Green & Sustainable Remediation Analysis of a Packed Tower Air Stripper Used to Remediate Groundwater Contaminated with CVOCs

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Introduction

The Savannah River Site (SRS) located in Aiken, SC, produced materials used in the production of nuclear weapons from the 1950s to the 1980s.

Trichloroethylene (TCE) and tetrachloroethylene (PCE) were the main solvents used in degreasing and other industrial operations. These solvents are categorized as dense non-aqueous phase liquids (DNAPLs), semi-volatile, and hazardous chemical compounds.

A pilot air stripper followed by a full-scale air stripper began operations in 1983 and 1985, respectively, to remediate the contaminated soil and groundwater.

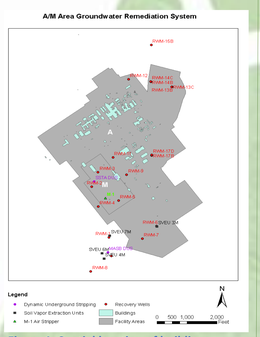

Figure 1. Spatial location of buildings, groundwater wells, soil vapor extraction units, and dynamic underground stripping wells for steam injection in A and M areas.

Problem Statement

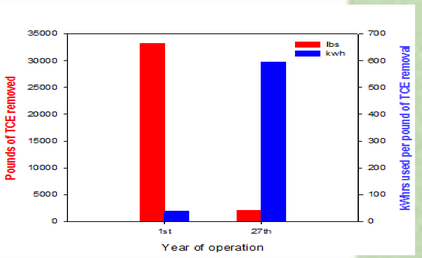

Figure 2. M-1 stripper TCE removal during 1st and 27th years of operation.

The main objective of the air stripper system is the hydraulic containment of the contaminant plume. The air stripper and well network system has operated continuously for over 30 years at an average electrical load of 150 kW and flow rate of 420 gpm, consuming 1.25 million kW-hr of electricity and pumping 2.1 billion gallons per year. The air stripper removed 33,231 pounds of TCE during its first full year of operation and removed 2,092 pounds of TCE during its 27th year of operation while consuming the same amount of electricity and removing the same amount of groundwater annually.

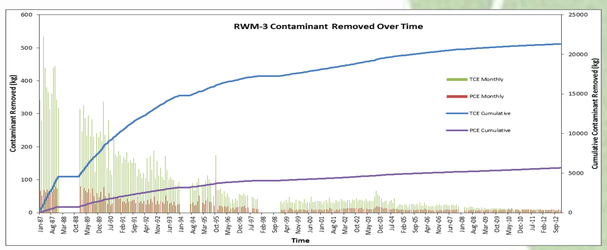

Figure 3. RWM-3 cumulative and monthly TCE and PCE mass removed.

Purpose

Green and Sustainable Remediation (GSR) involves the use of technologies, processes, protocols and other methods to mitigate the risk of contaminants reaching receptors while informing decision making with environmental, economic and community impacts. An optimized remediation system may consume less energy, pump less water, cost less and yet provide equal or greater environmental protection.

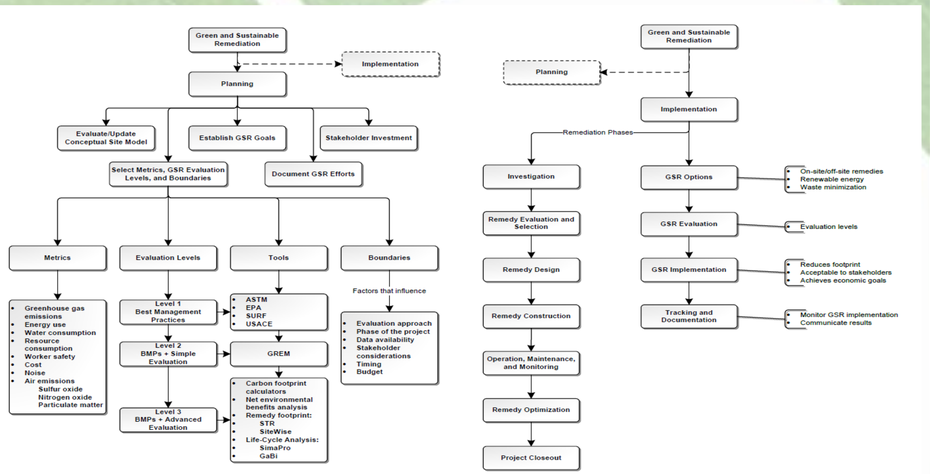

Figure 4. GSR Planning and Implementation Flowchart.

M-1 Air Stripper and Pump System

Since April 1985, contaminated groundwater in the A/M Area on the northern part of SRS has been treated with the M-Area groundwater remediation system (GRS) which consists of: a custom full-scale air stripper, an air blower with variable speed drive, a tails pump, air system instruments, a control building with associated piping instrumentation and controls and submersible groundwater pumps for each recovery well in the network.

The air stripping process is a mass transfer operation that provides contact between air and water, moving the VOCs from the water to the air.

Figure 5. Photograph of the full-scale M1 air stripper at M-Area at SRS.

Recommendations

Solar

- FIU recommends a solar photovoltaic (PV) system be installed to power the air stripper.
- Solar power is clean and sustainable.
- The cost has declined steadily in recent years making solar more cost-effective. The total electrical power generation capacity in the USA has greatly increased in the past decade.
- A solar alternative from Southern Atlantic Solar Company (see Figure 6) for $2.3M is estimated to pay itself back in 8.65 years under the worst case scenario, that none of the available solar incentive programs would be available

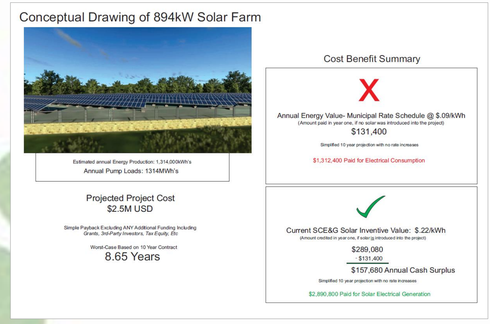

Figure 6. Analysis made by the Southern Atlantic Solar company

Blower

- FIU recommends an analysis be completed for the optimal motor speed sufficient to treat TCE and PCE at the concentrations entering the stripper to the desired 1 ppb release level. This has the potential to save a significant amount of electrical energy.
- The current blower 60 HP, 480V, 3-phase AC motor has a variable speed drive. FIU is not aware if the M1 air stripper blower motor speed has been optimized to a lower speed. A number of documents cite a 2000 cfm value for the blower motor.

Groundwater Modeling

- FIU recommends that a groundwater modeling analysis be completed to optimize the pumping rate for each recovery well and for the entire system that provides hydrologic containment in order to maximize the concentration of contaminants pumped to the stripper with possible lower total groundwater and air flow rates in the stripper.

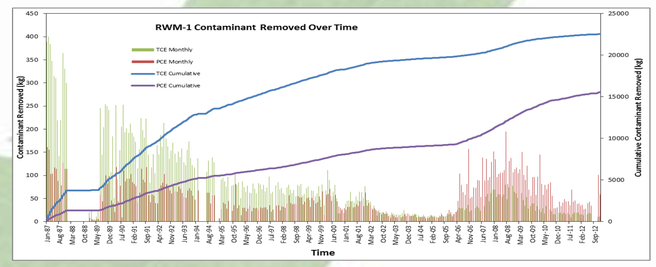

Figure 7. RWM-1 cumulative and monthly TCE and PCE mass removed.

Conclusion

Implementation of the recommendations to optimize the existing remediation system may result in decreasing the energy consumption, volume of water pumped and treated, and overall operating costs, while providing equivalent or improved environmental protection.

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