



IMPROVEMENTS TO THE WATER SUPPLY, WASTEWATER DISPOSAL, AND SOLID WASTE MANAGEMENT SYSTEMS FOR QUEBRADA HONDA COMMUNITY, GUAYANILLA, P.R.



MEMBERS

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WI-2015 and SP-2016

ABSTRACT

Quebrada Honda is a rural community of 240 inhabitants located in the mountain area of Guayanilla, Puerto Rico. Currently, a natural ravine provides the water that is consumed by the community. Since the water is not filtered nor disinfected, it does not comply with the Safe Drinking Water Act (SDWA). The sewage generated at each housing unit is disposed either in septic tanks/cesspools or directly over the terrain. The generated solid wastes are handled by the Guayanilla Municipality biweekly and disposed at the Yauco sanitary landfill, but at given times no collection occurs. The recycling materials are recovered biweekly by the L & M Waste Company, but not in the entire community.

Several alternatives were analyzed in order to improve the water supply, wastewater and solid waste management systems. The selected options were: a slow sand filter, two chambers septic tanks with distribution box and percolation trenches, an aerobic composting, a recycling route, and designated container for non-recyclable and non-compostable solid waste. These are the most feasible options from an environmental, public health, sustainability, and economical perspectives.

BACKGROUND

Quebrada Honda is a community composed of 115 homes. A population growth analysis forecasted that the community will not increase in the next 25 years and its water peak hour demand will remain at 27,000 GPD. Current water source provides 40,530 GPD.

The existing water supply system does not comply with the SDWA drinking water standards. This was confirmed by the water quality data provided by the Puerto Rico Department of Health and by the sampling and analysis done during the study period. Therefore, a water quality improvement is needed in order to satisfy the regulatory parameters established by the Environmental Protection Agency (EPA).

According to a survey conducted at the community, each home disposes its sewage either in septic tanks/cesspools or discharges over the adjacent terrain. These practices represent an environmental and public health risk.

A solid waste production study indicated that in the next 25 years the community will continue generating approximately 482.40 lb/day of garbage, which includes 173.62 lb/day of the organic matter (OM) and 170.34 lb/day of recyclable material. In order to reduce the amount of garbage that is conveyed to the Yauco sanitary landfill, the diversion (by recycling and composting) of such material from the disposal landfill facility is recommended.

OBJECTIVES

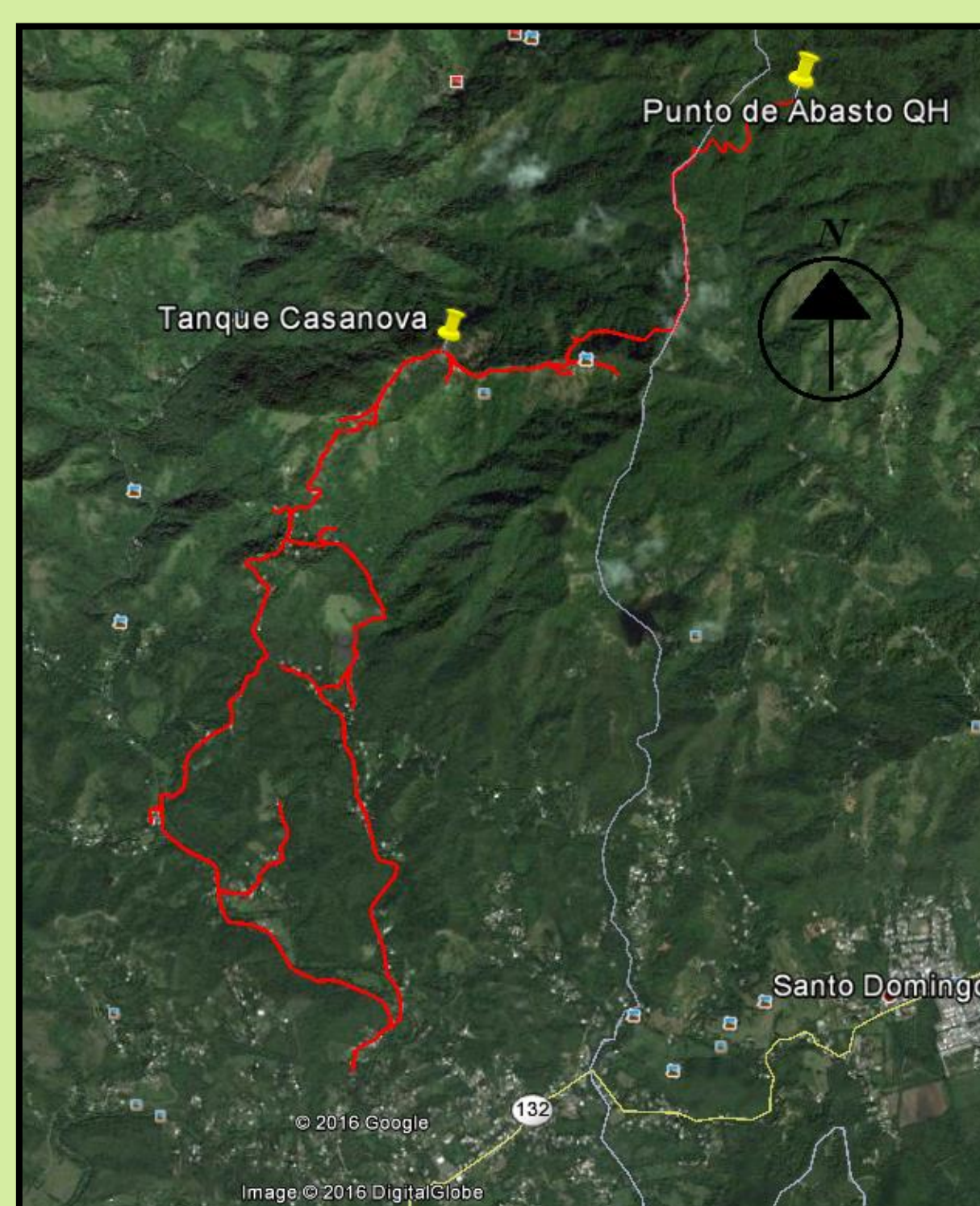
1. Improve the existing water supply system in order to comply with SDWA.
2. Upgrade the wastewater management system.
3. Develop an integrated solid waste management plan.



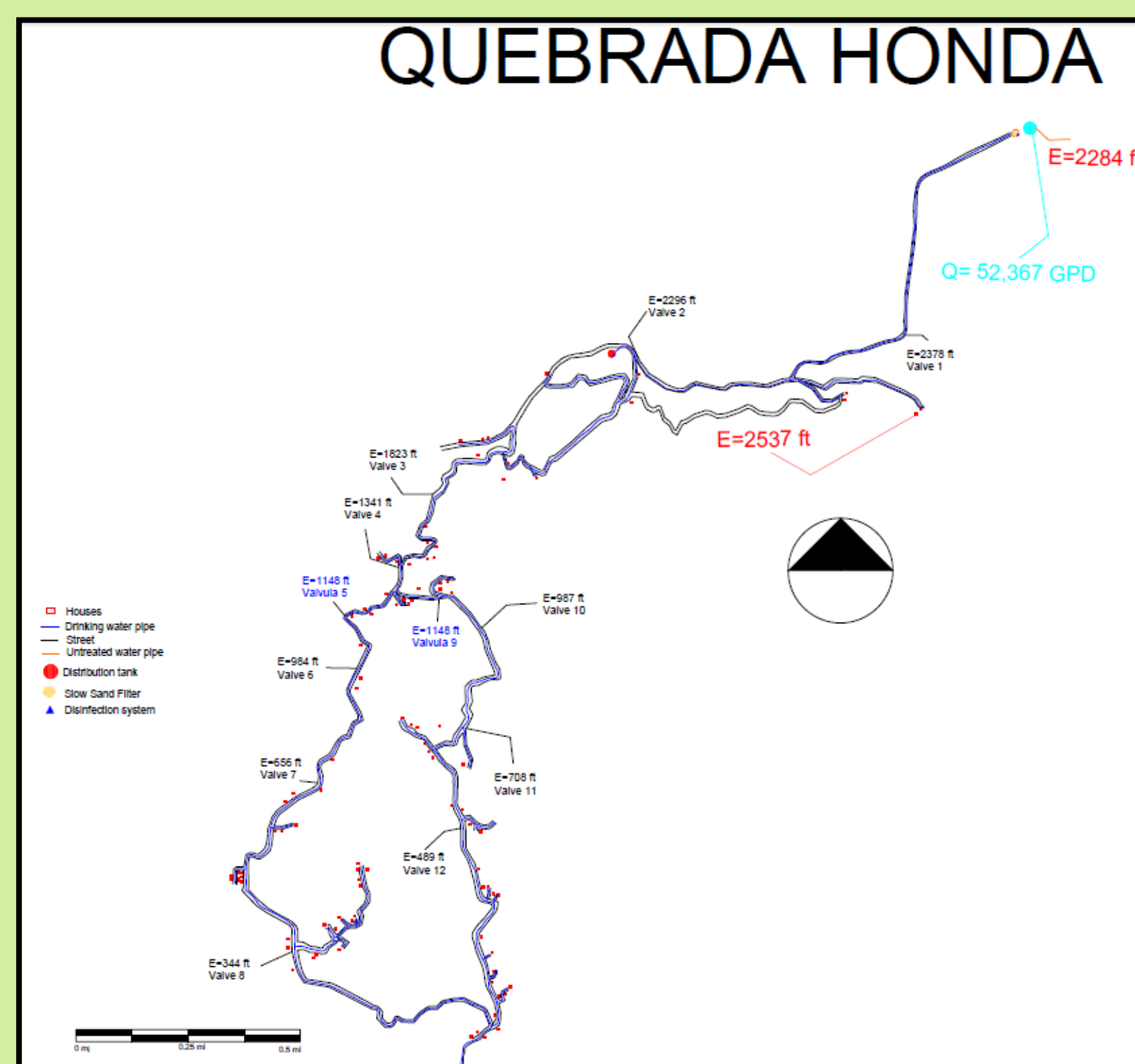
Guayanilla



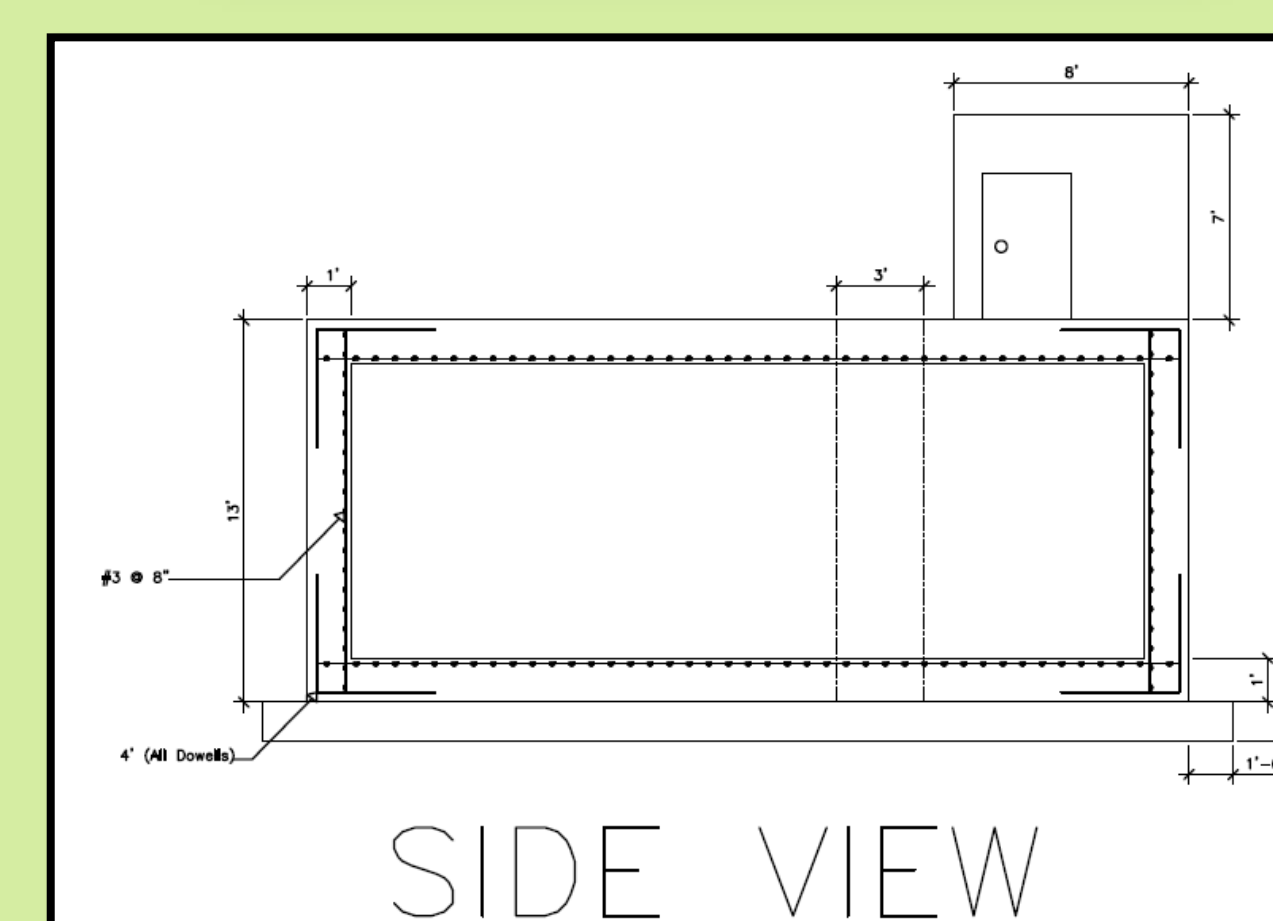
Quebrada Honda



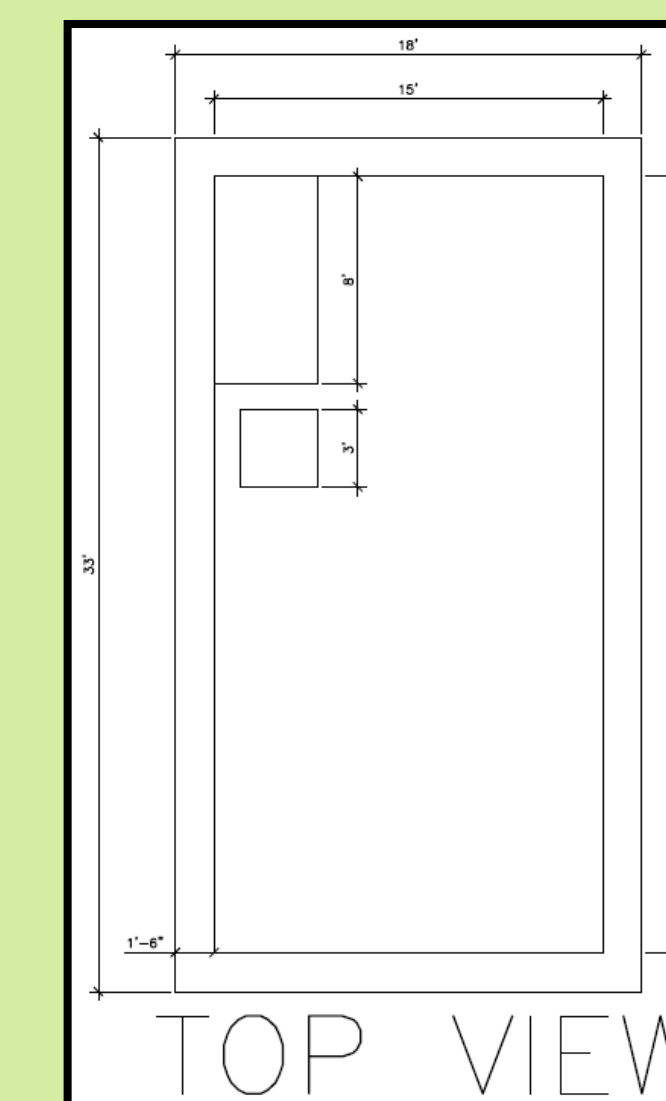
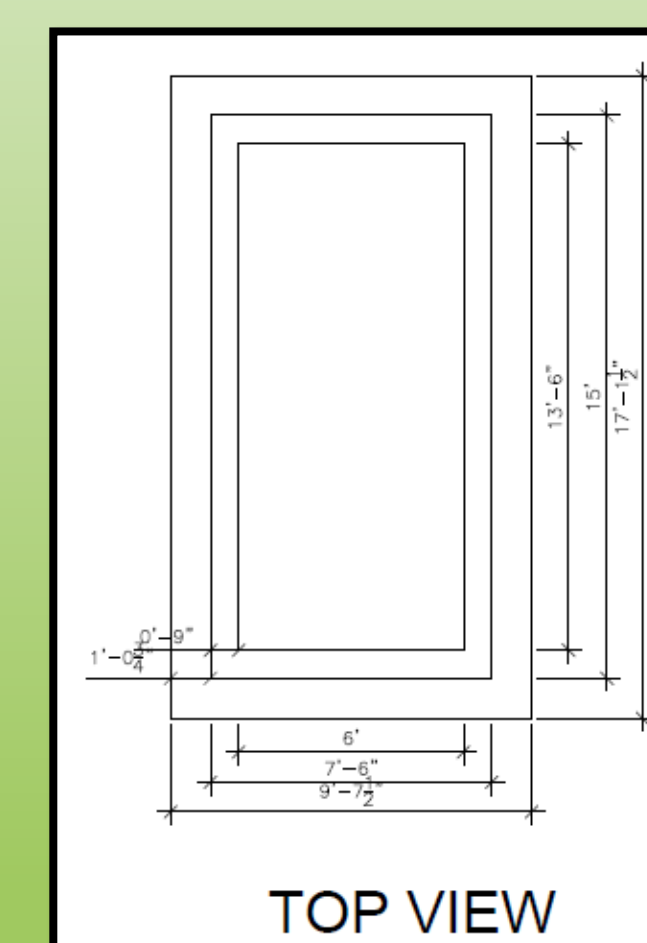
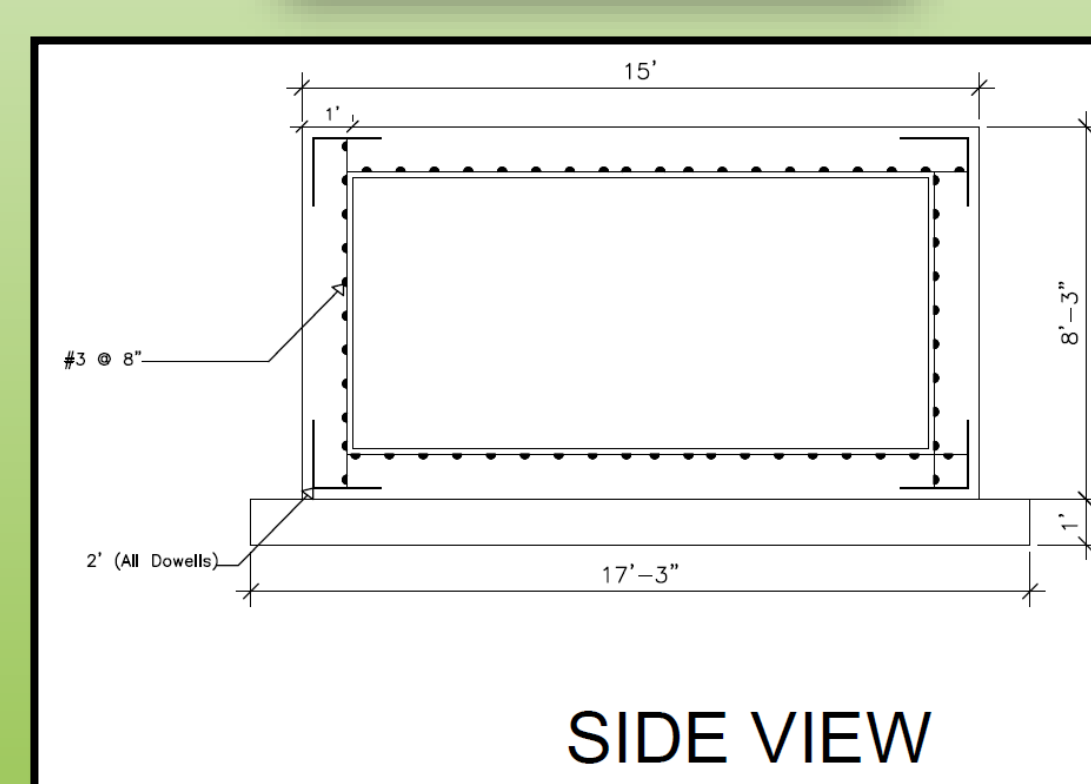
DRINKING WATER SYSTEM



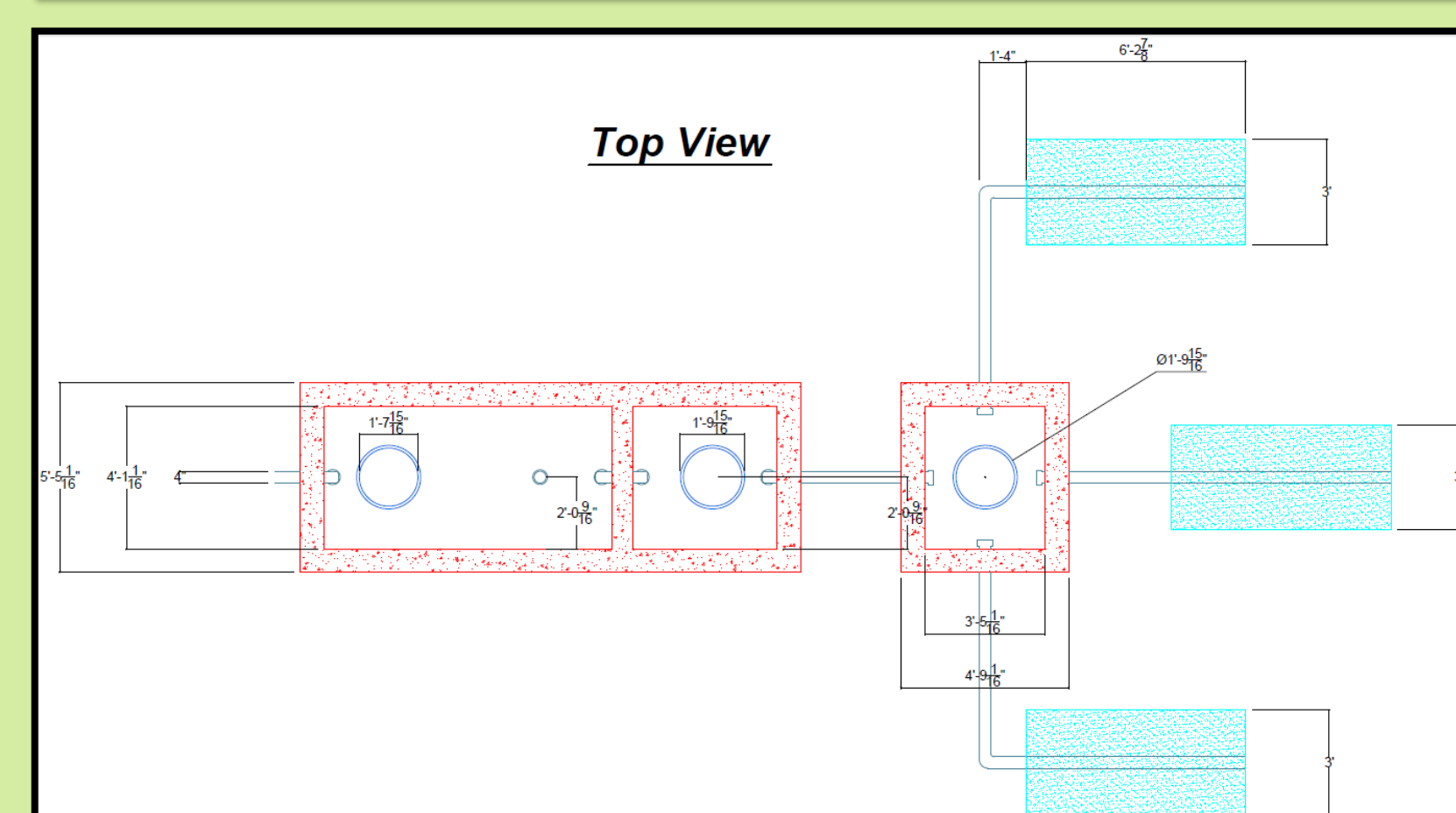
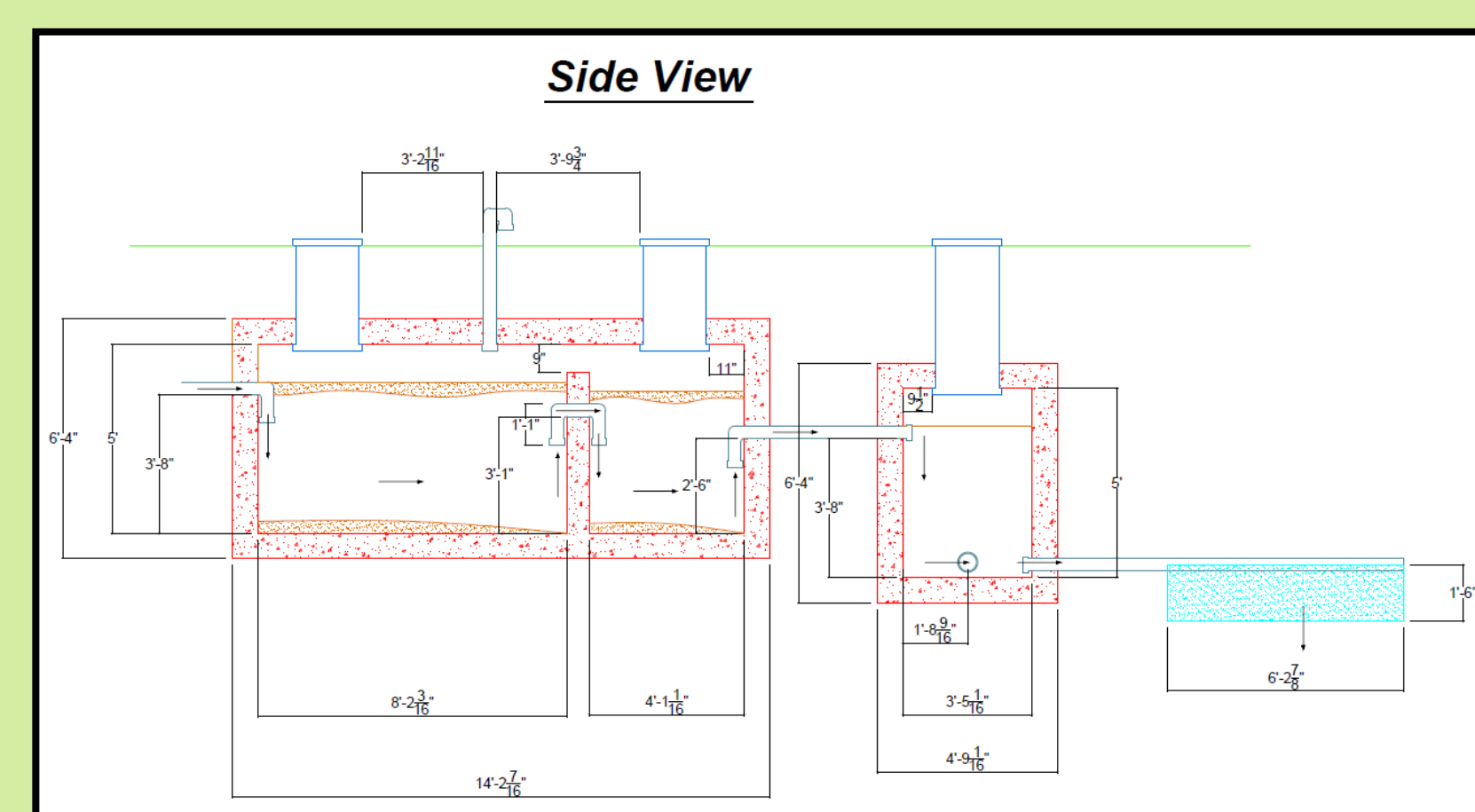
DISTRIBUTION TANK QUEBRADA HONDA



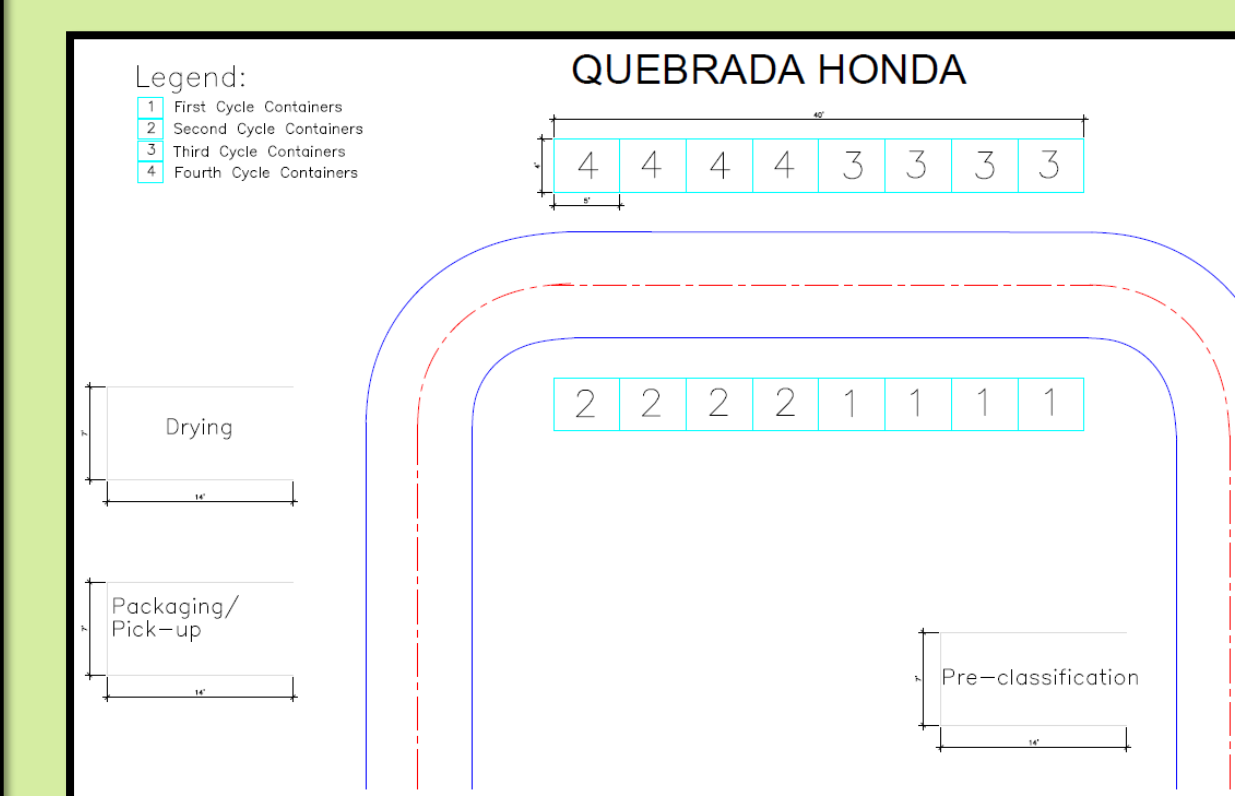
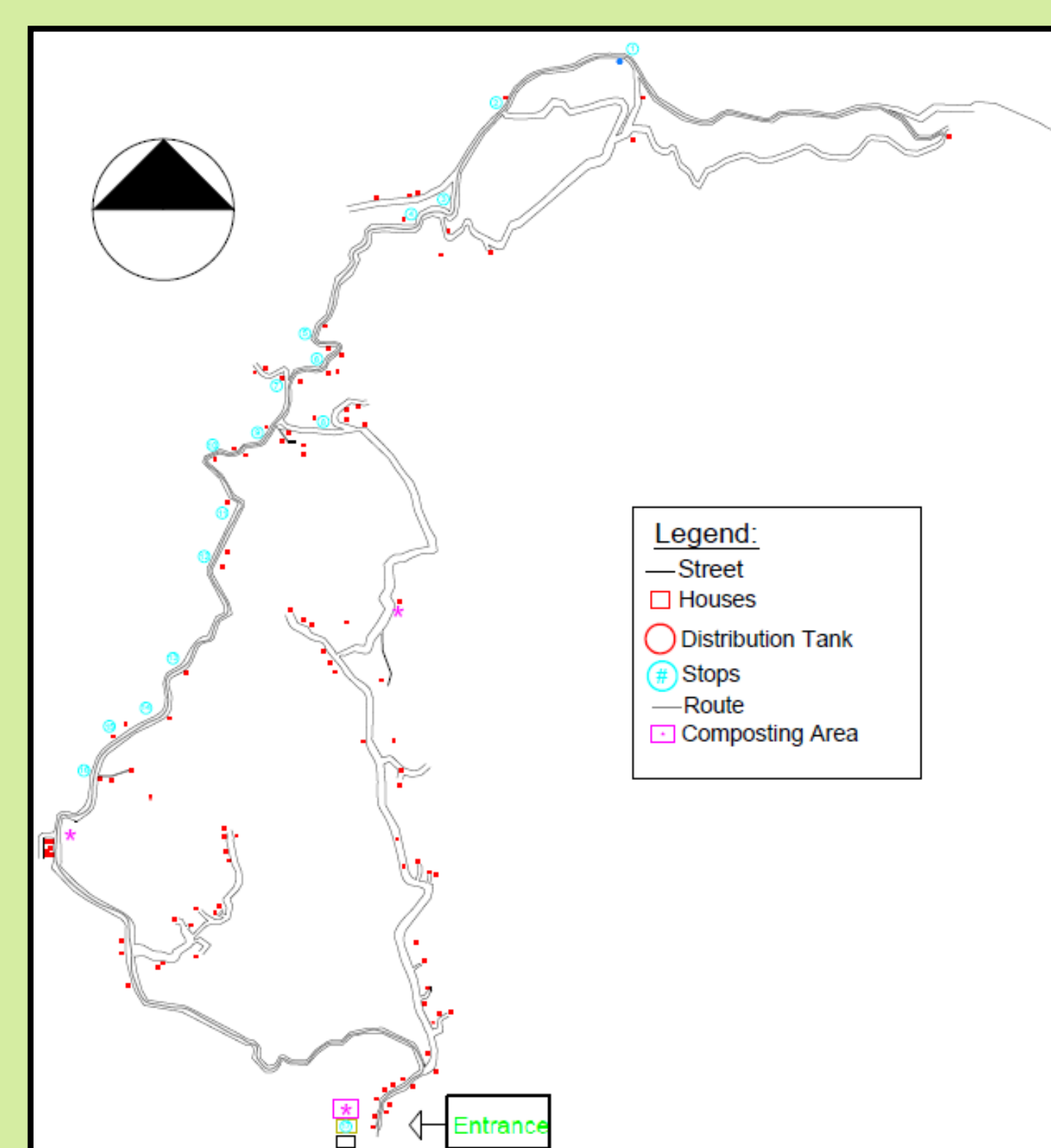
SAND FILTER



SEPTIC TANKS



SOLID WASTE PROGRAM



COST ESTIMATES

Drinking Water	Wastewater	Solid Waste
\$162,209	\$223,755	\$6,633
Total Project Cost:		\$392,597

DESIGN PROCESS

Several alternatives were evaluated and preliminary designed in order to improve water supply, wastewater, and solid waste management systems. Comparative tables and Leopold matrices were used to select the most feasible options from an environmental, public health, sustainability, and economical perspective.

Final designs of the selected alternatives were done utilizing the:

- Puerto Rico Aqueduct and Sewer Authority Design Rules.
- Environmental Protection Agency Manuals.
- Environmental Quality Board of Puerto Rico Design Rules.
- Puerto Rico Authority of Solid Wastes Guidelines.
- American Concrete Institute Codes.
- Portland Cement Association Design Manual.
- American Society for Testing and Materials International Standards.

FINAL DESIGN

Drinking Water:

Based on the Peak Hour Demand (PHD), the slow sand filter was designed for the next 25 years. Considering the water filtration rate of 0.15 m³/m².h, the required surface area of the filter is 135.78 ft².

Wastewater:

The suggested septic tank was design following the EPA suggested bedroom-based-guidelines. Using the community population and the amount of houses, around three to four bed were estimated at each residence, Therefore, and on-site septic tank of at least 200.71 ft³ is required to handle all the domestic wastewater generated at each property.

Solid Waste:

The community will produce 207.63 ft³ of organic matter during a 4-month composting production cycle. This amount was calculated considering a 2.01 lb/person of solid waste generation per day, a 70% compaction rate, and that density of organic and yard waste are 32.02 lb/ft³ and 14.14 lb/ft³, respectively. An area of 3,784 ft² is required for the aerobic composting.

Tank at Quebrada Honda		
Length	33.00	[ft]
Height	13.00	[ft]
Width	18.00	[ft]

Slow Sand Filter		
Length	20.33	[ft]
Height	11.00	[ft]
Width	10.33	[ft]

Septic Tank		
Length	14.25	[ft]
Height	6.33	[ft]
Width	5.42	[ft]

CONCLUSIONS

The existing water supply system and quality of the drinking water were improved with the design. The new septic tanks will provide sufficient volume to treat all wastewater generates in the homes of this community. The solid waste management program was improved by the diversion of OM and recyclable material to the landfill. These designs ensure that the drinking water complies with the SDWA, and the reduction of environmental impact by wastewater and solid wastes. The costs of the alternatives are \$392,597, if they are selected for each subject.

ACKNOWLEDGMENTS

We wish to express our gratitude to our mentor, José Borrageros, for granting this opportunity and providing us with guidelines throughout the project. Also, we wish to express our gratitude to the community leader, José (Pepe) Martínez, for providing us with the required information of the community.