

**A case study of urban wastewater balancing to study wastewater pollution loads
and groundwater pollution in the city of Nablus-East (Palestine) by
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ABSTRACT**

Analyzing the urban water cycle is crucial for adequate urban water management and pollution control of the natural water cycle. Nowadays, increasing concerns are raised about the contribution of untreated sewage to groundwater recharge and pollution, especially in under developed countries with poor infrastructure. In the West Bank of Palestine only 30% of the population is served with sewerage networks, mainly in the urban areas, while only 6% is served with wastewater treatment plants. This has resulted in blaming sewage for increasing nitrate concentrations in groundwater. Literature search clearly revealed that knowledge about exfiltration from sewer network is very limited; but the few available studies indicate that exfiltration pollution loads pose un-counted serious threat to groundwater. The research was carried out on Nablus-East with a population of 94,910 inhabitants as a case study to assess the pollution load of wastewater exfiltration from the sewers network and outlets.

The study area is divided into seven catchment areas based on topography. The investigations were carried out mainly on two catchments; a sub-main catchment, which is a small neighborhood, and a main catchment that represents 86% of Nablus-East. The wastewater produced from the sub-main catchment was quantified at the sewer outlet. The sub-main catchment was small enough to allow measuring rather accurately the amount of consumed water and turned over wastewater to be further generalized on the large catchment area, assuming that exfiltration from the small catchment is negligible since the sewer network is very new and of small length. For the main catchment, the wastewater flow was

measured at the outlet for four days, and the water consumed was obtained from the water meters records of Nablus Municipality. The water consumption records were provided by the municipality as ArcMap software shapefiles for the seven catchments. Wastewater samples were collected from the main and sub-main catchments' outlets. Water and nitrogen mass balances were carried out on the both main and sub-main catchment areas.

The water mass balance revealed that 82.2% of the consumed water ends up in the sewer network, while 17.8% is used outdoor. The exfiltration wastewater from the sewer network represent 12.8% of the consumed water, while 65.2% drains to wadi Al-Sajor through the outlets, and 4.2% ends up in cesspits. As an exfiltration rate, the daily exfiltration per kilometer is $0.02 \text{ m}^3/\text{day}$ for the average of 25cm diameter.

The specific pollution loads exfiltrated from the sewer part of Nablus-East were 2.4(g N/c.d), 0.25 (g TP/c.d), 23.5(g CODt/c.d) and 13 (g BOD/c.d). The total nitrogen load of the produced wastewater from Nablus-East is 1.88 (kg N/ha*day), out of which 1.49 (kg N/ha*day) reaches the outlets as a major point source pollution. The remaining 0.39 (kg N/ha*day) routes into exfiltration from sewer network of 0.29 (kg N/ha*day) and in cesspits is 0.10 (kg N/ha*day). The calculated annual urban nitrogen loading of Nablus-East wastewater is 688 (kg N/ha*yr), which is very high as compared with figures reported in literature for urban areas in Europe and Africa, due to high population density in Nablus East.

Therefore, in order to abate the pollution loads fluxes from Nablus East municipal wastewater, a treatment plant should be constructed as a first priority. Companying efforts should also be given to sewers network upgrade and rehabilitation to protect groundwater quality.