An update of the current Qualitative Status of Groundwater

Manuel Sapiano

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A Water Policy for the Future

Baseline Quality

Source	Nitrate content (mg/L)	Chloride content (mg/L)
The meeting point of the springs from Bingemma where they enter the Wignacourt Aqueduct near Casal Attard.	8	133
The Distribution tank at Porta Reale.	7	125
The distribution tank of the Fawwara Aqueduct at Zejtun Gate.	7	128
The well at Marsa, in the farm of Armier.	14	341
The aqueduct at Rabat, Gozo.	6	285

Analyses on Groundwater Samples performed at the War Department at Woolwich (UK) in 1865.

Major Quality Indicators

Key indicators for groundwater quality include nitrate, pesticides, chloride, pH and electrical conductivity levels as well as microbiological content.

EU Directives define Quality Standards for Nitrate and total pesticide levels in groundwater as 50mg/l and 0.5µg/l respectively.

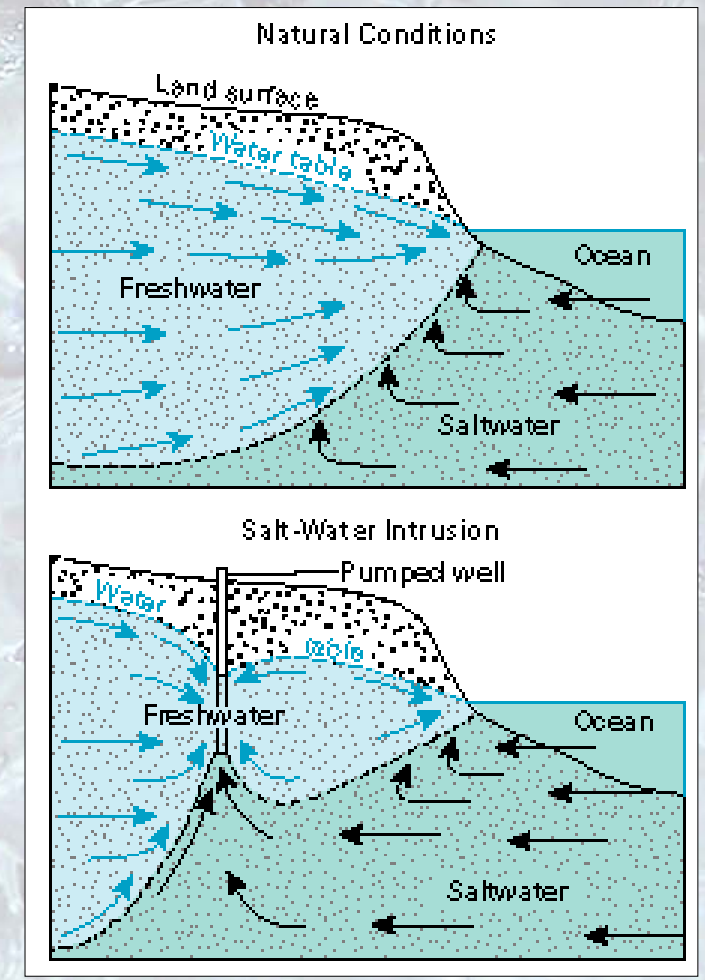
A full chemical analysis of the major groundwater sources performed by WSC in 2000 did not reveal any evidence of pesticide content in groundwater.

Contaminants have been found in many sources of previously clean water and, while the situation varies from one site to another it is clear that the overall quality situation in Malta has deteriorated in recent years.

Chloride Contamination

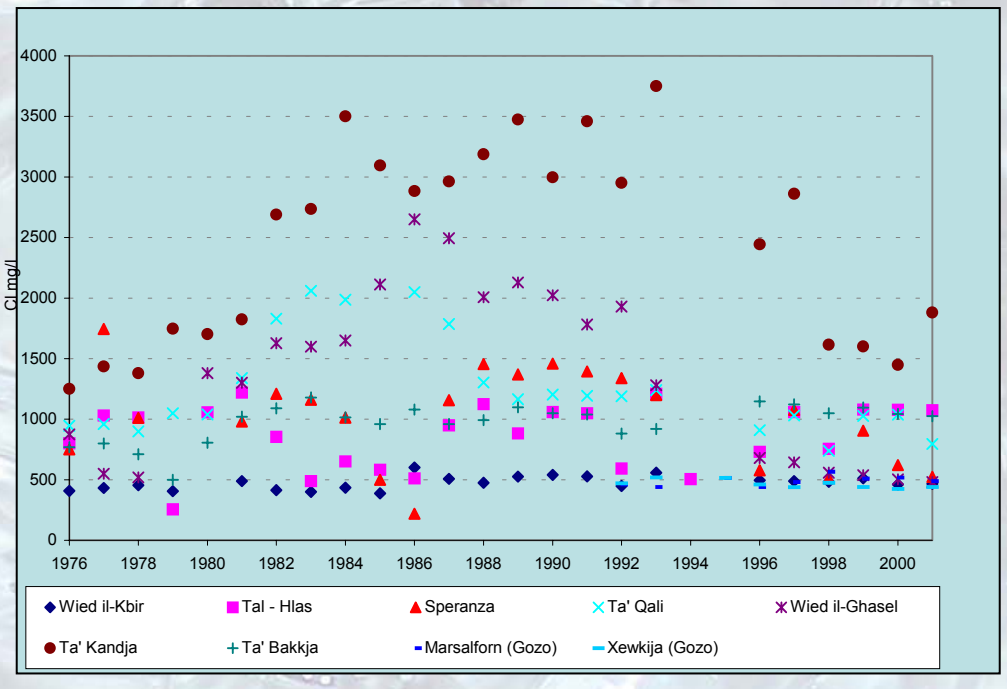
Fresh groundwater lenses such as the sea level aquifers in the Maltese Islands are subject to vertical saltwater intrusion (upconing) during well pumping.

The perched aquifers due to their location are relatively protected from chloride contamination. However irrigation with saline water could irreversibly damage these aquifers.



Chloride Contamination

Groundwater abstracted from the MSLA has high levels of chloride concentrations as a result of over-abstraction and seawater intrusion. Chloride levels in pumping stations range between 500 mg/l to 2000 mg/l in 2001.

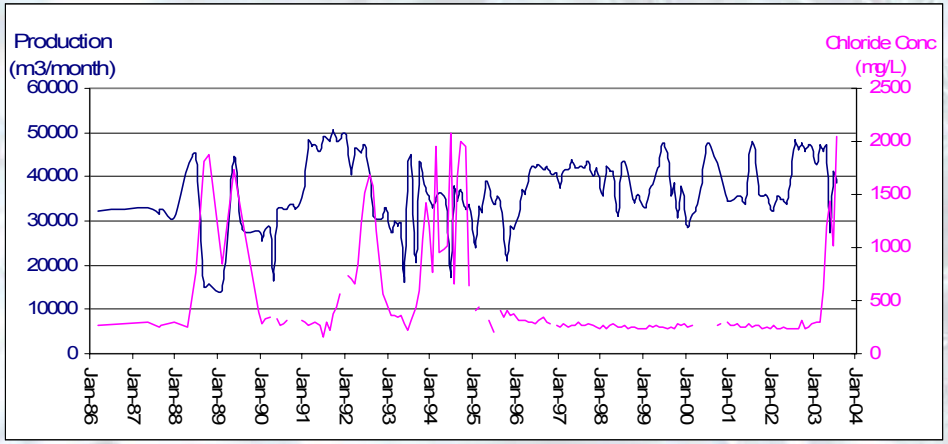


Chloride levels in perched aquifer pumping stations generally range between 150-200 mg/l. Higher values obtained in Bingemma and Mizieb pumping stations are attributed to periods of increased abstraction and influenced by seawater intrusion since top layer of clay lies below sea level.

Case Study – Sea-Water Intrusion

Sea-Water Intrusion in the Mizieb Aquifer (June 2003)

Increased pumping of groundwater by the WSC as well as the private sector (mainly agricultural activities) in the Mizieb Aquifer has led to the intrusion of sea-water with chloride levels reaching the 2000mg/L mark.



Over-exploitation of this aquifer has had the effect of making it more prone to salinisation.

Nitrate Contamination

The background Nitrate levels in the aquifers are expected to be low, since naturally occurring nitrate would only be produced as a by-product of the decomposition of naturally occurring organic matter. Natural levels of Nitrate in groundwater are generally found to be lower than 10mg/L. High Nitrate levels in groundwater can thus be attributed to anthropogenic activities.

The main 'nitrate' polluting activities are:

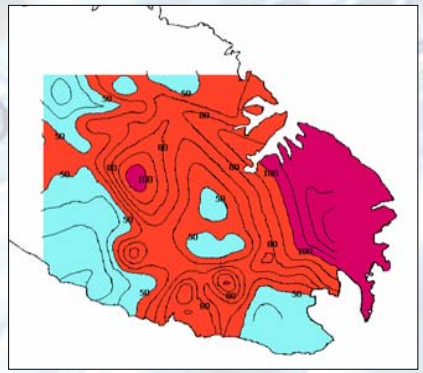
- **manure and artificial fertilizer use in agriculture,**
- **animal husbandry activities,**
- **leakages in the public sewer.**

Sea Level Aquifers

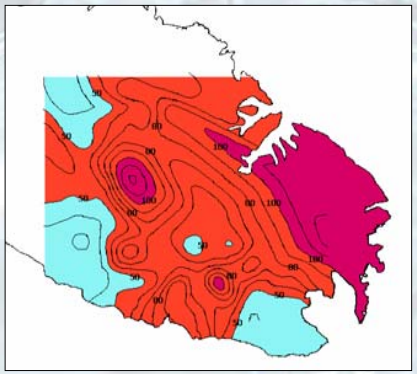
The WSC performs chemical analysis for a set of parameters including Nitrate content on all production sources on a monthly basis.

Linear projections were made for the state of the aquifer assuming the 'do nothing' scenario.

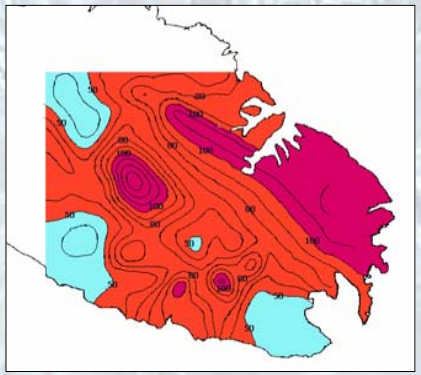
The study showed that most of the aquifer has a nitrate content in excess of 50mg/L; with some regions having a content in excess of 100mg/L. The trends indicate a sustained increase in the nitrate content of the aquifer.



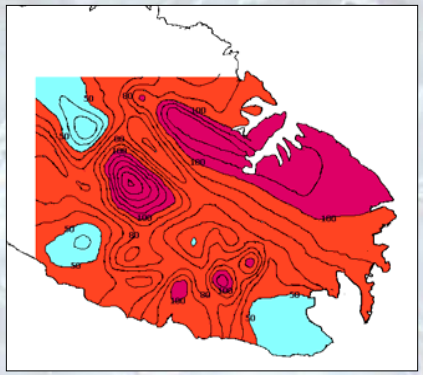
1995



2000

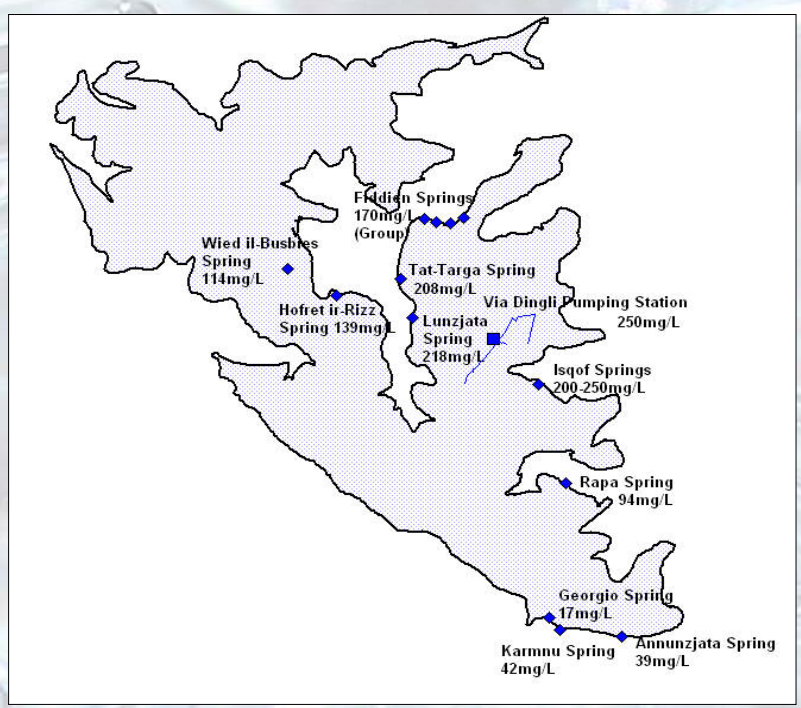


2005
(projected)



2010
(projected)

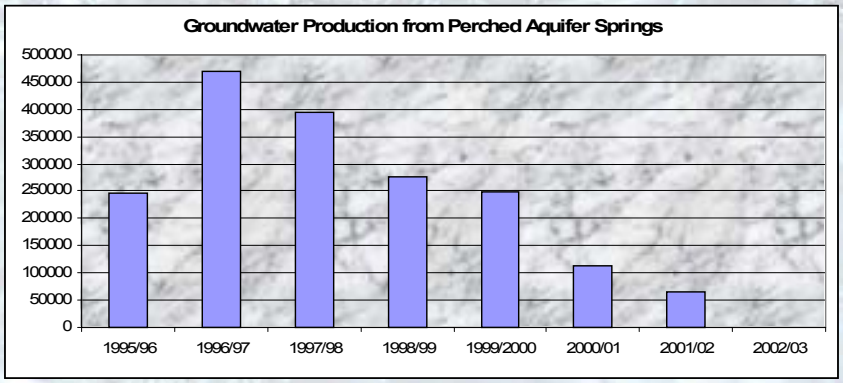
Perched Aquifers



Most of the sources in the perched aquifers contain high nitrate levels in excess of 200mg/L.

The springs of the Rabat-Dingli, Mgarr and Mellieha perched aquifers have been discontinued from the public supply.

WSC had to replace this groundwater which amounted to an annual volume of around 500,000m^3 with RO water; obviously at a higher cost.



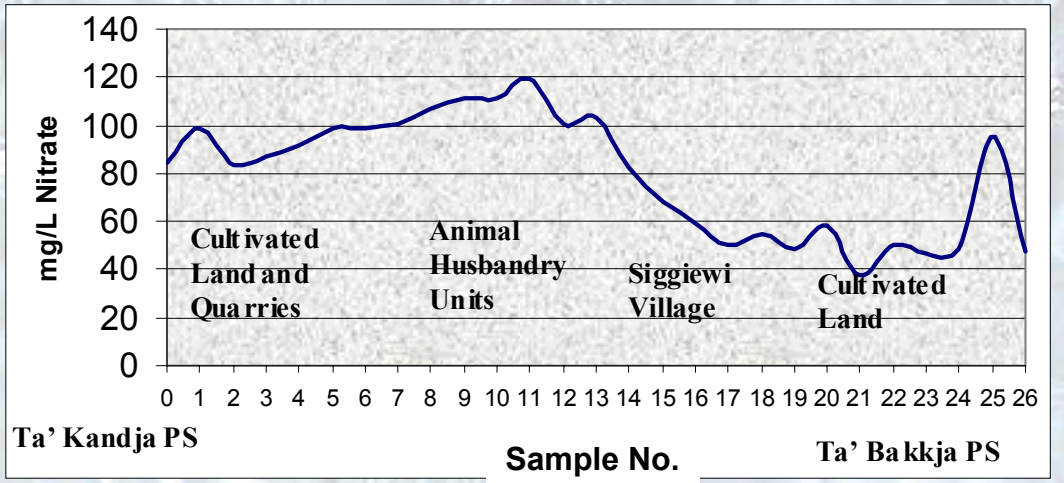
Case Study – Nitrate Profile

Horizontal Nitrate Profile
along the gallery linking Ta' Kandja and Ta' Bakkja Pumping Stations

Groundwater samples were collected from points at 100m stretches along the gallery and analyzed for their Nitrate content.

The highest nitrate concentration (120mg/L) was obtained beneath the central parts of the gallery, which has overlying animal husbandry units. Lower values were obtained beneath both the urban and agricultural areas.

Nitrate values in the area around Ta' Kandja PS are significantly higher than those around Ta' Bakkja PS; but the area around Ta' Kandja is highly quarried and so is expected to have lower attenuation and percolation times.



Alternative Sources - TSE

Currently there is a single sewerage treatment plant at Sant' Antnin which currently produces an average 10,000m^3/day of treated effluent.

The electrical conductivity of the effluent produced ranges between 7,000 and 15,000µS/cm; rendering the effluent almost unusable for agriculture.

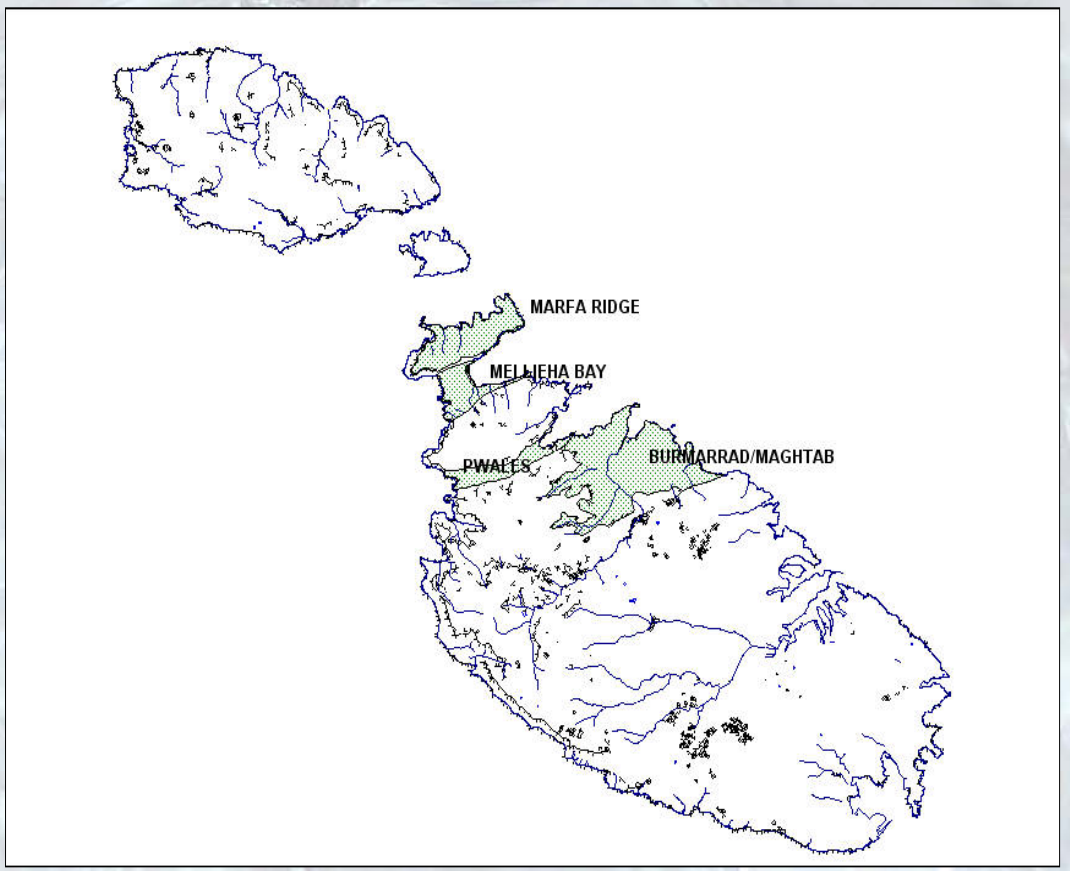
These high conductivity values arise due to the use of sewage from the 'Marsa Sea' network which is prone to saline intrusion as well as the dumping of saline water (such as the reject from small private RO Plants) into the sewers.

Possible uses of TSE

Treated sewage effluent could be used in regions which are detached from the main potable-water abstraction regions of the mean sea level aquifer.

TSE can thus be applied for irrigation and the gradual re-enstatement of severely depleted aquifers.

These possible uses of TSE however greatly depend on the cost and quality of the effluent produced.



EU Directives - WFD

The Water Framework Directive aims to ensure the progressive reduction of pollution of groundwater and prevents its further pollution

Thus under Article 4 the Directive sets the following Environmental Objectives

- **Member States shall implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater…..**
- **Member States shall implement the measures necessary to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater.**

EU Directives - GWD

The purpose of the Groundwater Directive is to prevent the pollution of groundwater by substances defined in Lists I and II of the same Directive.

A new Directive has been proposed which aims to prevent and control the pollution of Groundwater by:
"Implementing measures for groundwater protection, enhancement and restoration with the aim of achieving good groundwater status by the end of 2015, in accordance with Article 4 of the WFD, while ensuring a continuity in the protection regime of the Directive 80/68/EEC after its repeal."

This Directive will establish specific requirements regarding the management of diffuse and point sources of pollution, including a groundwater protection regime and management of historical point sources.

EU Directives – Nitrates Directive

This Directive has the objective of:

- **reducing water pollution caused or induced by nitrates from agricultural sources and**
- **preventing further such pollution.**

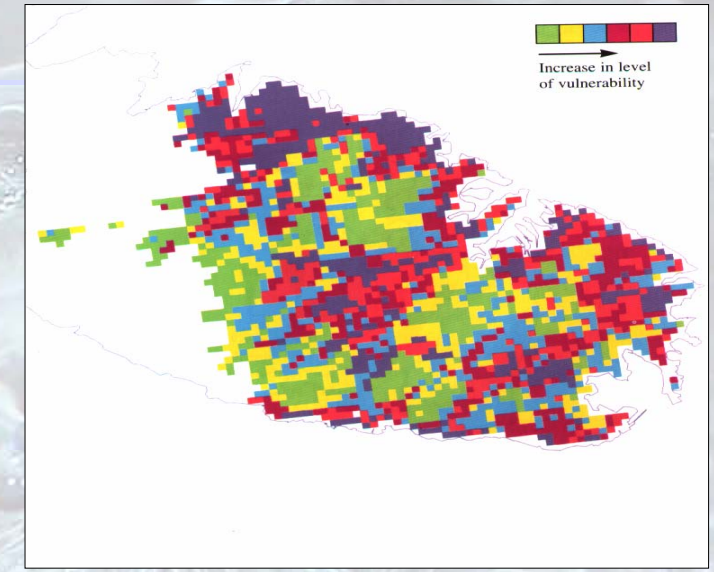
The Directive thus concerns the identification of '*waters affected by pollution and waters which could be affected by pollution*'. For the purpose of this Directive, this implies all '*groundwater which contains more than 50mg/L nitrates or could contain more than 50mg/L nitrates if action is not taken*'.

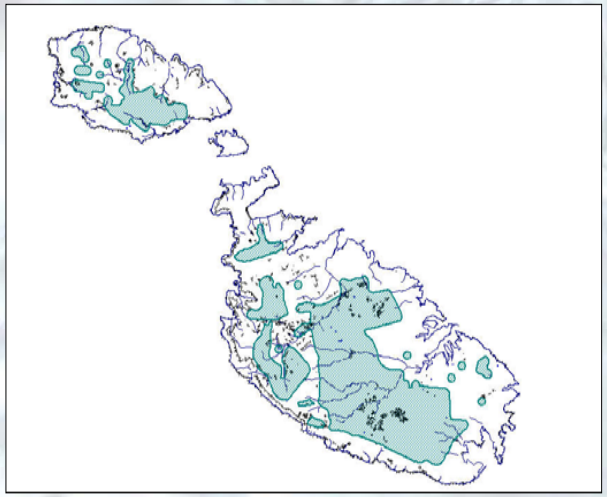
To achieve its objectives, the Directive indicates that the areas of land draining into polluted waters should be designated as Nitrate Vulnerable Zones and an action program should be drawn out so as to reduce the current nitrate problem and prevent any further such pollution from occurring.

Conclusions

Groundwater contamination is impacting the islands water economy and a policy to curb such contamination is required to avoid incurring in further water treatment costs.

Industrial, agro-industrial and agricultural water users should be induced to apply good practice.





The continuation of present practices in drilling boreholes and pumping water can lead, in the case of the sea-level aquifers, to further upconing of saltwater. Once overtaken by saltwater, it takes a very long time to restore their freshwater capacity. Thus groundwater abstraction should be regulated in order to preserve the functionality of the aquifers.