Improvements to the Water Supply, Wastewater Disposal and Solid Waste Management Systems for the Lupe Martí Community in San Sebastián, Puerto Rico

Community Development Engineering

Civil and Environmental Engineering Senior Design Project WI-16 and SP-17
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Abstract

Non-PRASA communities are known for their limitations to connections to potable water systems and sewer systems from the Puerto Rico Aqueduct and Sewer Authority (PRASA). These types of communities normally operate in conditions that challenge their opportunity of compliance with the Environmental Protection Agency (EPA) National Drinking Water Regulations. The Community Development Engineering (CDE) team worked on the improvements for Lupe Martí, a rural community located in the Mirabales ward in the Southeast of San Sebastián, which consists of 78 households. The community extracts its drinking water through a wellspring system located 688 feet above sea level. Currently, the community's drinking water supply does not receive filtration or disinfection.

Wastewater management in the Lupe Martí Community is an issue because the households do not have adequate septic tanks. In terms of solid waste management, CDE evaluated several ways to diverge generated waste from landfills and reduce the cycle of disproportionate generation and disposal.

The alternatives that have been selected were focused on the wellbeing of the community, the environment, the feasibility of implementation of the project, and the economic factors that are attached to the project itself.

Water Supply Design

Connection to the PRASA Potable Water System

The community has a maximum daily water demand of 28,875 GPD. The existing drinking water system does not have enough capacity to provide that quantity of water. Another issue is that the water is not receiving the proper treatment to comply with the regulations for safe drinking water. The alternative chosen for the Lupe Martí Community is the connection to the PRASA potable water system. The implementation of this alternative is a viable solution because many of the residents currently receive dual water service (from the community's wellspring and from the PRASA system). Therefore, not only will the connection to the PRASA potable water system give the community safe drinking water, but it will also comply with the required standards. The capital cost is of $38,600.

Water Distribution Pipelines

The proposed connection consists of ten pipeline sections to the existing PRASA water distribution network. The capital cost is of $33,789.

Table 1: Water Distribution Pipelines Details

Pipeline Sections	Pipe Material	Pipe Diameter	Total Length	Pressure Relief Valves
10	PVC	2"	8,830 ft	3

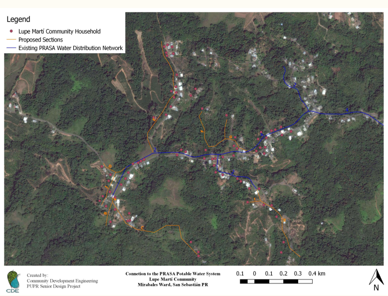

Figure 2: Proposed Water Distribution Pipe Connections

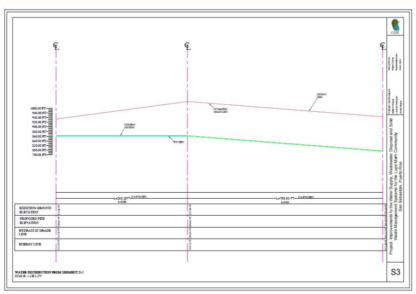

Figure 3: Profile of Proposed Water Distribution Pipeline

Table 2: Water Distribution Segments

Segment	Length (ft)	Pressure (psi)
A	104.82	30.81
B	376.48	75.59
C	1,957.74	66.30
D	263.25	32.04
E	2,030.87	66.87
F	940.94	65.74
G	776.18	50.24
H	1,410.37	62.06
I	179.63	45.62
J	789.83	64.57

Water Supply Project Schedule

The total construction time for water supply improvements is 59 days.

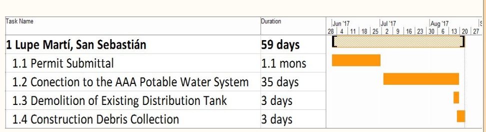

Figure 4: Water Supply Project Schedule

Objective

To design improvements to the current drinking water system, wastewater management system and solid waste management for the Lupe Martí Community in San Sebastián, Puerto Rico.

Wastewater Management

The wastewater management design was done using the International Private Sewage Disposal Code. Each household will have a 1,904-gallon double compartment septic tank with two interconnected EnviroFin™ infiltration systems. The tanks' material will be precast plastic, and the infiltration system consists of fibers and textiles that promote biological treatment for the wastewater.

- Capital cost: $7,232 per household

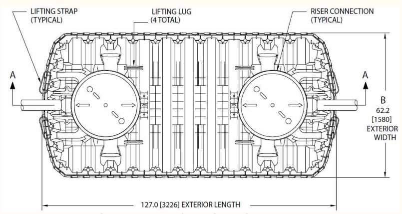

Figure 5: Top View of Septic Tank

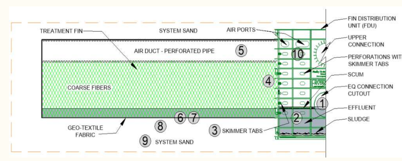

Figure 6: Ten Stages of Treatment of EnviroFin™

Wastewater Project Schedule

Total construction time for wastewater management for the community is 71 days.

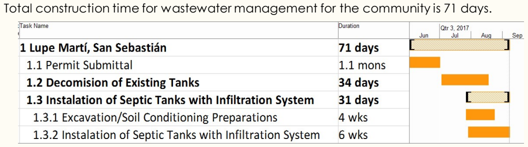

Figure 7: Wastewater Management Project Schedule

Conclusions

The final alternatives were the following: connection to the AAA potable water system to ensure safe drinking water distribution for the community, dual compartment septic tanks with EnviroFin™ infiltration systems for the wastewater management of each household, and an integrated plan for solid waste management that includes an aerobic compost program, a recycling program, and the improvements of waste collection routes. The chosen alternatives allow the fulfillment of the project's purpose, which was to provide designs that will have high viability for solving existing civil and environmental engineering problems at the Lupe Martí Community. These alternatives will improve the quality of life of the residents without affecting the quality of the existing natural resources of the community.

Lupe Martí Community

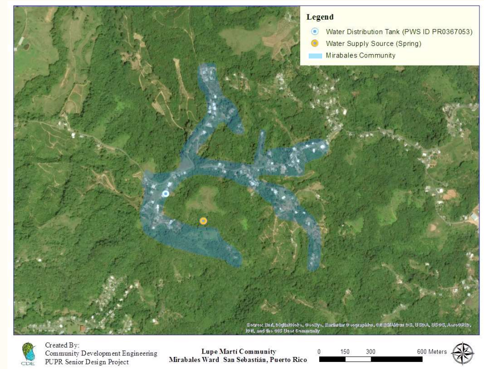

Figure 1: Top View of the Lupe Martí Community

Solid Waste Management

The community's solid waste generation is 2,169 lb/day

Aerobic Composting

- Diverged waste with aerobic compost program: 759 lb/day
- Capital cost: $1,847

Recycling

- Volume of recyclable materials generated: 837 lb/day
- Materials to be recycled: polyethylene plastic, paper, cardboard, and scrap metal.
- Capital cost: $2,648

Improvements to Waste Collection Routes

The number of waste collection zones to accommodate the waste generated by various households in the community is eight (8). The capital cost is $620.

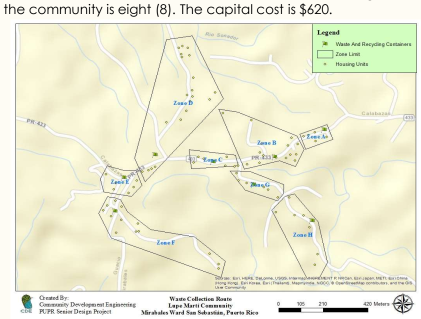

Figure 8: Solid Waste Collection Zones

Acknowledgements

Puerto Rico Department of Health – Drinking Water Division
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