



SFSLD 2024 CONFERENCE

DESALINATION STRATEGIES TO REPLENISH WATER TABLES AND TO REDUCE COASTAL SUBSIDENCE

**by Randy Truby
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UNITED STATES SINKING CITIES AND PORTS



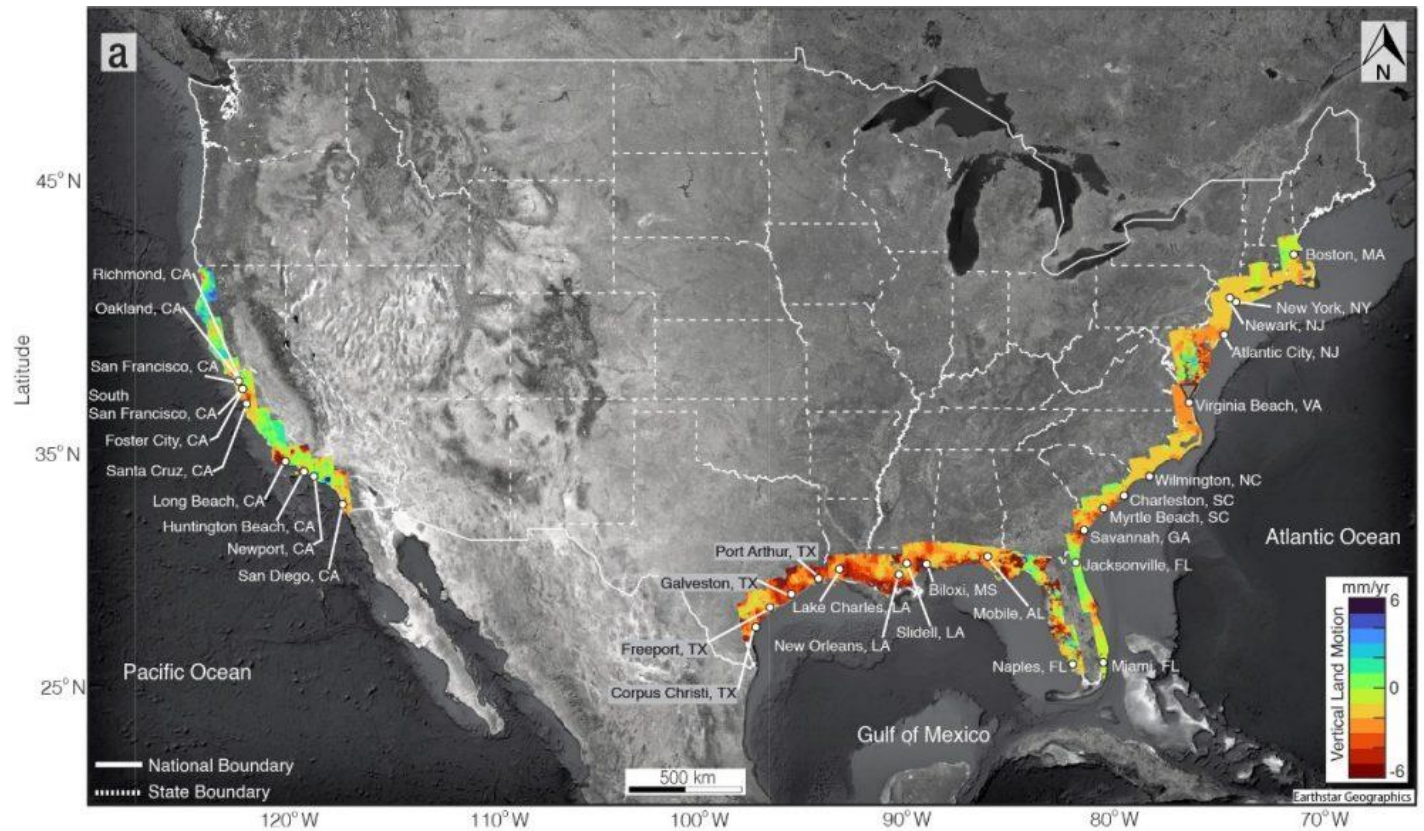
Article published in '**NATURE**' describes the **combined impact** of global sea level rise (projected 0.25-0.3 meters by 2050) and the sinking of coastal land areas (coastal subsidence).

The authors express concern that the combination of these forces may not be appreciated by planners and stakeholders.

- LINK IN THE AGENDA:

"Disappearing cities on US coasts"

UNITED STATES SINKING CITIES AND PORTS



DESALINATION TECHNOLOGY AND THEIR IMPACT ON SUBSIDENCE AND WATER TABLES



On the **Pacific Coast** well water has provided drinking water to large population centers. Both Orange and parts of San Diego County rely on well water.

During drought cycles the wells would subside (draw down) and seawater would intrude adding enough sodium chloride to remove the water from “potable” status.

The **Orange County Water District** (OCWD) developed a Ground Water Replenishment (GWR) strategy to recycle wastewater and inject it into the wells thus creating a barrier to seawater intrusion and combating subsidence.

This GWR approach has been highly successful and has been employed globally with great success.

OCWD GWR RECLAMATION DESALINATION SYSTEM 5MGD INSTALLED 1977 – TODAY 130MGD



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On the **Atlantic Coast** well water is relied upon to an even a greater extent than on the Pacific Coast. Florida processes and distributes Hundreds of Millions of Gallons of water per day from wells.

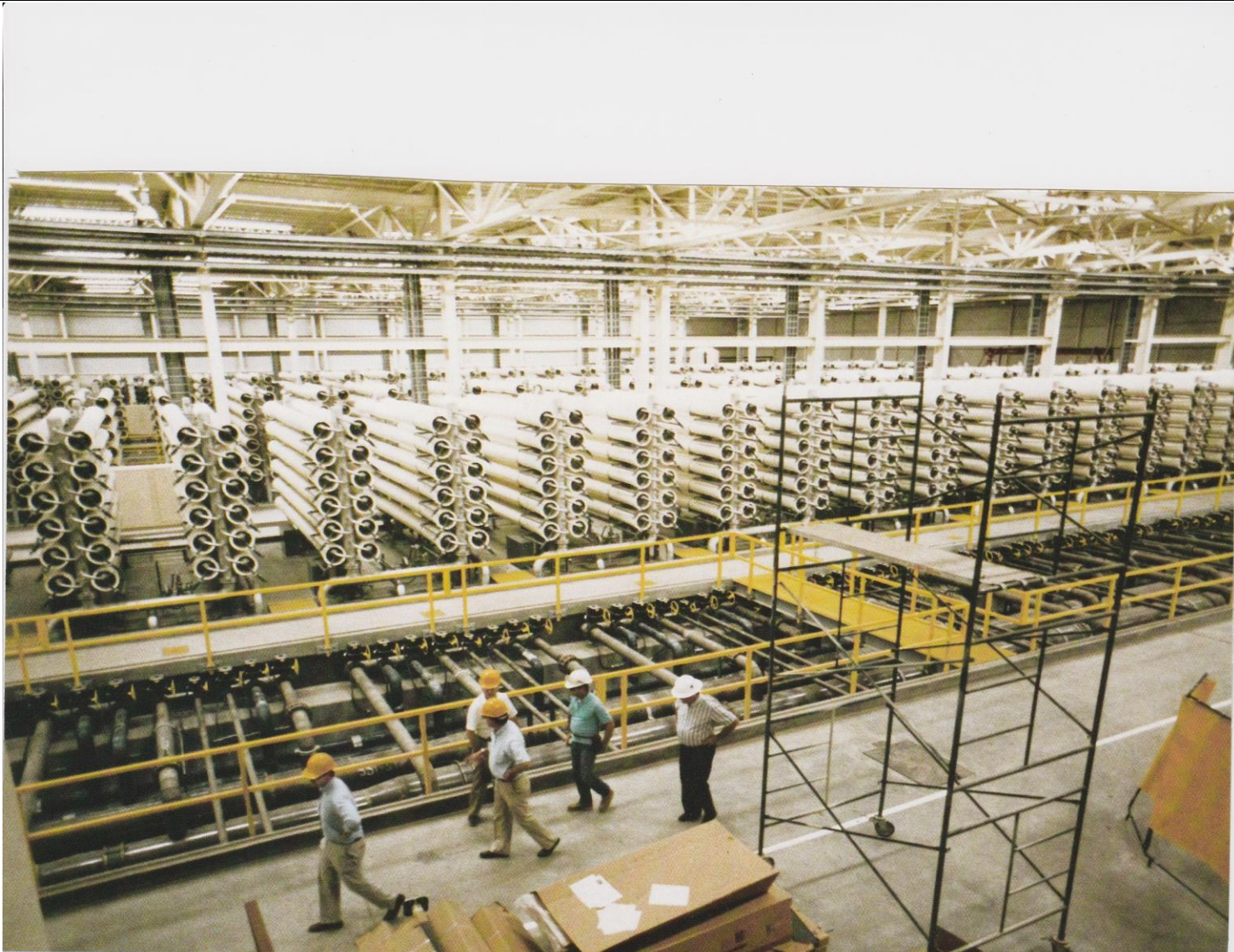
After years of utilizing these wells, incidents of "sink holes", seawater intrusion and subsidence have been increasing.

GWR strategies to combat seawater intrusion are being used where feasible.

In many coastal locations seawater desalination is utilized to provide potable water and thus reduce the reliance on groundwater and reduce subsidence.

The 25 MGD Tampa Bay Desalination System was the first large seawater installation in the USA.

108 MGD WASTEWATER DESALINATION SYSTEM YUMA AZ.



DEFINITION OF DESALINATION



The removal of salt from - - -

- In the many parts of the world Desalination means the removal of salt from - - - ***seawater***
- Since 1969 membrane desalination has been applied globally to desalt:
seawater,
brackish water, and for
wastewater reuse

DESALINATION – HISTORICAL EVOLUTION



- Membrane Desalination developed in the USA
- Two Disruptive Innovations patented with the aid of the US Government:
 - The Spiral Wound Element in - 1964
 - TFC polyamide membrane in – 1979

Today 99% of all desalination Membranes installed around the world use these two innovations.

Annual Membrane Sales \$5 Billion

Spiral Wound Element Design



First spiral wound element developed in 1964 at General Atomic Company San Diego CA.

TYPICAL SWRO DESALINATORS



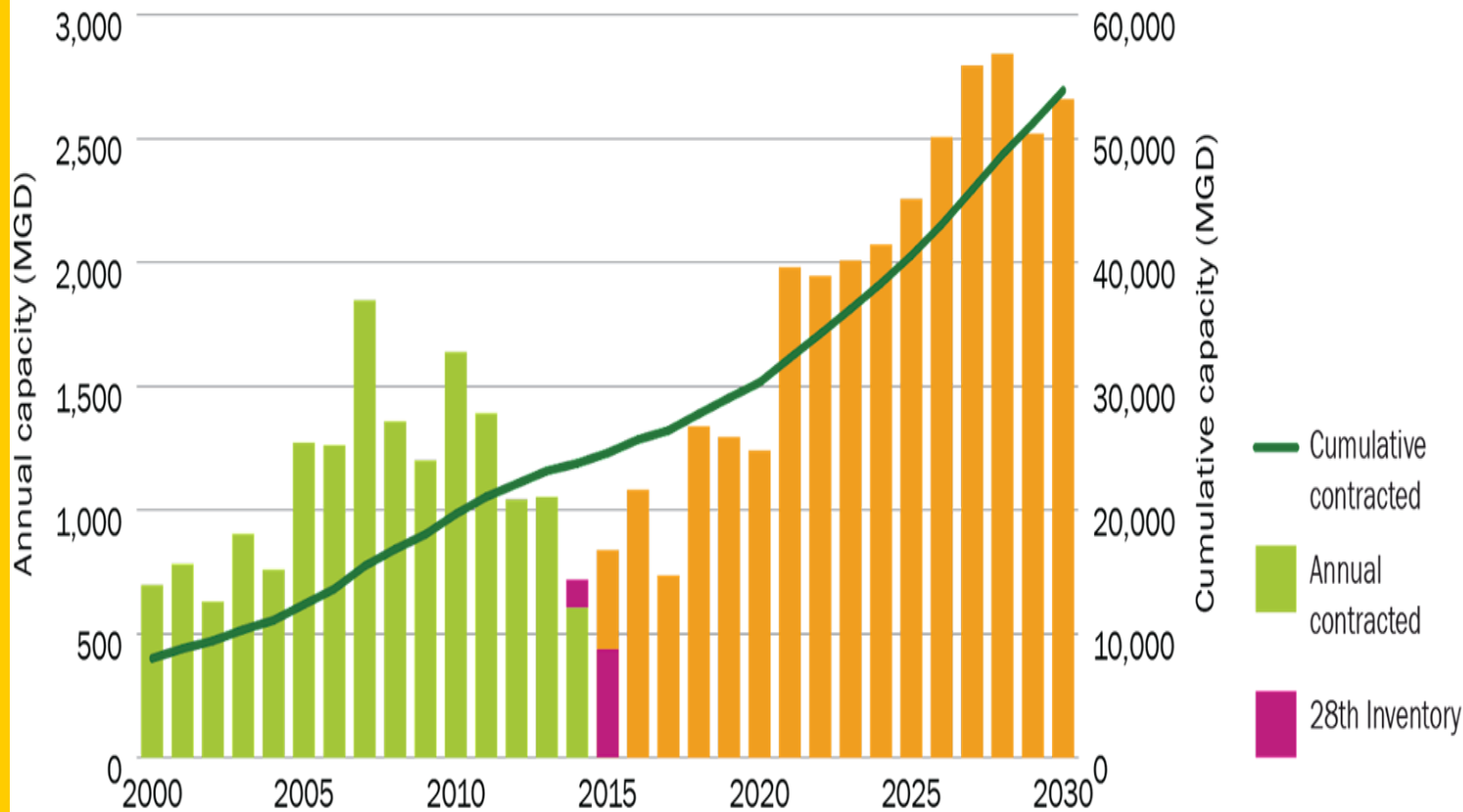
Hadera



Ashkelon



GROWTH-MEMBRANE PROCESSES (8% CAGR)



1977 - PIVOTAL YEAR FOR MEMBRANE DESALINATION



- FIRST LARGE SWRO
DESALINATION SYSTEM 2.3 MGD
– **KINGDOM OF SAUDI ARABIA**
- FIRST LARGE WASTEWATER
RECLAMATION SYSTEM 5 MGD
– **ORANGE COUNTY WATER DISTRICT**
- WORLDS LARGEST DESALINATION
SYSTEM OF ANY TYPE 108 MGD
– **YUMA DESALTING PLANT**

DIVERSIFIED DESALINATION SOLUTIONS



- **SINGAPORE** STAKEHOLDERS APPLY DIVERSIFIED DESALINATION--SWRO AND WWRO
- **AUSTRALIA** USES DIVERSIFIED SOLUTIONS IN RESPONSE TO REPEATED DROUGHT CYCLES
- **Israel** has 800MGD desalination systems for a population of 13 million (includes Palestine)

DIVERSIFIED DESALINATION SOLUTIONS-SAN DIEGO CA



- NEW YORK TIMES ARTICLE, OCTOBER 2021
- SAN DIEGO HISTORICALLY RELIED ON IMPORTED WATER FROM COLORADO RIVER (CRA) AND THE STATE WATER PROJECT (SWP)
- ALONG WITH AN AGGRESSIVE PROGRAM OF CONSERVATION AND RECYCLING FOR LANDSCAPE SAN DIEGO ADDED BWRO, SWRO AND SOON WWRO
- THIS DIVERSIFIED APPROACH IS GIVING SAN DIEGO A SUSTAINABLE DROUGHT PROOF RELIABLE WATER SUPPLY



DESALINATION CONCERNS

- **ENERGY CONSUMPTION** IS TOO HIGH
- ENVIRONMENTAL IMPACT
 - SEAWATER INTAKE KILLS PLANKTON
 - HIGH SALINITY BRINE DISCHARGE DAMAGES OCEAN FLORA AND FAUNA
- SOCIAL CONCERNS
 - ONLY WEALTHY CAN AFFORD DESAL
 - DESAL PLANTS MAY DISPLACE LOW INCOME FAMILIES FROM BEACH COMMUNITIES

THE FUTURE- INNOVATIVE SOLUTIONS



THE CLIMATE CHANGES BUT SO DOES DESALINATION

ENERGY EFFICIENCY

- 50% ENERGY REDUCTION SINCE 1977
- OARO-HIGH PRESSURE SALT REMOVAL
- BRINE CONCENTRATORS AT 1800PSI

- ***HYREC*** CONCENTRATES SEMI-CONDUCTOR WASTEWATER TO 296,000 TDS OR EIGHT TIMES SEAWATER

MF-NF-RO-OARO-----EVAP-CRYSTALLIZER

**MEMBRANES CONSUME 50% OF THE ENERGY-
AND PRODUCE 87% OF THE RECYCLED
WATER**

THE FUTURE- INNOVATIVE ENERGY SUPPLY



**DESALINATION SYSTEMS CAN
OPERATE ON WHATEVER ENERGY
SOURCE IS OPTIMUM**

ALTERNATIVE ENERGY

- SOLAR
- WIND
- HYDRO-ELECTRIC
- SUBMERGED
- GRAVITY
- SMR (SMALL MODULE REACTOR)

THE FUTURE- INNOVATIVE IMPROVEMENTS



INNOVATION DRIVES OPTIMIZATION

START-UP COMPANIES FOCUSING ON FOULING REDUCTION

- NALA MEMBRANES-CHLORINE TOLERANT TFC IMPROVES STERILIZATION *
- AQUA MEMBRANES-IMPRINTED SPACER REDUCES ENERGY CONSUMPTION BY 36%
- PURE BLUE TECH-EMBEDDED ULTRASOUND-PREVENTS FOULING AND ENHANCES CLEANING EFFICIENCY *
- ZWITTERCO-MEMBRANE TREATMENT LOWERS FOULING OF UF AND RO MEMBRANES



THE FUTURE- INNOVATIVE APPLICATIONS

WATER CONSERVATION

LESS WASTE WATER

ZERO LIQUID DISCHARGE (ZLD)

MINIMUM LIQUID DISCHARGE (MLD)

MINERAL MINING – LITHIUM

ARTIFICIAL INTELLIGENCE

SOFTWARE MONITORING AND ALGORITHMS COMBINE
TO LOWER ENERGY COST OF DESALINATION

PFAS REMOVAL AND DESTRUCT

AQUAGGA

“HALT” SYSTEM

ACLARITY

CLAROSTECH

UV TECHNOLOGY



SUMMARY

DESALINATION TECHNOLOGY HAS PLAYED A ROLE IN COMBATING SEA WATER RISE AND SUBSIDENCE

DESALINATION GROWTH-8%/YEAR

INNOVATIONS CONTINUE TO REDUCE ENERGY CONSUMPTION

INNOVATIONS WILL EXPAND THE FUTURE APPLICATIONS AND ROLE OF DESALINATION TECHNOLOGY BENEFITING HUMANITY