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TEXAS INDUSTRIAL ENERGY EFFICIENCY PROGRAM

Water Forum

The Nexus of Water and Energy Conservation

Innovative Water Solutions: Lessons from South Africa's Industrial Challenges

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Innovative Water Solutions

Contextual Learnings

Agenda & Background

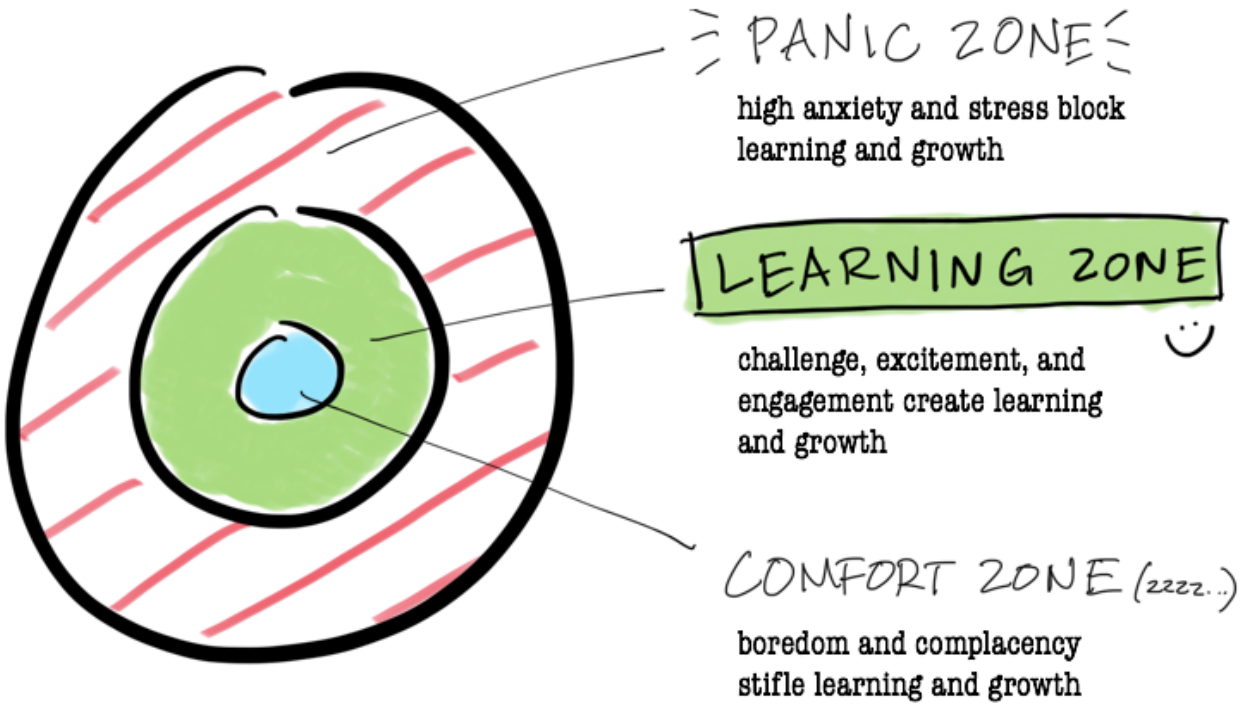
1. Setting the Scene (principles, learnings, business environment)

2. WCI & Fit for Purpose Water

3. Specific Learnings
    1. Closed loop brine softening
    2. CoolQuench Kidney Recovery
    3. High Rate Clarifier for Environmental Discharge

4. Closing

Setting the Scene – Mental Models



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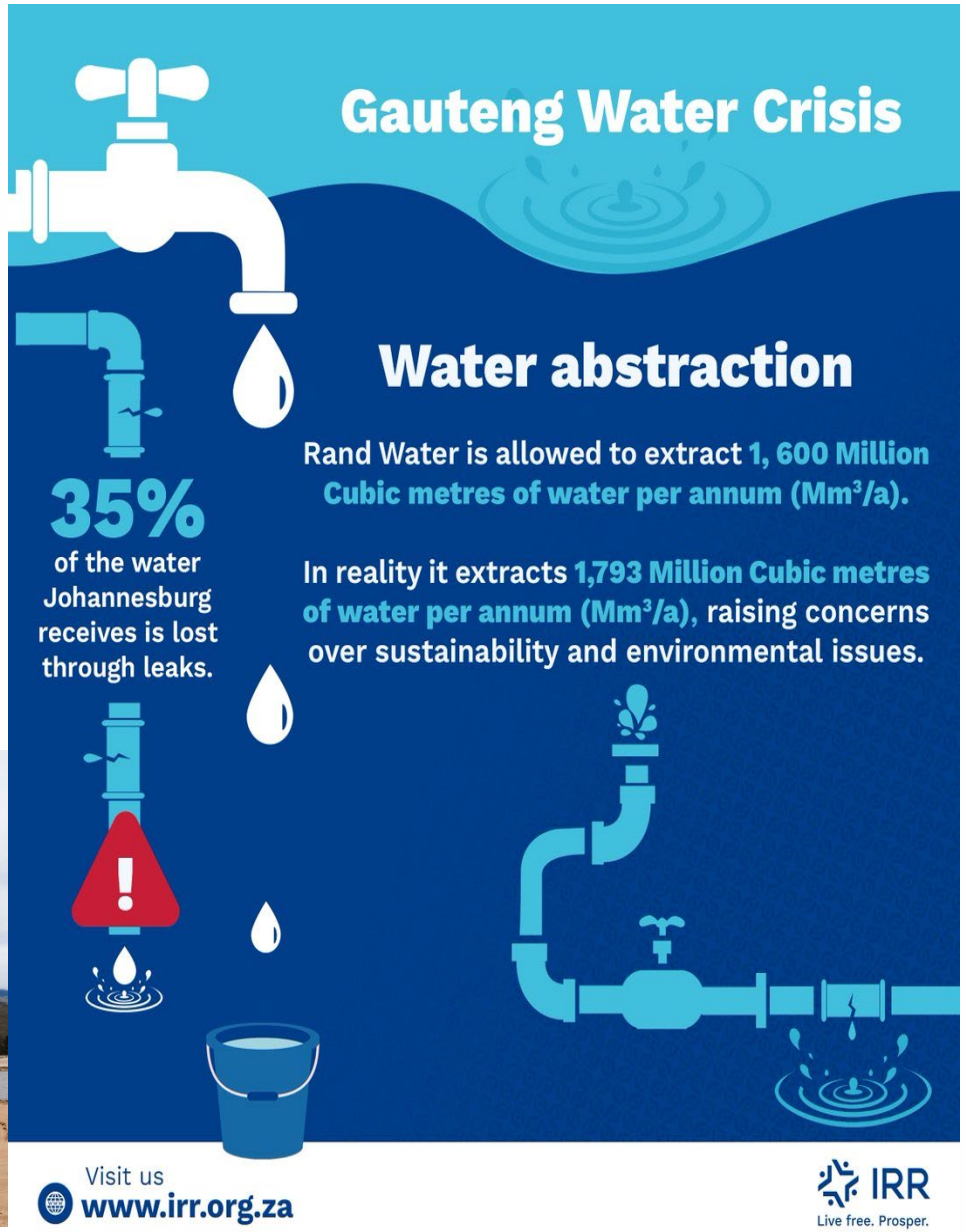
Circa 2007

South Africa Water Availability

- 2007 MSc Thesis – Industrial Brine Treatment
- 1000gal/pp/day - "Act like we're a water positive society"
- 10 years on - Cape Town's Day Zero

- Dec 2022: Water **supply** concerns
- Operation losing daily production $1.75m/week
- Private sector purchasing chemicals for municipality



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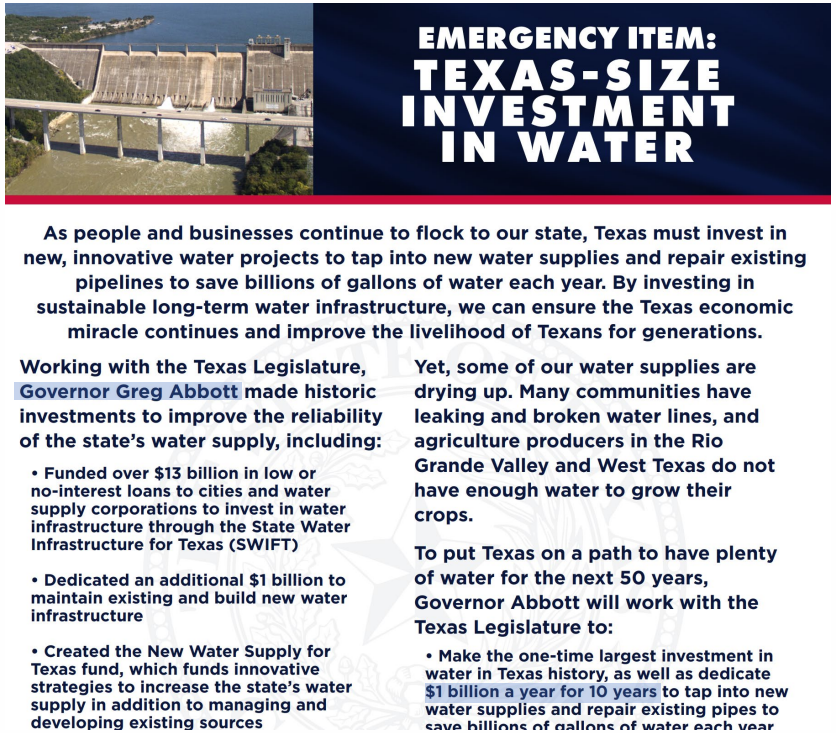
2025 – Texas Insights

My early interactions (insights)

- Ageing infrastructure
  - Early site visits (Baton Rouge / Bayport / Freeport)
  - News articles
- Governor Greg Abbott's "Texas Size Investment in Water"

Private Sector Interventions

- Water needs sources (surface/well/utility providers)
- Understand Water Balance & Salt Balances
- Fit for purpose water
- Opportunities to recycle water and offset freshwater intake



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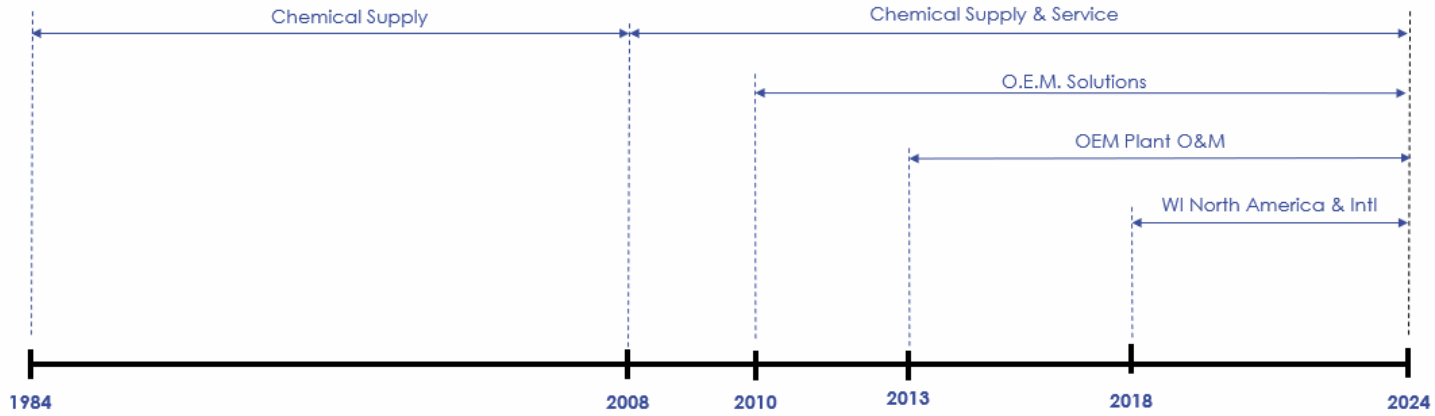
Watercare's Institutional Journey



- Stumbling South African Economy
- Shrinking Investment Market
  - Focus on core competence
  - Impacting Client Knowledge Base (Water)
  - Risk Reward Environment stimulating Innovation
- 2012 LiquidGold Project – Prefeasibility indicated a central R1bn Plant
- Broke down into Work Packages (focus on *Salt* Balance)
- Eventually key interventions including three Plants (<R40m)
- Watercare's evolution since

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Case Study 1

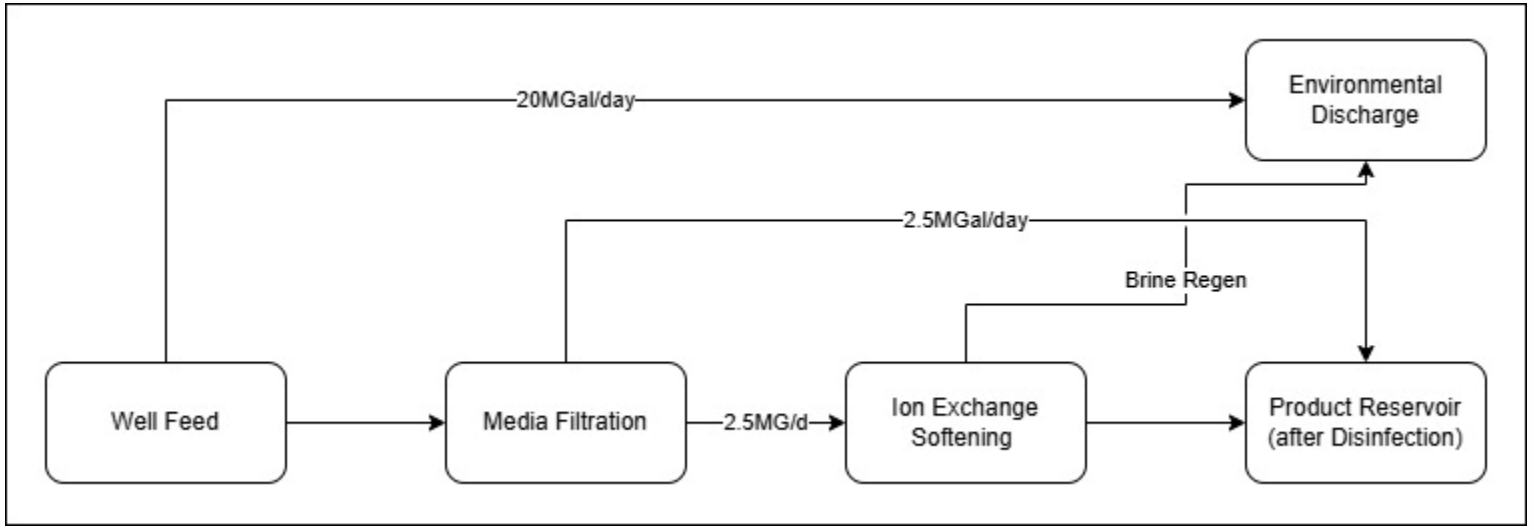
Softening Plant with Brine Recycle

Eliminating non-compliant environmental discharge in Potable WTP Operations

Softening Brine Recycling

Challenge:

- Well water source / Softening Plant / Municipal Water Supply
- Plant shut down – regenerant discharge
- Out of Specification on Water Discharge Quality (Chlorides)
- Clients Operating License under Threat
- Saving R14m/month ($700k/month)



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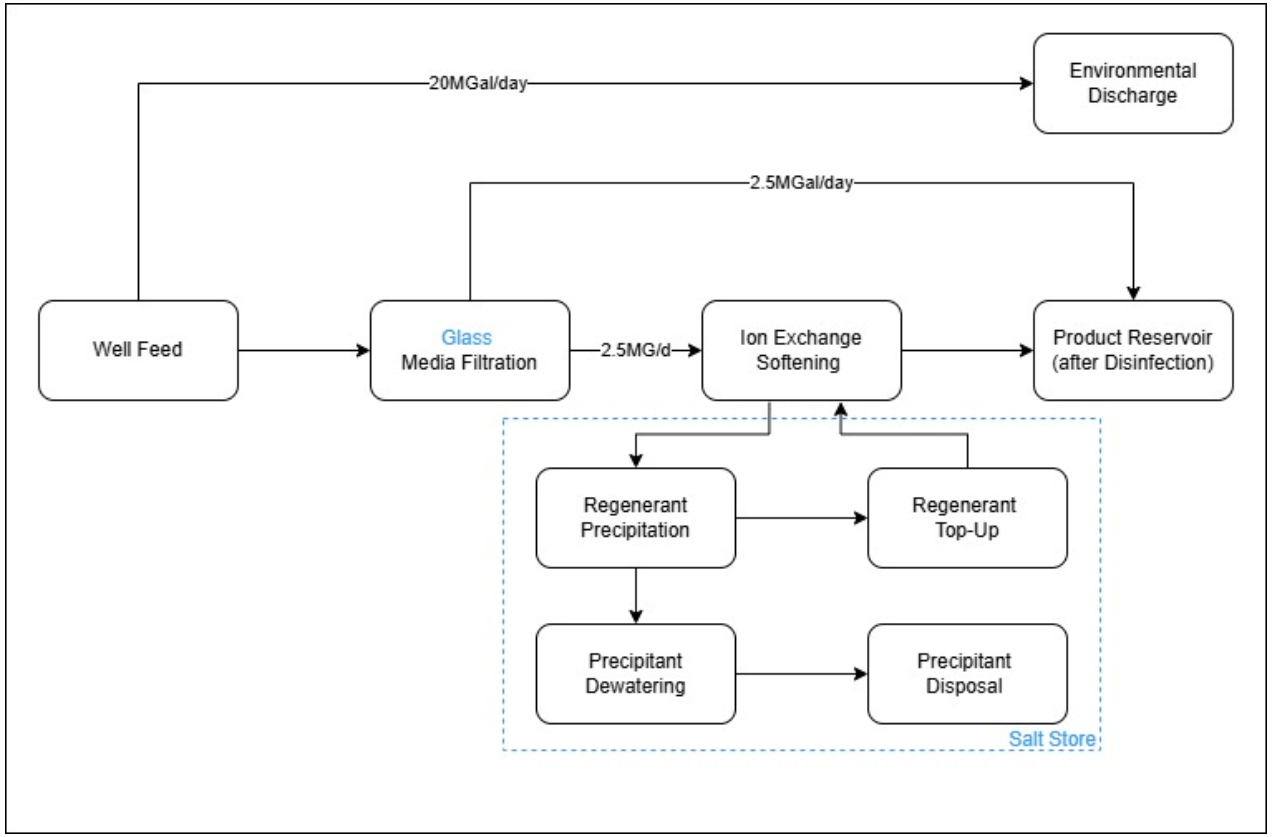
Softening Brine Recycling

Solution:

- Brine recycling process to recover NaCl
- 20% Solution with Air Blowdown
- Solid waste product (mainly $CaCO_3$)
- Used as neutralizing agent at neighboring site
- Liquid waste eliminated - client compliant with discharge permit
- Monthly savings reinstated
- Water produced at 25% cost of municipal water



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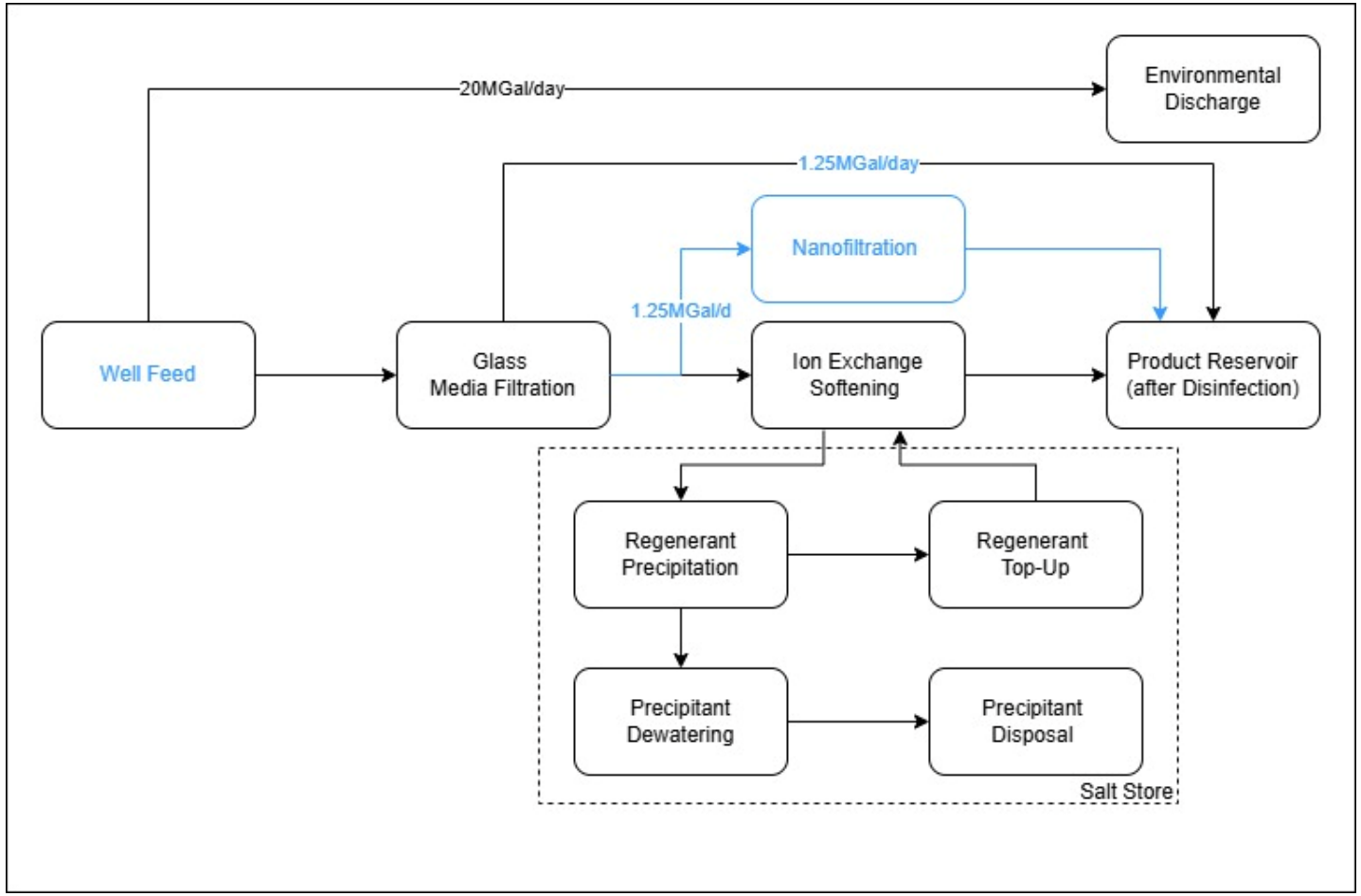
Softening Brine Recycling – Further Challenges

- Well water quality degraded further
- Required further softening
- Chosen technology – a BOO NF Plant



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Case Study 2

Cooling Tower Kidney Plant

Minimizing Blow-down & Make-up Volumes

Cooling Tower Kidney Plant

- **Challenge:**
- Client constrained with fresh water intake
- Client was aiming for a 25% reduction
- Cooling Systems Large Consumer of fresh water
- Cooling Tower bleed off operated close to scaling potential

- **Solution:**
- Looked at cooling tower from a salt balance perspective
- Treating cooling tower blowdown, recovering high purity water

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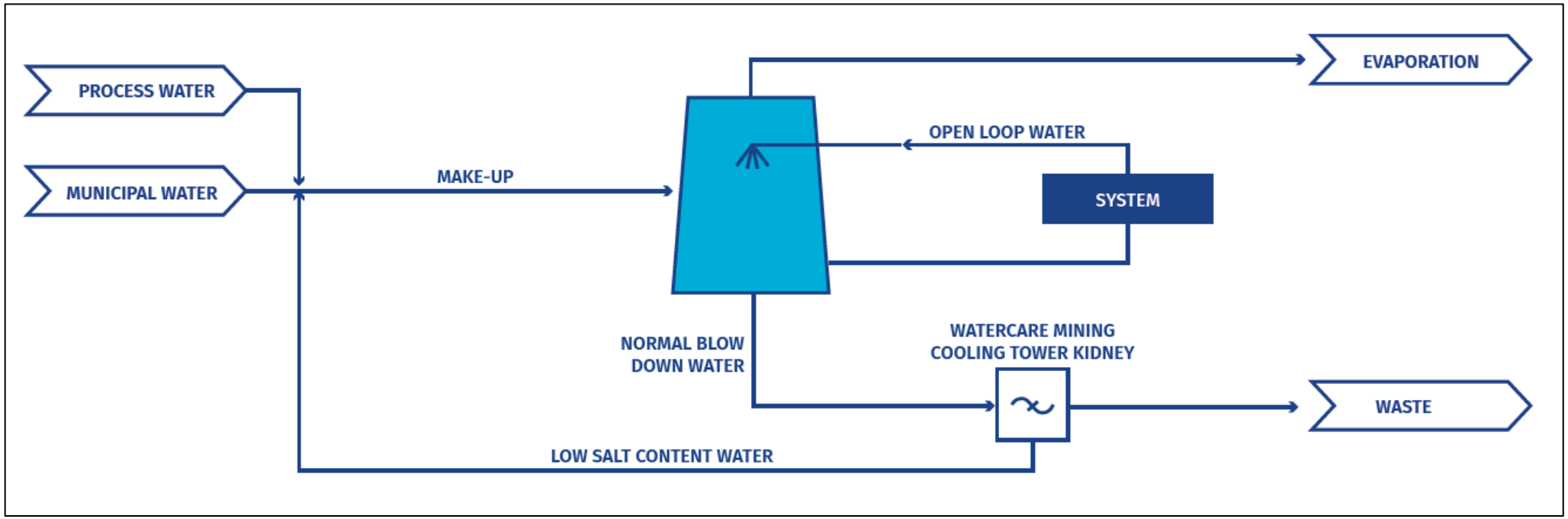
Cooling Tower Kidney Plant



Benefits

- 51% reduction in water intake
- COC increased, saving on fresh water intake
- Plant paid off in 28 weeks
- Chemical account impacted

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Case Study 3

Metals Recovery Plant

High-Rate Clarifier for Environmental Discharge

Acid Mine Drainage Clarifiers

Challenge:

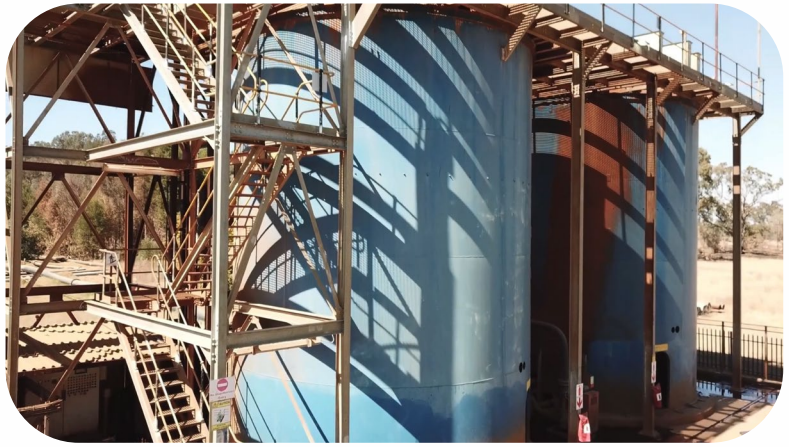
- Legacy non-operational underground mine (western basin)
- Acid Mine Drainage (AMD) discharged into environment
  - Environmental Discharge Limits
  - Nearby Operations Water Table Impacted
- Challenged by short timelines
- Large Volume to be treated (10Mgal/day)
- Acidic stream, containing solids
- Unit Processes (Aeration, pH correction, Flocculation and clarification)
- Targeting removal of TSS, Iron, Manganese, Uranium

- Eastern & Central Basin employ large diameter clarifiers (130 – 165ft / ± 13 300ft²)
- Project due diligence & execution would take years to complete

High-Rate Clarifiers

Solution

- WCI High Rate Clarifier – 2 x 25ft diameter (2x155ft² Area)
- Award to installation took 8 months
- Build own operate plant
- Utilizes product water for reagent make-up
- 130-135 ft/hr settling rates achieved



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Eastern & Western Basin Plants

- Eastern Basin & Western Basin Pictorial Comparisons
- 200ft Elevation
- Eastern Basin – 11MGal/day
- Western Basin – 10MGal/day

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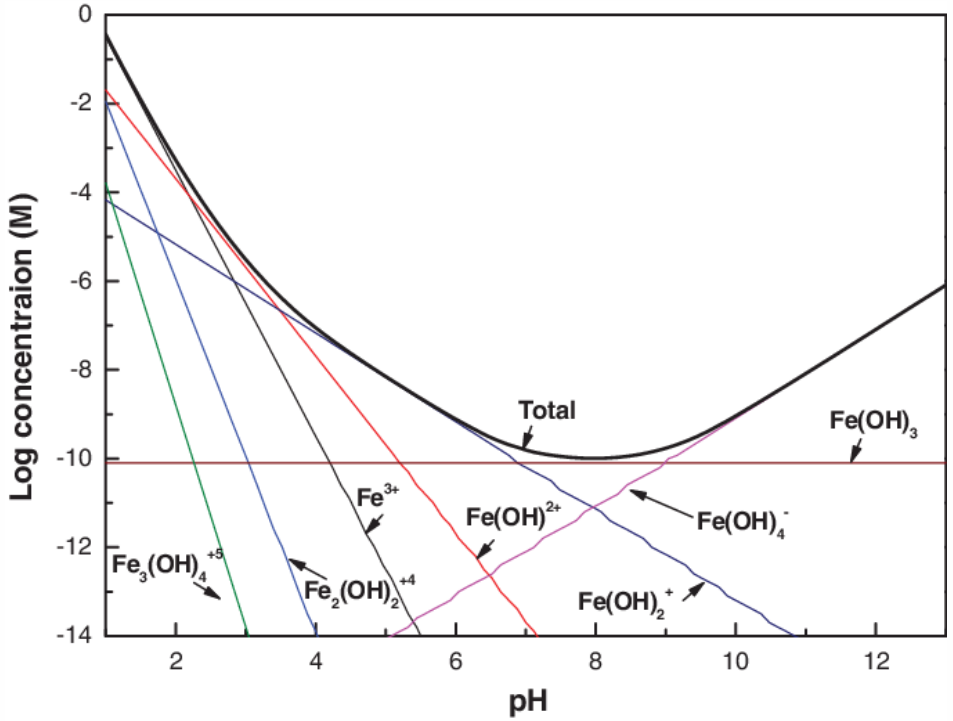
… Not Without Challenges

- Water Quality Changed through installation (Lab, Pilot Tests)
- Reduced solids levels
- Waters of hydration impacted settling rate (Sulphate, hydroxide precipitates)
- Suspended matter is very fluffy, mostly iron & manganese precipitate

- Implemented a pH change to alter precipitate waters of hydration
- Underflow recycle to ensure large crystal growth

- Plant been running for 10 years now
- Continue to be paid per gallon of compliant water

- Currently private & public sector undergoing stakeholder discussions to produce drinking water



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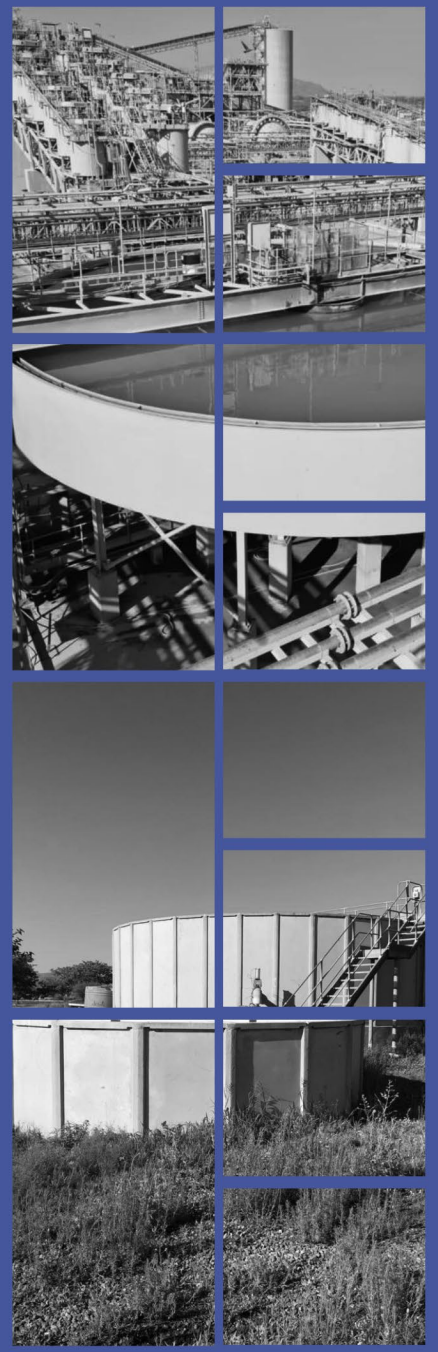

Conclusion

Closing

1. Consider the impact of water on your total operations
   - Availability
   - Fit for Purpose Uses
   - *True* ESG Benefits
2. Cognizant of Convenient Solutions – permanency & *real* bottom line impact
3. Hold your experts accountable
   - Alternative Business & Operating Models Exist
   - New technology – aligned to your operational profitability

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