

# First Municipal Seawater Desalination Plant in Ecuador: Challenges & Solutions

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## PRESENTATION OUTLINE

- Introduction: Puna Island location (map, community, shrimp farms), current status of water supply (salty water), existing water supply scheme
- Investigating/testing source water well
- Proposed treatment schematic, PFD / P&IDs
- Construction process
- Start-up process: pre-treatment, RO, post-treatment
- SDI testing
- Commissioning, test runs
- Opening Ceremony, water testing
- Lesson Learned
- Summary





**Puná Island** is an island off the coast of southern Ecuador at approximately 80 degrees west longitude and 3 degrees south latitude

- Area: 330 square miles (855 km<sup>2</sup>)
- Population: 5,000 people
- Major Businesses: Fishing, Shrimp Farming





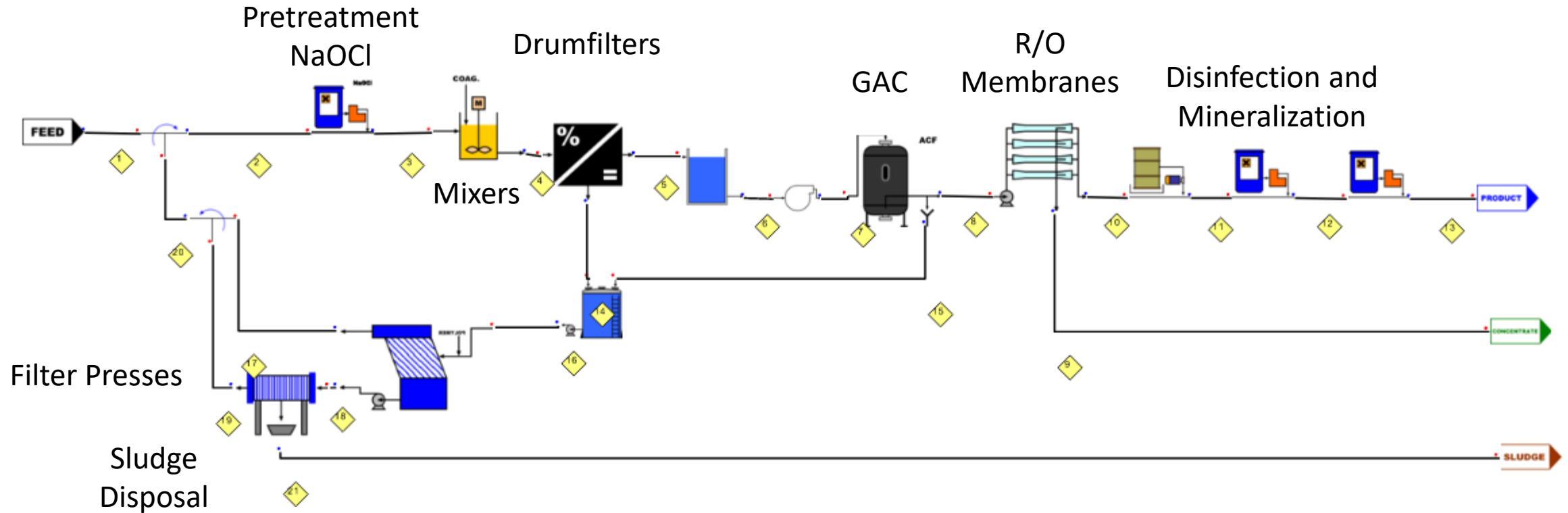
**The only connection with mainland is water**





**The potable water from the well carried high salinity with  
TDS ~ 2,000 mg/l prior to the project execution**

# Proposed Desalination Plant





# Construction of Desalination Plant





## Key Components of Desalination Facility

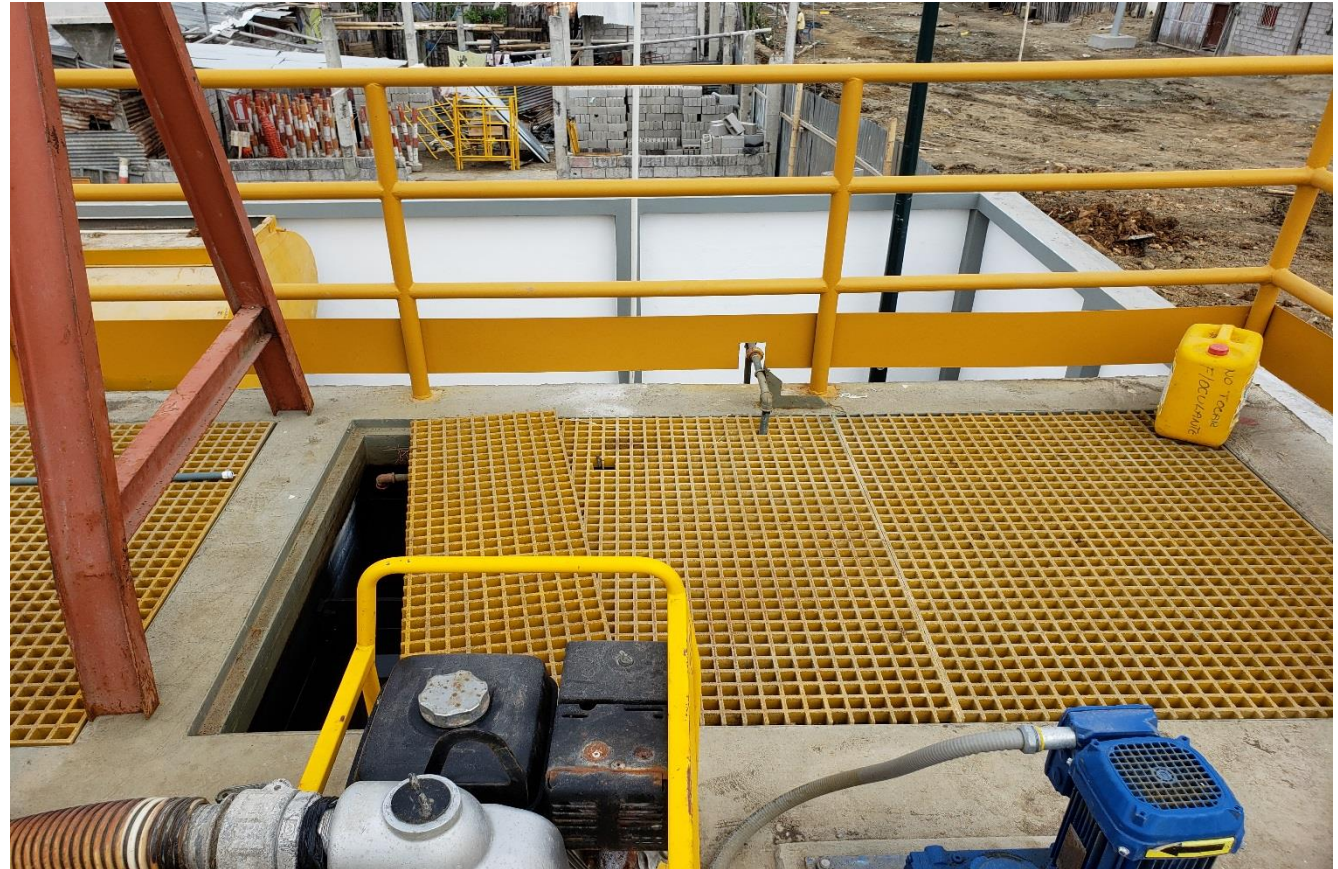
- Groundwater Well
- Coagulation and Flocculation Chambers
- Rotary Drum-screens
- Granular Activated Carbon Filters
- Reverse Osmosis
- Disinfection
- Solids Management Equipment

## Groundwater Well





# Coagulation and Flocculation Chambers





## Rotary Drum-screens



# Granular Activated Carbon Filters





## Reverse Osmosis, SDI Tests





# Reverse Osmosis Energy Recovery



# Disinfection





## Solids Management Equipment







## Low & High Tides



# Feed Water Chemistry

Compound	Concentration
TDS (mg/l)	43122
Mn (mg/l)	14.74
Ammonia (mg N/l)	7.41
Chlorides (mg/l)	27625
Turbidity (NTU)	8.34

INFORME DE ENSAYOS  
73350-1LABORATORIO DE ENSAYOS  
ACREDITADO POR EL SAE  
CON ACREDITACIÓN No.  
046 LE 3C-05-001

73350-1 15/09/18 10:14:52 Luis

VEQUA ECUADOR S.A.  
Representante Legal: BARBERAN SOLORZANO JEFFREY MANUEL  
VELLEZ 616 Y GARCIA AVILES, Guayaquil Guayas, Tel. 2118250  
Atención: Ing. José Serrano Mena

Guayaquil, 19 DE SEPTIEMBRE DEL 2018

## DATOS DE MUESTREO

Fecha/Hora/Lugar de Muestreo: 05/09/18 10:50 Isla Puná - Sector Barrio Lindo (Puná Bajo)  
Fecha/Hora Recepción Muestras: 05/09/18 14:57  
Punto e identificación de la Muestra: Agua de paso definitivo Puná (Proyecto tratamiento de AAPP)  
Método de la muestra: AGUA POTABLE  
Muestreador por/Muestreador/Tipo de Muestreo: GRUPO QUÍMICO MARCOS C. LTDA / Merchán Orellana José Marcelo / Simple  
Duración de Muestreo: 17M020704 9697622  
Coordenadas Geográficas: INEN 2268/2176-2013- PG GQM 09  
Norma Técnica de muestreo: Muestreo de Aguas Naturales y Residuales. Parámetros: DBO, DQO, Aceites y Grasas, TPH, Fenoles, ST y SST.  
Muestreo Actividad Acreditada: Muestreo de Aguas Naturales y Residuales. Parámetros: DBO, DQO, Aceites y Grasas, TPH, Fenoles, ST y SST.

## AGREGADOS/COMPONENTES FÍSICOS

PARÁMETRO	RESULTADO	UNIDADES	U K-2	MÉTODO	ANALIZADO POR
Conductividad Eléctrica (3)	71300.00	us/cm	7771.70	PEE-GQM-FQ-13	07/09/18 DF
Color Real (3)	< 10	UCP	—	PEE-GQM-FQ-34	06/09/18 SP
Salinidad (1)	50	g/l	—	PEE-GQM-FQ-27	07/09/18 DF
Turbidez	8.34	NTU	2.47	PEE-GQM-FQ-25	06/09/18 JV
Dureza total	10888	mgCO <sub>3</sub> Ca/l	1415	PEE-GQM-FQ-26	11/09/18 JV
Alcalinidad Total (M) (3)	573.89	mgCO <sub>3</sub> Ca/l	45.22	PEE-GQM-FQ-68	11/09/18 JV
Sólidos Totales	47430	mg/l	12203	PEE-GQM-FQ-22	12/09/18 NS
Sólidos Disueltos Totales	43122.00	mg/l	4911.80	PEE-GQM-FQ-23	07/09/18 DF

## INORGANICOS NO METALES

PARÁMETRO	RESULTADO	UNIDADES	U K-2	MÉTODO	ANALIZADO POR
Nitrogeno Ammoniacal	7.412	mg/l	1.543	PEE-GQM-FQ-31	07/09/18 DF
Cloruros	27623.01	mg/l	4143.45	PEE-GQM-FQ-08	11/09/18 JV
Nitratos	7.53	mg/l	0.98	PEE-GQM-FQ-10	07/09/18 DF
Nitritos (3)	0.001	mg/l	0.00	PEE-GQM-FQ-14	07/09/18 JV
Sulfatos (3)	4800.00	mg/l	835.20	PEE-GQM-FQ-28	06/09/18 DF
Sulfuros (3)	< 0.014	mg/l	—	PEE-GQM-FQ-36	07/09/18 DF
Cianuros (3)	< 0.05	mg/l	—	PEE-GQM-FQ-15	17/09/18 DF

## METALES

PARÁMETRO	RESULTADO	UNIDADES	U K-2	MÉTODO	ANALIZADO POR
Plata (1)	< 0.007	mg/l	—	3120 B	06/09/18 AUT
Aluminio (3)	37.3466	mg/l	9.8595	PEE-GQM-FQ-33	06/09/18 AUT
Asenico (3)	< 0.0031	mg/l	—	PEE-GQM-FQ-33	06/09/18 AUT
Boro (3)	4.3940	mg/l	0.5227	PEE-GQM-FQ-33	06/09/18 AUT
Bario	2.1726	mg/l	0.5559	PEE-GQM-FQ-33	06/09/18 AUT
Calcio (1)	1130.18	mg/l	101.72	PEE-GQM-FQ-33	06/09/18 ER
Cadmio (3)	< 0.0004	mg/l	—	PEE-GQM-FQ-33	06/09/18 AUT
Cromo total (3)	< 0.0024	mg/l	—	PEE-GQM-FQ-33	06/09/18 ER
Cobre	1.3311	mg/l	0.3980	PEE-GQM-FQ-33	06/09/18 ER
Hierro 2 (1)	< 0.019	mg/l	—	3500 Fe A	17/09/18 DF
Hierro (3)	12.1225	mg/l	3.3940	PEE-GQM-FQ-33	06/09/18 AUT
Mercurio (3)	< 0.005	mg/l	—	PEE-GQM-FQ-33	12/09/18 ER
Potasio (1)	462.9	mg/l	64.8	3120 B	06/09/18 AUT

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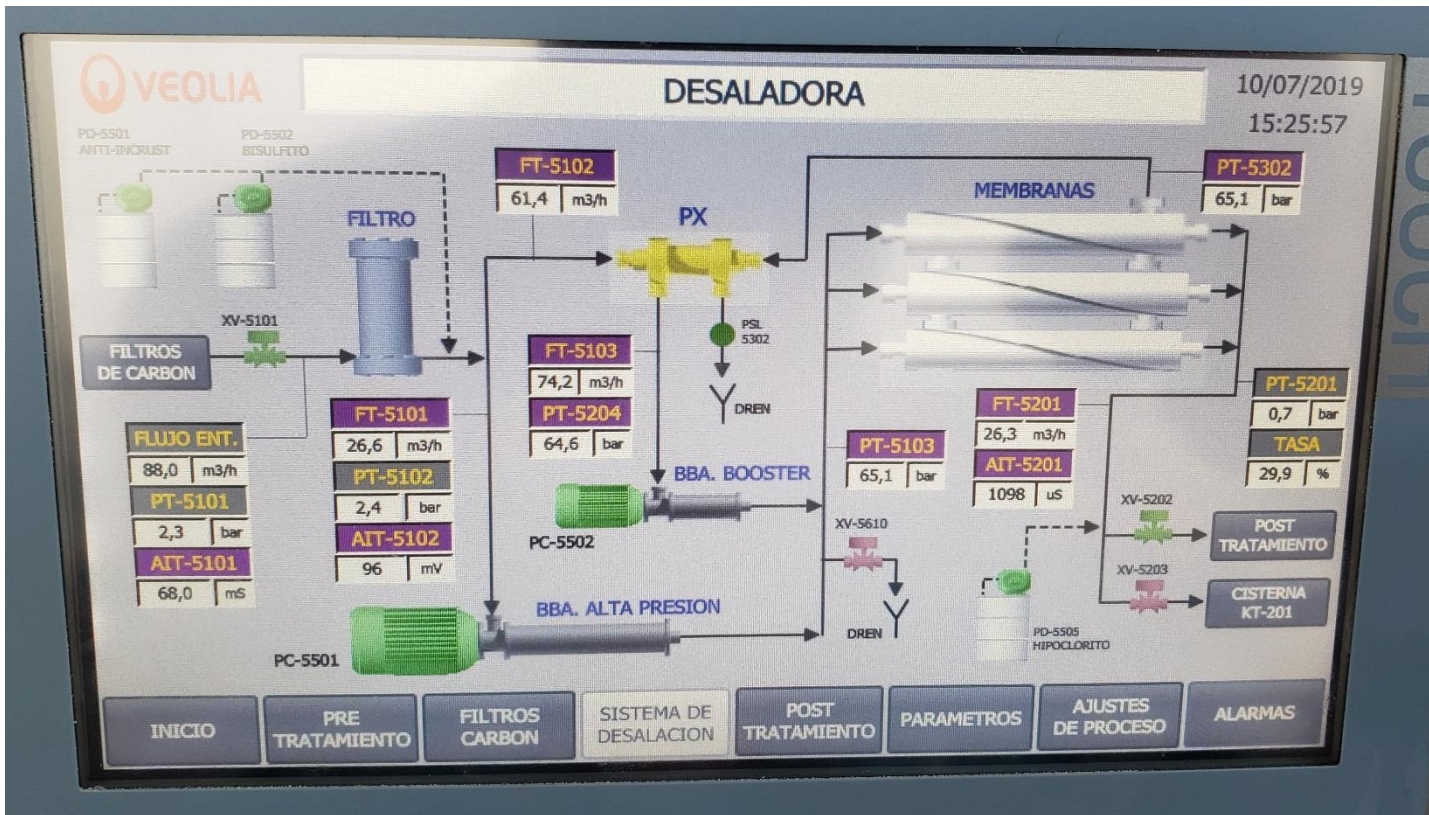
## Feed Water Chemistry

- Manganese
- Ammonia





# Commissioning, Test Run





## Opening Ceremony, Water Testing



## Lessons Learned

- Improve water quality on low income communities should come with education about water consumption and protection of water sources
- Investigate a better water source could help to obtain a better permeate quality and RO recovery
- Better water source improves pre-treatment operation and reduce chemical consumption
- In remote installations energy efficiency is important to reduce operational costs
- A remote installation requires planning ahead to get spare parts and chemicals timely





## SUMMARY

- Seawater desalination plant provided safe potable quality water for residents of Puna Island
- As the source water quality may fluctuates, the RO system design needs to be flexible to accommodate variations of the source water quality
- The island project has unique aspects and challenges for supply chemicals and consumables comparing to the mainland projects. The plant needs to be designed and operated with the minimal impact of the supplies from the mainland
- Future operators of the plant should be engaged with the project from the design phase practically and from the start of construction to allow learning plant operation from the inside