

Case Study: Oil & Gas Produced Water Reuse

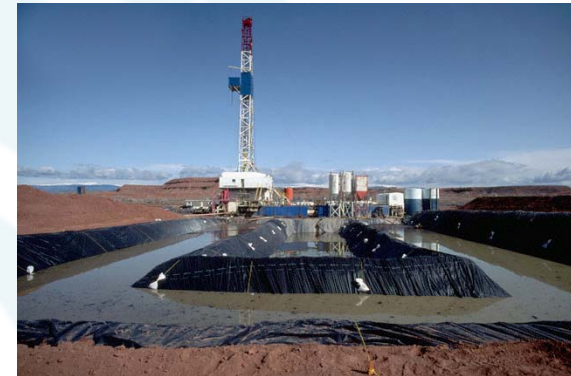
- Dozens of Haynesville and Eagle Ford Shale Projects completed since January 2010
- Range from 2000 bbls reclaimed up to 37,000 bbls reclaimed from a single drilling site



Recycling drilling wastewater for reuse as Completion Fluid

Case Study: Oil & Gas Produced Water Reuse (Cont.)

Analyte	ORIGINAL PIT H2O	Recycled H2O	units
Aluminum	47.0	1.01	mg/L
Antimony	ND	ND	mg/L
Arsenic	0.0471	ND	mg/L
Barium	7.05	ND	mg/L
Beryllium	ND	ND	mg/L
Boron	0.912	1.24	mg/L
Cadmium	ND	ND	mg/L
Calcium	133	61.0	mg/L
Chromium	0.106	ND	mg/L
Cobalt	0.0174	ND	mg/L
Copper	0.116	ND	mg/L
Iron	25.2	ND	mg/L
Lead	0.135	ND	mg/L
Lithium	0.0792	ND	mg/L
Magnesium	10.0	ND	mg/L
Manganese	0.472	ND	mg/L
Molybdenum	0.0887	ND	mg/L
Nickel	0.0384	ND	mg/L
Nitrate (As N)	ND	0.286	mg/L
Nitrite (as N)	ND	ND	mg/L
Phosphorus, Total	4.34	ND	mg/L
Potassium	16.5	5.29	mg/L
Selenium	ND	ND	mg/L
Silver	ND	ND	mg/L
Strontium	1.69	0.247	mg/L
Sulfate	10600	3840	mg/L
Thallium	ND	ND	mg/L
Tin	ND	ND	mg/L
Titanium	0.0748	ND	mg/L
Vanadium	0.0812	ND	mg/L
Zinc	0.188	ND	mg/L
Turbidity	1120	1.46	ntu
Total Suspended Solids	517	15.0	mg/L
Alkalinity, Total (As CaCO3)	500	30.2	mg/L
pH	7.36	7.08	Std Units
Organic Carbon, Total	57.9	1.64	mg/L
n-Hexane Extractable Material	ND	ND	mg/L
Total Dissolved Solids	3380	61300	mg/L
Sodium	553	30600	mg/L
Chloride	551	38700	mg/L



Only 100 Micron Filters for pretreatment
Direct Into OsmoBC™ FO System



Recovery of more than 80% wastewater for reuse

Case Study: Oil & Gas Produced Water Reuse (Cont.)

45% cost reduction

FO recycle process:

Drilling waste volume	25,000 bbl
FO Water recovery percentage	82 %
Water recovered / recycled	20,500 bbl
Total OPEX (under \$0.06 / gal - \$0.015/liter) equipment amortization overhead and profit)	\$ 50,548 (includes
Disposal and trucking of un-recoverable drilling waste (wastewater)	<u>\$ 16,962</u> \$3.76 bbl
Total FO recycle process cost	\$ 67,510 \$3.29 bbl (clean water)

Traditional disposal and fresh water process:

Fresh water acquisition and transportation	\$ 37,846 \$1.85 bbl (fresh water)
Disposal and trucking of drilling waste (wastewater)	<u>\$ 85,577</u> \$3.42 bbl
Total traditional process cost	\$123,423
Net cost savings	\$ 55,913