



'TORAY'

Toray's Activities towards
Saudi Vision 2030

FIRST SUCCESSFUL SWRO REFERENCE IN KHAFJI GULF

RAWAFID & AWT

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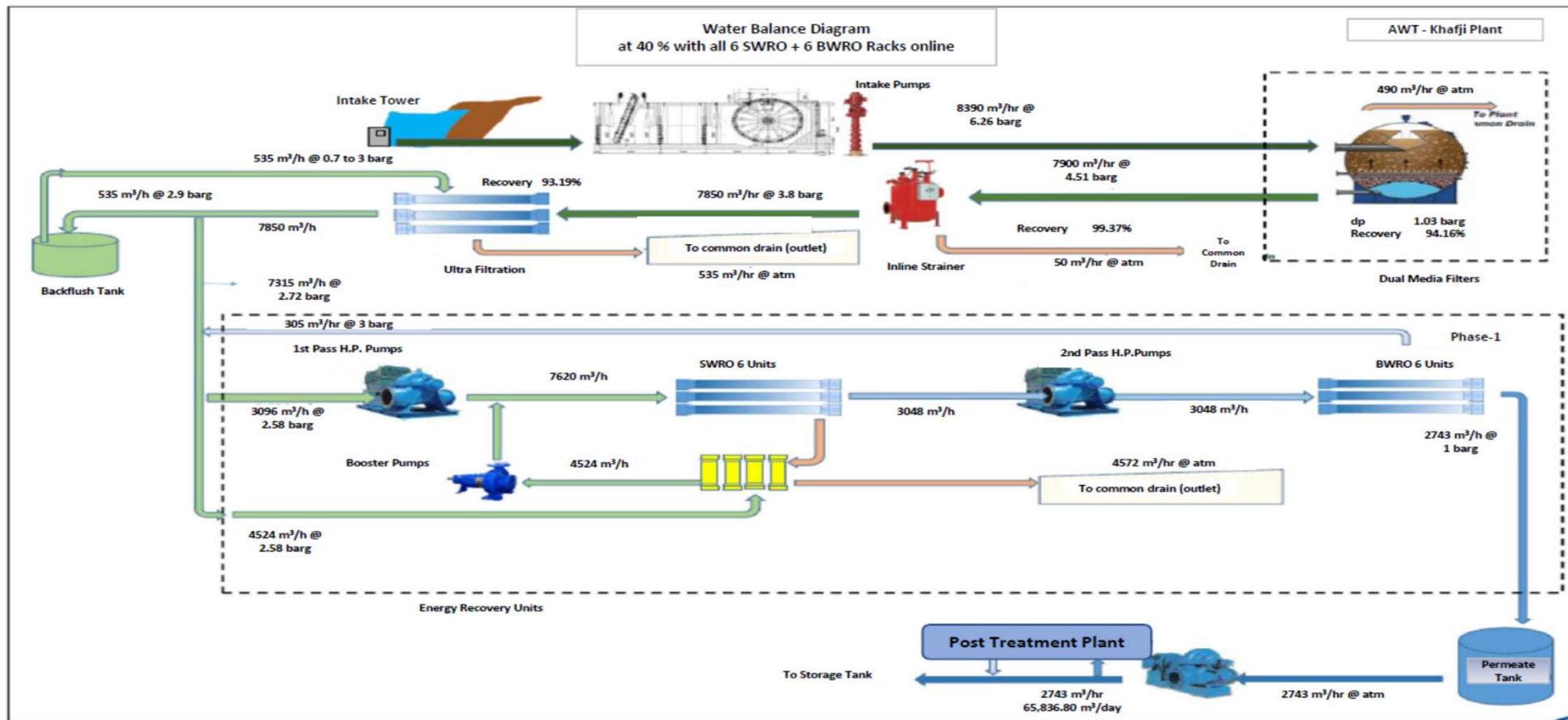
INTRODUCTION - LOCATION



**Khafji
City**

**Location 300 km north of Dammam, Saudi Arabia
Supplying potable water to Khafji City**

INTRODUCTION – PROCESS FLOW



INTRODUCTION

There were many challenges for the operation conditions at Khafji Gulf Sea water plant due to following reasons :

- High Feed Water TDS with Wide Temperature Range.
- Sea Shallowness
- Risk for Red Tide & Jellyfish Activities.

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RO SYSTEM DETAILS

Description	1 st Pass – SWRO	2 nd Pass – BWRO
System permeate flux	12.33 - 13.56 l/m ² /h	32.54 l/m ² /h
Recovery ratio	40 – 44 %	90 %
Number of trains	6	6
Number of vessels / train	144	Stage-1: 38 Stage-2: 16
Number of elements / vessel	7	7
Membrane model	TM820M-440	TM720D-400
Total number of membrane elements	6048	2268

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WATER QUALITY PARAMETERS

RO Feed Water Quality

Description	Unit	Value
Temperature	°C	16 - 40
pH	-	8.0 - 8.3
Calcium	mg/l	520.7
Magnesium	mg/l	1,718
Sodium	mg/l	14,511
Potassium	mg/l	499.9
Chloride	mg/l	26,011
Sulphate	mg/l	3,541
Bicarbonate	mg/l	177.1
Fluoride	mg/l	1.252
Silica	mg/l	0.417
Boron	mg/l	5.5
TDS	mg/l	47,000
SDI (15 mins)	-	< 3.0 (100% of the time)
Turbidity	NTU	< 0.5 (100% of the time)

RO Product Water Quality

Description	Unit	Value
TDS	mg/l	35
Chloride	mg/l	18
Boron	mg/l	2.4

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DMF WATER QUALITY - SDI

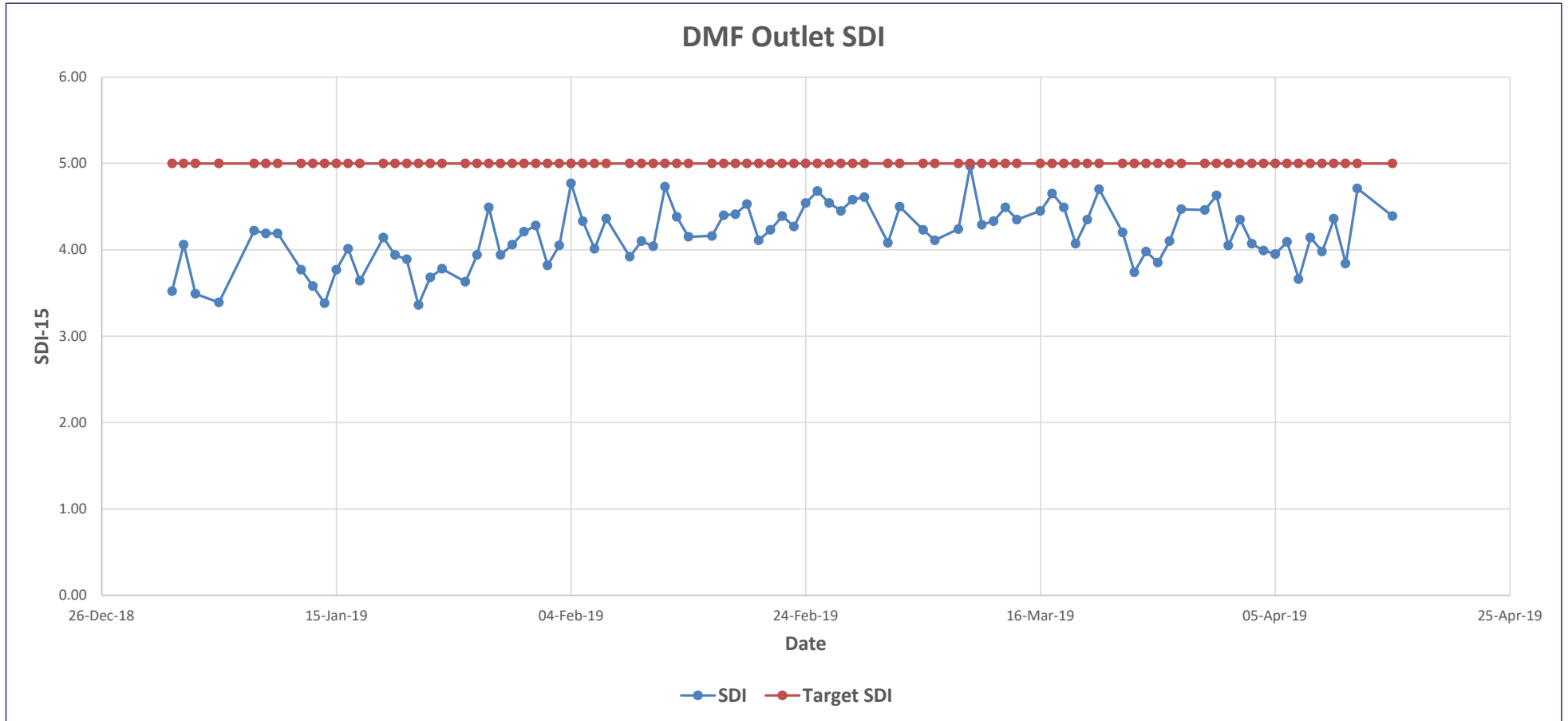


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RO FEED (UF) WATER QUALITY - SDI

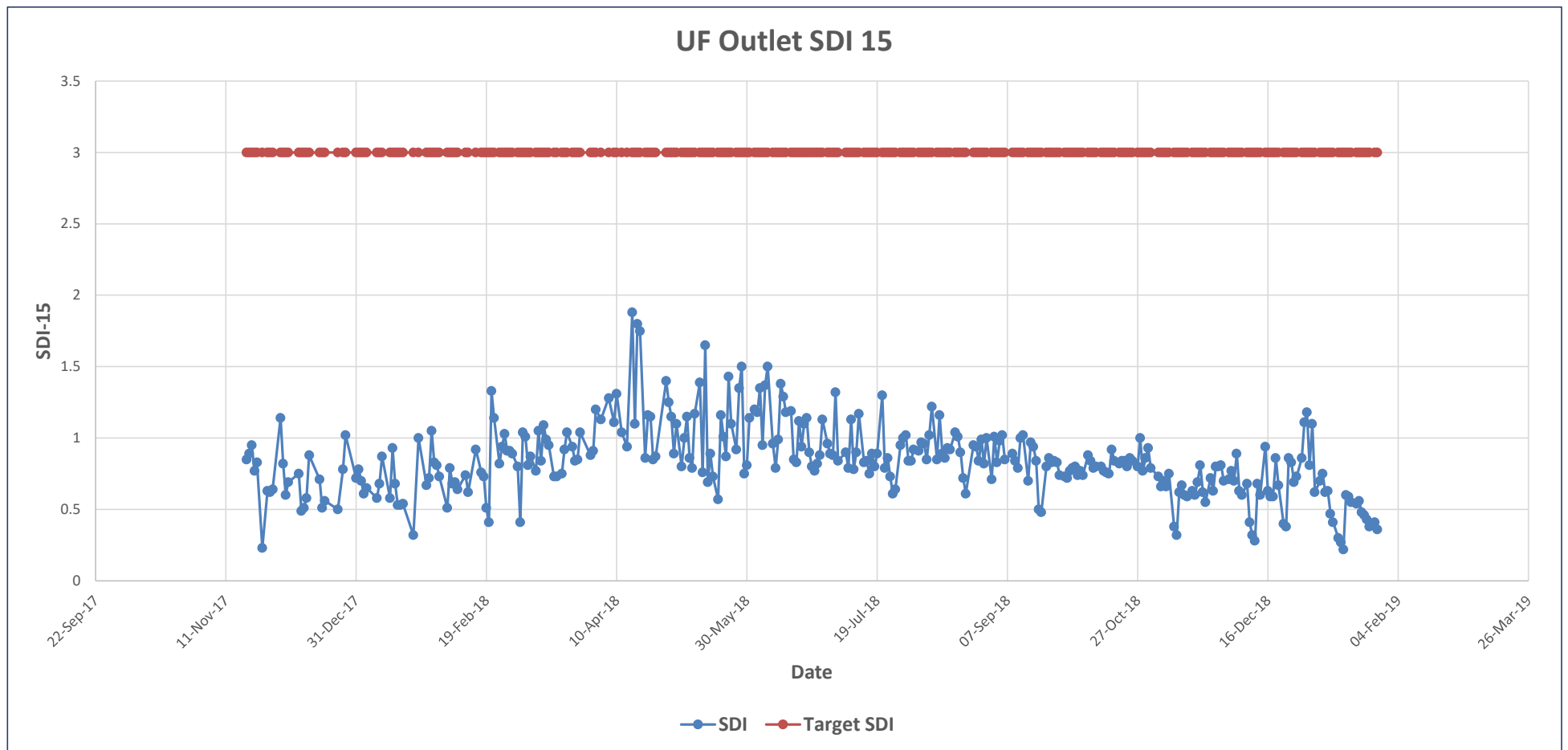
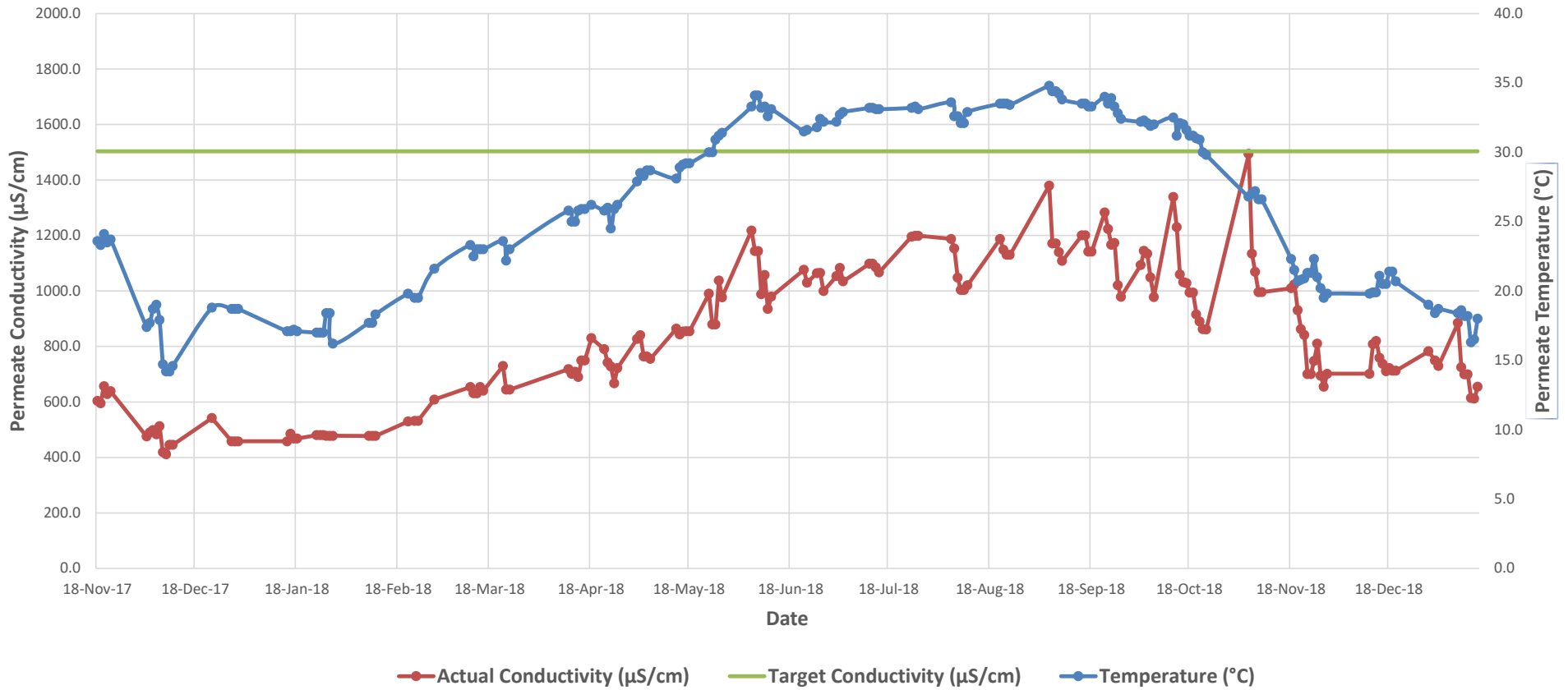


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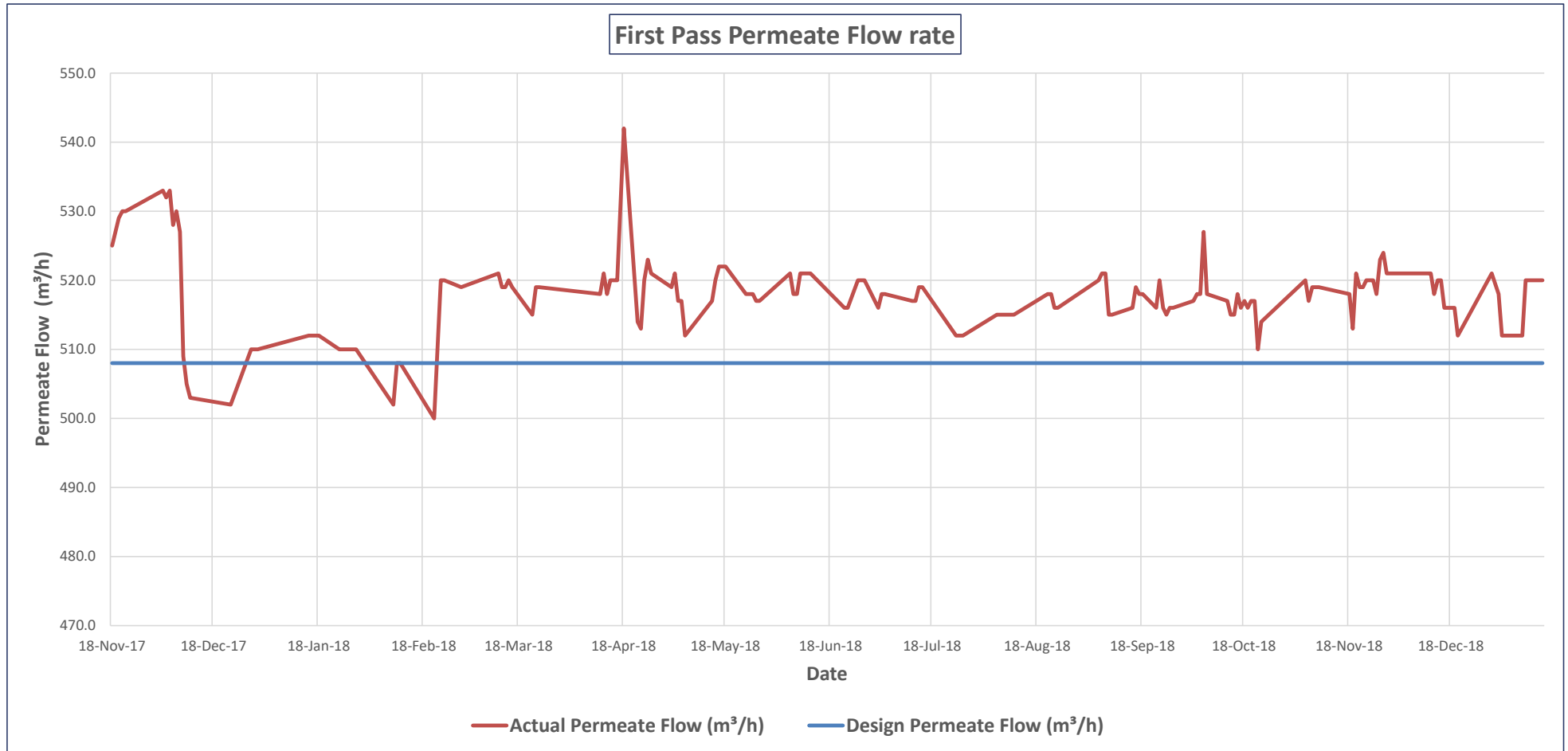
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SEAWATER RO PERFORMANCE

Permeate Water Temperature & Conductivity

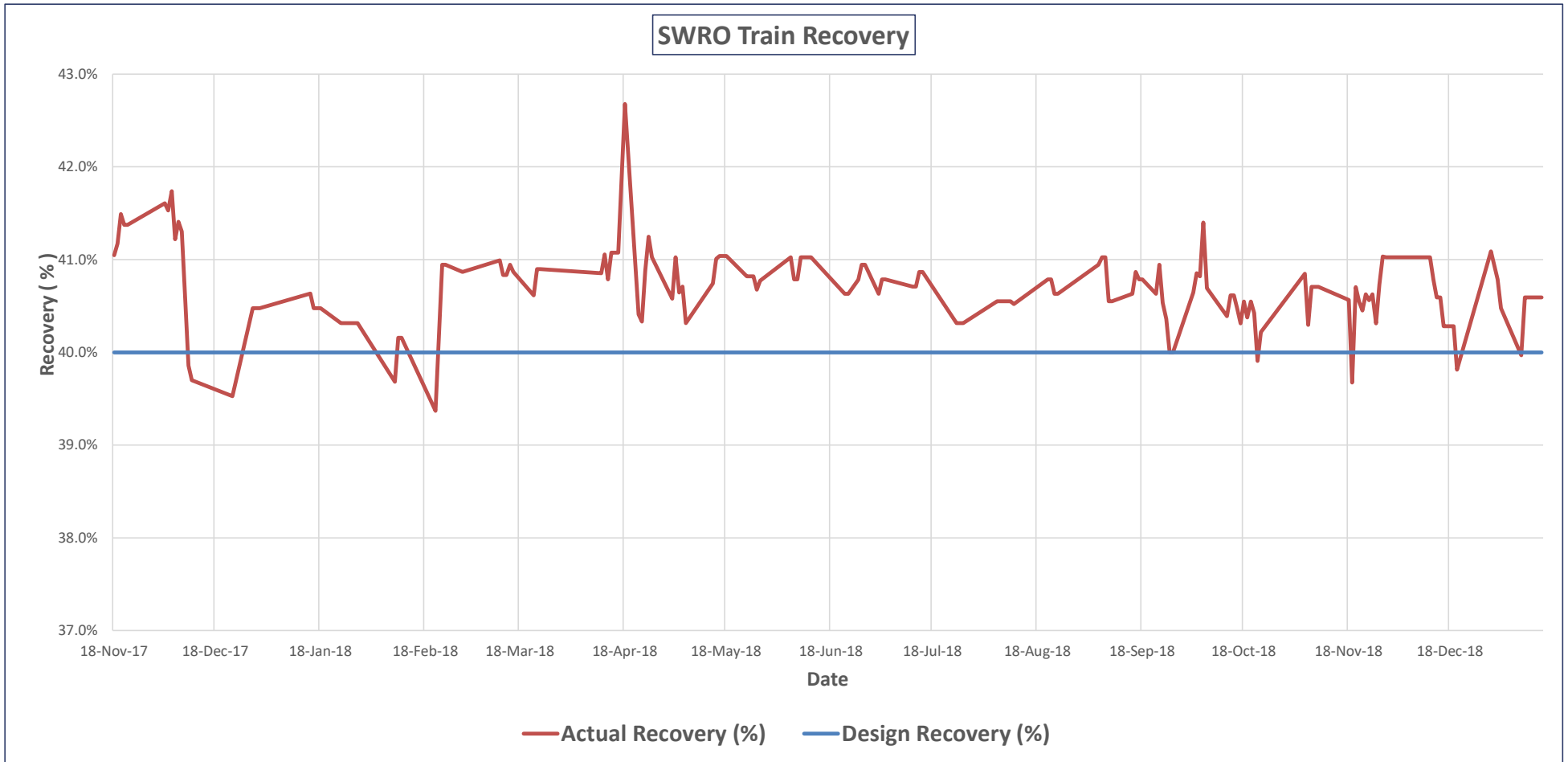


SEAWATER RO PERFORMANCE

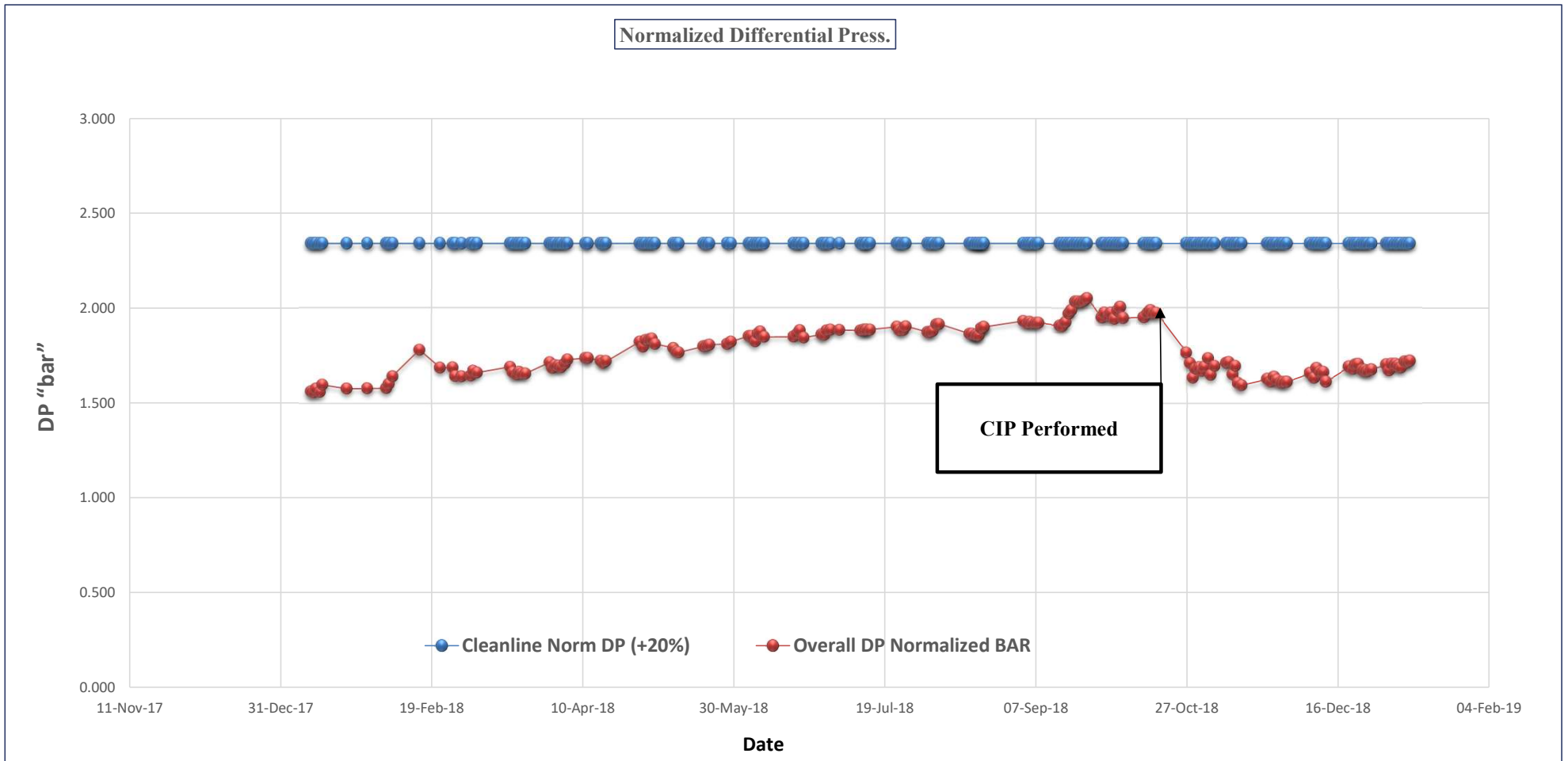


SEAWATER RO PERFORMANCE

SWRO Train Recovery



SEAWATER RO PERFORMANCE - NDP CURVE



SEAWATER RO PERFORMANCE - NSP CURVE

System Normalized Salt Passage with CIP line

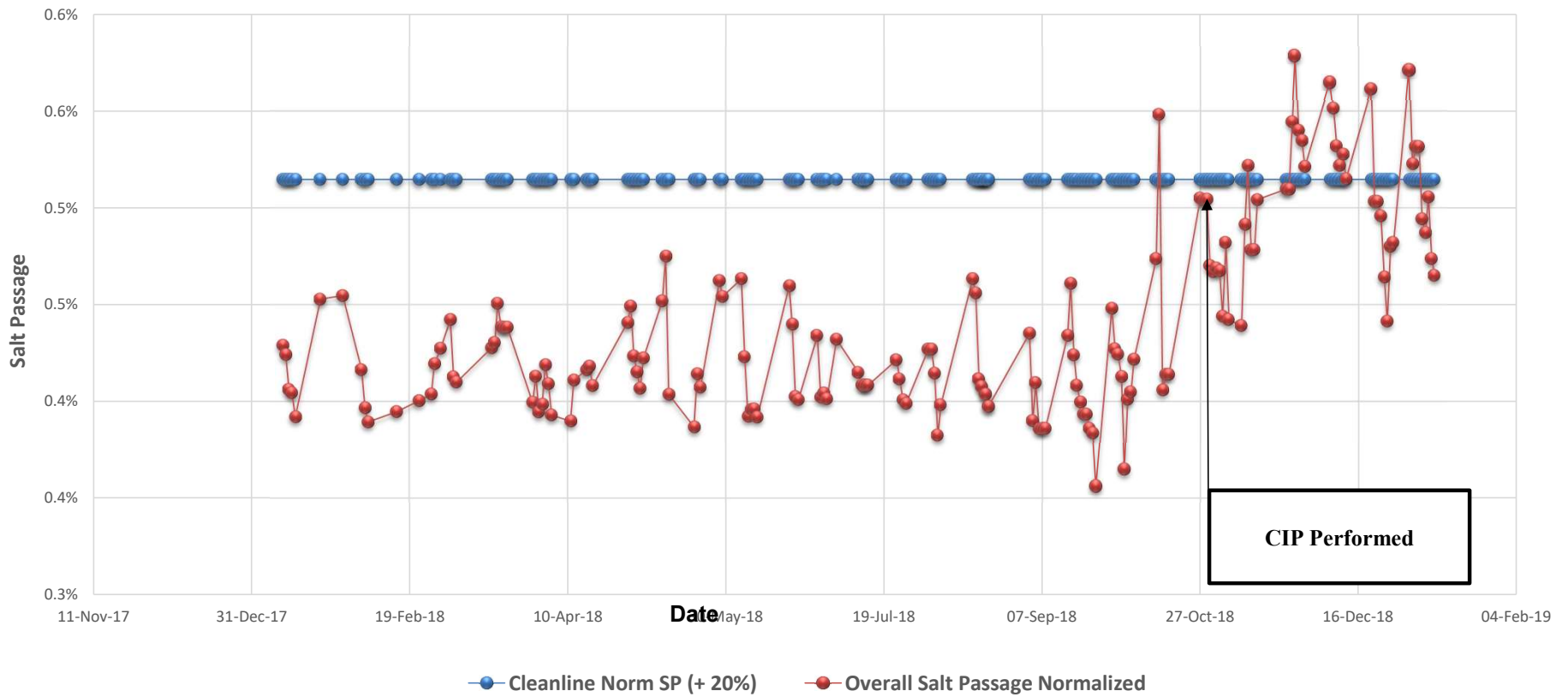


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CONCLUSION

- Al Khafji SWRO is successfully operating for more than one year.
- Even though the operation is not at the full capacity yet due to the low demand, the quality of the 2nd pass permeate water is according to the design parameters (TDS \leq 35 mg/l, boron \leq 2.4 mg/l).
- During the first year of plant operation, one Chemical Cleaning (CIP) cycle was performed for each train in the 1st pass unit.
- The steps considered by the operation team in the pretreatment including the intermittent chlorination, periodic sterilization & DMF disinfection (soaking) with chlorine demonstrates significant success to maximize the membrane performance with low CIP frequency.
- This result will be milestone to expand RO (Polyamide membrane) technology in Khafji Gulf.



**We have committed to
Saudi Arabia's Vision 2030**

TORAY

Toray Membrane Middle East LLC