The Assessment of Infiltrated Wastewater on the Efficiency of Recovery Reuse and Irrigation Scheme: North Gaza Emergency Sewage Treatment Project as a Case Study

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Abstract : Part of Palestine, Gaza Strip (365 km2 and 1.8 million habitants) is considered a semi-arid zone relies solely on the Coastal Aquifer. The coastal aquifer is only source of water with only 5-10% suitable for human use. This barely covers the domestic and agricultural needs of Gaza Strip. Palestinian Water Authority Strategy is finding non-conventional water resource from treated wastewater to cover agricultural requirements and serve the population. A new WWTP project is to replace the old-overloaded Biet Lahia WWTP. The project consists of three parts; phase A (pressure line and infiltration basins-IBs), phase B (a new WWTP) and phase C (Recovery and Reuse Scheme–RRS– to capture the spreading plume). Currently, only phase A is functioning. Nearly 23 Mm3 of partially treated wastewater were infiltrated into the aquifer. Phase B and phase C witnessed many delays and this forced a reassessment of the RRS original design. An Environmental Management Plan was conducted from Jul 2013 to Jun 2014 on 13 existing monitoring wells surrounding the project location. This is to measure the efficiency of the SAT system and the spread of the contamination plume with relation to the efficiency of the proposed RRS. Along with the proposed location of the 27 recovery wells as part of the proposed RRS. The results of monitored wells were assessed compared with PWA baseline data. This was put into a groundwater model to simulate the plume to propose the best suitable solution to the delays. The redesign mainly manipulated the pumping rate of wells, proposed locations and functioning schedules (including wells groupings). The proposed simulations were examined using visual MODFLOW V4.2 to simulate the results. The results of monitored wells were assessed based on the location of the monitoring wells related to the proposed recovery wells locations (200m, 500m, and 750m away from the IBs). Near the 500m line (the first row of proposed recovery wells), an increase of nitrate (from 30 to 70mg/L) compare to a decrease in Chloride (1500 to below 900mg/L) was found during the monitoring period which indicated an expansion of plume to this distance. On this rate with the required time to construct the recovery scheme, keeping the original design the RRS will fail to capture the plume. Based on that many simulations were conducted leading into three main scenarios. The scenarios manipulated the starting dates, the pumping rate and the locations of recovery wells. A simulation of plume expansion and path-lines were extracted from the model monitoring how to prevent the expansion towards the nearby municipal wells. It was concluded that the location is the most important factor in determining the RRS efficiency. Scenario III was adopted and showed effective results even with a reduced pumping rates. This scenario proposed adding two additional recovery wells in a location beyond the 750m line to compensate the delays and effectively capture the plume. A continuous monitoring program for current and future monitoring wells should be in place to support the proposed scenario and ensure maximum protection.

Keywords : soil aquifer treatment, recovery reuse scheme, infiltration basins, North Gaza
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