Water Needs in the Middle East Region

From Red Sea to Dead Sea- Water and Energy

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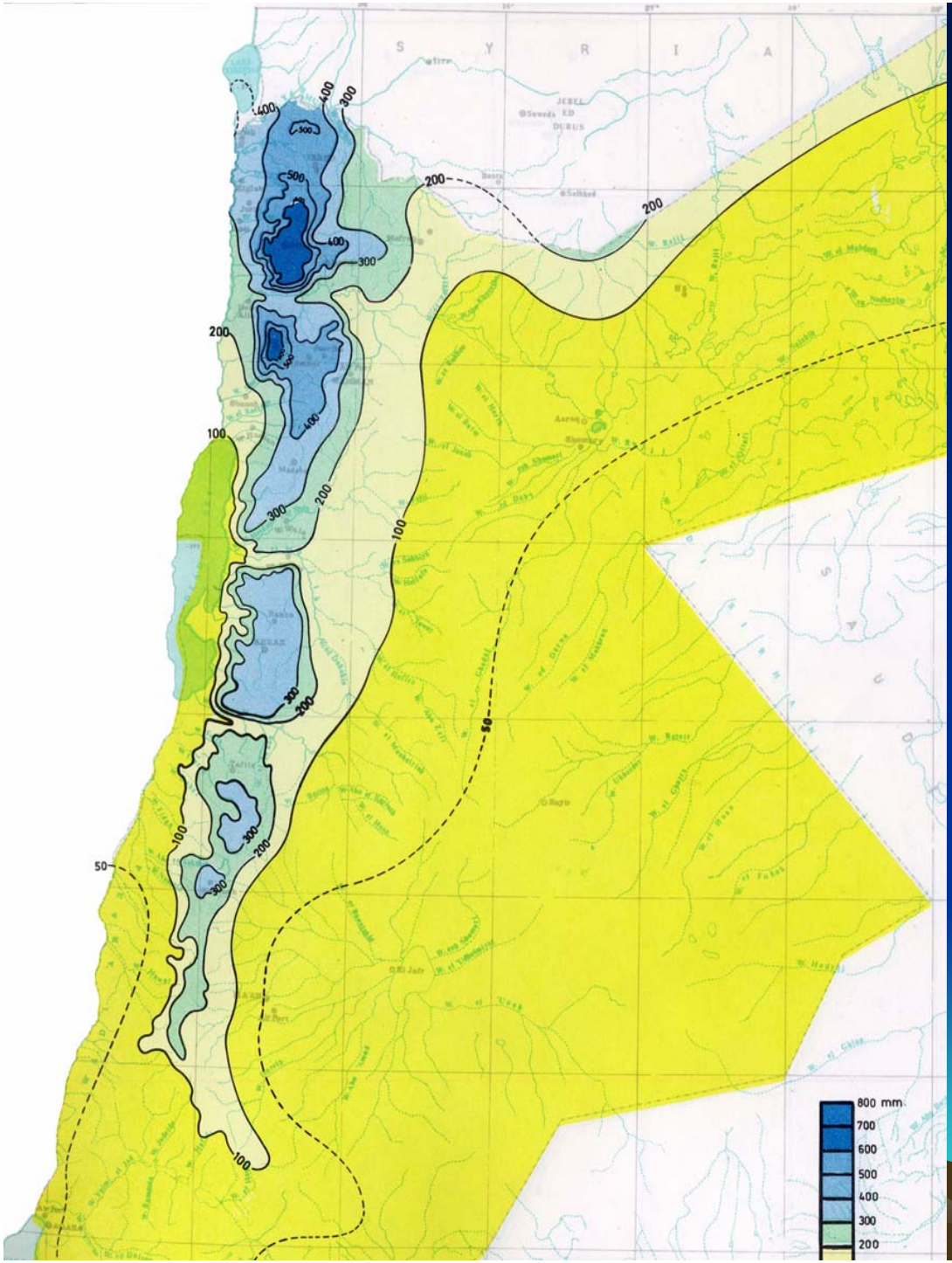
1. Introduction

- **Jordan is categorized between the arid and semi arid countries, and can be considered one of the most ten water stressed countries in the world, with less than 150 cubic meters (CM) annual per capita of fresh water resources, while the world water poverty line is 1000 CM.**
- **Jordan is divided into 15 surface water basins and 12 ground water basins, some of which extend to neighboring countries.**
- **Water resources depend on rainfall which varies in quantities, intensity and distribution from year to year, with most fall between the months of October and May.**

1. Introduction

- water scarcity is the single most important natural constraint to Jordan's economic growth and development
- Jordan's population reached 5.3 million in 2003 and is growing at a very high annual rate of 3.6 percent.
- Rainfall intensities vary from 600 mm in the North West to less than 130 mm in the eastern and southern deserts, which form about 91% of the surface area.
- The water scarcity issue is not only due to nature and poor resources, but is largely a man-made problem caused by politics in the region



Average Annual Rainfall

Jordan Valley

50-300 mm (5.7%)

High Land

400 – 600 mm (2.9%)

Desert Area (Badia)

50 – 200 mm (91.4%)

Annual quantities (MCM):

Wet Years 11000

Dry years 5800

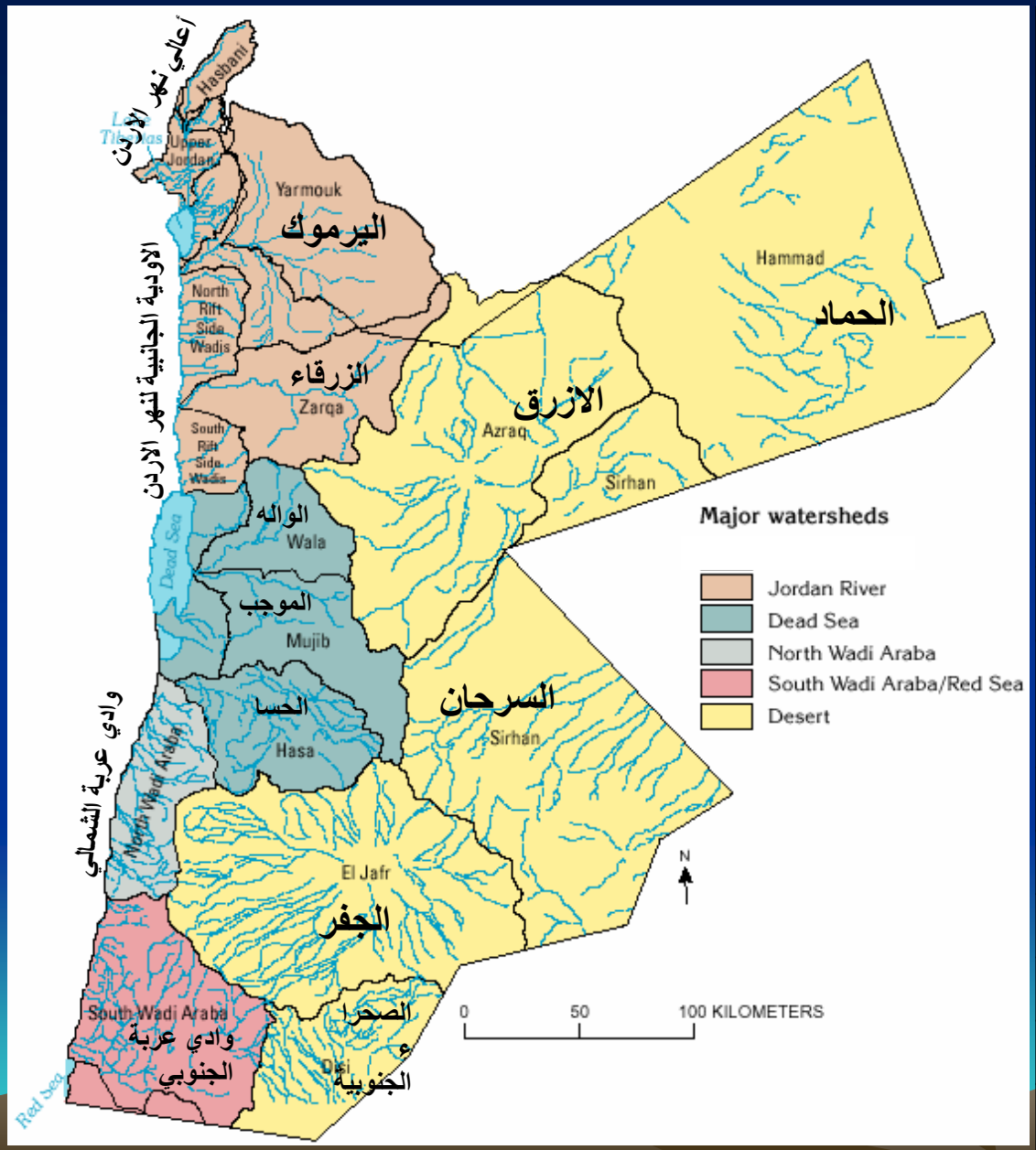
Annual average 8300

What is used from these quantities as surface and ground water is 8%

2. Water resources

- The potential for water resources in Jordan ranges from 1,000 to 1,200 MCM, including recycled treated wastewater
- Water resources consist primarily of surface and groundwater, with treated wastewater being used on an increasing scale for irrigation, mostly in the Jordan Valley

Surface Water Basins



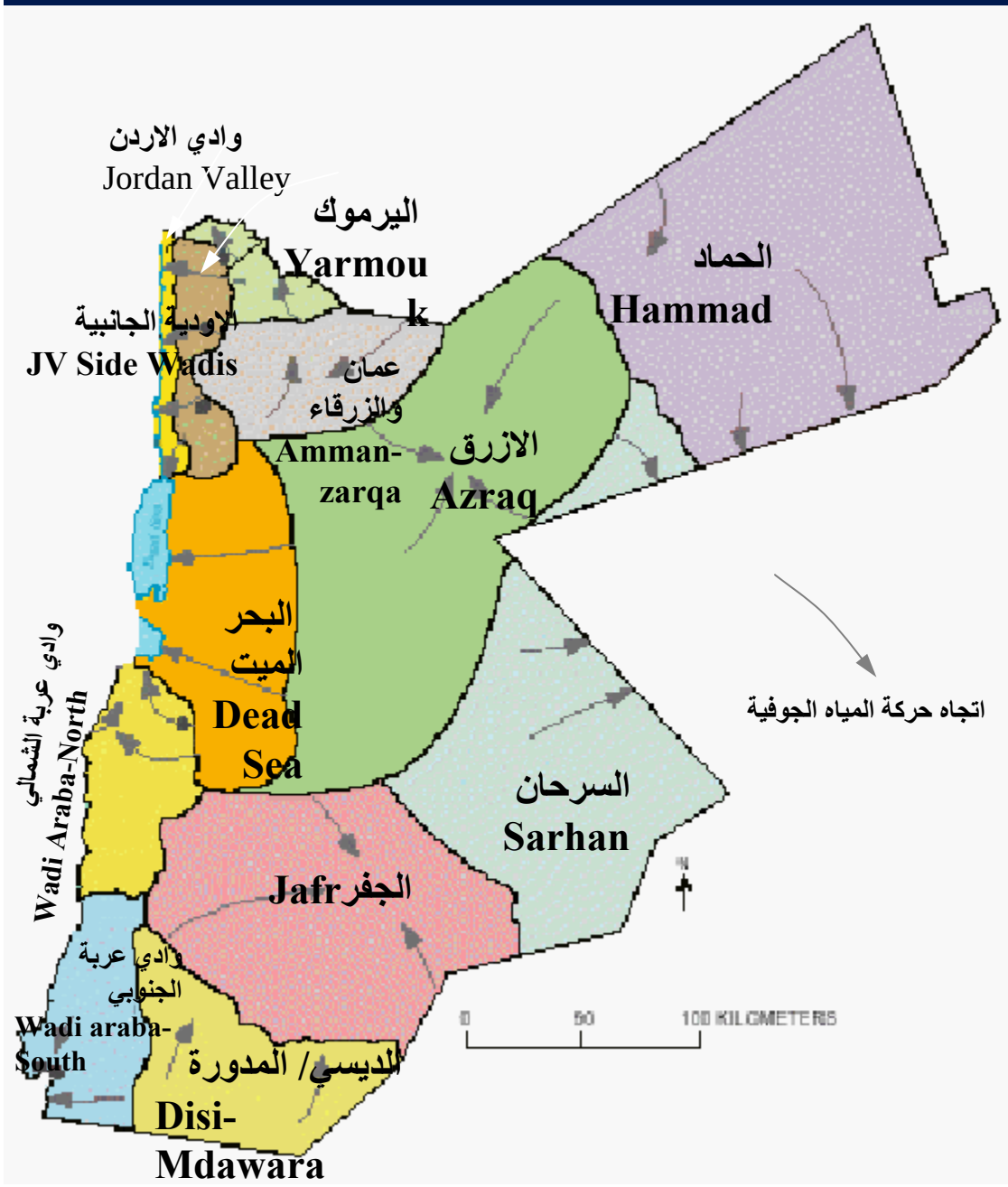
Annual Discharge MCM	Basin
166	1) Yarmouk*
84	2) Zarqa
58	3) Northern Side wadis
58	4 Southern Side Wadis
8	5) Jordan Valley
102	6) Mujib & Wala
43	7) Dead Sea Side Wadi
43	8) Hasa
41	9) Azraq
24	10) Hammad
18	11) Sarhan
13	12) Jafr
1	13) Southern Desert
46	14) Wadi Araba - North
8	15) Wadi Araba - South
713	Total

* Jordan share after the construction of Wehda dam + storage in Lake

Surface water resources

- The three major surface water systems in Jordan are the Jordan, Zarqa and Yarmouk, but all have become highly undependable
- The King Talal Dam is Jordan's largest aboveground reservoir, but it faces two problems. Erratic surface water levels often reduce trapped levels to below the total capacity of 86 MCM. Also, pollution from factories that dump untreated waste into tributaries leading to the dam is raising salinity, chemical, and metal levels.

Ground Water Basins



Safe Yield MCM/yr	Aquifer
60-70	1) Amman-zarqa
30-35	2) Azraq
30-35	3) Yarmouk
28-32	4) Jordan River Side Wadis
15-20	5) Jordan River
40-50	6) Dead Sea
11-12	7) Hammad
7-10	8) Sarhan
7-10	9) Jafr
2-3	10) Disi / Mdawara
5-7	11) Wadi Araba / North
4-6	12) Wadi Araba / South
240-294	Total

Groundwater resources

- Groundwater is considered to be the major source of water in Jordan, and the only source of water in some areas of the country
- The long term safe yield of renewable groundwater resources has been estimated at 275 MCM/year
- The main nonrenewable groundwater resource in Jordan exists in the Disi aquifer in the South, with a safe yield of 125 MCM/Year for 50 years

Available Water Resources (2006)

Groundwater Resources:

- **Average annual safe abstraction from renewable groundwater resources = 275 MCM**
- **Average annual return flow to groundwater = 56 MCM**
- **Total groundwater abstraction in 2005 = 507 MCM, out of which 178 MCM is over abstraction (99 MCM renewable and 79 non-renewable). This over abstraction if continued will cause an environmental disaster to the ground water basins.**

Surface Water Resources:

- **Average annual long term base flow and floods = 713 MCM**
- **Average annual exploitable Surface Resources = 534 MCM (Current uses = 395 MCM and current storage capacity = 360 MCM).**

Non – Conventional Water Resources:

- **Effluent from 22 waste water treatment plants in 2005 = 79 MCM. This figure will reach 85 MCM in 2006.**
- **Desalinated water for drinking purposes = 10 MCM from Abu Zeghan, in addition to 21 MCM from Zara in 2006.**

Total Water resources (2005) = 275 +56+395+79+10 = 815 MCM

Total Water resources (2006) = 275 +56+395+85+10+21 = 842 MCM

3. Water quality

- Water quality in Jordan has deteriorated due to various sources of pollution, and over-abstraction resulting in salination
- Reports indicate that:

- About 70% of spring water has biological contamination
- Surface water shows high fecal coliform counts from non-point pollution sources, including wastewater treatment plants operating over capacity
- Water resources have a significant level of toxicity
- Industrial discharges are improperly treated or untreated.
- Over-abstraction of groundwater for irrigation has reduced the water table by 5 meters in some aquifers and tripled salinity.
- Unregulated fertilizer and pesticide application has increased nitrates and phosphorus in water supplies.

4. Analysis of demand and supply of water

- Sustainable water supply in Jordan is limited, whereas demand is rising rapidly
- The present annual water demand amounts to 10% of the annual total rainfall on the country
- Almost all the economically viable surface water resources in Jordan have been harnessed, mainly for irrigation purposes

- The groundwater resources of the country are over-exploited; some basins have been completely depleted and the rest, if present trends persist, will run dry within a few years
- Increasing water demand for domestic and industrial purposes is expected as a result of the high population growth rate, and improvements in living standards and the anticipated developments in the tourism and industrial sectors

Water management and demand projections

Year	2004	2010	2015	2020	2022
Population (Million)	5.35	6.47	7.26	8.05	8.39
Population Growth	2.8%	2.5%	2.3%	2.1%	2.1%
Domestic Needs (MCM)	338	414	460	513	525
Industry & Remote Areas	59	77	100	120	125
Agriculture	900	1072	1040	983	980
Total Needs (MCM)	1297	1563	1600	1615	1630
Water Supply (MCM)	866	1150	1233*	1300	1832**
Deficit (MCM)	-431	-413	-367	-315	+202

* DISI starts at 2011 ** Red – Dead starts at 2022

The above table shows that there will be no water shortage by 2022, and water will be available to cover all water needs until 2040.

5. Impacts of water scarcity

Countries with less than 500 cubic meters per capita suffer from absolute scarcity

Government development plans could not be implemented in case of water shortage, which hinders reaching the annual development targets.

Water shortage causes the shrinkage of investments in the tourism, industrial, commercial and agricultural sectors, causing negative impact on the continuous efforts at all levels to attract investments.

Environmental impacts

- The use of groundwater aquifers has dried up a big percentage of aquatic ecosystems in the country
- Wastewater flows from treatment plants and wastewater collection systems damaged groundwater resources to a large extent. Most of the current wastewater treatment plants are working beyond capacity, and their resulting effluent is polluting the environment.

Social impact

- The most direct consequences of the lack of water on human life and well-being will be those affecting domestic use
- Jordan's inhabitants consume actually an average of only 85 liters a day in the households
- In Jordan, municipal demand has surpassed the available supply since the mid-1980s and rationing had to be introduced systematically in most provinces in 1988.
- Especially during summer, 85% of the Jordanians live at the hygienic brink. Even in the capital, Amman, running water is only available then for a few hours of the week.

Constraints to industrial development

- Industrial water consumption varies considerably, depending on the applied processing technologies.

Production	Water needed (liter)
A tin of vegetables	3
0ne kilogram of paper	100
One ton of cement	4500
One ton of leather	50 000
One ton of steel	280 000

- Most of the industrial companies that depend mainly on the public network declared that they had faced water shortages in the past, primarily during summer
- Another problem is related to water quality. Several companies reported that they had to treat their fresh water prior to use

The Ministry of Water & irrigation is working very hard for additional water resources, and for efficient management of water distribution and use in order to meet the demand of population increase and development.

6. Future Water Resources

DISI Project:

- Water quantities that can be exploited from DISI basin for drinking purposes will mount to 100 MCM starting in 2011.

Red Sea – Dead Sea Water Conveyance Project:

- Water quantities that can be exploited from desalination of Red Sea water will be around 570 MCM starting in 2022.

Surface Water Resources:

- Additional annual average surface water resources that can be exploited = 139 MCM (in addition to the currently exploited 395 MCM).

Non-Conventional Water Resources:

- Effluent from 34 waste water treatment plants = 89 MCM in 2020 (in addition to the currently exploited 85 MCM).
- Desalinated brackish and Red Sea water desalination at Aqaba = 65.5 MCM in 2020 (in addition to the currently exploited 31 MCM).
- Return flow to groundwater = 26 MCM (in addition to the currently available 56 MCM).
- Total new future Resources = 100+570+139+89+65.5+26 = 989.5 until year 2022.
- Available Current Resources = 842 MCM
- Total available Resources by 2022 = 1832 MCM

7. Water Sector On-Going Actions

- Expanding Waste water treatment services using the best international technologies according to the Jordanian and international standards.
- Sustainability of irrigated agriculture in the Jordan Valley, with no expansion of the irrigated areas.
- Institutional and legal development of the water sector
- Private sector participation in the management of water facilities. Examples are:
  - Amman Municipality Water Management Contract (LEMA). A Public company will be formed soon to manage the sector on commercial basis.
  - Aqaba Water Company
  - Consultancy Management Contract for Northern Governorates
  - Management contract for billing and collections in Madaba.
- The implementation of strategic projects such as building dams, the latest of which is Al-Wehda Dam (110MCM) at the Yarmouk River and the continuation of the water harvesting program, Zara-Maein project to supply the city of Amman with around 40 MCM/year, DISI Project, the Red Sea-Dead Sea water Conveyance Project.
- Requesting Jordan water rights in the trans-boundary waters from the neighboring countries.

8. Strategic Water Projects

To reduce water shortage

and bridge the gap between supply and demand in the future

Interdisciplinary and multidisciplinary work is the nature of modern water management.

Solving problems from a broad view

DISI Water Project

- **The project aims at the exploitation of around 100 MCM/year of DISI aquifer groundwater for drinking purposes in Amman.**

- **The project will include the digging of 37 wells in addition to the pumping stations, storage reservoirs and a 325 km pipeline (1600mm diameter).**

- **The estimated cost will be around 385 million JD's, and the implementation period around five years.**

Red Sea – Dead Sea

Water Conveyance Project

Importance of the Dead Sea

The Dead Sea is a unique international heritage.

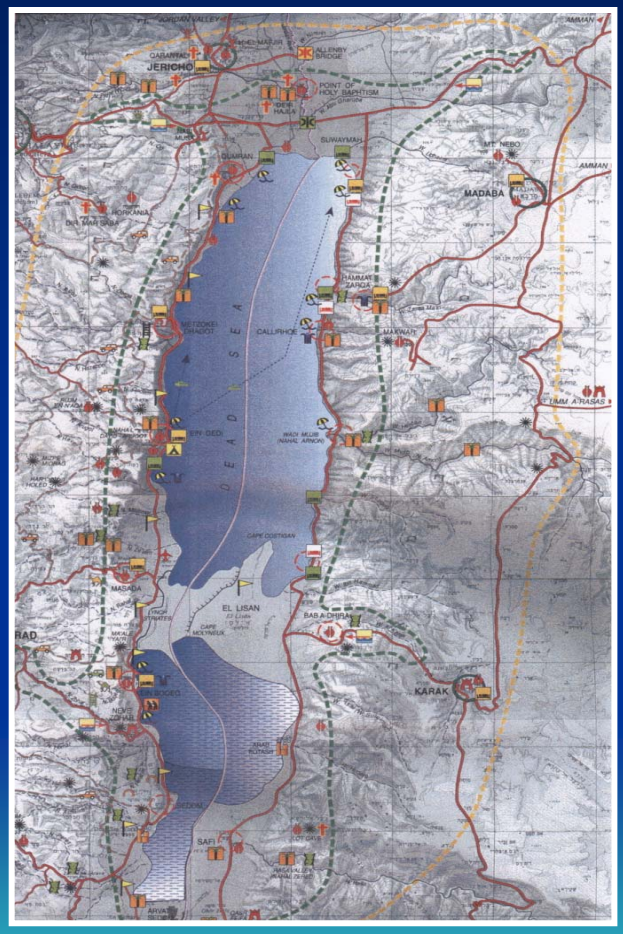
The uniqueness comes from:

1- Location, Climate and Properties

2- Cultural and religious treasure

3- Unique environment

4- Economic attraction

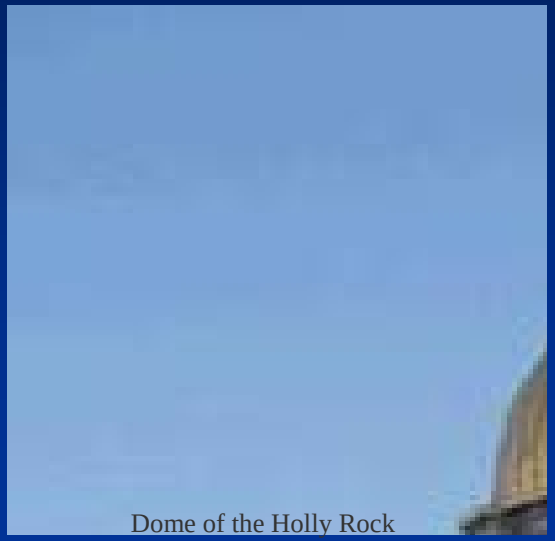


Location, Climate, Properties

- The Dead Sea is the lowest spot on earth (417 meters below sea level) and 400 meters deep.
- Located at 40 km from Amman , and 35 km from Jerusalem (both at about 800 meters above sea level).
- Dead Sea water contains more than 30% mineral rich salts. Salinity is 10 times higher than sea water.
- It has a unique mud that is rich in minerals, a high oxygen level climate and many thermo-mineral springs.

A Cultural and Religious Treasure

- Origin and/or center of religions and cultures
- Biblical history and places of pilgrimage
- The region has shaped the world


Dome of the Holly Rock


Mount Sodom and Lot's wife

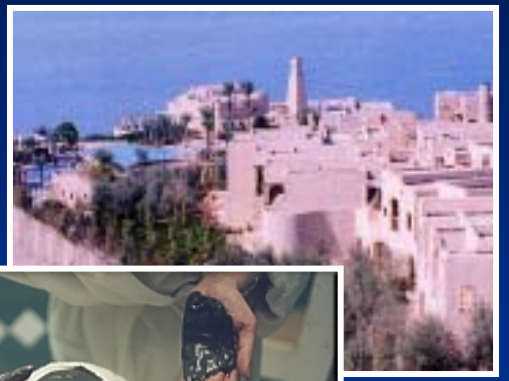

Pop John Paul II visit to Baptism site

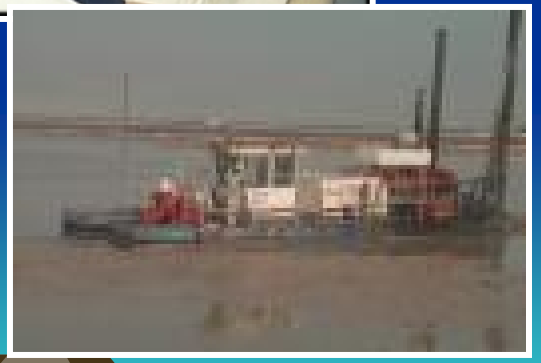
Unique Environment

- A unique eco-system housing rare wildlife and endangered species
- Sandstone Formations
- Spectacular landscape with rare attributes
- Multiple Nature Reserve

Economic Attraction

- **A promise of continued economic growth in the region while conserving the environment**
- **Huge tourism potential**
- **Unique medical and health resources**
- **Mineral Dead Sea products**
- **Potash Industry**

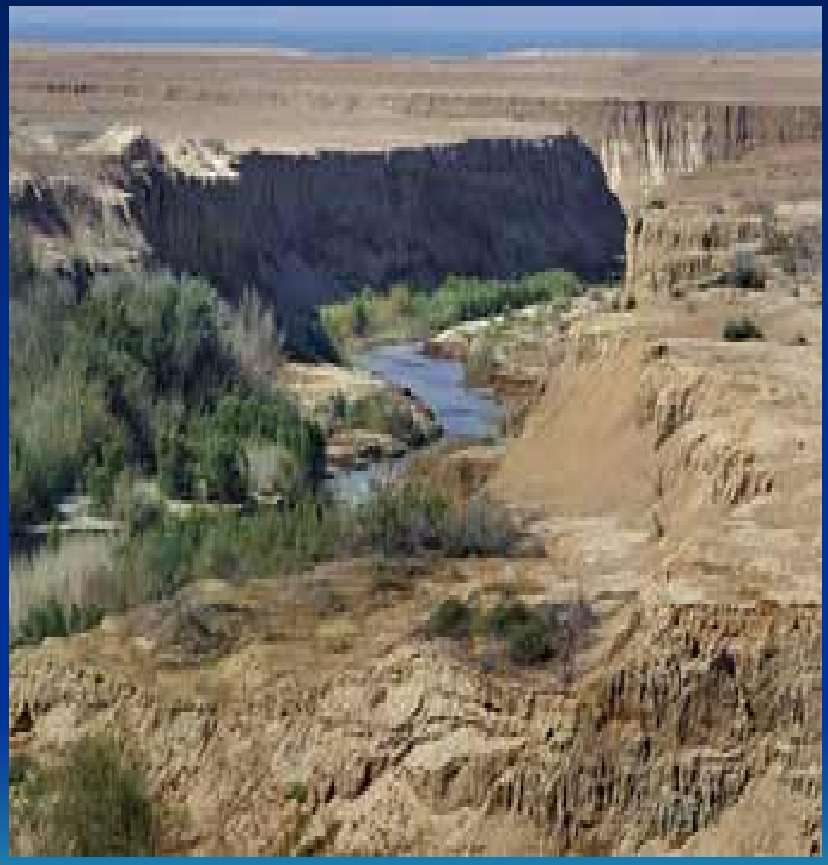




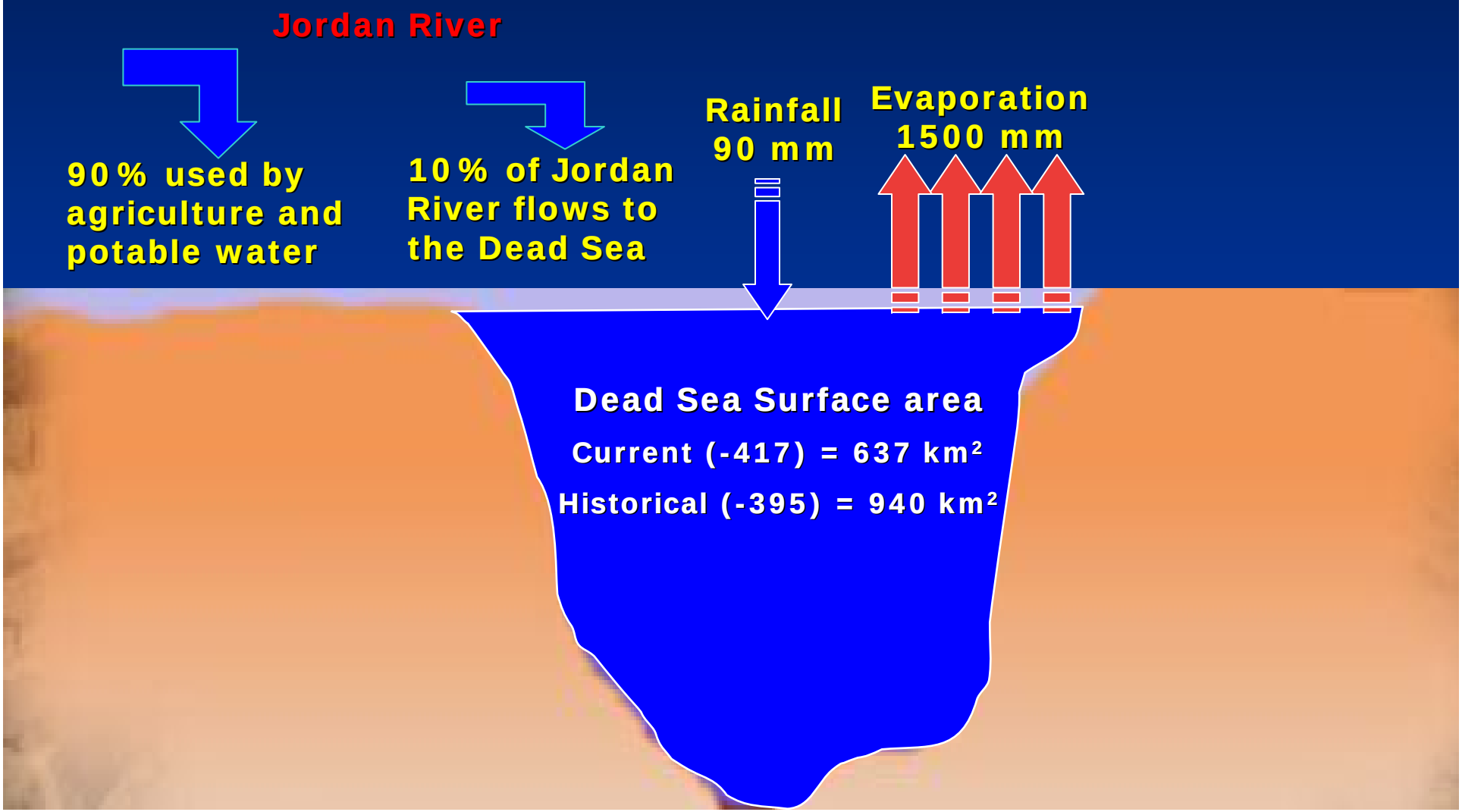
What is the problem ?

Circumstances

- Average annual inflow to the Dead Sea has decreased from natural 1,200 mcm/yr to about 250 mcm/yr, leading to a water level decline of about 1 m/year.
- This decline resulted from the vital human water requirements in this water-scare and arid region.
- Water level dropped by 24 meters, surface area shrank by about 33% in the last 55 years. 80% of this decline has occurred since the 1970's.



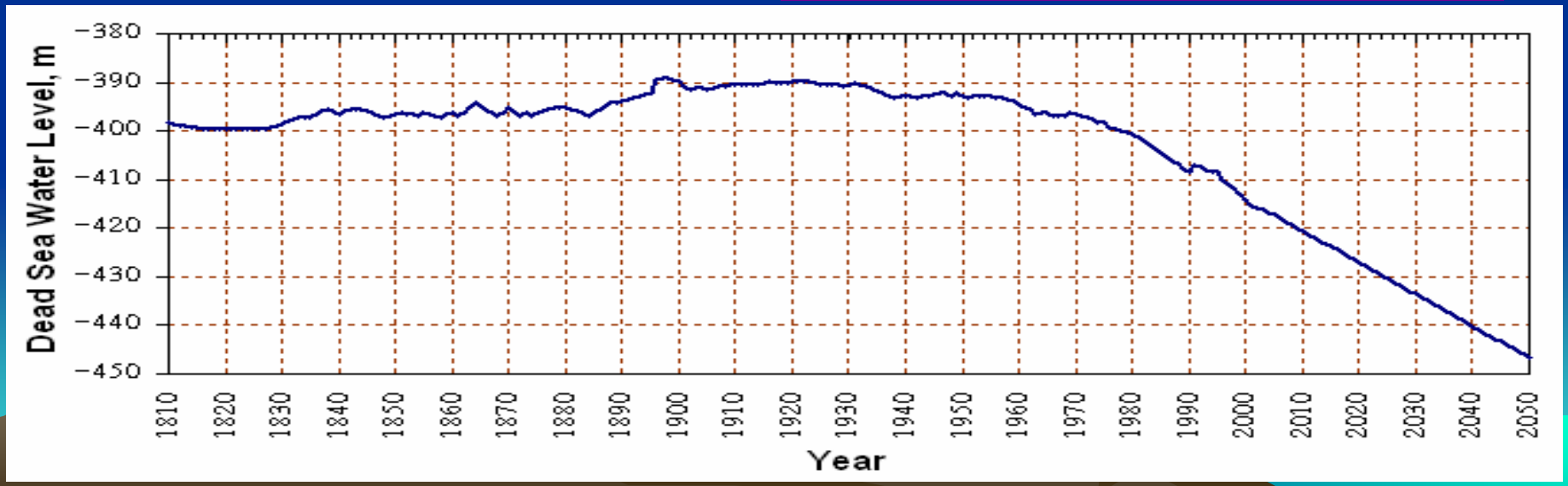
Dead Sea Schematic



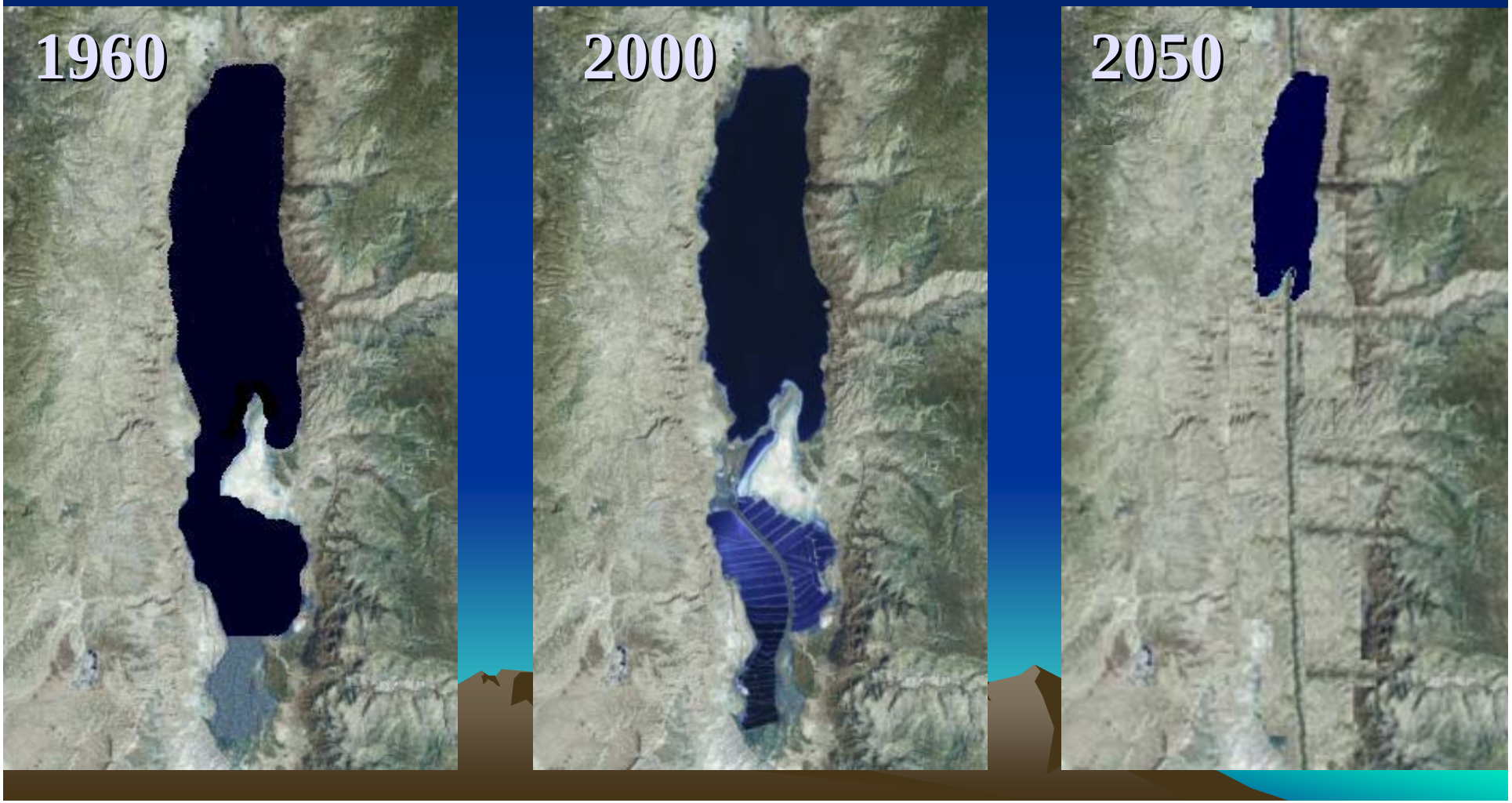
Consequences

- **Dead Sea level has fallen from 393 to less than 417 meters below sea level in less than 55 years**
- **More than 24 meters of sea level fall**
- **Current rate of decline is approximately 1m per year**

Year	Level, m	Area, Sq. Km
1950	-393	1043
1975	-397	926
2000	-414	642
2005	-417	637
2020	-427	622
2050	-447	582



The Dead Sea . . . in time



If no action is taken...

- **Loss of historic Dead Sea within 50 years – a treasure worth saving**
- **Loss of valuable ground water resources and formation of sink holes**
- **Ecological Imbalances: hydrologic systems, land quality, plant and wildlife habitats**

If no action is taken...

- **Loss of tourism development**
- **Reduce opportunities for social development in the basin**
- **Loss of future opportunities for regional development**
- **Region's economy would be adversely affected and future economic opportunities may be foreclosed**

Shared vision of Red Sea - Dead Sea Water Transfer

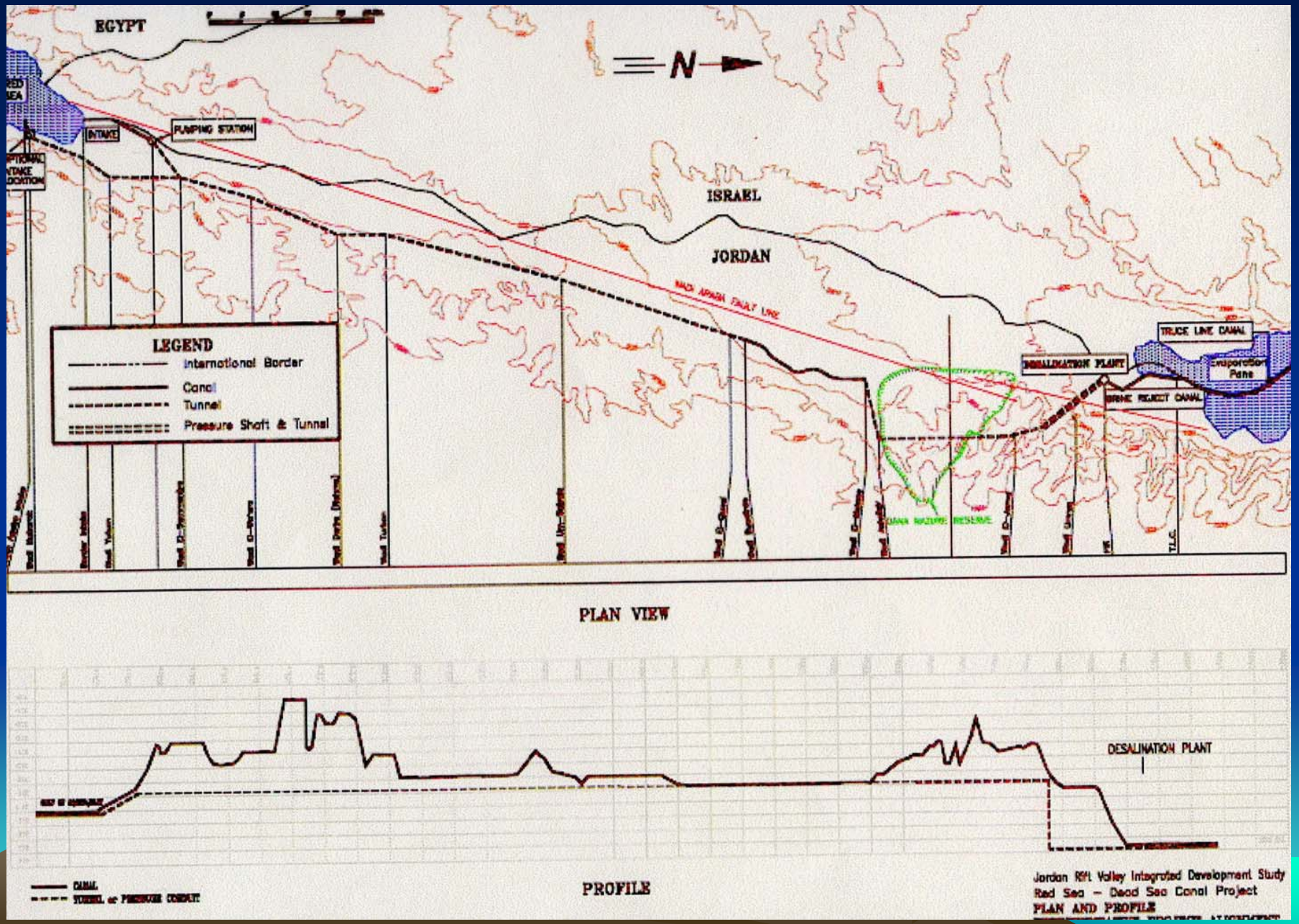
As stated by the beneficiary parties..

Save the Dead Sea from further environmental degradation

Desalinate water / generate energy at affordable prices for Jordan, Israel, and Palestine

Build a symbol of peace and cooperation in the Middle East

The Concept ...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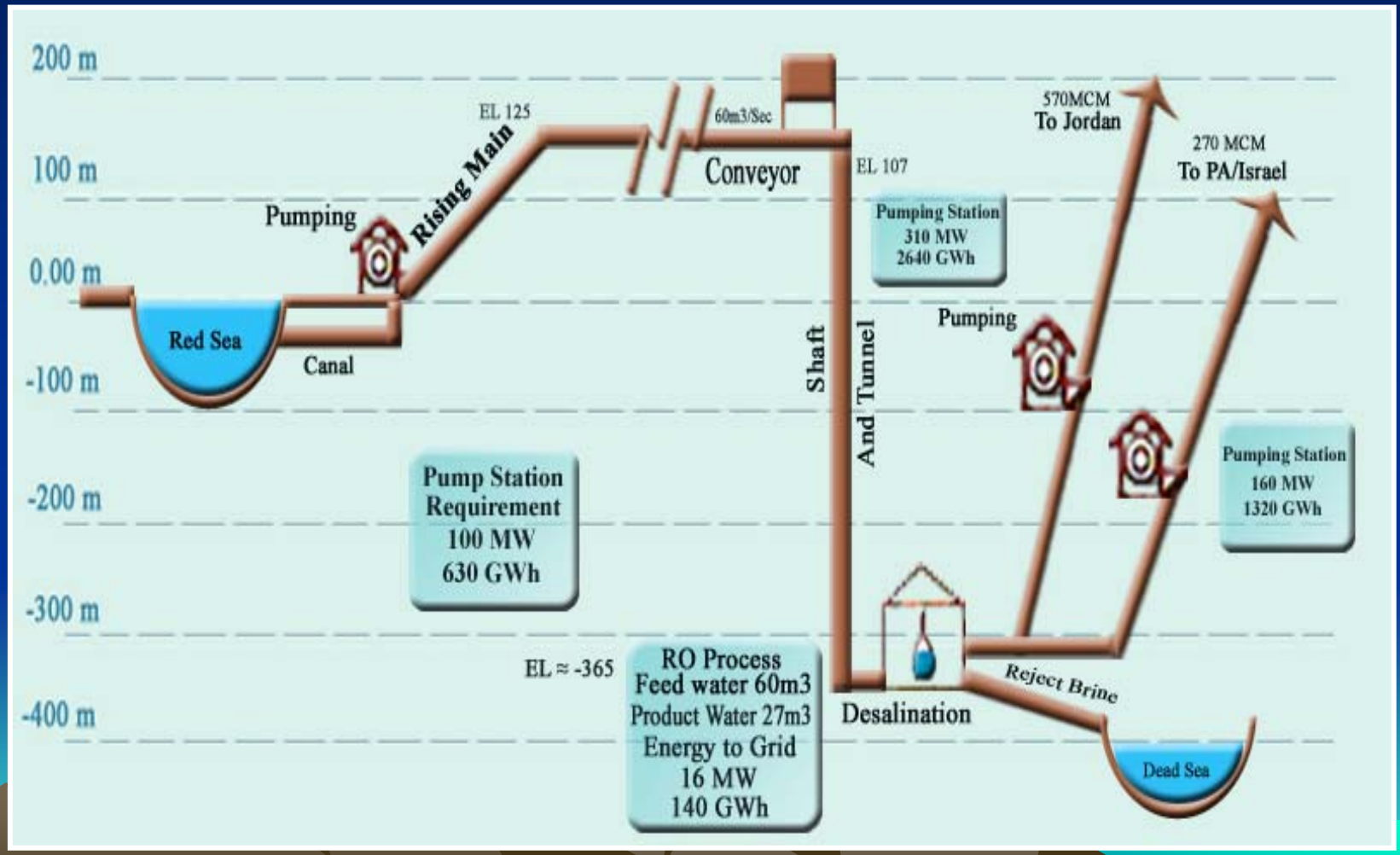
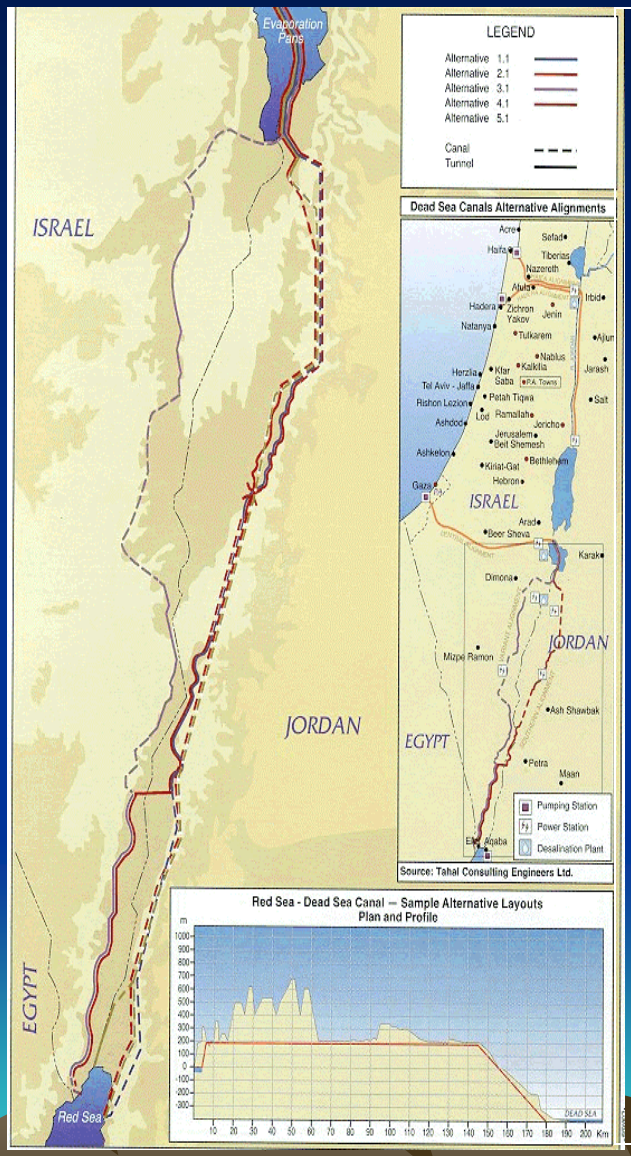
INTAKE
PUMPING STATION
ISRAEL
JORDAN
DEAD SEA RIFT FAULT LINE
LEGEND
International Border
Canal
Tunnel
Pressure Shaft & Tunnel
TRUCE LINE CANAL
DESALINATION PLANT
Evaporation Pans
BRINE REJECT CANAL
PLAN VIEW
DESALINATION PLANT
PROFILE
Jordan Rift Valley Integrated Development Study
Red Sea – Dead Sea Canal Project
PLAN AND PROFILE

The Concept ...

Project Schematic



Where Are We Now?



- **Several governments and international environmental organizations are now very anxious and interested in Saving the Dead Sea .**
- **Several bilateral and multilateral meetings were organized for the governments and the international organizations interested in Saving the Dead Sea.**
- **The World Bank was commissioned to prepare principles for the Terms of Reference (TOR) for the project Feasibility Study.**
- **June 11th 2007, World Bank will open F.S. offers from different companies for evaluation**


Thank you