Supplementary Material

Salient Ingredients for Direct Water Reclamation from Treated Municipal Wastewater for Potable Reuse: Diepsloot Township Case Study

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Table S1. GPS coordinates of the sampling sites along the Jukskei River.

Location	Latitude	Longitude	NWWTW
Heron Bridge College	-25.9550	27.9626	Downstream
Lion Park Quarry	-25.9484	27.9492	Downstream
William Nicol South	-25.9815	28.0160	Upstream
Lonehill Main Road	-26.0095	28.0375	Upstream

Table S2. Groundwater quality in Nietgedacht, 7.1 km from NWWTW (Kruidenier, 2019).

Determinands	**SANS 241:2015**	**Borehole 1**	**Borehole 2**
NO_3-N (mg/L)	≤11	1.11	1.28
NH_3-N (mg/L)	≤1.5	0.024	0.039
Al (mg/L)	≤0.3	<0.002	<0.002
SO_4 (mg/L)	≤500	23.1	8.27
PO_4-P (mg/L)	NS	0.099	0.038
Na (mg/L)	≤200	20	17.8
Ca (mg/L)	≤150	18.1	23.7
F (mg/L)	≤1.5	<0.263	<0.263
Fe (mg/L)	≤2	<0.004	<0.004
Cl (mg/L)	≤300	6.06	5.18
Mg (mg/L)	≤70	5.88	10.9
Mn (mg/L)	≤400	0.003	0.035
K (mg/L)	≤50	4.79	3.05
E.coli (CFU/100mL)	0	<1	<1
Total coliforms (CFU/100mL)	<10	<1	<1
Conductivity (µs/cm)	≤170	229	254
pH	5-9.7	7.16	6.78
Total dissolved solids (mg/L @180 °C)	≤1200	138	158
Total alkalinity (mg $CaCO_3$/L)	NS	89.2	137
Total hardness (mg $CaCO_3$/L)	NS	69	104

Abbreviation: NS-not specified.

Table S3. Simulated water treatment plant flowsheet using wet season water quality data from NWWTW.

	Feed from the WWTW	Clarification (Sand Ballasted) 1	UF	RO	Feed the from groundwater	Clarification (Sand Ballasted) 2	Blended water	Disinfection	Treated water	SANS 241:2015
Flowrate (m^3/h)	333.34	330.02	310.19	263.68	1333.41	1320.09	1583.65	1583.77	1583.77	
Temperature (°C)	22.00	22.00	22.00	22.00	20.00	20.00	20.00	20.00	20.00	NS
pH	6.94	5.38	9.58	7.86	6.75	6.71	6.71	6.72	6.72	≥5 - ≤ 9
Conductivity (µS/cm)	772.00	820.25	952.94	12.06	246.00	247.00	208.00	208.00	208.00	≤ 1700
Turbidity (NTU)	**24.14**	0.00	0.00	0.00	NS	0.00	0.00	0.00	0.00	≤ 1
ORP (mV)	406.00	510.00	404.00	365.00	429.00	432.00	432.00	803.00	803.00	NS
TDS (mg/L)	20.00	23.00	26.00	0.00	209.00	211.00	176.00	176.00	176.00	≤ 1200
TSS (mg/L)	70.00	21.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NS
Alkalinity (mg $CaCO_3$/L)	0.00	0.00	3.00	0.00	87.00	85.00	71.00	71.00	71.00	NS
Al (mg/L as ion)	0.00	0.35	0.07	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0.3
NH_3 (mg/L as N)	0.00	0.00	0.00	0.00	0.04	0.04	0.03	0.03	0.03	≤ 1.5
As (mg/L as ion)	0.002	0.002	0.002	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0.01
Cd (mg/L as ion)	0.0001	0.0001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0.003
Ca (mg/L as ion)	0.00	0.00	0.00	0.00	23.70	23.70	19.75	19.75	19.75	≤ 150

Table S3. Simulated water treatment plant flowsheet using wet season water quality data from NWWTW continued.

	Feed from the WWTW	Clarification (Sand Ballasted) 1	UF	RO	Feed from the groundwater	Clarification (Sand Ballasted) 2	Blended water	Disinfection	Treated water	SANS 241:2015
Cl (mg/L as ion)	0.00	0.00	0.00	0.00	5.00	5.00	4.00	4.00	4.00	≤ 300
F (mg/L as ion)	0.40	0.40	0.40	0.00	0.26	0.26	0.22	0.22	0.22	≤ 1.5
Fe (mg/L as ion)	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0.3
Mg (mg/L as ion)	0.00	0.00	0.00	0.00	10.90	10.90	9.09	9.08	9.08	≤ 70
Mn (mg/L as ion)	0.09	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	≤ 0.1
NO_3 (mg/L as N)	4.20	4.20	4.20	0.01	1.28	1.28	1.07	1.07	1.07	≤ 11
NO_2 (mg/L as N)	**3.00**	3.00	3.00	0.01	0.00	0.00	0.00	0.00	0.00	≤ 0.9
P (mg/L as P)	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	NS
K (mg/L as ion)	0.00	0.00	0.00	0.00	5.00	5.00	4.00	4.00	4.00	≤ 50
Na (mg/L as ion)	12.00	12.00	14.00	0.00	6.00	6.00	5.00	5.00	5.00	≤ 200
SO_4 (mg/L as SO_4)	0.00	2.00	2.00	0.00	23.00	25.00	21.00	21.00	21.00	≤ 250
Zn (mg/L as ion)	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	≤ 5
Bacteria (CFU/100mL)	**2419.90**	7.65	0.00	0.00	**0.9**	0.00	0.00	0.00	0.00	0

Abbreviation: NS-not specified

Table S4. Simulated water treatment plant flowsheet using dry season water quality data from NWWTW effluent.

	Feed from the WWTW	Clarification (Sand Ballasted) 1	UF	RO	Feed the from groundwater	Clarification (Sand Ballasted) 2	Blended water	Disinfection	Treated water	SANS 241:2015
Flowrate (m^3/h)	333.32	330.00	310.17	263.66	1333.39	1320.06	1583.59	1583.71	1583.71	
Temperature (°C)	NS				20.00	20.00	20.00	20.00	20	NS
pH	NS				6.75	6.75	6.75	6.75	6.75	≥5 - ≤ 9
Conductivity (µS/cm)	NS				246.00	247.00	247.00	247.00	247.00	≤ 1700
ORP (mV)	377.00	490.00	646.00	472.00	431.00	433.00	433.00	805.00	806	NS
TDS (mg/L)	NS				209.00	211.00	176.00	176.00	176.00	NS
TSS (mg/L)	68.00	33.00	0.00	0.00	NS					NS
Alkalinity (mg $CaCO_3$/L)	NS				87.00	85.00	71.00	71.00	71.00	NS
NH_3 (mg/L as N)	**28.00**	28.00	28.00	0.62	0.04	0.04	0.14	0.14	0.14	≤ 1.5
Ca (mg/L as ion)	0.00	0.00	0.00	0.00	23.70	23.70	19.75	19.75	19.75	≤ 150
Cl (mg/L as ion)	2.00	2.00	2.00	0.00	5.00	5.00	4.00	4.00	4.00	≤ 300
F (mg/L as ion)	0.00	0.00	0.00	0.00	0.26	0.26	0.22	0.22	0.22	≤ 1.5
Mg (mg/L as ion)	0.00	0.00	0.00	0.00	10.90	10.90	9.09	9.08	9.08	≤ 70
Mn (mg/L as ion)	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	≤ 0.1
NO_3 (mg/L as N)	**13.00**	13.00	13.00	0.03	1.28	1.28	1.07	1.07	1.07	≤ 11
NO_2 (mg/L as N)	**20.00**	20.00	20.00	0.04	0.00	0.00	0.01	0.01	0.01	≤ 0.9
P (mg/L as P)	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	NS
K (mg/L as ion)	0.00	0.00	0.00	0.00	5.00	5.00	4.00	4.00	4.00	≤ 50
Na (mg/L as ion)	0.00	0.00	0.00	0.00	6.00	6.00	5.00	5.00	5.00	≤ 200
SO_4 (mg/L as SO4)	0.00	2.00	2.00	0.00	23.00	25.00	21.00	21.00	21.00	≤ 250
Bacteria	**1300.00**	4.11	0.00	0.00	**0.90**	0.00	0.00	0.00	0.00	0.00

Abbreviation: NS-not specified

Table S5. Simulated water treatment plant flowsheet using water quality data from Darvill WWTW effluent.

	Feed from the WWTW*	**Clarification (Sand Ballasted) 1**	**UF**	**RO**	**Feed from the groundwater#**	**Clarification (Sand Ballasted) 2**	**Blended water**	**Disinfection**	**Treated water**	**SANS 241:2015**
Flowrate (m^3/h)	333.34	328.35	303.69	258.15	1333.41	1313.42	1571.45	1572.51	1572.52	
pH	7.38	7.33	7.33	5.29	6.75	6.71	6.69	6.69	6.69	≥5 - ≤ 9
Conductivity (µS/cm)	480.00	485.00	485.00	7.00	246.00	247.00	208.00	208.00	208.00	≤ 1700
Turbidity (NTU)	**1.83**	0.00	0.00	0.00	NS	0.00	0.00	0.00	0.00	≤ 1
ORP (mV)	394.00	397.00	397.00	485.00	429.00	432.00	429.00	800.00	804.00	NS
TDS (mg/L)	0.00	0.00	0.00	0.00	209.00	211.00	176.00	176.00	176.00	≤ 1200
TSS (mg/L)	9.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NS
Alkalinity (mg $CaCO_3$/L)	90.00	89.00	89.00	0.00	87.00	85.00	71.00	71.00	71.00	NS
UV_{254} (cm^{-1})	0.09	0.09	0.05	0.00	0.00	0.00	0.00	0.00	0.00	NS
True colour (HU)	8.53	8.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	<15
NH_3 (mg/L as N)	**2.15**	2.15	2.15	0.06	0.04	0.04	0.04	0.04	0.04	≤ 1.5
Ca (mg/L as ion)	0.00	0.00	0.00	0.00	23.70	23.70	19.75	19.75	19.75	≤ 150
Cl (mg/L as ion)	0.00	0.00	0.00	0.00	5.00	5.00	4.00	4.00	4.00	≤ 300
F (mg/L as ion)	0.00	0.00	0.00	0.00	0.26	0.26	0.22	0.22	0.22	≤ 1.5
Mg (mg/L as ion)	0.00	0.00	0.00	0.00	10.90	10.90	9.09	9.08	9.08	≤ 70

Table S5. Simulated water treatment plant flowsheet using water quality data from Darvill WWTW effluent continued.

	Feed from the WWTW*	Clarification (Sand Ballasted) 1	UF	RO	Feed from the groundwater#	Clarification (Sand Ballasted) 2	Blended water	Disinfection	Treated water	SANS 241:2015
Mn (mg/L as ion)	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	≤ 0.1
Nitrate (mg/L as ion)	3.80	3.80	3.80	0.04	1.28	1.28	1.08	1.07	1.07	≤ 11
P (mg/L as ion)	1.31	0.85	0.85	0.00	0.04	0.00	0.00	0.00	0.00	NS
K (mg/L as ion)	0.00	0.00	0.00	0.00	5.00	5.00	4.00	4.00	4.00	≤ 50
Na (mg/L as ion)	0	0	0	0.00	6.00	6.00	5.00	5.00	5.00	≤ 200
SO_4 (mg/L as ion)	0.00	2.00	2.00	0.00	23.00	25.00	21.00	21.00	21.00	≤ 250
Crypto (oocysts/10L)	**4.00**	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0
Giardia (cysts/10L)	**235.00**	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0
Bacteria (CFU/100mL)	**3650.00**	11.54	0.00	0.00	**0.9**	0.00	0.00	0.00	0.00	≤ 0
Viruses (PFU/L)	793.00	7.93	0.03	0.00	0.00	0.00	0.00	0.00	0.00	NS

Abbreviation: NS-not specified, * Freese et al, 2002, #Kruidenier, 2019.

Table S6. Simulated water treatment plant flowsheet using water quality data from Mmabatho WWTW effluent.

	Feed from the WWTW*	Clarification (Sand Ballasted) 1	UF	RO	Feed the from groundwater#	Clarification (Sand Ballasted) 2	Blended water	Disinfection	Treated water	SANS 241:2015
Flowrate (m^3/hr)	333.32	330.00	310.17	263.68	1333.39	1320.06	1583.61	1583.73	1583.73	
Temperature (°C)	23.00	23.00	23.00	23.00	20.00	20.00	20.00	20.00	20.00	NS
pH	7.70	6.71	7.78	6.04	6.75	6.69	6.69	6.69	6.69	≥5 - ≤ 9
Conductivity (µS/cm)	1055.00	1064.00	1087.00	5.00	246.00	247.00	209.00	209.00	209.00	≤ 1700
ORP (mV)	377.00	435.00	627.00	473.00	431.00	433.00	433.00	805.00	806.00	NS
TDS (mg/L)	677.00	691.00	706.00	0.00	209.00	211.00	176.00	176.00	176.00	≤ 1200
Alkalinity (mg $CaCO_3$/L)	0.00	0.00	0.00	0.00	87.00	85.00	71.00	71.00	71.00	NS
NH_3 (mg/L as N)	0.00	0.00	0.00	0.00	0.04	0.04	0.03	0.03	0.03	≤ 1.5
As (mg/L as ion)	**0.17**	0.17	0.17	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0.01
Ca (mg/L as ion)	0.00	0.00	0.00	0.00	23.70	23.70	19.75	19.75	19.75	≤ 150
Cl (mg/L as ion)	0.00	0.00	0.00	0.00	5.00	5.00	4.00	4.00	4.00	≤ 300
Cu (mg/L as ion)	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	≤ 2
F (mg/L as ion)	0.00	0.00	0.00	0.00	0.26	0.26	0.22	0.22	0.22	≤ 1.5
Fe (mg/L as ion)	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0.3
Pb(mg/L as ion)	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	≤ 0.01

Table S6. Simulated water treatment plant flowsheet water quality data from Mmabatho WWTW effluent continued.

	Feed from the WWTW*	Clarification (Sand Ballasted) 1	UF	RO	Feed the from groundwater#	Clarification (Sand Ballasted) 2	Blended water	Disinfection	Treated water	SANS 241:2015
Mg (mg/L as ion)	0.00	0.00	0.00	0.00	10.90	10.90	9.09	9.08	9.08	≤ 70
Mn (mg/L as ion)	0.04	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	≤ 0.1
NO_3 (mg/L as ion)	**15.20**	15.20	15.20	0.03	1.28	1.28	1.07	1.07	1.07	≤ 11
P (mg/L as ion)	3.82	3.35	3.17	0.01	0.04	0.00	0.00	0.00	0.00	NS
K (mg/L as ion)	0.00	0.00	0.00	0.00	5.00	5.00	4.00	4.00	4.00	≤ 50
Na (mg/L as ion)	0.00	0.00	0.00	0.00	6.00	6.00	5.00	5.00	5.00	≤ 200
SO_4 (mg/L as ion)	0.00	2.00	2.00	0.00	23.00	25.00	21.00	21.00	21.00	≤ 250
Zn (mg/L as ion)	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	≤ 5
Bacteria (CFU/100mL)	**5900.00**	18.66	0.00	0.00	**0.9**	0.00	0.00	0.00	0.00	0

Abbreviation: NS-not specified, *Akoth, 2018, #Kruidenier, 2019.