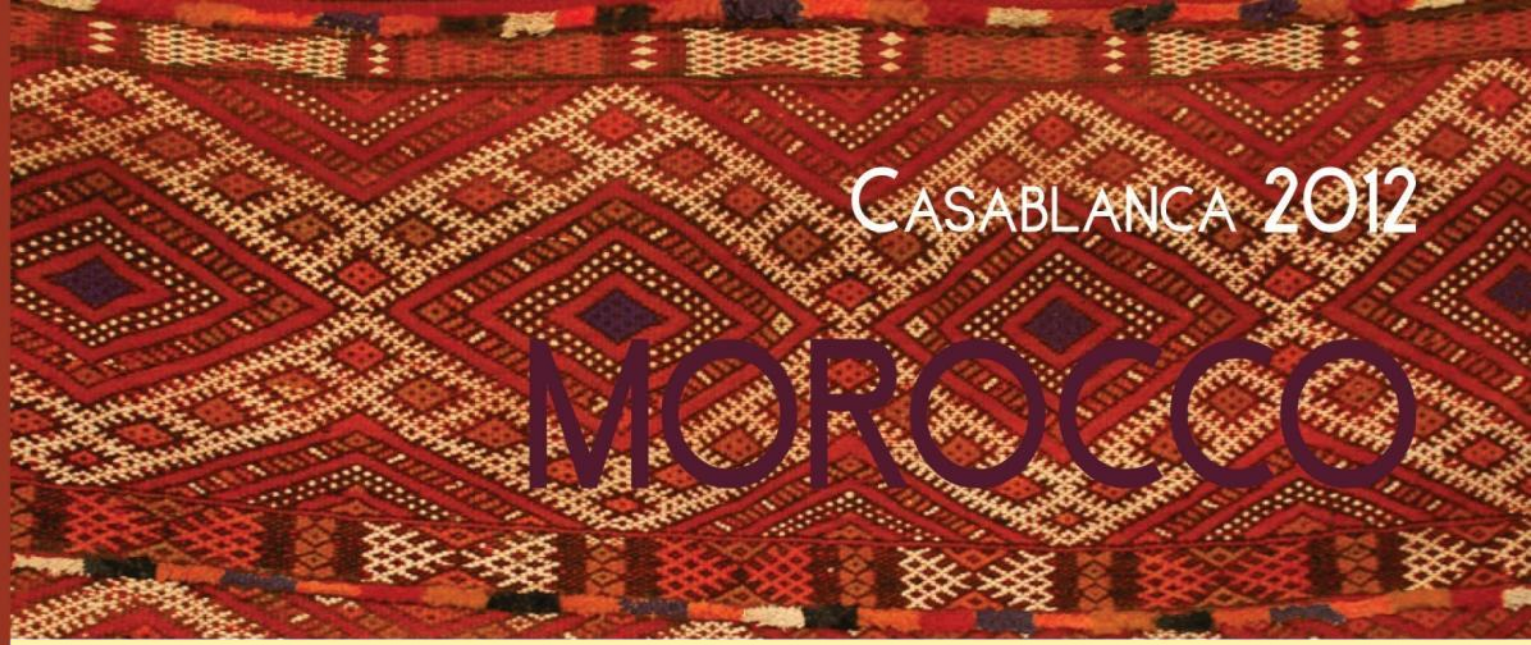
International Conference on Desalination and Sustainability

1 - 2 March 2012



Membrane Pretreatment in SWRO: Results from Operating Plants

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MOR12-009

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Introduction

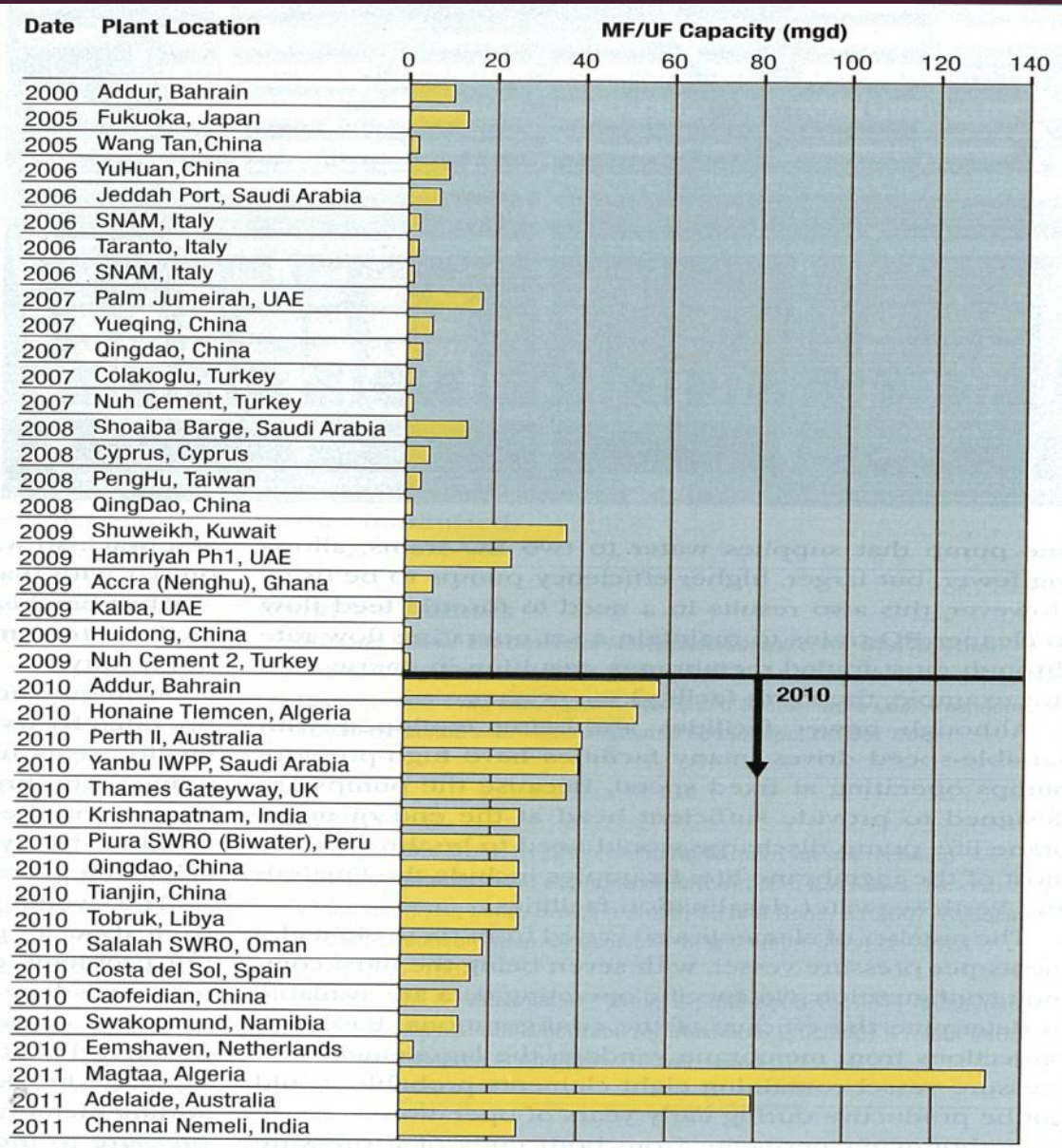
Technical feasibility of UF as pretreatment to SWRO is undisputed

- Able to treat difficult feed water (surface water intake)
- Better filtrate water quality (SDI < 3, reduction of microbiology)
- Smaller footprint
- Lower chemical consumption

Introduction

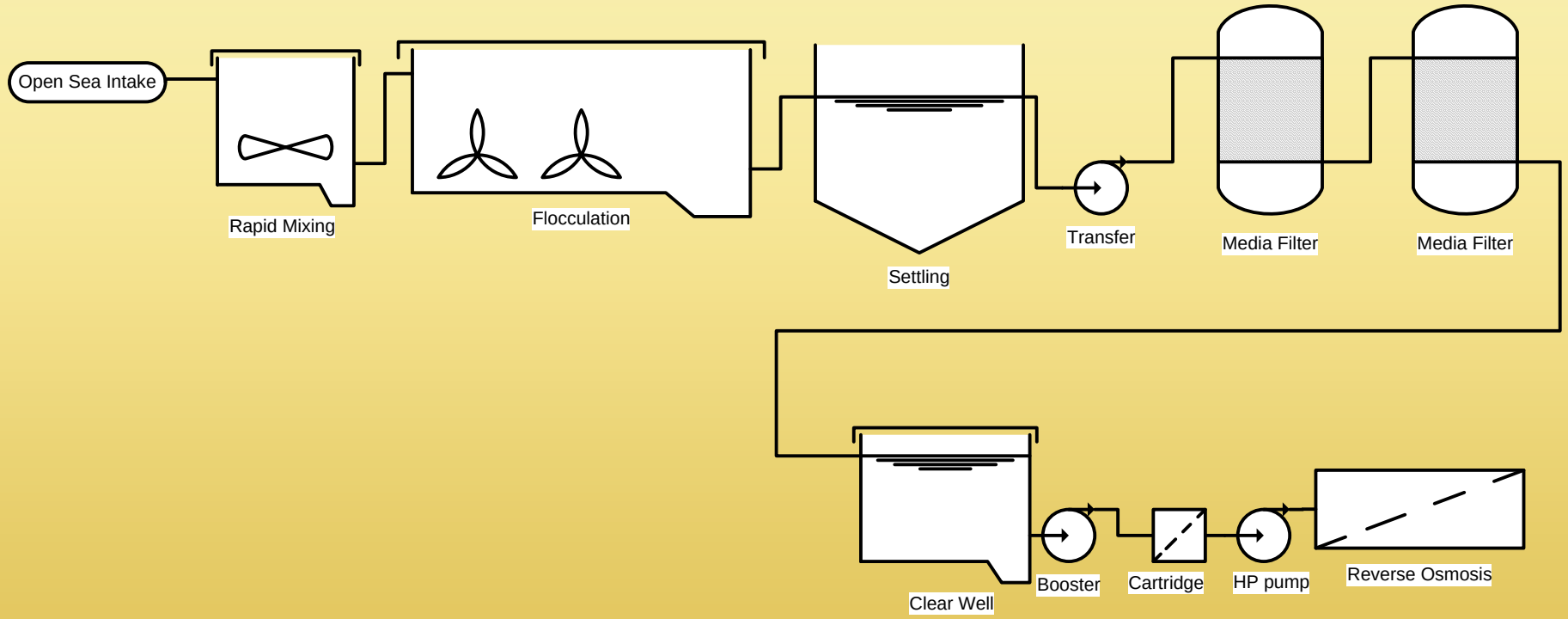
Global acceptance of membrane pretreatment on full scale desalination

UF pretreatment has been in operation since 6 – 8 years

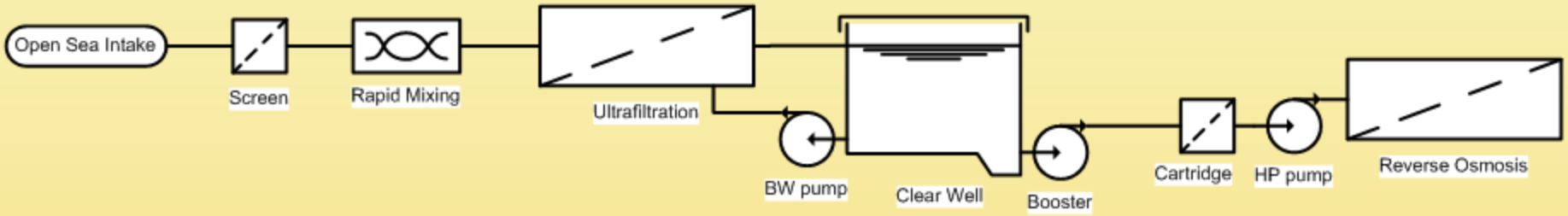


Source: IDA Journal Volume 3 number 4

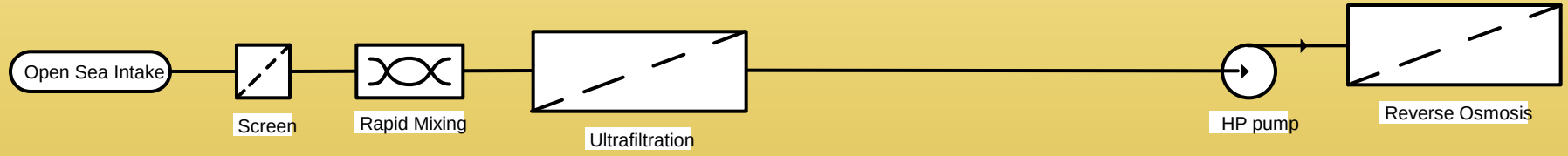
Conventional pretreatment



Seaguard UF pretreatment – option 1: with intermediate buffer tank



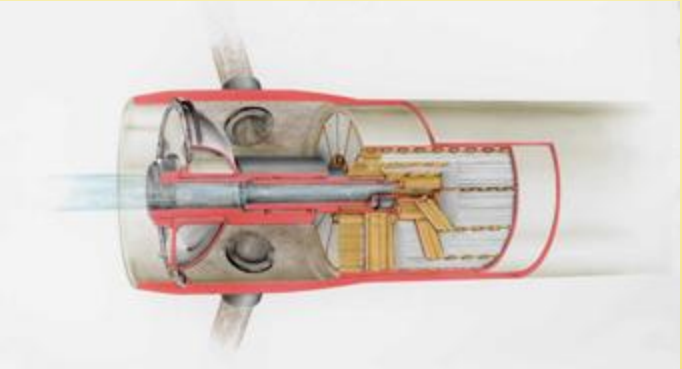
Seaguard UF pretreatment – option 2: in line operation



Membrane element design

Standardized design

- 8 inch diameter
- 60 inch long
- Central permeate tube
- Installed in pressure vessels



UF skids based on RO skid design

- Use of membrane housings
- Elements with interconnectors

Cost comparison

CONVENTIONAL

- Increasing operational cost
  - *Coagulants, polymers, labor*
- Deteriorating water quality
  - *Good locations have been taken*
  - *SWRO build close to centers of population*
- Higher water quality being requested
  - *Lessons learned from desalination plants with operational issues*
  - *Cost and downtime of RO cleaning*

SEAGUARD UF

- *Procurement*
  - *Economies of scale in membrane and equipment manufacturing*
  - *Standardization in equipment*
- *Operational cost*
  - *Fully automated operation*
  - *Improvements in operation (lower chemical consumption)*
- *Total installation cost*
  - *No need for separate water intake*
  - *Mechanical and civil construction in parallel*
  - *IWPP plants use cooling tower intake system*

Cost comparison

- Lower coagulant dose or no coagulant at all
- Less RO Cleaning
    - Lower consumption of cleaning chemical
    - Less down time
    - Longer RO membrane life time
- Less use of filter cartridges
- Smaller footprint

+ UF membrane replacement

Total savings 2 – 7% on total cost of ownership

Comparison – Non quantifiable benefits

1. Reduction in construction risk
   Unstable soil conditions

2. Site location & Intake
   Permitting

3. Better water quality - Independent from feed water quality

4. Reduced environmental impact

Case study: Koh Samui

- Desalination for potable water production
  Consumers: local population plus tourists
- Water source: Gulf of Thailand
- Project executed in two phases:
  Phase I: 6 MLD potable water production
  Phase II: 11 MLD potable water production

Case study: Koh Samui phase I

- Desalination plant characteristics
  Membrane pretreatment: X-Flow Seaguard ultrafiltration
  No of membranes: 96 elements
  Total UF surface area: 3840 m^2

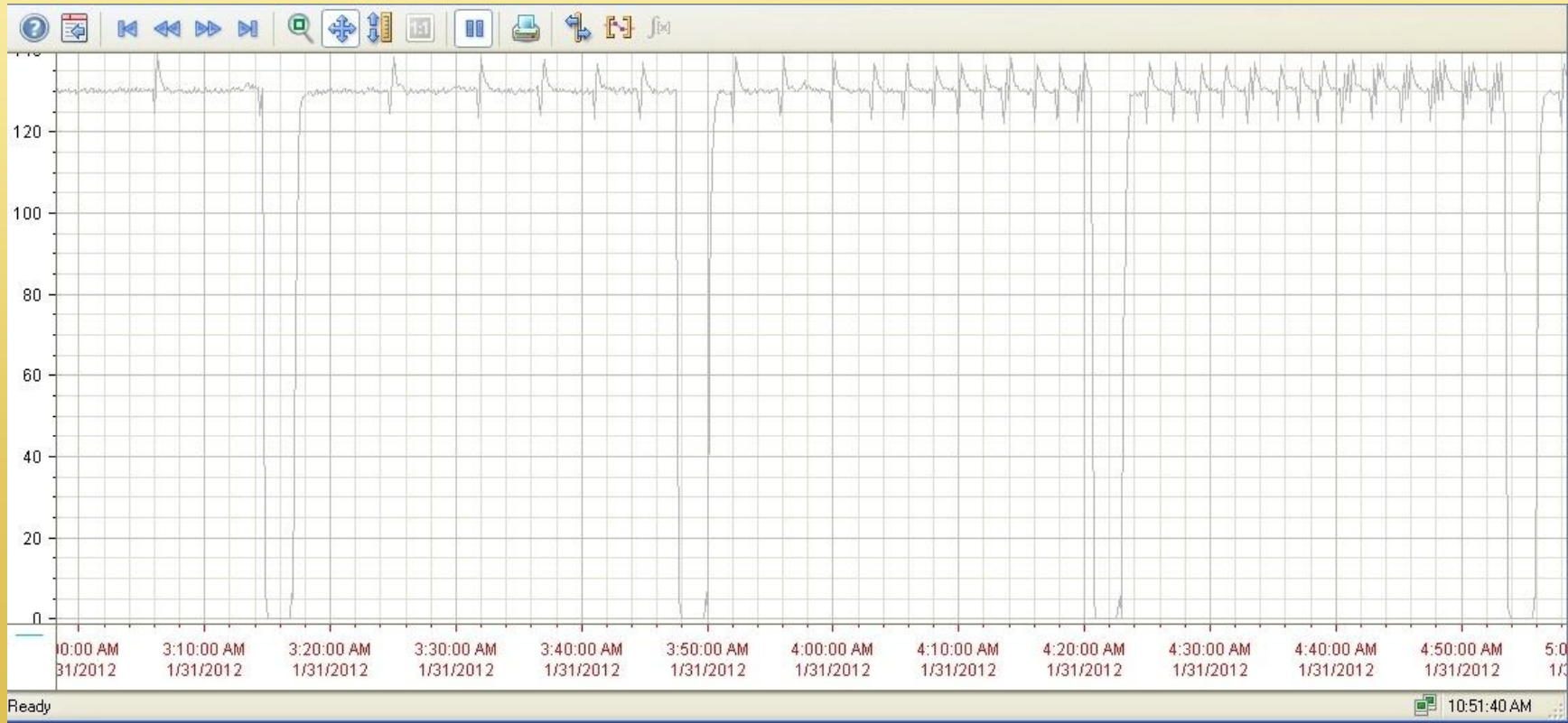
- Plant set up:
  Relatively small capacity
  Limited nr of UF skids
  Intermediate buffer tank

Case study: Koh Samui phase I

- Plant start up: 2009
  TMP trend over time showing filtration / backwash cycles

Case study: Koh Samui phase I

- Plant start up: 2009
  Flow trend over time showing flow during filtration / backwash cycles



Case study: Koh Samui phase II

- Desalination plant characteristics
  Membrane pretreatment: X-Flow Seaflex ultrafiltration
  No of membranes: 114 elements
  Total UF surface area: 6270 m^2

- Plant set up:
  Relatively small capacity
  Limited nr of UF skids
  Intermediate buffer tank

- Plant commissioning date
  spring 2012

Case study: Palm Jumeirah

- Desalination for potable water production
  Consumers: tourists
- Water source: Arabian Gulf
- Project executed in two separate locations:
  Each location: 32 MLD potable water

Case study: Palm Jumeirah

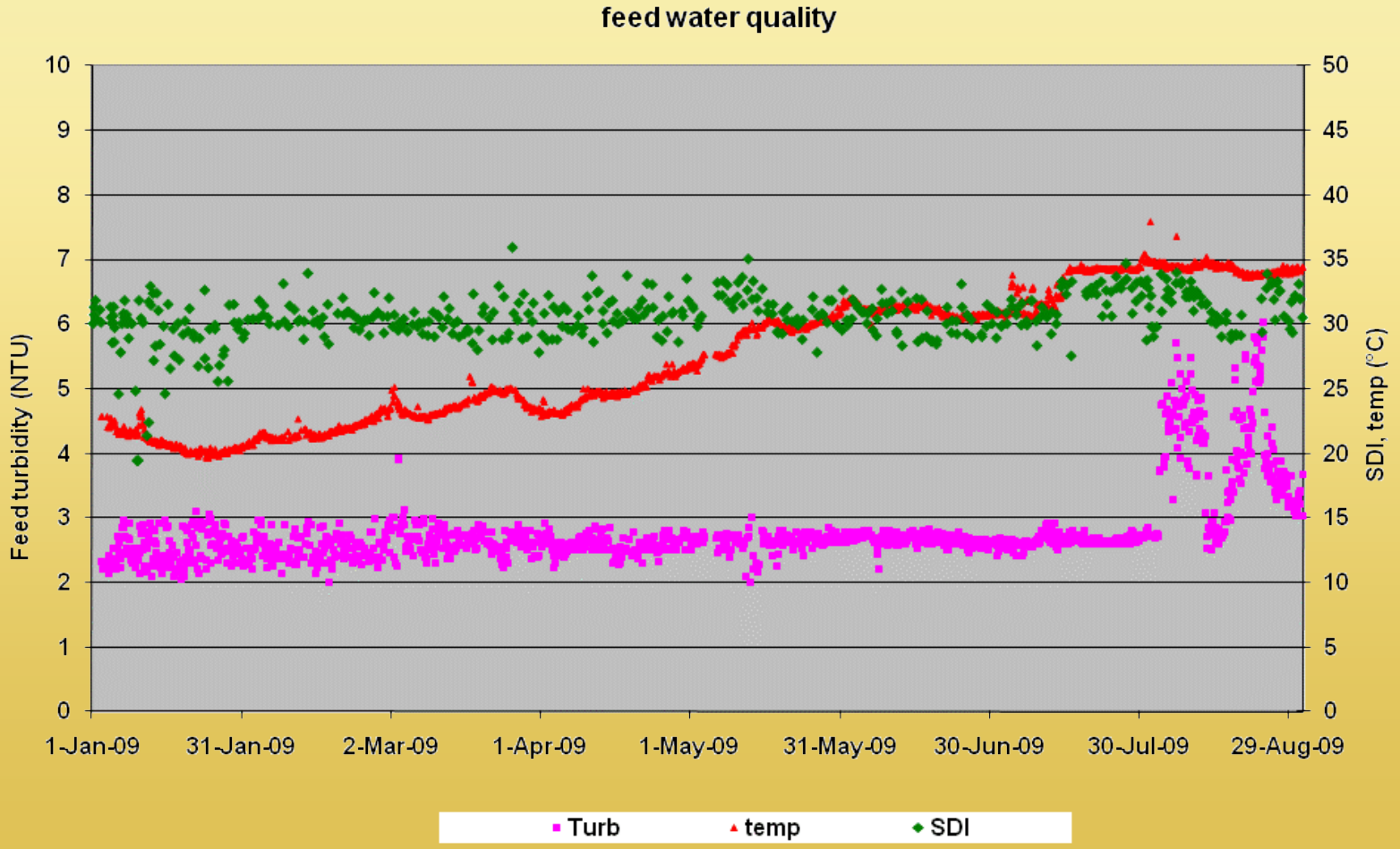
- Desalination plant characteristics

Membrane pretreatment:	X-Flow Seaguard ultrafiltration
No of membranes:	1920 elements per location
Total UF surface area:	76,800 m^2 per location

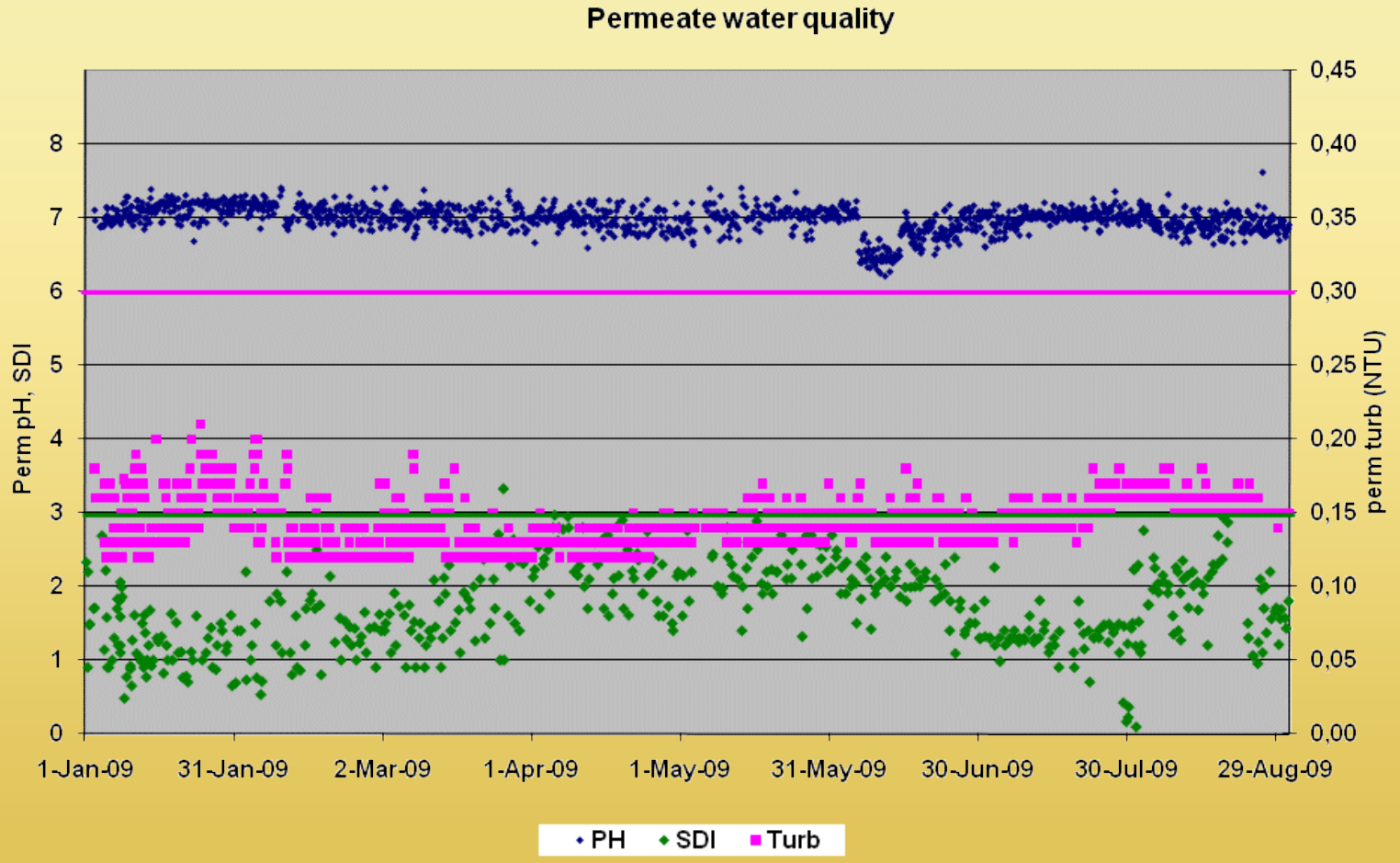
- Plant set up:
  Footprint available
  “Proven” technology
  Intermediate buffer tank

Case study: Palm Jumeirah

- Plant start up: 2008



Case study: Palm Jumeirah



Case study: Thames Gateway

- Desalination for potable water production
  Consumers: City of London / 2012 Olympics
- Water source: North Sea
- Nett capacity: 140 MLD potable water

Case study: Thames Gateway

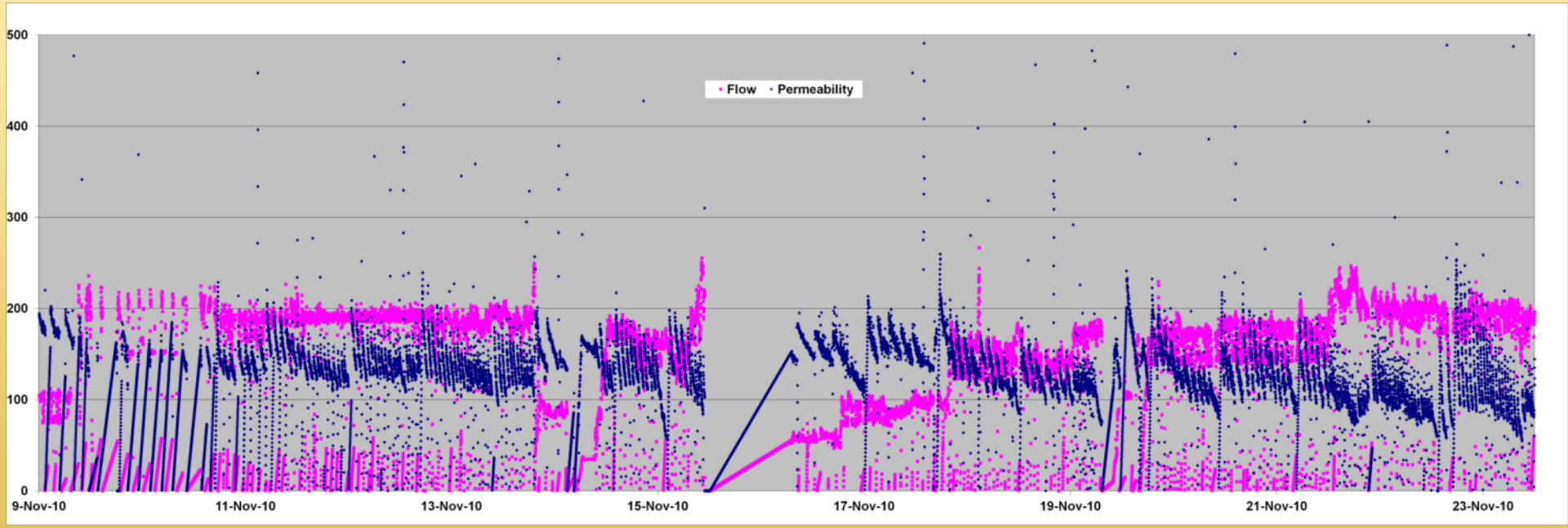
- Desalination plant characteristics

Membrane pretreatment:	X-Flow Seaguard ultrafiltration
No of membranes:	3360 elements
Total UF surface area:	134,400 m^2

- Plant set up:
  Limited footprint
  Lowest energy consumption
  Newest technology
  In line operation

Case study: Thames Gateway

- Plant start up: 2010
  Flow and permeability development of one typical skid over time



Case study: Shuwaikh

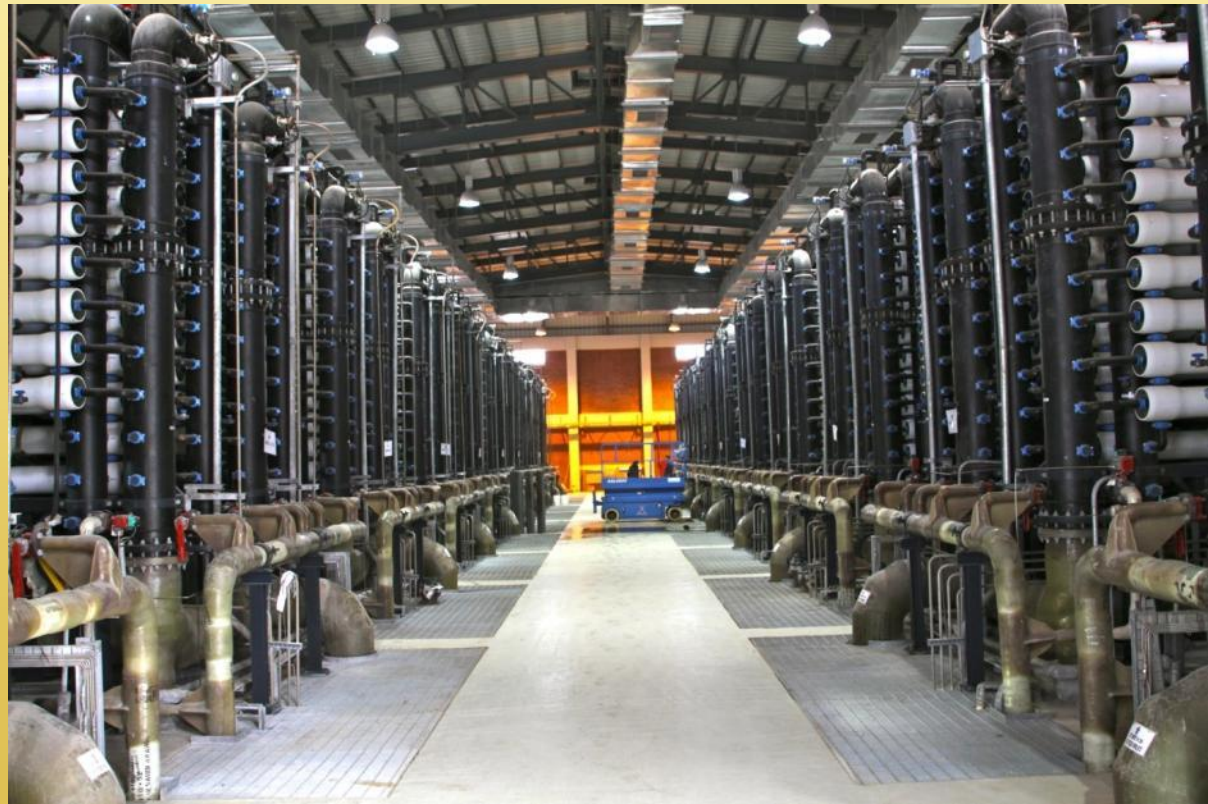
- Desalination for potable water production
  Consumers: Kuwait City
- Water source: Arabian Gulf
- Nett capacity: 182 MLD potable water

Case study: Shuwaikh

- Desalination plant characteristics

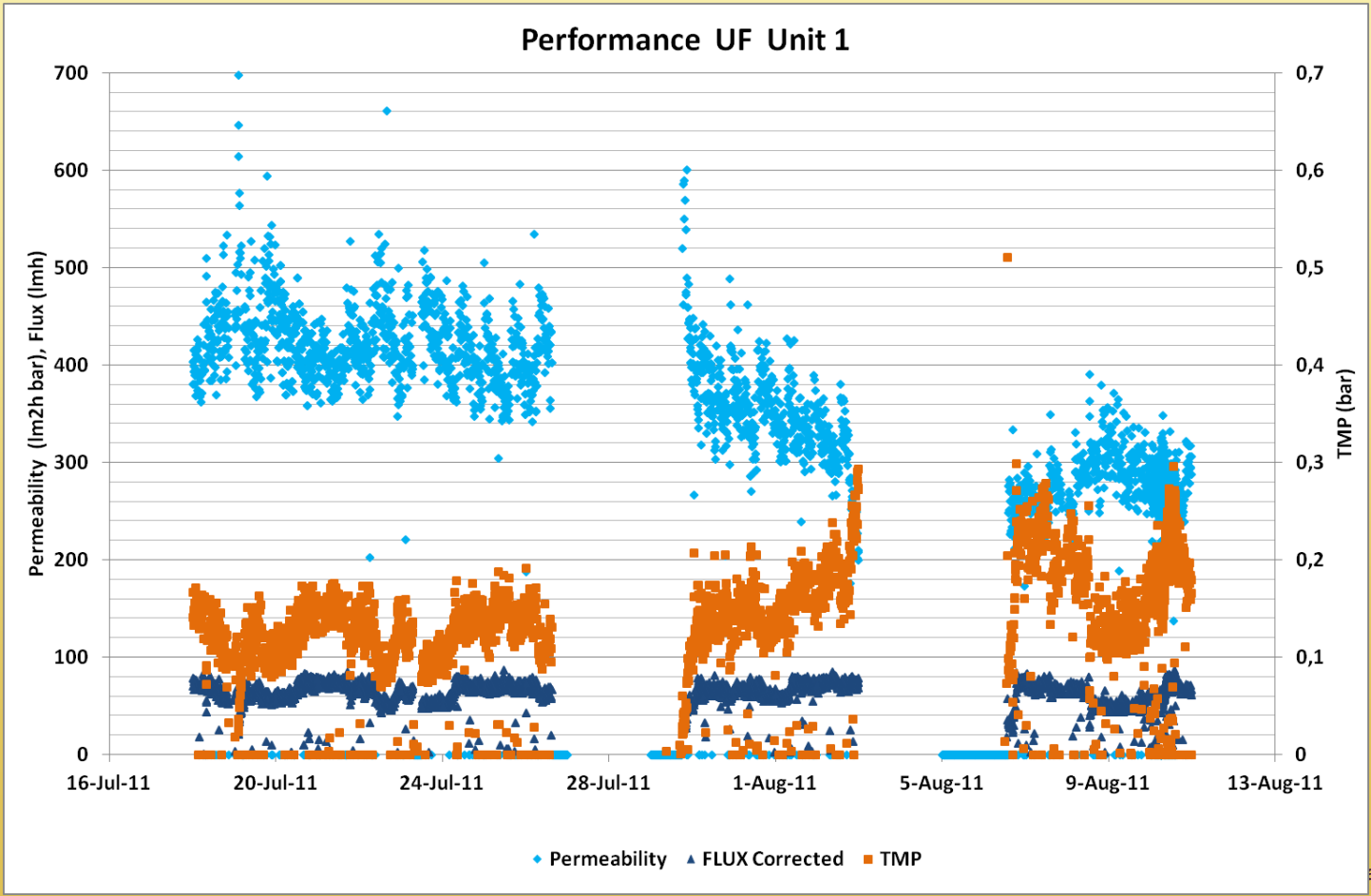
Membrane pretreatment:	X-Flow Seaguard ultrafiltration
No of membranes:	5840 elements
Total UF surface area:	233,600 m^2

- Plant set up:
  Large capacity
  Limited footprint
  In line operation

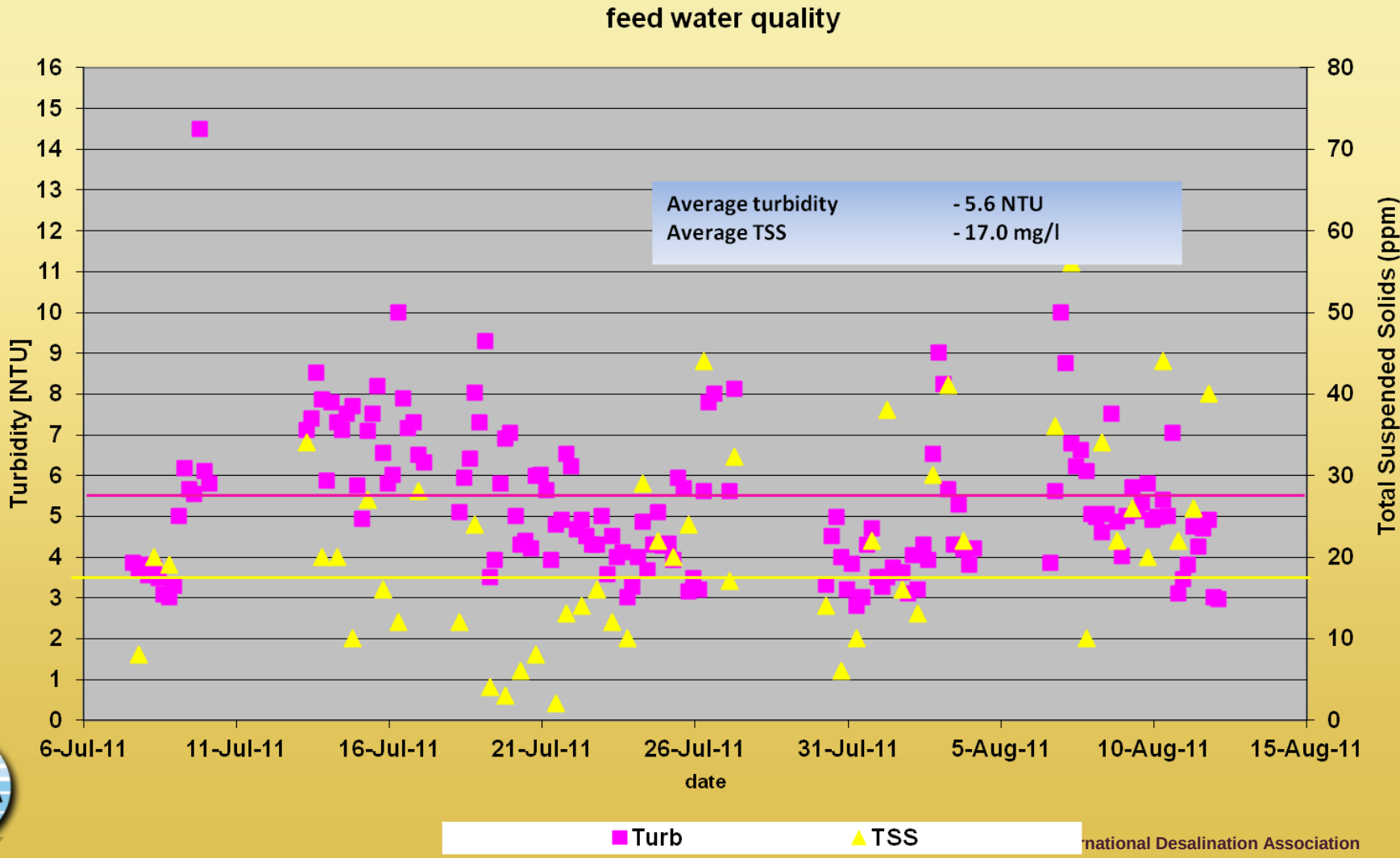


Case study: Shuwaikh

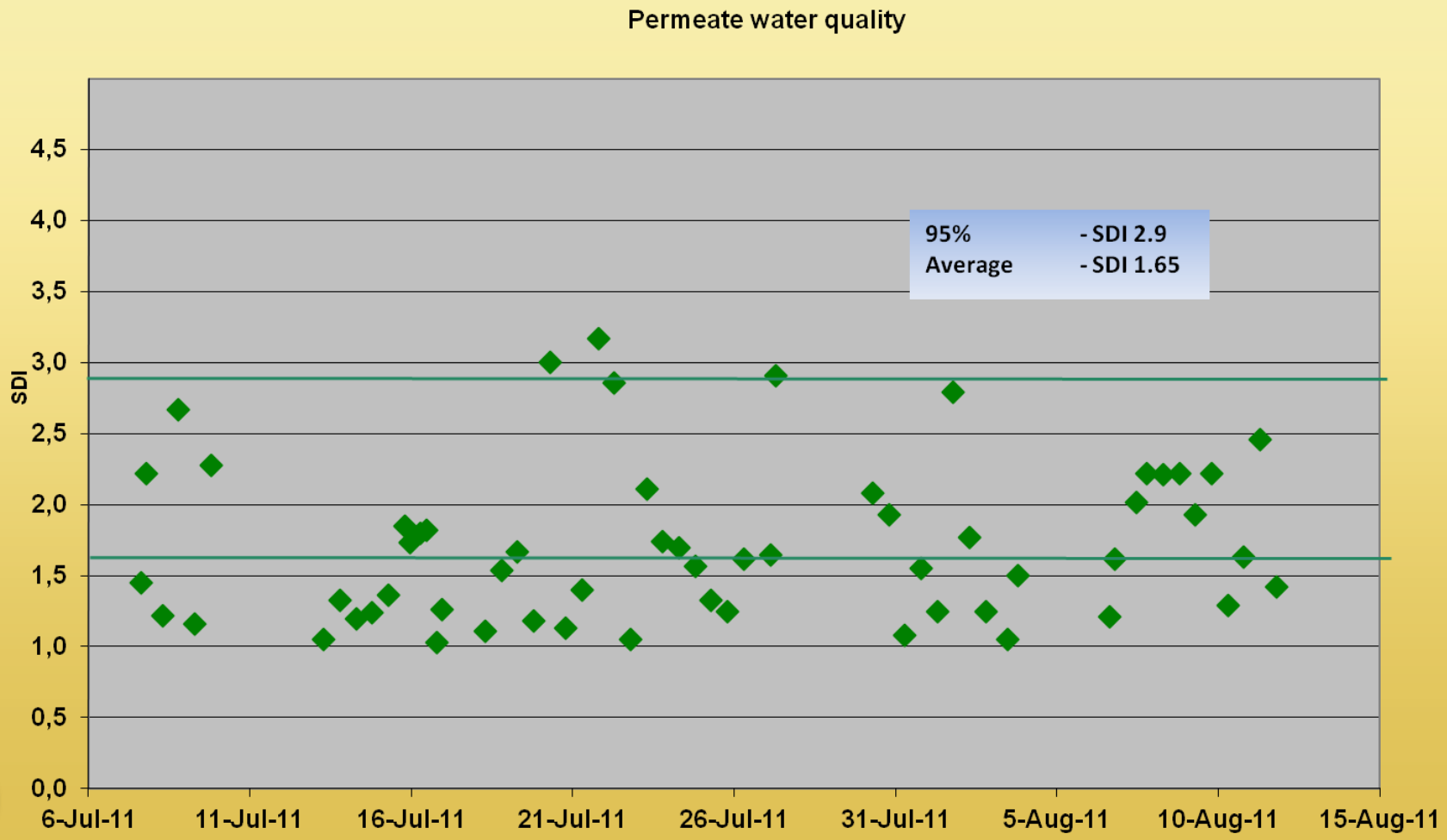
- Plant start up: 2011
  Flow and permeability development of one typical skid over time



Case study: Shuwaikh



Case study: Shuwaikh



Conclusions

- More opportunity / need for UF pre SWRO
  - UF has smaller foot print
  - UF is able to cope with water quality upsets
  - Better SWRO feed water quality
  - Operational experience of 6-8 years successful operation
  - Cost price of UF is comparable or even lower to conventional

- UF will be fully integrated with SWRO
  - No intermediate tanks / pumps
  - Reduction in energy consumption
  - Less biofouling
  - Quick ramp up / ramp down of production
  - Critical for large and very large desalination plants
  - Four centre design to use high pump efficiency

Conclusions: four centre design