GRAVITY-FED WATER DISTRIBUTION SYSTEM
BUCORI, PANAMA
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OUTLINE

- Mission Statement
- iDesign
- Background
  - Community/Politics
  - Project
- Methods
- Design Components
- Schedule
- Cost Estimations
- Conclusions and Recommendations
- Questions
Create a pipe network that will distribute water from 3 springs to the neighborhood of Central Bucori. Water will be treated individually at home.
INTERNATIONAL SENIOR DESIGN - IDESIGN

- 2 weeks in Panama
- Help developing communities
- Peace Corps Volunteer host during community stay
- 2016 iDesign: 11 students
  - 2 water teams
  - 1 bridge team
- Spent the semester working on design projects
SUMMARY OF TRIP

Day 1-3:
• Exploring Panama City
• Community Prep

Day 3-11:
• Traveling to Communities
• Data Collection

Day 11-14:
• Debrief
• Presentations
TRAVEL DETAILS

- Chiriqui Grande
- Bucori
- David
- Las Lajas
- Cerro Ortiga II
- Las Trancas
- Panama City
INTRODUCTION – COMMUNITY BACKGROUND

- Bucori, Panama
- Bucori was founded by the current president’s grandfather
  - Banana farm lawsuit over wages
- Wooden houses built on stilts to be safe from heavy rains
- Many streams in neighborhood of Central Bucori
INTRODUCTION – PROJECT POLITICS

- Community Leader
  - Faustino
- Water Committee
  - 7 positions. Only 3 are filled with active members
- Peace Corps Volunteer (PCV), Taylor Domagalla
- Project Funding
  - $8000 grant - PCV to submit application
- Community Contribution
  - Each house pay $1/month for system maintenance
INTRODUCTION – PROJECT BACKGROUND

- Water source - 3 springs
- System
  - From springs to large holding tank
  - From tank to community
- Access to water – 38 faucets
  - 7 Community Buildings
  - 31 homes (Average of 5 people per house)
INTRODUCTION – PROJECT BACKGROUND

- Design Components
  - 9 stream crossings
  - 1 valley crossing
  - 1 river crossing
  - Spring boxes
  - Holding tank
METHODS - SURVEYING OUTLINE

- Gallon Jug and Timer
  - Calculate flow rates of springs
- Petri Films
  - Water Quality Test
- Garmin GPS
  - GPS Coordinates of each location
- Water Leveling
  - Measures level differences across a surface
- Nikon Laser Rangefinder
  - Measure angle of elevation
- Measuring Tape
  - Measure distance between sites
METHODS - ANALYSIS

Monthly Flowrates for Springs

Flowrates (m³/d)

Months

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

A  B  C
EPANET – HYDRAULIC SIMULATION SOFTWARE

Spring A

Spring B

Spring C

New Tank
Hazen Williams Equation

\[ h_L = 4.727C^{-1.852} * d^{-4.871} * L \]

- \( h_L \): Headloss (m)
- \( C \): Coefficient for specific pipe material; PVC
- \( d \): Diameter of pipe (mm)
- \( L \): Length between nodes (m)
What is a spring?

Three Spring Boxes

Capture water directly from the spring source and protect it from contamination

Cleanout and overflow pipes will contain mesh screen to prevent contamination.
DESIGN - HOLDING TANK

Dimensions:
- 22 m³ (~6,000 gal)
- L x W x H
  - 3.92m x 3.92m x 2.38m

Water Supply
- Meets current demand for 4 days
Inflow from Springs

Overflow

Outflow

Clean Out
DESIGN - PIPING NETWORK

- SDR-26 PVC Piping
  - 2-inch piping Main Network
  - 1.5-inch piping on branches of network
- Pipe Fittings
  - 135 elbows, 400 unions, and 35 Y/T fittings
  - Cleanout/Air Valves
- UV spray for Protection and Maintenance
**DESIGN - WATER CROSSINGS**

- River Crossing
  - 40 meters
  - Suspension system holding the pipe
  - 4” pipe for protection
DESIGN - WATER CROSSINGS

- Valley crossing
  - 13.5 meters
  - Suspension system
  - 4” pipe for protection
DESIGN - WATER CROSSINGS

- Stream Crossings
  - Case 1
    - No extra support needed
    - < 10 m span
    - No risk of washout

< 10 m
DESIGN - WATER CROSSINGS

- Stream Crossings
  - Case 2
    - Extra support needed
    - < 10 m span
    - Risk of washout
WATER TREATMENT

- Water will be treated in home
  - Lack of community support
  - Difficult access to holding tank
- Bottle of Chlorine
  - 1 bottle (250 mg) of chlorine every 50 days for 5-person family
  - 0.02 mg chlorine per 1 L of water
CONSTRUCTION SCHEDULE

- Project will take 40 work days
  - 6-8 hours/work day
- Upwards of 6 people per task
  - Labor provided by community volunteers
- Materials and equipment bought in city and transported by canoe
Total Cost: $15,300

- Piping: 49%
- Transportation: 20%
- Equipment: 20%
- Other: 8%
- Concrete: 3%
CONCLUSIONS - RECOMMENDATIONS - NEXT STEPS

- Improve quality of life
  - Ease of water access
- Education will be provided by Peace Corps Volunteer
  - Maintenance of the system
  - Importance of sanitizing drinking water
  - Water committee training and development
- Grant proposal for funding
ACKNOWLEDGMENTS AND FINAL THOUGHTS...

“The purpose of life is to live it, to taste experience to the utmost, to reach out eagerly and without fear for newer and richer experience.”
Questions?