

# Using Kidneys in Reverse Osmosis

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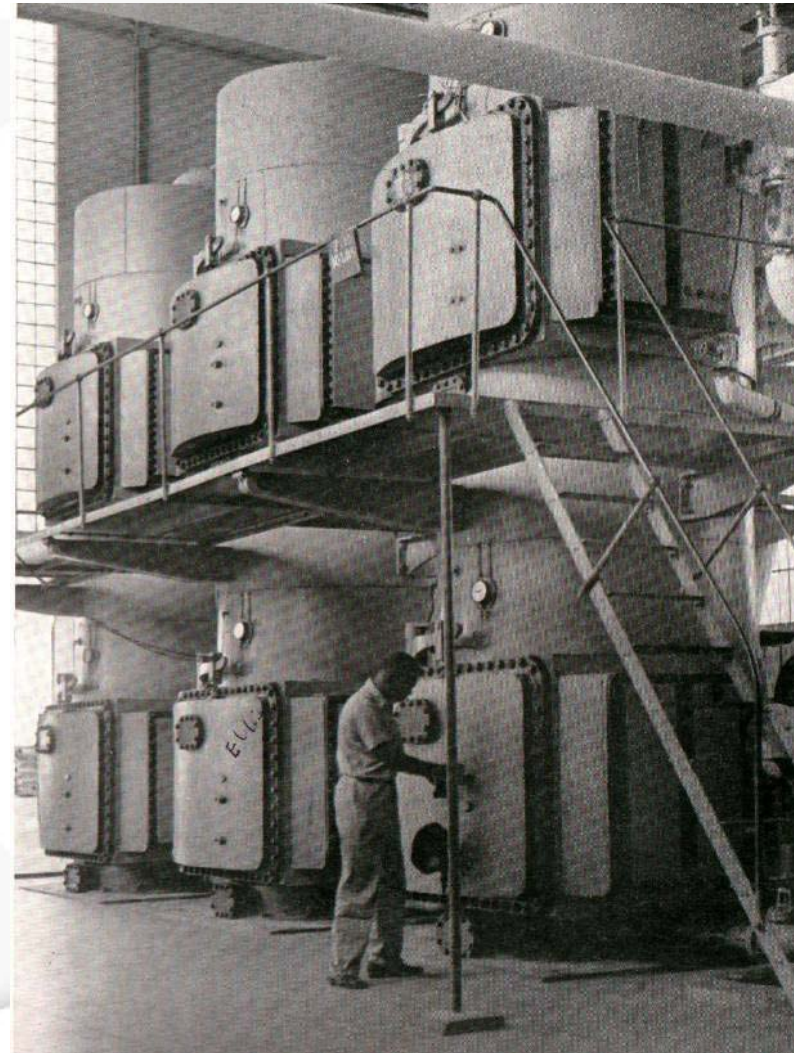
# Over 80 Years of Desalting

## CaribDA

Caribbean Desalination Association



- ▶ CaribDA has over 130 members  
[www.caribda.com](http://www.caribda.com)
- ▶ Some of the first Thermal & Membrane Desal plants
- ▶ Conference in the Cayman Islands, June 1 – 4, 2010



# Introduction

- ▶ More than 1,300 BWRO plants in the US produce about 130 MGD/145,610 AFA (assuming 100,000 gpd/system).
- ▶ This number will most likely double within a few years.
- ▶ 185 MGD of water is treated, with about 36.4 MGD going to waste (assuming a 70% system recovery).  
**This is not sustainable.**
- ▶ Where does 36.4 MGD/40,770 AFA (810 tons/day of salts) brine go?
  - Sewers, rivers & the ocean
  - Evaporation ponds
  - Deep well injection

# Introduction (cont.)

- ▶ **Brine Issues:**
  - Permits.
  - Increase salinity to other sources.
  - Costs for discharging (energy, land, etc.).
  - Sustainability.
- ▶ Where should it go – recover maximum permeate and use resalable salts.
- ▶ Lost resource for reuse.
- ▶ How do we do it?

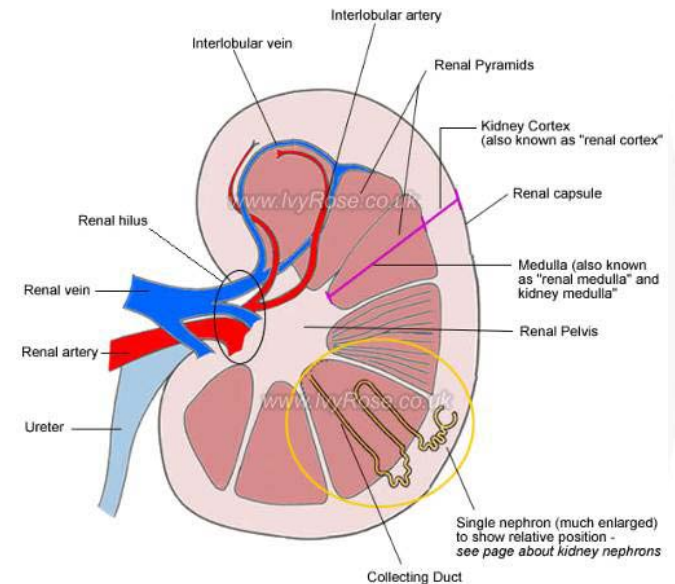
# How do we do it? Here's an example

## ▶ Kidneys in Desalting:

- RO – We all know about RO membranes.
- EDM – Introducing a technology that's been around but keeping a low profile.

## ▶ Combining Kidneys:

- EDM/ZDD.
- Other bolt-on technologies.



# BWRO – Process Scenarios

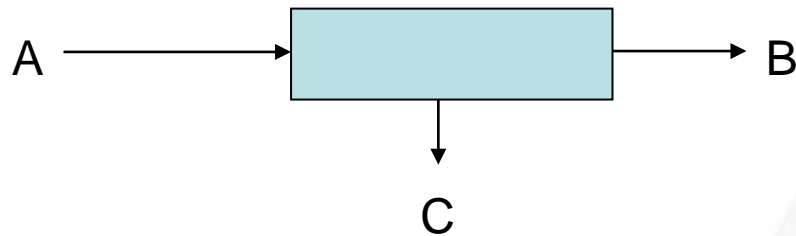
## ▶ 3-MGD scenarios considered (Alamogordo, NM):

1. Conventional BWRO.
  2. High recovery BWRO with softening.
  3. ZLD.
  4. ZDD.
- All remaining brine to evaporation ponds.
  - ZLD @ 100% (Conventional RO + Evap/Crystallizer) is more than 4½ times the cost to install and operate; therefore, the outcome – **ZLD is not considered for this evaluation**

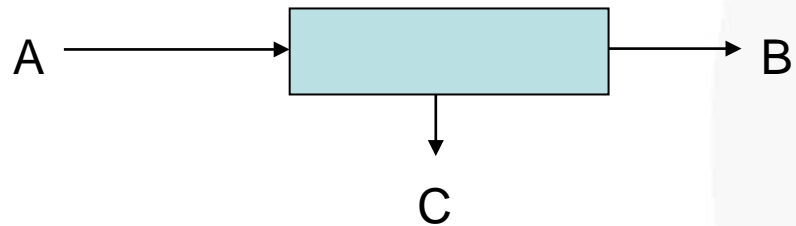
# BWRO – Process Scenarios

## With Sludge Dewatering System

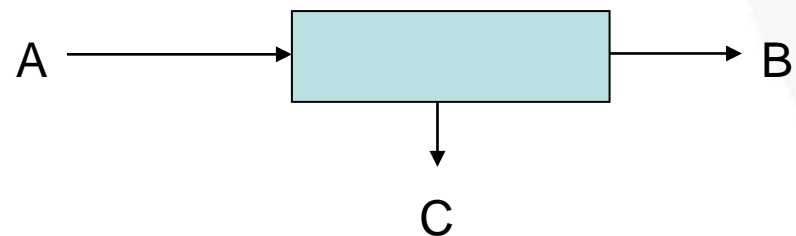
Conventional BWRO @ 72% recovery



Lime Softening & BWRO @ 95% recovery



ZDD @ 97% recovery

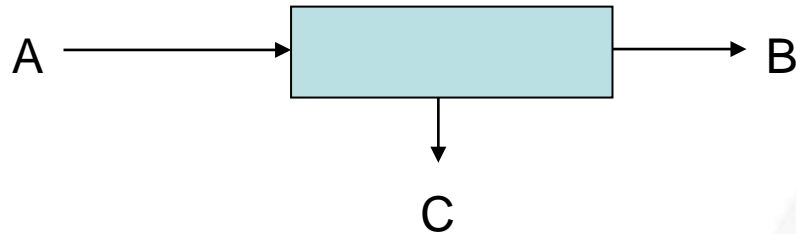


|   | <b>BWRO</b> | <b>HR BWRO</b> | <b>ZDD</b> |
|---|-------------|----------------|------------|
| A | 4.16 MGD    | 3.15 MGD       | 3.09 MGD   |
| B | 3 MGD       | 3 MGD          | 3 MGD      |
| C | 1.16 MGD    | 0.15 MGD       | 0.09 MGD   |

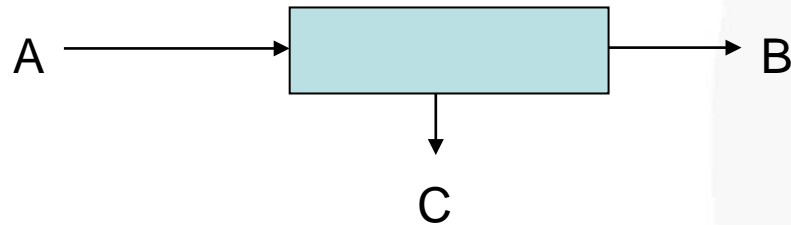
# BWRO – Process Scenarios

## Without Sludge Dewatering System

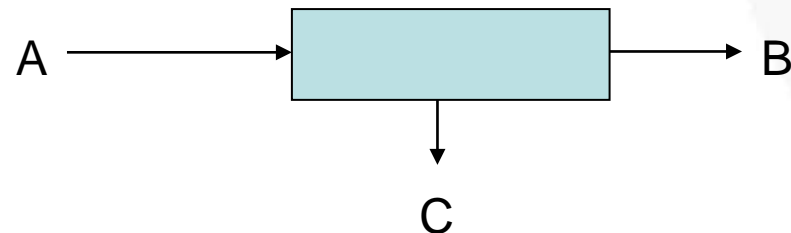
Conventional BWRO @ 72% recovery



Lime Softening & BWRO @ 90% recovery



ZDD @ 94% recovery



|          | <b>BWRO</b> | <b>HR<br/>BWRO</b> | <b>ZDD</b> |
|----------|-------------|--------------------|------------|
| <b>A</b> | 4.16 MGD    | 3.33 MGD           | 3.19 MGD   |
| <b>B</b> | 3 MGD       | 3 MGD              | 3 MGD      |
| <b>C</b> | 1.16 MGD    | 0.33 MGD           | 0.19 MGD   |

# BWRO – Process Scenarios

- ▶ Evaporation Pond Sizing (without dewatering):
  - \$130,000 / acre lump-sum installation cost.
  - Evaporation rate of 22.8 cm/month (average) per NOAA.
  - Conventional BWRO@72%
    - 817 gpm concentrate → 147 acres
  - High Recovery BWRO@90%
    - 231 gpm concentrate → 42 acres
  - ZDD@94%
    - 150 gpm concentrate → 24 acres

# BWRO – Process Scenarios

## ▶ Comparing the three scenarios:

- ZDD has the lowest installed cost due to the ponds.
- ZDD has a lower chemical cost than HR BWRO.
- ZDD'S highest cost is energy consumption.  
(about twice that of BWRO).

## ▶ Outcome:

- The spreads between the 3 scenarios are within 5-7%.
- Additional evaluation and piloting of ZDD is ongoing.

# BWRO – Process Scenarios

## ▶ Where do we go from here?

- Compare to deep well injection.
- Consider alternate energy sources.
- Continue to look at location-specific saleable products.
- Develop an interactive LCA tool.
- Use ZLD as the benchmark?