

A Driller's Diary

Graeme's Summit Schools Bore Hole Installation Diary Notes

Sunday 14 August 2011

George collected me from the airport and drove me to Summit Schools via a 'shortcut' using the new bypass. The part that was open was very good; the other part was like being driven off road by Colin MacRae in a competition rally. We picked up water on the way.

Arrived at Summit Schools and was greeted by James at 10:30am. We walked and talked through the installation and the arrangements. We walked down the road to the power distribution pole where the transformer was vandalised and has now been replaced by three single phase transformers which appear to be wired in either star or delta configuration. I can't tell by looking up from the ground. The new transformers are smaller and do not contain the oil that was the attraction to the thieves who vandalised the old one.

No cables have been put in the ground yet. The hedge is cleared to make access for the drilling rig. The generator building footings are in place ready to receive the walls.

I was tired. No sleep on the plane, so I slept for 2 hours in the afternoon. Had dinner with James and Karen, and then went to bed.

Monday 15 August 2011

George Mwangi (architect) arrived at 8am and we discussed the generator room design and build sequence. Agreed steel reinforcement for the concrete plinth and materials for the louvers.

I spoke with Davis & Shirliff who said that once the drilling report is received they can design the pump and supply within a maximum of 3 days. Suddenly the borehole commissioning is possible before I leave.

Muiruri arrived on site at 11am with the drilling rig and his men. We positioned the rig and the set up began. Muiruri and I discussed payment milestones and he agreed to order the pump and generator through Davis and Shirliff after the drilling report whilst we transferred funds direct to his account.

We drove to Thika to cash the traveler's cheques, but no bank accepted traveler's cheques. James drove me to Nairobi and we cashed £6,000 at a foreign exchange bureau where one of James's daughters knows the owner. We got a good rate.

Next we drove to Muiruri's office and paid him the 60% payment for the drilling, then back to the school arriving back at 7pm.

40 metres had been drilled. The generator building walls have been built up level with the ground from the footings.

Tuesday 16 August 2011

Continued drilling from 8am, then at 10:30am stopped as the temporary casing at the top of the hole slid down the hole. Removed all the drill sections (about 15) and tried to hook out the casing. The drillers told me that it would be no problem to leave the casing in the hole and continue. I was unhappy with this explanation. They set off back to Nairobi to collect another casing in order to continue. Meanwhile I spoke with Muiruri on the phone and voiced my concerns. When the drillers returned we agreed to remove the casing and spent the rest of the day making a three pronged hook by welding bits of an old car leaf spring onto a drill bit. It became dark and we ran out of light before we could attempt the casing retrieval.

Met Julius Jackson the electrician for the first time and we talked through the installation and marked out the cable routes and started digging. All the cables will be ducted, which allows us to pull the cables after the trenches have been back filled.

I marked out the generator plinth foundation and got the digging started. The generator will sit upon the plinth, which will be isolated from the building so that vibration is absorbed and not transmitted. I spoke with Davis and Shirliff and realised the plinth size and height needed to be reduced which I subsequently agreed with George the architect thus saving on concrete and steel reinforcement.

I made a rudimentary sighting level with some old bits of wood and a plumb line and used it to check the relative levels of the water tanks in order to determine which one should be used as the master and fitted with the level control and have the borehole output routed to it. I was unhappy with the accuracy of this arrangement and asked James if he could obtain a dumpy level, which is an engineer's level, for me to use.

Wednesday 17 August 2011

Started at 7:30am today with eager anticipation. Did a little bit more welding on our hook, then lowered it into the hole and pulled out the casing. The casing came to the surface, but when it got to the top, the 3 prongs on the hook snapped off and fell to the bottom of the hole. We got the casing out, but now had the problem of 3 large pieces of steel at the bottom of the hole 80m down. This meant that we could not drill anymore in this hole until the metal was removed, because it would destroy the drill bit. This time we got an old speaker and used the magnet to fish for the steel. We made up 80m of rope by scrounging everything we could find. We used bits of discarded cable and even the guy ropes from the drilling team's tents! However, although we were able to make up 80m of rope, none of this worked because we could not lift the steel from the bottom of the hole. We waited from 11am until 3pm for Jenga to arrive from Nairobi with a larger magnet.

I discussed abandoning the first borehole and starting another, but was advised that this was not possible because the pressure created in the ground during borehole development would blow water back up the first hole even if it was backfilled. So we have to fix this borehole.

My planned visit to the nearby mission to see their borehole was delayed whilst we waited for Jenga to arrive.

Jenga arrived with a purpose-made magnet for drilling rigs. It was super strong; so much so that it was very hard to remove metal that it touched. We connected it to the drill extension pieces and went down 50m and came back out with one piece of broken hook and a D shackle that we dropped the day before, although it wasn't quite that simple because we got the magnet stuck in the hole for one hour and could not withdraw it where it had become jammed. Persistence prevailed and it eventually came out. However, there were two remaining pieces of metal still in the hole. I agreed with the drillers that we should have no more than one more attempt to retrieve the lost metal and then if that failed we should move to a new borehole location.

The driller on site said that we could move to a site just 3m away from the first hole. However this conflicted with what he told me the day before when I asked him to move to another location: he said it had to be much farther away. They did not seem to want to move the rig very far. I rang Muiruri and asked what the minimum distance must be between boreholes and he said 10m and decided to go with that. Our choice of sites was limited; we either cut down several trees, or moved across the car park to a clear open area, which was my preferred choice. The drillers did not want to move that far, but I insisted and we moved to the new location. The piles of stones and sand that are currently in the way will require moving in the morning.

Thursday 18 August 2011

The drilling rig set up started at 7:30am. I got the stones and sand moved and moved a section of fence and arranged for a trench to be dug to guide the water from the bore hole down the drive and away from the school. I also got a team of 3 people to start filling in the first bore hole, which presented an extremely high danger to the children. The hole was 215mm diameter and 75m deep with water in the last 40m. It was wide enough for a child to fall in, the consequences of which would be fatal. Making this hole safe and keeping it covered until it was backfilled was my first priority. It was backfilled by about 9am.

I created a second revision to our cable schedule and measured the insitu lengths. I spoke with the electrician to get some ducting moved so that there will be no cabling trailing across the generator room floor. I agreed a floor slab construction and height with the architect.

After the drilling rig was set up, James gathered everyone together to pray at the site of the new bore hole. We started drilling about 9am and spent a little time getting the first casing in the ground. The ground was very muddy when mixed with water and the casing needed driving into the hole under the weight of the drilling rig. The top section of the hole was sufficiently loose to require a second 6m long casing so we welded another one to the first and drove that into the hole too, then welded a crow bar perpendicularly to the casing to prevent it sliding into the hole. We resumed drilling.

At about 11:45am and around 40m we hit water. A lot of water. The school suddenly became flooded by a 50mm deep, 3m wide river. There was much jubilation and excitement. We continued drilling all day until 7pm to a depth of 115m and the water continued to flow all day too. Karen diverted the water

flowing from the well into the banana plant fields. We dammed the entrance to the farm to stop the water flooding the farm. The bananas got lots of water.

I conducted a flow test in an attempt to calculate the volume of water flowing. My calculations showed around 24,000 litres of water per hour, which I could not believe. I rechecked my calcs but came up with the same answer.

When we stopped drilling we removed 6 x 5m drill lengths so that the drill bit was left hanging in clean water overnight to ensure the airways remained opened. It was very dark when we finished and the kids were having fun playing in the river in the dark.

Friday 19 August 2011

First task this morning was to replace the 6 X 5m drill lengths removed from the hole last night. This took about 30 minutes and we were drilling again by 8:30am. We got down to about 120m and the side wall of the hole somewhere above the drill bit collapsed and the cuttings (excavated material) could not be removed (blown) out of the hole. We started removing lengths of the drill pieces one by one in an attempt to raise the drill bit above the blockage and clear the blocked drill bit airways.

The generator building plinth foundation started today. This consists of 2 courses of stone around the perimeter of the base and infilled with compacted broken stone.

The cable trenches are nearing completion with the last part of the trench to the main incomer reaching the outside wall of the house. This leaves just the trench to the main water tank and the borehole to be dug. I gave Julius (electrician) the revised diagram and cable schedule, which now shows 3 more cables so that he can install the ducts that contain the underground cables, and we can start closing up the trenches.

There is another significant trench to be dug, which is the water supply pipe from the borehole to the master storage tank. I looked at the connection system between the tanks and yesterday determined which tank was highest and considered their relative fill rates. We decided to use Tank 4 outside James's house as the master since it is the highest. However, the tank outlets are all interconnected via a 1" pipe, which has the effect of limiting the flow rate between tanks thus affecting the rate at which each one fills. This means that even though Tank 4 is higher than the others it will overflow before the others because the rate of water entering the tank from the borehole will greatly exceed the rate at which water leaves it on its way to the other tanks via the 1" diameter interconnecting pipework. There are several possible solutions to this:

1. Increase the interconnecting pipework diameter to be similar to that of the borehole output pipe.
2. Increase the storage capacity of tank 4 to be say 10,000 litres, up from 5,000.
3. Direct the borehole output to all 5 tanks and fit level controls and wiring on each.
 - Option 3 can be discounted due to its high capital cost of water pipework and electrical wiring.
 - Option 2 is probably the cheapest and fastest solution.

- Option 1 is again a high cost solution requiring significant pipe work and labour to dig trenches in multiple locations around the school.

Q. What happens if we do nothing and simply connect to Tank 4?

A. It will fill faster than the other tanks, reach capacity, the level detector will switch off the pump. Water will filter to the other interconnected tanks and the level in Tank 4 will drop and the pump will switch on again. This cycle will repeat frequently which will dramatically shorten the pump life expectancy.

End of the day now and we were unable to remove the drill from the hole. It is stuck because loose material at a higher level fell back in on the drill bit and blocked the pathway for excavated material to reach the surface, hence blocking the hole. We burst a hydraulic pipe on the drilling rig by putting too much strain on the rig for too long, causing the hydraulics to get very hot and operate at high pressure, whilst trying to remove it, which we had to stop and fix. We only managed to remove 2 drill lengths (10m) so there is still 115m as well as the drill itself in the hole. I spoke with Jenga the geologist and he had estimated the flow rate to be somewhere between 15 – 20,000 litres of water per hour. We talked about stopping drilling once the drill bit was removed from the hole. We discussed the effect on longevity if we drilled no deeper. Jenga's view was that drilling deeper would have no effect and this borehole would be expected to last more than 50 years at the same high output. A later conversation with Muiruri confirmed Jenga's view. I agreed with Jenga that drilling would cease once the drill was removed and that the sleeve would be designed and installed along with the gravel pack. Then the test rig would move in to develop and test the bore hole. A larger drilling rig will remove the stuck drill bit, which will be here in the morning. If all goes according to plan, it is possible the process will be complete on Tuesday morning ready for pump design.

The pump required to meet the full capacity of the bore hole will be huge and significantly beyond our budget, furthermore, the school does not have the capacity to handle 15,000 litres/hour in its tank storage system. The cost of drilling will be less than anticipated since the bore hole is only 125m deep instead of the budgeted 180m, therefore there will be around £2,400 remaining from the drilling budget. However, we have gone over budget in other areas. There remains a trade off between using a larger size pump and increasing the storage capacity of the school. This can be determined when the exact capacity of the bore hole is known.

In the afternoon I visited the Catholic mission where they have a 3 year old bore hole, but it was not visible since it is encased in an inaccessible concrete chamber. On the way back we went to Maragua hospital where they also have a borehole but again this was not accessible. It could only be viewed from a distance and was shrouded in a concrete chamber.

Saturday 20 August 2011

The larger drilling rig arrived this morning to retrieve the stuck drill from the bore hole. It has a larger more powerful compressor and two drive motors on the drill as opposed to one on the first rig. The second rig was maneuvered into position, connected to the drill in the bore hole and within 5 minutes had cleared the hole. A ten metre high fountain of water shot up from the bore hole. It was brown

muddy water that went everywhere and sent people running for cover. It went high into the air because it was not possible to install the collets (drilling pipe guides) around the drill, thus leaving a clear path for the water upwards. We let the water run for 30 minutes or so to clear the debris from the hole, then the drill was removed from the hole. Meanwhile the flat bed lorry had arrived carrying the bore hole sleeves and gravel. There were 26 x 6m sleeves of which 8 were slotted. I looked at the sleeve design with Jenga and then the process of inserting sleeves into the bore hole and welding them together started.

James and I looked at the circular stone structure behind his house and considered how it could be used to support a master storage tank.

I phoned Kay in the UK and asked her to get the telephone number of Kentank in Nairobi so we could speak with them to get design sizes and costs of the respect tanks they sell. We obtained some information but it was unclear, so attempts were made to email them our request. It looks like we will need to go to Nairobi to speak with them in person.

20 sleeves are now in the borehole and the gravel pack installed in the lower 84m. The bore hole was developed, which is the process of cleaning the bore hole and preparing for use, for one and a half hours at the end of which the water was running nearly clear, sediment free and very warm.

During development we got a couple of photos of the drilling team. The drill pipes were removed and the drilling crew packed up for the night. Tomorrow morning they will leave site and on Monday the test rig will come to start 24 hours continuous pumping.

Another great day!

Sunday 21 August 2011

The drillers removed the temporary casing, welded a temporary cap in place over the sleeve and then packed up and left site. Now the bore hole drilling is complete, the next step is to test it by pumping for 24 hours, which will start on Monday. A temporary fence was erected around the bore hole to protect it, and others from it.

James and Karen invited me to accompany them to their friend's house 50km to the west. We left just before lunch with a trussed goat safely stowed in the car boot, which was to be a gift to the host. The road was dusty and very bumpy. As we drove along the road there was the occasional "bleat bleat" from the back of the car and the overwhelming smell of goat!

We arrived and were introduced to the family. More people arrived until there were 20 people present. We ate lunch and then a traditional Kenyan ceremony began where the man asks the woman's family for her hand in marriage. James conducted the proceedings and asked each of the people present to speak and offer some words of wisdom and blessing to the would-be bride and groom, at the end of which James invited me to say something. It was a great honour and a privilege.

I was shown around the farm and we looked at coffee and tea as well as macadamia nut trees and bottle brush trees.

The drive home was similar to the journey there but without the smell of goat.

Monday 22 August 2011

I spoke again with Muiruri and confirmed the test pumping rig was arranged and on its way. We spoke about the bore hole head design and material to finish off the sleeve surround from 0 – 36m (i.e. the area above the gravel, which went only as far as the slotted sleeved area of the bore hole).

George the architect arrived around 9am for our 7:30am meeting (I should have checked whether the arranged time was local or Muzungu – their name for foreigners – time). We looked at the steel reinforcement cage in the generator plinth and agreed some changes in order to provide sufficient concrete cover to the steel all round. We went over the programme timing again and confirmed that the plinth should be poured on Wednesday this week once I have the generator model defined and therefore know the holding down bolt positions, which will be cast into the concrete.

We looked at the circular stone structure behind James and Karen's house and I explained our plan to use it to support the master storage tank(s). I asked George to produce a suspended reinforced concrete slab design upon which the tank(s) would sit. We talked about the various implications of the different tank configurations and I agreed to let him know later that day what our chosen tank configuration would be.

I spoke with Julius the electrician about the intended plan for the master storage tank and the implications on cable and water pipe routing and therefore the timing of trench backfilling and their routes.

The test rig arrived on site at 11:30am and started the set up. They dug out the backfill around the sleeve and then completed the gravel pack to the surface. They removed the temporary cap and lowered the pump into the sleeve followed by 17 x 6m 1½" galvanised pipes. The resting water level was 20.6m. They began pumping at 2pm. The water began to run clear after about 30 minutes with a flow rate of 18,000 litres per hour. James and I looked at the water running from the pipe in the dark about 9pm and shone lights through it and took photos of it.

Tuesday 23 August 2011

I spent the morning looking at the tank and interconnecting pipework design. The test pumping completed at 2pm today, at the end of which the water level was read at 1 minute intervals to determine the rate of replenishment.

James and I went to Maranga to buy the electric cables, but they had none, so we will buy them tomorrow in Nairobi. I spoke with a seller of storage tanks and got prices for 10,000 litre tanks, which were quoted, at 65,000 Shillings each, about £500. James and I went to another supplier and ordered 2 tanks for 60,000 Shillings each. They will be delivered to site on Friday. We visited Barclays Bank and I enquired about opening a bank account for WellBoring, but this proved problematic because I was told all four trustees would need to be present at the same time to sign. We talked about ways of getting round this but bank business advisor was struggling to find a way, however, we agreed that he would look into it and call me later.

On the way back from Maranga, I saw a man transporting a 3 seater sofa on the back of a 125 motorcycle. It was a very impressive feat. No one seemed to pay any attention to it, and behaved as if this was completely normal. I guess I should have expected it be this way, especially since the enormous electrical cabinet for our installation arrived in a similar manner.

Wednesday 24 August 2011

James and I left at 7am for Nairobi to meet with Muiruri to agree pump and generator sizes. We arrived at his office at 8:20am and immediately got down to business. We agreed how much was owed for the final drilling payment, and then looked at the pump options. The bore hole has a yield of $18\text{m}^3/\text{hr}$. WRMA (the Water Resource Management Authority) will permit only 70% of maximum yield ($12.6\text{m}^3/\text{hr}$). Our design criteria was to extract the minimum amount of water that would satisfy all the needs of the school and farm, both now and in the future including allowance for expansion, and that of the surrounding community. The smaller the pump, the smaller the cables, generator and storage tank requirements and therefore the overall cost. We decided to use a $5\text{m}^3/\text{hr}$ pump and increase the size of the storage capacity. This design meant the pump would be subjected to fewer start ups and therefore increase its potential life expectancy. It also means it will draw less electricity and therefore is cheaper to run and requires a smaller generator. Having agreed our requirements, we set off for Davis and Shirtliff in Nairobi industrial area. We met with Stephen in the technical sales team, and one and half hours later had agreed the design. Muiruri agreed to buy the pump and generator through his account with D & S, which meant we could have it prepared straight away with the possibility of installation on Friday of this week. We went into the warehouse and opened a generator crate where I took the baseplate dimensions in order to set the holding down bolts correctly in our generator plinth to be poured tomorrow.

Next we went to Silent Flow exhaust systems where I agreed a custom manufactured flexible exhaust pipe connection intended to be fixed to the generator exhaust pipe to vent the fumes to atmosphere from inside the generator building.

Then on to the Star Electrical where we ordered the armoured cable for the installation. They did not have it all in stock so we had to go back to them later to collect.

Next stop the plumber's merchants to get all the plumbing fittings to connect the new tanks and also to upgrade the existing storage tank system so that it will accommodate the new faster rate of fill without overflowing and also automatically switch off when full. Purchasing all these fittings took more than 2 hours in a hectic hot environment where we were scrabbling around on the floor counting our fittings with pedestrian traffic stepping on them and carrying deliveries over our heads. When the ordered was found to have an error in their supply the resulting confusion took another half an hour to resolve.

Whilst I was attending to the plumbing fittings, James went to the bank to withdraw some money. After the plumbers merchant we carried the fittings to the car then back to Star Electrical who still had not received all the cable they had ordered. So we left them around 4:30pm and headed back across town to the foreign exchange bureau to cash the remainder of the traveller's cheques with which to pay Muiruri. We got stuck in traffic again in searing heat and eventually got to the bureau at 5:30pm where they had stayed open specifically for us. The traffic is unbelievable. Everywhere was gridlocked. There were people pulling barrows transporting goods mixed in with cars, buses and lorries; the man in front of us was on foot pushing a sack truck containing a filing cabinet! Even he was unable to move through the traffic.

After we collected the cash, we headed back into the traffic jams to collect the cable, but got completely stuck in the traffic, so I walked ahead whilst James tried to get through with the car. When I arrived at Star Electrical again at 6:20pm, our last cable had still not arrived, so I waited again, this time for the remaining cable and also for James to appear with the car, which he did at around 7pm. I checked the cables but could not see the cores, (number of individual conductors) so asked for the end of a cable to be cut off with a hacksaw. One cable was incorrect: 3 core instead of 4 core, so we had to pull more cable out from the shop front onto the pavement in the dark and measure out another 23m of 4 core cable and cut it in the street whilst people were stepping over us.

During this time I had over £3,000 in cash in my bag and began to feel acutely aware of the risk we were running. Having finally got all the correct cables delivered, cut and into the car, we left for home. By now it was too late to pay Muiruri and we would have to return the following day. The traffic was still impossible and it took us one and half hours just to get to the edge of Nairobi and start moving again. James had been invited to participate in a conference call at 9pm, so we switched drivers and I took over and drove the rest of the way home whilst James was on the phone to the US. We got home at 10pm hot, tired and hungry. Karen fed us and then to bed. I phoned through Muiruri's bank details to Neil back in the UK so that he could make the final payment to Muiruri the next day when we knew the final figure. Four hours sleep then it will be off again in the morning to pay Muiruri on the outskirts of Nairobi.

Thursday 25 August 2011

6am James and I set off to go and pay Muiruri. By 7:20am we were there. I paid the outstanding drilling balance, then we calculated the pump and generator set payments, where I paid him all the remaining in country cash and agreed to transfer the remaining outstanding balance direct to his bank account. We shook hands and set off back to the school stopping on the way for a quick bite or breakfast in Thika where I purchased some holding down bolts for the generator whilst James bought some other shopping.

When we got back to Maragua, we talked with a metal fabricator and I gave him a design for the holding down bolt base.

Upon return to the school, the first of our 10,000 litre storage tanks arrived and I got the workers started on digging the remaining trenches and excavating round the bore hole to enable the concrete slab to protect it to be poured.

In the afternoon the generator plinth was poured whilst George and I made up the holding down bolt positioning system and cones to enable movement and release of the bolts after concrete pouring. Time ran out and we had to make special arrangements for the guys to stay on a bit longer to also pour the concrete slab around the bore hole sleeve. It was getting late and the concrete gang were losing interest and left without floating (providing a smooth, flat, level finish) off the plinth.

Jenga the plumber arrived for me to talk him through my 3 phase installation plan:

1. Phase 1 – install the bore hole to existing supply system network via a temporary connection ... tomorrow!
2. Phase 2 – install the 2 x 10,000 litre tanks once the concrete slab has been poured and make the permanent connections of the borehole pump to the new tanks, then connect their output to the existing supply network
3. Phase 3 – upgrade the existing tank connections with ball valves to control fill, overflows to safeguard overfilling, large diameter pipework to maximize fill rates, non return valves to safeguard against contamination and lever valves to isolate individual tanks.

James is Jenga's spiritual father so he agreed to come tomorrow to install phase one of the plan. We have all the materials on site, so should be able to connect the borehole pump output to the existing supply infrastructure.

Tomorrow Indepth should arrive with the pump and generator to do the installation. We have some trenches to finish digging, but should be able to get it all done if all goes well.

Friday 26 August 2011

First job this morning was to get the remaining trenches dug and all the ducts installed to receive the cables. The pump would be arriving mid morning and the installation would begin, at which time we

needed to be ready to provide power via the installed cables, none of which were installed. There were 6 people digging trenches at 8am. By 10am all the trenches were complete.

I freed off the holding down bolts in the generator concrete plinth poured yesterday so that they would be ready to receive the generator.

The electrician arrived around 10am and started to lay the remaining ducts, but was slow to complete this and the cable installation task, so I worked with him to pull the cables, whilst simultaneously working the phone to get plumbing fittings delivered for the plumber via James who was driving around in the car fetching all the last minute items we needed and dispatching them back to the school by motorbike couriers.

Jenga the plumber arrived around 10:30am and started to lay the water pipe from the borehole to water tank 5 on top of the large circular stone structure. The tank is not there yet, so I agreed a temporary connection with James that will suffice until it is. There was a problem connecting the pump output to the tank supply line because of the change in size from uPVC 1½" to 1¼" and the unavailability of reducers. Jenga told me he had agreed with James that he would simply connect the pipe sticking up out of the ground and we could watch the water go up in to the air and cascade down to the ground to demonstrate the pump working and leave it at that. This was unacceptable because with a little more effort we were able to finalise the installation and I was focused on leaving the system operation at the point I left to return home, so after a few minutes English to Swahili conversation we agreed that I would find the correct reducer and bring it to him and he would make the temporary connection ... another phone call, a pick up and motorbike courier.

The pump installation crew arrived with the pump and generator. The pump installation was straightforward and did not take long. They also got started on the control panel installation in the head teacher's office. When we pulled the borehole power cable we found it was 1m short so we had to take a shorter route than planned which made it look slightly untidy. The installers took this to be the route for all the other cables and hacked out a large chunk from the wall next to the entrance door. It is quite unsightly, especially since none of them are clipped down. This will need doing later. They were fitting ducting above ground in which to run cables. Another English to Swahili conversation (snippets of English are relayed back to me from a Swahili conversation), which resulted in agreement that the ducting was not necessary.

The architect was due on site at 9:30am to discuss the concrete slab for the tanks. He arrived at 2:20pm on the back of a motorbike taxi and brought some of our much needed plumbing fittings. We discussed the slab and reached agreement on design, method and materials, but needed a conversation with James on pricing before giving the instruction to proceed. I drew a sketch of the borehole enclosure, which explained my design, and George (the architect) did a rough costing providing an estimate of 12,000 Shillings (about £80). I instructed him to proceed. We also discussed the generator room slab design and I learned that there are ants in Kenya that can eat through concrete, which is why they spray with pesticide before pouring floor slabs!

Meanwhile, various labourers were still digging around in the trenches causing more soil to fall back in on the ducts. Despite my efforts I seemed unable to stop them on any sort of permanent basis. They stopped when I asked, but when I went somewhere else and came back, they would be there again in the trench with their pangas (machetes) and pick, poking around at the soil edges.

I had to instruct the electrician not to order any trenches to be backfilled because he was causing us to have to dig them out again where he had thought the electrical ducts were complete or unaware that any other services would be required.

We got the electricity supply connected around 4pm, but found that despite it being made live around 3pm by Kenya Light and Power company, the yellow phase of the 3 phase power was down on voltage and therefore unusable. The electricians did not discuss this with me. I only found out when I stopped them ripping out the supply cable from the trench and asked them what they were doing. They told me about the problem and said they were going to use the cable to connect to the generator. I hid my frustration and told them to put the cable back where it was and remake the connection. The correct cable for the generator was lying on the ground next to the generator waiting to be connected and could be used right away. There was no need to rip out the cable we had just spent the last hour installing!

The generator was connected and fired up, but there was a problem with neutral, and I was unable to obtain clear definition of it. There were 6 people all crowded round the control panel trying to determine the problem when they decided it was a problem with our brand new generator, so they immediately started to dismantle it. I stopped them taking the generator apart and forcibly took the lead electrician by the arm and guided him away from the group to speak with me. We agreed he should go back to the control panel and check his wiring again. Miraculously the neutral problem disappeared 10 minutes later and our brand new generator was exonerated and spared being dismantled. Now we tried the pump. First attempt it was running in reverse, so we stopped and switched two phases, then started it again. The water started to flow from the open end of the pipe adjacent to tank 5, and as we had deliberately not made the connection and not directed the water away from the work area, started to fill the trench, which for a few seconds was not a problem, but could not be left to run, since the trenches would become water logged and possibly start collapsing. There was also a leaky water pipe and a leak at the water meter. We stopped, fixed the leaks and redirected the water away from the trenches. The pump installation team in their eagerness to complete the job and be on their way, started the pump again before the plumber had finished repairing the leaks, so it had to be hastily turned off again. Once the leaks were fixed we turned on the pump again and observed the water running and clearing as all the old debris in the pipes cleared. Next we isolated the old diesel pump from the system and made the temporary connection to the storage tanks and turned on the pump again. Now it was 6:40pm and dark. I climbed on top of the tanks and filmed water running into tank 4 by the light from my mobile phone.

We had done it. The bore hole is now connected to the storage tank system. Clean water is running into the tanks. There is no going back and the old diesel pump and surface well cannot be used again since it would pump the old surface well water straight down the bore hole. I agreed a permanent physical separation of the two systems with James so there can be no mistake.

Wow, what a day today!

Saturday 27 August 2011

First job today in the daylight was to ensure the bore hole was pumping water to all the tanks. I started the generator and switched on the pump and then watched the tanks fill in turn. Perfect.

8am I got the workers started clearing up the ground and starting to backfill some of the trenches.

George arrived on site to meet with me and James to discuss the borehole enclosure and the stone circle concrete slab. We went through my sketch together and agreed final design changes and to proceed on the basis of George's price. We discussed the slab and the various material supply options and again agreed to proceed with George's price. We agreed that both the borehole enclosure and concrete slab would be started on Monday and proceeded simultaneously with urgency to completion. The generator room that would encase the generator itself would follow after and in the meantime we would keep the generator protected with temporary covers.

I disconnected the generator cable to allow the generator to be moved from its delivered to its home position on the now completed plinth in the generator building. Julius the electrician arrived and pulled the last two cables through. The plinth shutters were stripped off and the holding down bolts made ready to receive the generator. James organized a section of the hedge to be cut out so the generator could be walked into position. We got some timbers and slid them underneath the generator frame and eight men lifted it and carried it into position. It was a delicate operation because we had to hold the generator weighing 428Kg and gently lower it into position without damaging the holding down bolts cast in the concrete. I packed the surface to keep the generator just clear of the bolts, and then lowered each corner in turn. It fitted perfectly and I tightened the bolts, thus securing it permanently in position. Julius finished pulling the cable through so I reconnected the generator terminating the connection with a cable gland, the only one that had been used in the entire installation!

Jenga arrived mid afternoon and lay 1½" pipes in the open trenches from the stone circular structure where tank 5 will go, back to the driveway in front of the borehole. These pipes would carry the water supply from tank 5 on top of the stone circular structure to the other storage tanks 1, 2, 3 and 4 thus bypassing all the old supply network and ensuring a fast free flowing supply of water that will fill the tanks quickly and minimize pump running times. This supply line was not connected as it will be used once tank 5 and 6 are in place and the line is completed to all the other tanks.

We completed laying these pipes soon after 4pm and then back filled all the trenches.

The school suddenly feels like it is returning to normal. There are no open trenches, no drilling rigs, no engines running; I can hear the kids chatting and laughing. After two weeks of heavy machinery and loud noises it feels like a school again. It is peaceful and calm. It feels really good and I like it.

After dinner I worked out the latest changes to the finances and now have the total cost figures. The entire installation cost £20,224 plus the cost of 2 flights to Kenya (one for Colin and one for me). I don't have enough WellBoring money with me, so gave James the balance of what I have and will transfer the remaining amount to the Summit School's bank account when I return.

The only thing that remains for me to do before my departure for Nairobi tomorrow afternoon and then flight home early Monday morning, is to talk James through the 'Outstanding work schedule' I have produced. There are 19 items left to complete. The entire installation although working right now, will be so improved from what existed before that it will:

1. produce drinking quality water
2. run completely unsupervised
3. be silent
4. be reliable
5. be shared with the community

I can't help feeling that although we worked really hard and were busy for 14 days straight with only 4 hours sleep some nights, we had an amazing amount of luck. Yes, there were plenty of obstacles, trials and tribulations (metal in the first bore hole, no electricity the day we installed the pump etc), but everyone we came into contact with wanted to help; and even though the odds of success were slim on some occasions (getting the foreign exchange bureau to remain open for an extra hour whilst we tried to get through Nairobi traffic in searing heat), it all just seemed to fall into place.

School Neighbours have been coming into the school and shaking my hand telling me that water is life and how grateful they are for what we are doing. People in the community have been telling me the same. Jenga the plumber was called by a local vicar who just wanted to speak with me on the phone and express his thanks. It has been a truly humbling and at the same time euphoric experience. James and Karen are already talking about the location from where they are going to be dispensing water to the community. If anyone is in any doubt about the difference that this bore hole will make to this community, please don't take my word for it, come and see it for yourself.

Sunday 28 August 2011

After breakfast I attended the Sunday morning school praise service. There was lots of singing and dancing. The songs were vibrant and loud and the kids were doing the most amazing dancing while singing along to the drum beat hammered out on an upturned plastic barrel. The singing finished and the lead girl then announced that I would now make a presentation. I did not know this beforehand, so had about 2 seconds to plan and prepare one. I talked about when I was at the school last year and what I had learned about the water problem and what we decided to do about it and how we went about it. I asked them what questions they would like to ask me and they asked how I became a civil engineer. Having answered that question, I went on to tell them about the borehole and how it worked. They were very interested to understand its operation and were visibly excited by it.

James took part of the service and praised the work that we had done and challenged the kids to think about why WellBoring had done what it had done and what our motives were and what generosity means.

After the service James and I talked through the outstanding work list again and looked at the various areas of work. James has put all his head teacher duties on hold for the last 2 weeks and done everything I have asked of him. I sense now that he needs to return to the school and resume his normal duties and is looking forward to the return of normal school life when the remainder of the kids return in one week's time.

As I write this it is 12:30pm on Sunday. We are just about to eat lunch, then I have to pack and will leave the Summit School when I am collected by George at 3pm. We will travel to his house where I am staying tonight before my flight home tomorrow morning.

A few days ago I told James I was feeling "ground rush" because it felt like my time here was running out fast and there was still lots to do. Well, we finished the borehole yesterday afternoon at 5pm when the trenches were back filled. Water now runs on demand.

It is a quiet Sunday in the school and I feel a quiet calm and deep sense of satisfaction at having been here to organize, conduct and represent everyone back home in achieving this project. We started talking about this a year ago and now it is a reality. We did it. Speaking with the kids this morning was humbling. They understand what we have done and its implications. Here, they are taught 'Water is

life' and many of the people I have spoken to have used this phrase. They speak of the challenge of receiving such a gift and their duty to use it well. James and Karen are talking about sharing it with the community and only this morning James and I drew a design showing the community take off point from the main storage tank. I am very proud to have played my part and feel very privileged to have been able to come here to Summit Schools in Kenya to deliver it on the ground.

George collected me at 3pm and we drove to Nairobi in readiness for my flight early the next day. He dropped me at Mercy's house. She is James and Karen's eldest daughter and is married to Keru with whom she has 3 teenage children, 2 girls and a boy. They live in a nice part of Nairobi, but even so, their house is part of a group of 7 or 8 houses contained in a walled compound with high walls topped with barbed wire, electric fence and a permanent guard who operates the high steel entrance gates.

The family were going to Keru's brothers daughters 'leaving for university in Canada' celebration that evening and invited me to come along. We set off and picked up their daughters on route who were returning from a music concert in Nairobi. When we arrived at Keru's brothers house, there were about 45 people there and I was made very welcome. I met the managing director of Davis and Shirtliff, finance managers, architects and engineers, as well as Dennis Tongoi, a minister who is looking for help creating bore holes in Garissa. We talked, looked at Google maps of Garissa on his iPhone together, and agreed to talk some more to see how we could work together to achieve our mutual aims of providing sustainable water supplies in Africa.

The family and friends at the gathering held a beautiful ceremony where Keru's brother's daughter was given advice and blessings and also invited to address the group. She leaves for Canada next Saturday for four years.

I stayed at Mercy's house that night and George picked me up at 5:30am the next day and took me to the airport. We drove in the dark along the Mombasa road out of Nairobi and I became uncomfortably aware of all the people dressed in dark clothes running across the 3 lanes of traffic in each direction.

George told me they count the death toll on this road by the number of people killed per week ! However, we reached the airport without running anyone over and I returned home.

Observation

Tail wind

I can't help thinking that we have had an unbelievable tail wind. The last 2 weeks keep reminding me of the film the 'Blues Brothers' where Jake and Elwood are released from prison and are on 'a mission from God' and seemingly impossible obstacles are overcome time after time and get progressively more unbelievable as the story unfolds. This is a similar representation for me to what has happened during our last 2 weeks. There were many problems and obstacles to success, but they all melted away and everyone came together to make this happen. It was surreal.

Lessons Learnt

Communications

A local phone is essential since phone calls made on a UK mobile become prohibitively expensive. The locals recognise a local and a foreign phone number and will not call or text a foreign phone. WellBoring has a local Kenyan phone. Texts to the UK cost K Sh 20 and calls to the UK are K Sh 3/min (landline), K Sh 20 /min (mobile). It is also important to understand if there is mobile phone coverage in the area too.

Travel

A safe, fast and reliable means of travelling about is essential to enable a borehole project to travel to meet people and to collect materials. A 4-wheel drive car with a local driver with knowledge of the roads is recommended. Lorries are required on site for the drilling and also for deliveries. There must be adequate access to get them in and out.

Security

It is not safe to travel on the roads at night, nor to be out at night because of the road hijacks and robberies. A safe and secure place is required to eat and sleep. This would typically be in a secure compound with locked gates and continuous overnight guard. The Summit Schools compound has a night watchman and 6 unfriendly dogs on the loose. James locks the steel doors to his house from the inside every night. All the windows have steel bars.

Welfare

There needs to be a safe source of clean drinking water and clean safe food that is hygienically cooked and served at meal times. Food needs to be bought and prepared from local safe sources and prepared by hygienic cooks.

Sleeping provision needs to be provided inside a mosquito net either inside a secure building with bedrooms, or a tent. There must be provision to hang a mosquito net.

Money

Transferring money to suppliers is difficult because Kenya does not like to deal with traveller's cheques because of the high level of fraud they have experienced from Nigeria and the Congo. Therefore the only place we found to change travellers cheques was a foreign exchange bureau in Nairobi; none of the banks would change them.

Transferring money from the UK to a Kenyan bank account is possible with the Swift BIC code and the payees bank details, however, it takes 5 working days to process and it is not possible to predict the exact amount that will arrive in the payees account because of the different bank charges and unknown exchange rate. So, this makes payment on delivery very difficult. There is also a limit on the amount of currency that can be carried into Kenya of £5,000.

Health

There are risks of illness from sickness, infection and malaria, besides the obvious risks of accidents or assault. Health care in Kenya is poor, with minimal care in the outlying towns and Nairobi hospital being usually a long way away, and extremely overcrowded to the point that it is not possible to get a bed. They share beds in Nairobi hospitals. The local hospital address and contact number should be determined in advance the driver should be made aware of how to get there.

Safety

Working in Kenya is subject to far less stringent safety rules than we are used to in the UK, to the point where I was not aware of any safety rules or even much awareness. This presents a risk to everyone. The workers work barefoot when digging trenches, lifting large rocks or heavy objects, or when chopping wood with a Panga. They use their bare feet to steady the wood whilst they chop it up! The local community has to be protected from the works and kept safe, but this is hard to achieve when there is little or no awareness on either side.

Labour

To construct a bore hole there is a wide range of labour skills required: Drillers, geologists, labourers (lots), plumbers, electricians, site manager, engineer, finance manager and a safety manager. Some of these roles are rolled into one, but nevertheless, there are a significant number of people required to come together at the right time at short notice to get the job done. Therefore, there needs to be someone locally who knows and has access to this resource and can call it in as required.

Materials

Electrical, plumbing, building and bore materials are required to construct a borehole and need to be sourced in country and delivered to site. There needs to be good or at least reasonable transportation links to get the materials to site in a safe and timely manner.