COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION

WATER RESOURCES RESEARCH CENTER

Desalination in Israel

Dr. Sharon B. Megdal, Director
smegdal@email.arizona.edu

GWAC Desalination Subcommittee
November 9, 2016

wrrc.arizona.edu

GREATER DEPTH, BROADER PERSPECTIVE FOR A CLEAR WATER FUTURE

We tackle key water policy and management issues, empower informed decision-making, and enrich understanding through engagement, education, and applied research.

wrrc.arizona.edu
wrrc.arizona.edu/subscribe

2006

Public Policy Review

by Sharon Megdal

Visit Shows Israel Faces Similar Water Management Issues as Arizona

I traveled to Israel this summer to present a paper at a conference and to meet with researchers and other water professionals to learn about Israeli water management and policy. My perception was that, while quite a bit of Arizona-Israeli collaboration on technical water issues seemed to have occurred, less had taken place in the social science and policy arenas. I hoped to build upon recent col-

nation. I explained that desalination along coastal California has the potential to enable landlocked Arizona to gain more Colorado River water. Israel, like the United States, has long considered seawater desalination. Repeated droughts there have prompted a program to construct several plants over a five-year period to eventually deliver 315 million cubic meters of freshwater. With construction having begun in 2003, the plant in Ashkelon was built through a public-private partnership as a build-operate
in 2005, the plant produc

2009

ARIZONA WATER RESOURCE

Volume 17, Number 4 *Fall 2009*

Arizona, Middle East Water Issues Focus of WRRC Workshop

Arizona, Israel, Palestinian Territories Share Common Concerns

AZIP Arizona-Israeli-Palestinian Water Management & Policy Workshop

The Arizona-Israeli-Palestinian Water Management and Policy Workshop (AzIP for short), a Water Resources Research Center project that was two and a half years in the planning, focused on critical water issues of the three arid and semi-arid

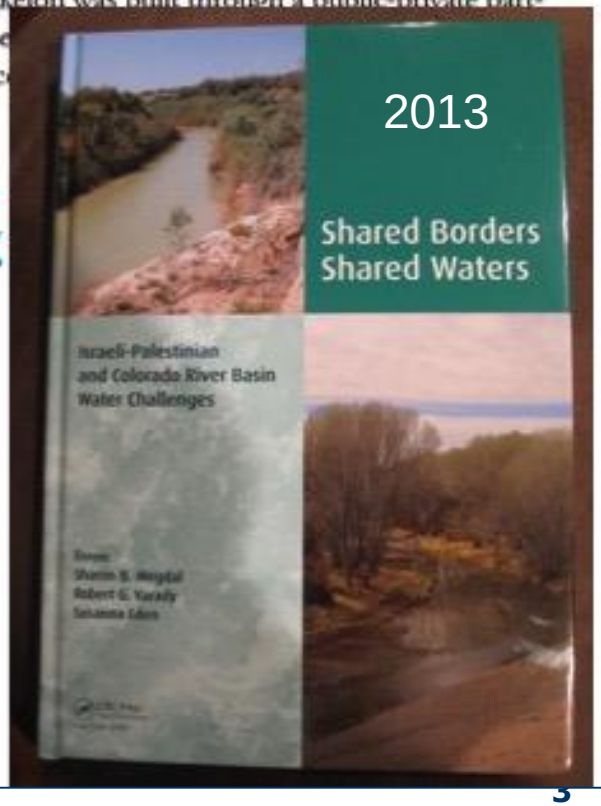
Complicating their task are the formidable political issues that trouble the waters, and much else in the Middle East. Arizona water affairs, too, are marked by the need to consider and negotiate the claims of sovereign entities, specifically neighboring Mexico and Indian nations. Arizona fortunately does not have to contend with the worrisome, highly-charged political climate prevailing in the Middle East.

It is hoped that the workshop will pay a long-term benefit by promoting peace. By working together to identify research needs and developing an international, collaborative research program, workshop

Special Workshop Edition of Newsletter

This issue of the *Arizona Water Resource* newsletter provides information about the Arizona, Israeli, and Palestinian Water Management and Policy Workshop. (See page 8 for workshop agenda.) Additional information about the workshop is available at the WRRC web site.

2013



Sea water desalination in Israel: Planning, coping with difficulties, and economic aspects of long-term risks

Abraham Tenne

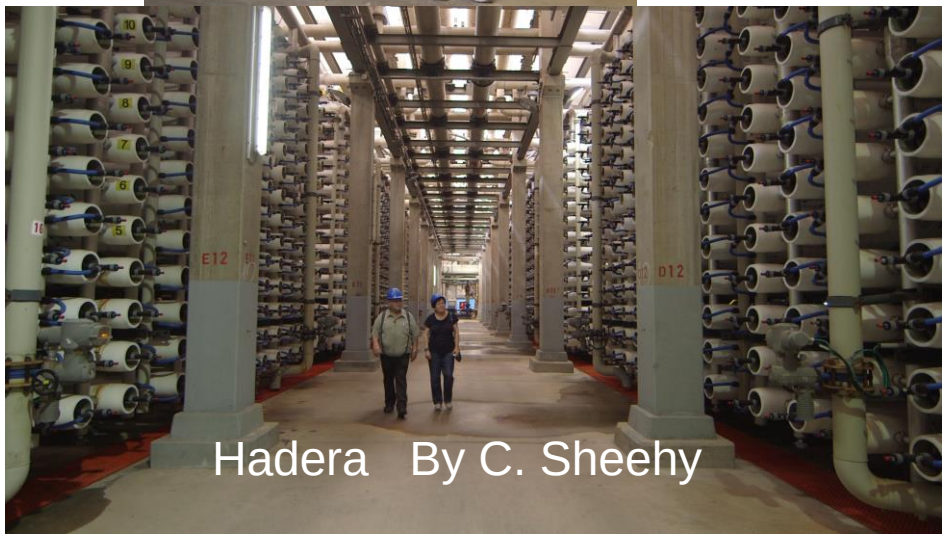
In 1999, the Israeli government initiated a long-term, large scale SWRO (Sea Water Reverse Osmosis) desalination program. The program is designed to provide for the growing demands on Israel's scarce water resources, and to mitigate the drought conditions that have characterized most years since the mid-1990's.

Since the initiation of the desalination program, there have been several changes in government decisions regarding the targeted annual quantity of desalinated water to be produced (Figure 1). These changes in target-production volumes were influenced by short-term changes in the history of inter-annual rainfall, and by changes in national consumption rates. The initial target capacity of 50 million cubic meters (MCM) per year was re-set in 2002, to 400 MCM/year. This target was reduced in 2003 to 230 MCM/year in response to an unprecedented large amount of rainfall in 2002. In July 2007, subsequent to several drought years, the targeted production-capacity was re-set to 505 MCM/year, to be reached by the year 2013. Additional drought conditions led to a further increase in target capacity in 2008, to 750 MCM/year to be reached by the year 2020. From the 750 MCM, 600 MCM will be provided as quickly as possible.

2015

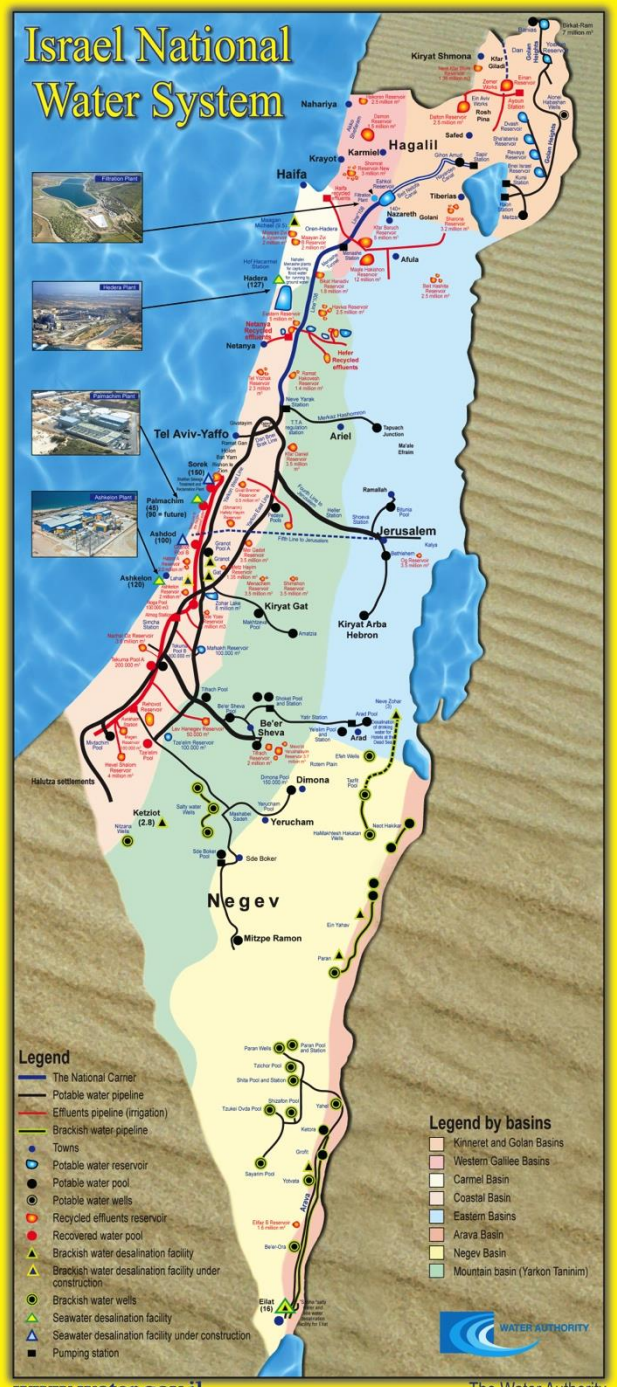
BeyondtheMirage.org
Filming done October 2015


Sorek


Hadera By C. Sheehy


Palmachim


Beirut
بيروت
Damascus
دمشق
Tyre
صور
Al-Qisa
قيسيا
M5
110
Haifa
10
25
Tel Aviv-Yafo
Amman
عمان
10
5
30
Jerusalem
40
15
65
Be'er Sheva
Jordan
Israel
5
65
5
16
Eilat
5
مخمية الطيبي


Israel National Water System
Kiryat Shmona
Nahariya
Hagalil
Karmiel
Krayot
Haifa
Tiberias
Nazareth
Golani
Afula
Hadera (127)
Netanya
Tel Aviv-Yaffo
Ariel
Palmachim (65) (90 = future)
Ashdod (100)
Ashkelon (120)
Jerusalem
Kiryat Gat
Kiryat Arba Hebron
Be'er Sheva
Dimona
Yeruchem
Ketziot (2.8)
Sde Boker
Negev
Mitzpe Ramon
Eilat (16)
Legend
The National Carrier
Potable water pipeline
Effluents pipeline (irrigation)
Brackish water pipeline
Towns
Potable water reservoir
Potable water pool
Potable water wells
Recycled effluents reservoir
Recovered water pool
Brackish water desalination facility
Brackish water desalination facility under construction
Brackish water wells
Seawater desalination facility
Seawater desalination facility under construction
Pumping station
Legend by basins
Kinneret and Golan Basins
Western Galilee Basins
Carmel Basin
Coastal Basin
Eastern Basins
Arava Basin
Negev Basin
Mountain basin (Yarkon Taninim)
WATER AUTHORITY
www.water.gov.il
The Water Authority

Centralized authorities

- Israel Water Authority (changed to Authority from Commission in 2006)
  - Has significant powers for planning, water allocations, and rates
- High degree of reuse of water, mostly by agriculture
- Has deployed desalination technology, both seawater and brackish water
- Has been a leader in public-private partnerships
- Strong national identity with water
- Mekorot, Israel's National Carrier, recently celebrated the 50th anniversary of the construction of its major pipeline from the Sea of Galilee. (http://www.mekorot.co.il/Eng/newsite/Projects/NWC/Pages/NWCJubilee.aspx)
- Has addressed scarcity while preserving a vibrant agricultural sector

“Replumbing” the System

Main Policy Points and Recommendations
Administering the National Freshwater System

State of Israel
WATER AUTHORITY

- The national water system will be administered in a centralized and integrated manner.
- The Sea of Galilee will be designated primarily for use in northern Israel.
- Supply to the center of the country will be based on desalination plants, as a supplementary source to natural water sources.
- High supply reliability in the central, regional and local supply systems (aiming to establish: looped systems, a number of consumer connections from a range of water sources, storage, etc.)

Master Plan for the National Water Sector

Main Points of the Policy Paper

Israel has water and wastewater master plans

State of Israel

WATER AUTHORITY

Main Core Issues

1. Water balance, analysis under uncertainty (scenarios)
2. Management of the potable water system
3. Management of sewage and treated wastewater
4. Management of natural water sources
5. Water quality
6. Demand management
7. Urban water management
8. Water and agriculture
9. Management of drainage and runoff water
10. Water and energy
11. Environment and water for nature

5

August 2012 Israel Water Master Plan, p. 54

Table 1 – The National Water Balance – Basic Scenario

Population		
Year	National popn. (millions)	Per capita consumption (cu.m. per capita per year)
2010	7.6	100
2020	9.1	99
2030	10.9	98
2050	15.6	95

Water Sources (mcm/year)							
Year	Natural freshwater (1)	Brackish (direct consumption)	Treated wastewater (incl. Dan Region STP)	Desalination of brackish waters	Desalination of sea water (2)	Additional Required (3)	Total supply *
2010	1,200	174	450	23	280	4	2,131
2020	1,140	150	573	50	750	9	2,672
2030	1,080	140	685	60	750	50	2,765
2050	1,020	130	930	70	750	671	3,571

In 2008, an additional 46 mcm of floodwater was used that was not taken into account.

(1) Total average replenishment of natural freshwater, less losses for water with less than 400 mg. of chloride per liter.

(2) "Desalination" – according to the approved government decisions.

(3) "Required supplement" = the difference between total consumption of freshwater (bottom table) and total sources of freshwater.

Year	Urban	Water Consumption (mcm/year)												
		Industry			Agriculture				Regional *	Reservoir storage recovery	Nature and landscape**		Unforeseeable	Total consumption
		Fresh-water	Brackish	Total	Fresh-water ***	Brackish	Treated wastewater (incl. Dan Region STP)	Total			Fresh-water	Total		
2010	764	90	30	120	500	144	400	1,044	143	0	10	60	0	2,131
2020	902	95	30	124	490	120	528	1,138	143	200	50	95	70	2,672
2030	1,064	99	30	129	470	110	645	1,225	143	0	50	90	114	2,765
2050	1,482	108	30	138	450	100	900	1,450	143	0	50	80	278	3,571

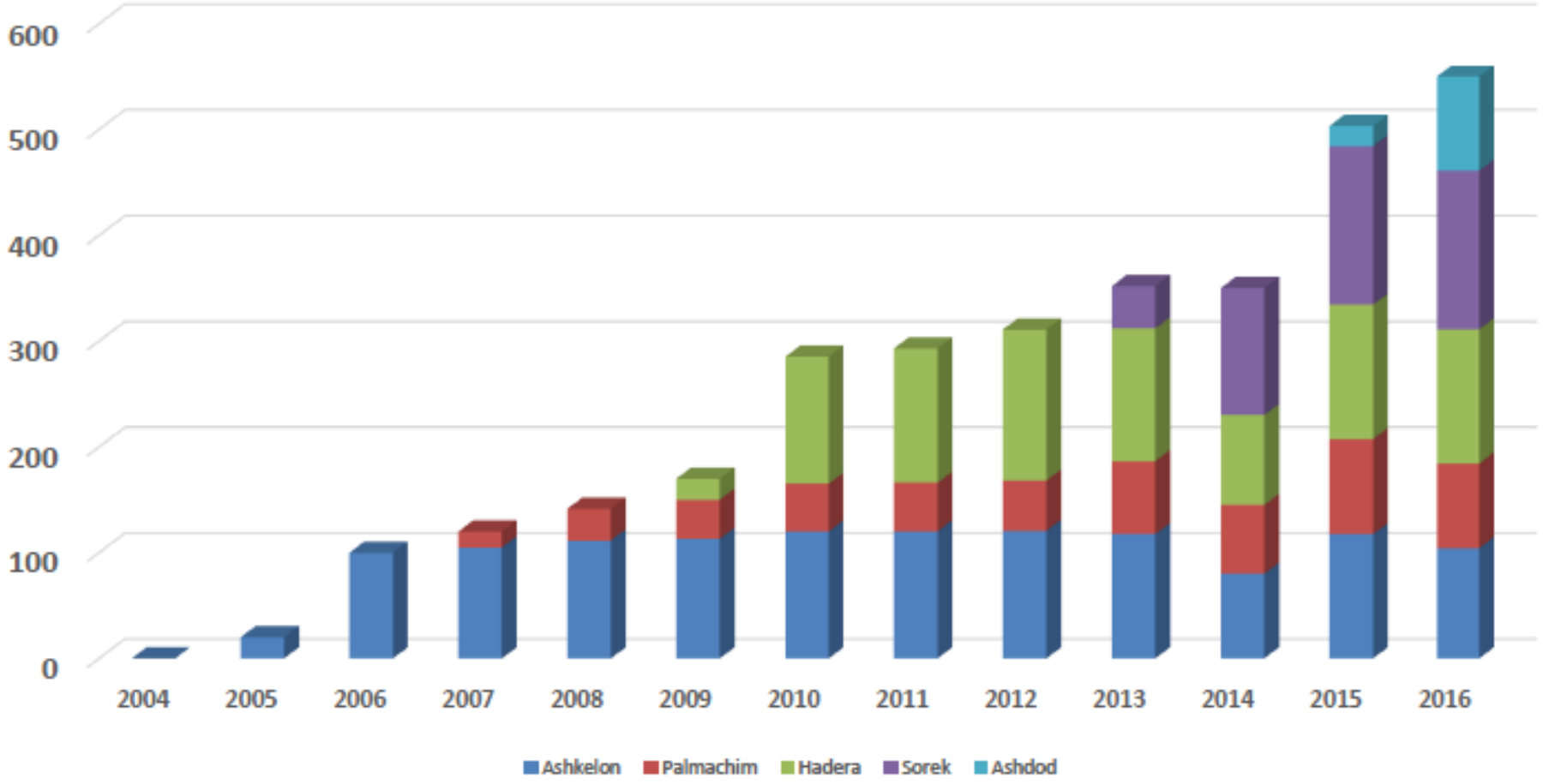
* Regional consumption includes supplies to the PA and Jordan.

** Some of the treated wastewater used for nature and landscape is treated wastewater that is not actually used, and flows in riverbeds.

*** The decline in consumption of freshwater for agriculture is contingent on conversion to high quality treated wastewater, and a change in definitions of well protection radii.

WATER AUTHORITY
ISRAEL

SWRO Facilities - Annual Production

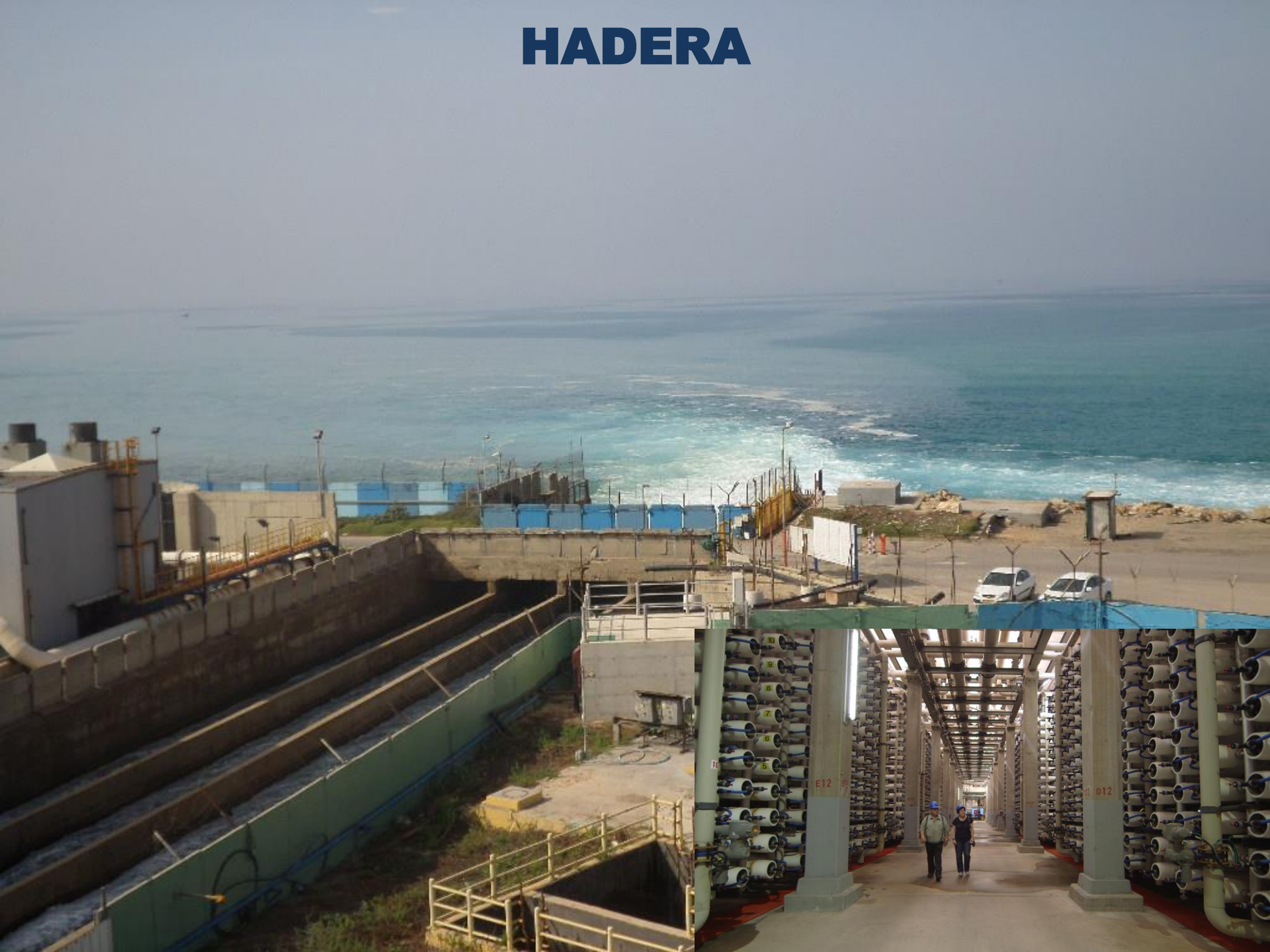


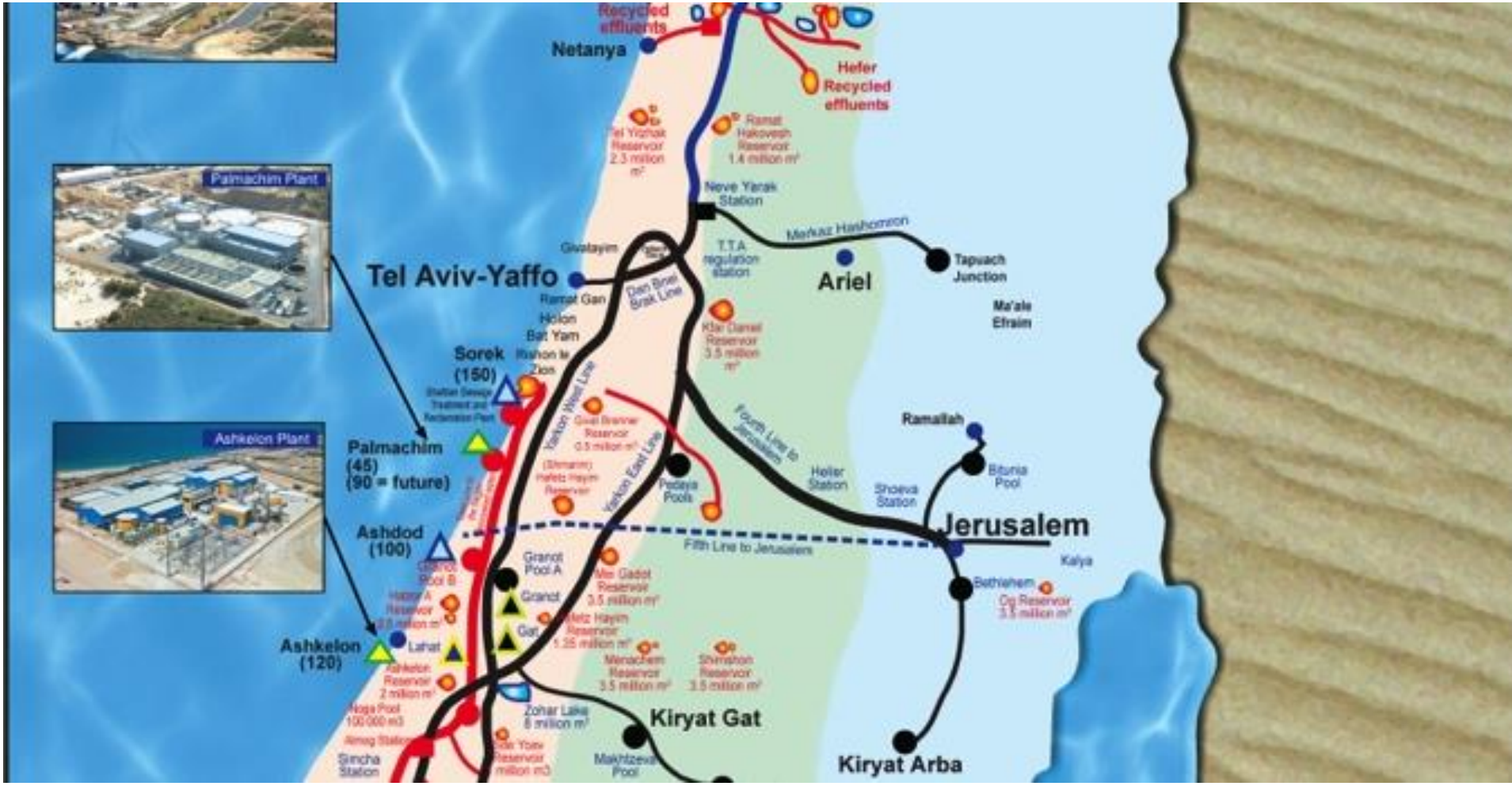
* 2016 – Projected data

Israel National Water System

Nahariya
Kiryat Shmona
Kfar Giladi
Dan
Golan Heights
Banias
Birkat-Ram 7 million m³
Yoshiya Reservoir
Zemer Works
Eman Reservoir
Ein Aviv Works
Rosh Pina
Ayoun Station
Dalton Reservoir 2.5 million m³
Alonei Habashan Wells
Golan Heights
Dvash Reservoir
Safed
Sha'aberia Reservoir
Hagalil
Karmiel
Krayot
Haifa
Ghon Amud
Sapir Station
Revaya Reservoir
Bnei Israel Reservoir
Kursi Station
Eshkol Reservoir
Tiberias
Nazareth
140+
Golani
Sharona Reservoir 3.2 million m³
Kfar Baruch Reservoir 5 million m³
Afula
Menashe Station
Maale Hakishon Reservoir 12 million m³
Bet Hashita Reservoir 2.5 million m³
Oren-Hadera
Hof Hacarmel Station
Hadera (127)
Eastern Reservoir 5 million m³
Haviva Reservoir 2.5 million m³
Netanya Recycled effluents
Netanya
Hefer Recycled

HADERA




Palmachim Plant
Ashkelon Plant
Recycled effluents
Netanya
Hefer Recycled effluents
Tel Yitzhak Reservoir 2.3 million m³
Ramat Hakovesh Reservoir 1.4 million m³
Neve Yarak Station
Merkaz Hashomron
Tel Aviv-Yaffo
Givatayim
Ramat Gan
Holon
Bat Yam
Rishon le Zion
T.T.A regulation station
Ariel
Tapuach Junction
Ma'ale Efraim
Dan Bnei Brak Line
Kfar Daniel Reservoir 3.5 million m³
Sorek (150)
Shafdan Sewage Treatment and Reclamation Plant
Yarkon West Line
Givat Brenner Reservoir 0.5 million m³
Ramallah
Fourth Line to Jerusalem
Palmachim (45) (90 = future)
Yarkon East Line
Peduya Pools
Heller Station
Shoeva Station
Bituna Pool
Ashdod (100)
Jerusalem
Fifth Line to Jerusalem
Kalya
Granot Pool A
Granot
Gat
Lahat
Ashkelon (120)
Ashkelon Reservoir 2 million m³
Noga Pool 100 000 m3
Zohar Lake 8 million m³
Kiryat Gat
Makhtzeva Pool
Kiryat Arba
Simcha Station

PALMACHIM

By C. Sheehy

SOREK

http://www.water-technology.net/projects/sorek-desalination-plant/

ASHDOD

http://www.battus.co/portfolio-item/ashdod-desalination-plant/

Ashdod SWRO desalination Plant – Israel

Previous

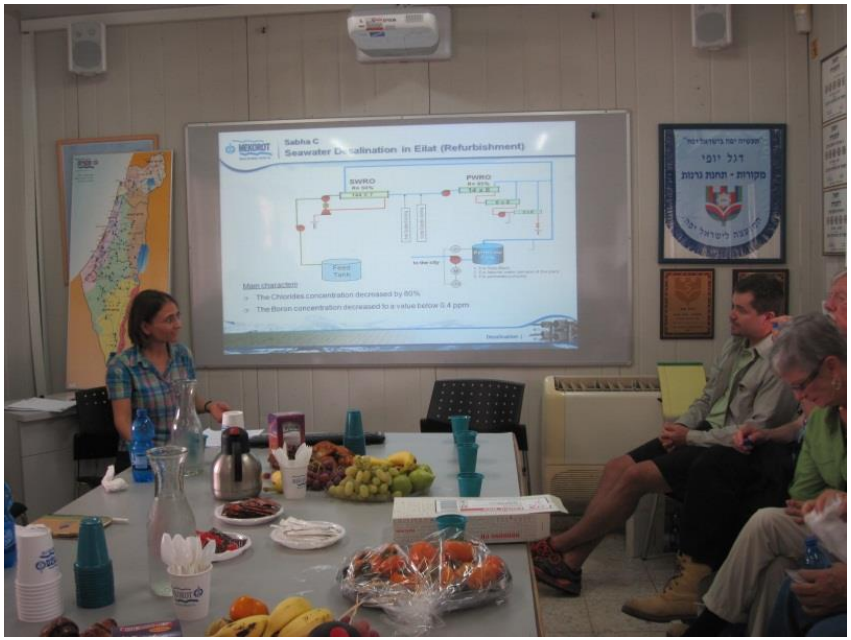
The Ashdod Desalination Plant Seawater Reverse Osmosis (SWRO) facility is a BOT project initiated by the State of Israel requiring the financing, design, construction, operation, maintainenance of a water treatment plant with a planned nominal production capability of 100 million m3 per year. The Government of Israel and the concessionaire, Ashdod Desalination Ltd, signed the BOT Concession Agreement in August 2011.

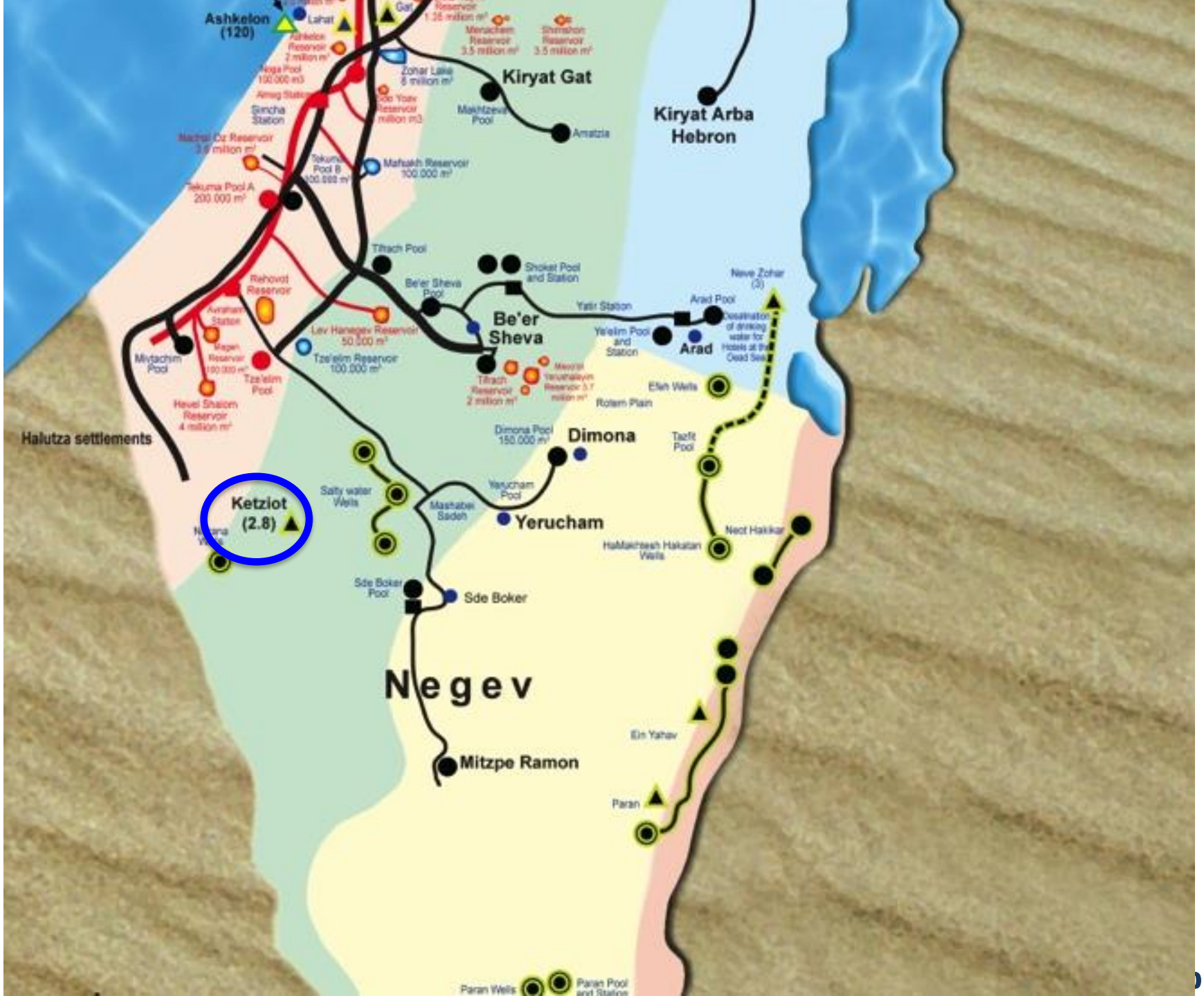
The construction of the SWRO facility and all ancillary works was planned to be delivered over a period of 24 months for Sub-Phase 1 and 27 months for the whole facility. Intake pipes were installed by mechanised pipe-jacking and open cut, with the marine intakes and brine lines being carried out by marine dredging and pipe sinking techniques. Equipment within the plant includes 2x pre-treatment ultra-filtration membrane streams, 2x RO membrane treatment streams followed by post-treatment water conditioning (re-mineralisation and chlorination) prior to on-site storage and then into a local supply storage reservoir. There is significant energy recovery infrastructure throughout the plant and further developments include the construction of an on-site power plant to provide a dedicated energy source independent of the national grid supply.

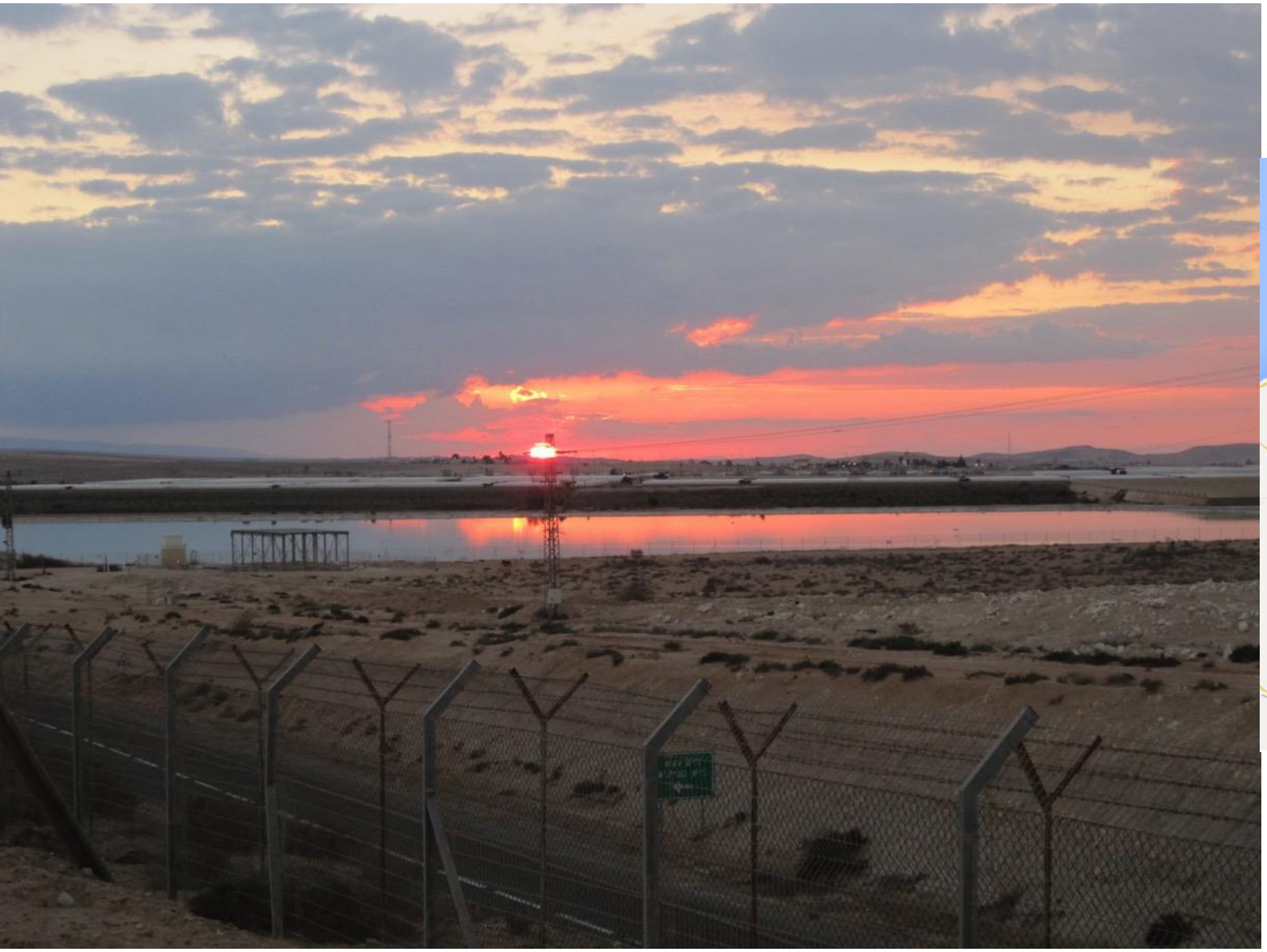
The facility was successfully fully commissioned in December 2015 when the project commenced its Commercial Operation Phase.

Brackish Water Desal -- Granot

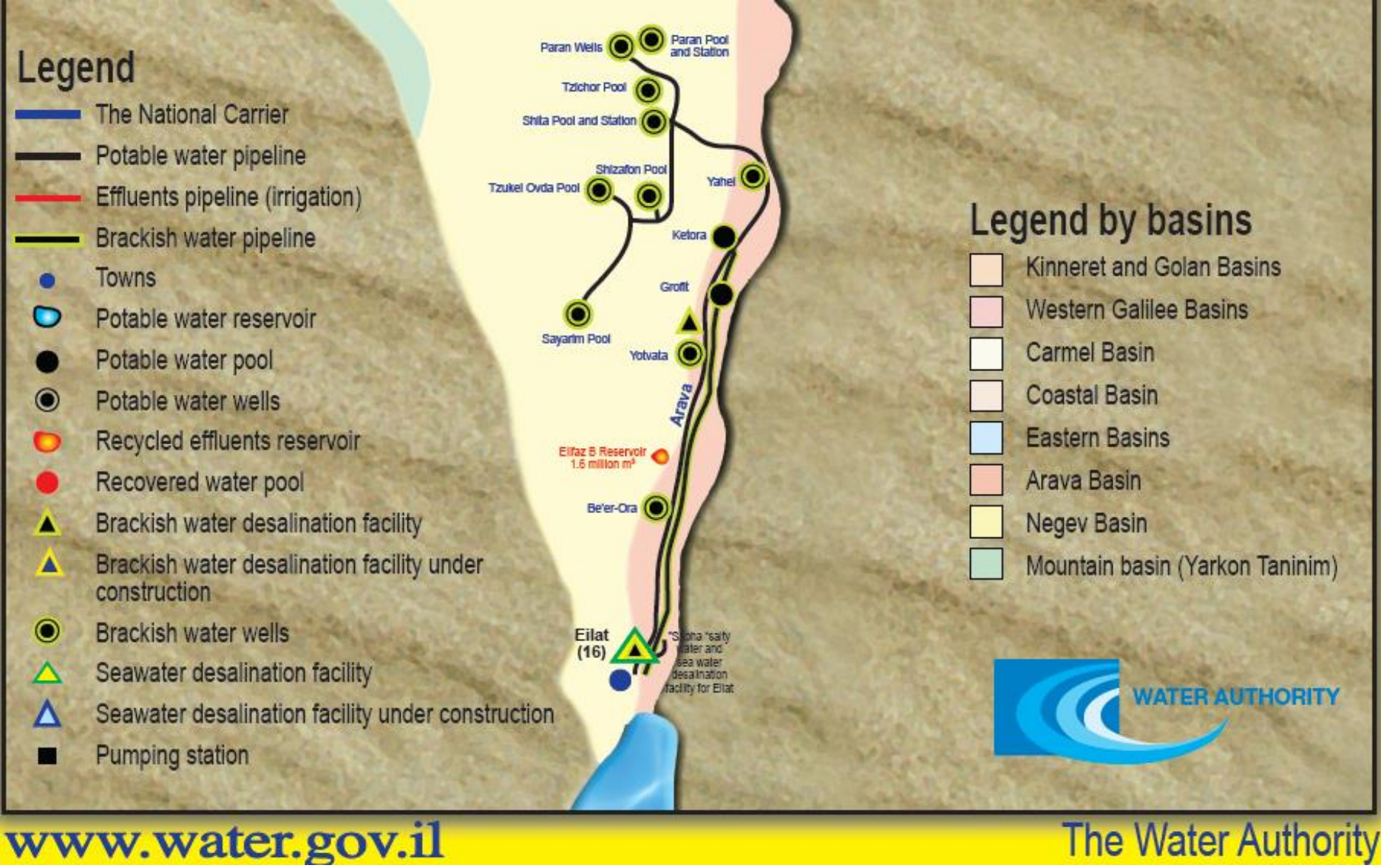
Granot Brackish Water Desal Plant




Ashkelon
(120)
Lahat
Gat
Menachem
Reservoir
3.5 million m³
Shimshon
Reservoir
3.5 million m³
Ashkelon
Reservoir
2 million m³
Zohar Lake
6 million m³
Kiryat Gat
Makhtzeva
Pool
Amatzia
Kiryat Arba
Hebron
Sincha
Station
Mahsakh Reservoir
100,000 m³
Tekuma Pool A
200,000 m³
Tifrach Pool
Shoket Pool
and Station
Be'er Sheva
Pool
Rehovot
Reservoir
Avraham
Station
Lev Hanegev Reservoir
50,000 m³
Tzafelim Reservoir
100,000 m³
Be'er
Sheva
Yatir Station
Arad Pool
Neve Zohar
(3)
Ye'elim Pool
and Station
Arad
Mivtachim
Pool
Magen
Reservoir
Tzafelim
Pool
Tifrach
Reservoir
2 million m³
Mevo'ot
Yeruhalayim
Reservoir 3.7
million m³
Efeh Wells
Rotem Plain
Halutza settlements
Dimona Pool
150,000 m³
Dimona
Tazfit
Pool
Ketziot
(2.8)
Salty water
Wells
Mashabei
Sadeh
Yerucham
Pool
Yerucham
Neot Hakikar
HaMakhtesh Hakatan
Wells
Sde Boker
Pool
Sde Boker
Negev
Ein Yahav
Mitzpe Ramon
Paran
Paran Wells
Paran Pool
and Station



Brine Evaporation Ponds
Kzi'ot Brackish Water Desal Plant



Red Sea Desalination in Jordan and related water exchange

Summary Points

- Obvious differences between the regions, particularly with respect to land availability, legal and regulatory framework, and politics
- Israel has overcome many obstacles and “problems”
  - Drought a key driver
- Role of the private sector in financing
- There are significant opportunities to “compare notes” when looking for solutions to water management challenges
- Addressing water issues across borders of importance

Thank you!

Sharon B. Megdal, Ph.D.
smegdal@email.arizona.edu
wrrc.arizona.edu