

## **Village Source to Environment**

Combined Village supply system and Village Waste Management team

### Village Supply System

[Six teams from CEE 4540 Fall 2013 explored options. Background information](#) is available. We need better cost data for cost optimization ([Cost estimate for elevated AguaClara facility](#)). Student teams showed that the transmission line can be designed to have more head loss than the distribution pipes without reducing equity. They explored both orifice and small tubes as the flow restrictions for each household. The small tube option may be an excellent approach.

One goal for this project are to carefully evaluate designs that eliminate the need for an elevated storage tank and an elevated AguaClara plant.

There are two options that meet this goal.

- A single electric pump sends water through a pressurized LFSRSF and to the town. Chlorine and coagulant are both somehow metered into the influent of the pump.
- One electric pump lifts water from the well to an AguaClara facility that is at ground level. A second electric pump sends the water to the distribution system.

The 2 pump system may be preferable because it may be easier to operate LFSRSF that aren't pressurized. Chlorination prior to filtration is not a good option and thus adding chemicals at the intake to the submersible pump in the well is not recommended.

### **Parallel Tasks**

- Design of the photovoltaic and pump system. The 2 pump option will require a control system to balance the flows from the two pumps. One option is to divide the power between the two pumps in such a way that the chlorine contact tank at the effluent from the treatment plant remains at the target level. Whatever control system is developed it must be as simple as possible so that maintenance is easy. The photovoltaic system design should be based on a plan for how to handle the cloudy days of winter. One option to consider would be to divert all of the power to the first pump on cloudy days and provide an option for villagers to collect water from the ground

level chlorine contact tank. Note that the control system should automatically divert all of the power to the well pump when the chlorine contact tank isn't full and so this option would be easy to implement.

- Design of the distribution system (pipe sizes), pressure target, and flow restrictions. This will require an algorithm to determine the target operating pressure in the village to meet a reasonable equity of distribution. This algorithm should be a function of elevation differences within the village, housing density, number of households, and cost of the PVC pipe and solar panels. The system must also be designed to handle some growth. We will need to have conversations with our partners in India about the growth and equity targets.
- Design of household safe water infrastructure. This design includes the flow restriction element, the float valve, storage tank, and tap. It is common for village schemes to provide a tap that mimics the spout on a well pump and that requires that water be managed using the traditional system of pots, buckets, and pouring from container to container within the household. It is unlikely that this tap system is what the households actually prefer and from a public health standpoint this system is a poor choice. The households need a system that facilitates water use for hand washing and food preparation and that handles the production of contaminated water appropriately (a sink!).

### Village Waste Management

This is new project team will evaluate options for handling both human waste and grey water at the household/village level. This could include anything from redesign of the toilet (use less water or use no water) to design of a greywater system. The context for this invent project could be a village in India or perhaps a coastal community in Indonesia.

What options are available for the huge plastic disposal problem in Honduras? Is small scale waste to energy a possibility? Many communities in Honduras either have no trash handling system and thus trash is just thrown on the ground or trash is collected and dumped off the side of a road into a ravine. Some of this trash is carried by streams to the ocean. The AguaClara

team experienced the result of a lack of any appropriate handling of plastic directly on our last day in Honduras when we hoped to spend a few hours on the beach and found a beach filled to a depth of several feet with trash. What solutions could we suggest for small communities that don't have any solid waste management in place?

As for human waste, there are promising technologies that don't combine excreta with water. They include composting toilets and urine-diverting dry toilets. The latter could benefit from improvements in venting in the excreta collection bin.

- Design of household greywater system. The sink converts safe drinking water into greywater that can be used for irrigation. If not handled appropriately the greywater can become a nuisance and attract mosquitoes. We need to learn how greywater is being handled in Jharkhand villages currently and assess options for beneficial uses.