Wastewater Modelling to Reduce the Disaster Risk from Groundwater Contamination

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Background

Cases of past water contamination in Israel:
In some cases the authorities issued instructions to refrain from drinking tap water until the contamination was cleared up.

Several towns have been forced to close down contaminated wells, stop relying on their own water supply, and to connect to the National Carrier Water instead.

Irrigation with wastewater -
A major cause of groundwater salinity.

Irrigation with wastewater

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- *A reliable supply of water at a low cost*
- *A partial solution for effluent disposal*
- *Reduces the need for fertilizer use*

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- *Damage to crops and soils*
- *Increases the risk of groundwater contamination*

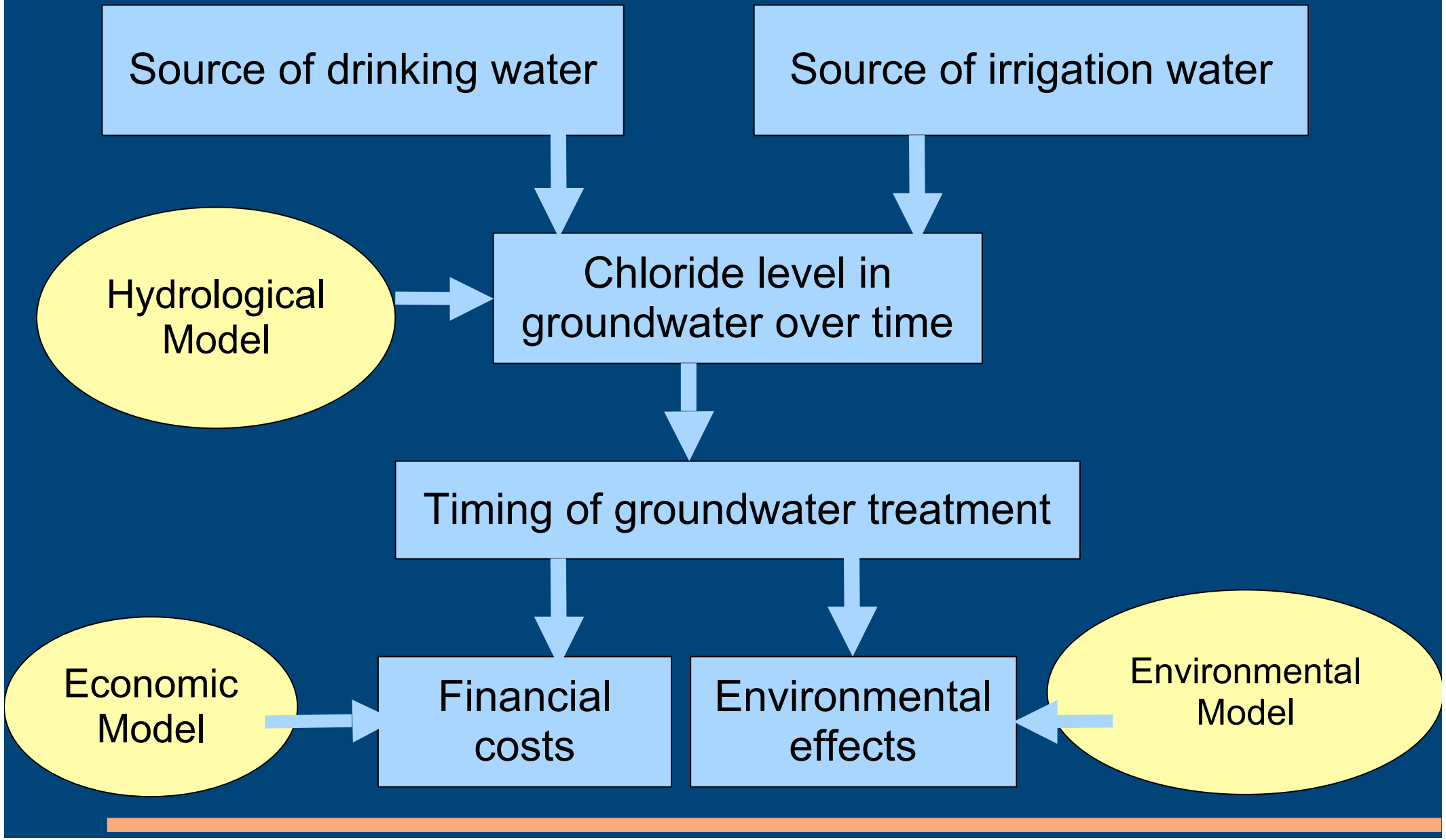
Higher level treatment reduces the potential damage,
but is more expensive.

Methodology

- ***A combined hydrological-environmental-economic water management model.***
- ***Varying alternatives of water supply for drinking and for irrigation; different wastewater treatment alternatives.***

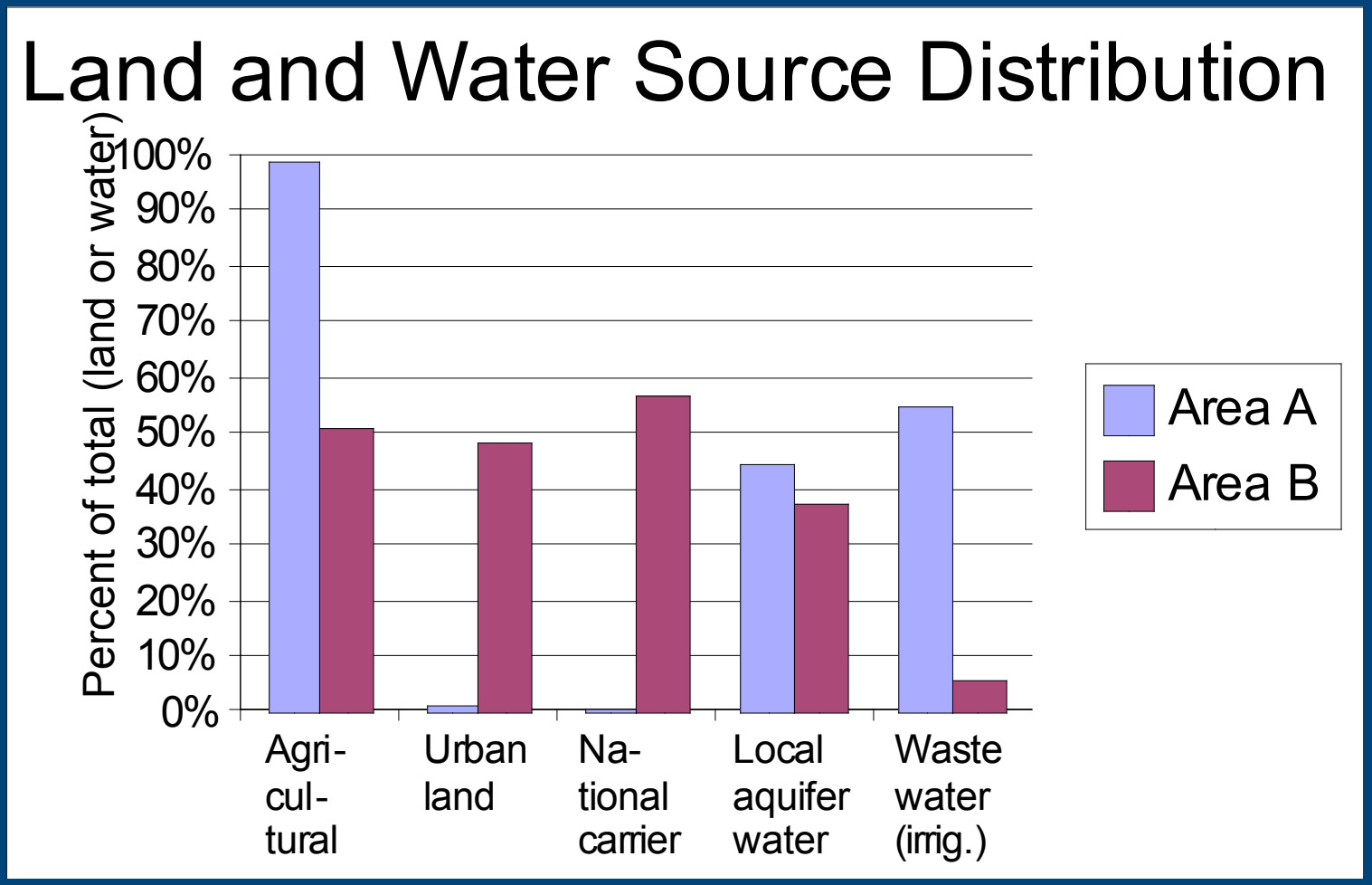
Goal: To identify the optimal treatment and reuse methods that will ensure a safe, stable and sustainable supply of drinking water.

The Model


Source of drinking water
Source of irrigation water
Hydrological Model
Chloride level in groundwater over time
Timing of groundwater treatment
Economic Model
Financial costs
Environmental effects
Environmental Model

Case Study

Two Areas in the Coastal Aquifer of Israel



Scenarios

Scenarios include:

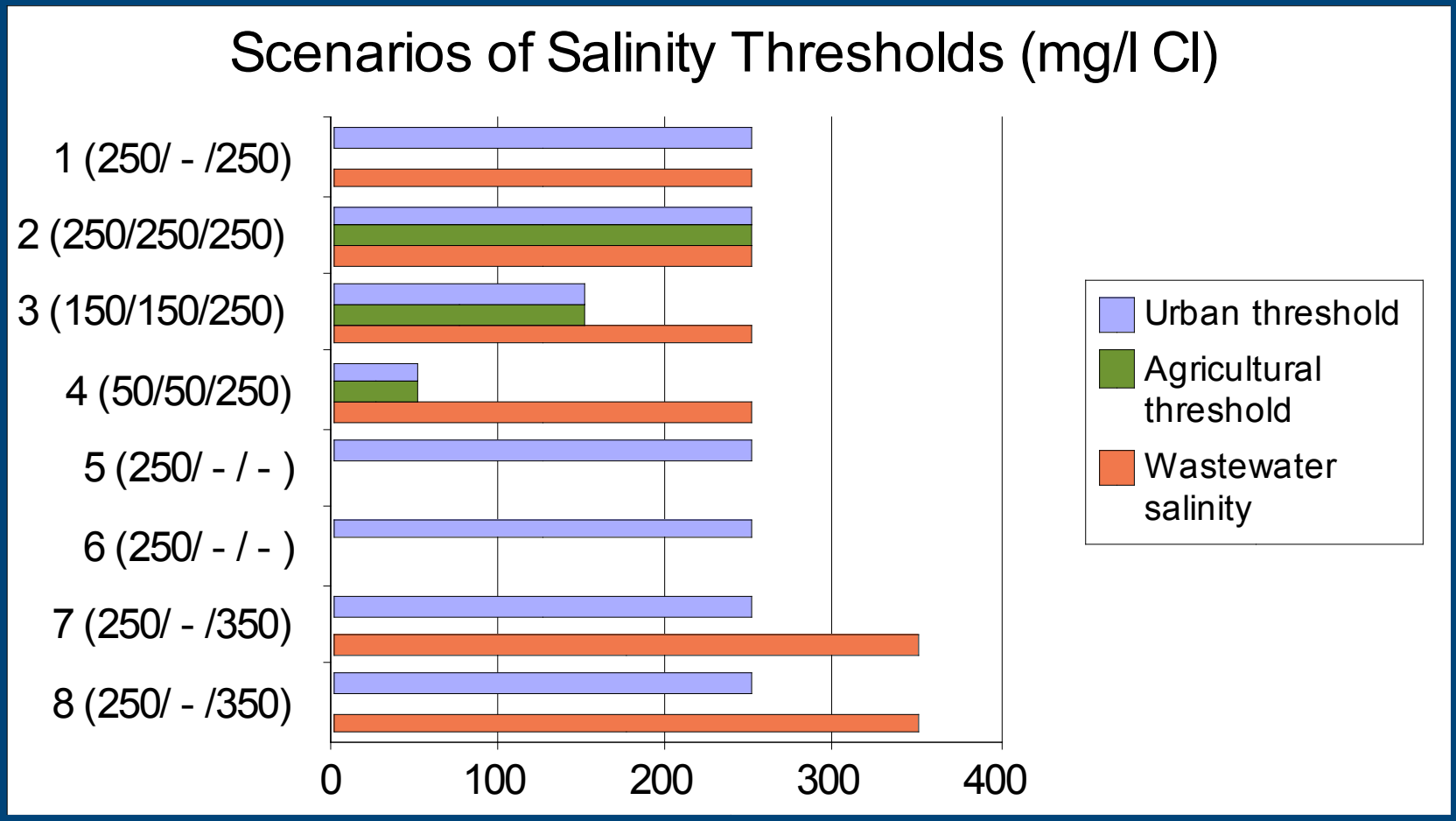
Chlorine thresholds for drinking water and for irrigation

Range: 50 – 250 mg/l Cl.

Source of water for irrigation: freshwater or wastewater (wastewater at 250 – 350 mg/l Cl.)

Desalination alternatives: brackish groundwater, national carrier water, wastewater, seawater.

Scenarios



Scenarios (urban threshold/ agricultural/ wastewater salinity)

Hydrological model

Simulates:

- Contaminants flow through the unsaturated zone of the soil.
- The effect of irrigation with wastewater on chlorides in groundwater.

Chlorine concentration increases -
Reaches a predefined threshold -
Groundwater treated & combined with freshwater sources to reach the permitted concentration level.

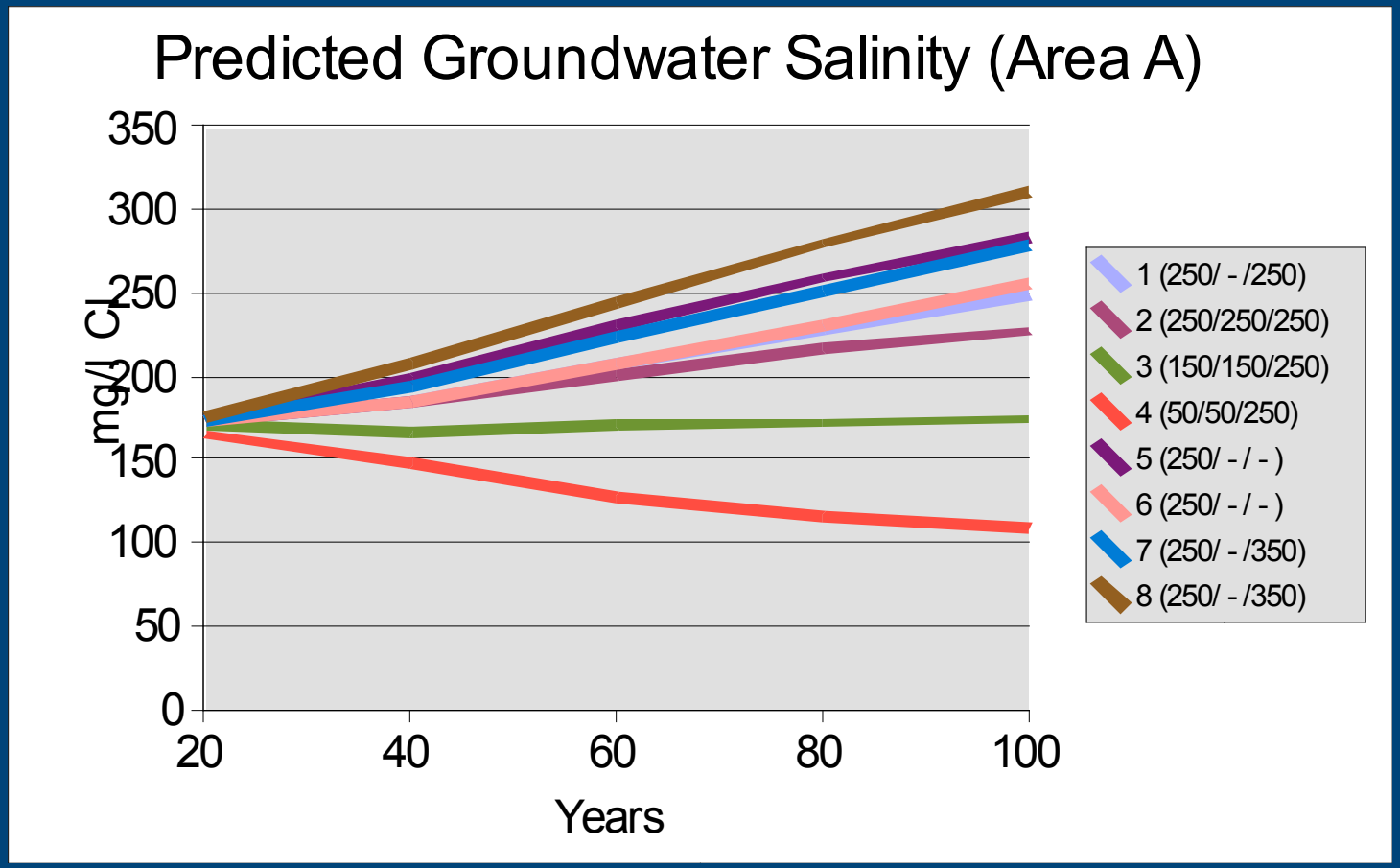
Environmental model

Economic model

Costs: treatment, storage, transport of wastewater,
adapting irrigation equipment for wastewater

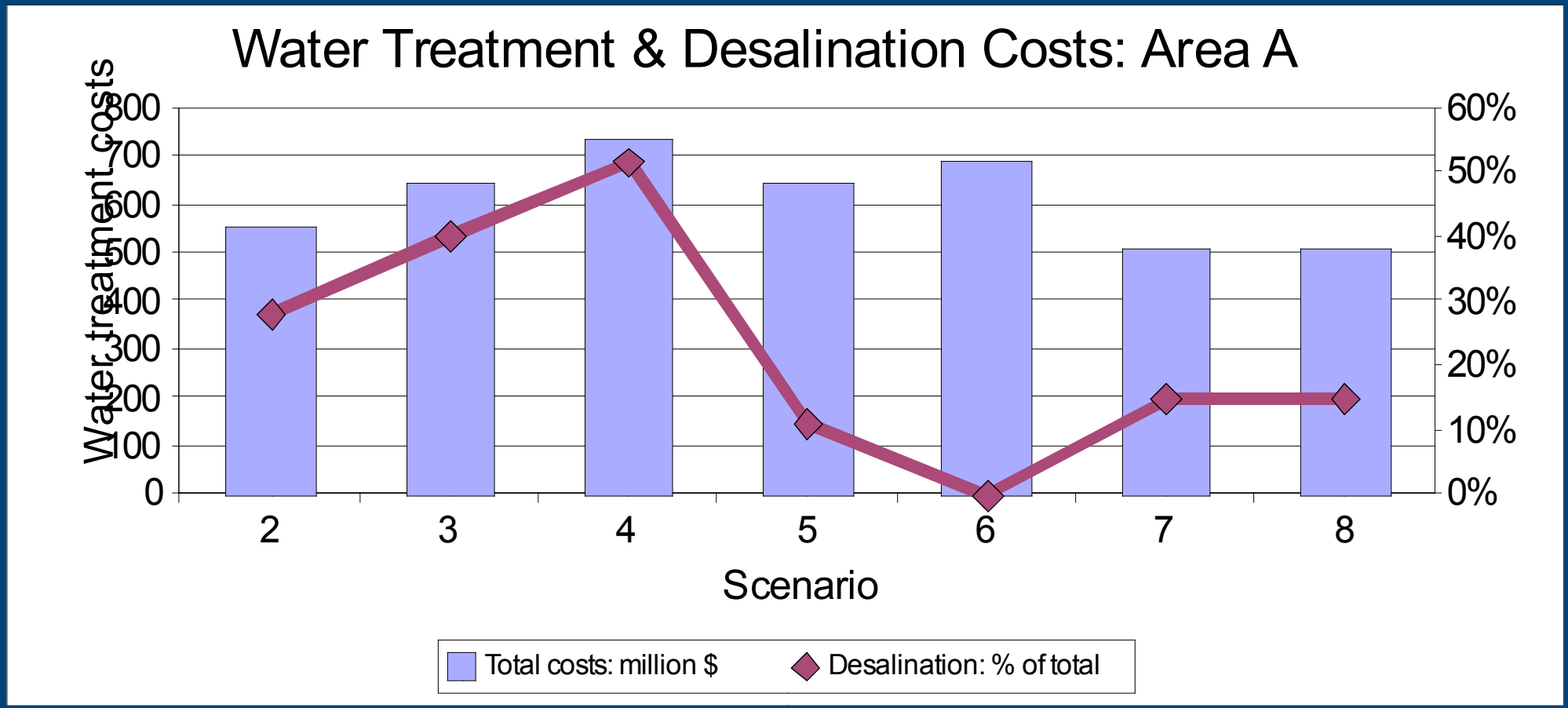
Results

The predicted increase in aquifer salinity by scenario:
Salinity level lower in scenarios with greater restrictions



Economic

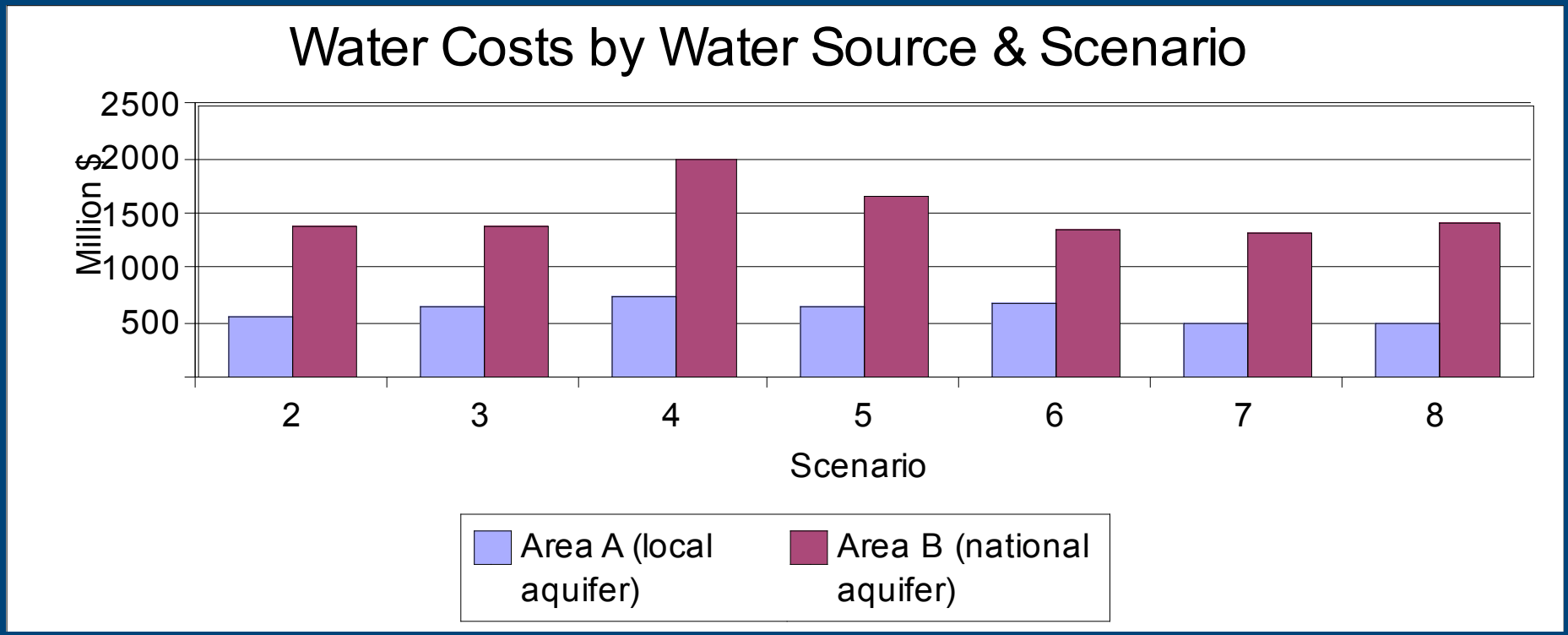
Irrigation with wastewater increases salinity -
increases desalination costs; decreases the total cost of water supply
Greater restrictions increase costs significantly



Economic

Area B (higher salinity and more national carrier water):

- Higher cost in every scenario
- Salinity & cost comparisons between scenarios similar in both areas



Recommendations

- Allow wastewater reuse in agriculture:
  - To reduce costs of treatment
  - To insure a stable supply of water for irrigation

- Monitor groundwater to reduce the disaster risk of groundwater contamination