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Pokot Turkana Peace Initiative

Kapedo Water Project

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Background

In Kapedo, Kenya there is conflict between two tribes, the Pokots and the Turkanas. In the region, food is scarce and access to clean water is limited. The primary objective of this project is to meet the agricultural and potable water needs of the small village of Kapedo to aid in relieving the conflict and provide a way to generate income. Additionally, although the village has education facilities, a hospital, and gathering centers, there is no electricity in the town. A secondary objective of this project is to produce a reliable source of electricity. Solving these problems aims to contribute to creating peace and prosperity in the area.

Figure 1. Buckets and containers are currently used to deliver water from the river

Figure 2. Energy source for electricity

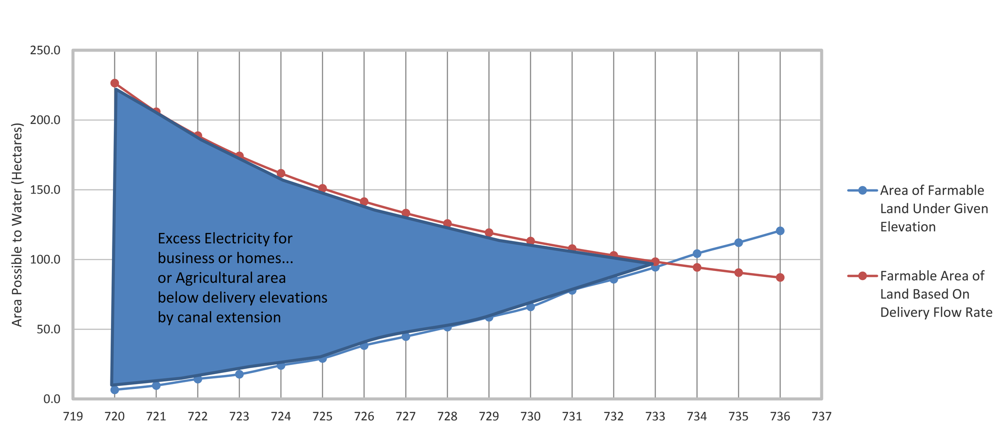
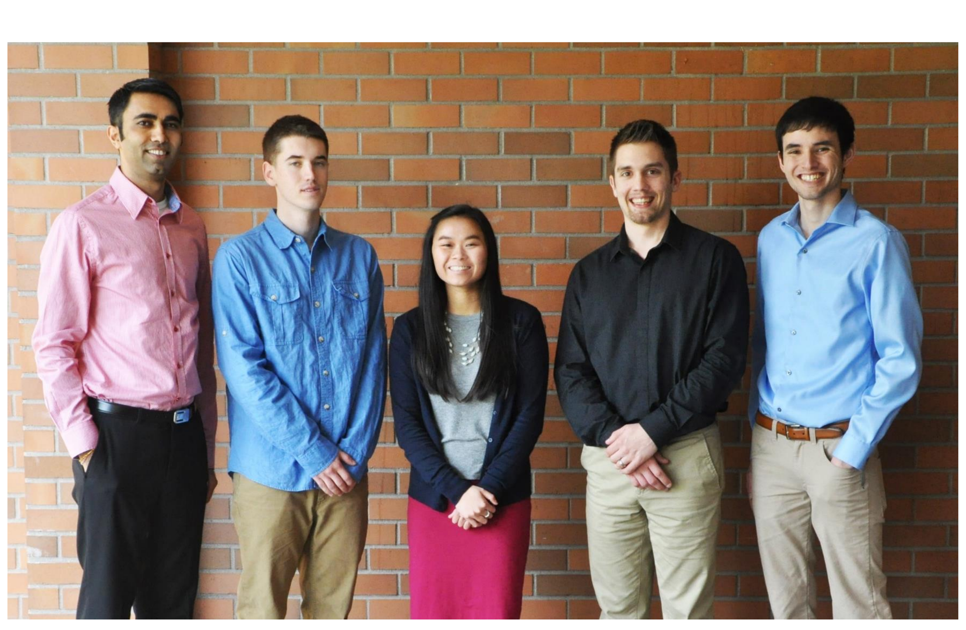


Figure 3. Phase 1 optimization of water delivery elevation



Left to Right:
Rasik Sanghani, Nathan Wiggins, Jenna Hills, Tyler Roth & Colin Daniel

Objective

Provide agricultural water, potable water and generate electricity to the village of Kapedo:

Phase 1: Provide sufficient water to irrigate orchards and gardens.
Phase 2: Provide clean drinking water to people in village.
Phase 3: Provide electricity to charge batteries, power lights, and small machinery in the village.

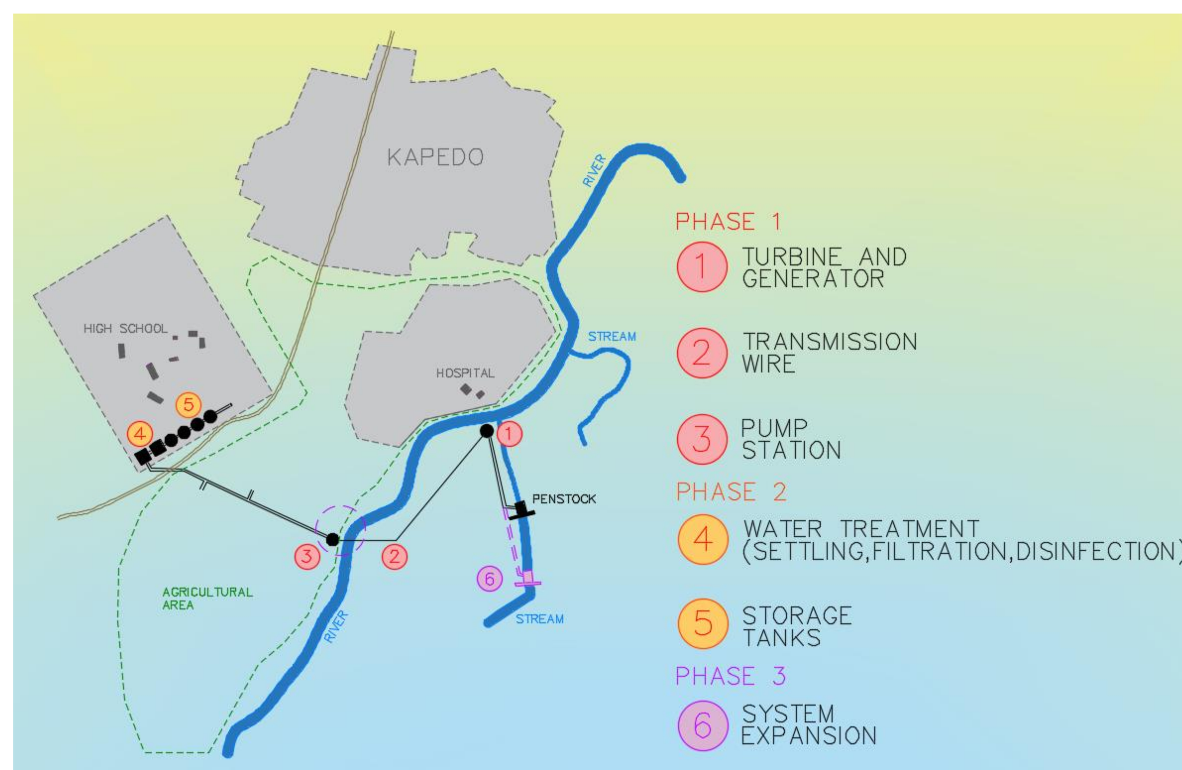


Figure 4. Phase layout showing each proposed design component

Phase 1 and Phase 2

A nearby stream is located higher than the village, but the water is too salty for irrigating crops or for consumption. Thus, to meet the objectives of Phases 1 and 2, a hydropower system was designed to capture the energy of the water in order to power a pump that will lift freshwater from a nearby river. The penstock pipe, turbine, and electrical components are the heart of the hydropower system. The penstock pipe is 355 mm (14 inches) in diameter and carries 200 L/s of water to the turbine. The penstock pipe carries water from the stream (elevation 717 meters) down to the turbine (elevation 711 meters), which is located 150 meters from the stream intake. The crossflow turbine converts the potential and kinetic energy of the water into mechanical energy. The generator attached to the turbine then converts the mechanical energy into electrical energy. Given an elevation head of 6 meters and 200 L/s of water being delivered to the turbine through the penstock, the hydropower system can generate up to 7kW of power.

The objective of Phase 1 is to provide water to irrigate orchards and gardens. The Phase 1 design requires a pump to lift water from the river (elevation 710 meters) to the top of agricultural fields (elevation 730 meters). The water demand for irrigating mango and citrus trees was calculated to be 1.7 m^3/hour/hectare. Taking this demand rate and the power generated by the hydropower system, a pump was sized to provide enough water to irrigate 60 hectares (150 acres) of land.

The objective of Phase 2 is to provide treated potable water to the village at a rate of 40,000 liters/day. Three treatment steps are included in the design: settling to remove larger particles, slow sand filtration to remove smaller particles and bacteria, and disinfection. Water is pumped from the river to the settling tank and is gravity fed to the slow sand filter and then a chlorination device, where it is disinfected before entering storage tanks. Chlorination provides a residual disinfectant that will keep the water disinfected as it sits in storage. All of these methods are common in developing countries.

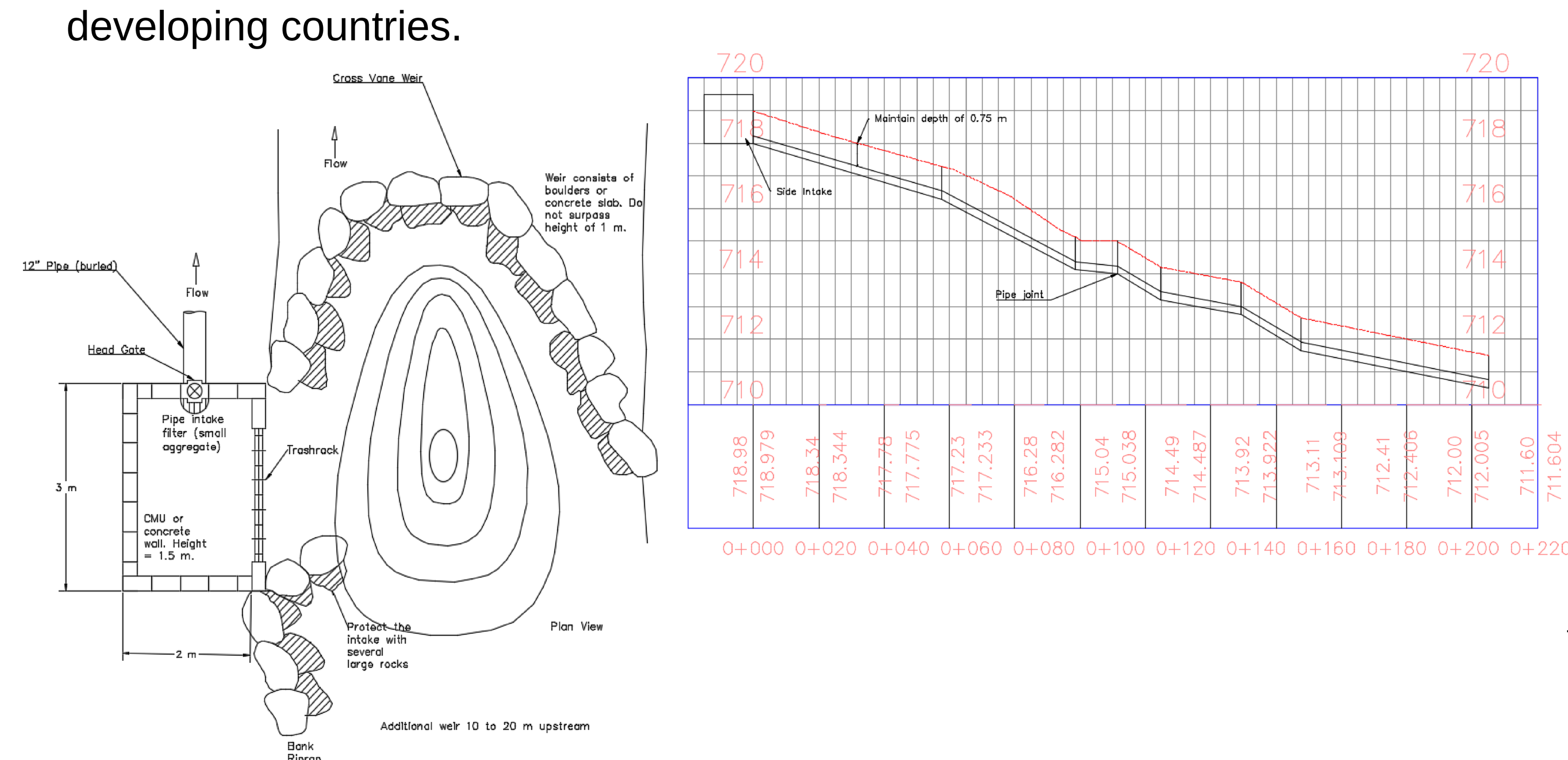


Figure 5. Water intake structure and penstock pipe profile

Phase 3

In Phase 3, the penstock will be lengthened from 150 meters to 400 meters and a new diversion structure built at an elevation of 723 meters. This will increase the water flow to the crossflow turbine. The turbine will produce 13 kW of power, which is 6 kW of additional power. The additional power can be used to irrigate 50 more hectares (125 acres) of land than in Phase 1. The additional power can also be used in the village to power lights, small equipment, machinery, and charge batteries. Power generation is a significant step in helping the village grow economically.

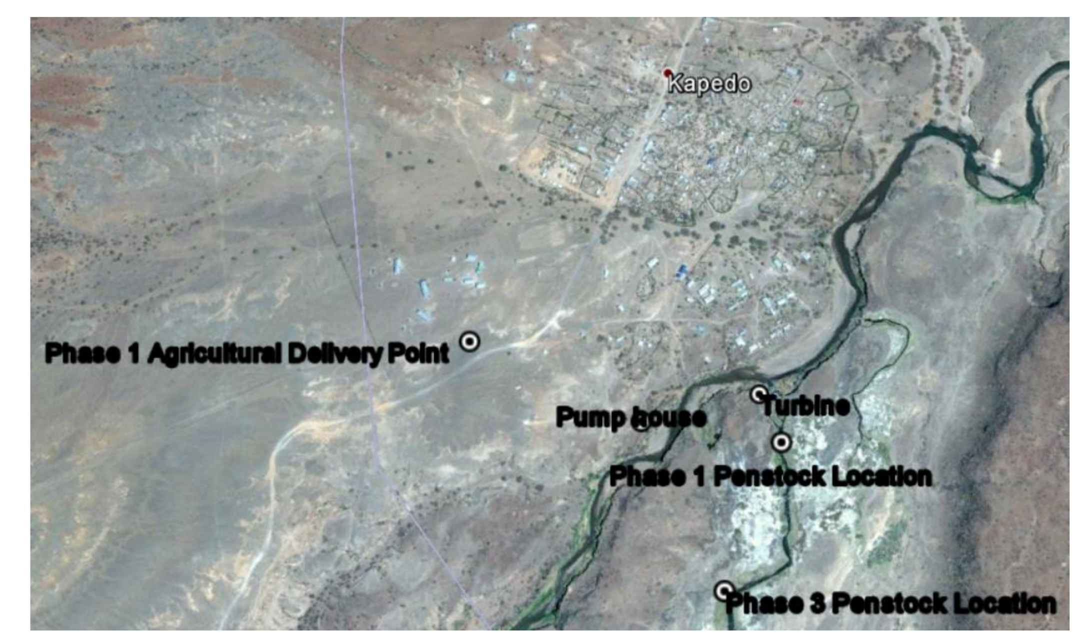
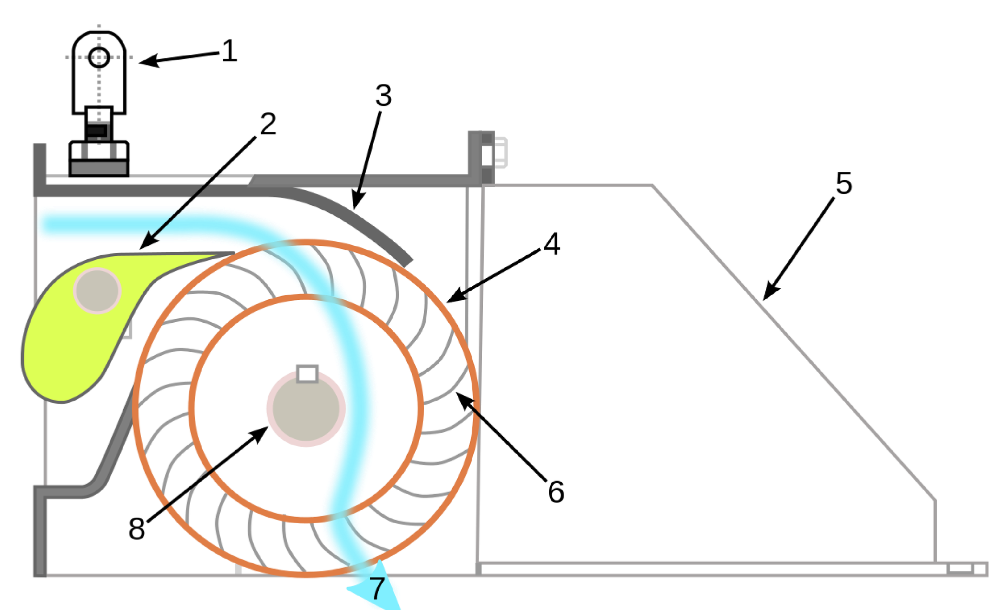


Figure 6. Map of Kapedo



† **Figure 7.** Crossflow Turbine (1) air-venting valve, (2) distributor, (3) turbine casing, (4) runner, (5) removable rear casing, (6) blades (7) water flow, (8) shaft

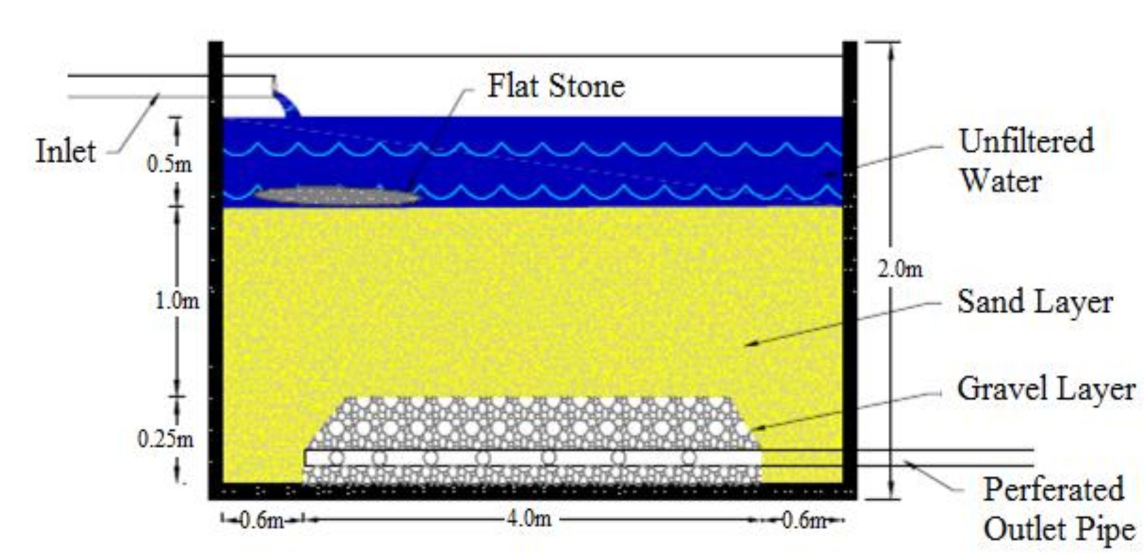


Figure 8. Slow sand filtration design

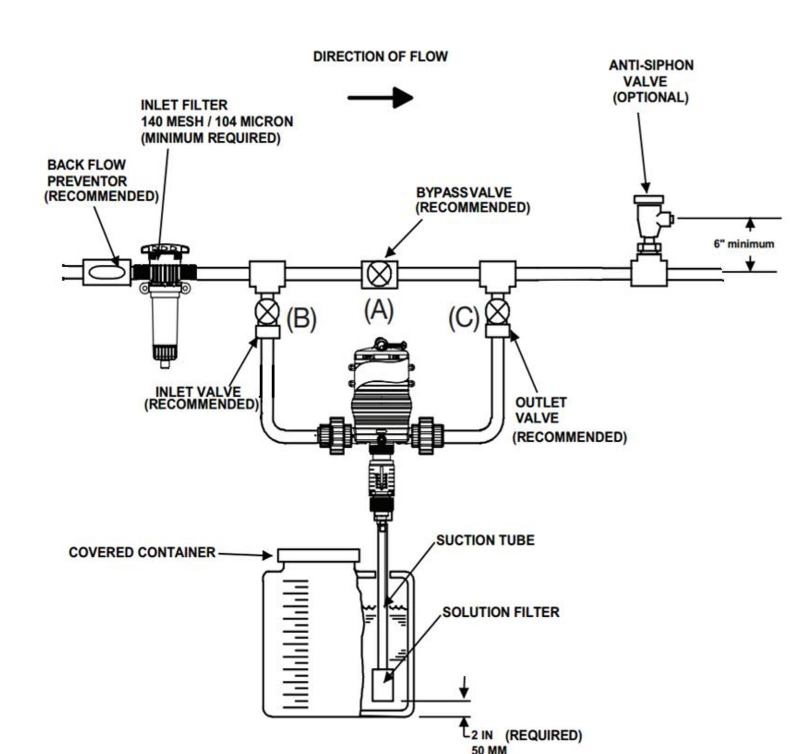


Figure 9. Chlorination design

† *Cross-flow turbine.* Digital image. *Https://en.wikipedia.org/wiki/Cross-flow_turbine.* N.p., n.d. Web.

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