



Water Development Department



Ministry of Agriculture, Natural  
Resources and Environment

# Artificial Recharge of Tertiary Treated Sewage to the Ezousas Aquifer in Cyprus

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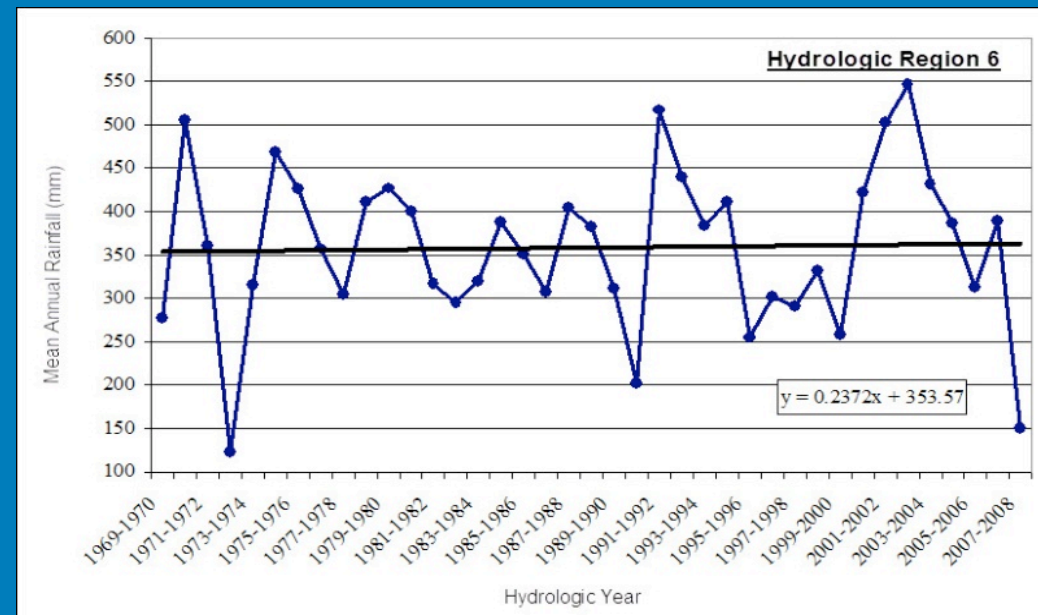
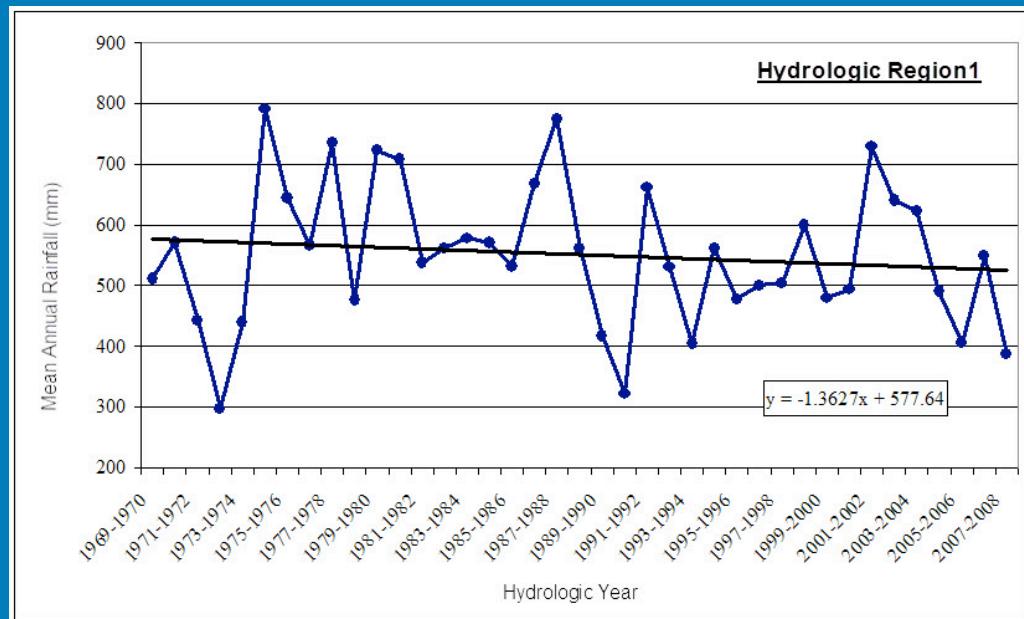
# Introduction

- Cyprus is divided into 9 hydrologic regions each of which exhibits some homogeneity
- Since the last couple of decades, all of Cyprus water resources were originating from rainfall
- Based on a long series of observations, the mean annual rainfall including snowfall it was 503 mm, but observations on the last four decades indicate that it is reduced to 463 mm



# Introduction

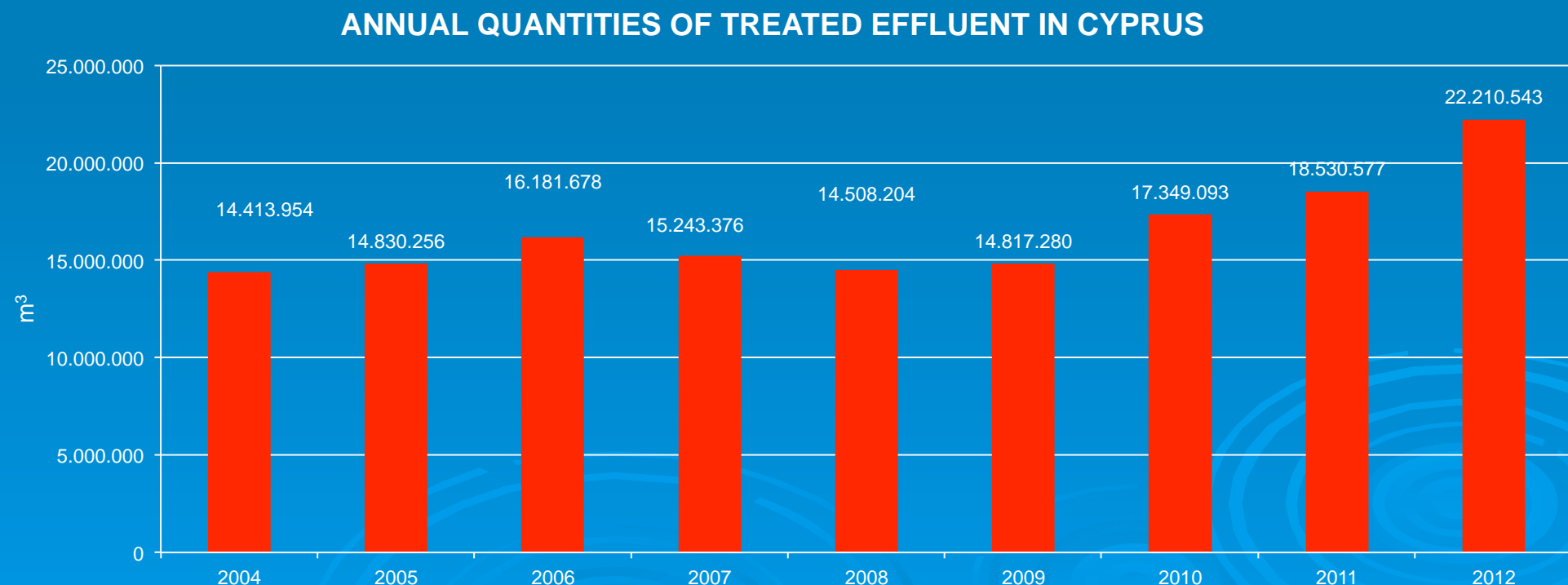
- Cyprus is experiencing a big variation of rainfall and also frequent droughts which have duration of two to three years.



- Statistical records reveals
  - 15% stepped drop of precipitation in the early 70's,
  - almost 40% in river run-off
  - a reduction in the replenishment of aquifers
- Increases in evapotranspiration and reduction in the effectiveness of major water works such as Dams
- Reduction in volumes of available water coupled with the increasing demand for water is worsening the water scarcity problem, with severe water shortages and negative socio-economic and environmental impacts

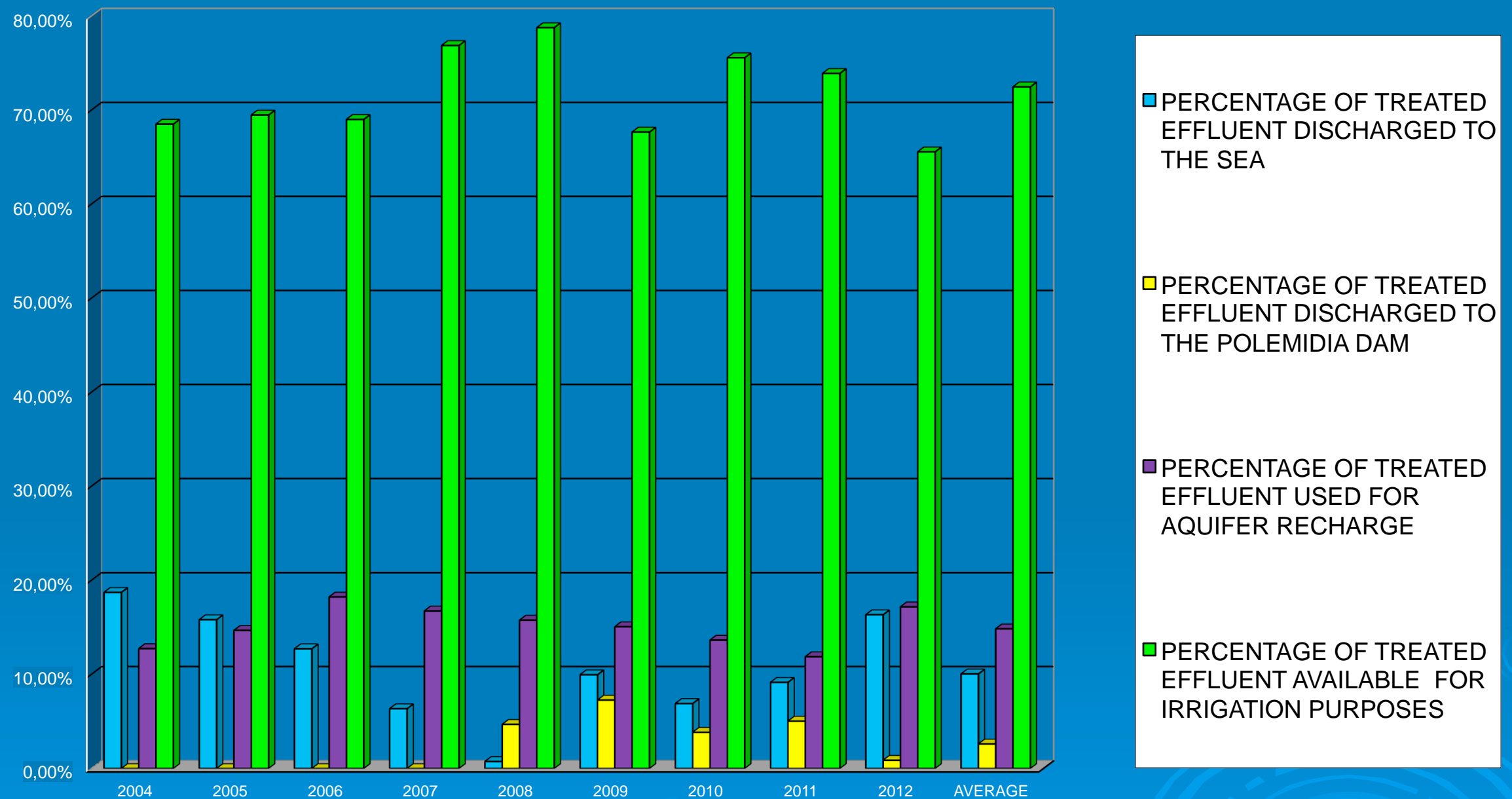
# Cyprus Water Policy

- Maximizing the exploitation of non-conventional water resources, such as recycled water
- Tertiary treated recycled water is use for irrigation of existing cropping land and for recharging aquifers
- Full exploitation of recycled water which will decrease or even eliminate the necessity to build more desalination plants
- Today, 20,2 million cubic meters of recycled water are being produced from tertiary treatment and is estimated to increase to 52,52 million cubic meters by 2025



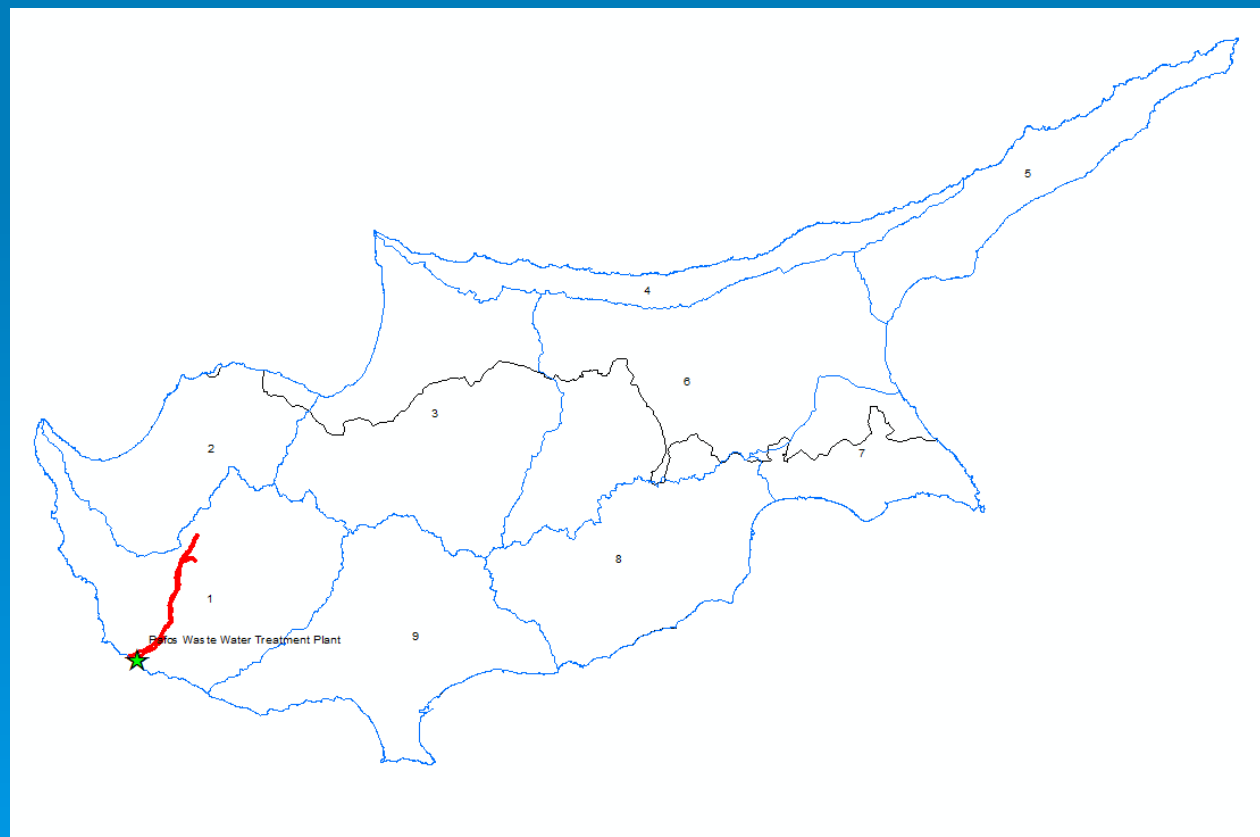
# Cyprus Water Policy

## USES AND PERCENTAGES OF TREATED EFFLUENT IN CYPRUS



# Ezousas Aquifer

- The Ezousas aquifer is a river alluvial aquifer, developed along the Ezousas river valley, in Pafos District (HR1)
- It extends from the coast to the Kannaviou dam
- Kannaviou dam, with 8 million m<sup>3</sup> capacity, was constructed on this river approximately 26 km upstream of the coast
- The dam covers part of the local irrigation demand and some quantities of water are being diverted by pipeline to Asprokremmos Water Treatment Plant for domestic use in Pafos town and several villages.





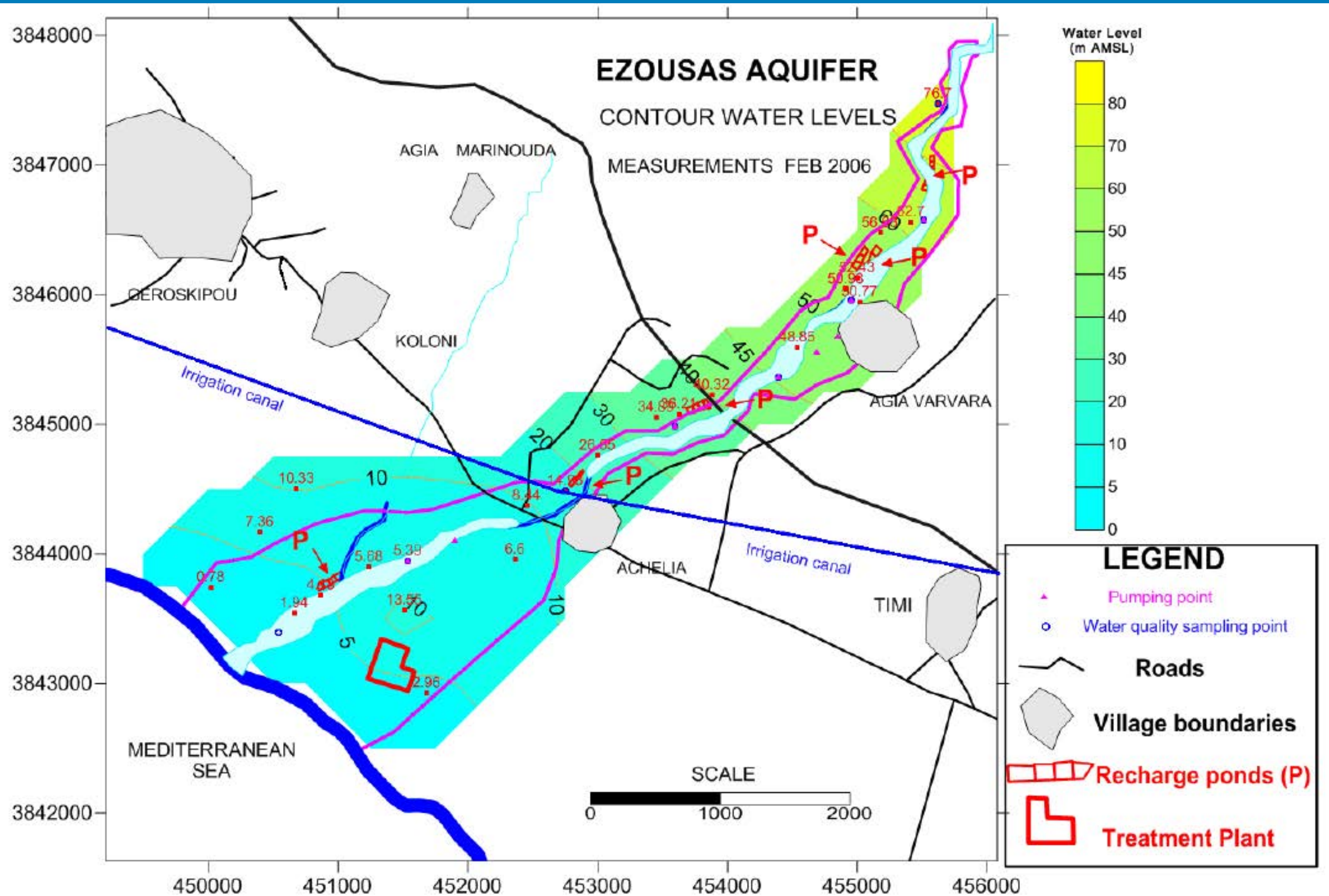
# Ezousas Aquifer

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- The coastal part of the aquifer, stretching up to eight kilometers from the coast
- It is utilized as a natural reservoir for storage and reuse of the tertiary treated sewage from Pafos town
- Treated water recharges the aquifer through specially constructed shallow ponds
- This water, after natural purification, is pumped again from the aquifer for irrigation in the Pafos Project area







# Recharge Description

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## Land use

- Land use is mainly agricultural with predominant crops being citrus trees.
- The intensive nature of the agriculture and the use of fertilizers in the area are endangering the groundwater quality in coastal plain.

## Chemical composition of the groundwater (prior recharge)

- There were indications of increasing nitrate concentration and localized problems of seawater intrusion appeared in a few coastal zones.
- The elevation of the impervious base of the coastal aquifer was generally above mean sea level.
- In few places where the elevation of the impervious base was below sea level, seawater intrusion problems appeared.
- The average sulfate concentration in both surface and groundwater was approximately 450 mg/l.
- High boron concentration has also been measured in this aquifer.

# Recharge Description

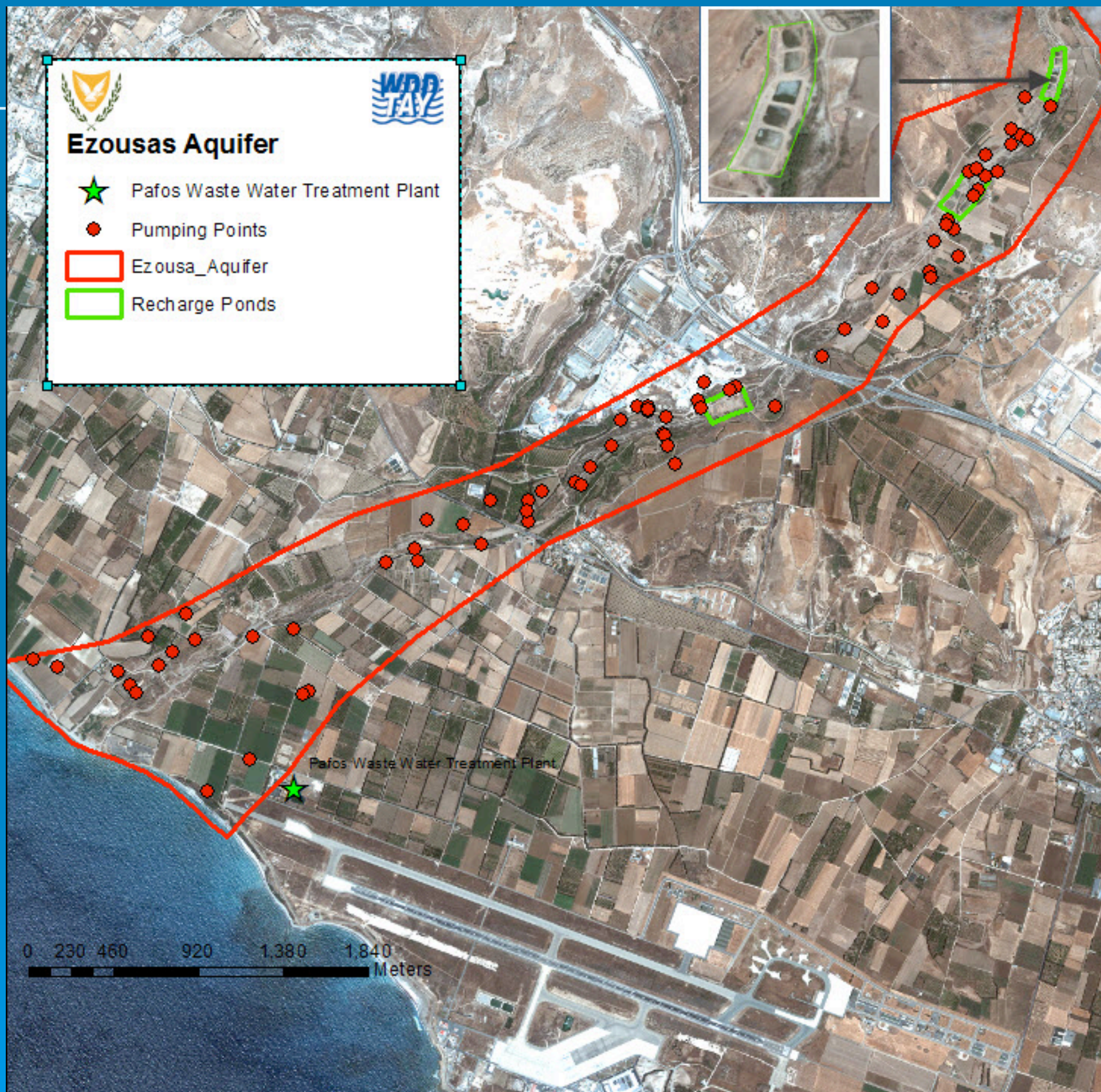
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## Discharge and abstraction data

- About 20 private boreholes and wells operated in the coastal area and their yield ranges from 1 to 20 m<sup>3</sup>/hour
- Many of these boreholes have been drilled in the last twenty years
- Dry years and water deficits in the last twenty years have forced abstraction to increase









# Operation of the Artificial Recharge Scheme

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- Tertiary treated water, which is also disinfected, is pumped from the treatment plant to five shallow ponds in turns.
- The water level in each pond reaches up to 0.5 m from where it slowly seeps into the ground.
- Water is pumped from the aquifer into a canal (open channel) at a ratio of 1:20 (aquifer water to dam water).
- The canal carries water from Asprokremmos dam to the Pafos irrigation scheme and passes across the Ezousas aquifer.
- Water from the aquifer is pumped from the already existing wells, which are located 100 m to 1000 m downstream of the recharge ponds.
- Pumping is carried out strategically so that retention time in the aquifer is maximised.



# Results / Lessons Learn

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Disinfected tertiary treated water, is being used for artificially recharging an aquifer with low quality (natural high sulphate and boron concentrations) water and then is utilised for irrigation purposes.

- ✓ Artificial recharge with effluence water is a good case study, which can be applied in areas with similar geological conditions suffering from droughts
- ✓ Seawater intrusion is being controlled
- ✓ Saving of equal quantities of fresh water for domestic use.



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# Thank you for your attention

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