Mulanje Mission Hospital, Malawi, Water Supply Resilience

To Drill, or Not To Drill: That is the question:

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The What: Mulanje Mission Hospital in Malawi is currently supplied water from a groundwater reservoir and a surface water reservoir (Figure 1).

- The main hospital campus (delineated by the shaded white polygon: Map 1) has an annual supply of groundwater (90m^3/d) from BH1 and BH2 with a storage capacity of 88m^3/d (Map 1);
- The staff housing, nursing hostels and the community inside the hospital catchment (delineated by the unshaded white polygons: Map 1) are without water during the dry season (September—November).

Figure 1: Water Board surface water reservoir (left) & the hospital groundwater reservoir (right) are located on a hill above the hospital. Three 5,000 ltr tanks are located on the hospital grounds (Map 1)

The Why: the hospital have asked Mott MacDonald to undertake a desk study and a field investigation to:

- increase the efficiency of the current supply by improving the conveyance network and pumping groundwater into the surface water reservoir in the dry season (Figures 2); or
- to investigate the most appropriate location to drill new BHs (Figure 3&4), to supply both reservoirs with groundwater and increase the storage capacity around the campus;
- to investigate the proposed location (Map 1) for two new deep BH (approx. 80 mBGL) which were chosen by a local drilling contractor or to propose an alternative location and depth if the initial site is deemed to be inadequate.

Figures 2 to 4 left to right: investigating the head difference between boreholes and reservoirs (2), and the source of the local watercourse (3) and groundwater contamination sources such as pit latrines (4) (see Map 1).

The How: A desk study[1] indicated the area is underlain by rocks of the Basement Complex, which is deeply weathered.

- This weathered, saprolitic material (commonly 15 to 30 m thick but locally over 30 m) forms the principal aquifer. Boreholes in this weathered, saprolitic material typically yield 0.3 to 0.5 l/s.
- Field work tasks were carried out at the hospital during August 4 —10th 2017 with the assistance of an the hospital technician and plumber(s) and included a BH2 pumping test and flow and pressure test (Figure 5), (see handout for details).

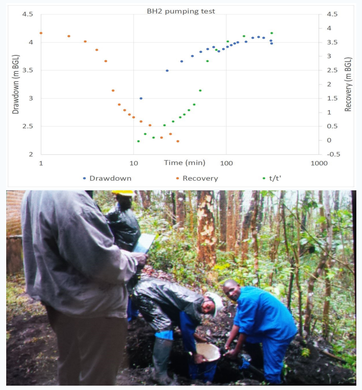

Figure 5 clockwise from the left: the pumping test at BH2; pumping test analysis indicated a transmissivity of 30 m^2/d; and measuring the flow rate at the delivery point.

Options presented to Mulanje Mission Hospital: a number of options were presented to the hospital who want to commence work before the dry season begins in September 2017 (see handout for details):

- Hospital preferred option: Use Water Board Reservoir + New Borehole + New Storage Option;
- Greater overall resilience in the system (reduced reliance on the yields provided by existing boreholes). More opportunity for future expansion of the hospital, which would require additional storage only; a plan to install a solar array and battery system to overcome power outages. This will require 15 to 20 m^3 of additional storage (17 to 22% increase) to meet peak demand.

Map 1: the alternative location for drilling the new borehole(s) and the groundwater contamination risks

Conclusions

- BH1 and BH2 have an average discharge of 0.6 – 0.8 l/s and 2.0 l/s which indicates that the current BH location area is productive;
- The efficiency of BH1 and BH2 could be improved by replacing inadequately sized fittings at the headworks;
- Several contamination risks (Map 1) will influence the location of the new BHs;
- The Zimba River (Map 1) flows for most of the year and therefore groundwater levels in the area along the river and floodplain are unlikely to drop by a significant amount by the end of the dry season; and
- Most of the local groundwater is found in the top 40 m and the basement rock is very hard to drill.

Mott MacDonald Recommendations

Drill new borehole(s) to a depth of 40 mBGL to produce an extra 1.0 to 1.5 l/s in the area delineated by the purple polygon (Map 1). Based on the field investigation, this area is at least risk of any significant contamination. The water table will remain high in this area in the dry season.

- Location/depth proposed by the drilling contractor is inadequate because the principal aquifer is in the weathered zone which is likely to be more prominent closer to any geological lines of weakness, such as may occur along the route of surface watercourses, rather than at higher elevations (closer to the reservoirs).
- There is likely to be a greater risk of a lower yield and/or no yield in the dry season.

Acknowledgements

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References

[1]Hydrological Assessment SADCC Countries Country Report: Malawi, December 1990.