

Governor's Water Augmentation Council
Desalination Committee

November 9, 2016





Desalination Disasters & Challenges



Arizona Water Initiative
Governor's Water Augmentation Council
Desalination Committee Meeting
November 9, 2016

Zacary Richards



Desalination Disasters

1. Wonthaggi, Australia
2. Hong Kong MSF
3. Carboneras, Spain
4. Tampa Bay, Florida
5. Carlsbad, California
6. Ad Dur RO, Bahrain
7. Point Lisas, Trinidad
8. Santa Barbara, California
9. Jeddah 1 MSF, Saudi Arabia
10. Palm Jumeirah, UAE

“The biggest risk in the desal business is not on the technology or operations side of the project – it is on the demand side.”



Christopher Gasson;
Global Water Intel 2012

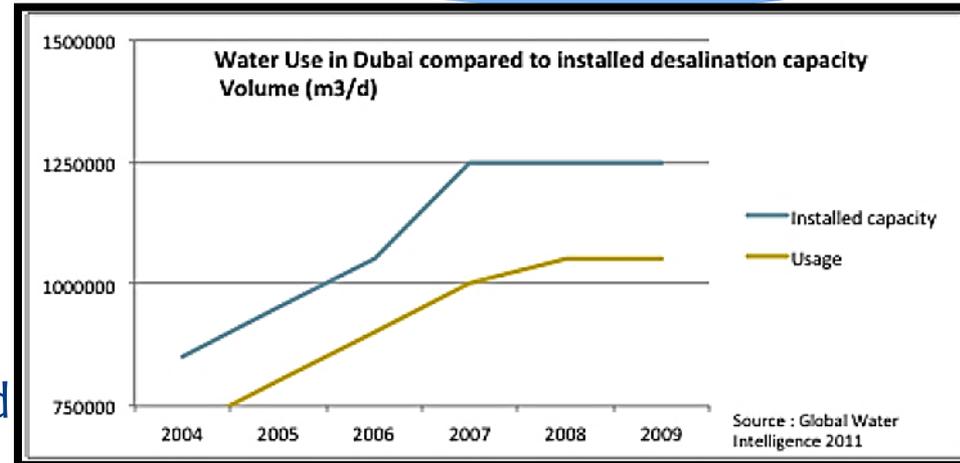
Desalination Project Challenges

Demand Over-projection

#10

Palm Jumeirah Wastewater Plant

- * Before the recession, Dubai was predicting a potable water demand increase of 10% annually
- * Demand since 2008 has leveled off, leaving many projects abandoned
- * Palm Water, a private utility, declared bankruptcy and the Dubai Electricity and Water Authority (DEWA) took charge of its assets including a 8.5mgd RO plant that was suspended before the membranes were installed



Desalination Project Challenges

#9

Design Flaws

Jeddah Desalination Plant (Saudi Arabia)

- * Commissioned in 1989
- * Uses a multi-stage flash distillation (MSF) process to produce 26mgd
- * Temperatures of 250 degrees F result in increased efficiency but also increased calcium sulfate scale formation and accelerated corrosion of metal surfaces
- * Stainless Steel High-Pressure piping showed pitting and crevice corrosion issues for 316L or 317L after a few months
- * 254 SMO and SAF 2507 became the most common material in the Arabian Gulf
- * Using sponge-ball acid treatment for alkaline scale control once per week (phosphorus or hydrofluoric acid)



Desalination Project Challenges

#8

Rained Out

Santa Barbara

- * Voters agreed to spend \$34m for a desalination plant that operated for four months in 1991
- * When the drought ended, the plant was shut down until 2016 when the Santa Barbara City Council is planning to spend \$40m to modernize the facility due to Lake Cachuma falling to 30% of its capacity
- * Will cost \$5.2m in operational costs
- * Costs a third more than Santa Barbara's imported water
- * Monthly water bills may increase up to \$108 for the average household use of 900 gallons a month
- * Will provide for 30% of the city's demand



Source: Los Angeles Times
Sept, 2016

Desalination Project Challenges

#7

Wasted Water

Point Lisas, Trinidad

- * Has provided 40mgd of RO treated water to the Point Lisas Industrial Estate since 2002
- * Capital Cost of \$150m
- * Brine is channeled to a private manufacturer of nitrogenous fertilizers via an outfall pipeline
- * Desalcott is contractually bound to sell the water to the Water and Sewage Authority (WASA) for 20 years
- * Ongoing disputes have occurred between Desalcott and WASA over the cost of the product water (\$2110 per acre foot – the average cost for desalinated water)
- * WASA, which supplies 92% of the potable water in Trinidad, estimated a non-revenue of 45% due to infrastructure leaks and local farmers siphoning the supply



Source: UNESCO,
2006

Desalination Project Challenges

#6

Filtration Frustrations

Ad Dur, Bahrain

- * An ultrafiltration pretreatment system was added as part of the rehabilitation process for DuPont's desalination plant initiated in 1999
- * The filtration equipment was unique in its reversible-flow spiral wound elements that used backwash procedures to clean the membranes
- * Heavy fouling and scaling problems occurred due to the high organic contents in the seawater from industrial and residential waste
- * Presently, the filtration unit is according to specifications with the addition of Multi-bore Ultrafiltration Membranes

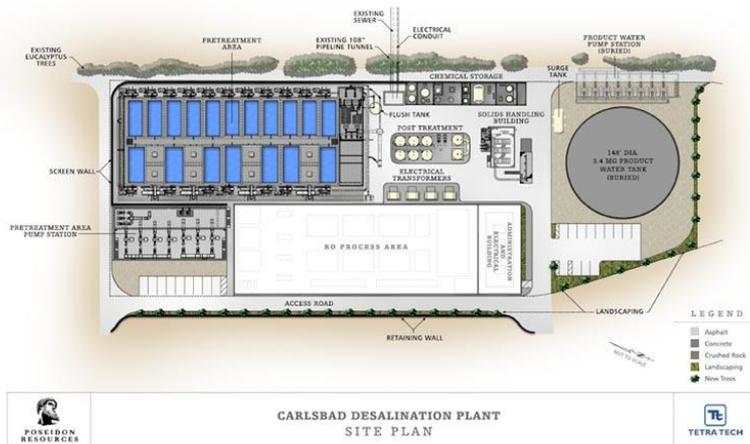


Desalination Project Challenges

#5 Permitting and Lawsuits

Carlsbad Desalination Plant

- * Six years of government permitting, from the Carlsbad City Council to the California Coastal Commission, as well as having to confront 14 lawsuits and appeals by environmental groups like the Surfrider Foundation before finally breaking ground
- * Required to build 66 acres of wetlands in San Diego Bay to offset the plant's environmental harm
- * It also must blend its brine at a 5:1 ratio with other seawater before flushing it back into the ocean so it won't harm marine life

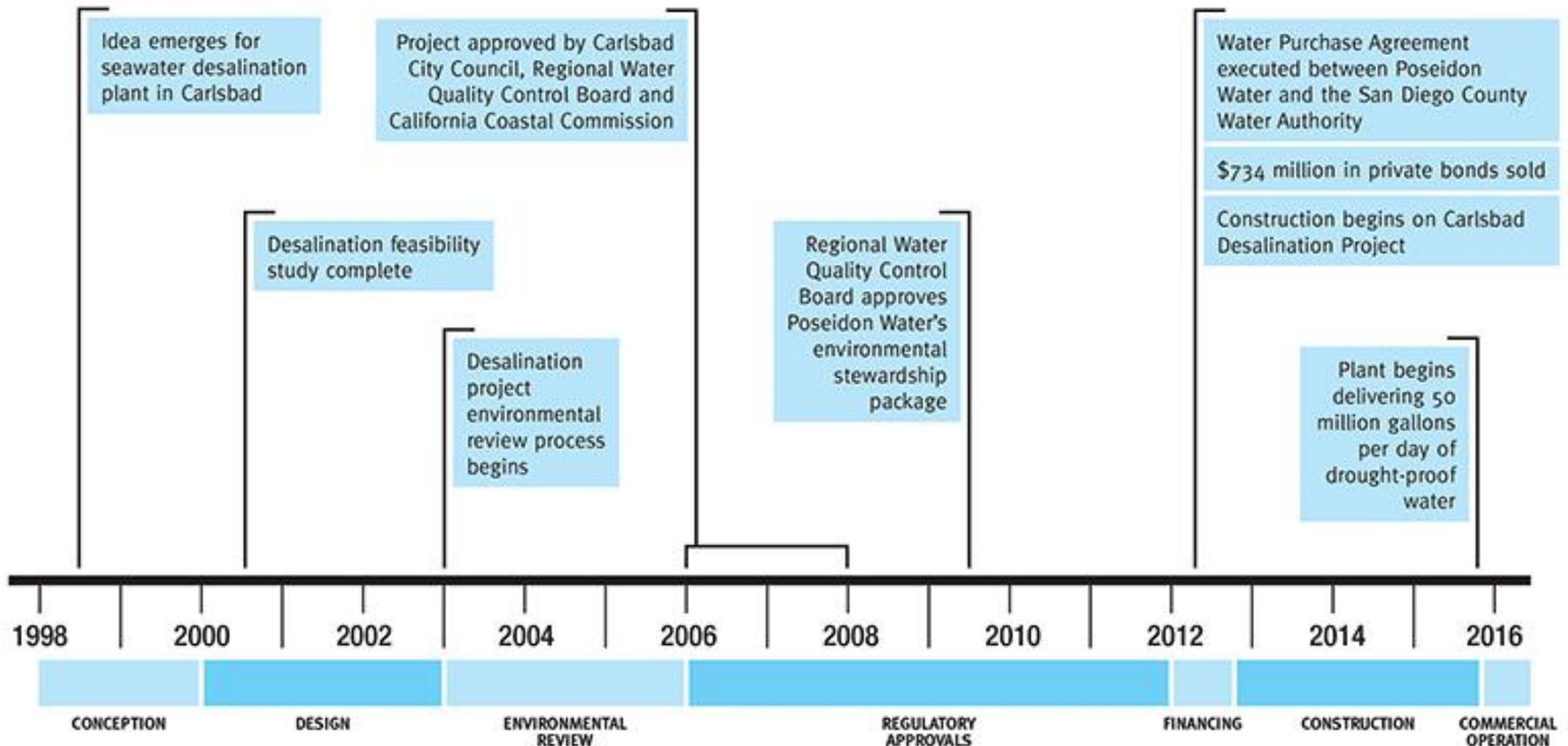


Desalination Project Challenges

Permitting and Lawsuits

Carlsbad Desalination Plant Milestone Timeline

Source: Carlsbad Desalination Project, 2016



Desalination Project Challenges

Collapsing Contracts

#4

Tampa Bay Seawater Desalination Plant

- * Produces 25mgd (10% of the region's drinking water supply)
- * Request for Proposals in 1996 and awarded to S&W Water, a Stone and Webster – Poseidon JVC
- * Plant was co-located with the Big Bend 2,000MW power station
- * Capital Cost: \$100m, rose to \$158m due to additional remediation



Desalination Project Challenges

Collapsing Contracts

Tampa Bay Seawater Desalination Plant

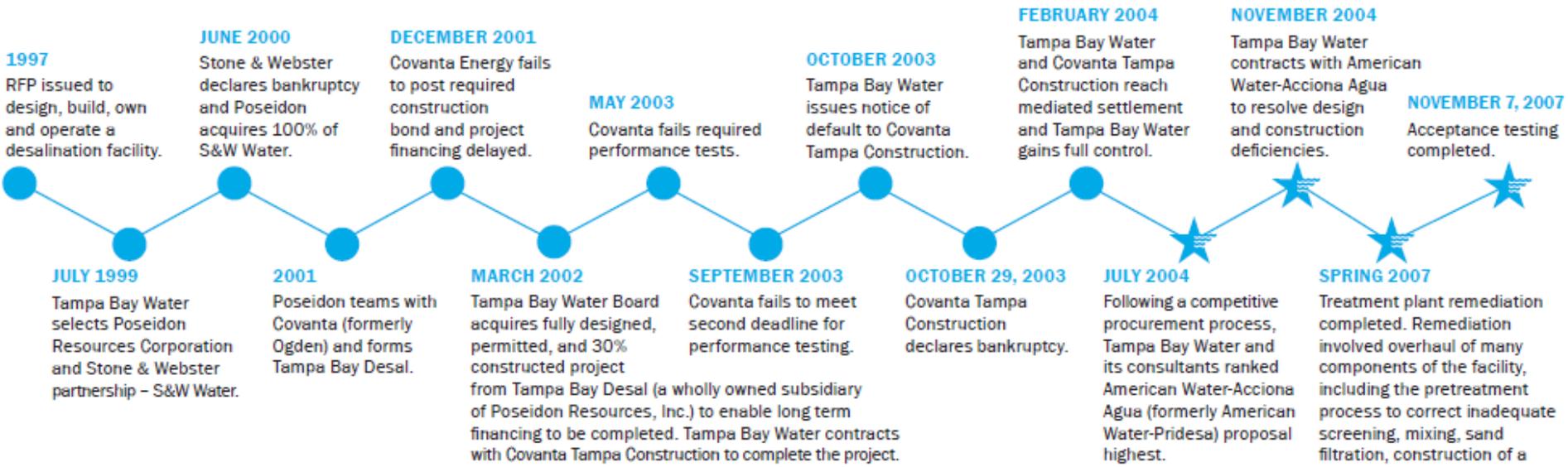
- * Stone & Webster declared bankruptcy in 2000 leaving S&W without an engineering and construction partner
- * Poseidon teamed up with Covanta Energy that same year and created Covanta Tampa Construction which resumed operations in 2001
- * In 2002, Poseidon and CTC were unable to secure long-term financing and Tampa Bay Water bought out Poseidon's interest while retaining CTC to finish the job
- * Deadlines were missed in 2003 and a test performance revealed 31 deficiencies, including excessive membrane silting caused by Asian green mussels clogging the filters
- * After five months of being unable to pass the 14-day performance test, CTC followed its parent company into bankruptcy
- * American Water/Pridesa were awarded a contract to fix the plant (payable upon completion) in 2004 and completed in 2007





TAMPA BAY SEAWATER DESALINATION PLANT

In 1998, Tampa Bay Water began to implement a plan to meet the region's growing water needs. The plan was designed to provide geographic diversity and to include alternative drinking water sources to offset required reductions in groundwater pumping. An integral part of the plan was to construct a 25 mgd seawater desalination facility.



**RIBBON CUTTING CEREMONY
TAMPA BAY DESALINATION PLANT
JANUARY 25, 2008**

Following acceptance of the project in November 2007, American Water-Acciona Agua has continued to operate the facility in accordance with its contractual obligations and in full compliance with all regulatory and environmental compliance criteria. During 2008, the first full contractual year of operation, American Water-Acciona Agua produced over 7,000 million gallons of desalinated water exceeding consumables expectations and providing savings for Tampa Bay Water and American Water-Acciona Agua on chemical and power consumption.



AMERICAN WATER

**WE CARE ABOUT WATER.
IT'S WHAT WE DO.**

Desalination Project Challenges

#3

Relying on Subsidies

Cabreras Desalination Plant

- * Completed in 2004
- * Designed to provide 90% of its produced water for agricultural purposes
- * The water was subsidized at 3% of the urban water price
- * Farmers in Almeria began selling the desalinated water to urban concessionary companies at market price during periods of drought
- * After the construction bubble burst in 2007, the Spanish government was unable to subsidize the cost of the desalinated water
- * The cost of power rose dramatically
- * Farmers began buying only enough desalinated water to dilute the brackish groundwater for irrigation purposes



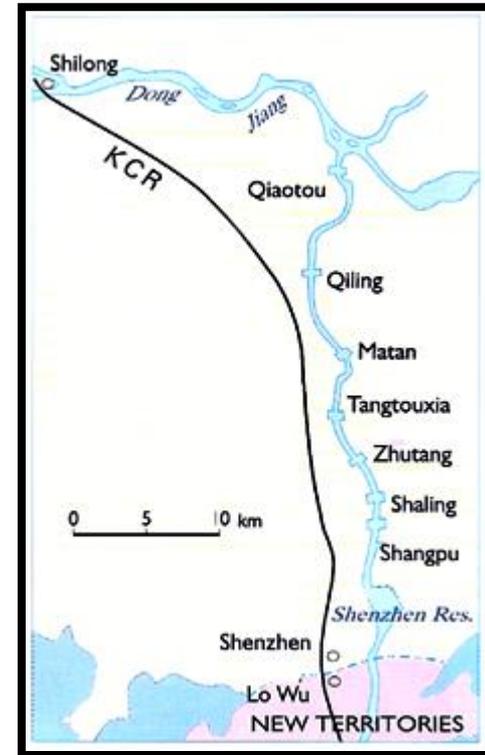
Desalination Project Challenges

#2

A Cheaper Alternative

Hong Kong MSF

- * A large Multi-Stage Flash distillation facility was built in 1975
- * Its operation was more expensive than importing water from the Dongjiang, a river north of Hong Kong, via pipeline, and the plant was decommissioned in 1981
- * Since the price of imported water has increased from \$1 to \$3 per cubic meter (264 gallons), Hong Kong announced in 2011 the construction of a new RO seawater desalination plant
- * The MSF facility had energy costs that were too high in comparison with an RO facility



Desalination Project Challenges

Lots of Money, For Not a Lot of Demand

#1

Wonthaggi (Victorian) Desalination Plant

- * Completed in 2012
- * \$3.5b to construct the largest plant in Australia
- * 120,000-160,000 AFY
- * Operating costs are charged by a private firm over a 27 year period, even if no water is produced
 - * \$1.8m per day or \$18b total
- * Plant has been on stand-by since Melbourne's reservoirs reached 80% capacity in 2010 officially ending the drought
- * Water bill for residents estimated to rise 64% over the next five years



The Eight Inquiries

1. Is there a demand for it?
2. How long will that demand last?
 - * Growth Projections
 - * Drought Severity and Longevity
3. Is it competitive?
4. Can we pay for it?
5. Do we have the most cost-effective technology and materials?
6. Are the contractors dependable?
7. Is the existing infrastructure reliable?
8. Have we involved all of the necessary stakeholders in the design process?

Questions?

Arizona Water Initiative



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