

GROUNDWATER RESOURCES MANAGEMENT IN SAUDI ARABIA

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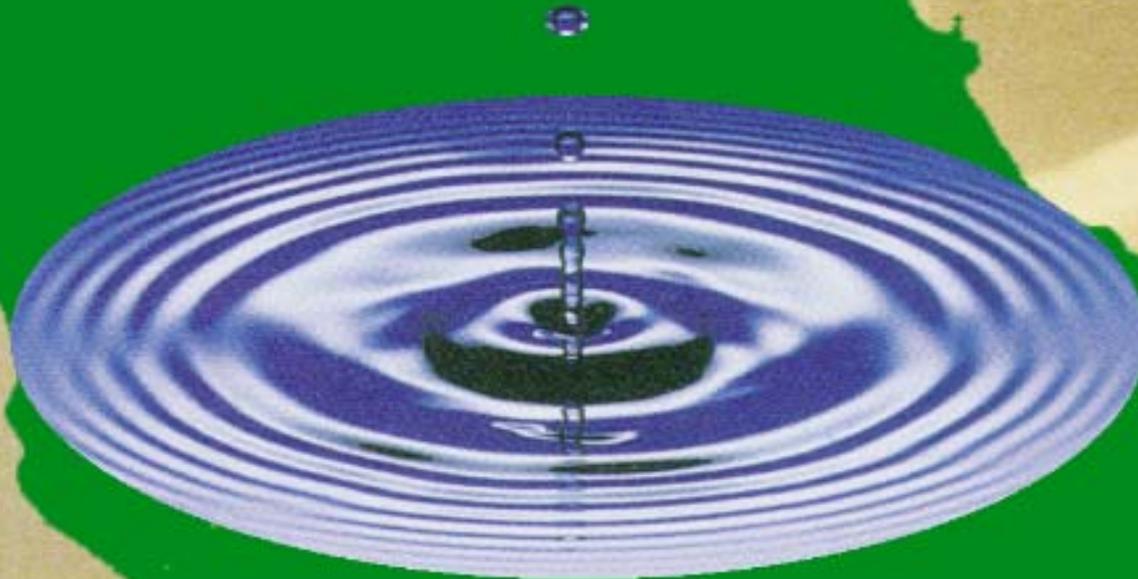
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Workshop**
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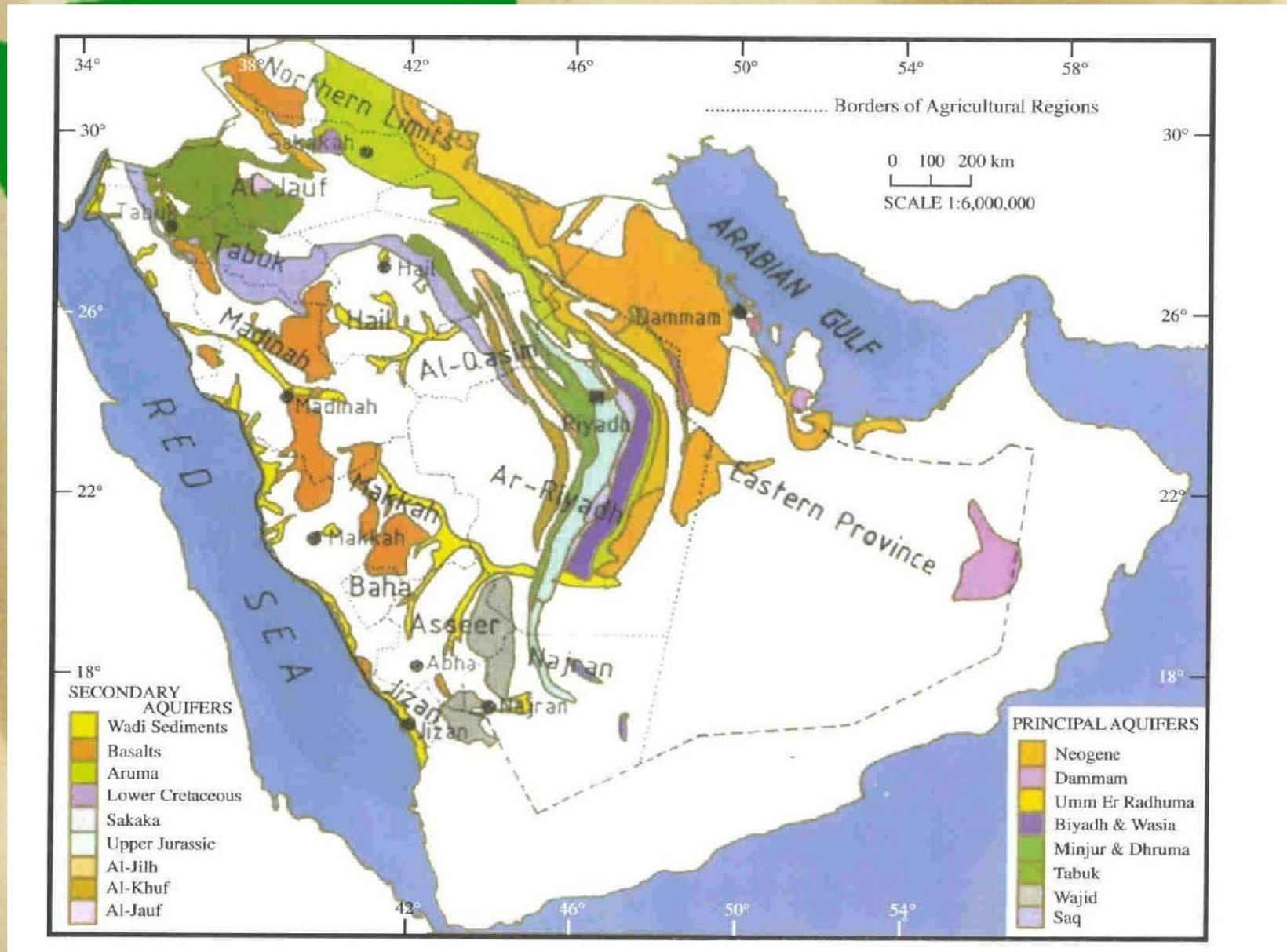
- INTRODUCTION
- WATER RESOURCES IN SAUDI ARABIA
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- IMPACTS OF INTENSIVE USE OF GROUNDWATER AND ADOPTED MEASURES
- ADDITIONAL MANAGEMENT ACTIONS FOR SUSTAINABLE WATER RESOURCES
- CONCLUSIONS



WATER RESOURCES IN SAUDI ARABIA



The extension of the outcrop areas of principle and secondary aquifers in agricultural regions i Saudi Arabia



Available Water resources in Saudi Arabia in 2003-2004(MCM)

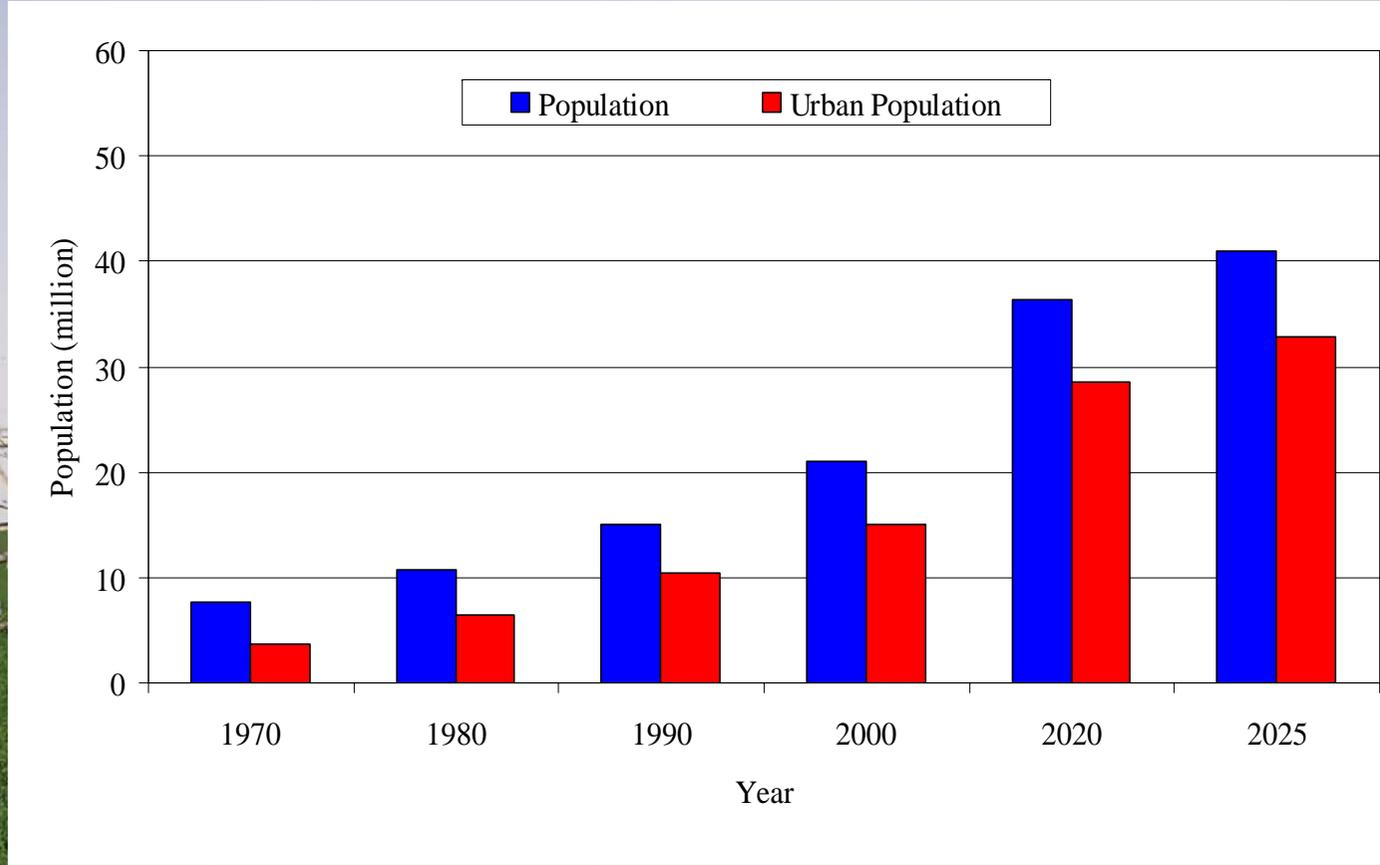
Surface water	5,000-8,000 (2,230 available for use)
Groundwater resources	2,269,000 (84,000 renewable groundwater in shallow aquifers)
Groundwater recharge	3,958 (1,196 to shallow aquifers and 2,762 to deep aquifers in the Arabian Shelf)
Desalination	1,050
Treated wastewater	240

Average Water Share

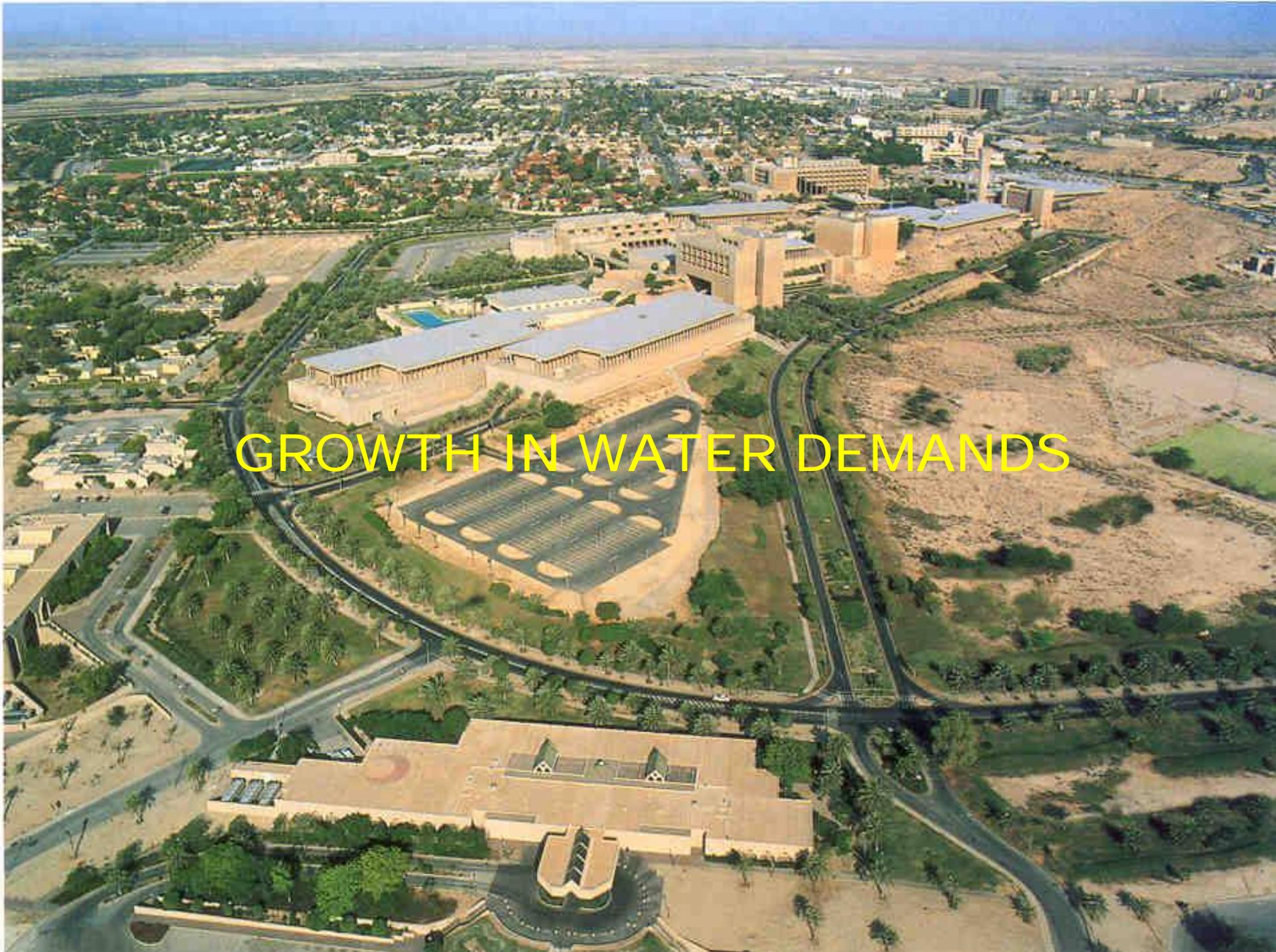
The total **volumes of available renewable** water resources from surface water and groundwater recharge are **about 6,188 MCM**. The average **water share** from renewable resources is **about 281** cubic meters per person in 2005. According to the scarcity index the country is under extreme water shortages. **But, when the non-renewable groundwater resources are considered**, the situation of the available water resources will be different.

An aerial photograph of a vast, lush green field, likely a crop field, with the text 'NATIONAL DEVELOPMENT AND WATER USE IN THE KINGDOM' overlaid in white, italicized font.

*NATIONAL
DEVELOPMENT AND
WATER USE IN
THE KINGDOM*

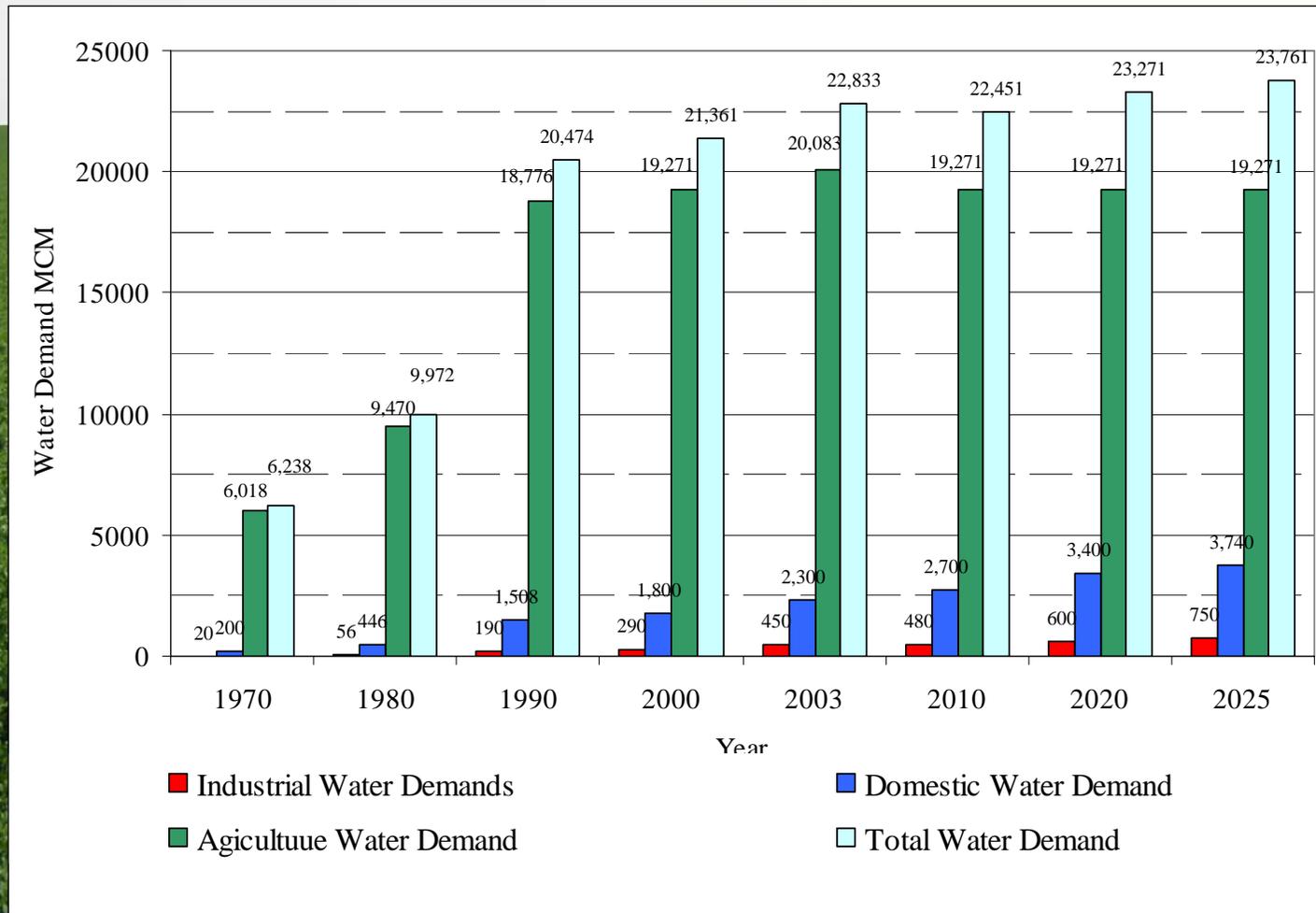


Population Growth in Saudi Arabia

An aerial photograph of a large university campus in a desert environment. The campus features several large, multi-story buildings with light-colored facades and flat roofs. A prominent feature is a large, rectangular, open-air structure with a grid-like pattern, possibly a sports field or a large parking lot. The campus is surrounded by a mix of greenery, including palm trees and other desert plants, and is connected to the surrounding urban area by roads. The background shows a vast, flat desert landscape under a clear blue sky. The text "GROWTH IN WATER DEMANDS" is overlaid in the center of the image in a bold, yellow, sans-serif font.

GROWTH IN WATER DEMANDS

Growth in Industrial, Domestic, and Agricultural, water demands in the Kingdom



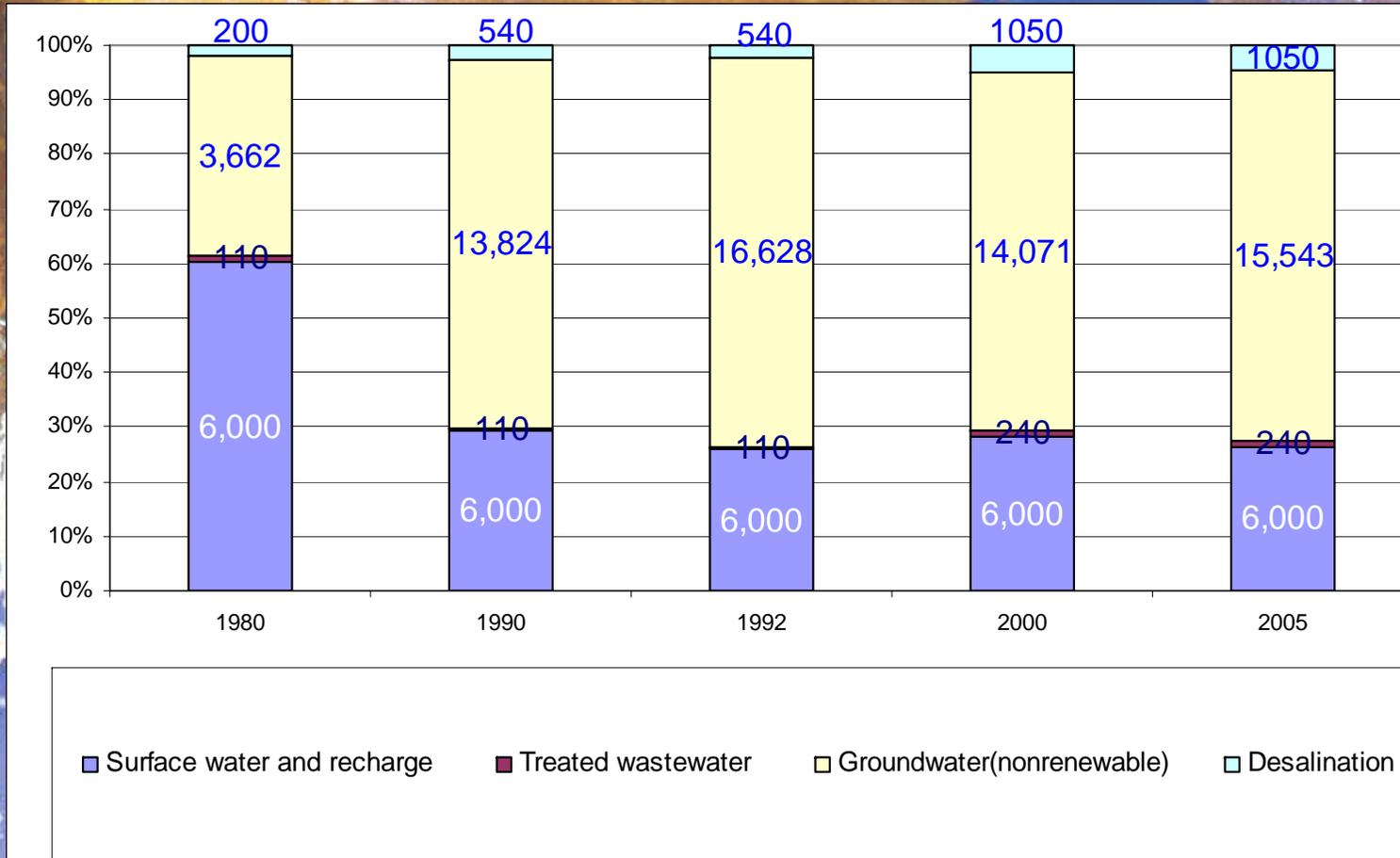
A satellite-style map of Saudi Arabia, showing the country's geographical features in shades of brown and tan. The surrounding oceans are a deep blue. The text "WATER SUPPLY SOURCES IN SAUDI ARABIA" is overlaid in white, sans-serif font across the center of the map.

WATER SUPPLY SOURCES IN SAUDI ARABIA

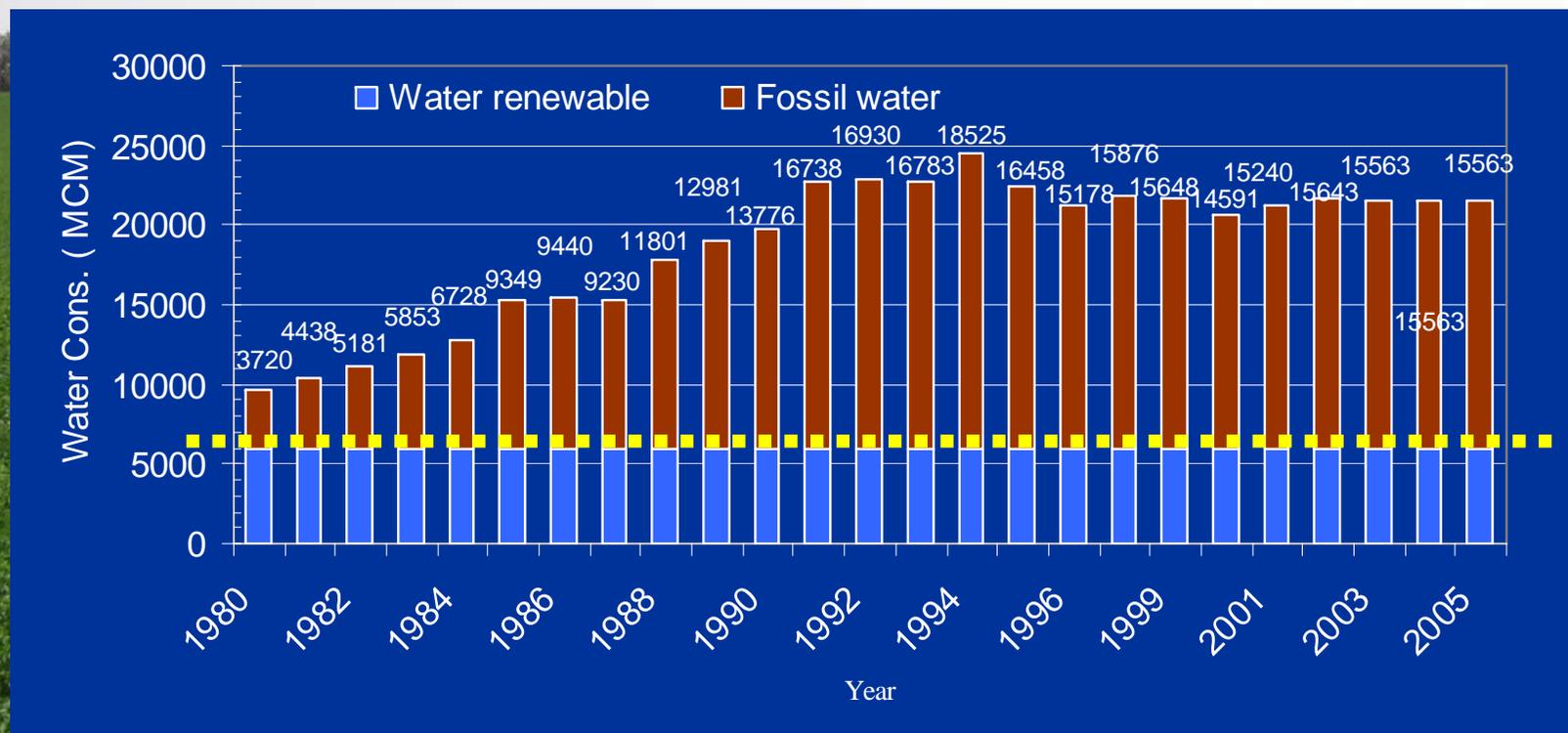
Water Supply in Saudi Arabia (MCM)

Water source	1980	1990	1992	2000	2003
Treated wastewater effluents	110	110	110	240	240
Desalination	200	540	540	1050	1050
Surface water & recharge to deep and shallow aquifers (renewable water)	6000	6000	6000	6000	6000
Groundwater nonrenewable	3,662 (36.7%)	13,824 (67.5%)	17,628 (75.7%)	14,071 (65.9%)	15,543 (68%)
Total	9,972	20,474	23,278	21,361	22,833

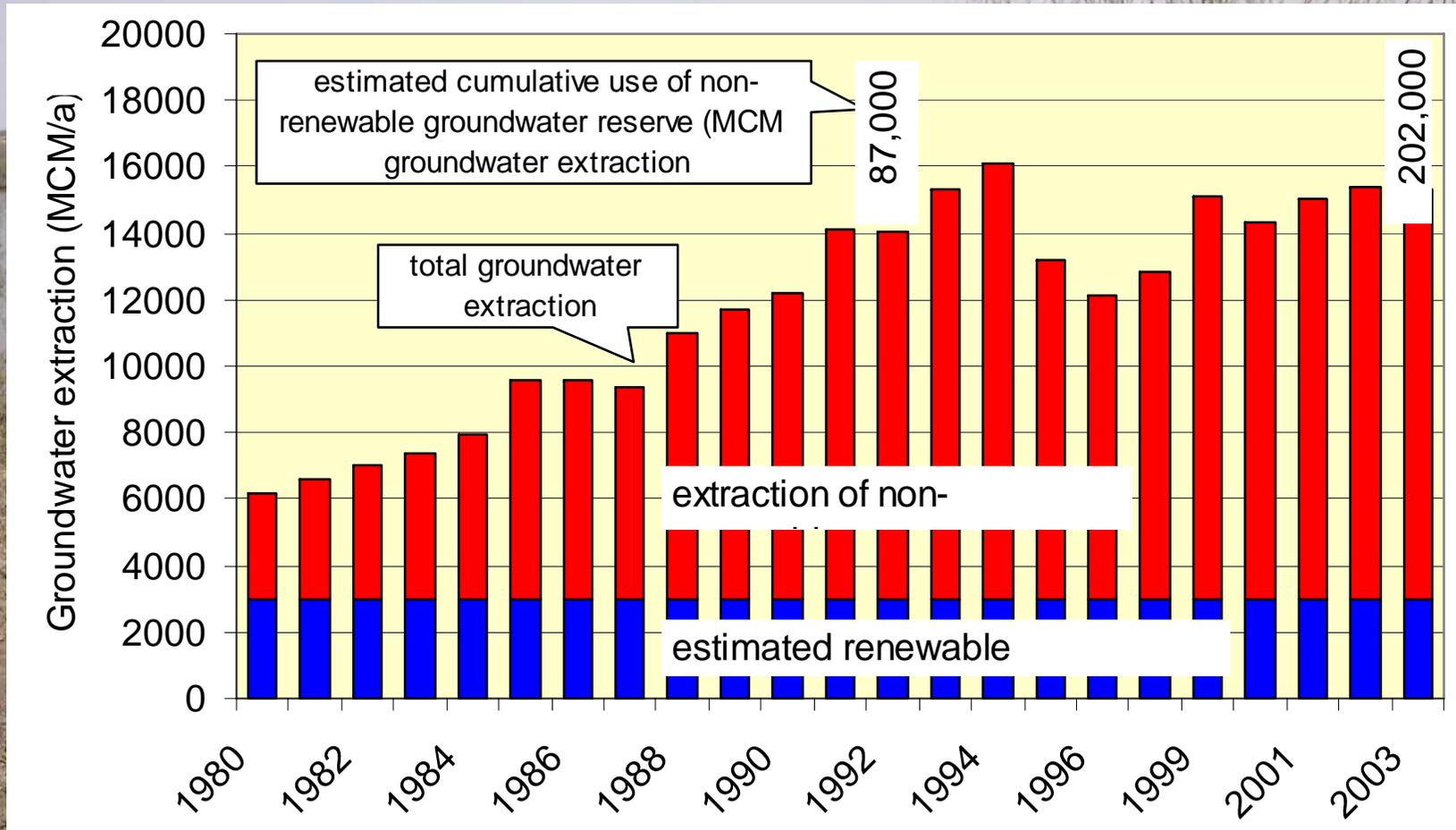
Water Supply in Saudi Arabia (MCM)



Groundwater Supplies in Saudi Arabia



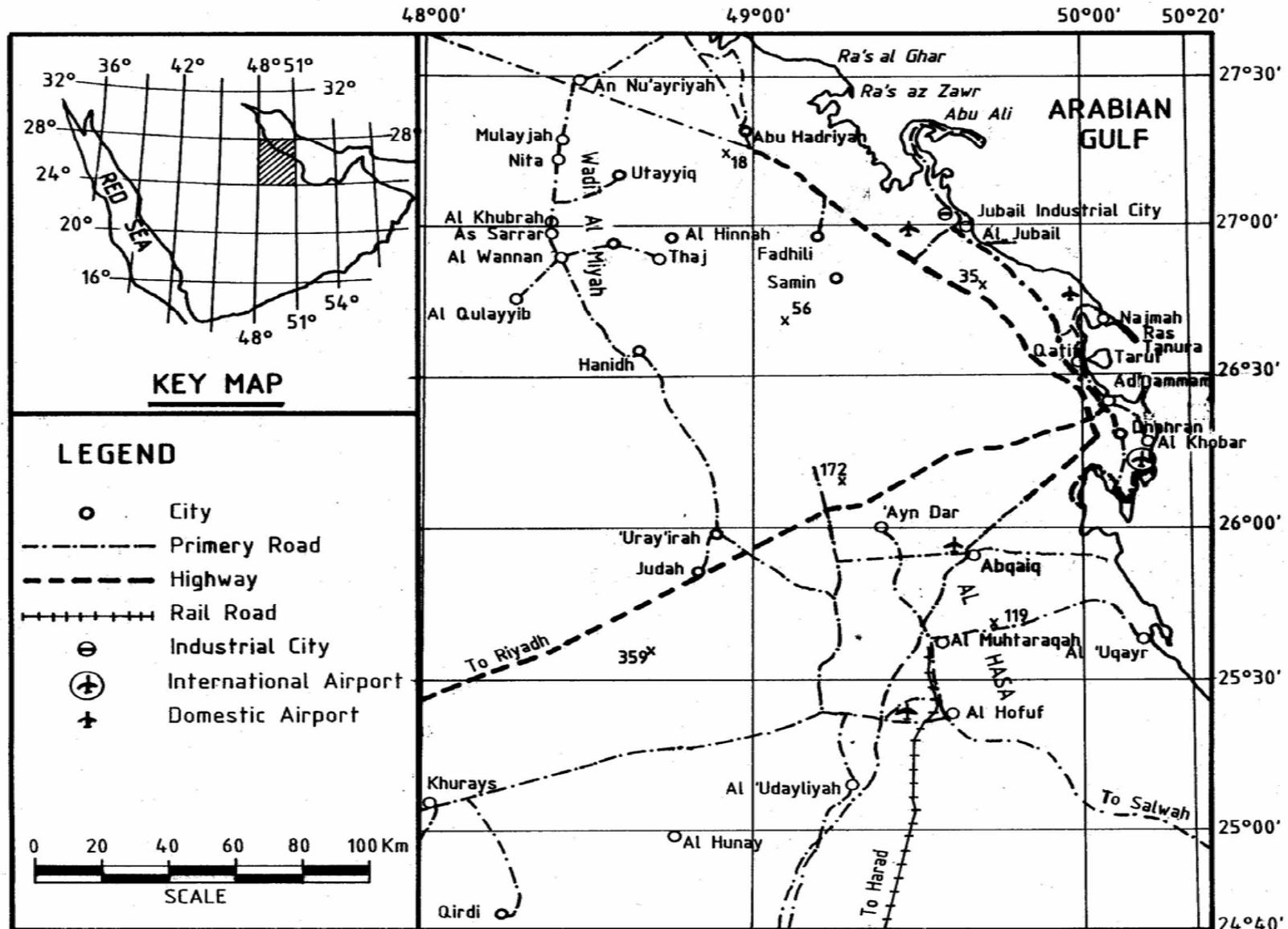
Accumulative Groundwater Consumption in Saudi Arabia



Case Studies



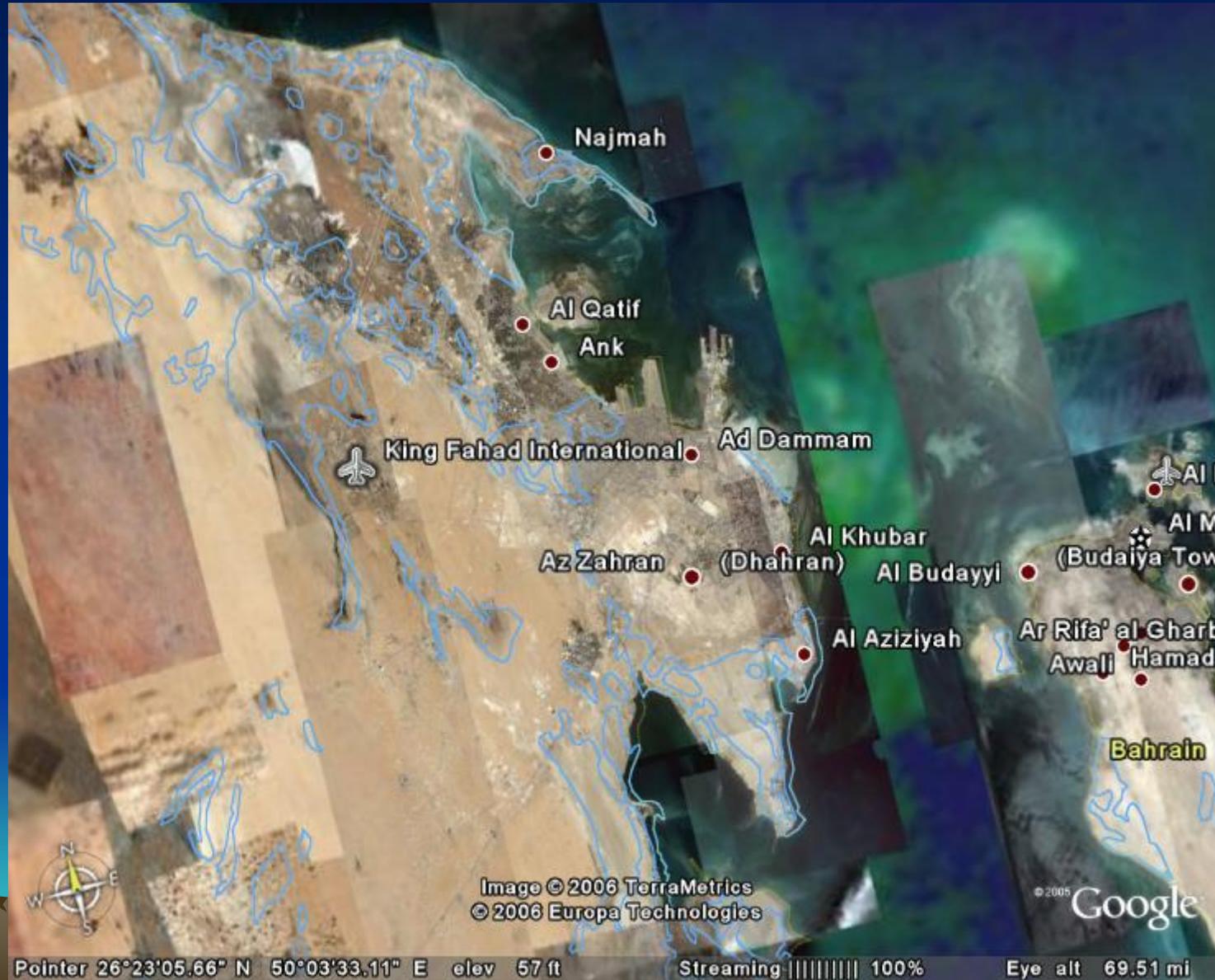
EASTERN PROVINCE



EASTERN PROVINCE



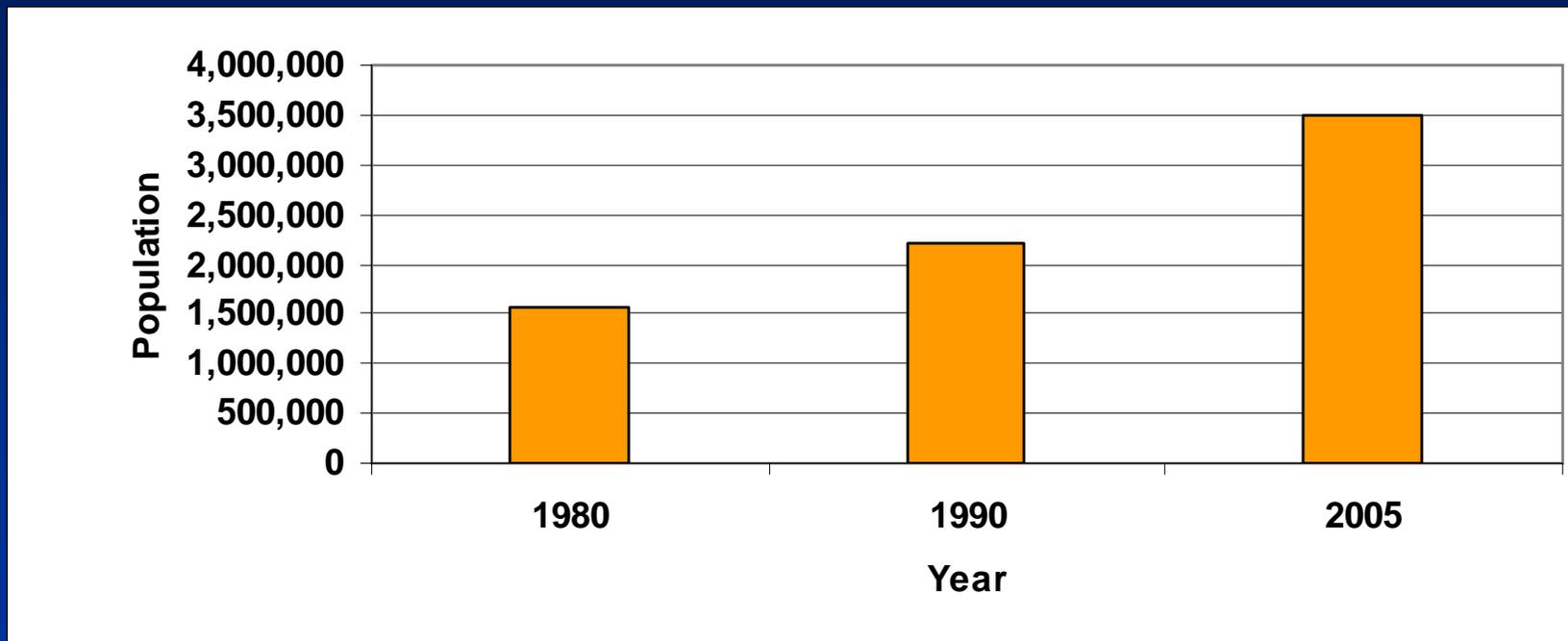
EASTERN PROVINCE



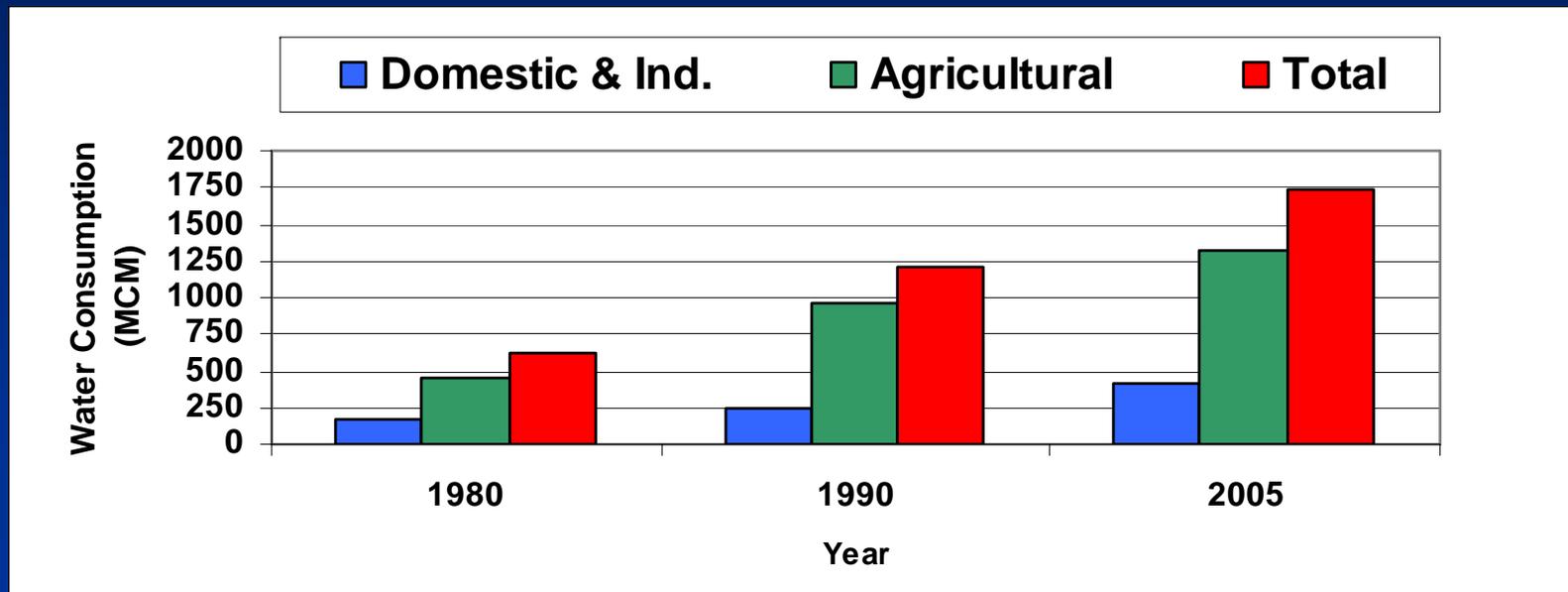
The Eastern Province has a very low annual precipitation (about 63 mm) and groundwater resources from local aquifers are the main water supply source for about 90% of the total demands in the province



Population Growth in Eastern Province



Growth in Water Use in Eastern Province



Aquifer System in Eastern Saudi Arabia

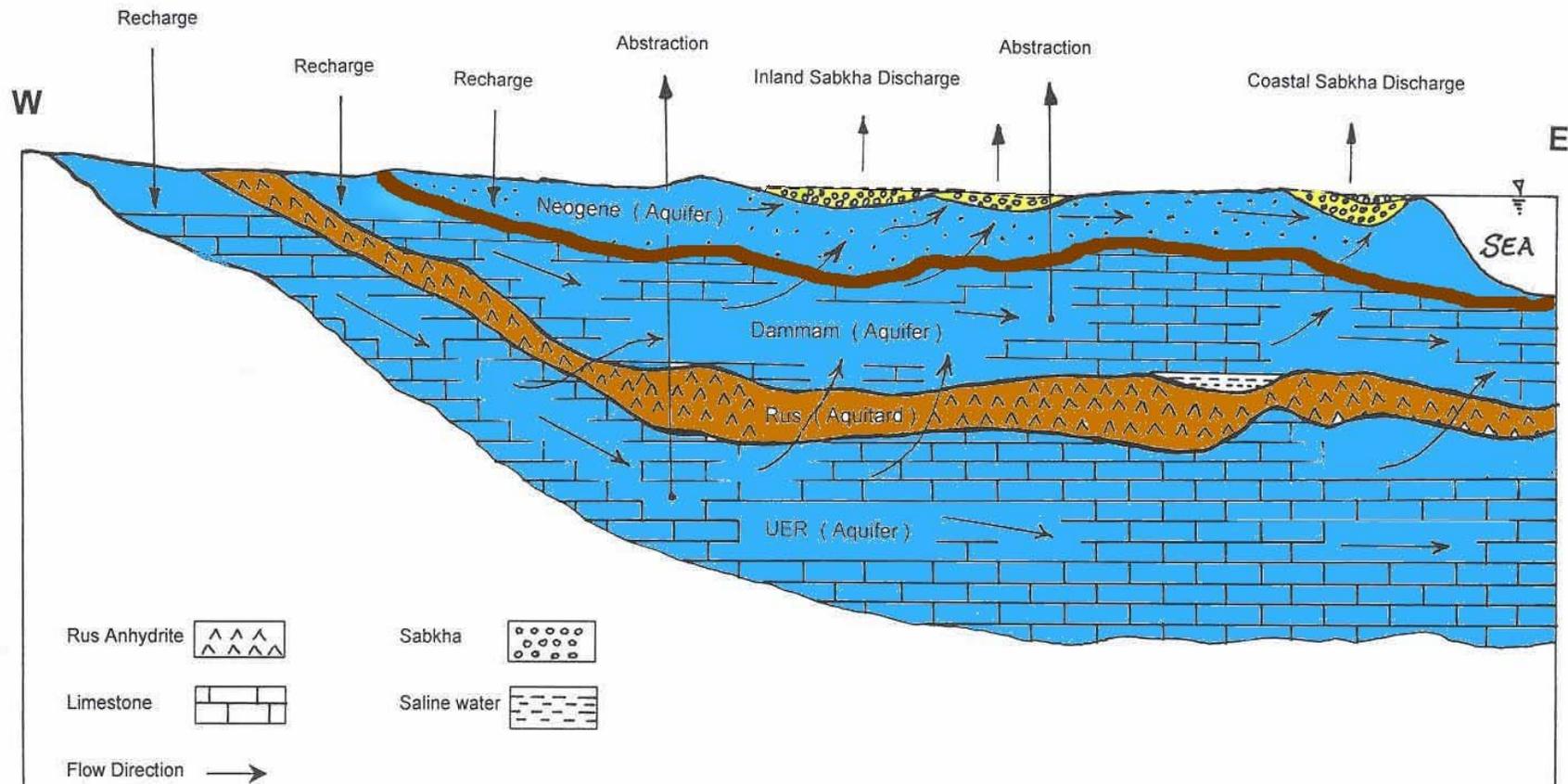
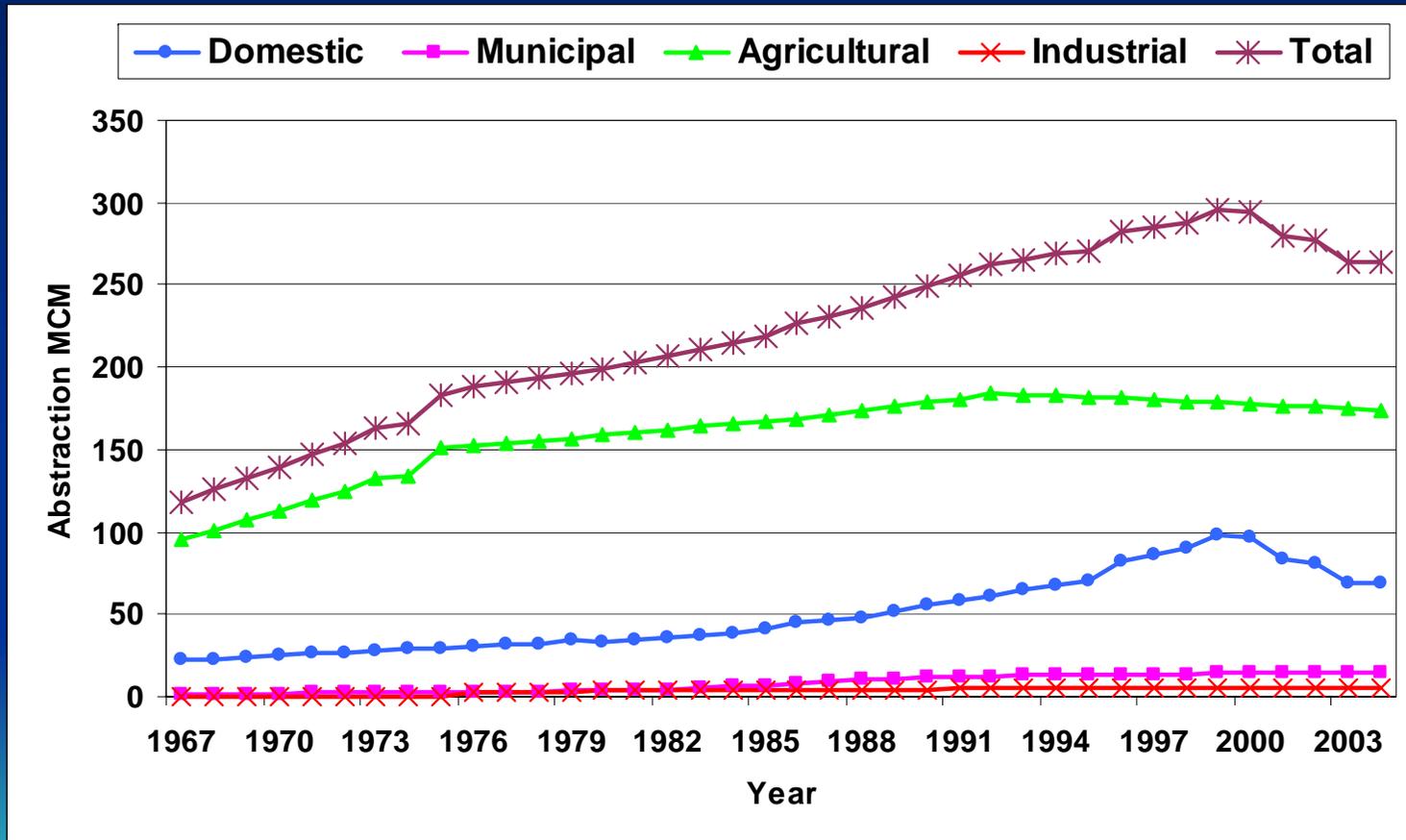
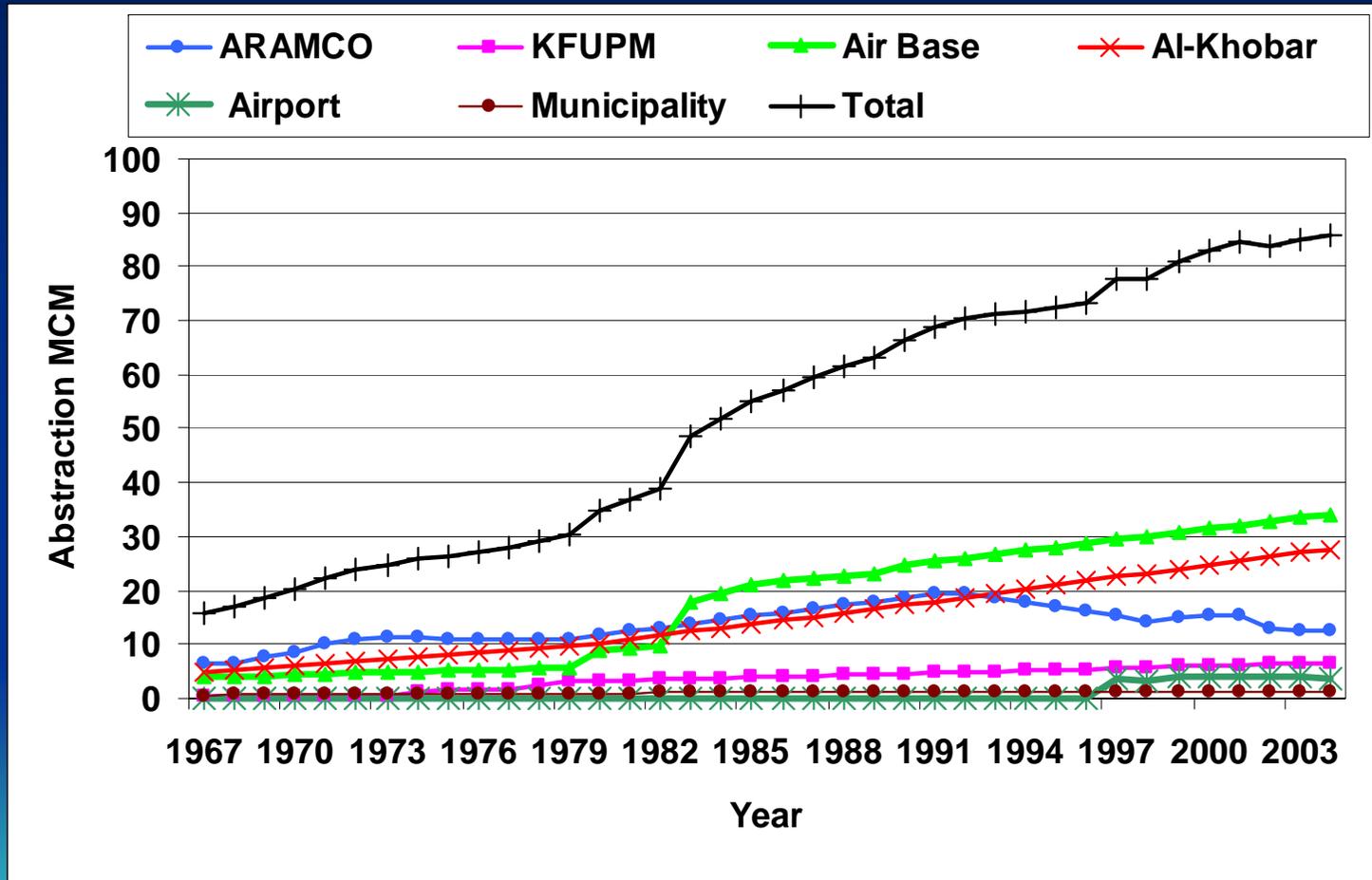


Figure 4.2 Conceptual Model of the Groundwater System in Eastern Province, Saudi Arabia

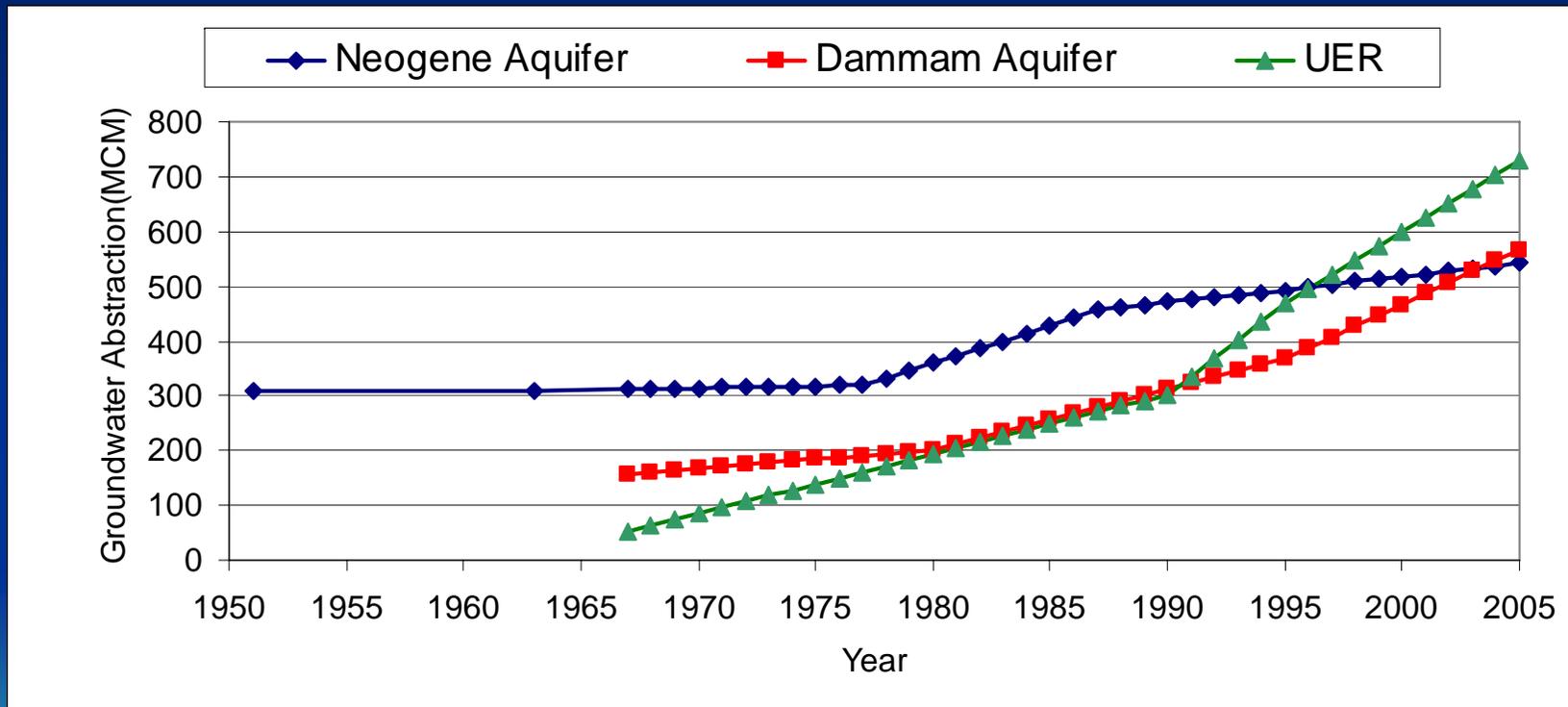
Present Water Abstractions from Dammam Aquifer in Greater Dammam Area (MCM)



Present Water Abstractions from UER Aquifer in Greater Dammam Area (MCM)



History of Water Abstractions (MCM)



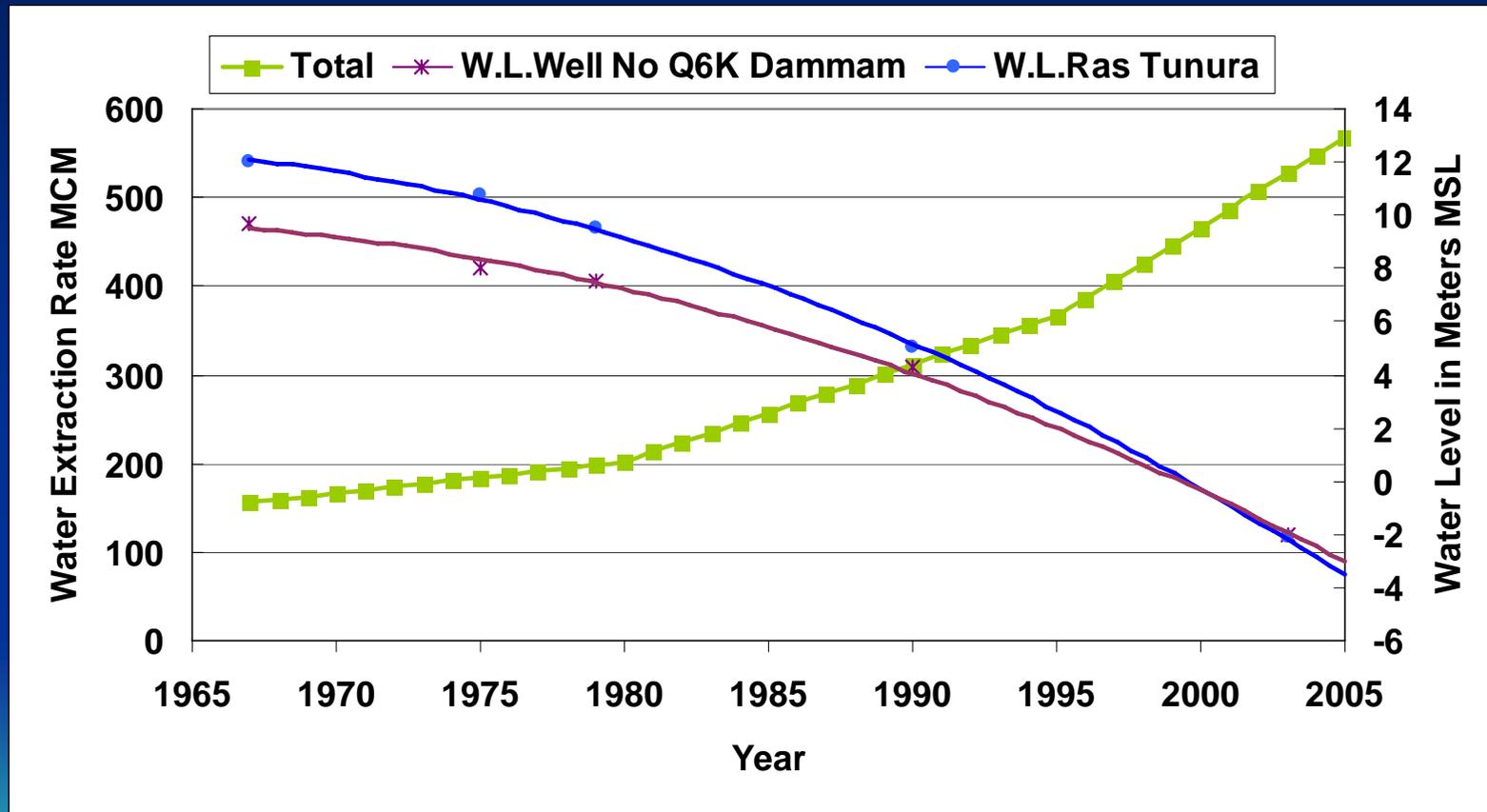
**Impacts of Increase in
Groundwater
Abstraction on levels
and qualities**



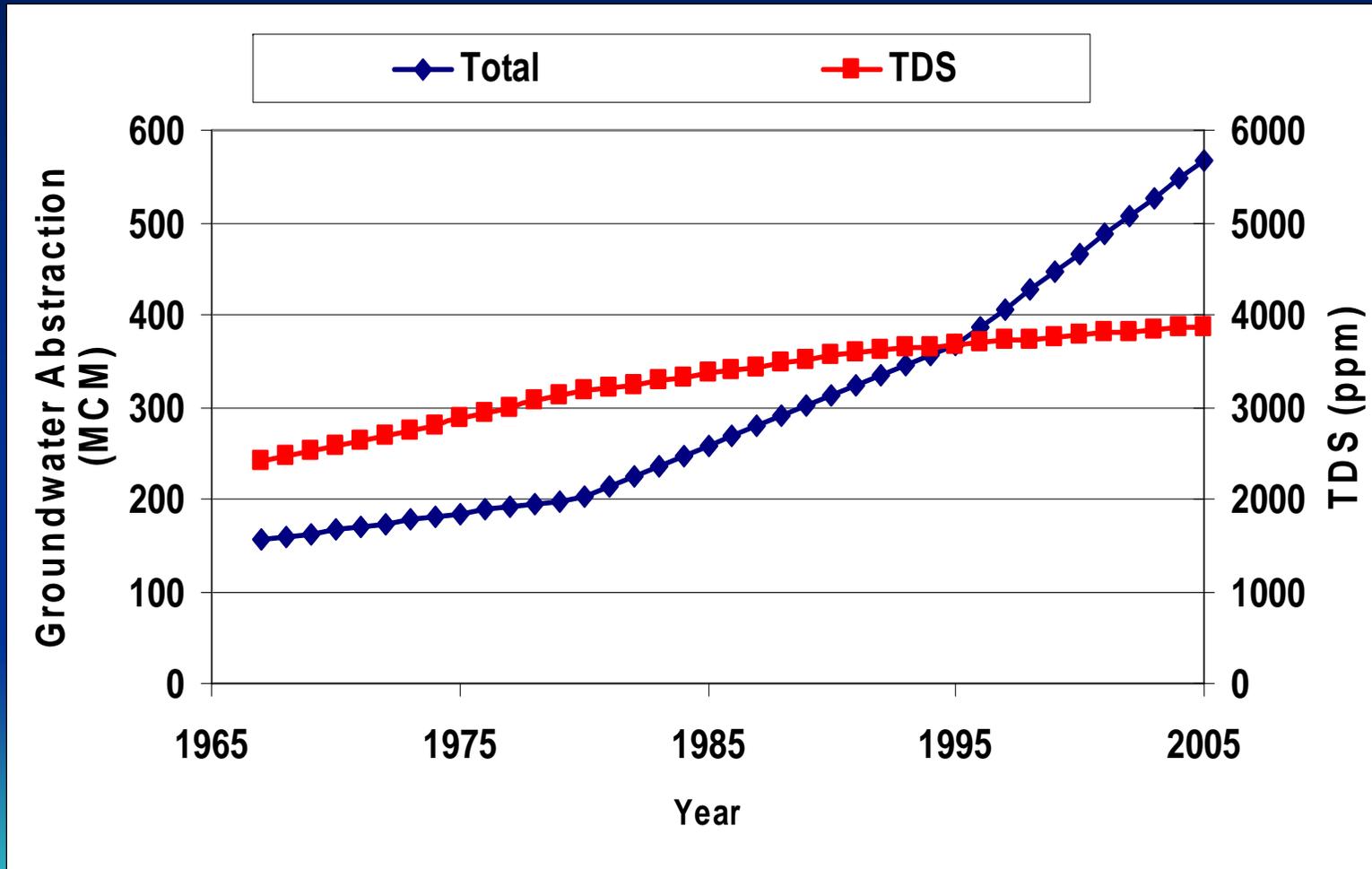
DAMMAM AQUIFER



The Impact of Increase in Groundwater Pumping from Dammam aquifer on water level (1967-2005)



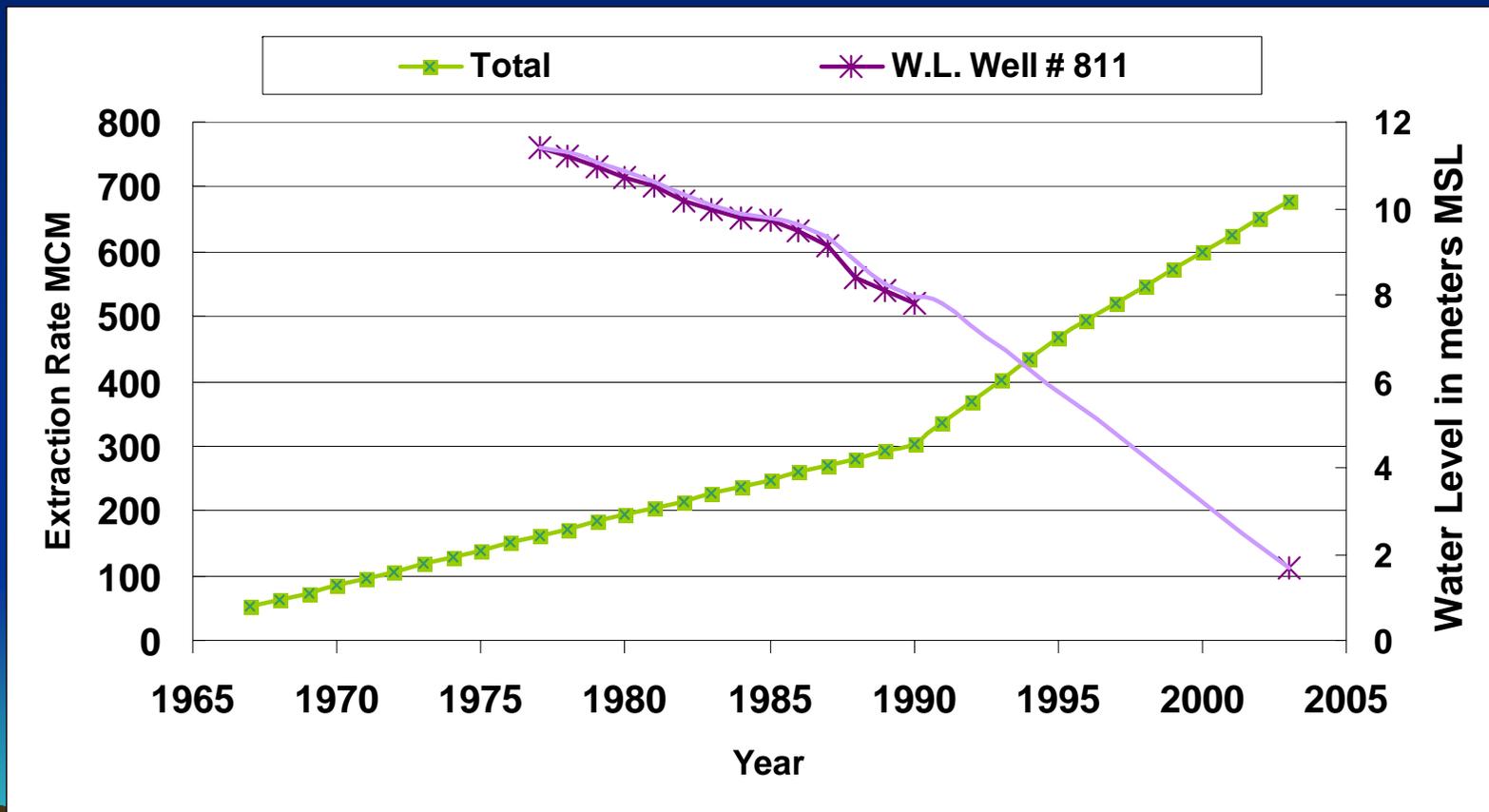
The Impact of Increase in Groundwater Pumping from Dammam Aquifer on Salinity level Change in Dammam Area (1967-2005)



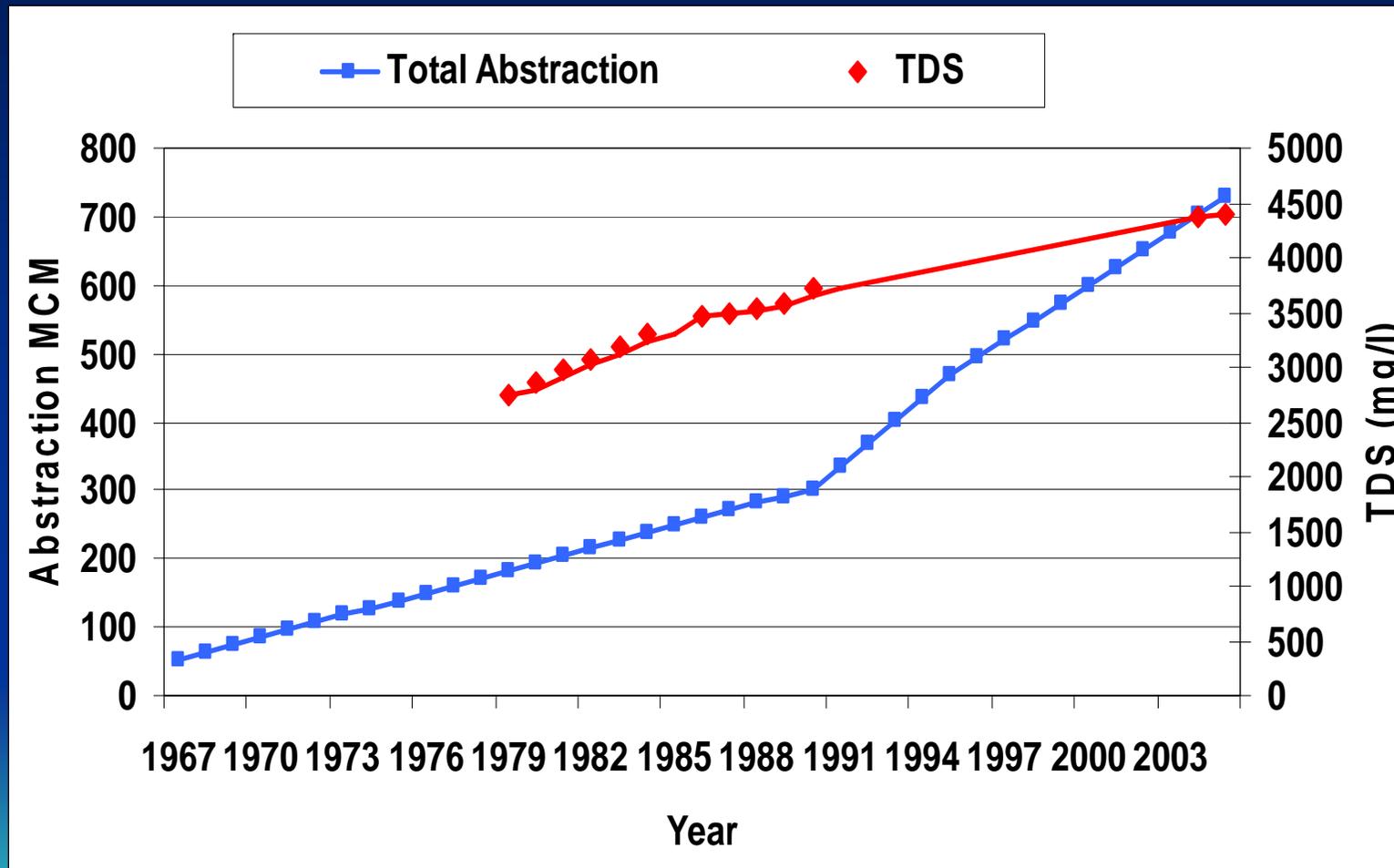
UMMER
RADHUMA
AQUIFER



The Impact of Increase in Groundwater Pumping from UER aquifer on water level in Dhahran Area (1967-2004)



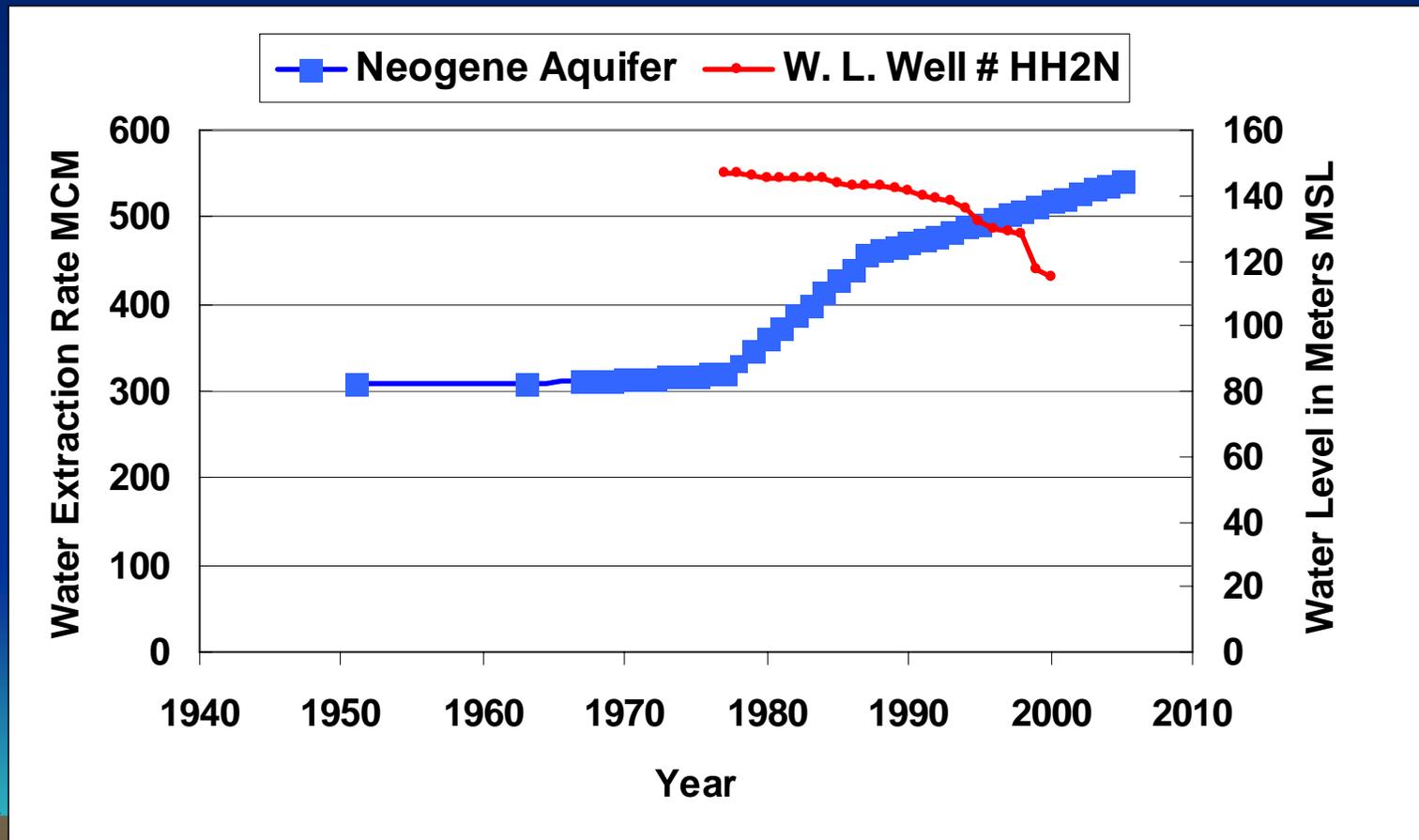
The Impact of Increase in Groundwater Pumping from UER Aquifer on Salinity level Change in Dhahran Area (1979-2005)



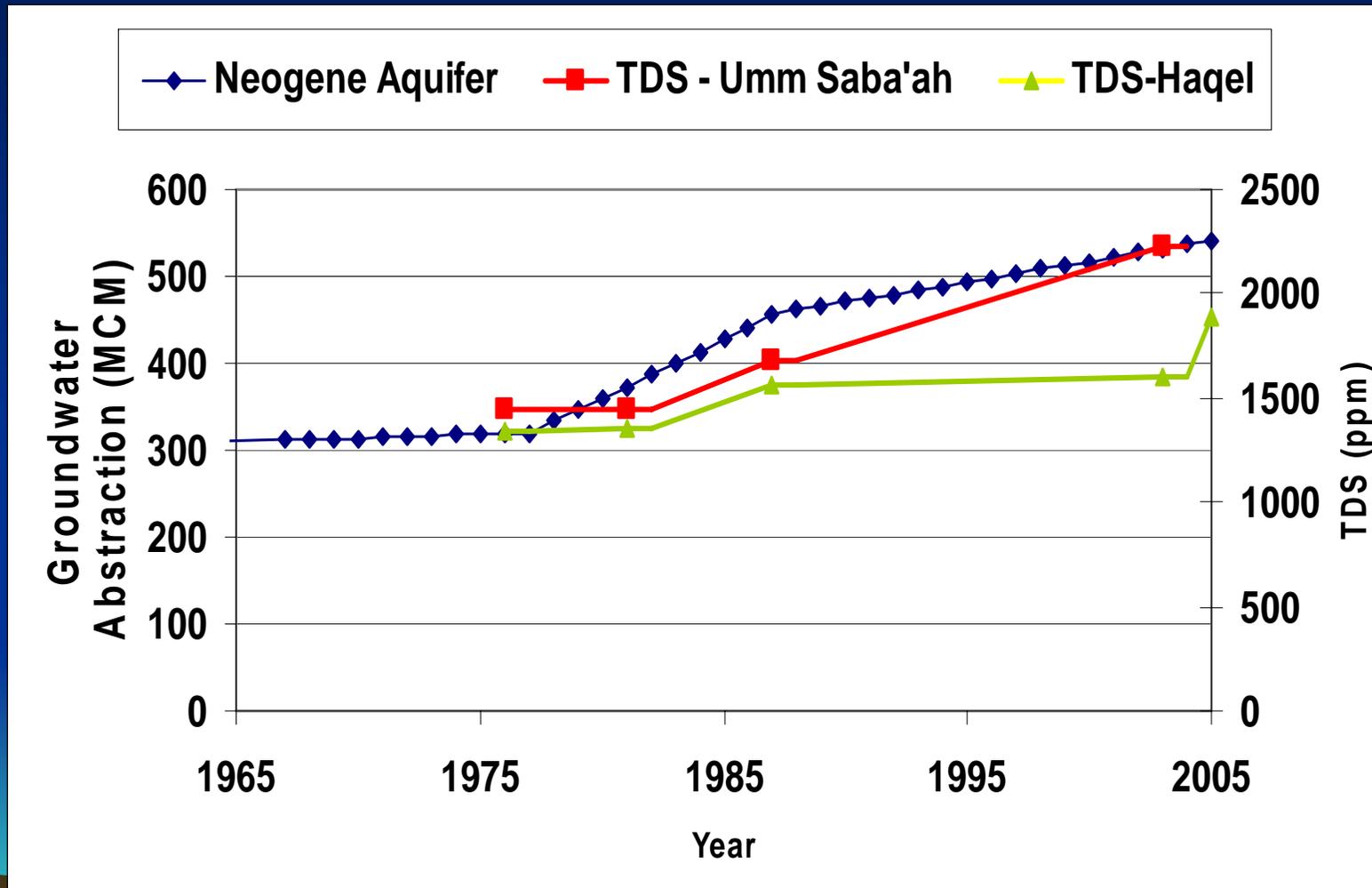
NEOGENE AQUIFER



The Impact of Increase in Groundwater Pumping from Neogene aquifer on water level (1951-2005)



The Impact of Increase in Groundwater Pumping from Neogene Aquifer on Salinity level Change (1979-2005)



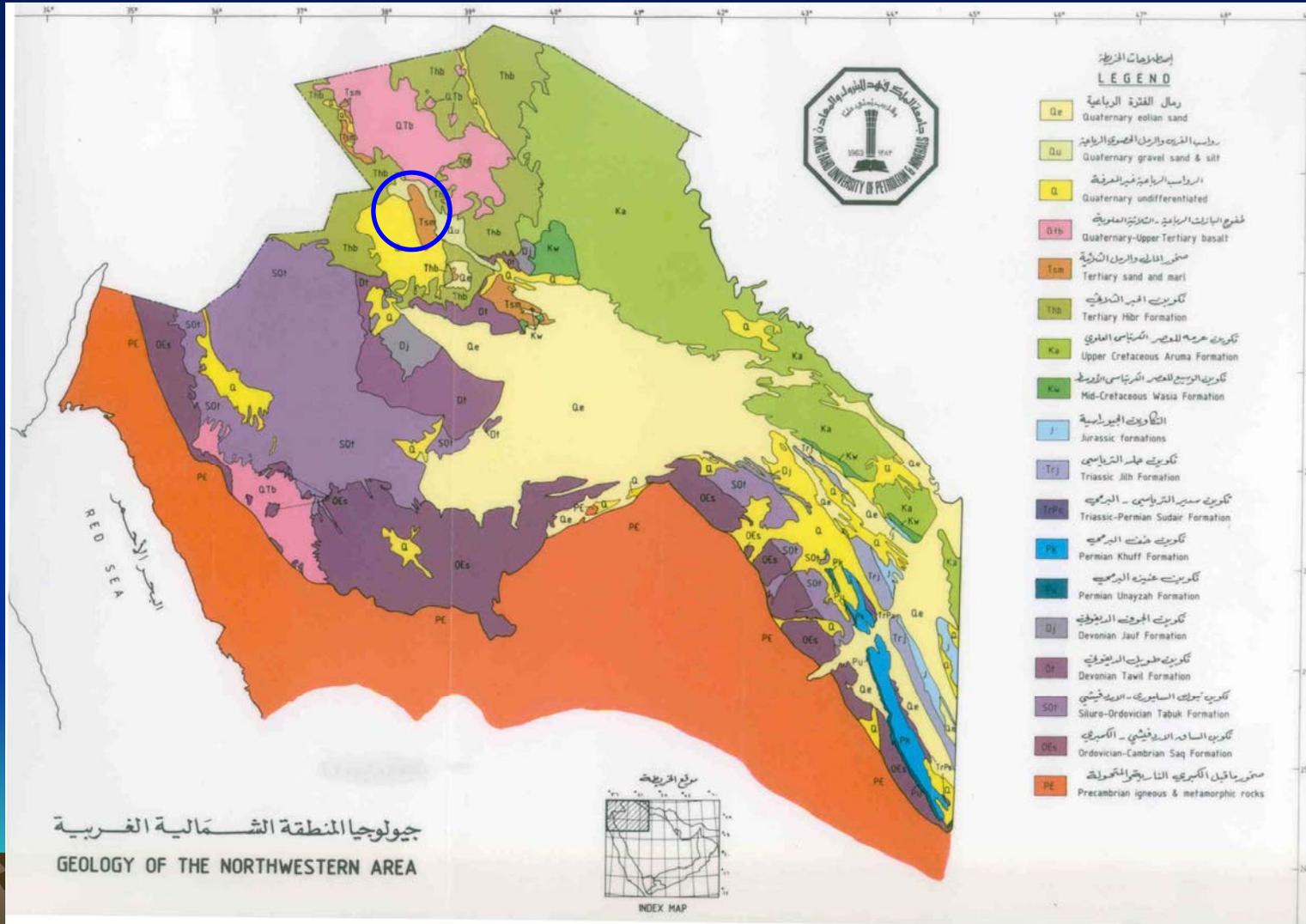
North Western Province



North Western Province



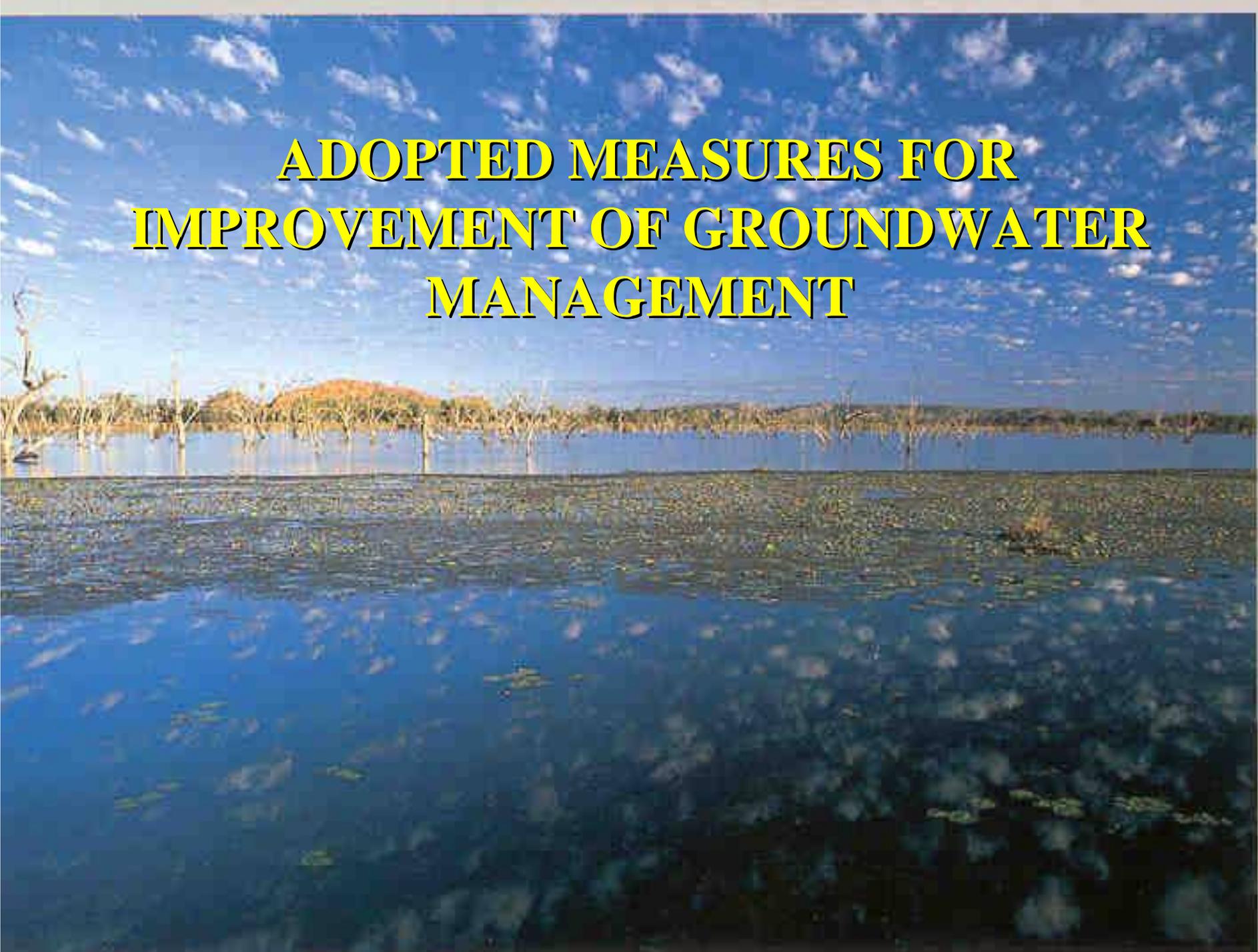
North Western Province



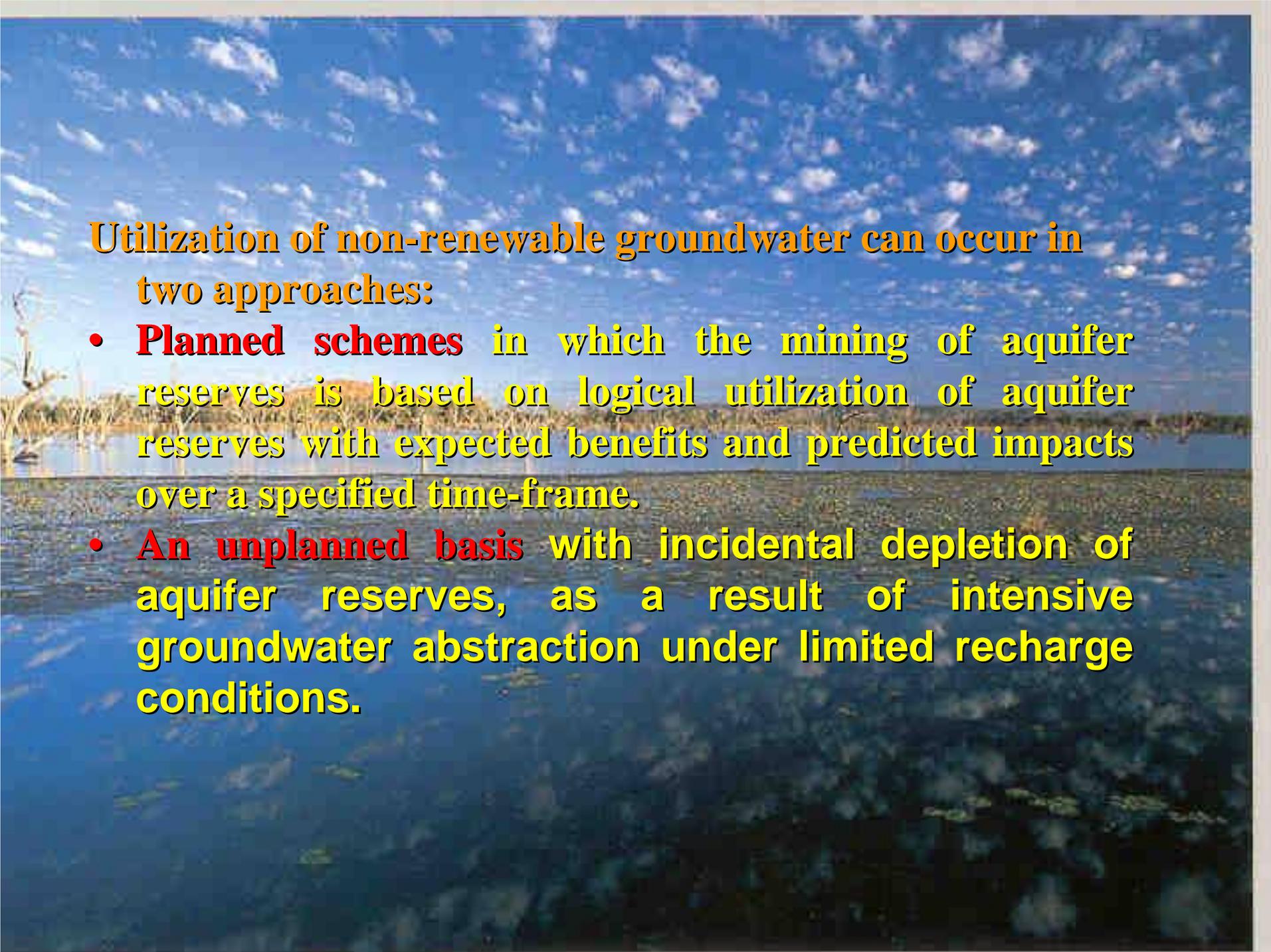
North Western Province

- More than 1,500 wells have been pumping about 2,300 MCM/year of groundwater with salinity level of less than 400 ppm since 1986.
- About 48 BCM of groundwater have been pumped after 1986.
- This is equivalent to 3.5 times the total production of the desalination since early seventies of the last century until now.



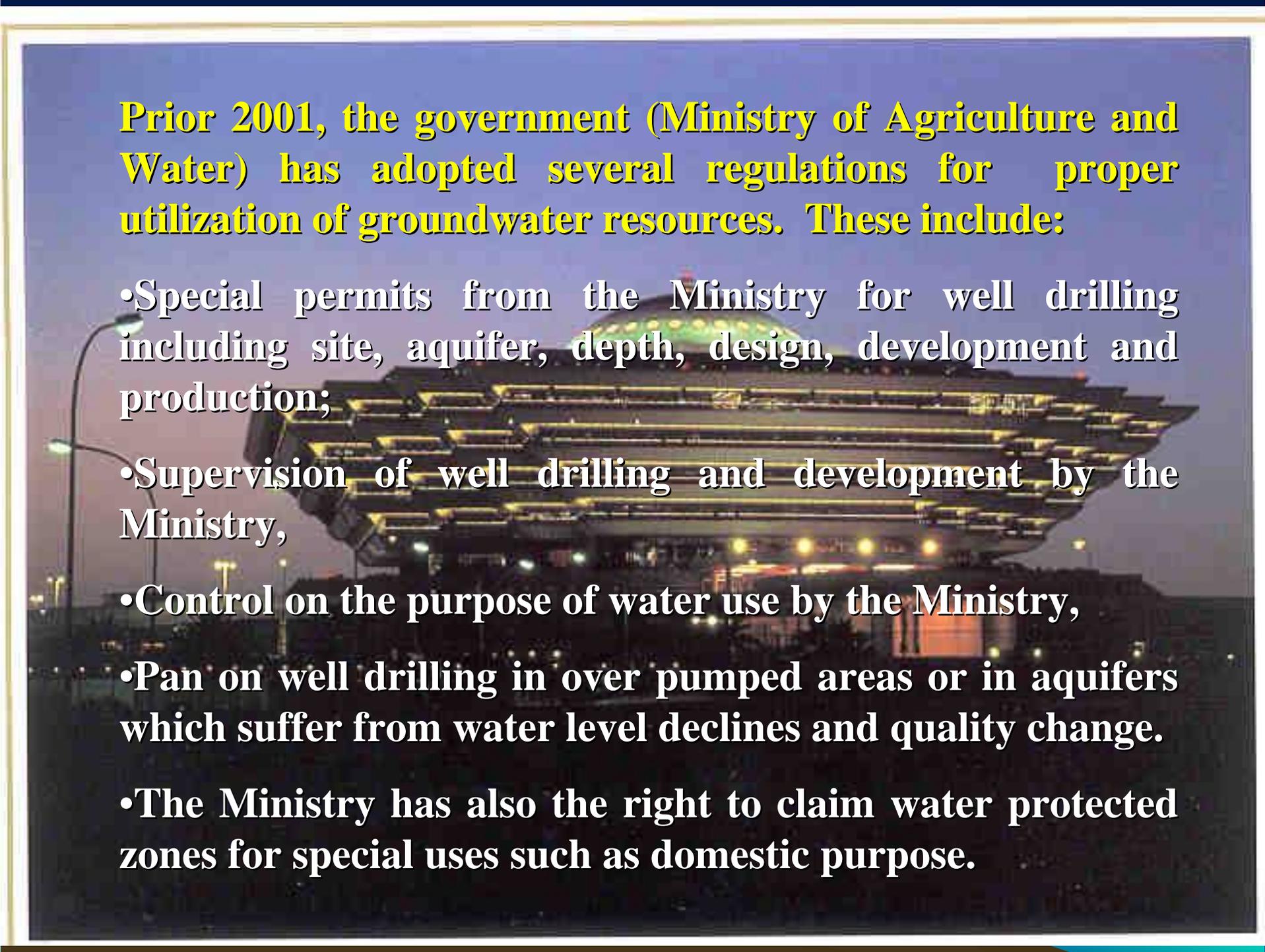


**ADOPTED MEASURES FOR
IMPROVEMENT OF GROUNDWATER
MANAGEMENT**



Utilization of non-renewable groundwater can occur in two approaches:

- **Planned schemes** in which the mining of aquifer reserves is based on logical utilization of aquifer reserves with expected benefits and predicted impacts over a specified time-frame.
- **An unplanned basis** with incidental depletion of aquifer reserves, as a result of intensive groundwater abstraction under limited recharge conditions.



Prior 2001, the government (Ministry of Agriculture and Water) has adopted several regulations for proper utilization of groundwater resources. These include:

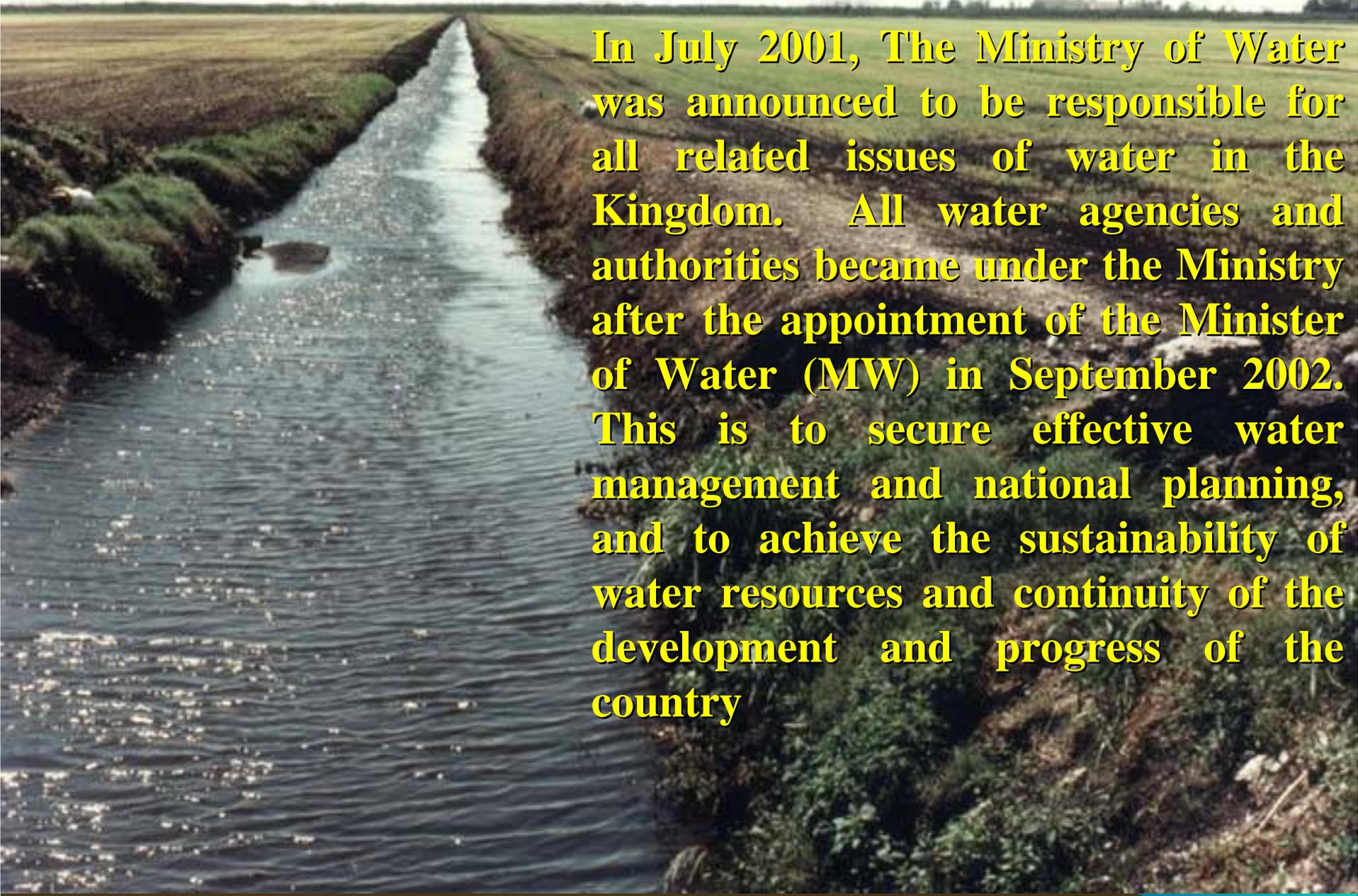
- Special permits from the Ministry for well drilling including site, aquifer, depth, design, development and production;

- Supervision of well drilling and development by the Ministry,

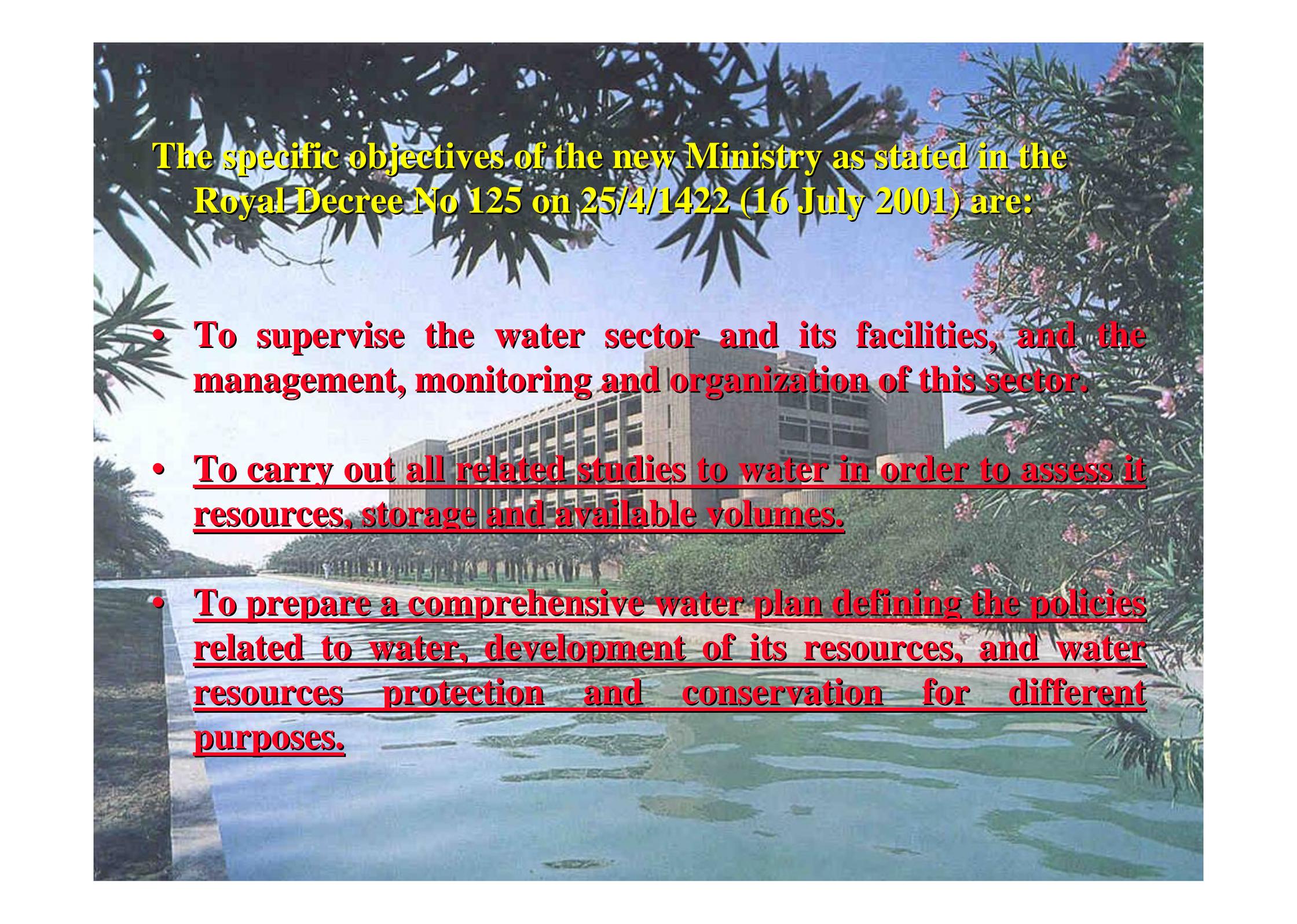
- Control on the purpose of water use by the Ministry,

- Ban on well drilling in over pumped areas or in aquifers which suffer from water level declines and quality change.

- The Ministry has also the right to claim water protected zones for special uses such as domestic purpose.



In July 2001, The Ministry of Water was announced to be responsible for all related issues of water in the Kingdom. All water agencies and authorities became under the Ministry after the appointment of the Minister of Water (MW) in September 2002. This is to secure effective water management and national planning, and to achieve the sustainability of water resources and continuity of the development and progress of the country

The background of the slide features a photograph of a large, modern, multi-story building with a grid-like facade, situated behind a row of palm trees. In the foreground, there is a body of water reflecting the sky and the surrounding greenery. The scene is framed by the dark silhouettes of trees and branches at the top and right edges.

The specific objectives of the new Ministry as stated in the Royal Decree No 125 on 25/4/1422 (16 July 2001) are:

- **To supervise the water sector and its facilities, and the management, monitoring and organization of this sector.**
- **To carry out all related studies to water in order to assess its resources, storage and available volumes.**
- **To prepare a comprehensive water plan defining the policies related to water, development of its resources, and water resources protection and conservation for different purposes.**

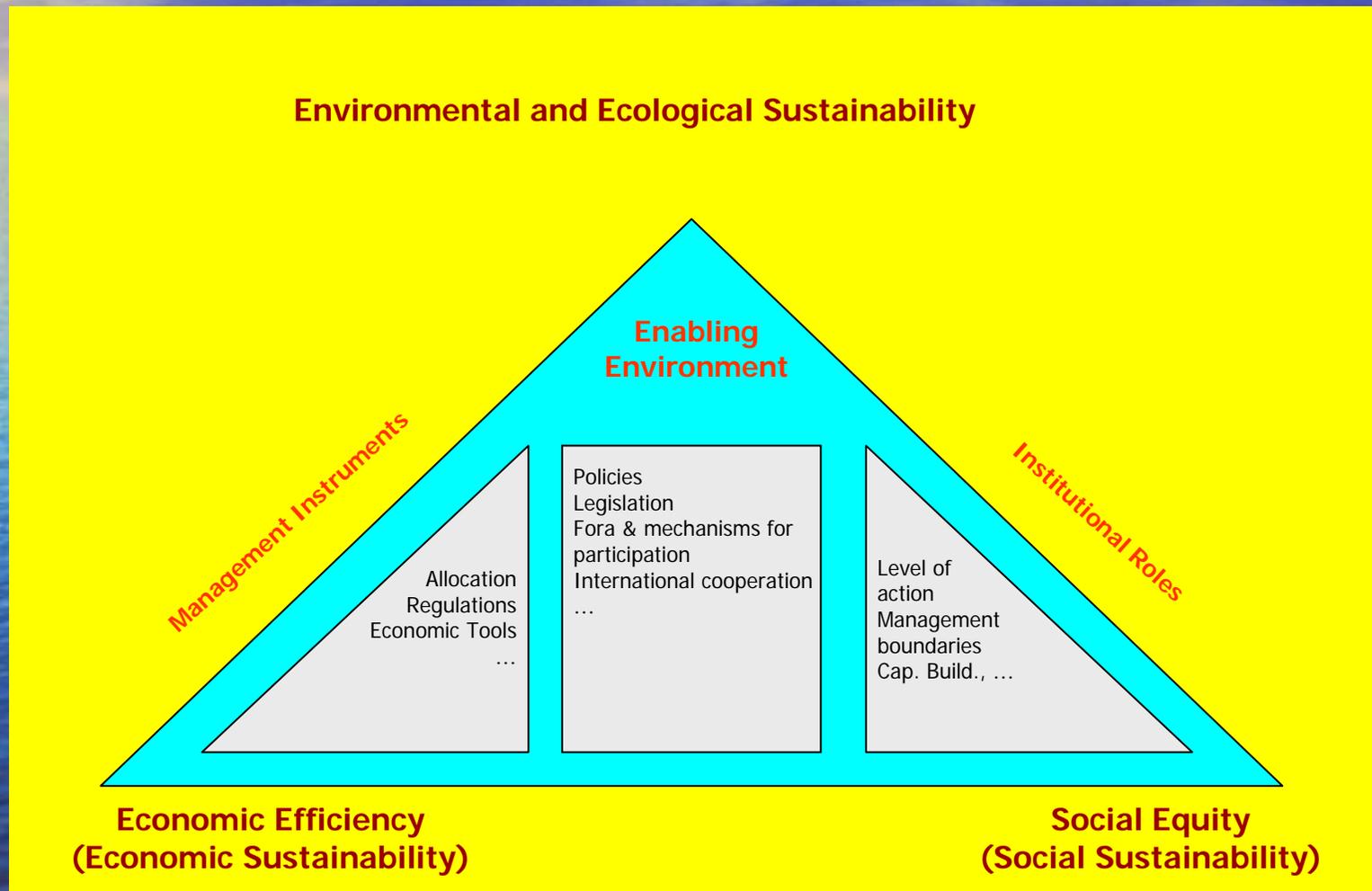
The Ministry has adopted the Integrated Water Resources Management (IWRM) as the main tool to achieve sustainability of water resources and development of the Kingdom.

IWRM is a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems



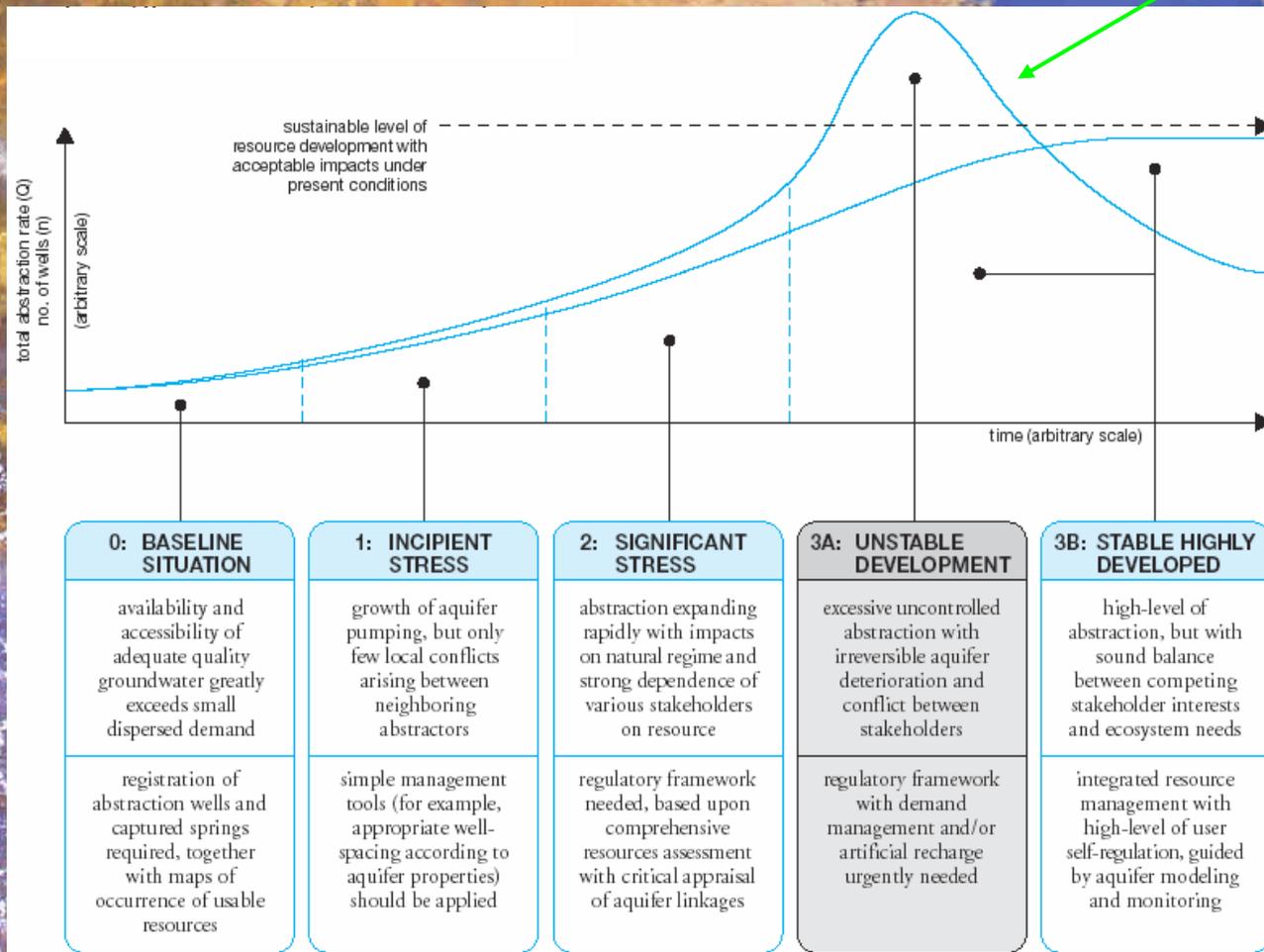
Objectives, tools and actions of IWRM

(World Bank, 2003)

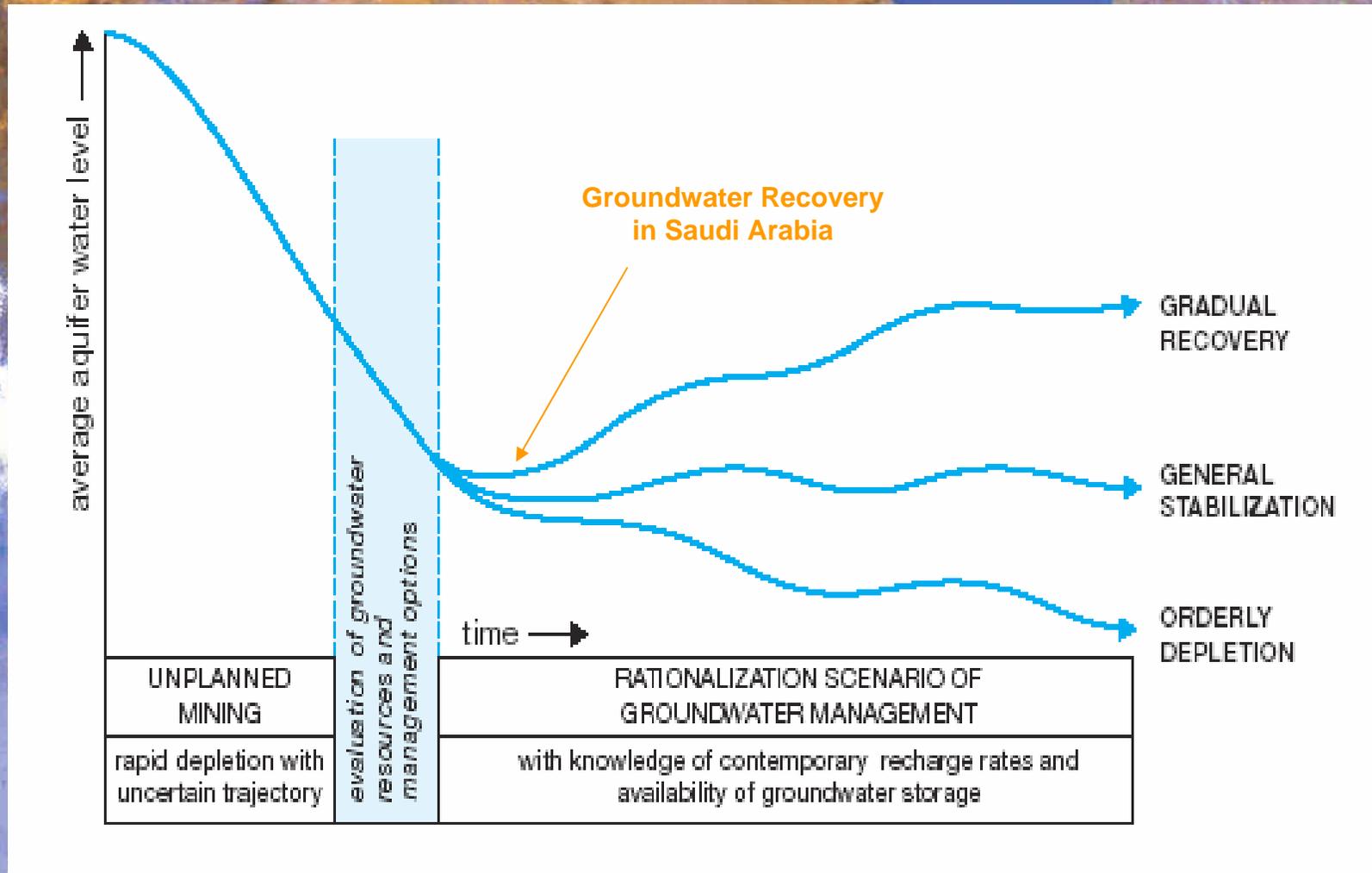


Stages of groundwater resource development in a major aquifer and their corresponding management needs (UNEP, 2003)

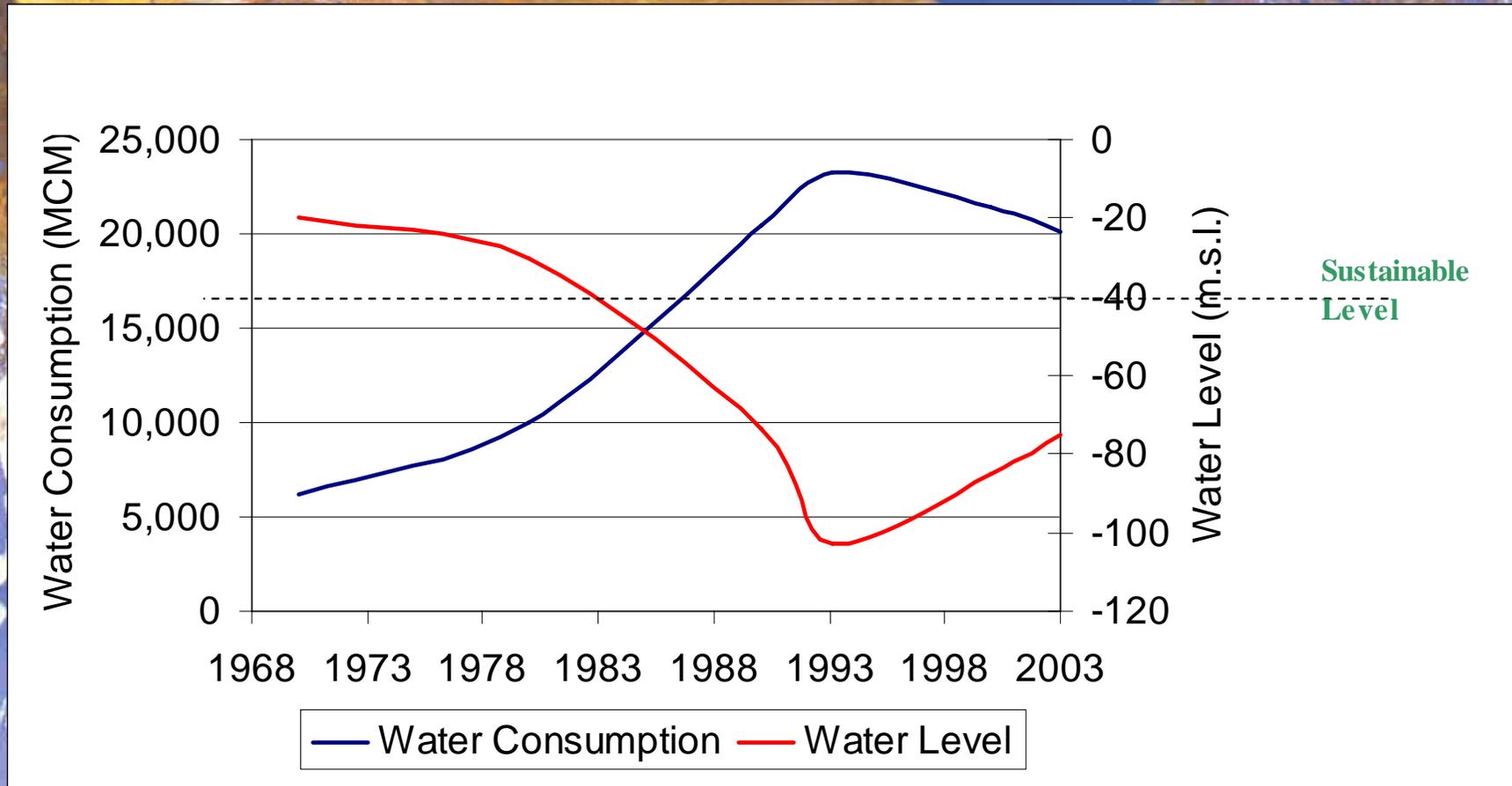
Groundwater
Conditions in Saudi
Arabia

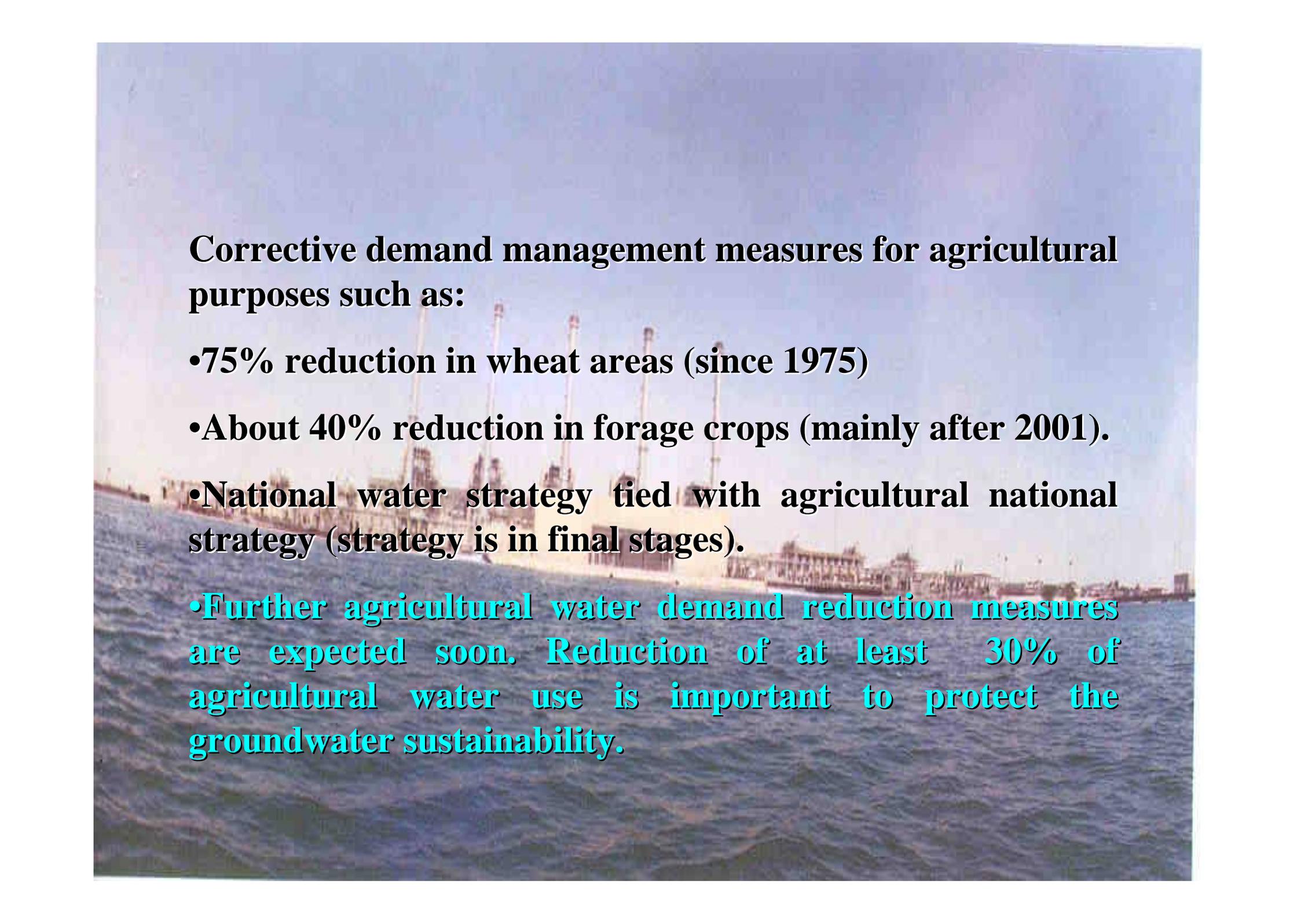


Targets for groundwater resources management in 'rationalization scenarios' following indiscriminate and excessive exploitation (UNEP, 2003)



Rationale Groundwater Resources Management in Saudi Arabia Following Excessive Exploitation 2003





Corrective demand management measures for agricultural purposes such as:

- **75% reduction in wheat areas (since 1975)**

- **About 40% reduction in forage crops (mainly after 2001).**

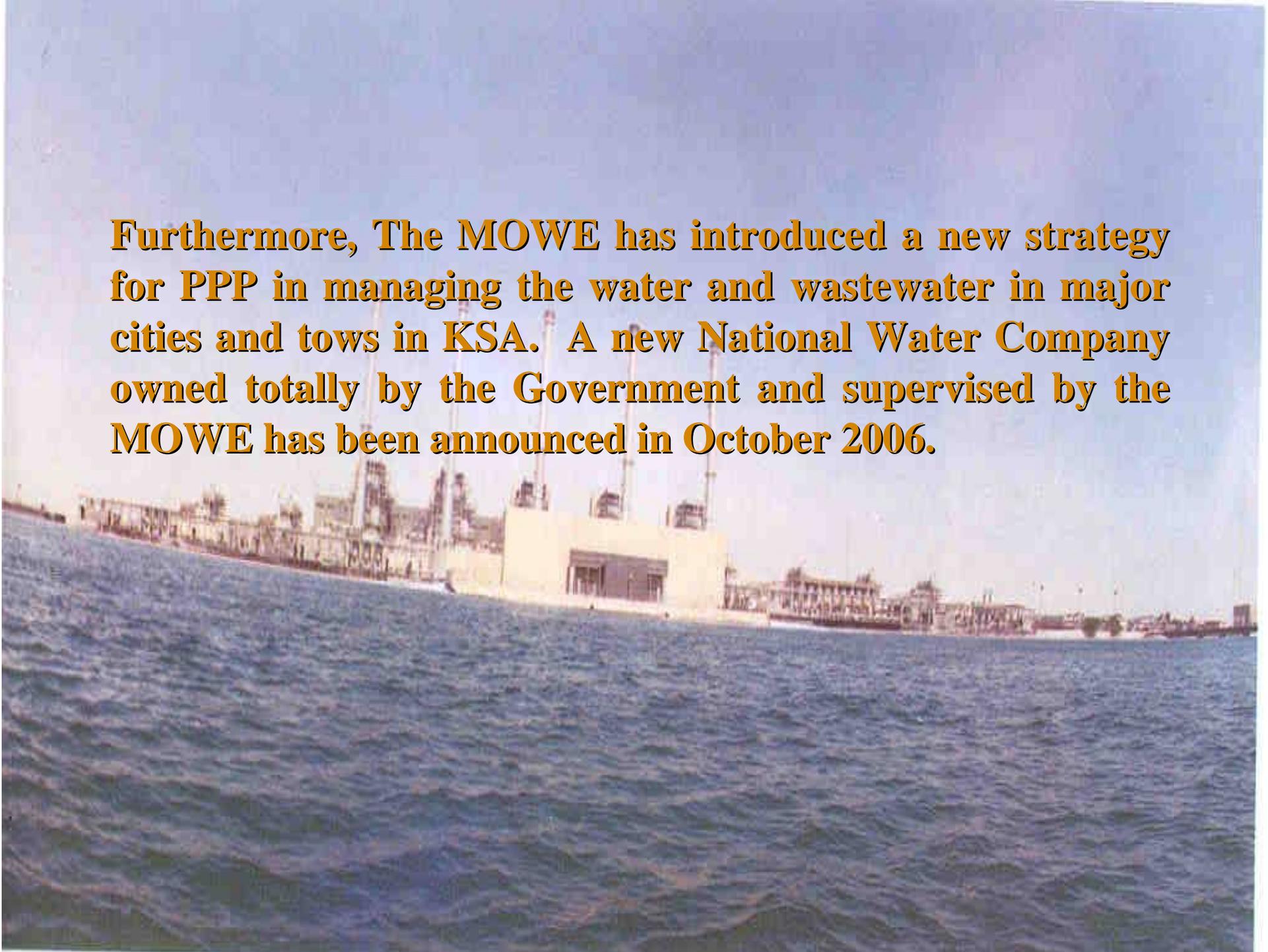
- **National water strategy tied with agricultural national strategy (strategy is in final stages).**

- **Further agricultural water demand reduction measures are expected soon. Reduction of at least 30% of agricultural water use is important to protect the groundwater sustainability.**

Corrective demand management measures for domestic purposes in urban and rural areas have been implemented. Daily savings of about 30% of domestic use or about 524,000 M3 (equal to the production of 4 desalination plants) have been achieved .

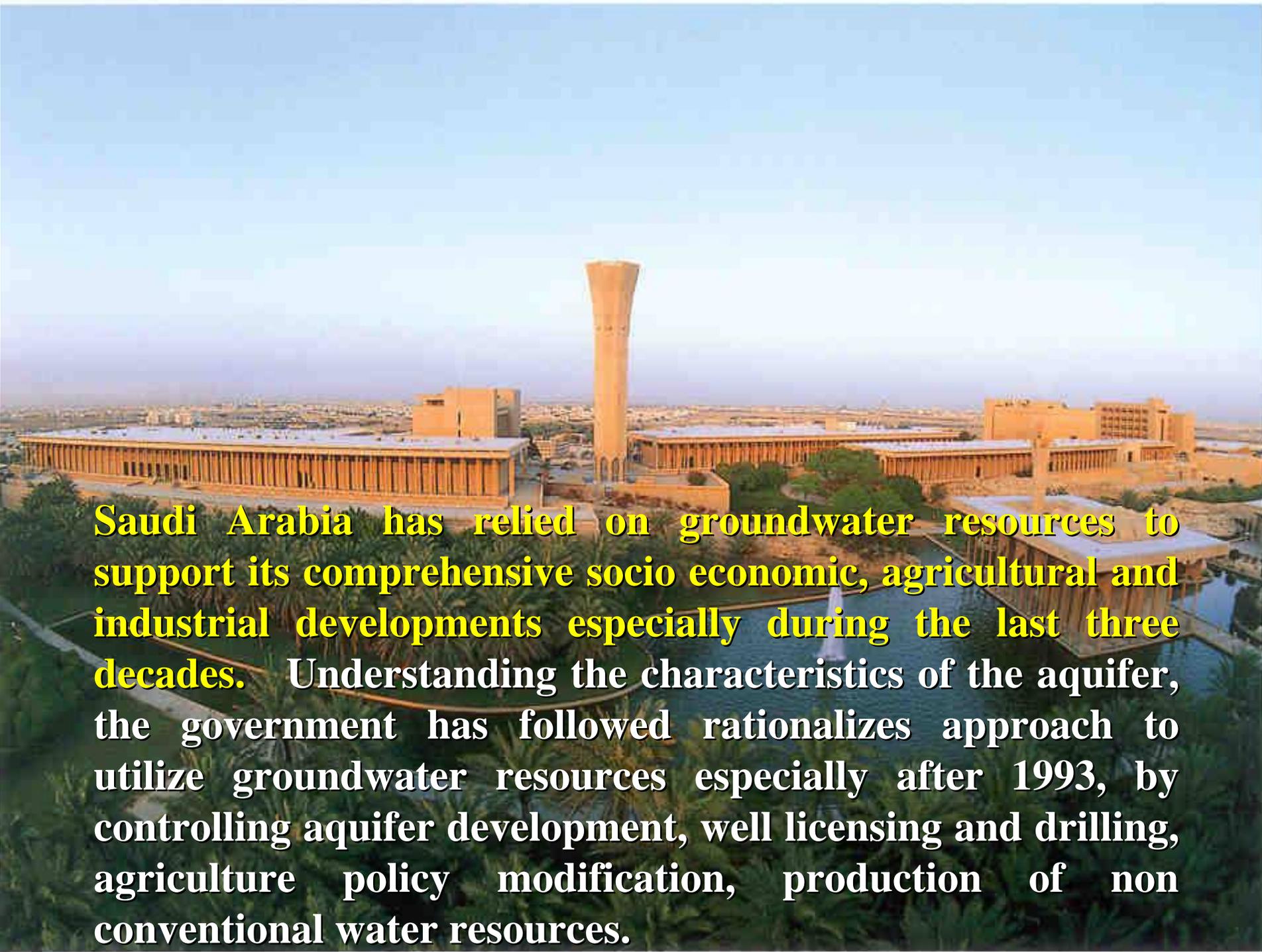


Furthermore, The MOWE has introduced a new strategy for PPP in managing the water and wastewater in major cities and towns in KSA. A new National Water Company owned totally by the Government and supervised by the MOWE has been announced in October 2006.

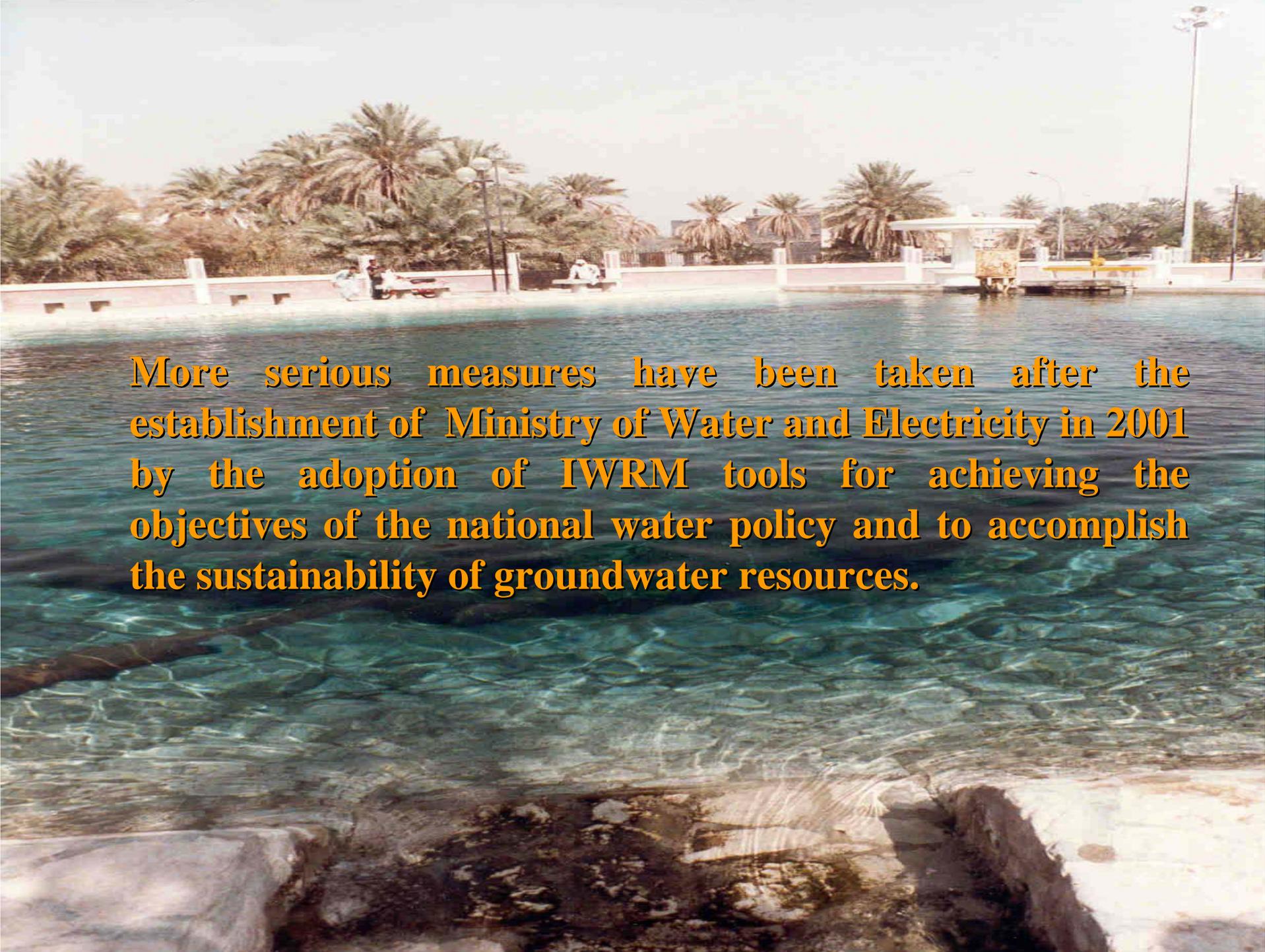


CONCLUSIONS



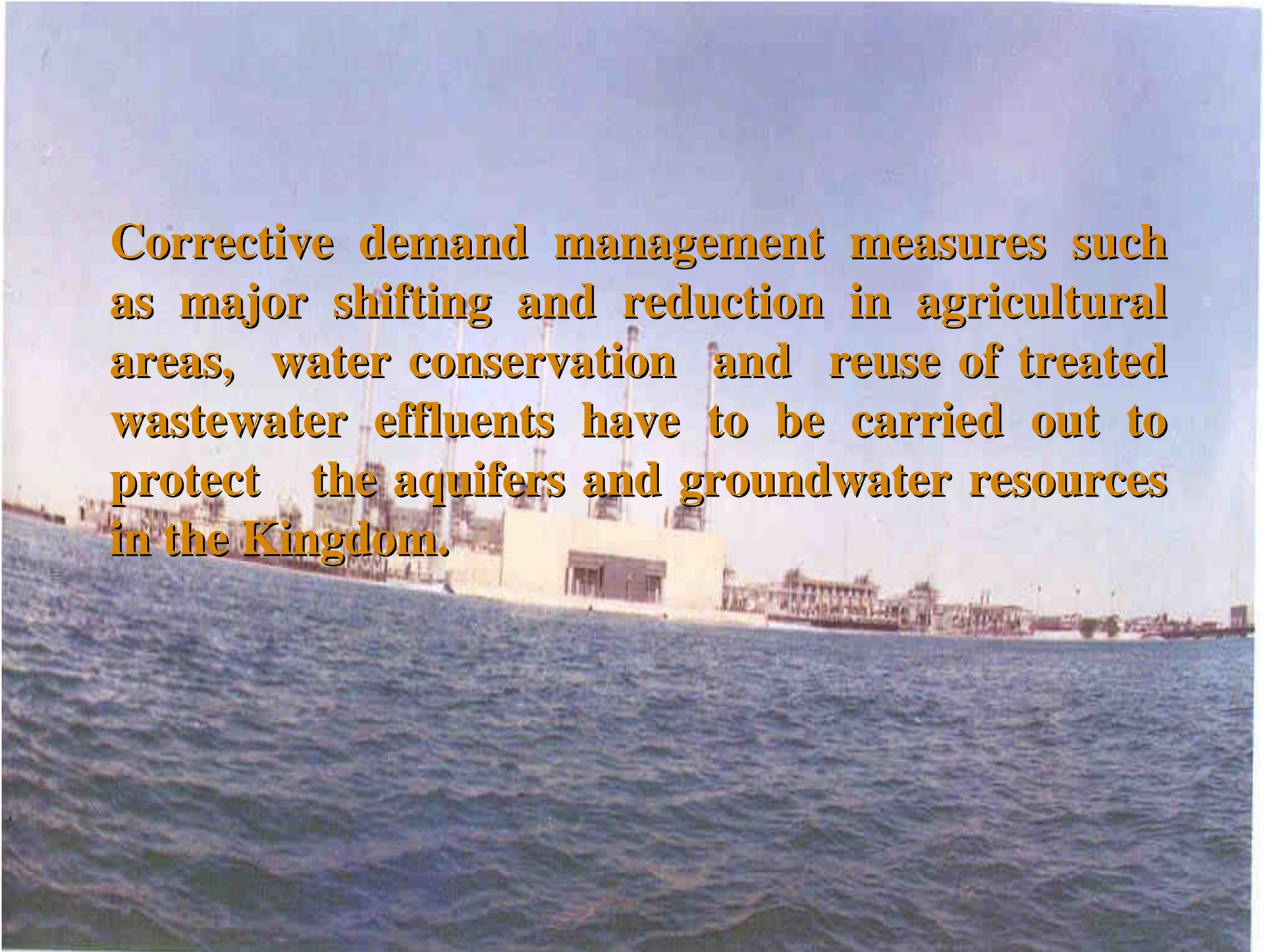


Saudi Arabia has relied on groundwater resources to support its comprehensive socio economic, agricultural and industrial developments especially during the last three decades. Understanding the characteristics of the aquifer, the government has followed rationalizes approach to utilize groundwater resources especially after 1993, by controlling aquifer development, well licensing and drilling, agriculture policy modification, production of non conventional water resources.



More serious measures have been taken after the establishment of Ministry of Water and Electricity in 2001 by the adoption of IWRM tools for achieving the objectives of the national water policy and to accomplish the sustainability of groundwater resources.

Corrective demand management measures such as major shifting and reduction in agricultural areas, water conservation and reuse of treated wastewater effluents have to be carried out to protect the aquifers and groundwater resources in the Kingdom.



An aerial photograph of a university campus. In the center, a tall, slender, cylindrical tower stands prominently. To its left and right are long, low-rise buildings with a series of vertical columns. In the foreground, a large, curved fountain with a single white water spout is surrounded by lush greenery and palm trees. The sky is a clear, light blue. The text "Thank You" is overlaid in the center in a bold, yellow, serif font with a black outline.

Thank You