CaribDA
Caribbean Desalination Association

# CaribDA 2012 Conference & Exposition

***"80 Years of Desalination Makes For One Happy Island"***

in conjunction with

## W.E.B. Aruba N.V.'s 80th Anniversary Celebration

***19 – 22 June 2012 in Aruba***

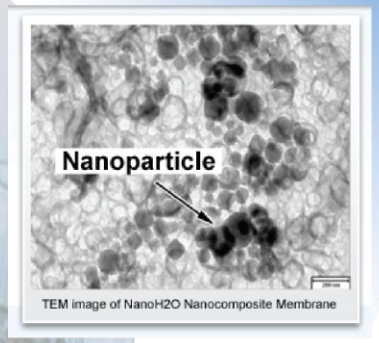
# Energy Savings and Salt Rejection Improvements using Seawater Nanocomposite Membranes in Caribbean Waters

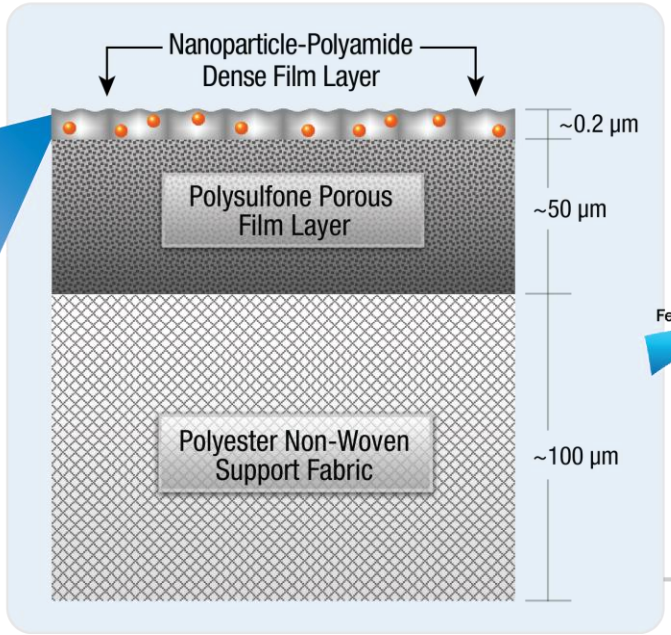
**Bob Burk**

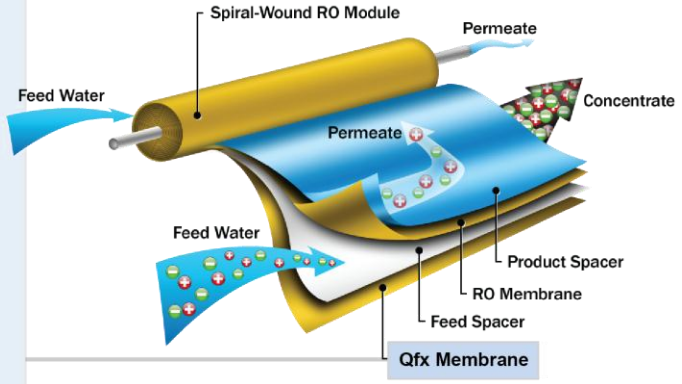
**Nano$H_2O$, Inc.**

# Thin-Film Nanocomposite Membrane Technology

- ✓ Best-in-class flux and salt rejection
- ✓ Standard 4 and 8-inch element design
- ✓ Easy to retrofit existing RO plants
- ✓ Nanoparticles are benign materials





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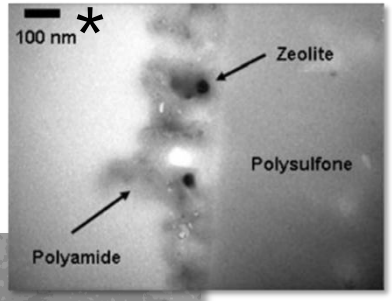
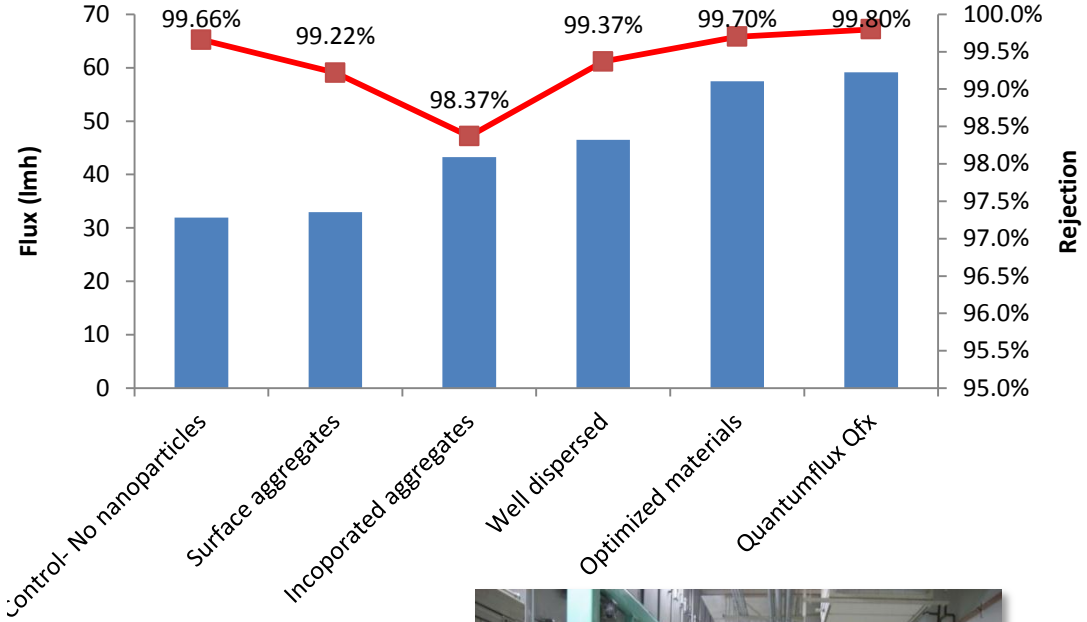
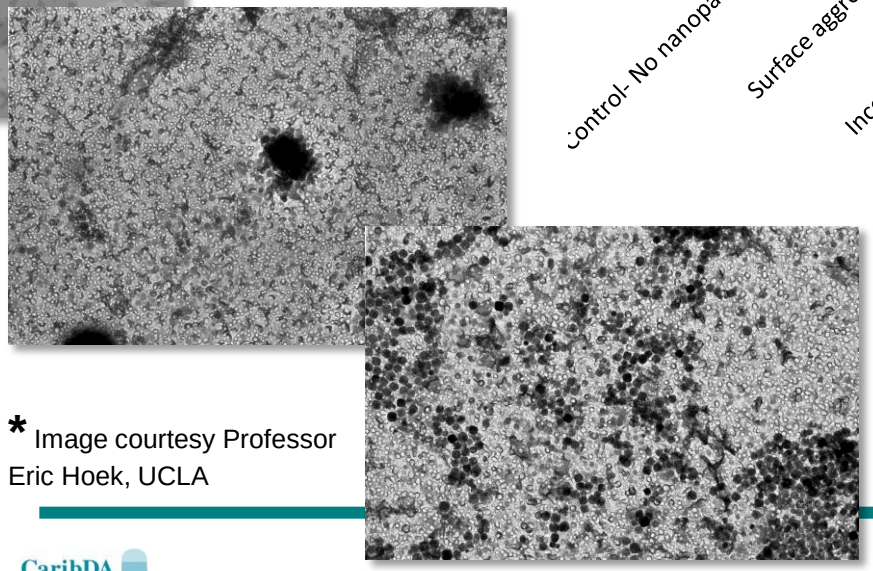
# Nanocomposite Membrane Development




Coupon tests: 55 bar (800 psi), 32,000 ppm NaCl



* Image courtesy Professor Eric Hoek, UCLA



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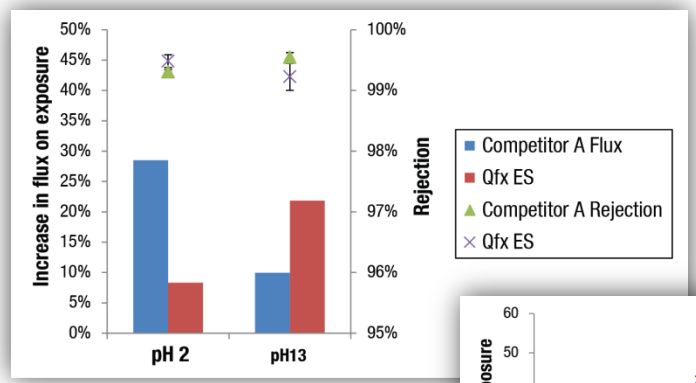
# Available Nanocomposite Membranes – Qfx ES, R, SR

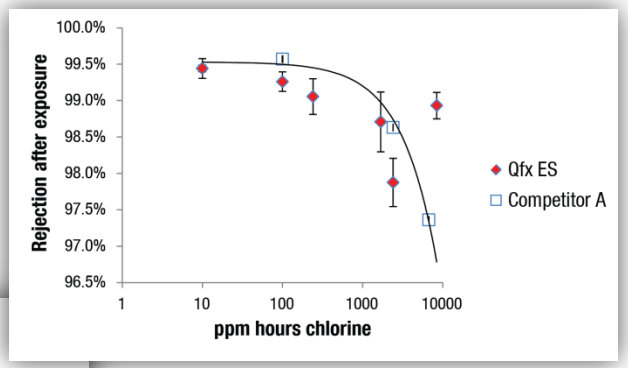
| Product Specifications | Qfx SW 400 ES | Qfx SW 400 R | Qfx SW 400 SR |
|---|---|---|---|
| Permeate Flow Rate, $m^3/d$ (gpd) | 52 (13,750) | 34 (9,000) | 24.6 (6,500) |
| Minimum NaCl Rejection, % | 99.7 | 99.75 | 99.75 |
| Stabilized NaCl Rejection, % | 99.8 | 99.85 | 99.85 |
| Active Membrane Area, $m^2$ ($ft^2$) | 37 (400) | 37 (400) | 37 (400) |
| Feed Spacer, mil | 28 | 28 | 28 |
| Stabilized Boron Rejection: % | 89 | 93 | 93 |

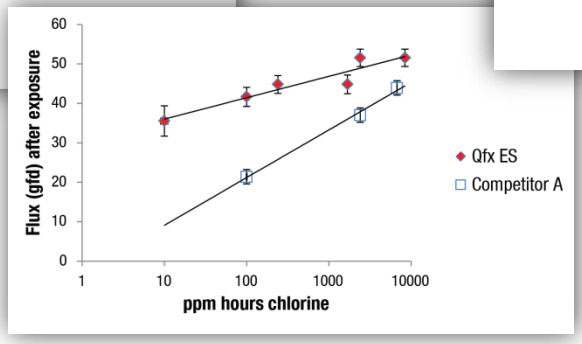
**Dimensions**

| | |
|---|---|
| Length (A) | 1016 mm (40 in.) |
| Element O.D. (B) | 200 mm (7.9 in.) |
| Per Tube I.D. (C) | 28.6 mm (1.125 in.) |
| Weight | 16.4 kg (36 lbs.) |

# Chemical Resistance




- Conclusion: ***Quantum*Flux** membranes can withstand the same chemical cleaning procedures as competing membranes.

***"Performance values for all but two cleaners (L212 and P911) fell into the normal ranges established for the control samples . . . the membrane samples soaked in L212 and P911 actually improved."***

***-Avista Technologies Report October 2010***



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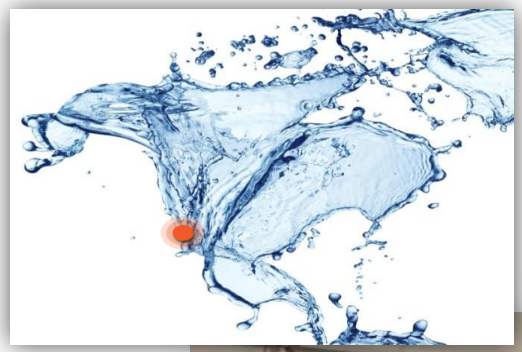
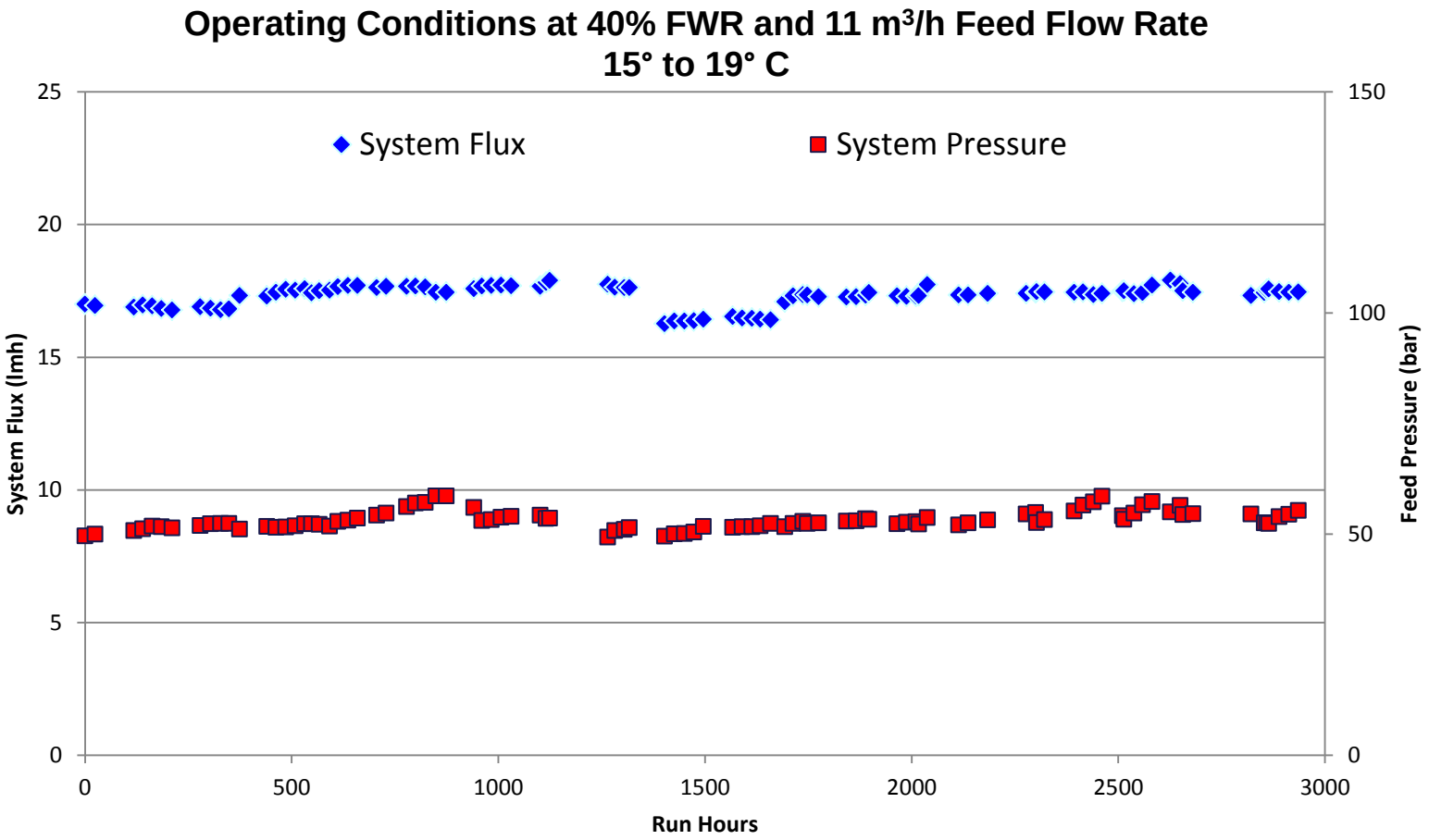
# Pilot Installation - Port Hueneme, California

- NanoH$_2$O pilot system installed in 2008 at U.S. Navy Desalination Testing Facility
- Utilizing Qfx ES membrane elements
- 34,000 ppm; 15˚ - 19˚C
- 11 m$^3$/h feed flow
- PX30 energy recovery device
- Submerged UF (GE Zenon) pretreatment



# Qfx SW ES Final – U.S. Navy Test Facility



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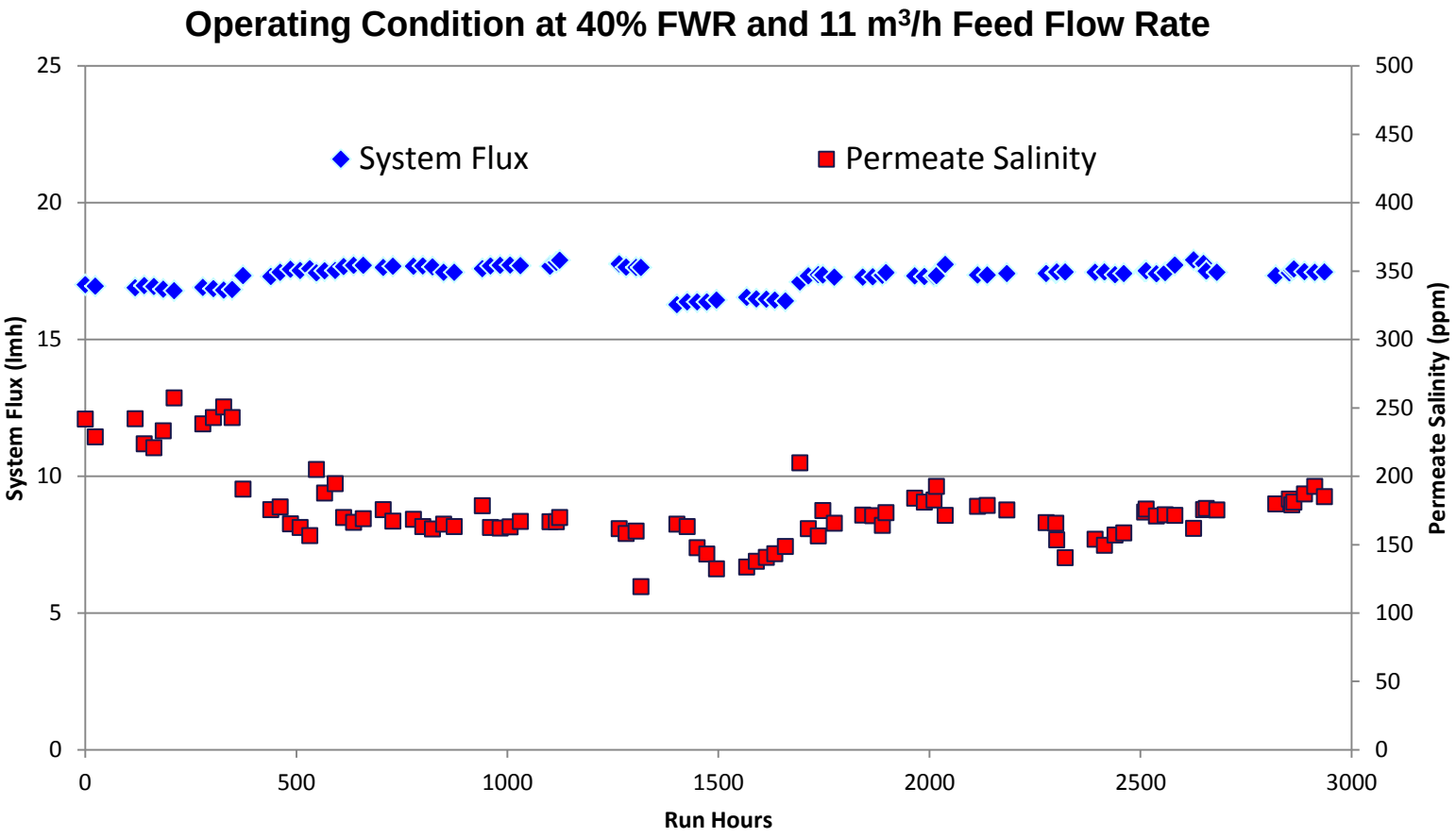
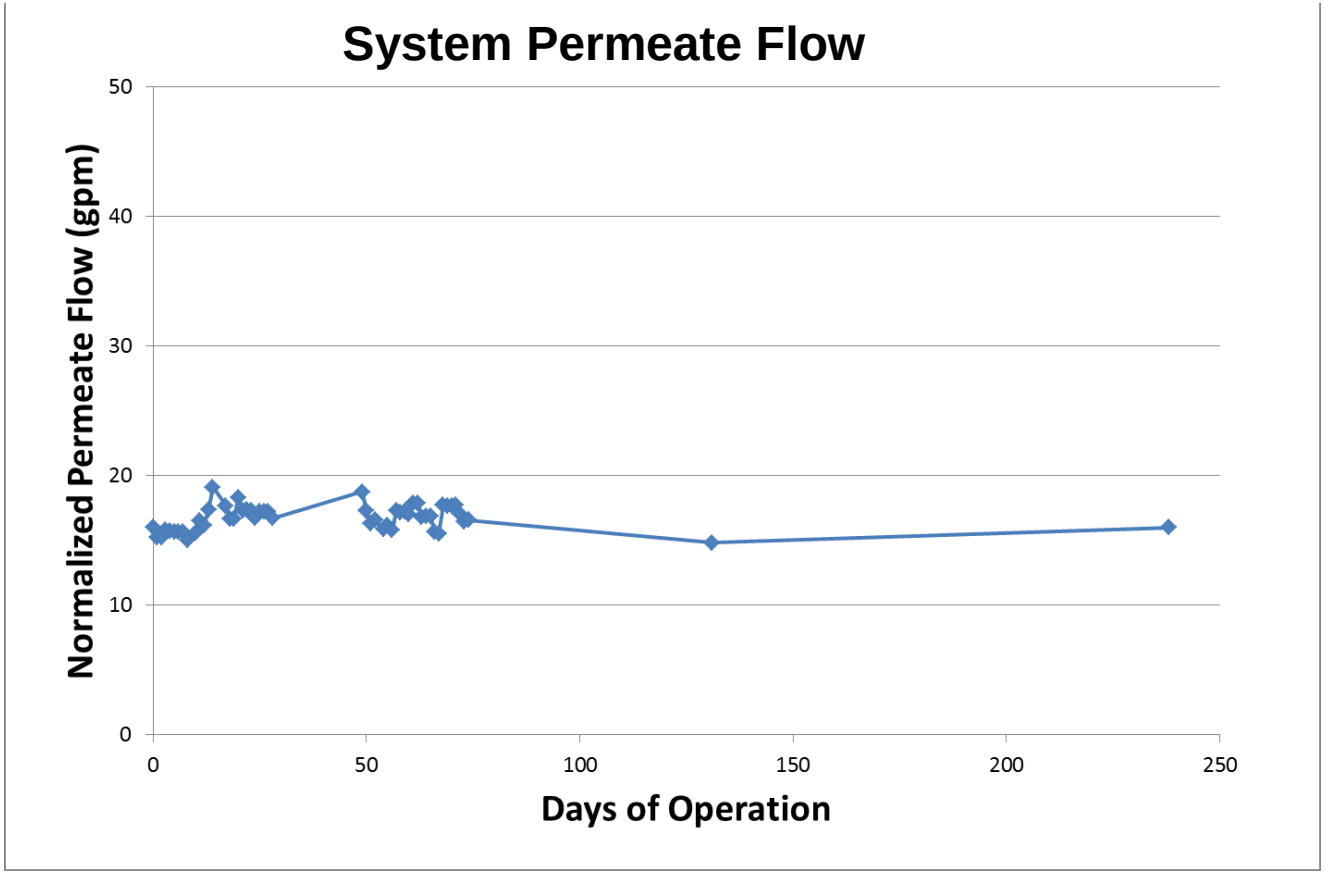


# Red Hook – St. Thomas, USVI

- Installed in early 2011
- Utilizing Qfx ES membrane elements
- 36,500 ppm; 29˚C
- Intake located in a boat harbor, one meter below the water's surface
- Excellent fouling resistance

# Red Hook – St. Thomas, USVI





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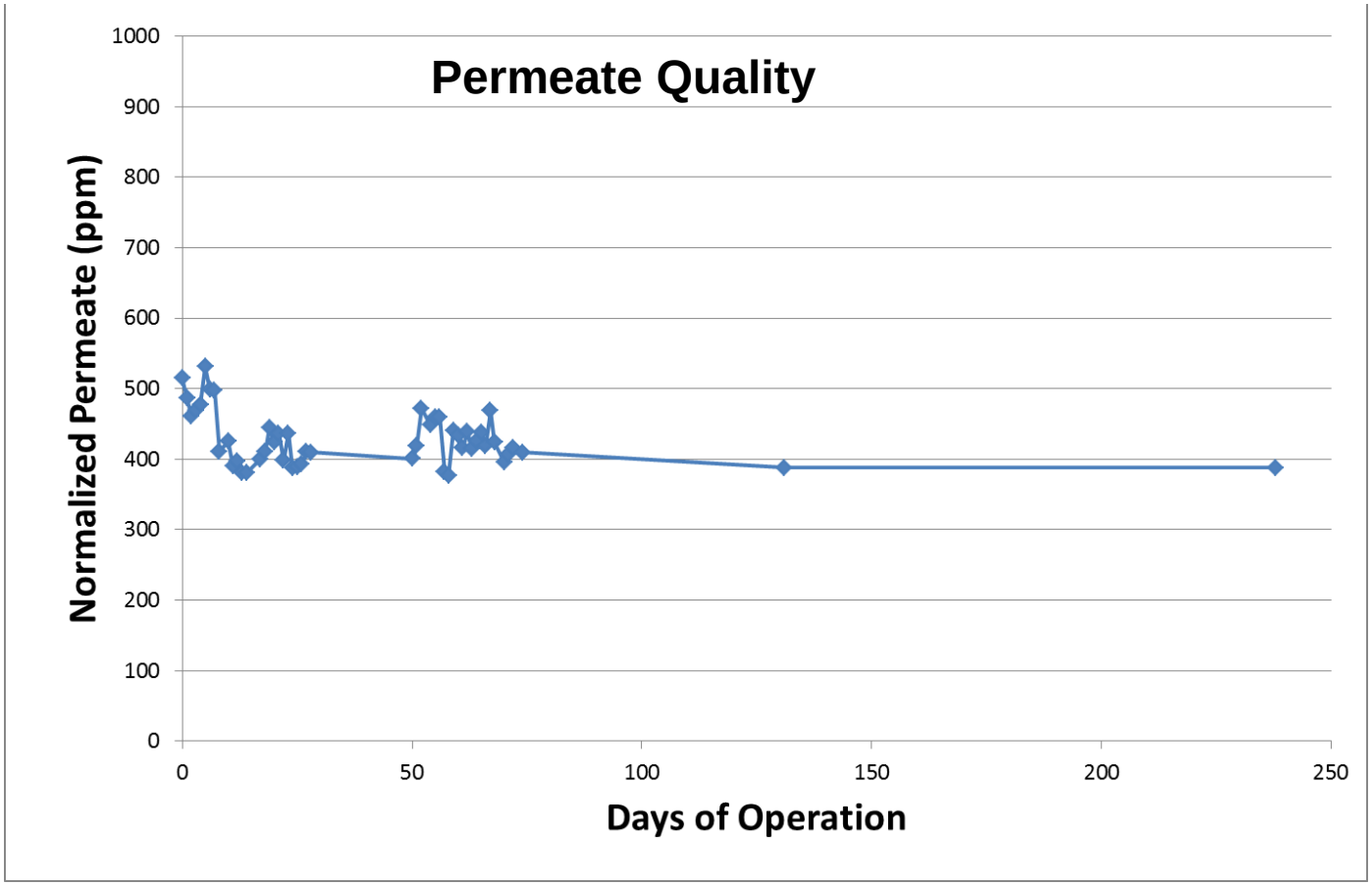
# Red Hook – St. Thomas, USVI



# Cayman Brac – Cayman Islands

- Installed in July 1, 2011
- Retrofit utilizing Qfx ES membrane elements
- 30,620 ppm; 25˚ - 29˚C
- Membrane Performance Contract
- Total energy reduction of 28%

# Cayman Brac – Cayman Islands

| | |
|---|---|
| **Site Location** | Cayman Islands |
| **Date** | July 1, 2011 |
| **Scale** | 556 $m^3$/d (146,880 GPD) |
| **Product** | Qfx SW 365 ES |
| **Offering** | Membrane Service Program |
| **Client** | Water Authority Cayman |

*Table 1: Plant operating parameters **PRIOR** to installation of **Quantum**Flux elements.*

| Stream | BAR (PSIG) | $m^3$/h (USGPM) | TDS |
|---|---|---|---|
| **LP Feed** | 1.6 (23) | 59.3 (261) | 30973 |
| **Overall HP Feed** | 70.6 (1024) | 59.3 (261) | 34380 |
| **HP Pump Feed** | 70.6 (1024) | 23.2 (102) | 30973 |
| **1st Pass Permeate** | 0.69 (10) | 15.2 (67) | 120 |
| **2nd Pass Feed** | 14.1 (205) | 6.6 (29) | 289 |
| **Overall Permeate** | 0.69 (10) | 20.4 (90) | 50 |
| **Specific Energy** | 3.47 kWh/$m^3$ (13.14 kWh/1000 USG) | | |
| **1st Pass Recovery** | 37% | | |

Note: Temperature range is between 25° to 29°C

*Table 2: Plant operating parameters **AFTER** installation of **Quantum**Flux elements.*

| Stream | BAR (PSIG) | $m^3$/h (USGPM) | TDS |
|---|---|---|---|
| **LP Feed** | 1.6 (23) | 57.7 (254) | 30620 |
| **Overall HP Feed** | 44.8 (650) | 57.7 (254) | 31445 |
| **HP Pump Feed** | 44.8 (650) | 23.2 (102) | 30620 |
| **1st Pass Permeate** | 0.69 (10) | 16.1 (71) | 263 |
| **2nd Pass Feed** | 14.1 (205) | 6.81 (30) | 544.7 |
| **Overall Permeate** | 0.69 (10) | 21.6 (95) | 110 |
| **Specific Energy** | 2.49 kWh/$m^3$ (9.44 kWh/1000 USG) | | |
| **1st Pass Recovery** | 40% | | |

Note: Temperature range is between 25° to 29°C

**Lowered Energy from 3.47 kWh/$m^3$ to 2.49 kWh/$m^3$**



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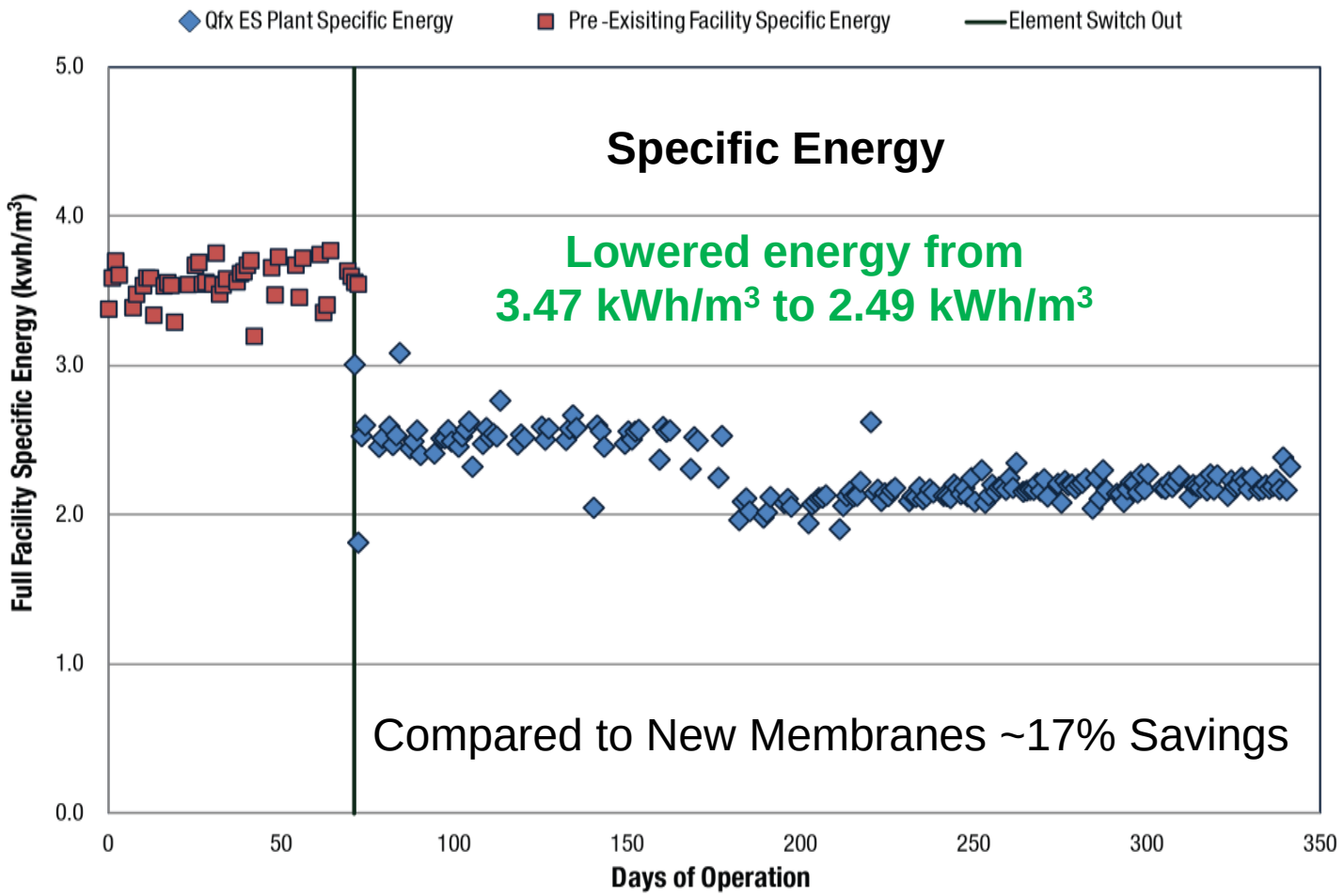
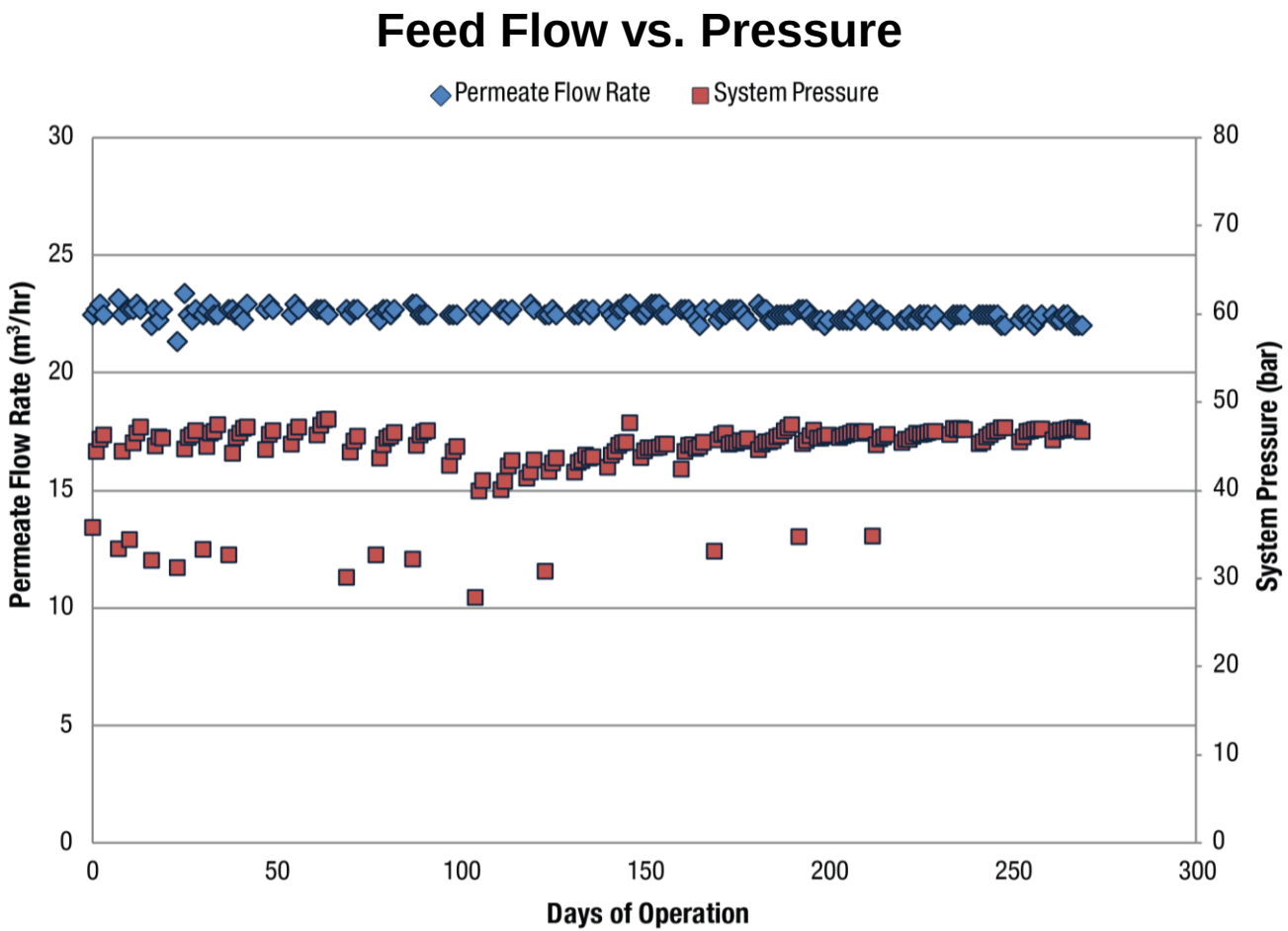
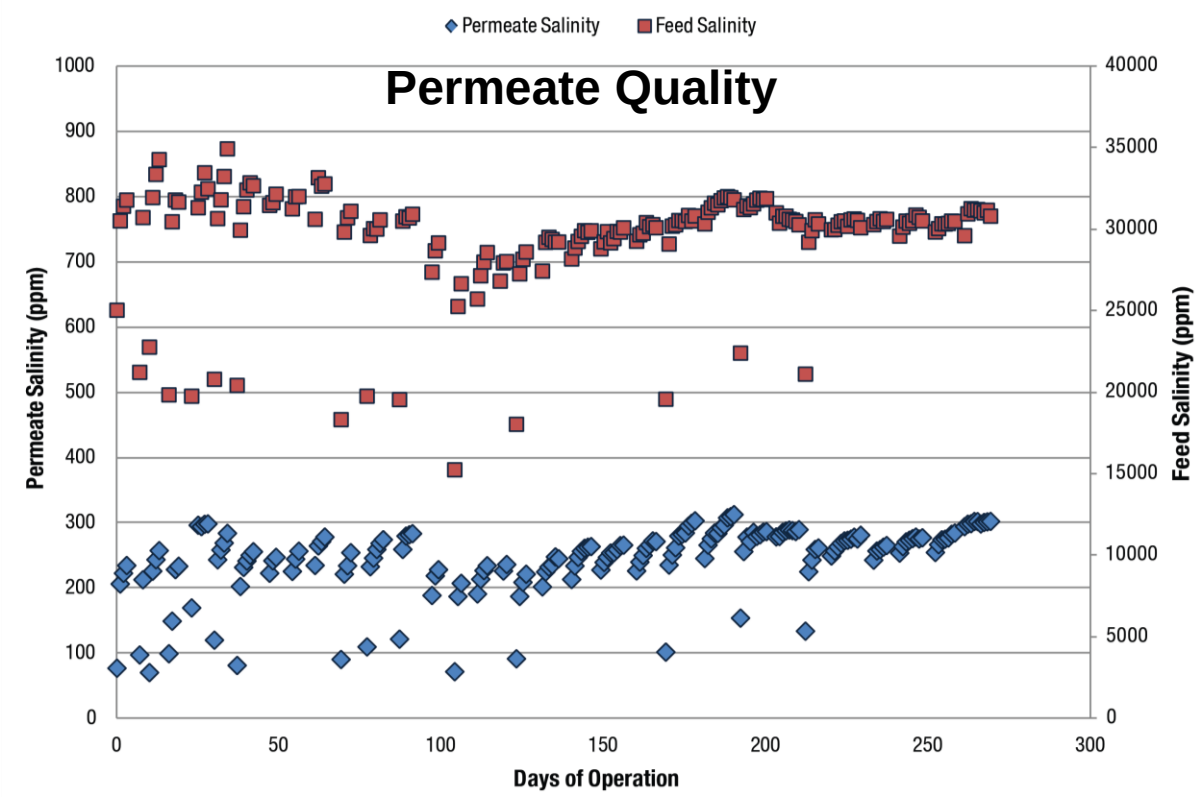
# Cayman Brac – Cayman Islands



# Cayman Brac – Cayman Islands



# Cayman Brac – Cayman Islands

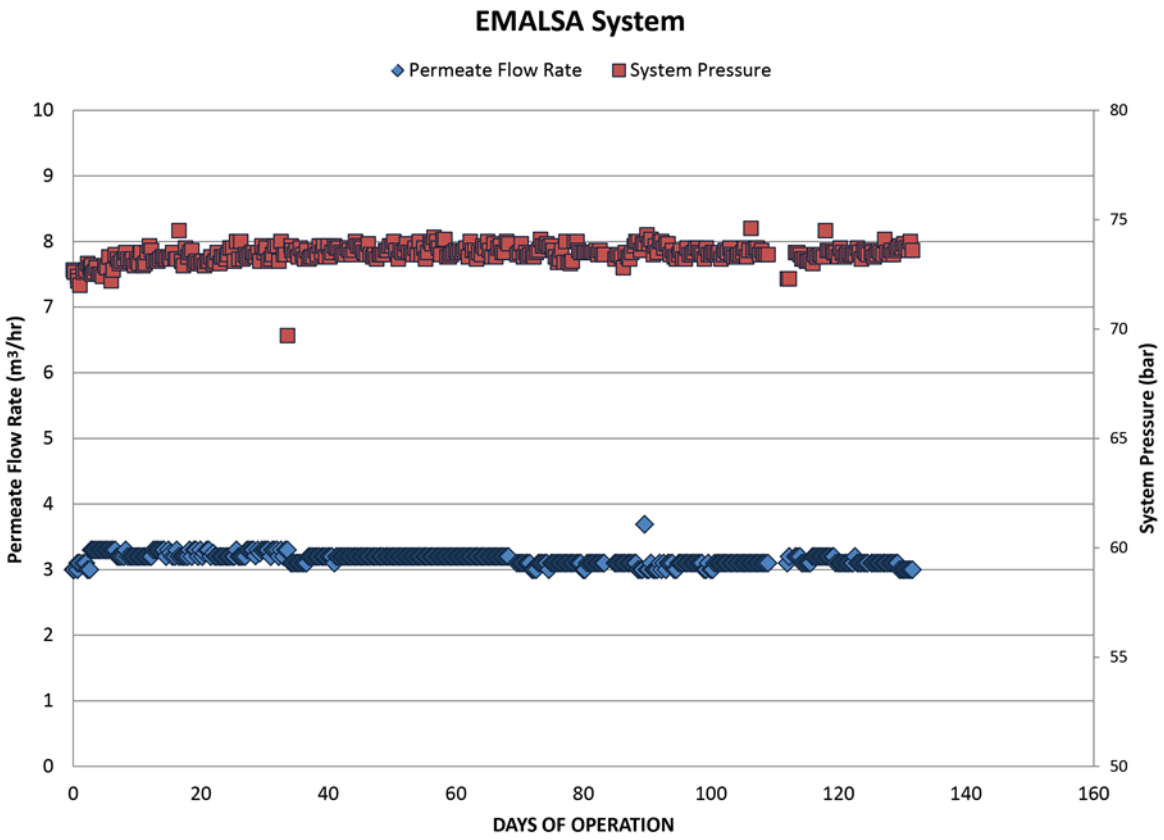



*Feed water salinity increases as water is pumped from a well to the desalination system. The plant is shut down in between data points – which is when the salinity returns to its natural state. This results in fluctuating feed and permeate salinity. Membrane performance is considered stable by the Water Authority Cayman.*

# EMALSA - Canary Islands, Spain

- Pilot system installed in 2011
- Utilizing Qfx R and SR
- 50% increase in water production
- Improved permeate quality
- 4% reduction in energy

# EMALSA - Canary Islands, Spain



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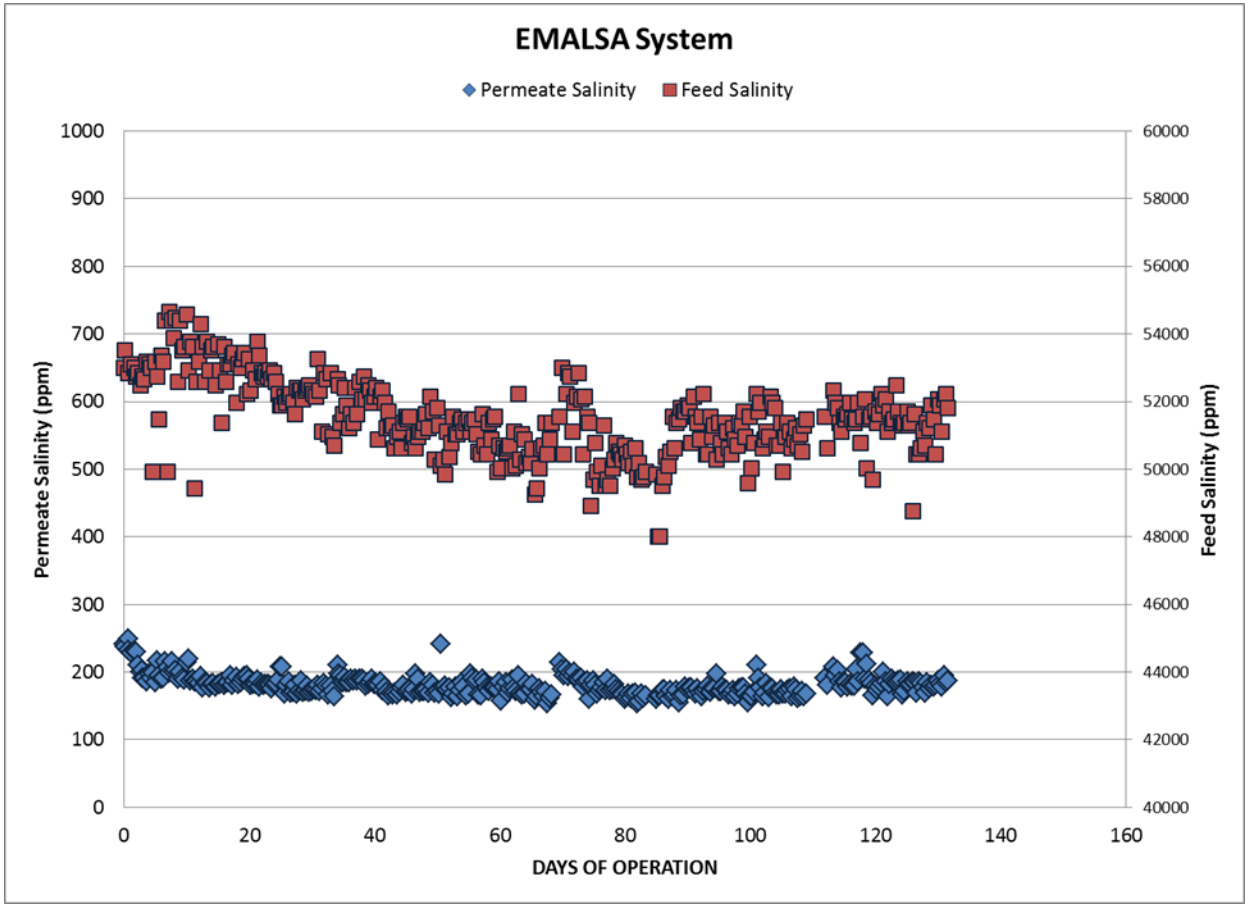
# EMALSA - Canary Islands, Spain



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# Summary – Nanocomposite Membranes

- ✓ Early Research to Product with Demonstrated Performance
- ✓ Nanocomposite SWRO Membranes – Highest Flux

  Qfx SW 400 ES: 13,700 GPD, 99.8%
- ✓ Nanocomposite SWRO Membranes Highest Rejection SWRO Membranes on Market:

  Qfx SW 400 R: 9,000 GPD, 99.85%  Qfx SW 400 SR: 6,500 GPD, 99.85%
- ✓ 200,000+ Operating Hours / 50+ Installations / 13 MGPD (50,000 $m^3/d$) Cumulative Capacity
- ✓ Installations in: California, Caribbean, Spain, Israel, Latin America, Australia, India, Korea, Egypt
- ✓ Just the Beginning!

# Contact Information

## Thank You

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