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Water for Mphero in Malawi

by Charles Rich

A severe drought persists across a large region of South Africa and drinking water is scarce. Many traditional sources of water such as ponds and shallow borehole wells are either drying up, polluted (due to nearby latrines, waste areas, livestock); or because of competing demands (e.g. irrigation for crops) are simply becoming unreliable. In many communities, women spend hours carrying buckets of water from whatever sources remain accessible to them.

Within this challenging setting, four students from the Engineers Without Borders University of Delaware Chapter (EWB-UD) traveled to sub-Saharan Malawi in August to implement a focused groundwater exploration & development program aimed at helping to augment the availability of groundwater nearer its point of use. Accompanying them and serving as the Team's Professional Mentor was CA RICH's President, Hydrogeologist, Charles Rich, PG, CPG.

The Team completed two newly-located deep borehole wells for the rural community of Mphero (pop. 600), situated within the Sakata Region of Malawi. Mphero is in the lower Shire part of the Rift Valley situated upon a very flat alluvial plain.

To determine the ideal locations for prospective well sites, two test boreholes approximately 500m apart, were located by geophysical resistivity profiling, then drilled using the air rotary drilling method down into the top of what can be described geologically as a buried, syenitic granite

(Continued on page 3)

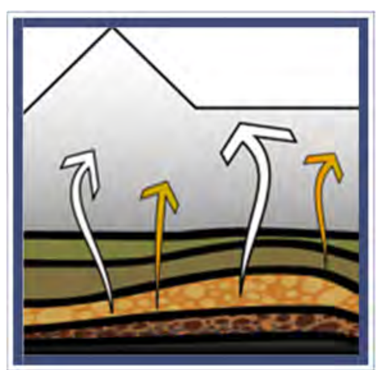
Vapor Intrusion Mitigation During Building Rehab

By Jason Cooper

CA RICH is in the process of completing the installation of a Sub-Slab Depressurization (SSD) system for a Client conducting rehabilitation/ renovation activities to improve an affordable housing apartment building located in the Brownsville section of Brooklyn.

Prior to renovations in the building, our Client was required to complete a Phase I Environmental Site Assessment (ESA) for the New York City Department of Housing Preservation and Development (NYCDHPD) and the New York City Department of Environmental Protection (NYCDEP) in accordance with the City Environmental Quality Review (CEQR).

CA RICH's Phase I ESA identified Recognized Environmental Conditions (RECs) related to the historical use of a neighboring property as a dry cleaner. Our targeted sampling in the follow-on Phase II investigation revealed persistent dry cleaning related vapors



present beneath and within the building. The concentrations of these vapors were compared to the New York State Department of Health (NYSDOH) decision matrices and were found well above applicable mitigation levels.

Based on these results, CA RICH expeditiously prepared a Remedial Action Plan (RAP) for the installation of an active SSD system and epoxy vapor barrier. The RAP was submitted to NYCHPD and NYCDEP and quickly approved.

Implementing the approved RAP began with the installation of an epoxy vapor barrier over the floor within the

(Continued on page 2)

Vapor Intrusion… Continued from page 1

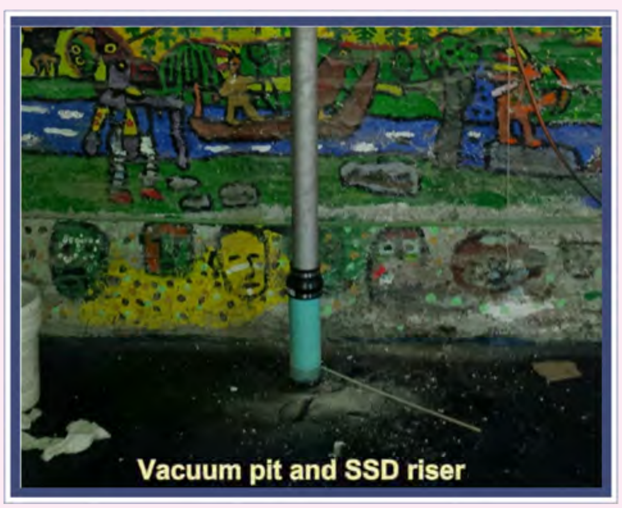
entire building basement footprint. Because this project involved retrofitting a pre-existing building, installation of a sub-slab vapor barrier was not practicable.

Prior to installation of the epoxy vapor barrier, the basement floor consisted of bare uneven concrete with areas containing old paint/epoxy on its concrete surface. As such, the floor had to be prepped to accept the application of the epoxy vapor barrier. Upon completing the required floor preparation, the epoxy vapor barrier was applied. The epoxy vapor barrier seals the pre-existing concrete floor and is capable of filling small cracks and breaks in the old floor slab. This method of resurfacing helps to prevent intrusion of sub-slab soil vapors into the building.

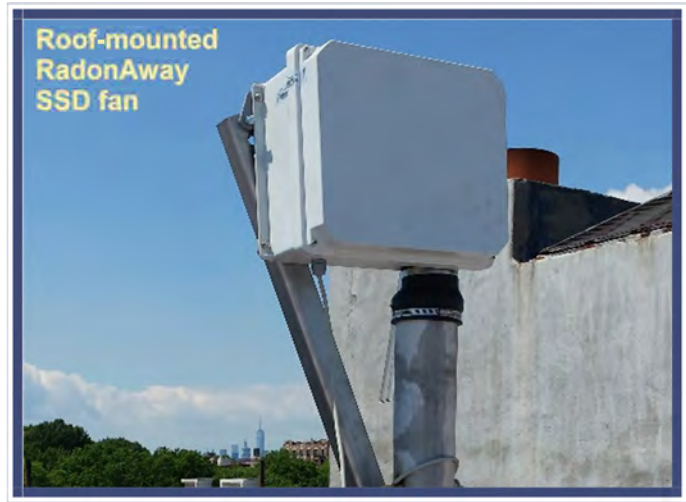
After the epoxy vapor barrier was completed, work on the SSD system was implemented. A pilot test was conducted to properly size the SSD system including determination of the proper fan size and number of vacuum pits required to gain sufficient vacuum control over the sub-surface vapors beneath the entire building (an area of approximately 80,000 square feet).

Measuring vacuum control across the building's subsurface was achieved during the pilot test via coring through the basement slab at five locations and excavating vacuum pits. Four-inch diameter perforated PVC piping was then installed at each location and sealed to the slab. A FanTech fan was used to apply vacuum to the pits and multiple vacuum readings were then taken at several locations to measure the influence of the fan-induced vacuum beneath the building slab.

Review of the pilot test data determined that an additional vacuum pit would be required to provide sufficient vacuum beneath the entire footprint of the building. Additionally, the sub-slab soils were found to be compact and silty, a condition that adversely impacts the ease of air flow through the subsurface. This condition resulted in a necessary modification in system design to substitute a RadonAway fan in place of the originally-specified FanTech fan. The RadonAway Fan was preferred as it will induce greater air flow to the vacuum pits with little increase in vacuum.



Vacuum pit and SSD riser



Roof-mounted RadonAway SSD fan

Installation of an additional vacuum pit was completed to extend vacuum beneath the entire building footprint and then the SSD system piping was installed. Because the building is six-stories in height, ladders could not be used to install the piping. In addition, due to logistical Property constraints, erecting scaffolding was estimated to take two to three weeks and was deemed impractical.

CA RICH interviewed numerous companies regarding the challenging installation of the SSD system piping and determined the most cost-effective and quickest way to install the piping would be by 'repelling' from the side of the building while anchored to the roof. This method proved to be quick and efficient as it took only three days to install all of the SSD system piping .

The SSD system is now in the final stages of completion pending installation of an electrical connection to power the two rooftop RadonAway fans. Once the fans are powered, a system startup test will be conducted to confirm site-wide vacuum and proper operation. During the test, any issues related to system operations shall be addressed. To confirm the continued effectiveness of this vapor mitigation strategy at the Property, indoor air quality samples will be collected from the basement during the heating season, as per NYSDOH requirements.

SSD systems and vapor barriers are proven to be effective mechanisms to limit sub-slab soil vapors from entering the lowest level of a building. A typical system can be expected to operate maintenance-free from 5 to 15 years.

Water… Continued from page 1

weathered bedrock basement beneath a thick, relatively dry and impermeable, unconsolidated saprolitic layer.

These boreholes were then screened & cased, developed, and pump-tested using a locally-hired driller overseen by the EWB-UD Team. Hydrogeologic conditions encountered between the two boreholes varied considerably. Total borehole depths, based upon local lithology (drill samples), were 37.1m & 40.5m. Both test sites were then field-located (surveyed) by handheld GPS. The first borehole exhibited the most promising pump test results. It was completed with a sanitary cement grout seal, a concrete well pad (requiring a minimum 72 hrs. for cement to cure), and installation of an 'Afridev' hand pump. The Afridev hand pump, approved by the Malawi government, is a robust, simple design, manual water pump that is relatively easy to repair. Finally, fresh formation groundwater samples were tested for potability using field sampling kits (bacteria, pH, TDS, chloride, nitrates, metals, etc.) to ensure the well water was safe for consumption. After subsequent sanitizing, the first finished well located in the heart of the village immediately became subject to an almost continuous daytime pumpage by appreciative Villagers.

This well is 37.1m deep and fitted with 113mm plain PVC pipe casing and slotted screen (12m with 1mm slot size). Due to limited local availability of well materials, the filter material backfilled into the well's annular space between the downhole screen & casing and the geologic formation earth materials (referred to as the gravel pack) was coarse sand obtained from Mkope in Lake Malawi (cleaned lake sediment). A clay seal was set above the filter pack and covered with cement grout. After step-testing the well, the 8 hr. constant rate aquifer pumping test, with a pre-test static depth-to-water of 5.2 m, indicated a pumping depth-to-water of 23.2 m – yielding a relatively high, safe sustained pumping rate of 35 L/minute (about 9-10 gpm).

The dimensions of the newly-constructed cement well pad closely conformed to the standard Malawian government

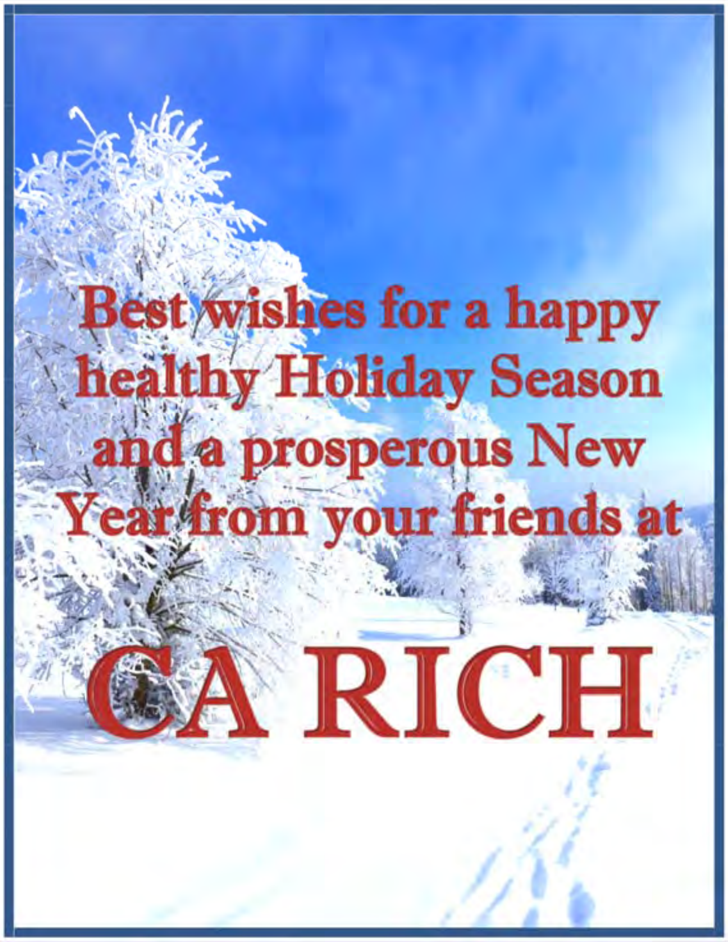
UD students oversee well drilling

EWB-UD Team, including our own Charles Rich (far right) & villagers around new well

octagonal or heptagonal shape well pad design (2m across, all side lengths 2 m). The EWB-UD Team had received design specifications for well pads from the Malawian Water Ministry during their visits to government offices on earlier 'assessment' trips.

An existing Village Water Committee and Village Implementation Committee, consisting of twelve (12) dedicated Village members, were then given 3 days of Operation & Maintenance (O&M) information and practical (hands-on) training led by a well-regarded local water expert and community organizer, relating to the Afridev pump maintenance, wear & tear, repair, and sanitation. This training was in Chichewa, with occasional translation into English for the benefit of the EWB Team. In addition, an O&M Manual was provided to the Mphero Water Committee in both Chichewa, the local language, and in English. To pay for the upkeep of the well, the water committee is collecting 200 Kwatcha monthly (Ed. Note: 1,000 Kwatcha is about $1.60) from each household within the community to maintain an 'operation and maintenance fund' established at the local Opportunity Bank branch in Zomba, the nearest town or 'population center' some 20 km by unpaved road to the west of Mphero.

The next phase of this important program will be to evaluate the success of these water wells over the coming years. In addition, EWB-UD plans to start a concurrent partnership with another nearby village in this Villages-in-Partnership (VIP) Program. To that end, while performing the recent water work for Mphero, the Team conducted initial assessments at four other nearby villages that are qualified for the EWB-UD Malawi Program: Chilimani, Liti, Kanyenda, and Nkagula - to evaluate the villages' current water supply situation and identify their individual challenges. In 2017, the EWD-UD Team will select one of these four communities, pending priorities and budgets, to initiate a new project partnership(s), hopefully with an outcome similar to the success in Mphero.



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