



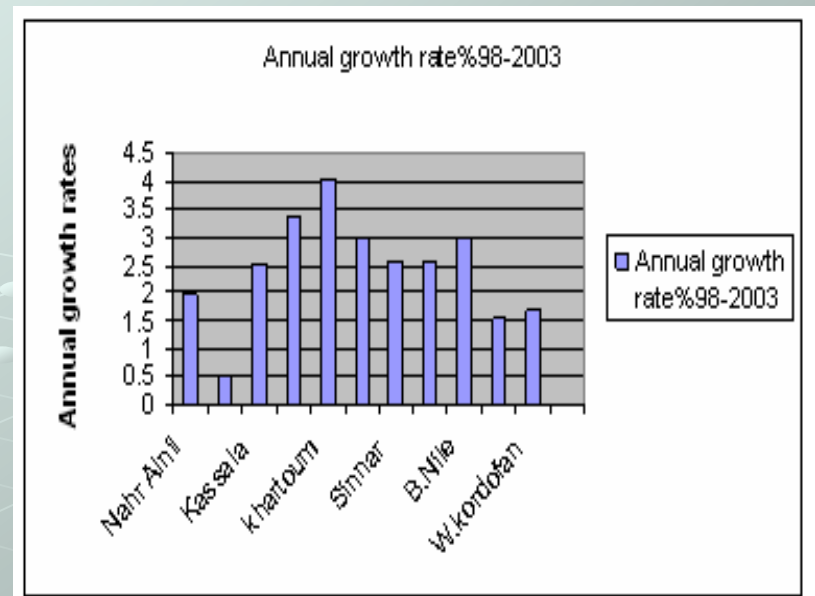
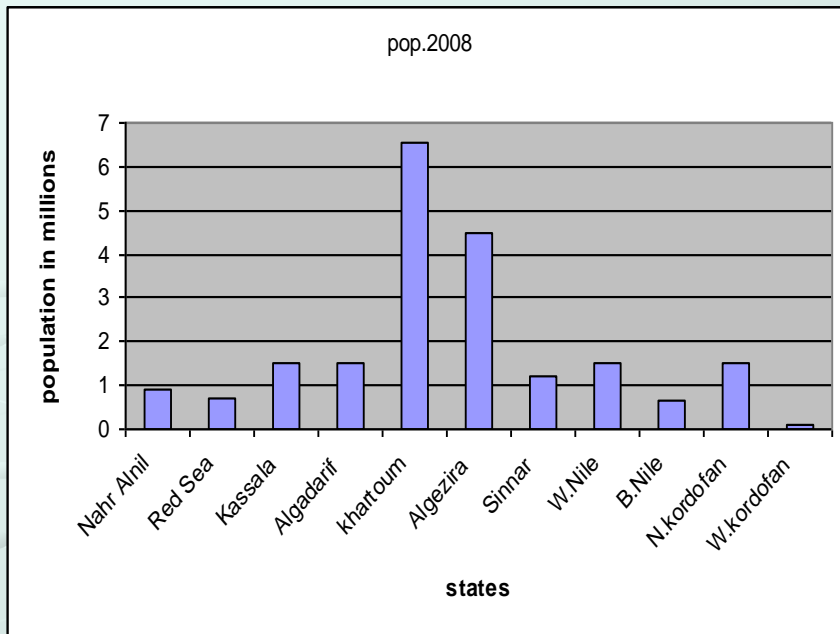
***GROUNDWATER QUALITY EVALUATION AT
URBAN KHARTOUM STATE***

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White Nile

Blue Nile



According to (SHHS projections 2008) 5% of the urban population lives in first class areas, 10% in second class and 85% in third class areas.

The Year 2008 Population for Some States of The Sudan (The United Nations Population Fund, and The Central Bureau of Statistics Khartoum office, April 2008).

Some States of the Sudan Population Annual Growth Rates Showing the Most Populated States in the Sudan, Source Central Bureau of Statistics.

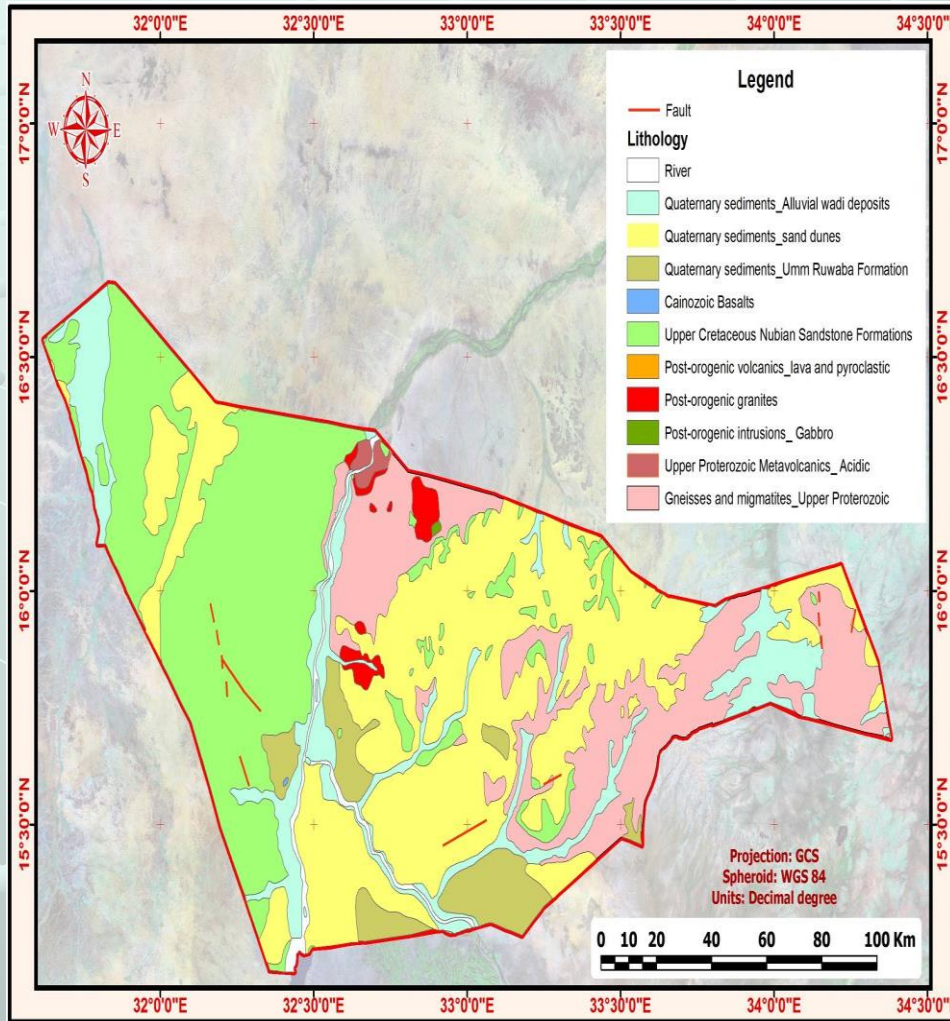
Conjunctive Water Supply:-

In the State of Khartoum, the demand for water is met with from two main sources:-

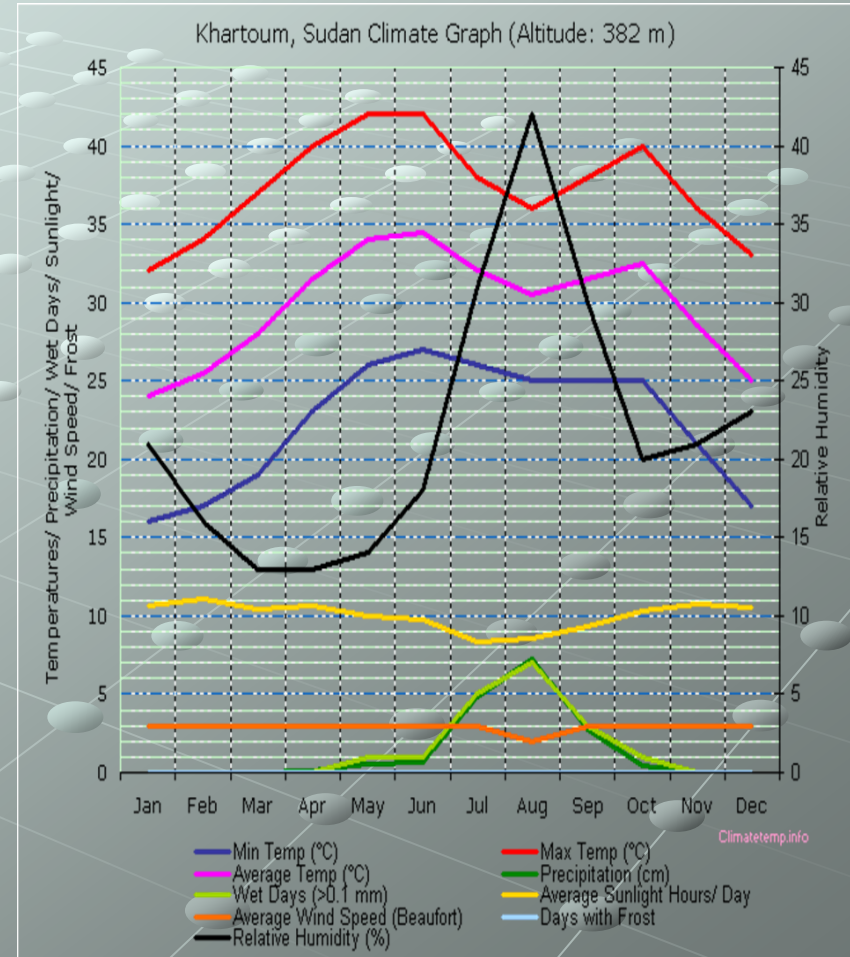
- **Surface water, there are seven waterworks, 5 treatment plants in Khartoum, 4 treatment plants in Khartoum North, 4 treatment plants in Omdurman.**
- **Ground water, there are more than 10,000 boreholes distributed all over the state.**

The third phase of the Mogran waterworks as well as the completion of the Souba waterworks has provided additional thousands of cubic meters per day.

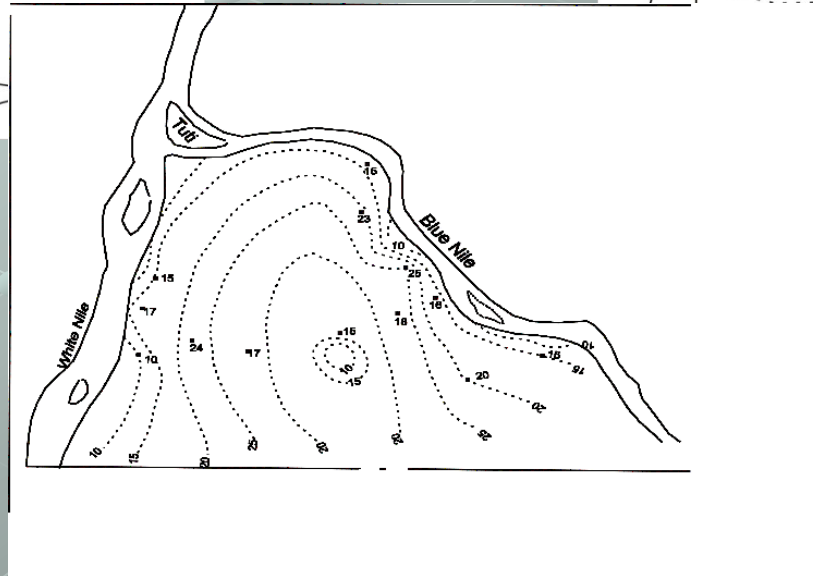
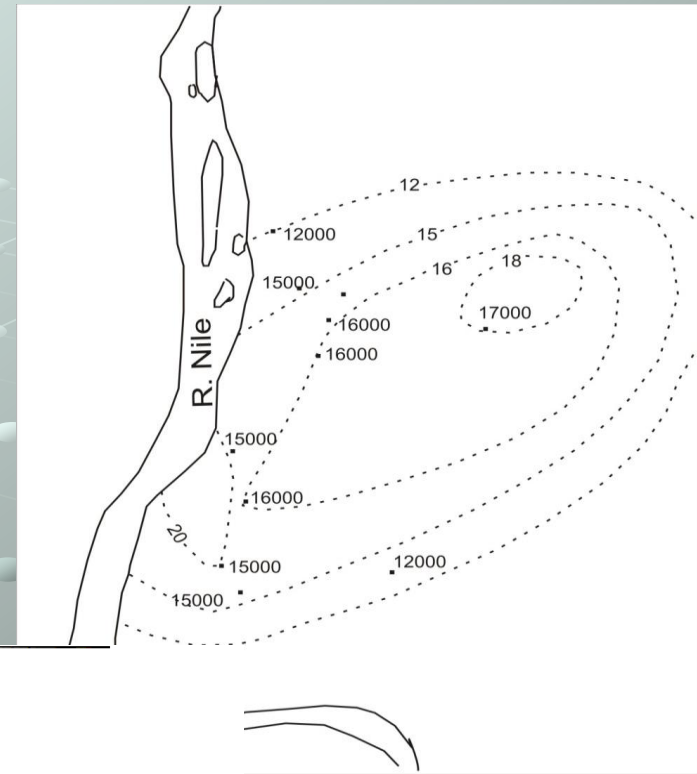
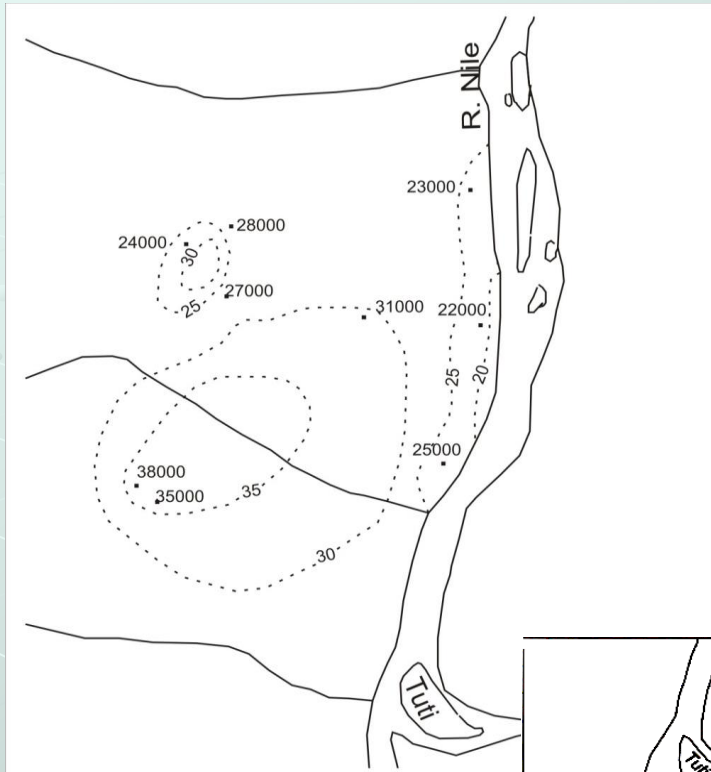
The Geologic map of Khartoum state



The State of Khartoum Climate Graph Showing Temperature, Precipitation, Wind Speed, Humidity and Average Sunlight Hours



The Hydraulic Conductivity Values of Khartoum



River Nile Water Quality

The collected samples from the Niles at many sites in Khartoum indicate that :-

- The Nile water is generally alkaline with electrical conductivity ranging between 80umho/cm to 240umho/cm, a relatively low conductivity that increases during the flood season.
- The Nile water is neutral to slightly alkaline in nature (PH 7- 8.3).
- The total hardness ranges from 40 to 90 milligrams per liter for the main Nile. The low salt content makes the Nile water excellent for irrigation purposes as it helps in avoiding the salinization problems in irrigated soils.
- The calcium magnesium contents are usually higher than the sodium potassium ratios. Sulphates are of trace values to zero; chlorides are also found in small ratios mostly of meteoric origin.
- Nitrates are of low content in the White Nile raw water, except at some areas. In the Blue Nile water, nitrates are encountered in many areas, which could be attributed to farming activities and breeding spots adjacent to the Blue Nile River banks.
- The Nile water chemistry records shows no significant changes from the year 1945 to the year 2015.

Groundwater types of Khartoum

- The first water type represents wells located near the White Nile, where this type was detected in wells of Alkalakla, AbuAdam and Lamab.

Na/K>Mg/Ca

HCO₃/Cl>SO₄/Cl

The second water type is present in the supply wells of Azhari, Inqaz, Eid Hussein and Abu Adam wells. These wells occur in the area between the two Niles, away from River Nile Banks.

Na/K>Mg/Ca

SO₄/Cl>HCO₃/Cl

The third water type represents the wells near the Blue Nile, and occurs in the supply wells of Erkoelit, Alriyad, Algeraif and Almamoura wells.

Ca/Mg>Na/K

HCO₃/Cl>SO₄/Cl

The TDS values of Eid Hussein and Al Azhari areas have high TDS values (300ppm and 350ppm), whereas areas such as Imtidad Nassir and Al Mamoura have low values of (100ppm and 125pp). This could be explained by their proximity to the Blue Nile side and its continuous recharge of water.

Water types and the Hydro-chemical Processes in Khartoum State:-

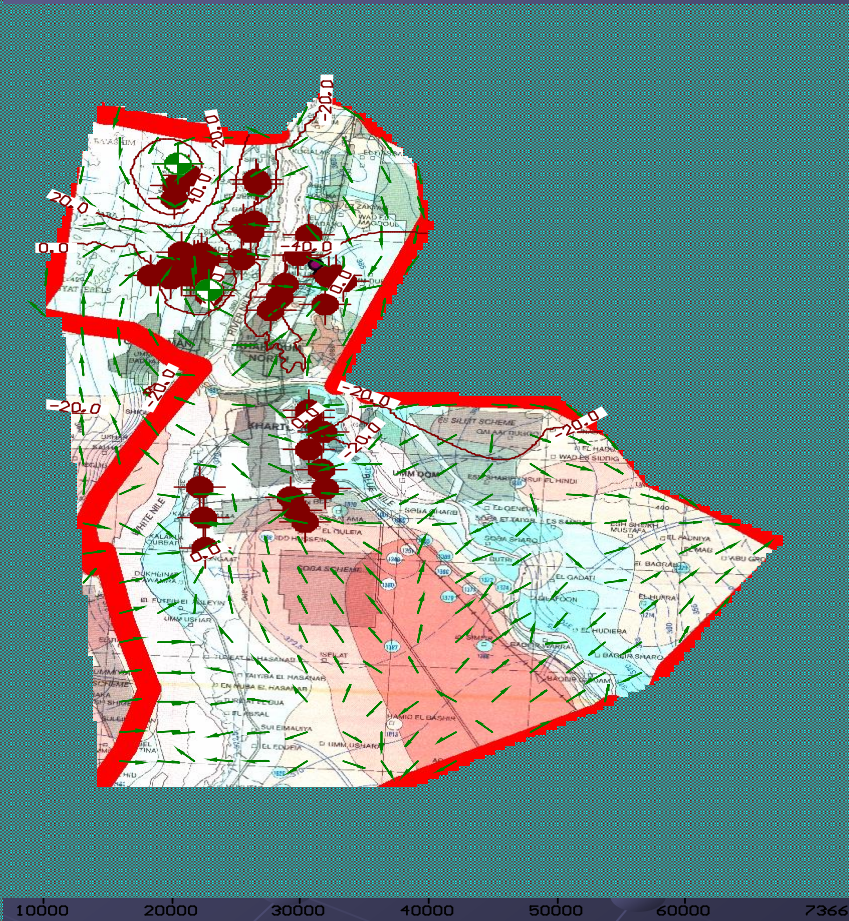
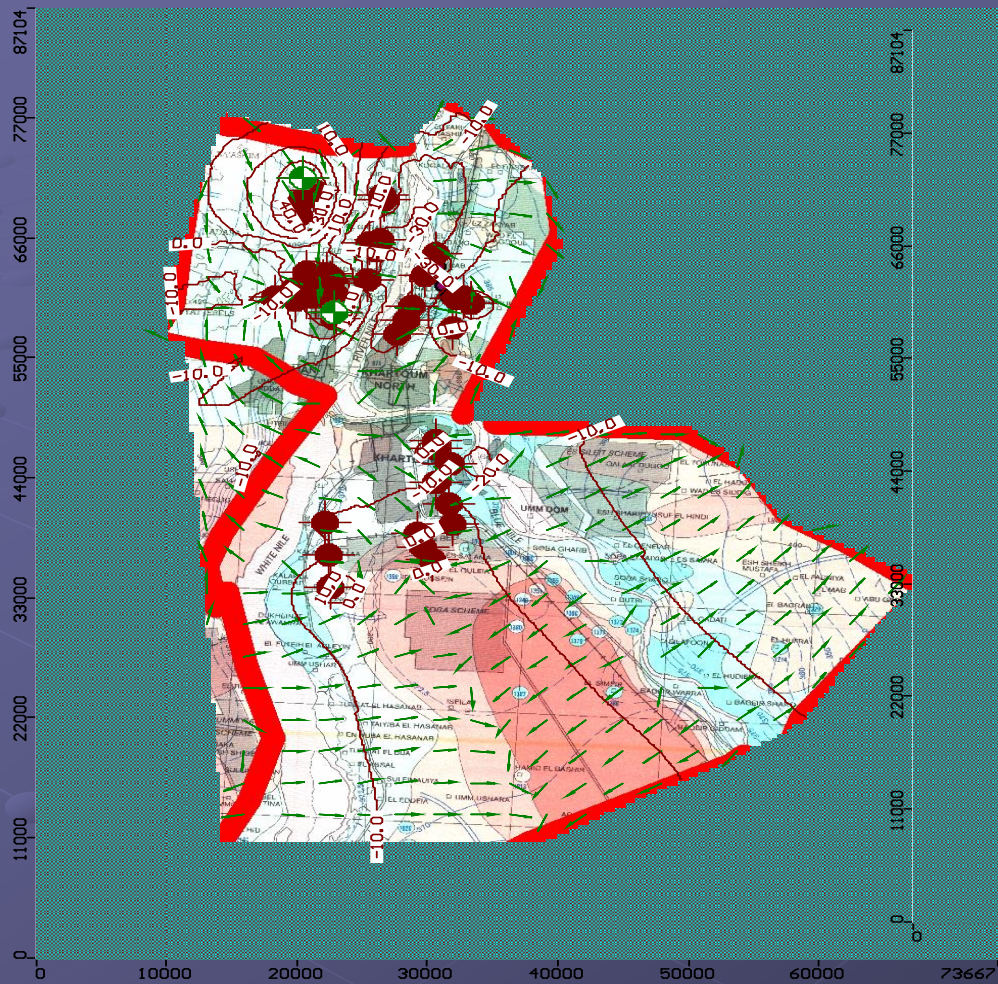
- The hydro chemical processes of groundwater in the upper Nubian aquifer are mainly dissolution of carbonates, sulphates and chlorides.
- Sulphates and chlorides dissolution are locally related to the presence of the salt pockets- Idd Hussein- that created salty water pockets at that area.
- The main water types which result from the prevailing mentioned processes are

Khartoum between two Niles	Omdurman	Bahri
CaHCo ₃ , MgHCo ₃ water type near the Blue Nile	CaHCo ₃ , MgHCo ₃ water type	CaHCo ₃ , MgHCo ₃
CaCl, CaSo ₄ water type	CaS ₄ , Ca Cl	
NaHCo ₃ water type near the White Nile	NaHCo ₃ water type	

Basic simplifying assumptions in modelling:-

- The impermeable boundaries of the side and bottom of the modeled flow region .
- Well lumping.
- Net work of canals and drains of surface water is placed in the model by a simplified rectangular net work.
- The aquifer used in the model of the 3 locations in Khartoum state, is unconfined homogenous, isotropic and single layered.
- The rainfall recharge of the aquifer is uniformly distributed throughout the whole of the study area during the months of August, September and October and equal to 10% of the average annual rainfall.
- Observation wells, piezometers, used are 3 in Omdurman, 3 in Khartoum and 2 in Bahri.

The Flow pattern , second stress period 6 years time



The results were as follows:-

- 1-The stoppage of few wells did not change the discrepancy value, have no significance.
- 2-Stopage of 20 working wells showed very high discrepancy value and deficit in the water balance.
- 3-The pumping of wells increases the river leakage towards aquifers to recharge them, but without over drafting.
- 4-The stop of pumping reduces the river leakage towards aquifers to recharge them. With continuous abstraction at low levels, water levels go down, which causes depletion of the water due to weak river leakage.
- 5- Wells are to be pumped at the abstractions showed in the model as maximum limit to ensure the recharge of aquifer.
- 6-Wells are to be put out of work according to a working plan to avoid drop of the water levels.



Thank you