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Wisam M. Khadra[1,2], Pieter J. Stuyfzand[1,3], Ibrahim M. Khadra[4]

[1]Delft University of Technology, Dept. of Geoscience and Engineering, section Geo-environmental Engineering, P.O. Box 5048, 2600 GA Delft, Netherlands.
[2] American University of Beirut, Dept. of Geology, P.O. Box 11-0236, 1107 2020 Riad El-Solh Beirut, Lebanon.
[3] KWR Watercycle Research Institute, P.O. Box 1072, 3430 BB Nieuwegein, Netherlands.
[4] Northcentral University, Engineering and Technology Management, 10000 University Dr, Prescott Valley, AZ 86314, USA.

Table S1
Chemistry of groundwater extracted at well D5 (Damour aquifer – Lebanon) for both wet and dry seasons. The well is cased to 83 m below groundwater level (BGL), slotted between 13 and 74 m BGL, and pump installed at 34 m BGL. Fresh top water is selected based on samples collected in the very close vicinity at 4 m BGL. Reliable observations deeper than 35 m BGL are not available.

	Season (mg/L)		Freshwater on top (mg/L)
	Wet	***Dry***	
TDS	1094	1587	792
Cl	373	700	209
SO_4	58	84	66
HCO_3	307	260	261
NO_3	4.3	5.5	6.3
PO_4	0.1	0.1	0.1
Na	156	340	93
K	5.6	5.9	4.1
Ca	101	128	86
Mg	57	65	34
Fe	0.007	0.008	0.005
Mn	0.003	0.003	0.001
NH_4	0.065	0.065	0.065
SiO_2	9.0	10.9	8.9
Barium	0.032	0.032	0.027
Boron	0.107	0.176	0.061
Strontium	0.207	0.207	0.174
pH	7.2	7.5	7.18

Table S2
Rainfall data in the Damour area over a 10-year period, variable on monthly basis for the first year (based on year 2009 available data) and annually averaged for the remaining 9 years.

Rate (mm/yr)	Start Time (day)	Stop Time (day)
660	0	31
852	31	58
660	58	89
84	89	119
72	119	150
0	150	180
0	180	211
0	211	242
504	242	272

312	272	303
1176	303	333
1272	333	365
825	365	720
825	720	3650

Table S3
Detailed cost analysis of a HR-RO tandem plant for a total capacity of 400 m^3/d. Expansion of the system to higher volumes requires a series of the proposed skid design where the total cost is multiplied by the number of units involved.

Primary RO – Pass 1		**Secondary RO – Pass 2**		**RO Tandem**	
Unit set for economic evaluation	m³-m³/h-bar	Unit set for economic evaluation	m³-m³/h-bar	Unit set for economic evaluation	m³-m³/h-bar
System water production (m³/h)	11.8	System water production (m³/h)	3.5	System water production (m³/h)	15.3
System recovery (%)	71	System recovery (%)	72	System recovery (%)	92
Project Economic Variables		**Project Economic Variables**		**Project Economic Variables**	
Project Life (years)	10	Project Life (years)	10	Project Life (years)	10
Interest rate (%)	8	Interest rate (%)	8	Interest rate (%)	8
Power cost ($kWh)	0.17	Power cost ($kWh)	0.17	Power cost ($kWh)	0.17
Projection Results		**Projection Results**		**Projection Results**	
Pass 1 permeate production (m³/h)	11.8	Pass 2 permeate production (m³/h)	3.5	Tandem permeate production (m³/h)	15.3
Pass 1 feed pressure (bar)	17.2	Pass 2 feed pressure (bar)	17.2	Tandem feed pressure (bar)	17.3
Pass 1 concentrate pressure (bar)	12.2	Pass 2 concentrate pressure (bar)	13.5	Tandem concentrate pressure (bar)	12.6
Pass 1 recovery (%)	15.0	Pass 2 recovery (%)	15.0	Tandem recovery (%)	15.0
Pass 1 energy recovery efficiency (%)	50.0%	Pass 2 energy recovery efficiency (%)	50.0%	Tandem energy recovery efficiency (%)	50.0%
Capital Expense		**Capital Expense**		**Capital Expense**	
Pass 1 pressure vessels	5	Pass 2 pressure vessels	6	Tandem pressure vessels	11
Pressure vessel cost ($/vessel)	20,000	Pressure vessel cost ($/vessel)	20,000	Pressure vessel cost ($/vessel)	20,000
Pass 1 capital for pressure vessels	$100,000	Pass 2 capital for pressure vessels	$120,000	Tandem capital for pressure vessels	$220,000
Product	HSRO-390-FF	Product	LC LE-4040	Product	HSRO-390-FF + LC LE-4040
Pass 1 total elements	15	Pass 2 total elements	18	Tandem total elements	33
Element cost ($/element)	$10,000	Element cost ($/element)	$10,000	Element cost ($/element)	$10,000
Pass 1 capital for elements ($)	$150,000	Pass 2 capital for elements ($)	$180,000	Tandem capital for elements ($)	$330,000
Capital for pre-treatment ($)	$200,000			Pre-treatment capital	$200,000
Pass 1 capital ($)	$250,000	Pass 2 capital ($)	$300,000	Land acquisition [a] ($)	$0
Pass 1 capital($/m³)	$0.24	Pass 2 capital($/m³)	$0.98	Disposal pipelines ($)	$10,000
				Construction works ($)	$30,000
				HR-RO Tandem capital ($)	$790,000
				HR-RO Tandem capital($/m³)	$0.59
Operating Expense		**Operating Expense**		**Operating Expense**	
Power		**Power**		**Power**	
Pass 1 pumping power (kW)	11.9	Pass 2 pumping power (kW)	2.9	Tandem pumping power (kW)	9.2
Pass 1 pump specific energy (kWh/m³)	1.01	Pass 2 pump specific energy (kWh/m³)	0.83	Tandem pump specific energy (kWh/m³)	0.96
Brine energy recovery (kWh/m³)	-26.8	Brine energy recovery (kWh/m³)	-26.8	Brine energy recovery (kWh/m³)	-26.8
Pass 1 net energy consumption (KWh/m³)	1.01	Pass 2 net energy consumption (KWh/m³)	0.83	Tandem net energy consumption (KWh/m³)	0.96
Pass 1 net energy cost ($/year)	$1,063	Pass 2 net energy cost ($/year)	$259	Tandem net energy cost ($/year)	$1310

Energy expense NPV ($)	$7,133	Energy expense NPV ($)	$1,740	Energy expense NPV ($)	$8,792
Pass 1 energy expense ($/m³)	$0.17	Pass 2 energy expense ($/m³)	$0.14	Tandem energy expense ($/m³)	$0.16
Membrane cleaning		**Membrane cleaning**		**Membrane cleaning**	
Pass 1 cleaning frequency (cycle/year)	2	Pass 2 cleaning frequency (cycle/year)	4	Tandem cleaning frequency (cycle/year)	6
Pass 1 Cleaning expense ($/cycle)	$5,000	Pass 2 Cleaning expense ($/cycle)	$5,000	Tandem Cleaning expense ($/cycle)	$5,000
Pass 1 cleaning expense ($/year)	$10,000	Pass 1 cleaning expense ($/year)	$20,000	Tandem cleaning expense ($/year)	$30,500
Pass 1 cleaning expense NPV ($)	$67,101	Pass 2 cleaning expense NPV ($)	$134,201	Tandem cleaning expense NPV ($)	$204,657
Pass 1 cleaning expense ($/m³)	$0.01	Pass 2 cleaning expense ($/m³)	$0.07	Tandem cleaning expense ($/m³)	$0.02
Labor (for both passes 1 and 2)				**Labor**	
Full time employee (FTE)	1			Full time employee (FTE)	1
Salary for each FTE ($/year)	$7,200			Salary for each FTE ($/year)	$7,200
Total labor ($/year)	$7200			Total labor ($/year)	$7,200
Total labor NPV ($)	$48,313			Total labor NPV ($)	$48,313
Labor expense ($/m³)	$0.02			Labor expense ($/m³)	$0.01
Membrane replacement cost		**Membrane replacement cost**		**Membrane replacement cost**	
Pass 1 replacement rate (%/year)	10	Pass 2 replacement rate (%/year)	10	Tandem replacement rate (%/year)	10
Replacement price ($/element)	$10,000	Replacement price ($/element)	$10,000	Replacement price ($/element)	$10,000
Pass 1 replacement cost for elements ($/year)	$15,000	Pass 2 replacement cost for elements ($/year)	$18,000	Tandem replacement cost for elements ($/year)	$33,000
Pass 1 replacement membrane NPV ($)	$100,651	Pass 2 replacement membrane NPV ($)	$120,781	Tandem replacement membrane NPV ($)	$221,432
Pass 1 membrane replacement expense ($/m³)	$0.15	Pass 2 membrane replacement expense ($/m³)	$0.59	Tandem membrane replacement expense ($/m³)	$0.25
Pre-treatment elements replacement cost (for both passes 1 and 2)				**Pre-treatment elements replacement cost**	
Replacement cost ($/year)	$20,000			Replacement cost ($/year)	$20,000
Replacement cost NPV ($)	$134,202			Replacement cost NPV ($)	$134,202
Pre-treatment replacement expense ($/m³)	$0.19			Pre-treatment replacement expense ($/m³)	$0.15
				Water quality monitoring cost	
				Lab capital cost ($)	$5,000
				Full time employee (FTE) salary ($/year)	$7,200
				Consumable items ($/year)	$10,00
				Total monitoring ($/year)	$8,200
				Total monitoring NPV ($)	$60,023
				Water quality monitoring expense	$0.01
Operating expense subtotal		**Operating expense subtotal**		**Operating expense subtotal**	
Pass 1 operating expense NPV ($)	$223,197	Pass 2 operating expense NPV ($)	$256,723	Tandem operating expense NPV ($)	$539,862
Pass 1 operating expense per m³	$0.54	Pass 2 operating expense per m³	$0.79	Tandem operating expense per m³	$0.59
Pass 1 Total		**Pass 2 Total**		**Tandem Total**	
Pass 1 cost NPV ($)	$373,197	Pass 2 cost NPV ($)	$436,723	Tandem cost NPV ($)	$869,862
Life Cycle Cost ($/m³)	$0.36	Life Cycle Cost ($/m³)	$1.43	Life Cycle Cost ($/m³)	$0.65
Total System		**Total System**		**Total System**	
Capital	$250,000	Capital	$300,000	Capital	$790,000
Operating expense NPV ($)	$223,197	Operating expense NPV ($)	$256,723	Operating expense NPV ($)	$539,862
Cost of water NPV ($/m³)	$0.59	Cost of water NPV ($/m³)	$1.82	Cost of water NPV ($/m³)	$0.99

PV: The present value (*PV*) is the total amount that a series of future payments is worth now.

[a] *Land acquisition* is zero because the selected well (well D5 in the Damour aquifer – Lebanon) already owns enough space as part of its local territory.

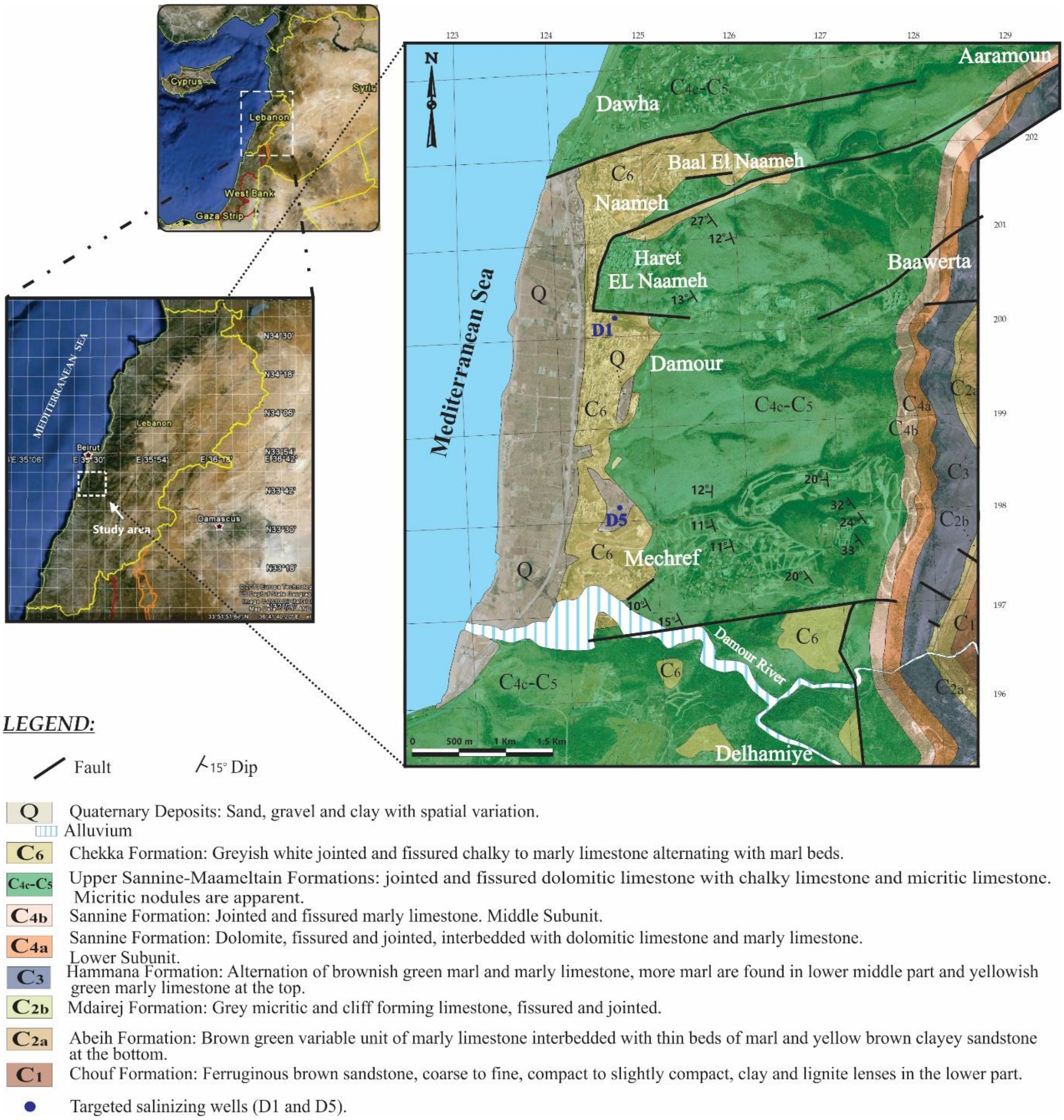

Fig. S1. Geological map of the Damour area (Khadra and Stuyfzand 2014).

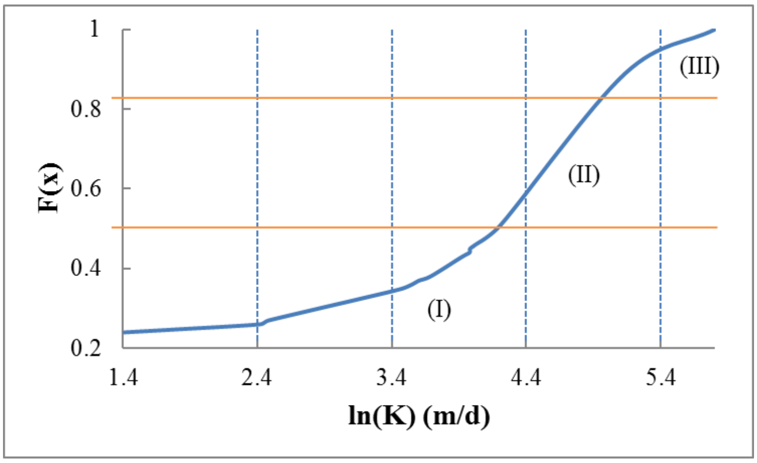

Fig. S2. Cumulative distribution function (CDF) of the Gaussian *ln(K)* distribution generated using a variance and mean of 85 m/d and 65 m/d, respectively. Values are sorted then discriminated into three zones (I, II and III), which are subsequently attributed to the corresponding lithofacies (higher values to more permeable lithofacies).