# CYC Environmental Engineering

#### **Gravity-Fed Water System for the Community of El Hueco**

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#### Outline

- Community Background
- Problem Description
- Project Description
- Data Collection
- System Modeling
- Final Design
- Scheduling and Cost Estimation
- Construction and Maintenance
- Conclusion



### **Community Background**

- Location
  - North of the Pan-American Highway
- Peace Corps Volunteer
  - Shellee Merryman, stationed in Guayabital
- Four villages in area
- People
  - Subsistence farmers or employees of larger farms
- Education
  - Grade school and "Colegial"





#### **Problem Description**

- El Hueco Low income community of 15 people
- Five homes in community
- Rio Chico is main source of water
  - Health risks
  - Carried uphill



Rainwater Catchment in El Hueco

#### **Project Description**

- Design a gravity-fed system to deliver water to the people of El Hueco
- Project stakeholders
  - People of El Hueco
  - Inieda Loma Chata Water Committee
    President
  - *Representante* of Toza area
- Paid for by the *representante* with government funds
- Built by people of El Hueco



#### Loma Chata Tank

#### **Data Collection-Surveying**



Satellite View

**Elevation Profile** 

#### **Data Collection**





- Flow Rate Tests
  - Total Water Flow: 23,000 (gal/d)
  - Available Water: 105 (gal/person/day)
  - W.H.O. Guidelines: 5.3 (gal/person/day)
  - MINSA Guidelines: 26.4 (gal/person/day)
- Coliform Tests
  - Very Few Coliforms Found
  - Storage Tank is Chlorinated





#### System Modeling





## Spring Box/Tank and Water Treatment

- Tomas and tank already established
- Water chlorinated on distribution side of tank
- Residence time of chlorine calculated:
  - 536 minutes
  - Sufficient time
  - Residuals may be depleted
- Recommend chlorine testing at homes





## Pipe Network

- SDR 26 PVC pipe (160 psi)
- 7960 meters tank to branch
- 2" Pipe 1360 meters
- 1" Pipe 6600 meters
- <sup>1</sup>/<sub>2</sub>" Pipe to taps
- 1.5 gpm design tap flow
- 25-50 psi at taps



#### Pipe Network



#### Shut Off and Clean Out Valves

- 11 shut off valves:
  - 3 upstream of highest pressure points
  - 2 at the pressure break tank
  - 1 before the road crossing
  - 1 at each water tap stand
- Clean out valve: One clean out valve at a low point in the system where sediments are most likely to build up
- No air release valves needed



### **Tap Stands**

- Reinforced concrete tap stands at five sites
- Shut off valve beneath tap stand in case of breaking
- Community members can build off of tap stand



(Handbook of Gravity-Flow Water Systems, Jordan, 1980)

### Pressure Reducing System

- Attempted use of flow reducing disks
  - Impractical
- Pressure break tank will be used
  - 0.5 km from the village
  - Made of concrete blocks and cement mixture
  - Float valve





## Road Crossing

- Paved road requires crossing
- Paid for and built by Guayabital
  Water Committee

Anchor concrete volume: 0.08 yd<sup>3</sup>

Tension in cable: 126 lbs



View from one side of proposed road crossing to the other



Basic Design of Suspended Crossings (Field Guide to Env. Eng. for Dev. Workers, Mihelcic, et al., 2009)

#### **Two River Crossings**

- Two rivers that water line must cross
- Current crossings for Guayabital system are unsustainable

#### 20-meter river crossing

- Anchor concrete volume: 0.07 yd<sup>3</sup>
- Tension in cable: 78 lbs

#### 40-meter river crossing

- Anchor concrete volume: 0.18 yd<sup>3</sup>
- Tension in cable: 155 lbs



Road and river crossing anchor design Reinforced concrete (Field Guide to Env. Eng. for Dev. Workers, Mihelcic, et al., 2009)

#### Stream Crossings

- Many small stream crossings
- Estimated at 1.5 meters wide
  - Tension in cable: 12 lbs
- Use 15" ground anchors



Stream Crossing Design

#### **Construction Scheduling**

- Anchors:
  - Road Crossing
  - Two River Crossings
- Pressure Break Tank
- 8 Main Line Sections
- Distribution Lines
- Water Tap Stands
- Four months to complete: January May

Road Crossing Anchors	13 days
River Crossing 1 Anchors	13 days
River Crossing 2 Anchors	13 days
Pressure Break Tank	25 days
Main Line Section 1	8 days
Main Line Section 2	7 days
Main Line Section 3	8 days
Main Line Section 4	7 days
Main Line Section 5	8 days
Main Line Section 6	7 days
Main Line Section 7	8 days
Main Line Section 8	7 days
Distribution Lines	5 days
Water Tap Stands	12 days

#### **Cost Estimation**

#### Budget Goal/Pump Cost: \$8,000

Total Cost: \$14,500

- Road Crossing: \$600
- Fuel for Trench Digger: \$2,400
- Reinforced Tap Stands: \$800
- Water Crossings: \$1,400
- Delivery: \$2,000

Reduced Cost: \$7,500

- Pipes : \$6,800
- Miscellaneous: \$700

#### **Construction and Maintenance**

Buckets must be placed on the ground when being filled

Two taps may be open at once in the village of El Hueco

The pressure break tank should be cleaned at least every 6 months

Clean out valve must be cleaned every 2 weeks

*Tomas* and storage tank must be cleaned out occasionally



Inside of toma

#### Conclusion

- Provide clean source of water to El Hueco
  - $\circ$  5 taps for 15 people
- Funding from Panamanian government
- Reduced budget is less than the budget goal of \$8,000
- Construction Time: 4 Months from January to May 2018



## Thank You!

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