Assessing subsurface hydrology in Ntisaw, Cameroon

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Project Background

In 1994, a rural community of approximately 1000 people in the Northwest province of Cameroon raised enough money to hire a local engineer to construct a gravity-fed water distribution system for the village. While the details are still unclear as to what happened with the hired engineer, the result was the following: a spring box was built and nothing more. In 2008, the Engineers Without Borders chapter at the University of Illinois at Urbana-Champaign (EWB-UIUC) began working with the village to complete the water distribution system. Designs were created and approved and this past January, 3 students (myself included) and our mentor, traveled to the village to begin construction. By June, all 4 stone water storage tanks had been built, and the entire 6.5 km pipeline was installed.

Problem Definition

The spring box however, cannot provide enough water during the height of the dry season during severe drought years. To make matters worse, simply digging the spring box deeper to capture more water is not an option due to the minimal elevation difference between the spring box and the village – any deeper and a pump would be required. Therefore, the team proposed installing drains[1] further along the pipeline where other spring sources appear to supplement the main water source. To determine water flow patterns and decide on the feasibility of such a plan, the team installed 31 monitoring wells throughout the catchment area while in-country this past January.

Term Paper Proposal/Update

While in country this past winter, we collected GPS data approximately every 10-20 feet in the catchment area. From this data, I will build a 3D map and plot the monitoring well locations on it. This will allow me to correlate the well depth measurements that we are receiving from the village to this map and thereby begin to understand the subsurface hydrology. So far I have only started reviewing the data, seeing what is statistically relevant, and then putting it into excel sheets that can be uploaded unto, and read by, ArcGIS.

For the entire village (including catchment area), GPS points that were collected were georeferenced with GoogleEarth to provide a more complete picture of the area. Once I figure out how to do this (!), I will georeference the image in ArcGIS (as opposed to MapWindows as shown below) to create contour lines of the area, and possibly compare this information with other available basemaps (HydroSHEDs, USGS). However, I am not sure realistically what other datasets will provide more/better information than I already have since the area I am working with is comparatively small.

[1] Drains as opposed to a second spring box was proposed since it is technologically simple (the village can install and maintain the system themselves) and economically more feasible

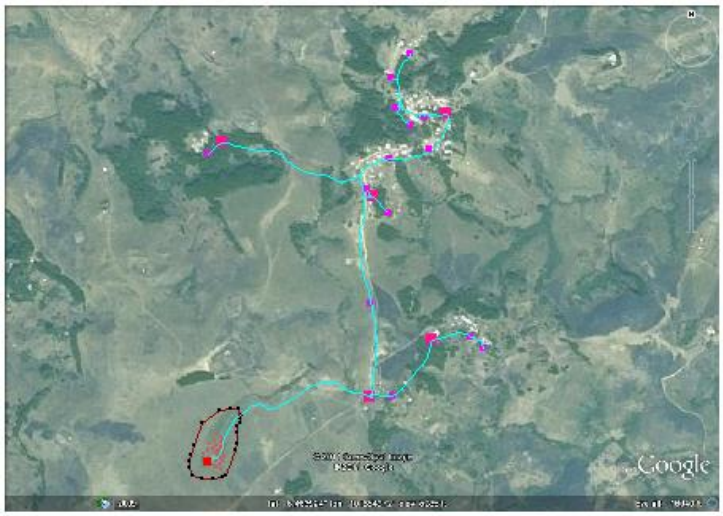

Figure 1. GoogleEarth image of Ntisaw Village, Cameroon. The blue line represents the pipeline, the large pink boxes are the storage tanks, the small pink boxes the public tap stands, the red large box is the spring box, the small red boxes (in the polygon) are the monitoring wells, and the brown polygon represents the fence that was built surrounding the catchment. The length of the box shown is ~3 km.

Construction on a fence has actually already started in the village to protect the watershed from grazing cattle. In realty, the catchment is significantly larger than the area we demarcated; however, extending the fence further was not an option owing to the fact that this land is prime grazing land. GPS data from the fence was collected and it will be plotted on the 3D map (mentioned above) as a polygon. After the fence is drawn on the map, I would like to model contaminants as they flow through the catchment to determine how much contamination from outside the fence will reach the spring box itself. If contamination rates are high, then I will model a berm (one option that is being considered in the village as an additional method of protecting the spring box) placed around the fence to determine how this impacts contamination flow patterns in the catchment.

The village is currently responsible for collecting data on temperature, rainfall, and measuring monitor well depths. I will analyze the results that we receive and calculate the fluctuating water table heights. From this, flow rates and directions can be determined and plotted.

The issues that I've encountered thus far are:

1) Not understanding how to properly georeference the google map in ArcGIS. In MapWindows you just bring it in as a jpeg and then visually reference/mark 3 points from the map and what those elevation, latitude, and longitude correlate to. In ArcGIS though it is taking the jpeg into the program as three different layers (based on color) and so I tried putting it in as one RPG baselayer. I am sure this isn't difficult – I need to do a little more research on it though.
2) I also need to learn more about putting contour lines in

Issues I expect to encounter:

1) 3D imaging
2) Contaminant removal tracing (do something similar to what we did in class last week?)

3) Stimulating a berm along the outer rim of the fence to prevent run-off from entering the catchment – I don't know how I will do this yet.