Reverse Osmosis

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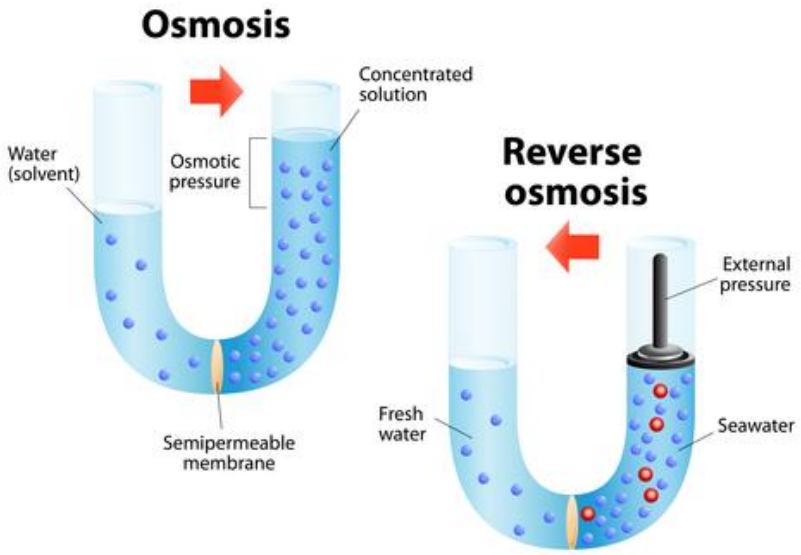
What is Osmosis?

- Under normal pressure, water spontaneously passes through a semi permeable membrane from a region of higher concentration to a region of lower concentration until the concentrations are equal



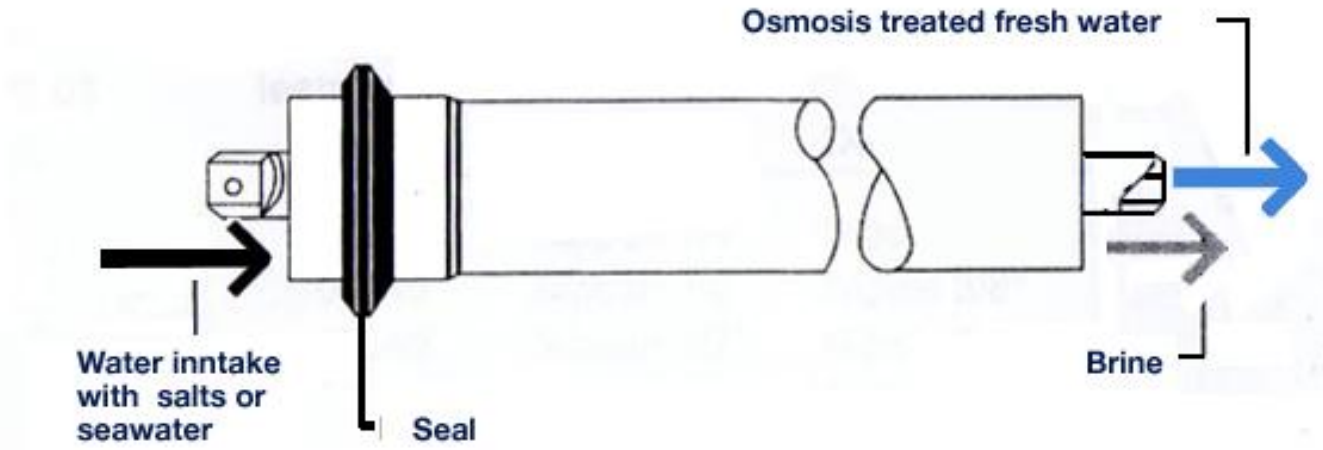
History

- Seabirds use reverse osmosis to desalinate seawater. They possess a membrane in their throats which allows water molecules to get through and stops the salt. This enables them to drink fresh, desalinated water, and they spit out the salty waste.
- Humans worked out how to copy this process around 40 years ago for the same reason - to desalinate seawater.
- When applied pressure exceeds the osmosis pressure, Reverse Osmosis will take place.
- In the Reverse Osmosis situation, water passes through the membrane to the diluted solution leaving behind suspended particles and salt.

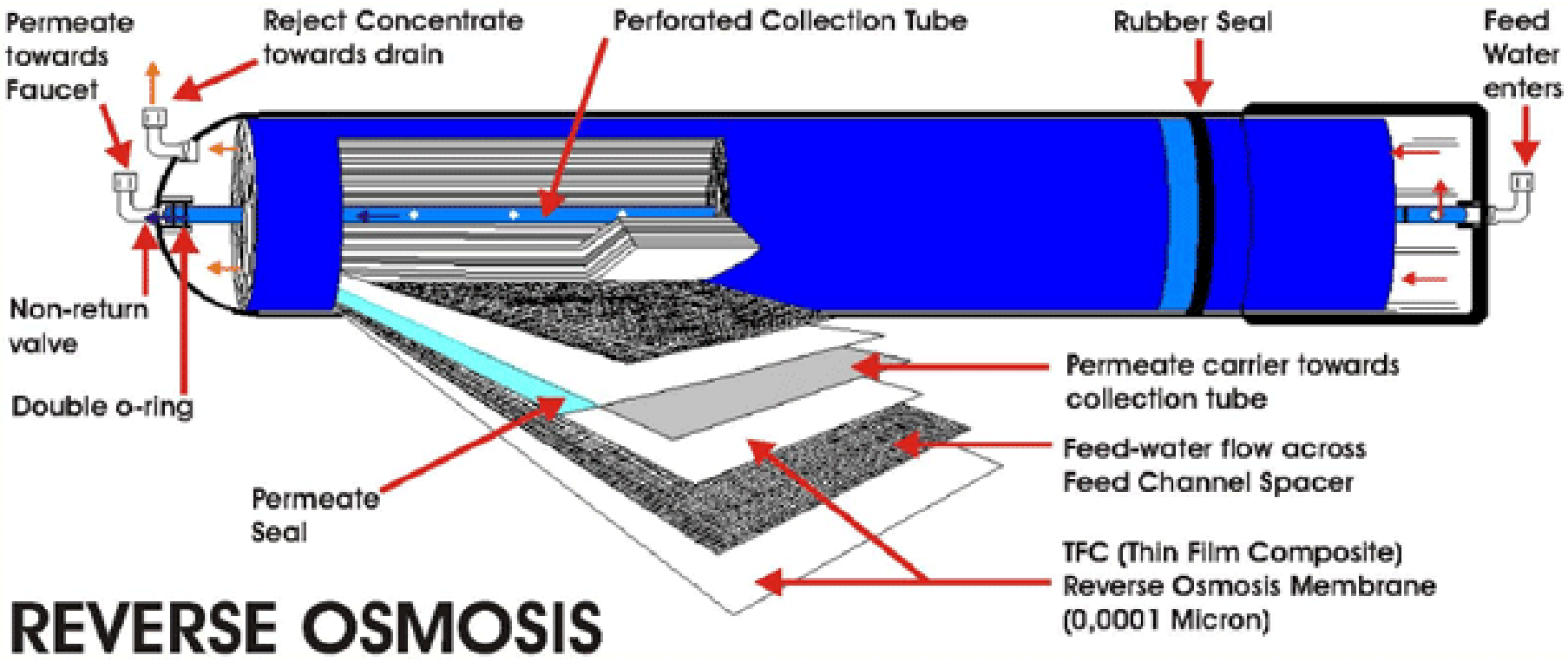
Applications

- Sea Water Desalination
- Ultra-Pure Water Production for Semiconductor Industry
- Pharma/Medical Industry (Sanitizeable RO)
- Power Stations
- Potable Water

RO Spiral Bound Membrane



Cut Out of RO Membrane



Suppliers of RO Membranes

- Hydranautics
- GE Water
- Koch Membrane
- Filmtech DOW
- TORAY

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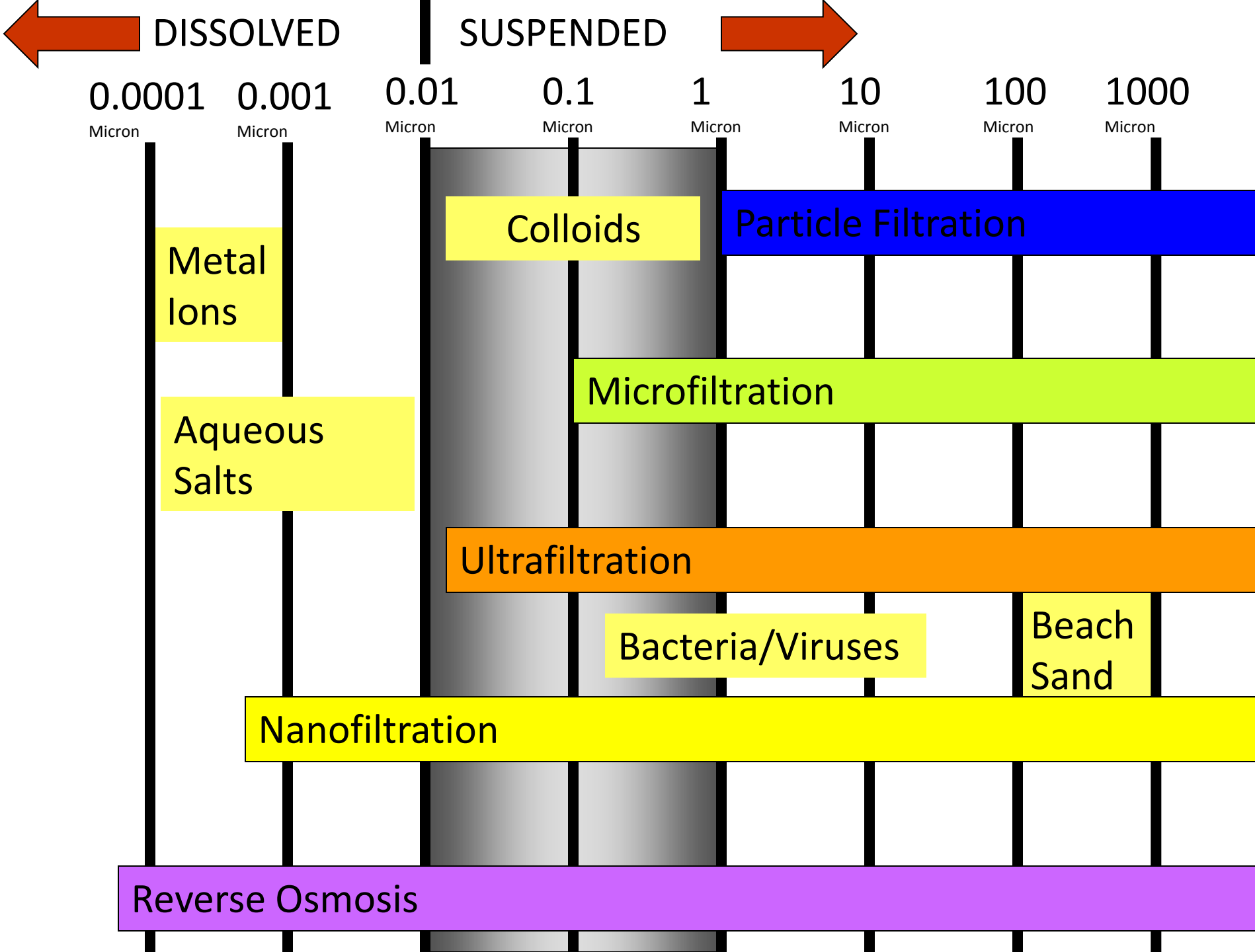
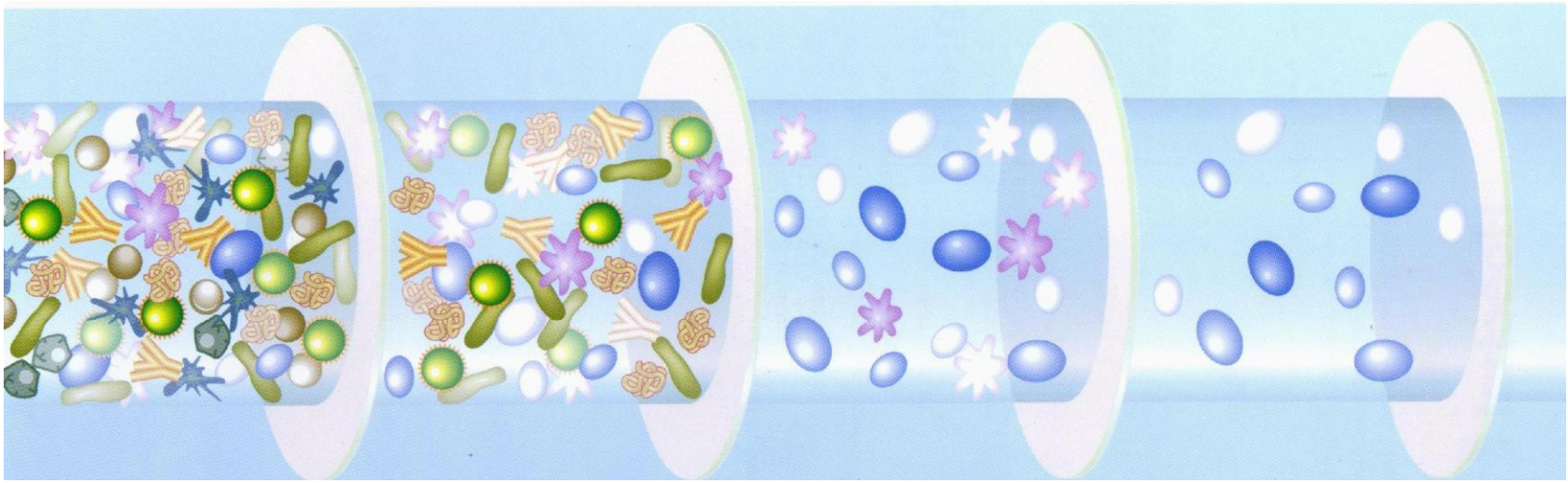

DISSOLVED
SUSPENDED
0.0001 Micron
0.001 Micron
0.01 Micron
0.1 Micron
1 Micron
10 Micron
100 Micron
1000 Micron
Colloids
Particle Filtration
Metal Ions
Microfiltration
Aqueous Salts
Ultrafiltration
Bacteria/Viruses
Beach Sand
Nanofiltration
Reverse Osmosis

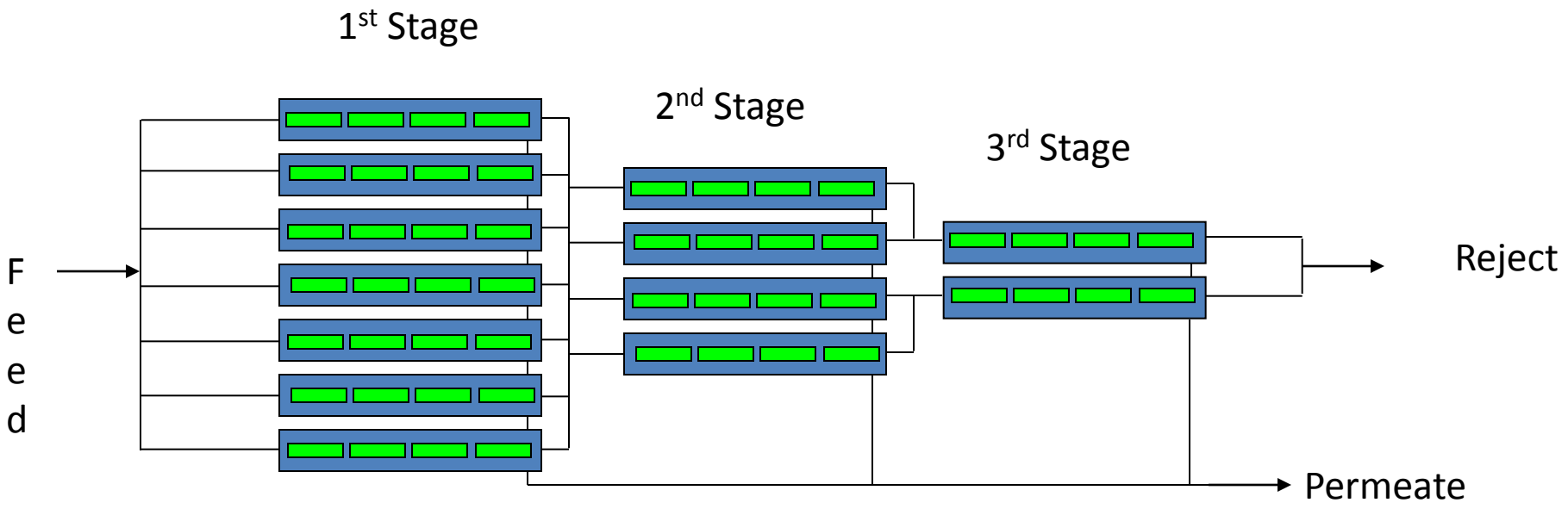
Membrane Separation



Mikrofiltration	Ultrafiltration	Nanofiltration	RO
> 0,1 µm	0,1 - 0,01 µm	0,01 - 0,001 µm	< 0,001 µm
- turbidity - Suspended solids - Algae	- Colloidal substances - Micro organism	- Organics - Pesticides - CaSO4	- Ions

Staging R.O. Membranes

- 7-4-2 Concentrate Staging Configuration



Real Life RO System

RO Membrane Fouling/Deterioration/Damage

- Scale
- Colloids
- Oxidizing Chemicals
- Color
- Bacteria
- High/Low pH
- Sudden Pressure Changes
- Organic solvents
- Very high T

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RO CIP Station

Monitoring the RO

- Ionic composition (weekly)
- Alkalinity (daily)
- Hardness (daily)
- Chlorine (daily)
- T, pH (per shift)
- Conductivity, SDI (per shift)
- TOC, Color (daily)
- Bacteria count (every 3 days)
- Silica (weekly)
- Humic/Fulvic acid (weekly)
- H2S (weekly)
- Boron (daily)
- Oil and Hydrocarbons (weekly)
- Pressure and Flow (Online)

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Pre-Treatment for the RO

- Clarification
- Micron Filtration (Sand Filter, MMF, Gravity Filter)
- UF
- Chlorination/Dechlorination
- Biofiltration

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