



**MUNICIPAL EFFLUENT:  
WASTE STREAM OR  
RESOURCE?**

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## Algeria: Selling price of desalinated water

Site	Capacity (m <sup>3</sup> /d)	Tariff (\$/m <sup>3</sup> )
Arzew	90,000 + 321Mw	0.9
Beni Saf	150,000	0.7
Tlemcen	150,000	0.76
Mostagenem	100,000	0.729
Hamma	200,000	0.81
Skikda	100,000	0.7398
Zeralda	100,000	0.7505
Cap Dijnet	100,000	0.7275

Contract basis: 25 year BOO



## Cost Comparison of treating CAS effluent and seawater

Component	Units	A: From CAS effluent	B: From sea water	Ratio (B/A)
<b>Capital costs</b>				
Pretreatment	\$/m <sup>3</sup> /d	161	238	1.48
RO	\$/m <sup>3</sup> /d	321	492	1.53
Total	\$/m <sup>3</sup> /d	482	730	1.51
<b>Total life cycle costs</b>				
Capital	\$/m <sup>3</sup> /d	0.07	0.1	1.51
O&M	\$/m <sup>3</sup> /d	0.21	0.62	2.87
Total	\$/m <sup>3</sup> /d	0.28	0.72	2.55

Source: Zenon



## Cost Comparison

- The Total Life Cycle Costs of a water re-use scheme is only 40% of the equivalent sized Seawater desalination plant.
- In water stressed areas it must be preferable to treat the sewage for industry rather than desalinate seawater.



## Value of recovered water

- Potable water is usually treated further for industrial applications.
- TDS of drinking water 50-500mg/l
- Cooling water 50mg/l
- Low pressure boiler 1-5mg/l
- High pressure boiler 0.05-0.1mg/l



## Value of recovered water

- Ion exchange is usually used to reduce salinity for waters for high purity applications.
- RO is cheaper than ion exchange for a feed water of over 150mg/l.
- The recovered water will have a TDS of 20-50mg/l (about 2% of sewage TDS)
- Desalinated seawater will have a TDS of 300mg/l



## Cost of ion exchange treatment

- Mixed bed polished water
  - Sodium <0.01mg/l
  - Silica < 0.01mg/l
  - Conductivity <10 mega ohm/cm (TDS 0.05mg/l)
- Cost of water production with 3 bed ion exchange system (cation-anion-mixed bed)
  - 400mg/l feed           \$0.83/m<sup>3</sup>
  - 40mg/l feed             \$0.38/m<sup>3</sup>



## Industry Benefits

- Supplying recovered water at 40mg/l TDS rather than potable water at 400mg/l give an industrial ion exchange user a saving of \$0.45/m<sup>3</sup>.
- Recovered water can be more valuable to industry than potable water.



## Case studies Design changes over 25 years

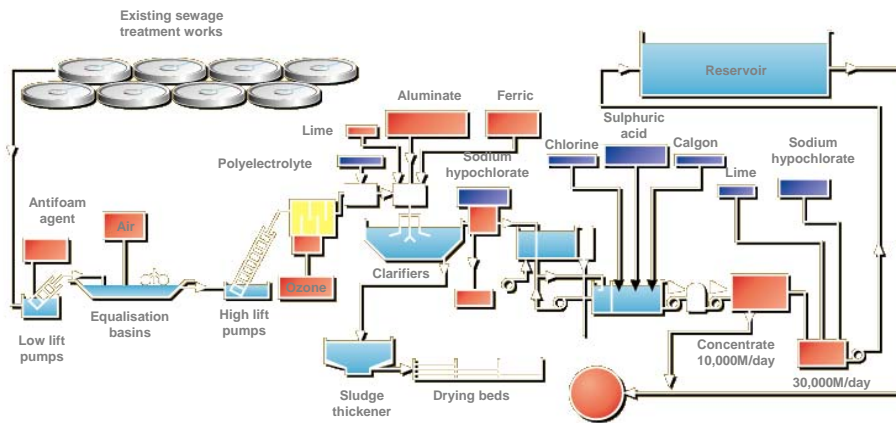


## Jeddah Water Reclamation Plant

- Start-up date 1981
- Output 30,000m<sup>3</sup>/d
- Source Secondary effluent
- Process equalisation/aeration, ozonation, clarification, filtration, reverse osmosis.



## Jeddah Water Reclamation Plant



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## Jeddah Water Reclamation Plant



## Scottsdale, Arizona

- Start-up date 1998-2003
- Output 52,000m<sup>3</sup>/d
- Source Secondary effluent
- Process Microfiltration,  
Reverse osmosis



## Scottsdale, Arizona

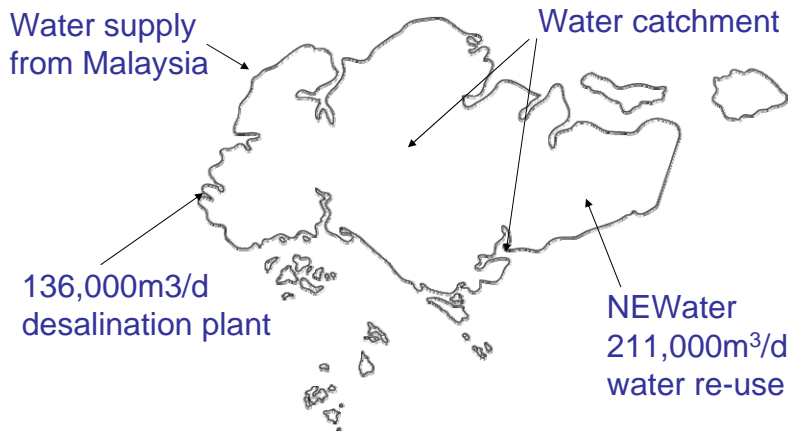


# Singapore

- Previously reliant on 50 year water purchase from Malaysia which expires 2015.
- Currently developing the "4 Taps" approach to reduce the reliance on Malaysia



# The 4 Taps



## NEWater

- 3 existing plants with a total capacity 96,000m<sup>3</sup>/d
- Sewage collected with a new deep tunnel sewer and sent to Changi sewage works.
- Fourth plant at Changi with a capacity of 115,000m<sup>3</sup>/d will be operational in 2006.



## Uses of NEWater

- Target to supply 250,000m<sup>3</sup>/d or 15% of the total water supply for direct non-potable use by 2011.
  - Main uses: cooling water, ultra-pure water for wafer fabrication.
- Target to supply 45,000m<sup>3</sup>/d or 2.5% of the total water supply for indirect potable use by 2011.
  - The NEWater will be blended with raw water in the reservoirs.



## We already re-use municipal effluent in the UK

### NEWater

- UF or MF
- Reverse osmosis
- Ultraviolet

### UK example

- 400m of river
- Sludge blanket clarifier
- RGF
- Chlorine

Which would you rather drink?



## Water re-use possibilities in the UK

- **Direct re-use:**
  - In industries requiring high purity water such as power generation or electronics.
- **Indirect re-use**
  - Aquifer re-charge
  - Reservoir augmentation



## Limitations and solutions

- Require new distribution network to transmit recovered water to industry or reservoir/aquifer injection.
- Any new water source will require a new distribution network. Whether it is from a desalination plant or supplying water from Kielder to London.



## Conclusions

- Treatment of sewage to very high standards is achievable at competitive costs.
- Recovered Water affords significant savings for producers of high purity water compared to the supply of potable water.
- Recovered Water could be used for aquifer re-charge or reservoir augmentation to relieve water shortages.

**Or should we continue to send treated effluent down the river and have hose pipe bans?**



Any Questions?

