Egyptian Journal of Aquatic Research (2016) 42, 33–39

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National Institute of Oceanography and Fisheries

Egyptian Journal of Aquatic Research

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FULL LENGTH ARTICLE

# Application of electrical resistivity prospecting in waste water management: A case study (Kharga Oasis, Egypt)

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Received 3 November 2015; revised 13 January 2016; accepted 13 January 2016
Available online 9 February 2016

**KEYWORDS**

Kharga Oasis;
Groundwater;
VES;
Aquifer

**Abstract** Electrical resistivity technique has been used to detect the subsurface stratigraphy and structures around Kharga Oasis, Egypt. 1D inversion approaches have been applied to interpret the electrical data obtained along 10 vertical electrical soundings (VES) using electrode spacing from 3 to 400 m.

A preliminary quantitative interpretation of the vertical electrical sounding curves was achieved firstly using two-layer standard curves and generalized Cagniard graphs. The manual models were used as initials to prepare the final model using the algorithm IPI2Win program. Model results were used to construct a geoelectrical section.

Three geoelectric units were identified: the superficial geoelectrical layer is composed mainly of sand and gravel with relatively high resistivity values (8–372 ohm m) and low thicknesses (0.523–4.92 m). The age of this layer is from late Pleistocene to Holocene (Quaternary deposits).

The second geoelectrical layer is composed of shale (Dakhla Shale). It is characterized by relatively very low electrical resistivity values (0.3–4.92 ohm m). The maximum depth to this layer ranges from 13.8 to 45.7 m.

The third layer represents the first Nubian Sandstone aquifer with moderate electrical resistivity values (23.9–233 ohm m) detected at the maximum depth of penetration, a great contrast for values according to the lithological content.


## Introduction

Kharga Oasis (Fig. 1) is one of the oases in the New Valley Governorate. Economically, it depends mainly on agricultural activities which yield large amounts of the agricultural drainage and wastewater. Such water is collected through drainage canals in the vacant and uncultivated lands, forming wastewater pond. The occurrence of most of those ponds poses a risk

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Peer review under responsibility of National Institute of Oceanography and Fisheries.

http://dx.doi.org/10.1016/j.ejar.2016.01.001
1687-4285 

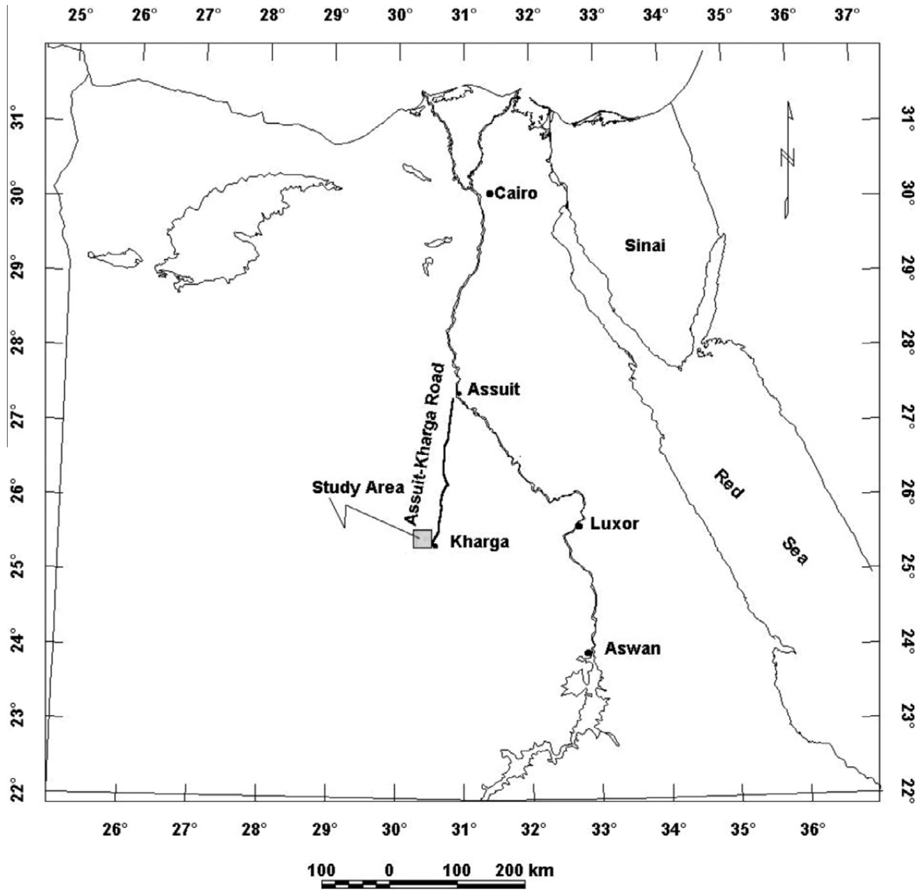


**Figure 1** Location map showing Kharga Oasis.

of collapse of the wall of the surrounding area and a risk of flooding the neighboring cultivated lands. So, that pond represents a serious threat to the population of that oasis.

Electrical resistivity investigation is a powerful tool for exploring the subsurface geology and collecting more information about the subsurface layers and structures (Mohamaden et al., 2009; El-Sayed, 2010). The target of the present study was to conduct an electrical resistivity investigation at the land areas surrounding ponds in order to determine the vertical and horizontal distributions of the subsurface layers. The results will throw light on the impact of the collected water for irrigation on the community and shallower ground water aquifers.

The leakage of water into the underground aquifer represents a serious threat to the population in this region, especially because they are totally dependent on groundwater. The presence of an impermeable layer such as shale and clays prevents the leakage of wastewater into the underground fresh water aquifer. Therefore, the shallow subsurface layers were studied to determine the shale distribution and the possibility of leakage through the different areas around the ponds and to determine the suitable areas for further activities using wastewater.

The area under investigation is located between latitude 25.367236 and 25.435271 N and Longitude 30.525545 and 30.624352 E (Fig. 2).

In this study, the geoelectrical resistivity method was used for shallow subsurface investigation to determine the distribution and thickness of the shale layer.

Many authors such as Koefoed (1965a, 1965b, 1965c), Gosh (1971), Zohdy (1975, 1989), Santos et al. (2006), El-Galladi et al. (2007), Sultan et al. (2004, 2009a, 2009b, 2009c, 2009d, 2009e), Sultan and Santos (2008a, 2008b, 2009), Mohamaden and Mahmoud (2001), Mohamaden (2005, 2008), Mesbah (2003), Mousa (2003), Ibrahim et al. (2004), Hosny et al. (2005), Nigm et al. (2008), Mohamaden and Abu Shagar (2008), Abbas and Sultan (2008) and Mohamaden et al. (2009). Hemeker (1984) studied the quantitative interpretation of the geoelectric resistivity measurements. The interpretation of the apparent electrical resistivity data was achieved using two methods, the first is based on the curve matching technique using the Generalized Cagniard Graph method constructed by Koefoed (1965), the output results are treated according to the inverse problem method using computer program (IPI2Win). Then results were represented as geoelectrical section.

The electrical resistivity survey consists of a transmitter, receiver, power supply, stainless steel electrodes, and shielded cables. In the present study, IRIS SYSCAL-PRO instrument was used which computes and displays apparent resistivity for many electrode configurations.

The geoelectrical configuration used in the study was Schlumberger collinear four symmetrical electrodes configuration, the current electrode separation being from 3 to 400 m.

The result of the geoelectrical survey was processed and quantitatively interpreted using available geological information