TETRA OASIS TOTAL DESALINATION SOLUTION

PBWIEC

March 4, 2025

ABOUT TETRA

ENERGY SERVICES // **INDUSTRIAL CHEMICALS** // CRITICAL MINERALS

- Founded in 1981. Headquarters in The Woodlands, TX
- Leveraging 40+ years of aqueous chemistry
  - Leading provider of brine-based chemistries and fluid systems for offshore deepwater markets
  - Leader in produced water treatment and recycling in unconventional oil & gas
  - Leading global producer of calcium chloride
  - Produced water desalination and mineral extraction

Publicly Traded (**NYSE: TTI**)

OPERATIONS in 13+ COUNTRIES

REVENUE IN 23 COUNTRIES

1,400+ EMPLOYEES

PRIMARY MARKETS WE SERVE

Energy Services

- Completion Fluids
- Production Testing & Flowback Services
- Water Management Solutions

Industrial Chemicals

- Calcium Chloride
- Zinc Bromide-Based Electrolytes
- Bromine Resources

Critical Minerals

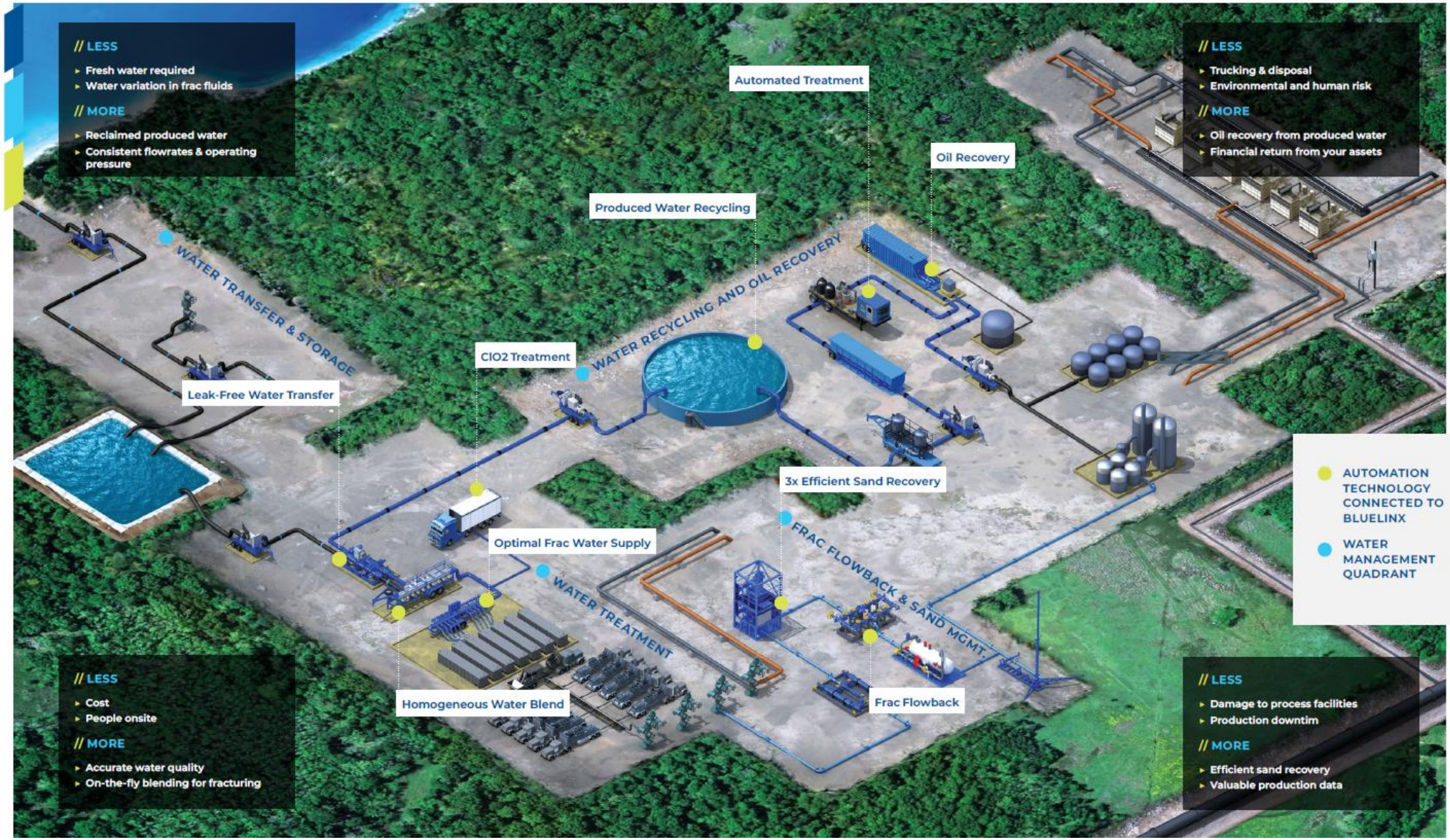
- Undeveloped Brine Resources Rich in Lithium and Bromine
- Uniquely Positioned with O&G Operators for Produced Water Mineral Extraction

WATER & FLOWBACK SERVICES

2019 Finalist Best Water Management Technology Award

* World Oil Awards

WATER & FLOWBACK SERVICES BUSINESS SEGMENT



WATER & FLOWBACK SERVICES BUSINESS SEGMENT

	**Produced Water Treatment & Recycling**	▸ Recycled over 3.0 billion gallons of produced water and treated over 4.3 billion gallons for hydraulic fracturing operations in 2023 ▸ Licensing agreements with OARO and VMD technologies for the desalination of produced water for beneficial reuse
	**BlueLinx Automated Control System**	▸ Safer and improved service quality ▸ Entire system digitization and automation reduces operating costs & personnel requirements
	**TETRA SandStorm Advanced Cyclone Technology**	▸ Up to 99+% sand capture efficiency (vs. 45-55% for traditional sand management units) ▸ Modular design adaptable to different operating conditions ▸ Expanding international
	**Automated Drillout System**	▸ Improves customer's well economics ▸ Reduces rig up/down time by 40% ▸ Reduces manpower by 30%; reduces HSEQ exposure
	**TETRA Steel 1200 Lay Flat Hose**	▸ Leader in produced water market ▸ Transferred >105M bbls of produced water in Permian basin in 2023, 42M bbls in rest of the U.S. ▸ Exclusive supplier agreement

LITHIUM AND OTHER CRITICAL MINERALS

Doing our part to reduce carbon emissions for a more sustainable future.

LEVERAGING RESOURCES & CAPABILITIES FOR ENERGY TRANSITION

Mineral Assets

Chemistry

Manufacturing Capabilities

TETRA's mineral assets, chemistry R&D strength, and patented manufacturing capability has created a clear path to Low Carbon Energy Solutions in carbon capture, energy storage, and ESG-friendly lithium production.

Energy Storage

- Patent-pending ultra-pure zinc bromide and zinc chloride solutions for energy storage technologies
- Commercial full electrolyte production

Lithium Resources

- Standard Lithium agreement with 1.3M tons LCE inferred resources (1) (2) (3)
- Joint TETRA/ExxonMobil Evergreen Production Unit approved by Arkansas Oil and Gas Commission

Critical Minerals

- Extensive experience and expertise in brine chemistry
- Global leader in calcium chloride
- Rich resource base with Smackover brine leases

(1) Inferred resources are considered to have the lowest level of geological confidence of all mineral resources. Investors are cautioned that inferred resources do not have demonstrated economic value and have a high degree of uncertainty as to their existence and to whether they can be economically or legally commercialized. See "Forward Looking Statements" on slide 2. (2) Using a conversion factor of 5.323 to convert an estimated 44,000 short tons of elemental lithium to lithium carbonate equivalent. (3) As reported by Standard Lithium.

ENERGY STORAGE – HIGH PURITY ZINC BROMIDE ELECTROLYTE

- Partnering with Eos Energy Enterprises for zinc-bromide as a key electrolyte for safe, long duration energy storage
- TETRA will provide a minimum of 75% of Eos' full electrolyte aggregate annual demand
- TETRA uses a proprietary manufacturing process to produce a high purity zinc-bromide (TETRA PureFlow)
- TETRA is one of two global and the only U.S.-based manufacturer of ultra-pure zinc bromide

PRODUCED WATER DESALINATION

An economically viable alternative to saltwater disposal that converts a waste into a resource.

WATER DESALINATION - TODAY

Sea/brackish water desalination is a well-established global business today

- Estimated global market of $22 billion (2024)
- **Membrane technology** dominates the technology segment (84% of desal plant)
- **Seawater** dominates the water source segment
- **Municipal** dominates the application segment
- Middle East and Africa are highest shareholders in global market

WHAT MAKES PRODUCED WATER DESALINATION SO CHALLENGING?

Desalination Plant in Indonesia

Source: Global Water Intelligence

SEAWATER VS. PRODUCED WATER DESALINATION

Key Parameters (ppm)	Seawater[1]	Produced water[2]
TDS	34,000-45,000	5,000-250,000
TSS	3-20	60-800
Calcium	440-500	60-8,000
Magnesium	1,140-1,670	10-1,900
Iron (Fe II)	<0.1	0.5-7
Strontium	7-8*	29-1,400
Barium	0.005-0.023*	0.1-262
Sulfate	2,600-3,000	100-1,300
Boron	4-5	17-76
Ammonia	Trace	300-800
Radionuclides (Ra-226/Ra-228) (pCi/L)	0.04-0.16	1-1,000
TOC	0.2-2, 8-10**	2-250
Nature of organics	Polysaccharides, Humic substances, Low m.w. acids and neutrals[3]	VOCs, SVOCs, Organic acids, PAH

1: The Guidebook to Membrane Desalination Technology, Mark Wilf, 2011
2: TETRA analyses and Jiang et al, J. Hazardous Mat., 430 (2022) 128409
3: Seawater Pretreatment, Nikolay Voutchkov, 2010
*Earth and planetary Sci Let. 16 (1972) 75
**During algae blooms

TDS: Total Dissolved Solids; TSS: Total Suspended Solids; TOC: Total Organic Carbon; VOCs: Volatile Organic Compounds; SVOCs-Semi-Volatile Organic Compounds; PAH: Polyaromatic Hydrocarbons

Key Takeaways

Produced water has

- Significant variability in composition
- Generally, much higher level of constituents including radionuclides
- Presence of ammonia
- Higher levels and different organics than in seawater

While some concepts may be borrowed from saltwater desalination, above differences require customized treatment approaches for produced water desalination.

BARRIERS TO BENEFICIAL RE-USE OF PRODUCED WATER

	Barrier	Solution
REGULATIONS / LIABILITY	▸ Toxicity ▸ Reliability / quality ▸ Public perception	▸ Testing and research ▸ Extended piloting ▸ Reputable service & technology provider
COST	▸ High energy costs (thermal) ▸ Capital intensive ▸ Multiple treatment steps	▸ Membranes ▸ Optimized end-to-end solution ▸ Mineral extraction
TECH CAPABILITY	▸ Varying feed quality ▸ Energy efficiency ▸ Greenhouse gas emissions	▸ Derisking via extensive compatibility and failure testing ▸ Evolving technologies
END-USE MARKETS	▸ Local industrial takeaways not established	▸ Government incentives ▸ Cross-industry collaboration

PILOT STUDY SUMMARY

Customer	Location	Desal. Technology	Permeate (OARO) or Distillate (VMD) Flow Rate	PW TDS	Permeate or Distillate TDS	Post-Treatment	Success criteria met
			gpm	ppm	ppm		
A	South TX	OARO	1-3	4.5-11K	90-200	None	Quality per TX RRC guidelines for land application permit
A	Permian Basin	VMD	0.4-1.2	108K	250-390	Ammonia, Boron	Quality per TX RRC guidelines for land application permit
B	Permian Basin	VMD	0.4-1.2	136K	40-150	Ammonia, Remineralization	Passing of WET Test*
B	Permian Basin	OARO	1.8-2	136K	350-400	Ammonia, pH	Passing of WET Test*

*Whole Effluent Toxicity (WET) Tests conducted with two freshwater species under acute and chronic exposure conditions at a third-party laboratory

TECHNOLOGY CENTER // CONROE, TX

- Professional disciplines: Ph.Ds., Engineers, Chemists, Researchers, Technicians
- Labs consist of:
  - 2 R&D
  - 2 Tech Services
  - 1 Analytical
  - 1 Mobile

2 acres
Facility

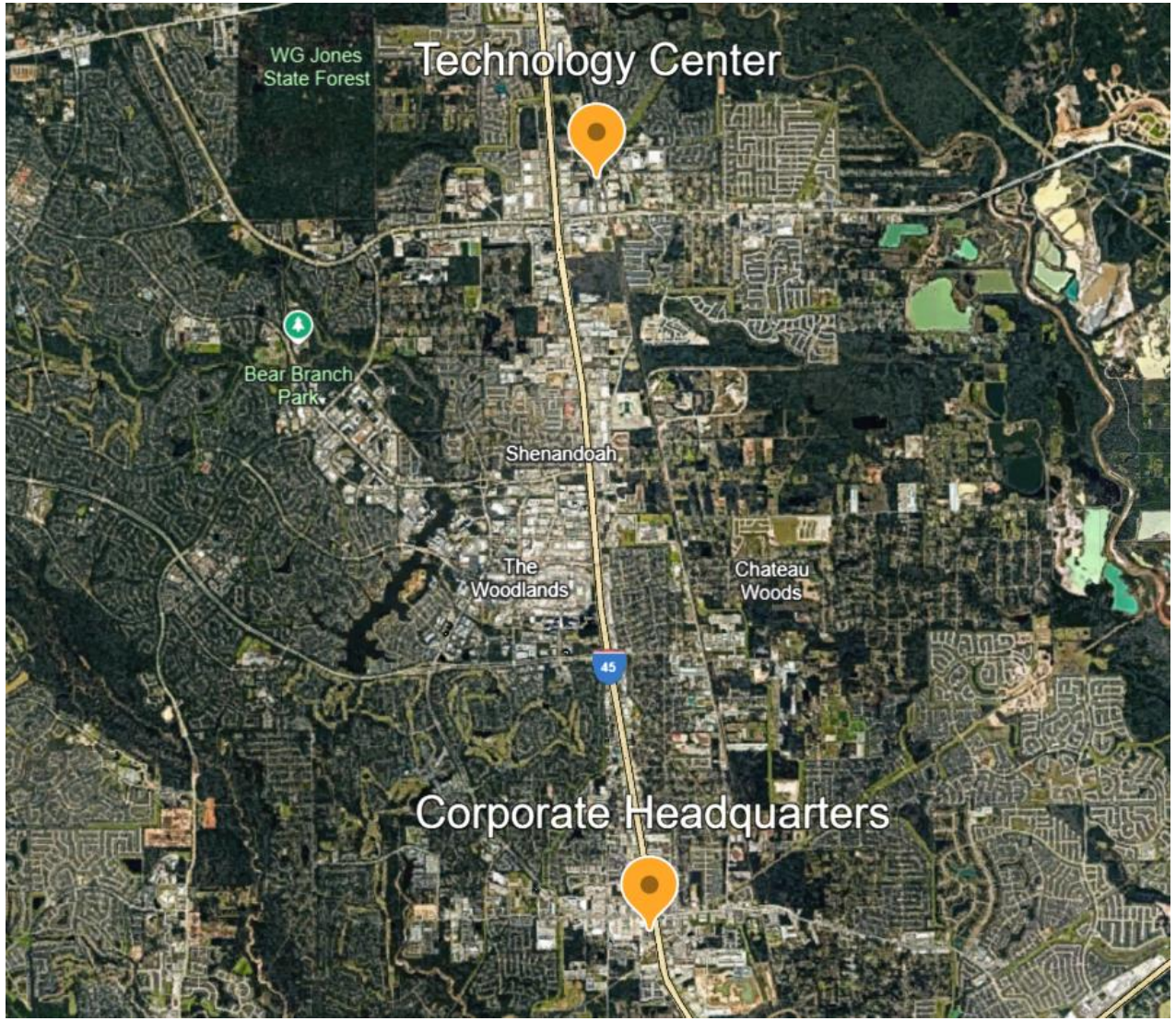
32k sq ft
Indoor space

6k sq ft
Lab space

22k sq ft
Pilot space

32
Professionals

101
Patents & applications

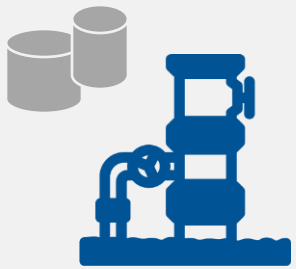


OVERCOMING BARRIERS

TETRA Oasis 'End-to-End' Desalination Solution: Transforming a Waste into A Resource

"RAW" PRODUCED WATER (PW)

PW GATHERING SYSTEM



PW Feed Tank

PRE-TREATMENT

TETRA SOLUTIONS

Removal of constituents that are damaging to the membranes

- Organics
- Metals
- Scale Formers
- Temperature Adjustment
- pH Adjustment

DESALINATION

TETRA LICENSED TECHNOLOGIES

Vacuum Membrane Distillation (VMD)

Osmotically Assisted Reverse Osmosis (OARO)

POST-TREATMENT / MINERAL EXTRACTION

CLEAN WATER

<500ppm TDS

POTENTIAL END USES

CONCENTRATED BRINE

>300,000ppm TDS

POST TREATMENT

Ammonia, Boron, Organics, pH, etc.

MINERAL EXTRACTION

Iodine, Magnesium, Strontium, Boron, Lithium, etc.

END USE

BENEFICIAL REUSE

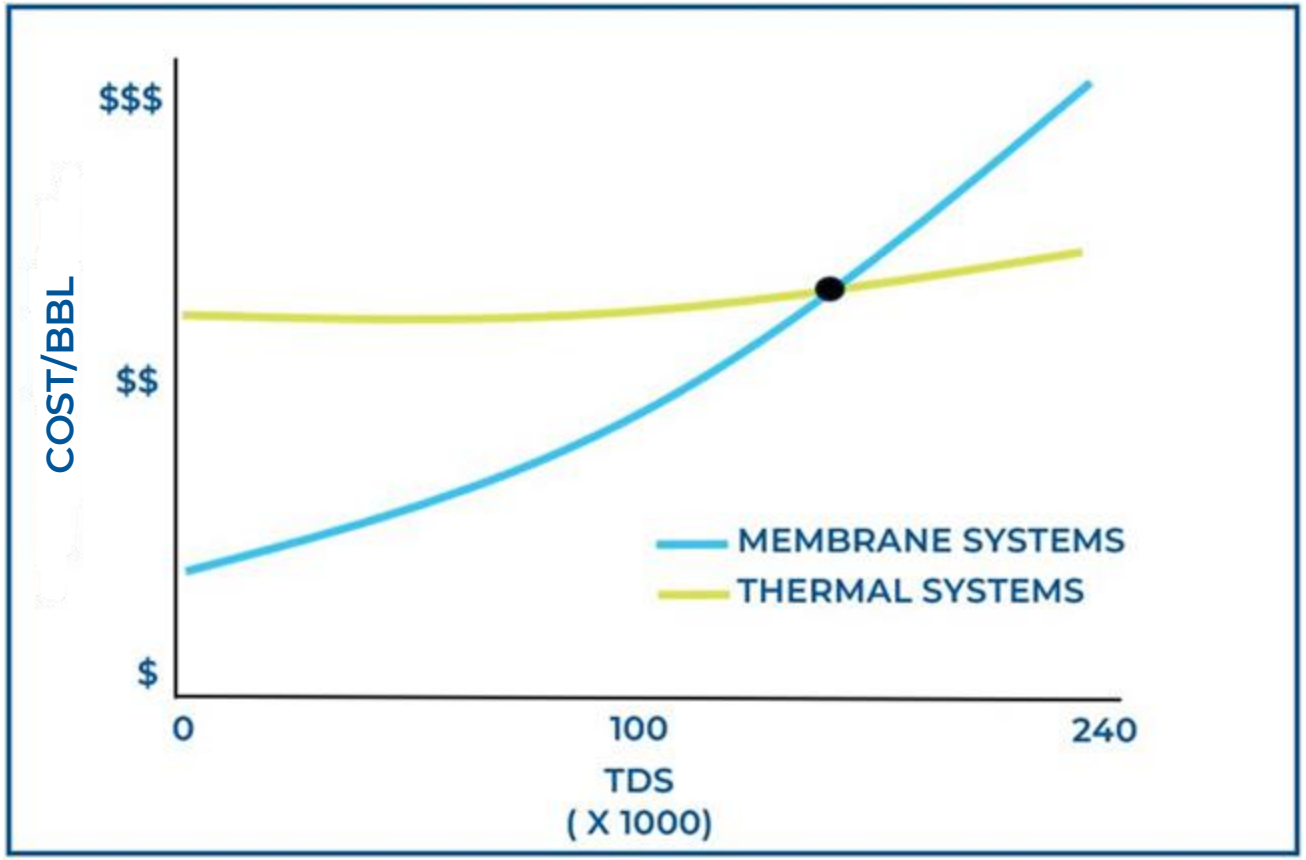
- Agriculture
- Irrigation
- Industrial Use

WASTE BRINE

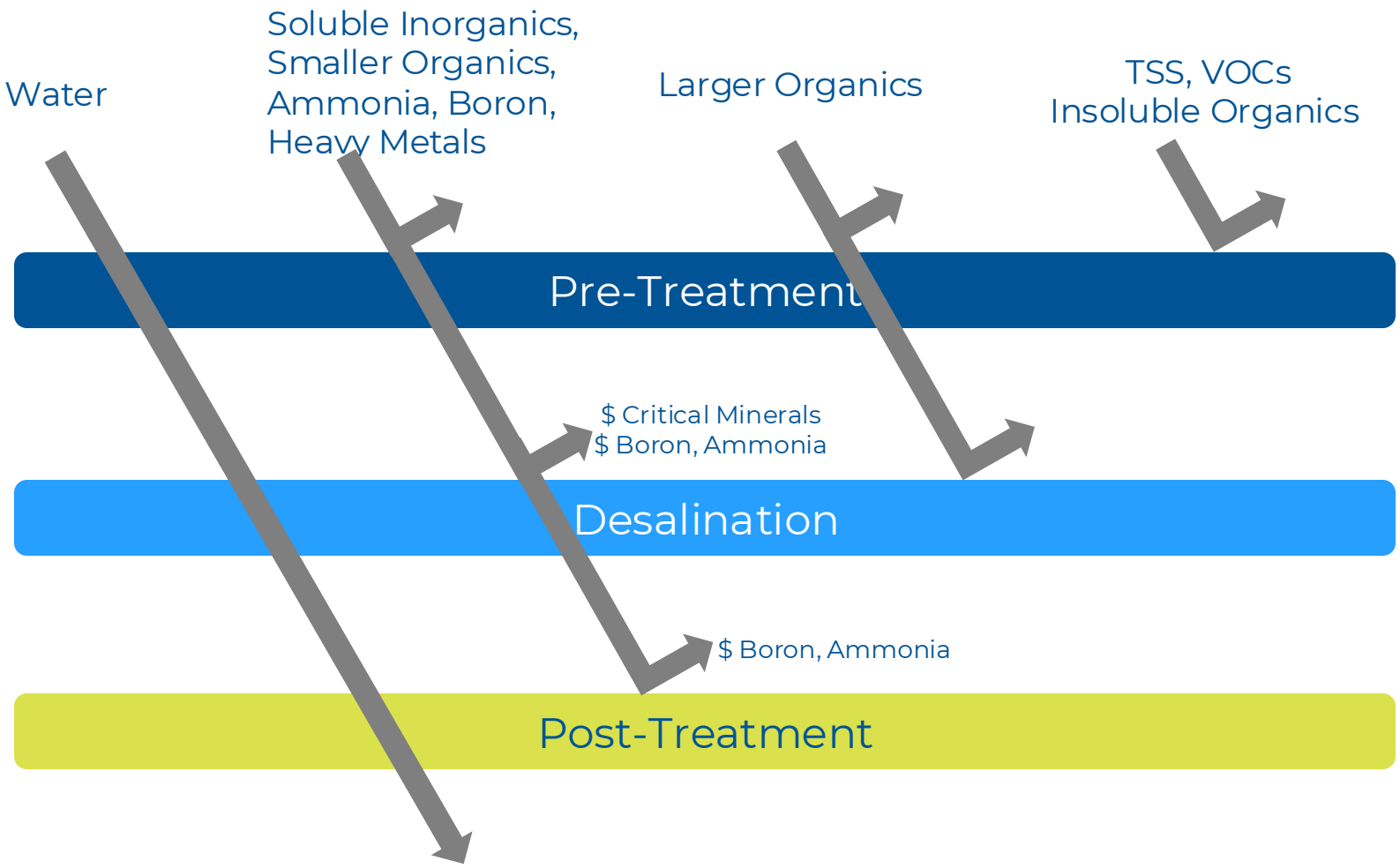
- Saltwater Disposal
- Completions
- Well Control

HYBRID SYSTEM

- OARO from ~100k TDS to ~200k TDS
- VMD from ~200k TDS to 240k TDS (saturation of NaCl)

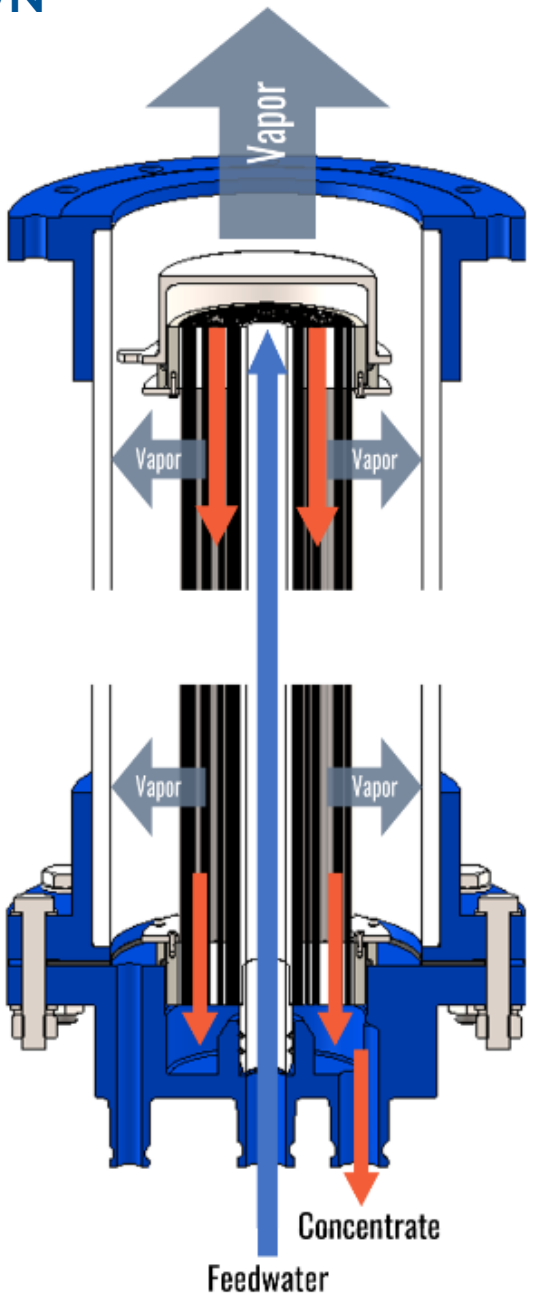


TETRA OASIS PROVIDES MULTI-BARRIER PROTECTION



VACUUM MEMBRANE DISTILLATION

- Reliably desalinates up to and beyond the point of saturation
- Energy costs reduced when using waste heat as energy source
  - Compressor exhaust / flare gas
  - Eliminates differential pressure challenges that limits conventional membrane separation technologies

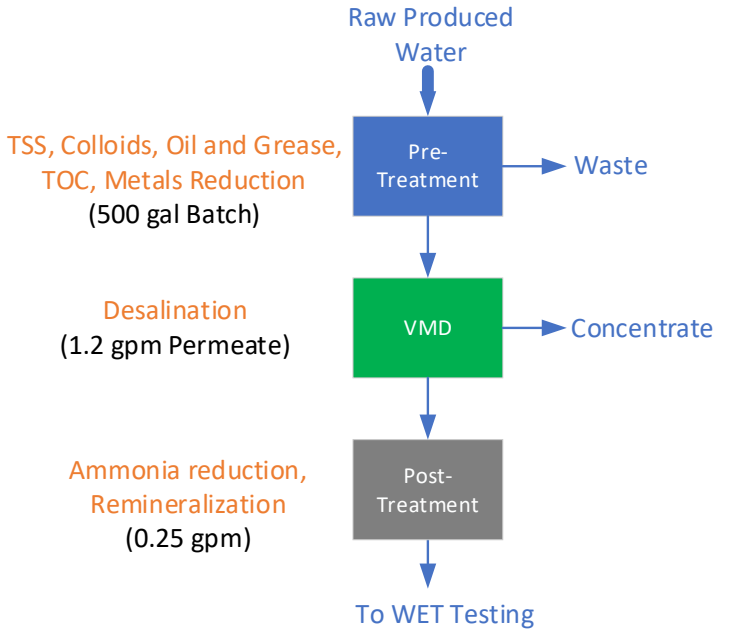


How it works:

- Feedwater enters module and flows up through center core
- Feedwater reaches top of module, is distributed and flows downward through the fiber to the concentrate outlet and then recirculated in the same manner
- The hydrophobic membrane acts as a barrier to the liquid and only vapor can pass through the membrane
- Vacuum is applied on the shell side (outside of the membrane)
- Combination of vacuum depth and heat creates phase transition from water to vapor on the membrane surface.
- Water vapor passes through the membrane, and is condensed downstream (heat recovered)

CASE STUDY FOR HIGH TDS PRODUCED WATER

Pilot Trial:



Parameter	Unit	TX RRC guidelines for land application pilots	Raw PW	VMD Permeate	Post-treated VMD Permeate
pH	pH Units	6.5-8.4	6.67	9.66	7.5
Turbidity	NTU	30	15	1.2	<0.5
Total Dissolved solids (TDS)	mg/L	1,000	136,000	150	19
Sp. Conductivity	µS/cm	1,500	186,000	123	22.9
Total Hardness	mg/L as $CaCO_3$	150	15,400	1.38	8.05
Total Alkalinity	mg/L as $CaCO_3$	100	96.4	218	10.8
Ammonia Nitrogen	mg/L	30	500	53	0.11
Total Organic Carbon (TOC)	mg/L	10	49.7	3.32	2.47
Sodium Adsorption Ratio (SAR)		4	4.48	1.43	0.13
Boron	mg/L	0.75	55.8	0.85	0.66
PFAS (40 compounds)	ng/L		2.21 (PFBA); Rest non-detect	3.49 (PFOS-6:2 FTS); Rest non-detect	None of the 40 detected

Success Criteria:

- Stable membrane flux and rejection
- Quality per RRC guidelines for land application pilots
- Successful WET test for potential surface discharge applications

CASE STUDY FOR HIGH TDS PRODUCED WATER

Parameter	Unit	TX RRC guidelines for land application pilots	Raw PW	VMD Permeate	Post-treated VMD Permeate
Cations					
Aluminum	mg/L	5	<0.275	<0.00549	<0.00549
Arsenic	mg/L	0.1	<0.0345	<0.000690	<0.000690
Beryllium	mg/L	0.1	<0.0136	<0.000271	<0.00134
Cadmium	mg/L	0.01	<0.012	<0.00024	<0.000271
Calcium	mg/L		5,150	0.551	3.65
Chromium, Total	mg/L	0.1	<0.028	0.000904	0.001
Cobalt	mg/L	0.05	<0.0178	<0.000355	<0.000355
Copper	mg/L	0.2	<0.05	0.105	0.00179
Iron	mg/L	5	1.67	0.0731	<0.0283
Lead	mg/L	5	<0.0184	0.00833	<0.000367
Lithium	mg/L	2.5	36.1	<0.0174	<0.0174
Magnesium	mg/L		606	0.0445	0.0631
Manganese	mg/L	0.2	0.58	<0.00436	<0.00436
Molybdenum	mg/L	0.01	<0.0128	0.0022	<0.000255
Nickel	mg/L	0.2	<0.0264	0.000946	<0.000528
Phosphorus	mg/L	5	0.279	<0.0184	<0.0184
Selenium	mg/L	0.02	0.0443	<0.00059	<0.000590
Sodium	mg/L	100	31,700	1.03	0.554
Vanadium	mg/L	0.1	<0.0225	<0.00045	<0.00045
Zinc	mg/L	2	<0.137	0.0104	0.0163
TOTAL Metals	**mg/L**	**10**	**2,105**	**0.43**	**0.033**

Parameter	Unit	TX RRC guidelines for land application pilots	Raw PW	VMD Permeate	Post-treated VMD Permeate
Anions					
Chloride	mg/L	100	83300	2.16	1.17
Fluoride	mg/L	1	<50	<0.1	<0.1
Nitrate Nitrogen	mg/L	45	<19.6	0.0502	<0.0391
Nitrite Nitrogen	mg/L	10	<35	<0.0699	<0.0699
Organics					
Oil and Grease	mg/L	35	2.30	<1.57	<1.65
Organic - SVOC - TPH	mg/L	10	4.27	<0.972	<0.005
Radionuclides					
Radium 226	pCi/L	30	0.186	0.179	0.0134
Radium-228	pCi/L	30	6.43	0.131	0.806
Gross Alpha/Beta	pCi/L	15	3050	0.785	0.498

WET TEST RESULTS

- WET analysis is required for US EPA's NPDES permits, to determine aggregate toxic effects from all pollutants in the effluent to aquatic organisms

- NPDES program is created by the Clean Water Act. NM and TX follow NPDES requirements for surface discharge

Test Method	**Results (VMD)** (Concentration as % Effluent)			
	Ceriodaphnia dubia (Fresh water Flea)		Pimephales promelas (Fathead Minnow)	
Acute: (EPA 821-R-02-012) 48-hr; non-renewal	**Survival** NOEC: 100 LOEC: >100 LC50: >100		**Survival** NOEC: 100 LOEC: >100 LC50: >100	
Chronic; (EPA 821-R-02-013) 7-days with daily water renewal	**Survival** NOEC: 100 LOEC: >100	**Reproduction** NOEC: 100 LOEC: >100 IC25: >100	**Survival** NOEC: 100 LOEC: >100	**Growth** NOEC: 100 LOEC: >100 IC25: >100

Test Method	**Results (OARO)** (Concentration as % Effluent)			
	Ceriodaphnia dubia (Fresh water Flea)		Pimephales promelas (Fathead Minnow)	
Acute: (EPA 821-R-02-012) 48-hr; non-renewal	**Survival** NOEC: 100 LOEC: >100 LC50: >100		**Survival** NOEC: 100 LOEC: >100 LC50: >100	
Chronic; (EPA 821-R-02-013) 7-days with daily water renewal	**Survival** NOEC: 100 LOEC: >100	**Reproduction** NOEC: 50 LOEC: 100 IC25: 75.4	**Survival** NOEC: 100 LOEC: >100	**Growth** NOEC: 50 LOEC: 100 IC25: 76.2

MINERAL EXTRACTION

- U.S. needs critical minerals through an environmentally friendly process
- Sale of minerals helps offset the cost of desalination
- Examples of key minerals
  - Bromine
  - Iodine
  - Lithium
  - Calcium
  - Manganese
  - Magnesium

Iodine Extraction Pilot Unit TETRA Innovation Group

THANK YOU.

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