Embera Puru Water Supply

KRV Water Solutions, Inc.

To improve quality of life: one community, one design, and one drop of water at a time.

GLOBAL Brigades

1885 Michigan Tech

LEAVE A FOOTPRINT. MAKE IT GREEN. FOOTPRINT POSSIBILITIES INC.

Team Introductions

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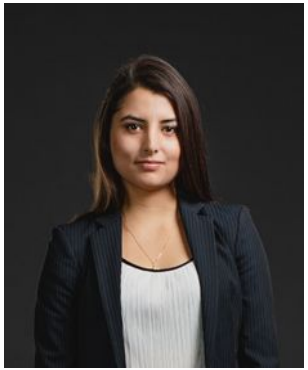

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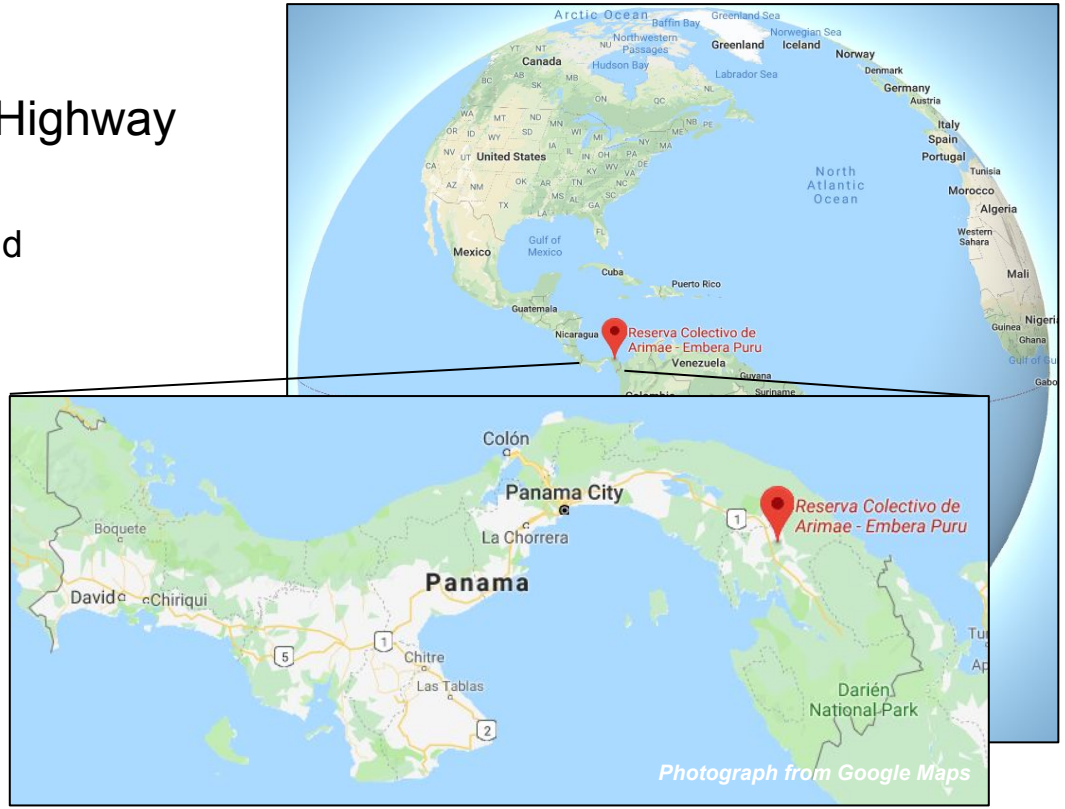
Outline

- Project Introduction
- Site Assessment Phase
- Design Phase
- Planning Phase
- Challenges
- Looking Forward
- Questions

Introduction - Community Background

- Darien Province, Panama
- Located along Pan-American Highway
- Indigenous Community
  - Reservation Area: ~ 32 mi^2 of land
  - Population: 318 people

Cultural Event at Embera Puru



Introduction - Problem Definition

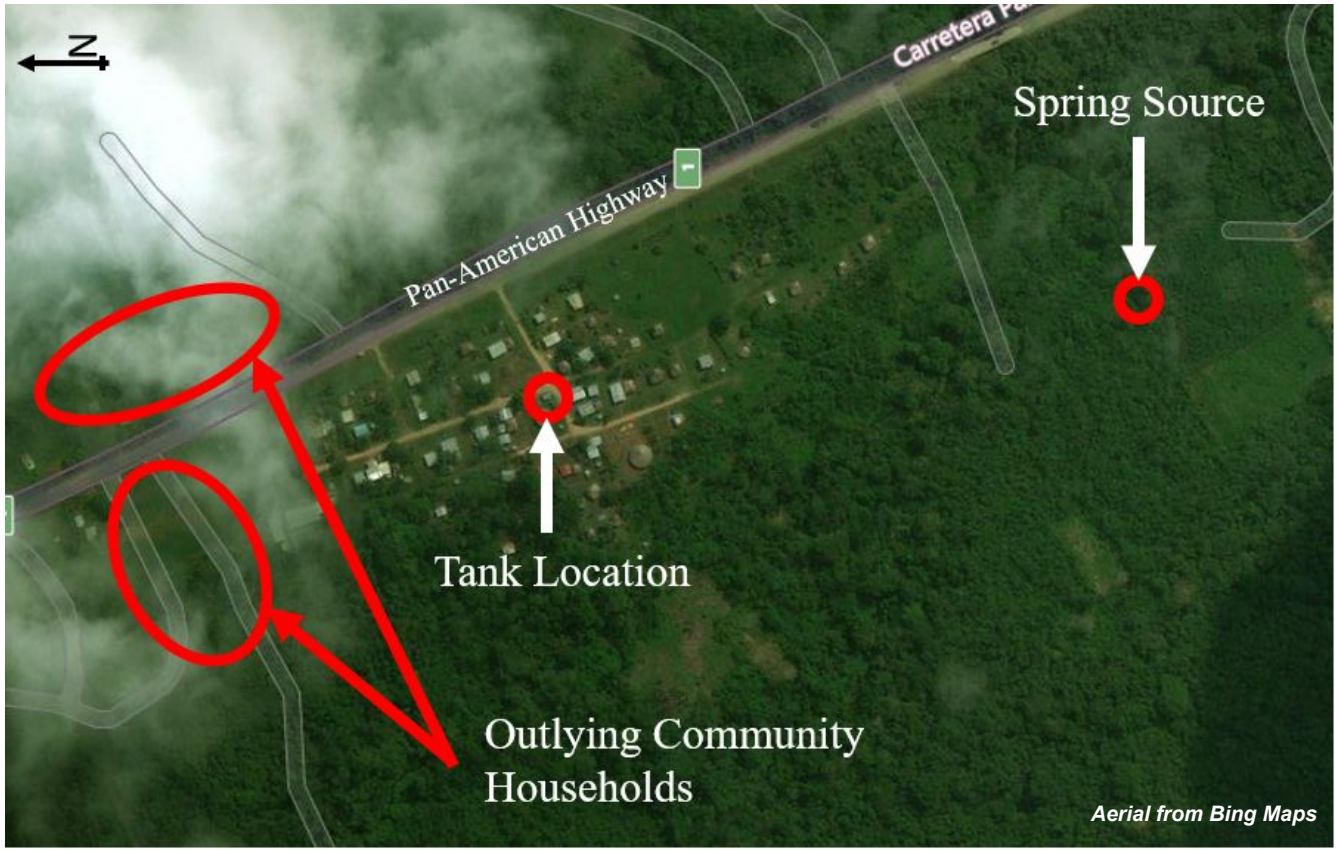
- 81% of Indigenous Territories are Extreme Poverty Level
- End of Functioning System
  - Wet Season: Water 1-2 days/week
  - Dry Season: No water!
- Population Growth
- Increase in Demand

Spring defined as potential source: “Source 1”

Introduction - Project Background

- **Goal:** Provide potable water to meet water demand of 20-year projected population
- **Project Stakeholders:**
  - Community Members
  - Footprint Possibilities Panama
  - Global Brigades Panama
- **Access to water:** 74 faucets
  - 3 community buildings
  - 1 school (5 taps)
  - 63 homes (Average 4 people per house)

Introduction - Site Overview



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Site Assessment Phase

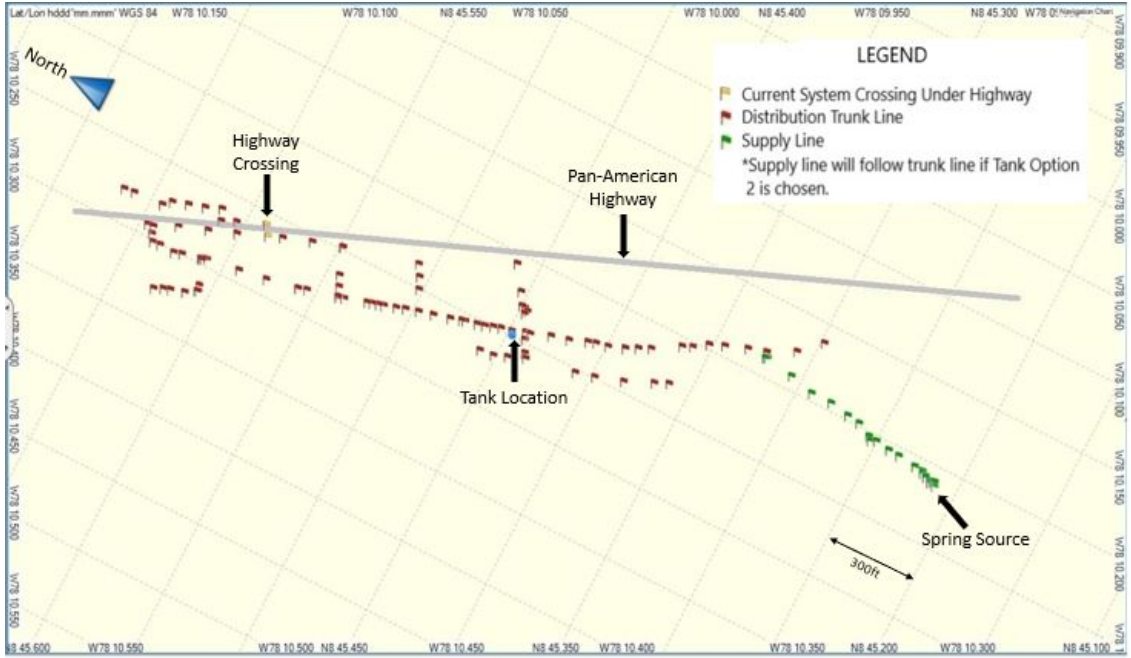
Existing Conditions

- Fundacion San Jose de las Canasas (Foundation) System
  - Supplied by Rio Sabana (~ 50 km away)
  - Well-built and Established System (1994)
  - Supplies 13 communities
  - Embera Puru is at the end
  - *Problem:* System has been outgrown
- TRUNZ Ultrafiltration System
  - Supplied by remote spring source
  - Vandalized and abandoned 7 years ago
  - *Problem:* Inappropriate Technology

Data Collection - Topographic Data

Data Collection

- GPS Points
- Nikon RangeFinder
- Compass Bearing



Data Collection - Soil Classification

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Tests:

- Settlement test on level surface: 1 minute, 1 hour and 24 hours
- Turbidity Test: Additional 4 days undisturbed
- Knife Test

Results:

- High Silt and Clay Content

Table 1: Soil Sampling Results

Location	Percentage		
	Sand	Silt	Clay
Spring Source	17%	40%	43%
Tank Option #1	Inconclusive		

Hole for Sample at Spring Source

Knife Test at Spring Source

Data Collection - Water Quality

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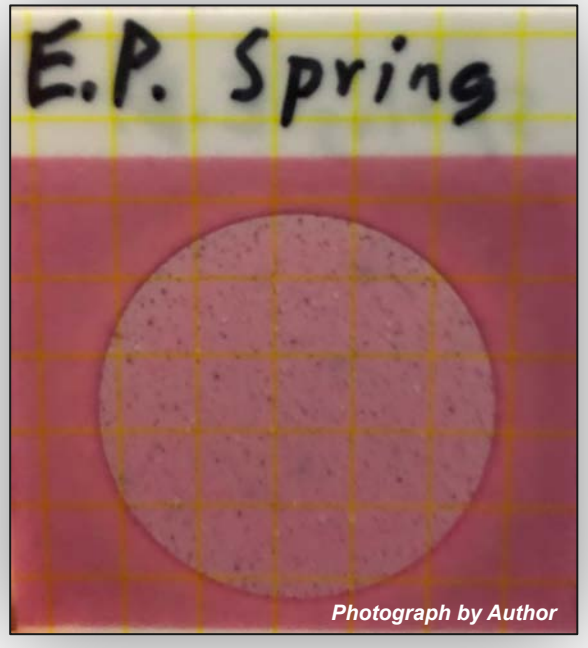
Test: Incubation on 3M Petrifilm Plates Coliform

Results:

- *Tap (existing Foundation system):* 0 coliform count, no settled solids
- *Spring Source:* coliform count of 12 per square or 240 total count, minimal settled solids

Verification:

- Consistent with Laboratory Observations



Results of Spring Source

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Design Phase

Design Parameters - Criteria

- Appropriate Technology
- Mitigate Safety and Environmental Hazards
- Capacity Requirements
  - Current Design Population: 305 people (central community)
  - 15.85 gallons (60 liters)/person/day
  - 4% Population Growth Factor
  - 20 year projection
- Metered Distribution System
- Protective Barriers (i.e. fences, locks, etc.)

Design Parameters - Constraints

- Viability of Spring Source
  - Spring Flow Rate
- Electrical Power Supply
  - Pumps
  - Control System

Design Parameters - Assumptions

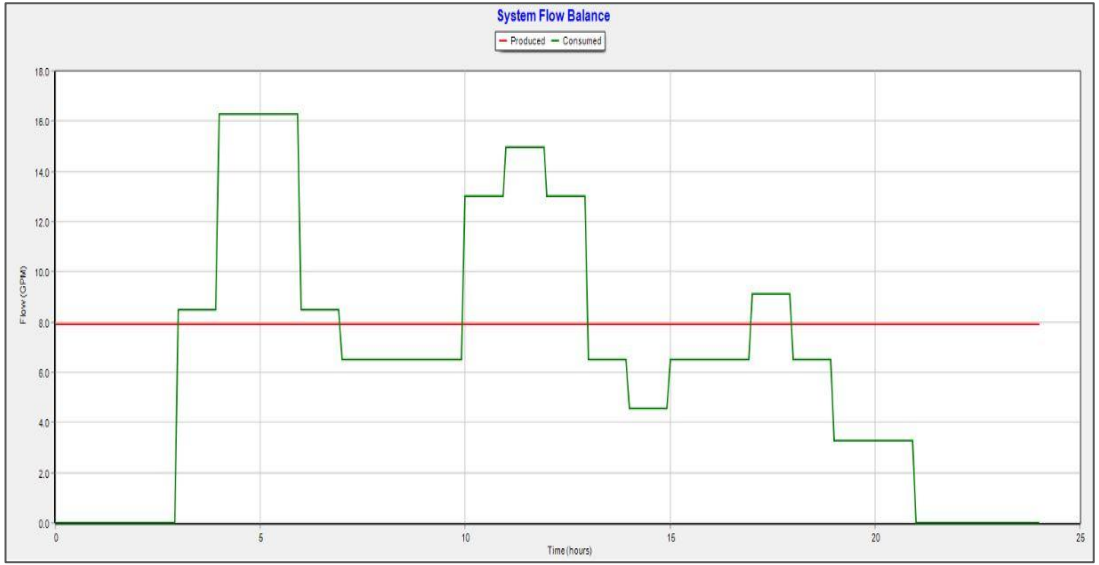
- Spring Source
  - Enough water to meet design criteria
  - Flow Rate: Minimum 7.9 GPM
  - Minimum Water Output: 10,600 gallons per day
- Household Height
  - 7-ft above ground elevation

Example of Elevated Houses

Kelsey

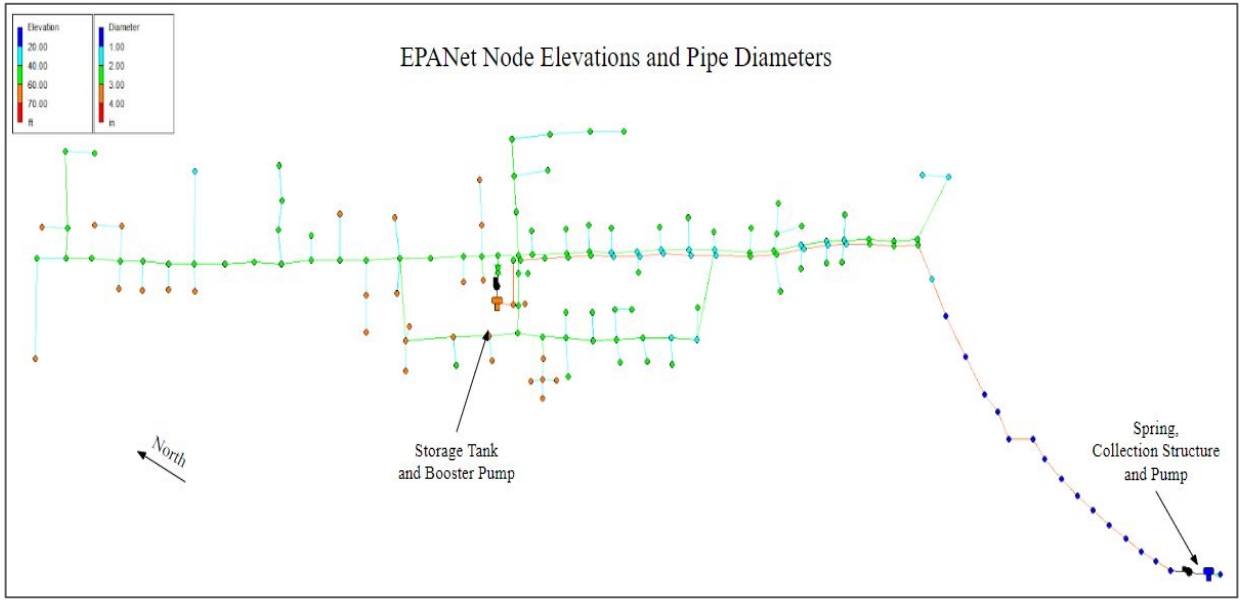
System Analysis - Water Balance

- **<u>Projected Population:</u>** 670 people in 20 years (4% growth from current)
  - 7.9 gpm needed to maintain storage tank level
  - 10,600 gallons total usage



System Analysis - EPANet Model

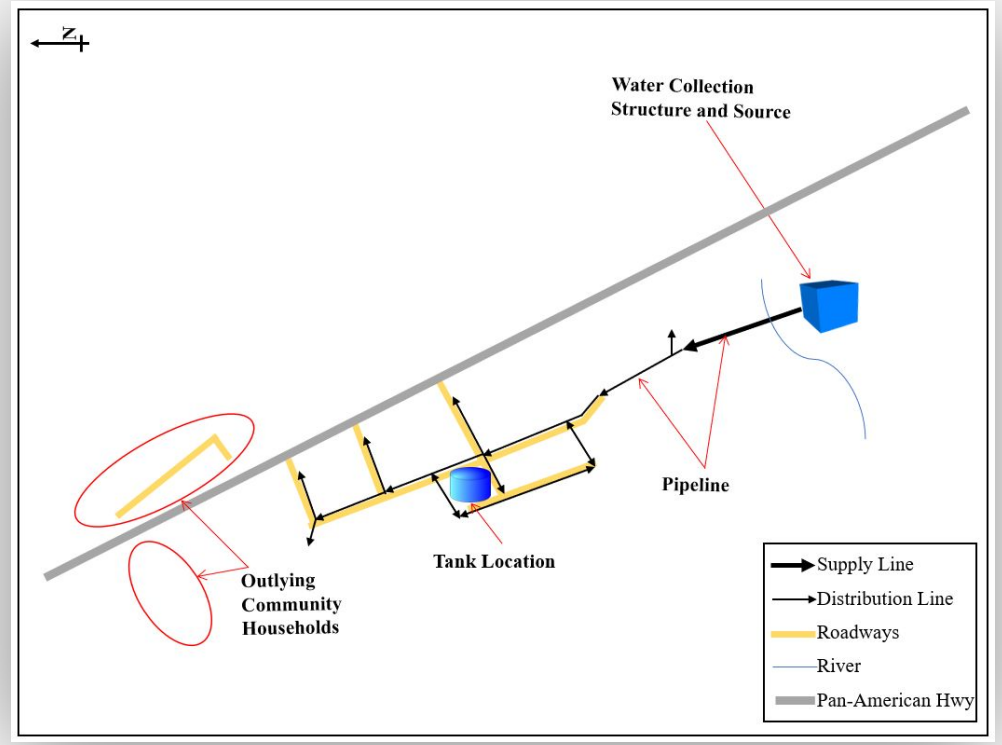
- **Design:**
  - Tank Capacity
  - Pipe Sizing
  - Pump Locations
- **Analyses:**
  - Head
  - Pressure



EPANet Model Showing Node Elevations and Pipe Diameters

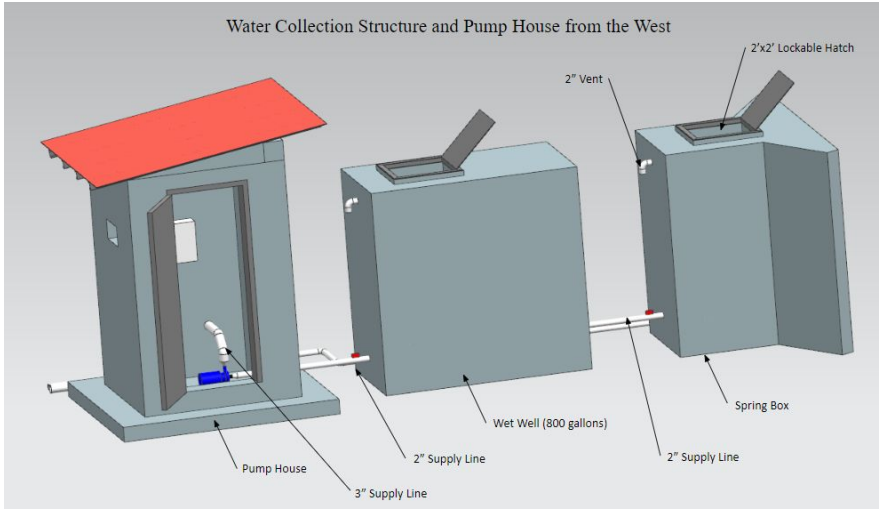
Design Overview: Emberá Puru

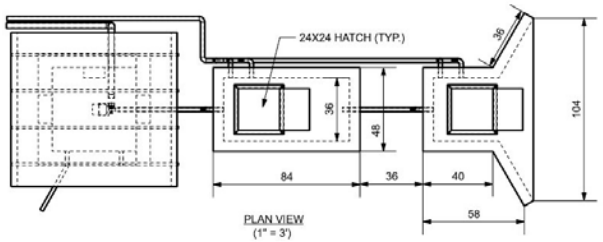
- **Design Components:**
  - Water Collection Structure
  - Pump Stations
  - Electrical Supply
  - River Crossing
  - Water Storage Tank
  - Water Treatment
  - Supply and Distribution Pipelines

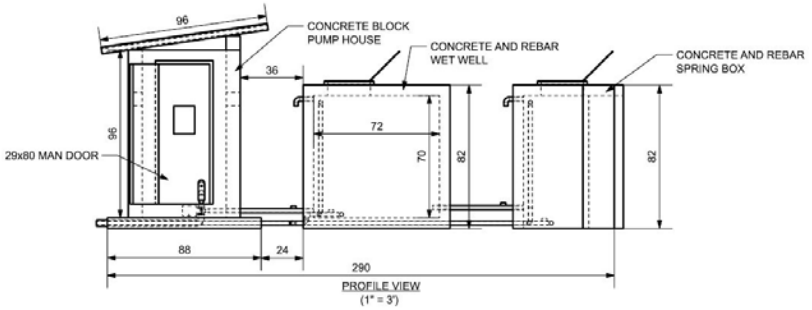


Water Collection Structure

- **Catchment:** Collect water from Spring
- **Wet Well:** Provide buffer for Pumping
- *Feeder Pipe* with Roughing Filter

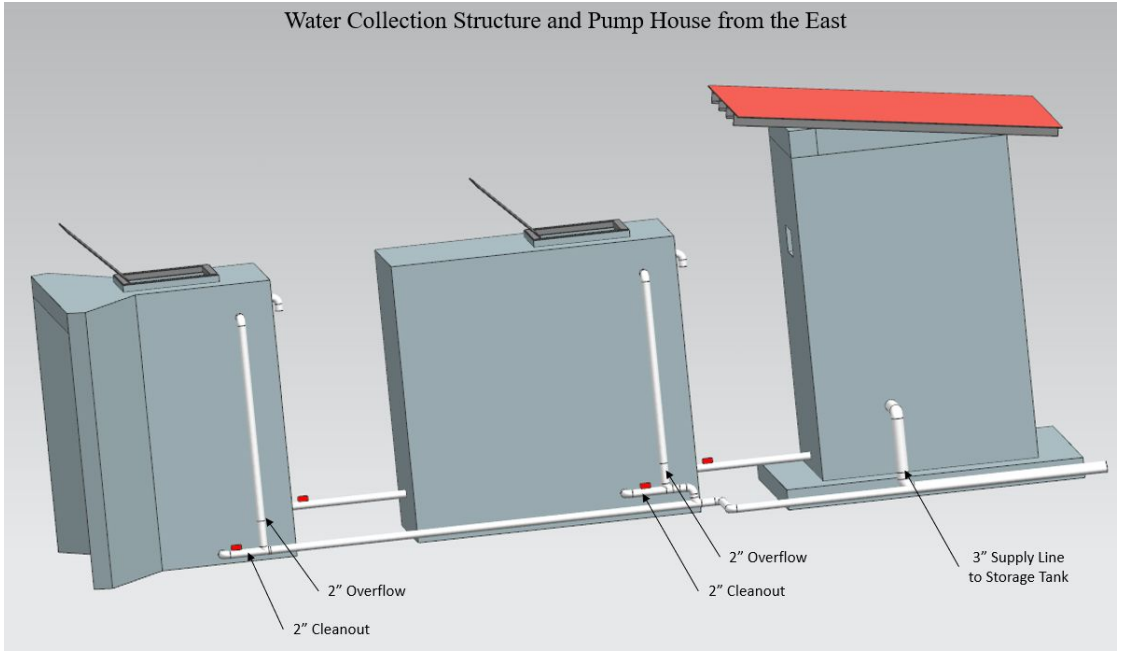






Water Collection Structure

- **Control Accessories:**
  - Clean-out and Overflow Pipeline
  - Vent Pipes
  - Shut-off Valves
- **Hatch:** Lockable access for Maintenance



Pump & Pump Station

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Pump at Source:

- *Purpose:* Deliver water to tank
- Centrifugal Pump
- One-stage Pumping
- Single-phase

Recommended Centrifugal Pump

Pump at Water Tank:

- *Purpose:* Deliver water to taps
- Booster Pump
- Maintains 20-30psi

Recommended Booster Pump

Electrical Supply & Controls

- **9-panel Solar Array:** Power Supply at Spring
- **Pad-mounted Control Box:** Electrical Controls
  - Required Voltage: 115 V
  - Minimum Required Amperage (Spring): 15 A
  - Minimum Required Amperage (Tank): 20A

Recommended Solar Array with Battery Pack

Recommended Pump Control Box

River Crossing

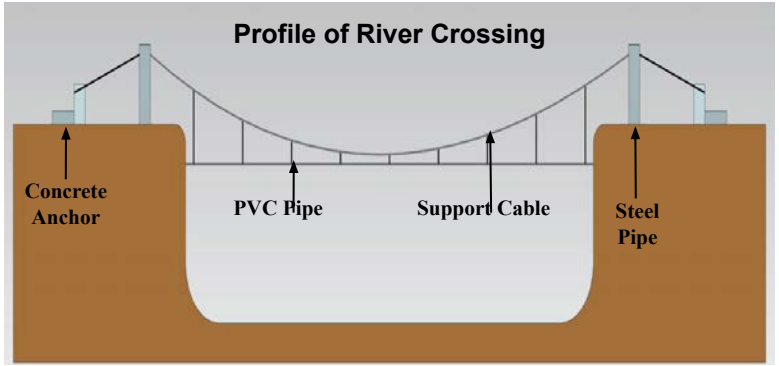
Suspension Bridge Design:

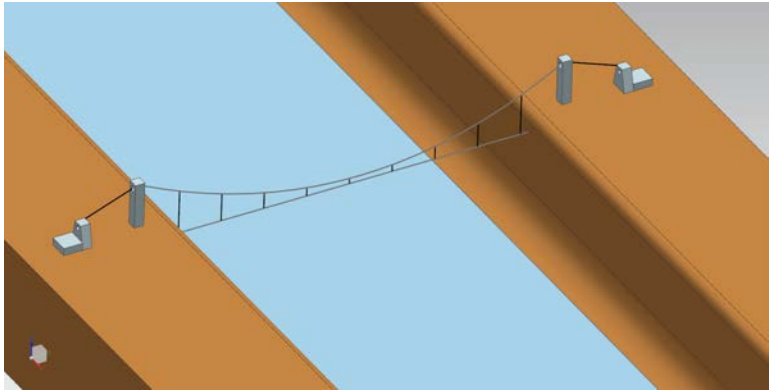
Support Supply Line and Electrical Conduit

- Pipe Span: 36-ft

Fixtures - Tower and Anchor:

- Tower to Tower Span: 45-ft
- Tower Material: Steel Pipe Column
- Anchor Material: Reinforced Concrete
- Galvanized Vinyl Coated Steel Wire

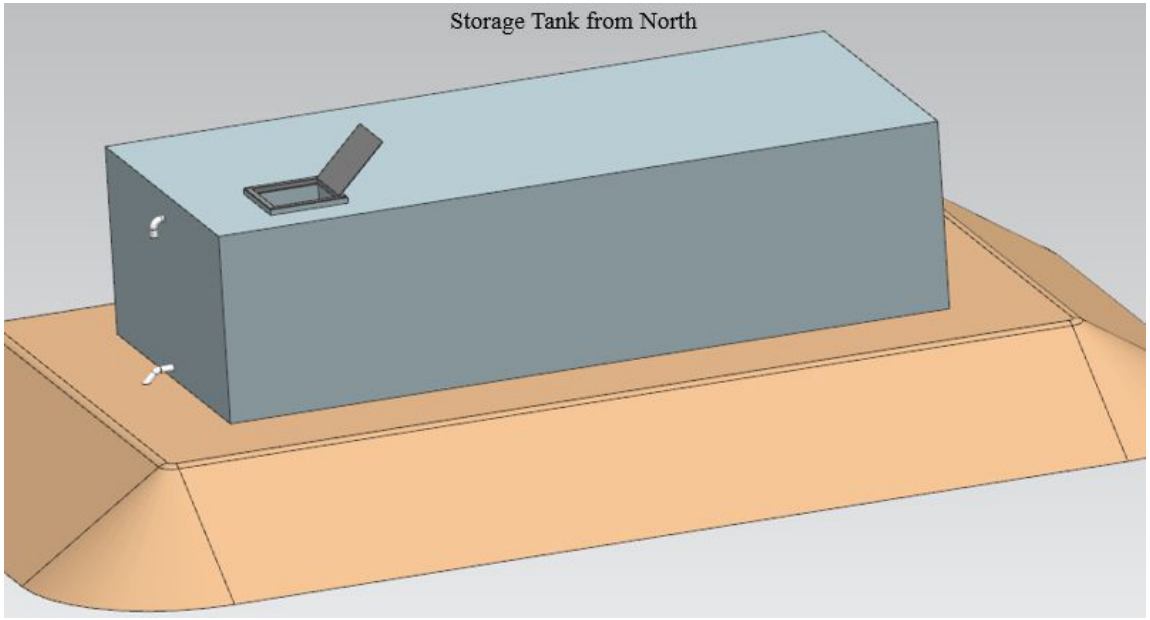




Conceptual Design for Pipe Bridge Across a Small River

Water Storage Tank and Treatment

- **Capacity:** 5,400 gallons
- **Foundation:** Earth-build to supply 3’ head to pump
- **Hatch:** Lockable access for Maintenance



Water Storage Tank and Treatment

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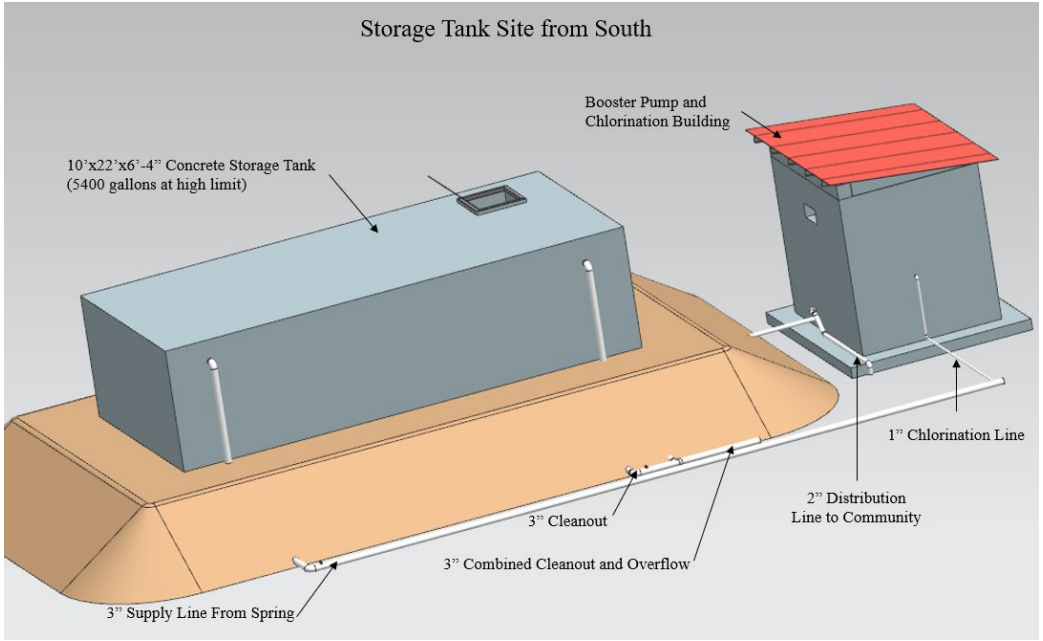
- **Treatment:** Chlorine Injection
- **Required Contact Time:** 11 min

Recommended Injection System



Supply Pipeline

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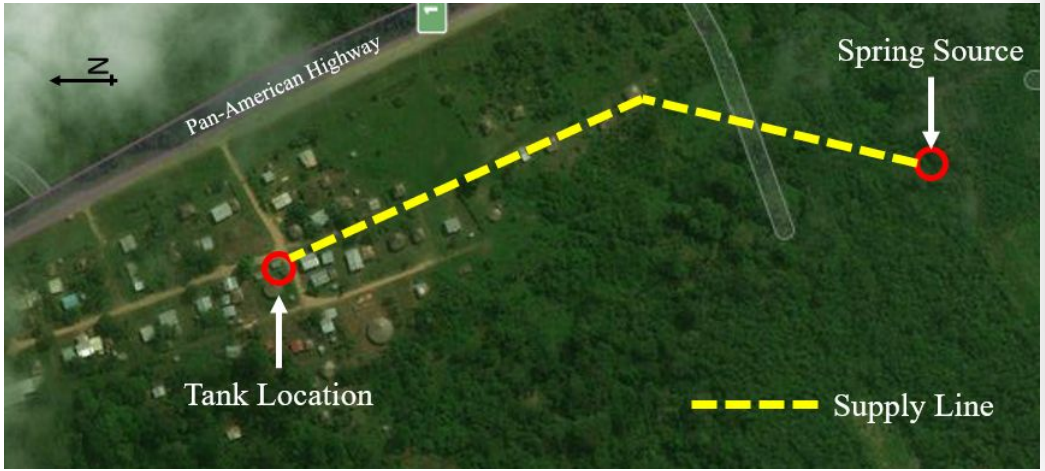
SDR 26 PVC Pipe

- 3” Pipe
- *Length:* 1634-ft
- *Burial Depth:* 2-ft



Distribution Pipeline

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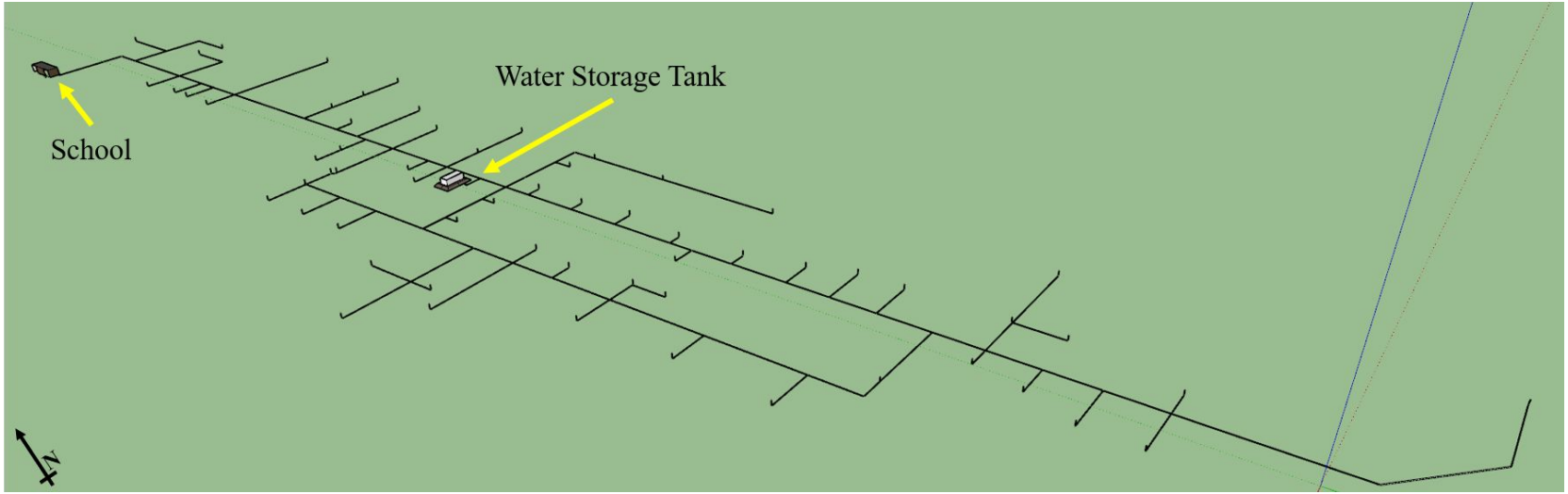
SDR 26 PVC Pipe:

- *Trunk:* 2” Pipe
- *Branches:* 1” Pipe
- *Spigot:* ½”

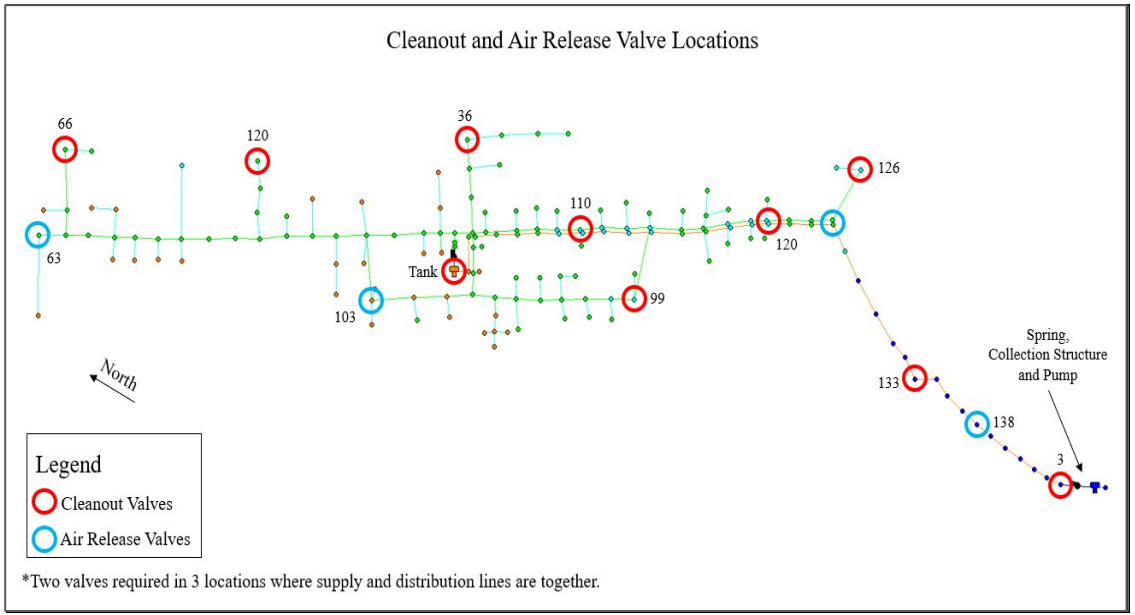


Distribution System Layout of the Central Community (3D Model).

System Valves

- **Shut off Valves:** Central and Critical Locations
- **Cleanout Valves:** Local Low Elevations
- **Air Release Valves:** Local High Elevations

Recommended Valve Box



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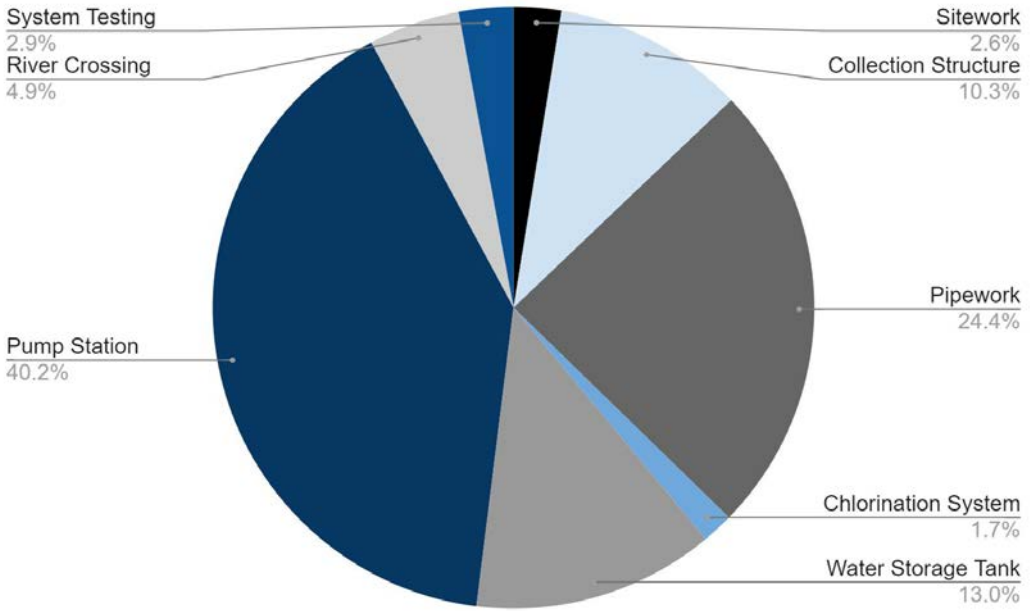
Planning Phase

Cost Estimate

Estimated Required Budget

- Full Labor: $235,000
- Reduced Labor: $69,000



Cost Breakdown for Reduced Labor by Bid Package in US Dollars

Schedule

Task Name	Duration of Task
Project Start	0 days
Order Materials	2.25 days
Remove Ultrafiltration	1 day
Pipe Installation	136.5 days
Piping Complete	0 days
Build Water Collection Structure	38 days
Build Water Storage Structure	126 days
Storage Tank Complete	0 days
Install Fencing	8.25 days
Install Pump and Solar Array	2.25 days
Install Chlorination System	1.25 days
Electrical Work	8 days
Pre-Start Tasks	6.75 days
Project Complete	0 days
Project Total Duration	**208 days**

Construction Schedule extracted from Gantt Chart

Duration: 7 months

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Challenges

Challenges

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- Communication Barriers
  - Language Barrier with Community
  - Outstanding Action Items (4 months overdue)
- Unique Design and Conditions
  - Unknown Flow Rate
  - 2 Pumps
- Timeline & Alternatives

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Looking Forward

Looking Forward

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- Community Involvement
- Educating the Community
  - Rainwater vs. Treated Water
  - Importance of System Maintenance
  - Awareness of Water Scarcity
  - Disposal of Wastewater
- Operation and Maintenance
- Outstanding Action Items

Photograph by Author

Acknowledgements

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Questions?

Thank You For Your Attention!