

Running Water Distribution System in Rural Panama

Vallecito: Rural Latin America

Vallecito is located only a few hours by bus from Panama City. In contrast to the modern capital, however, Vallecito is a traditional farming community of several hundred people with few luxuries. Latino families settled the area about 70 years ago and continue to raise crops and animals for their own consumption and for market.

The community stretches along a river about 7 km north to south and 1 km east to west, and centers around its school, soccer field, church, and public meeting area. The terrain is lush and hilly with abundant pastureland and patchy second-growth forest. The climate is tropical with distinct wet and dry seasons.



Figure 1: Location of Vallecito in Panama [http://www.educatecentralamerica.org/]

Current water supplies

About 13 scattered aqueduct systems were built by families to serve the water needs of households and the town center. These PVC pipelines connect some houses to springs. Yet, service interruptions are common due to leaks or disconnects:

- Most pipe is 20 years old or more.
- Due to rough terrain, pipe is largely unburied and thus exposed to agricultural activity.
- The layout is inefficient because service lines are decentralized from a single main.

The spring sources present difficulties, as well:

- Nearly all springs are unprotected and susceptible to runoff contamination by animal feces, fertilizer and pesticides.
- The source for the public facilities in the town center is located on private land, whose owner plans to use pesticides in the near future.
- Virtually no households are known to treat or disinfect their water coming directly from these unimproved sources.

An estimated one-third of households in the community lack any household tap at all and must walk some distance to a storage tank, tap, or spring.



Figure 2: Hilly, pastured slopes in Vallecito

Goal of new design

CDAC wishes to implement a new aqueduct system that will ensure the southern half of Vallecito is receiving 30 gallons of water per day per community member. This equals a daily demand of roughly 9600 gallons, residential and public facilities included, for southern Vallecito. Using the following design proposals:

- There will be a mainline aqueduct originating from the 13,000 gal/day source and ending in the town center.
- Service lines will be installed off the mainline for the households adjacent to the mainline.
- In-line chlorination will be utilized in order to ensure adequate drinking water.
- The water committee will be informed of new maintenance procedures, tax collection, and other responsibilities relevant to the water system.

Data collection & analysis

Surveying

CDAC used a water level to collect survey data. The water level consists of a PVC tube containing water and a 20 meter tube that is connected to a long rod with a tape measure attached. The difference in elevation is determined by the height of the water in the tube attached to the rod with respect to a benchmark elevation. The distance between the PVC tube and rod is also measured. This process was repeated over 650 times. CDAC surveyed more than 4.2 kilometers of land.

Hydraulic Model (EPANET)

All elevation data was entered into EPANET to assess the feasibility of the surveyed route. EPANET allowed CDAC to determine where pressure break tanks and air release valves would be necessary in order to alleviate pressure (preventing pipe bursting) and release trapped air, respectively.

A concern with the proposed route was whether or not there would be adequate pressures in transporting water to the tops of hills and to the town center. EPANET showed that there is enough pressure to successfully distribute water throughout the entire system.

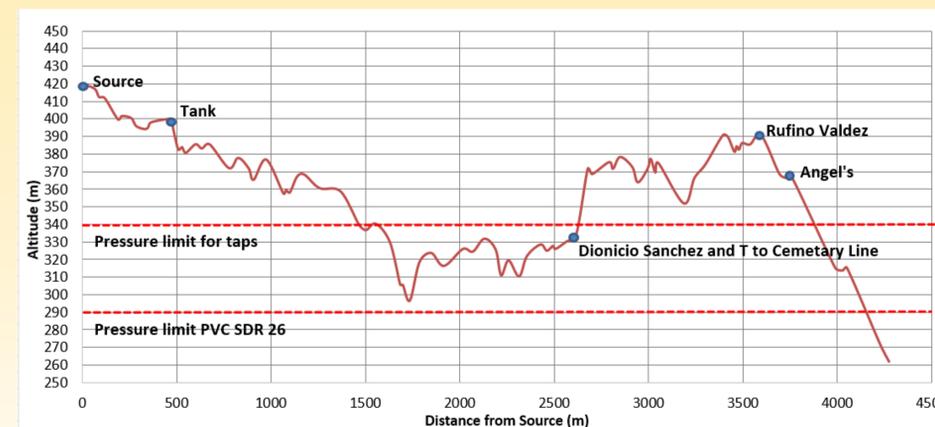


Figure 3: Water distribution system profile

Using EPANET, CDAC was also able to determine that there would be adequate pressures throughout the system to supply the southern half of the community with water. Additionally, towards the middle of the survey route, the elevation goes below the proposed static pressure limits for tap stands. Therefore, during construction, the location of the tap stand will have to be changed to ensure safe pressures for users.

System components

Spring box: Already built, this concrete encasement protects the source from contamination (Figure 4).

Storage tank: An existing 15 m³ concrete tank ensures a quantity of water sufficient for peak demand 20 years in the future; also provides contact time for chlorine disinfection (not shown).



Figure 4: Existing spring box

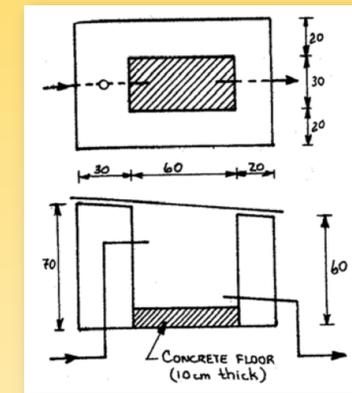


Figure 5: Break pressure tank design [A Handbook of Gravity-Flow Water Systems, Thomas D Jordan Jr., UNICEF 2010.]

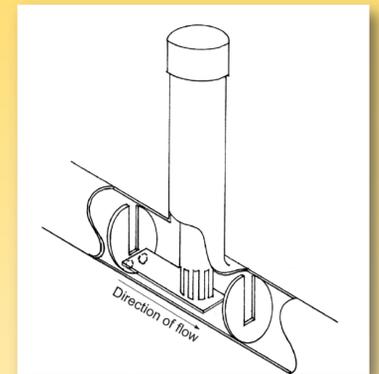


Figure 6: CTI 8 in-line chlorinator [CTI 8 Chlorinator Manual, Compatible Technology International]

Break pressure tanks: Concrete and masonry tanks, release pressure buildup at low elevation points in the system (Figure 5).

Air release valves: In-line PVC tees, each with a floating stopper ball to relieve air trapped at high elevation points (Figure 7).

Tap stands: Point-of-use household taps made of 1" PVC tube and PVC or steel spigots (not shown).

In-line chlorinator: Uses chlorine tablets to disinfect water prior to distribution; chlorine dosage can be adjusted by valve (Figure 6).

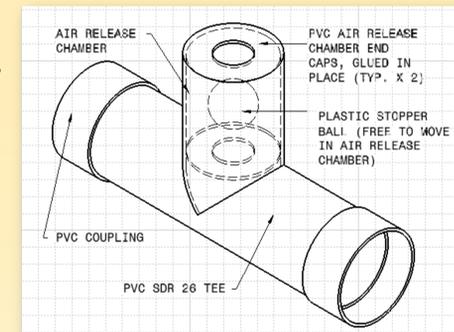


Figure 7: Air release valve design

Cost estimate & schedule

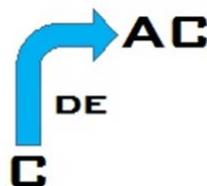
- Grand total construction estimate = **\$9000**
- Total project completion time = **6 months**

Conclusions

As is common in traditional Latin American farming communities, existing water distribution systems are failing to meet the needs of Vallecito, Panama. CDAC's aqueduct design will ensure a clean, adequate, and affordable water supply meeting the needs of all community residents. Construction and initial maintenance will require cooperation between the Peace Corps volunteer and the water committee. Long-term maintenance will be the responsibility of the community.

Table 1: Estimated construction cost summary

| Design Component | Estimated Cost |
|--|----------------|
| Conduction Line | 469.33 |
| Chlorinator | 54.70 |
| Main Line Pipe | 4560.10 |
| Service Line (Cemetery) Pipe | 216.84 |
| Tapstand | 171.10 |
| Air Release Valve | 119.40 |
| Break Pressure Tank | 181.80 |
| Miscellaneous | 1887.15 |
| Total Estimated Cost (before contingencies) | 7660.42 |
| Design Contingency (10%) | 766.04 |
| Estimate contingency (8%) | 612.83 |
| Total Estimated Cost (after contingencies) | 9039.30 |



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