

Raw Water

WCA Water Summary (by H. Corbin 97may28)					
Pretreatment and Reverse Osmosis Chemistry Estimates					
Note: Calc's based only for systems only as designed by WCA.					
		Rationalized		Sand	Polished
Parameter	Units	Raw Water	Reactor	Filtered	RO Feed
Temp	C/F	24	24	24	24
pH	S.U.	7.72	10.5	8	5.5
Cond	mmhos	6700			
TDS	mg/l	5160			
Ca	mg/l	125	75	75	75
Mg	mg/l	45	15	15	15
Na	mg/l	1405	1500	1500	1500
K	mg/l	30	30	30	30
Cl	mg/l	2226	2226	2226	2226
SO4	mg/l	285	285	370	400
HCO3	mg/l	200	0	35	0
CO3	mg/l	0	35	0	0
F	mg/l	0	0	0	0
PO4	mg/l	nil	nil	nil	nil
Mn	mg/l	0.02	0	0	0
Si	mg/l	85	35	35	35
As	mg/l	0.061	n.r.	n.r.	n.r.
Fe	mg/l	0.07	0	0	0
OH	mg/l	0	20	0	nil
CO2	mg/l	25	nil	nil	50
Ion Bal.	%Err	0%	0%	0%	0%
SDI	index	off scale	off scale	5	2
Cations	CaCO3	3599	3558	3558	3558
Anions	CaCO3	3599	3552	3552	3555

Raw Water

Daily Average Flows		<u>m3/hr</u>	<u>lbs/hr</u>		
Sys Conversion		45%			
Raw water:		118	260047		
Rxtr effluent:		117	257447		
Rxtr blowdown:		1	2600		
Filter Inlet:		117	257447		
Filter effluent:		113	249645		
Filter backwash:		4	7801		
RO inlet:		111	244444		
RO waste:		61	134444		
RO product:		50	110000		
<u>Pretreatment Chemical Estimates</u>					
	<u>mg/l</u>	<u>lbs/day</u>			
Lime	50	312	(100% basis)		
NaOH	165	1031	(100% basis)		
H2SO4	117	725	(100% basis)		

Filter Eff.

WCA Water Summary (by H. Corbin 97may28)					
Pretreatment and Reverse Osmosis Chemistry Estimates					
Note: Calc's based only for systems only as designed by WCA.					
<u>Parameter</u>	<u>Units</u>	<u>FILTER EFFLUENT</u>	conversion	<u>(Ionic Check)</u>	
			factor	ppm as CaCO3	
Temp	Deg. C	N/A		31 assumed	
pH	S.U.	9-9.5			
Cond	mmhos	9500			
TDS	mg/l	5500			
Ca	mg/l	150	2.5	375	
Mg	mg/l	50	4.12	206	
Na	mg/l	1755	2.18	3826	
K	mg/l	118	1.28	151	
Cl	mg/l	1680	1.41	2369	
SO4	mg/l	310	1.04	322	
HCO3	mg/l	50	0.82	41	
CO3	mg/l	50	1.67	84	
F	mg/l	0.9	2.66	2	
PO4	mg/l	nil	n/a		
Mn	mg/l	0	1.82	0	
Si	mg/l	25	n/a		
As	mg/l	0	n/a		
Fe	mg/l	0	n/a		
N-NH3	mg/l	nil	n/a		
NO3-N	mg/l	nil	n/a		
Ion Bal.	%	1%	n/a	21%	
Tot. Cations		n/a		4558	

Filter Eff.

Tot. Anions		n/a			2967
System Conversion Rate		50%			
Raw water flow:		200	m3/hr (daily average value)		
Clarifier effluent flow:		198	m3/hr (daily average value)		
Clarifier blowdown flow:		2	m3/hr (daily average value)		
Filter Inlet flow:		198	m3/hr (daily average value)		
Filter effluent flow:		192	m3/hr (daily average value)		
Filter backwash flow:		6	m3/hr (daily average value)		
RO 1st stage inlet flow:		210	m3/hr (daily average value)		
RO 1st stage waste flow:		92	m3/hr (daily average value)		
RO 1st stage product flow:		118	m3/hr (daily average value)		
RO 2nd stage inlet flow:		118	m3/hr (daily average value)		
RO 2nd stage recycle flow:		18	m3/hr (daily average value)		
RO 2nd stage product flow:		100	m3/hr (daily average value)		
H2SO4 to Filter Inlet:		26	mg/l (100% basis)		
Note: fed as 93% solution.		123	Kgm/day (100% basis)		

1st RO Inlet

WCA Water Summary (by H. Corbin 97may28)					
Pretreatment and Reverse Osmosis Chemistry Estimates					
Note: Calc's based only for systems only as designed by WCA.					
<u>Parameter</u>	<u>Units</u>	<u>1st Stage RO Inlet</u>	conversion	<u>(Ionic Check)</u>	
			factor	ppm as CaCO3	
Temp	Deg. C	N/A		31 assumed	
pH	S.U.	7			
Cond	mmhos	8762			
TDS	mg/l	5073			
Ca	mg/l	138	2.5	346	
Mg	mg/l	46	4.12	190	
Na	mg/l	1619	2.18	3529	
K	mg/l	109	1.28	139	
Cl	mg/l	1550	1.41	2185	
SO4	mg/l	286	1.04	297	
HCO3	mg/l	46	0.82	38	
CO3	mg/l	0	1.67	0	
F	mg/l	1	2.66	2	
PO4	mg/l	nil	n/a		
Mn	mg/l	0	1.82	0	
Si	mg/l	23	n/a		
As	mg/l	0	n/a		
Fe	mg/l	0	n/a		
N-NH3	mg/l	nil	n/a		
NO3-N	mg/l	nil	n/a		
Ion Bal.	%	1%	n/a	23%	
Tot. Cations		n/a		4204	

1st RO Inlet

Tot. Anions		n/a		2659
System Conversion Rate		50%		
Raw water flow:		200	m3/hr (daily average value)	
Clarifier effluent flow:		198	m3/hr (daily average value)	
Clarifier blowdown flow:		2	m3/hr (daily average value)	
Filter Inlet flow:		198	m3/hr (daily average value)	
Filter effluent flow:		192	m3/hr (daily average value)	
Filter backwash flow:		6	m3/hr (daily average value)	
RO 1st stage inlet flow:		210	m3/hr (daily average value)	
RO 1st stage waste flow:		92	m3/hr (daily average value)	
RO 1st stage product flow:		118	m3/hr (daily average value)	
RO 2nd stage inlet flow:		118	m3/hr (daily average value)	
RO 2nd stage recycle flow:		18	m3/hr (daily average value)	
RO 2nd stage product flow:		100	m3/hr (daily average value)	
H2SO4 to Filter Effluent:		150	mg/l (100% basis)	
Note: fed as 93% solution.		721	Kgm/day (100% basis)	

1st RO Product

WCA Water Summary (by H. Corbin 97may28)					
Pretreatment and Reverse Osmosis Chemistry Estimates					
Note: Calc's based only for systems only as designed by WCA.					
<u>Parameter</u>	<u>Units</u>	<u>1st Stage RO Product</u>	conversion	(Ionic Check)	
			factor	ppm as CaCO3	
Temp	Deg. C	N/A		31 assumed	
pH	S.U.	5			
Cond	mmhos	175			
TDS	mg/l	101			
Ca	mg/l	3	2.5	7	
Mg	mg/l	1	4.12	4	
Na	mg/l	48	2.18	105	
K	mg/l	4	1.28	5	
Cl	mg/l	54	1.41	76	
SO4	mg/l	6	1.04	6	
HCO3	mg/l	2	0.82	1	
CO3	mg/l	0	1.67	0	
F	mg/l	0	2.66	0	
PO4	mg/l	nil	n/a		
Mn	mg/l	0	1.82	0	
Si	mg/l	1	n/a		
As	mg/l	0	n/a		
Fe	mg/l	0	n/a		
N-NH3	mg/l	nil	n/a		
NO3-N	mg/l	nil	n/a		
Ion Bal.	%	1%	n/a	15%	
Tot. Cations		n/a		121	

1st RO Product

Tot. Anions			n/a			89
System Conversion Rate			50%			
Raw water flow:			200	m3/hr (daily average value)		
Clarifier effluent flow:			198	m3/hr (daily average value)		
Clarifier blowdown flow:			2	m3/hr (daily average value)		
Filter Inlet flow:			198	m3/hr (daily average value)		
Filter effluent flow:			192	m3/hr (daily average value)		
Filter backwash flow:			6	m3/hr (daily average value)		
RO 1st stage inlet flow:			210	m3/hr (daily average value)		
RO 1st stage waste flow:			92	m3/hr (daily average value)		
RO 1st stage product flow:			118	m3/hr (daily average value)		
RO 2nd stage inlet flow:			118	m3/hr (daily average value)		
RO 2nd stage recycle flow:			18	m3/hr (daily average value)		
RO 2nd stage product flow:			100	m3/hr (daily average value)		
Divalent Rejection			98%			
Monovalent Rejection			97%			

1st RO Reject

WCA Water Summary (by H. Corbin 97may28)					
Pretreatment and Reverse Osmosis Chemistry Estimates					
Note: Calc's based only for systems only as designed by WCA.					
<u>Parameter</u>	<u>Units</u>	<u>1st Stage RO Reject</u>		conversion	(Ionic Check)
				factor	ppm as CaCO3
Temp	Deg. C	N/A			31 assumed
pH	S.U.	7.3			
Cond	mmhos	19968			
TDS	mg/l	11560			
Ca	mg/l	315		2.5	788
Mg	mg/l	105		4.12	433
Na	mg/l	3689		2.18	8041
K	mg/l	248		1.28	317
Cl	mg/l	3531		1.41	4979
SO4	mg/l	652		1.04	678
HCO3	mg/l	105		0.82	86
CO3	mg/l	0		1.67	0
F	mg/l	1		2.66	2
PO4	mg/l	nil		n/a	
Mn	mg/l	0		1.82	0
Si	mg/l	53		n/a	
As	mg/l	0		n/a	
Fe	mg/l	0		n/a	
N-NH3	mg/l	nil		n/a	
NO3-N	mg/l	nil		n/a	
Ion Bal.	%	1%		n/a	23%
Tot. Cations		n/a			9580

1st RO Reject

Tot. Anions			n/a			6060
System Conversion Rate			50%			
Raw water flow:			200	m3/hr (daily average value)		
Clarifier effluent flow:			198	m3/hr (daily average value)		
Clarifier blowdown flow:			2	m3/hr (daily average value)		
Filter Inlet flow:			198	m3/hr (daily average value)		
Filter effluent flow:			192	m3/hr (daily average value)		
Filter backwash flow:			6	m3/hr (daily average value)		
RO 1st stage inlet flow:			210	m3/hr (daily average value)		
RO 1st stage waste flow:			92	m3/hr (daily average value)		
RO 1st stage product flow:			118	m3/hr (daily average value)		
RO 2nd stage inlet flow:			118	m3/hr (daily average value)		
RO 2nd stage recycle flow:			18	m3/hr (daily average value)		
RO 2nd stage product flow:			100	m3/hr (daily average value)		
1st RO Concentration Ratio:			228%			

2nd RO Product

WCA Water Summary (by H. Corbin 97may28)						
Pretreatment and Reverse Osmosis Chemistry Estimates						
Note: Calc's based only for systems only as designed by WCA.						
Parameter	Units	2nd Stage RO Effluent		conversion factor	(Ionic Check) ppm as CaCO3	
Temp	Deg. C	100			31 assumed	
pH	S.U.	4.5				
Cond	mmhos	7				
TDS	mg/l	4				
Ca	mg/l	0		2.5	0	
Mg	mg/l	0		4.12	0	
Na	mg/l	2		2.18	4	
K	mg/l	0		1.28	0	
Cl	mg/l	2		1.41	3	
SO4	mg/l	0		1.04	0	
HCO3	mg/l	0		0.82	0	
CO3	mg/l	0		1.67	0	
F	mg/l	0		2.66	0	
PO4	mg/l	nil		n/a		
Mn	mg/l	0		1.82	0	
Si	mg/l	0		n/a		
As	mg/l	0		n/a		
Fe	mg/l	0		n/a		
N-NH3	mg/l	nil		n/a		
NO3-N	mg/l	nil		n/a		
Ion Bal.	%	1%		n/a	15%	
Tot. Cations		n/a			5	

2nd RO Product

Tot. Anions			n/a			4
System Conversion Rate			50%			
Raw water flow:			200	m3/hr (daily average value)		
Clarifier effluent flow:			198	m3/hr (daily average value)		
Clarifier blowdown flow:			2	m3/hr (daily average value)		
Filter Inlet flow:			198	m3/hr (daily average value)		
Filter effluent flow:			192	m3/hr (daily average value)		
Filter backwash flow:			6	m3/hr (daily average value)		
RO 1st stage inlet flow:			210	m3/hr (daily average value)		
RO 1st stage waste flow:			92	m3/hr (daily average value)		
RO 1st stage product flow:			118	m3/hr (daily average value)		
RO 2nd stage inlet flow:			118	m3/hr (daily average value)		
RO 2nd stage recycle flow:			18	m3/hr (daily average value)		
RO 2nd stage product flow:			100	m3/hr (daily average value)		
Divalent Rejection			99%			
Monovalent Rejection			96%			

2nd RO Recycle

WCA Water Summary (by H. Corbin 97may28)					
Pretreatment and Reverse Osmosis Chemistry Estimates					
Note: Calc's based only for systems only as designed by WCA.					
<u>Parameter</u>	<u>Units</u>	<u>2nd Stage RO Recycle</u>	conversion	(Ionic Check)	
			factor	ppm as CaCO3	
Temp	Deg. C	N/A		31 assumed	
pH	S.U.	5.5			
Cond	mmhos	1168			
TDS	mg/l	676			
Ca	mg/l	18	2.5	46	
Mg	mg/l	6	4.12	25	
Na	mg/l	321	2.18	700	
K	mg/l	25	1.28	33	
Cl	mg/l	362	1.41	510	
SO4	mg/l	38	1.04	40	
HCO3	mg/l	2	0.82	1	
CO3	mg/l	0	1.67	0	
F	mg/l	0	2.66	0	
PO4	mg/l	nil	n/a		
Mn	mg/l	0	1.82	0	
Si	mg/l	5	n/a		
As	mg/l	0	n/a		
Fe	mg/l	0	n/a		
N-NH3	mg/l	nil	n/a		
NO3-N	mg/l	nil	n/a		
Ion Bal.	%	1%	n/a	16%	
Tot. Cations		n/a		804	

2nd RO Recycle

Tot. Anions			n/a			583
System Conversion Rate			50%			
Raw water flow:			200	m3/hr (daily average value)		
Clarifier effluent flow:			198	m3/hr (daily average value)		
Clarifier blowdown flow:			2	m3/hr (daily average value)		
Filter Inlet flow:			198	m3/hr (daily average value)		
Filter effluent flow:			192	m3/hr (daily average value)		
Filter backwash flow:			6	m3/hr (daily average value)		
RO 1st stage inlet flow:			210	m3/hr (daily average value)		
RO 1st stage waste flow:			92	m3/hr (daily average value)		
RO 1st stage product flow:			118	m3/hr (daily average value)		
RO 2nd stage inlet flow:			118	m3/hr (daily average value)		
RO 2nd stage recycle flow:			18	m3/hr (daily average value)		
RO 2nd stage product flow:			100	m3/hr (daily average value)		
2nd RO Concentration Ratio:			667%			

Summary

WCA Water Summary (by H. Corbin 97may28)									
Pretreatment and Reverse Osmosis Chemistry Estimates									
Note: Calc's based only for systems only as designed by WCA.									
Summary: Worst Case analysis shows that system will reliably achieve the required product water quality and quantity when using the Well MER-24 as raw water and when operating the system at an overall water recovery of 50% .									
Chemical consumption is calculated on a maximum basis and assumes 100% on line time .									
This is summarized below (actual on line time and chemical consumption are expected to be lower):									
With the better quality raw water from the wellfield, chemical consumption may be lowered by as much as 60% and the system water recovery may be adjusted to as high as 75%.									
In all cases, the product quality and the production rate will be achieved.									
Pretreatment maximum									
Worst Case Chemicals:									
		<u>Kgm/day</u>		<u>Kgm/yr.</u>					
	Caustic Soda:	117		42,849					
	H2SO4:	843		307,740					
<u>RO membrane Cleaning Chemicals:</u>									
With (MER-24) raw water, expect to clean the membranes 3-4 times per year at a chemical cost of approximately \$10-15,000/yr for chemicals (depending on fouling mode and contaminate type).									
<u>RO anti-scalant chemical:</u>									
Add 5 ppm (shipped in 55 gal drum, about 3 drums per month), approximately \$25,000 per year.									