Providing hydrogeological support to the humanitarian sector

Geraint Burrows
Groundwater Relief’s Objective

“To prevent and relieve poverty and sickness and promote the good health of people anywhere in the world by developing their and their water providers capacity to sustainably use and develop groundwater resources.”

The Basic Concept

To link groundwater professionals with humanitarian and development projects

Some Facts

- Started providing technical support 3 years ago
- Registered as a UK Charity in June 2016
- Growing membership of 180 groundwater experts
- Have carried out 70 projects and supported over 100 enquiries
Service Provision

Via our membership we provide:

• Remote support (including desk studies, pumping test analysis, contractual support, reviewing other hydrogeological work carried out by local contractors)
• Field support (including borehole siting, drilling supervision, water resource assessments)
• Rapid Response Unit
Rapid Response Unit

Rapid Response Unit (RRU): Field Experts on call 24/7
Remote Support Unit (RSU): Working in Tandem with RRU
Rapid Mobilisation
Hydrogeological Equipment Ready For Deployment

How to Engage Groundwater Relief?
Submit a request form:
Call out rate of £400 per day + mobilisation + accommodation

For more information contact: help@groundwater-relief.org

Groundwater Relief is a UK registered charity (1167458). Our aim is to alleviate poverty by helping others to sustainably develop and manage groundwater resources. We carry out our work through a membership of groundwater experts.
Feedback

By making people available to go to the field and train our staff ‘on-the-job’ Groundwater Relief have contributed to increasing greatly the knowledge and capacity of some of our key field staff. This has already proved to be useful in Tanzania and I have no doubt in future interventions as well. We now have some good equipment and some well trained people.
Water and Sanitation Advisor, MSF-OCA

We initially engaged with Groundwater Relief in Sierra Leone during the opening of the GOAL operated 100-bed Ebola Treatment Centre (ETC). Most recently we have engaged Groundwater Relief to provide hydrogeological and geophysical support for GOAL’s project in delivering water to 11 hospitals and health centres, including the capacity building of a government geophysics team. We have been consistently impressed with the support, professionalism and responsiveness of Groundwater Relief and see the partnership as one of long term collaboration in delivering technical skills that we do not have within the organisation.
Global WASH Advisor, GOAL

I don’t think we would have been able to implement the project properly without the help of Groundwater Relief. Through their input we have removed the need to use drilling rigs which will save many thousands of pounds for every borehole/well and pump installed. As such the service Groundwater Relief provided has been fantastic value for money, and absolutely essential to the successful implementation of this years project and future water-based projects.
Cameroon Catalyst Team
6 hydrogeologist team carried out a desk study to assess groundwater potential for irrigation wells
ArcGIS online map produced: https://arcg.is/15aP9b
An aquifer was identified and quotes obtained from two international contractors to carry out geophysical survey to identify extents of aquifer system.
Initial hydrogeological assessment of Happy Home orphanage and Roseate primary school, Kisumu County, Kenya

2 hydrogeologist team carried out initial desk study including a highly experienced Kenyan hydrogeologist

Plan of action developed for next steps including quotes obtained to support Happy Homes with planning

Kenyan team ready to supervise drilling works when funding obtained
Evaluation of geophysical data to determine groundwater potential of the Pulka Region, Northern Nigeria - Oxfam

Four hydrogeologist team reviewed geophysical data provided by contractor led by a Professor of Geophysics

Currently supporting identification of targets for further groundwater exploration using remote sensing data
South Sudan – International Organisation for Migration, Bentiu POC
Bentiu POC in March 2016
10 boreholes supplying 125,000 people within the POC.
Camp population receiving under 10l/p/d
Many of the boreholes poorly performing, inefficient and pumping silt
Concern on groundwater availability
Consideration to construct a pipeline system from river Nile
IOM having problems obtaining permission and consensus to drill new boreholes.
Regional Geology
Conceptual Regional model (vertical exaggeration and not drafted using geological logging data)
- No supervision of contractor
- Screen installed in wrong location
- Geology logged in Juba after completion of borehole
- Borehole camera survey revealed inaccuracies in logs in terms of screen placement.
- Contractor enjoying a monopoly at Bentiu charging exhaubatant rates
Local Geology at Bentiu Camp
Field Work Programme – Pumping Tests
**MSF HOSPITAL PUMPING BOREHOLE**

**Bentiu PoC**

**DATA SHEET**

**Depth**
- 0m
- 10m
- 20m
- 30m
- 40m
- 50m
- 60m
- 70m
- 80m
- 90m
- 100m

**Geological Log**
- Clay
- Sand-Clay
- very fine Sand
- fine Sand
- fine Sand
- coarse Sand
- very coarse Sand
- medium Sand
- coarse Sand
- medium Sand
- coarse Sand
- Slotted 6" PVC casing
- Plain 6" PVC Casing

**Installation**
- 57m (pump depth)

**Observed Water Levels**
- Discharge Rate (m³/h)
- Current Pumping Rate (4.05 m³/h)
- Step Test
- Rest Water Level

**Step Discharge Pumping Test Results**
- Analytical Plot of s/Q vs Q
- Apparent Well Efficiency = 94% at current pumping rate (4.05 m³/h)

**Aquifer Test Results**
Analysis indicates that this borehole is installed into a ‘leaky’ aquifer type

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Calculated Transmissivity (m²/d)</th>
<th>Analysis Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant Rate Drawdown</td>
<td>8.12</td>
<td>Hantush &amp; Jacob (1955)</td>
</tr>
<tr>
<td>Constant Rate Recovery</td>
<td>12.74</td>
<td>Thesi Recovery (1946)</td>
</tr>
</tbody>
</table>

**Water Chemistry**
- Electrical Conductivity = 2220 μS/cm at current pumping rate (4.05 m³/h)
- Turbidity = 0 NTU at current pumping rate (4.05 m³/h)
From the pumping test data were able to upgrade some pumps..........

<table>
<thead>
<tr>
<th>Location of residence</th>
<th>Population</th>
<th>Borehole serving</th>
<th>Current abstraction rate (m³/h)</th>
<th>Possible new abstraction rate (m³/h)</th>
<th>Pumping Time (hours per day)</th>
<th>Estimated daily provision (l/person/day)</th>
<th>Future daily provision</th>
<th>Current Shortfall or Excess (m³/d)</th>
<th>Future shortfall or excess (m³/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PoC 2</td>
<td>2512</td>
<td>Sector 2 Buffer Zone</td>
<td>2.5</td>
<td>2.0</td>
<td>14</td>
<td>14.0</td>
<td>11.1</td>
<td>-2</td>
<td>-10</td>
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<tr>
<td>PoC 3</td>
<td>7,349</td>
<td>Sector 2 Block 10</td>
<td>4.0</td>
<td>4.0</td>
<td>16</td>
<td>8.7</td>
<td>8.7</td>
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<td>-46</td>
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<tr>
<td>PoC 6</td>
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<td>Sector 2 Block 15</td>
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<td>2.9</td>
<td>17</td>
<td>14.4</td>
<td>14.4</td>
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<td>-2</td>
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<tr>
<td>Sector 1</td>
<td>10,662</td>
<td>Sector 1 Block 7</td>
<td>7.5</td>
<td>7.5</td>
<td>19</td>
<td>13.4</td>
<td>13.4</td>
<td>-17</td>
<td>-17</td>
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<tr>
<td>Sector 2</td>
<td>7,005</td>
<td>Sector 2 Block 6</td>
<td>4.7</td>
<td>4.7</td>
<td>18</td>
<td>12.1</td>
<td>12.1</td>
<td>-20</td>
<td>-20</td>
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<tr>
<td>Sector 3</td>
<td>35,685</td>
<td>Sector 3 BH</td>
<td>10.8</td>
<td>17.0</td>
<td>20</td>
<td>6.1</td>
<td>9.5</td>
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<td>-195</td>
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<td>Sector 4</td>
<td>23,094</td>
<td>Sector 4 BH</td>
<td>8.5</td>
<td>17.0</td>
<td>19.5</td>
<td>7.2</td>
<td>14.4</td>
<td>-181</td>
<td>-15</td>
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<tr>
<td>Sector 5</td>
<td>30,597</td>
<td>Sector 5 BH</td>
<td>10.1</td>
<td>20.0</td>
<td>17.5</td>
<td>5.8</td>
<td>11.4</td>
<td>-282</td>
<td>-109</td>
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<tr>
<td>New Arrivals</td>
<td>4,365</td>
<td>MSF*</td>
<td>4.1</td>
<td>9.0</td>
<td>19</td>
<td>8.9</td>
<td>39.2</td>
<td>-27</td>
<td>106</td>
</tr>
<tr>
<td><strong>TOTAL Camp Population</strong></td>
<td><strong>124,704</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Water shortfall (m³/d)</strong></td>
<td><strong>-897</strong></td>
<td><strong>-310</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Based on MSF distributing half their water supply to the hospital facilities.
Decommission some poorly performing boreholes........

<table>
<thead>
<tr>
<th>Location of borehole</th>
<th>Generator Make</th>
<th>Power Rating</th>
<th>Submersible Pump</th>
<th>Litres/day of Fuel</th>
<th>Cost of diesel ($/l)</th>
<th>Fuel Costs ($/day)</th>
<th>Cost of maintaining generators and pumps ($/day)</th>
<th>Staff costs* ($/day)</th>
<th>Volume of water delivered</th>
<th>Total Cost ($)</th>
<th>Cost per m³ ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 B12</td>
<td>OLYMPIAN</td>
<td>18 kva</td>
<td>SPA 12</td>
<td>75</td>
<td>3.1</td>
<td>233</td>
<td>34</td>
<td>30</td>
<td>216</td>
<td>297</td>
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<tr>
<td>S2 B6</td>
<td>OLYMPIAN</td>
<td>13.2 kva</td>
<td>Grundfos SQS-70</td>
<td>40</td>
<td>3.1</td>
<td>124</td>
<td>34</td>
<td>30</td>
<td>85</td>
<td>188</td>
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<tr>
<td>S2 B15</td>
<td>KIPPO</td>
<td>5 kva</td>
<td>SQF2.5</td>
<td>20</td>
<td>3.1</td>
<td>62</td>
<td>34</td>
<td>30</td>
<td>50</td>
<td>126</td>
<td>2.54</td>
</tr>
<tr>
<td>S2 B2</td>
<td>KIPPO</td>
<td>5 kva</td>
<td>SQF2.5</td>
<td>20</td>
<td>3.1</td>
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<td>34</td>
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<td>35</td>
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<td>3.00</td>
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<tr>
<td>Sector 2 Total</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>105</td>
<td>3.1</td>
<td>326</td>
<td>136</td>
<td>120</td>
<td>233</td>
<td>582</td>
<td>2.49</td>
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<tr>
<td>Water Trucking</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>120</td>
<td>4.00</td>
</tr>
</tbody>
</table>

* Based on total IOM staff costs of $4540/month for maintenance of 5 boreholes

** Based on IOM monthly expenditure of $1000/borehole

Cost savings of replacing the less efficient boreholes in Sector 2 with a more efficient borehole equivalent to $95,000 per year
Groundwater Monitoring

- Highest recovery representing RWL
- Rainy season ends
- Borehole dynamic drawdown and recovery
- Borehole ceases to operate
- RWL measured in the year previously on 31/3/16

[Graph showing water level changes with dates and measurements]
Drilling Works

Challenges encountered with:
• Politics
• Logistics
• Drilling Practice
• Poor quality casing
• Weather
• Environment
the pocket dipper

Instructions

Step 1
Attach device to surveyor tape using the carabiner snap.

Step 2
Turn the device on by pressing the button at the top of the Pocket Dipper. The device should start emitting a buzzing noise.

Step 3
Lower the Pocket Dipper down the well attached to the surveyor tape. Once the buzzer sound stops pull the Pocket Dipper up a couple of meters until the sound recommences and lower it again this time more slowly. When you are sure of the distance at which the buzzer sound stops record a measurement using a fixed datum at the top of the well.

Step 4
To obtain a true reading of groundwater level you will need to add the distance between the buzzer and the start of the measuring tape to your reading.

If you have connected the surveyor tape to the Pocket Dipper using the carabiner snap then this distance is approximately 18cm.

Specifications

Dimensions: ø 20 mm x 140 mm.
Range: Suitable for measuring shallow water levels (up to about 30m below ground level).
Sound: 82.5 dB
Product Testing: The Pocket Dipper has been tested in water with a maximum exposure of 20 hours under 44 psi of pressure. However it is recommend that the Pocket Dipper is used as a dipping device only and should not be left under water or used as a plumb.

Water level = M + PD