
Installation of spring box	1	1
Totals	19	27

# Aqueduct Replacement Time

- Time
  - Min: 107 days
  - Max: 230 days
- Based on weather and available volunteer labor

Task	Time (Days)	
	Min	Max
Boat Transport	1	2
Dig Pipe Trench Section	0.125	0.25
Install Piping Section	0.004	0.008
Bury Piping Section	0.021	0.063
<b>Total Time for 15' Section</b>	<b>0.15</b>	<b>0.321</b>
<b>Total Time for whole system</b>	<b>107</b>	<b>230</b>

# Cost Estimate & Summary

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# Cost Estimate

- Materials breakdown based on local costs
- 3 potential springs
- 15% excess piping for aqueduct
- Peace Corps Grant for rainwater tanks

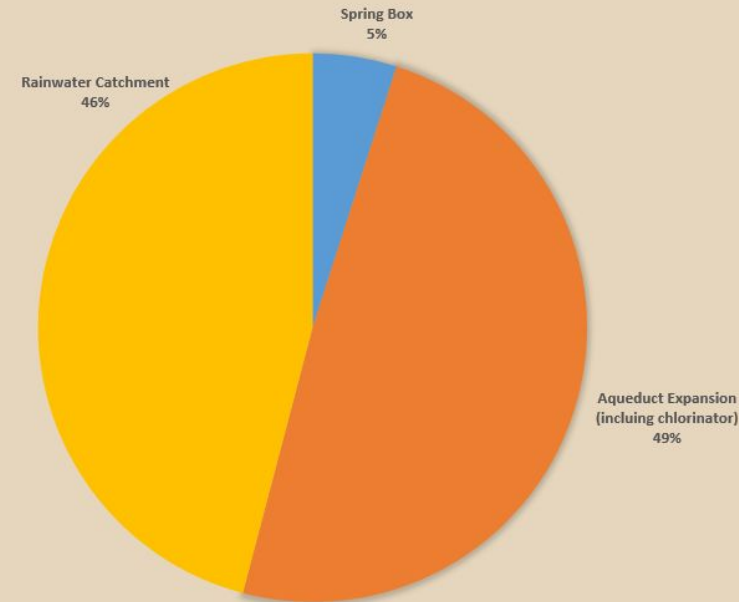
Item	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
1	Spring Box	3	Individual	\$153.50	\$460.50
2	Aqueduct Expansion	1	Individual	\$4553.00	\$4553.00
3	Chlorinator	1	Individual	\$19.15	\$19.15
4	Rainwater Catchment	30	Individual	\$142.00	\$4271.00
				<b>Total:</b>	<b>\$9,300.00</b>



# Summary

- Improvements in quality
  - Springbox
  - Chlorinator
- Improvements in quantity
  - Modify storage tank setup
  - Rainwater supplement
- Overall cost: \$9300

## Cost Breakdown



A photograph of a brown and white dog sitting in a boat, looking out at a tropical island. The island is covered in dense green foliage, including many palm trees. A small, simple house with a white roof is visible on the island. The water is dark and calm. The sky is blue with some white clouds. The dog is wearing a blue collar with a green tag.

Questions?