Hydrogeological Study - Executive summary

Nestle requested from Fugro Consult GmbH (FCG). to assess the sustainability of the water resources in the aquifers that Nestle exploits, in the light of the local and regional hydrogeological conditions, the legislative framework and the socio-economic environment and its expected development.
This assessment has been done in the form of 3-phased study: First all readily available information was analyzed in a Desk Top Study, subsequently additional information was gathered during a field work campaign and finally all information was integrated and analyzed to come to the assessment which is presented in this report.
The Karachi Port Qasim Area is challenging in the light of water supply. The climate and the huge population of greater Karachi put a high strain on the water resources. Most water supplied/used is surface water from the Indus and the Hub Dam. Groundwater is used, illegally or not, by private households, farmers and mafia-like structures reselling water. Bigger industries also rely on their own tubewells, basically because they cannot afford to rely on the poor quality of water supply infrastructure. Surface water quality is very poor due to pollution and lack of treatment capacity and infrastructure. Shallow groundwater is very saline and not usable for domestic (drinking) water supply. The salinity seems to decrease with depth according to the previous hydrgeological studies done for the Nestle Water Factory and also according to measurements at the PQF wells and water analyses at different depths at the Quality Golf premises (20 km to the north east of the PQF). It is assumed that groundwater recharge occurs from the north. This is supported by the geological profiles of the Geological map of Sindh as discussed in section 11.2. It can unfortunately not be supported by reliable water level measurements, because these are not available. This has turned out to be one of the greatest problems during this investigation: the lack of reliable data, due to the non-existence of institutionalized or private groundwater quantity and quality monitoring programs.
The groundwater recharge from the north, in this report estimated with a water budget model, is expected to be insufficient to cover the current and projected groundwater use. The in this report estimated groundwater abstraction in the surroundings of the PQF is most likely only a fraction of the total amount of water abstracted from the water balance area, but approximately equals the groundwater recharge from this area.
As was mentioned in the DTS more detailed information on the hydrogeology is needed, particularly about the existence of different aquifers with a wider spatial distribution. From the gathered information during the field work (interviews and reports) it becomes clear that it is not likely that distinctive separate aquifers exist in the area of the PQF. Apparently a spatially inhomogeneous interlayering up to a large depth of sand, clay, silt- and sand and limestone characterizes the local hydrogeological situation. The pump tests, particularly those at the new deep DW11 (section 12.1.5) support this interpretation.
The deep groundwater (at the site of PQF) is of the Chloride type. Concentrations decrease with depth, but seem to show an increasing trend during the long pumping test at the DW11 (12.2.3.3).
The dynamic water level at the PQF is currently in the wells at the PQF at 60 meter below sea level, which means that eventually sea water will reach the wells, because the recharge with relatively fresh water from the north is expected not to be capable to compensate the current abstractions. In the light of the planned developments in the Port Qasim Area the groundwater abstraction will only increase.
The deeper groundwater may be longer protected from organic pollution (human waste) and heavy

metals, but eventually this pollution will reach the deeper regions of the aquifer system. An influx from salt seawater will not guarantee that no pollution will enter the deep wells.
It is expected that the mineralization of the deeper groundwater will increase in time through the intrusion of sea water, because of the negative hydraulic pressure gradient land inwards and mixture of water over the whole thickness of the inhomogeneous but unified aquifer system. Their level of mineralization will eventually reach the level of mineralization of the shallower wells (DW 3 and DW 4). This process will be accelerated by increasing abstraction of groundwater through projected industrial development. This implicates that the drilling of deep wells is on the long term no guarantee for the abstraction of relatively fresh water and is therefore not recommended.

This scenario can be potentially slowed down by an improvement of the municipal surface water supply from the Indus River and the Hub Dam, which will decrease the incentive to drill (illegal) private wells and the abstraction rate of the groundwater decreases.
Continuation of the quarterly monitoring of the groundwater quality of the pumping wells at PQF and Tri-Pack is recommended, in order to monitor the development of mineralization, as well as potential trends of changes in chemical composition of the groundwater. The latter can be achieved by plotting the data in Piper diagrams.
Installation of observation wells at PQF and Tri-pack is recommended, at different depths, and preferably on also on other locations in the PQ area in order to obtain accurate data on the vertical and lateral hydraulic pressure distribution.. This could potentially be the start of a regional groundwater monitoring network, possibly in corporation and with support of WAPDA or PCRWR.
The execution of pump tests with the use of observation wells is strongly recommended. This will provide information on the nature (confined, unconfined) of the (sub-) aquifer(s) and their hydraulic parameters (storativities, transmissivities).