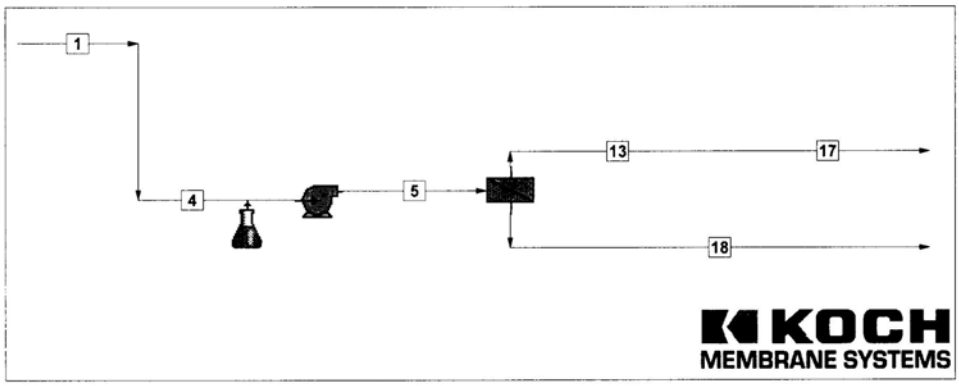
Appendix C – Initial RO Projection

Project: BVWSD
Prepared By: aeg

Description: Initial RO Projection
Type: Single Pass Design

PROJECT SUMMARY

PROCESS FLOW DIAGRAM



RO Recovery [13/4] = 70.0%
Design Temperature = 77.0 Deg F

Overall System Rec [17/(4+15)] = 70.0%

PASS 1
Array Recovery [13/4] = = 70.0%
Element Age = 0.00 Years
Fouling Allowance (FA) = 0.0%

Bank	Element Type	Tubes /Bank	Elems /Tube	Avg Flux (GFD)
1	TFC 4820HR	2	6	15.6
2	TFC 4821ULP	1	6	11.5
System/Pass Total				14.2

Stream	Pressure with FA (Psig)	Flow Rate (USGPM)	TDS 180C (mg/L)	Hardness (CaCO3)	Chloride (mg/L)
1	0.0	20.0	5947.65	2036.2	2364.0
4	0.0	20.0	5947.65	2036.2	2364.0
5	217.5	20.0	5969.09	2036.2	2364.0
13	0.0	14.0	228.51	33.5	110.6
17	0.0	14.0	228.51	33.5	110.6
18	186.2	6.0	19363.89	6709.1	7621.9

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ARRAY SUMMARY - PASS 1

Permeate Flow	14.0 USGPM	Temp (Design/Avg)	77.0/ 77.0 Deg F
Pass Recovery	70.0 %	Fouling Allowance (FA)	0.0 %
Inlet Pres w/o FA	217.5 Psig	Conc. Pres w/o FA	186.2 Psig
Inlet Pres w/FA	217.5 Psig		

Bank	Element Type	Tubes /Bank (#)	Elems /Tube (#)	Elems /Bank (#)	Elem Age (Yr)	Boost Pressure (Psig)	Manifold Loss (Psig)	Perm Back Pressure (Psig)
1	TFC 4820HR	2	6	12	0.00	0.0	0.0	10.0
2	TFC 4821ULP	1	6	6	0.00	0.0	0.0	0.0

Bank	Total Feed (GPM)	Tube Feed (GPM)	Total Conc. (GPM)	Tube Conc. (GPM)	Avg Flux (GFD)	Inlet Pres (Psig)	Avg NDP (Psig)	Bank DP (Psig)	Final Element Beta
1	20.0	10.0	9.9	4.9	15.6	217.5	121.5	13.4	1.080
2	9.9	9.9	6.0	6.0	11.5	204.0	62.9	17.8	1.039
System					14.2				

Stream Number	Net Feed 4	RO Inlet 5	Conc. 18	Permeate 13
Concentration	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Ca++	675.00	675.00	2224.06	11.12
Mg++	85.13	85.13	280.50	1.40
Na+	1327.00	1327.00	4252.88	73.05
K+	4.07	4.07	12.92	0.28
NH4+	0.10	0.10	0.30	0.01
Sr++	6.22	6.22	20.49	0.10
Ba++	0.15	0.15	0.49	0.00
Fe++	0.45	0.45	1.48	0.01
Mn++	1.00	1.00	3.29	0.02
CO3--	0.00	0.13	0.42	0.00
HCO3-	292.00	220.02	691.59	18.04
SO4--	1303.00	1359.66	4484.91	20.27
Cl-	2364.00	2364.00	7621.86	110.63
NO3-	7.68	7.68	22.61	1.28
F-	1.53	1.53	5.00	0.04
SiO2	28.90	28.90	92.98	1.44
CO2	4.74	56.60	56.60	56.52
Sum of Ions	6096.23	6081.04	19715.79	237.69
TDS (180 C)	5947.65	5969.09	19363.89	228.51
pH	8.00	6.80	7.30	5.71
Hardness (as CaCO3)	2036.22	2036.22	6709.15	33.54
Osm Pressure (Psig)	51.62	51.35	165.68	2.35
Langlier Index	1.76	0.43	1.94	-3.65
Stiff-Davis Index	1.32	0.00	1.02	---

Membrane data file version: Jul-27-2001
Please review the Design Notes & Warnings page attached.
Concentrate exceeds solubility limit - see warnings sheet.

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CHEMICAL ADDITION

14.9 lb/day of 93.2% Sulfuric Acid (H_2SO_4) is required to achieve the target pH in stream [5].

CONCENTRATE SATURATION DATA - STREAM 18

Langlier Index	=	1.937	<== Warning: Scaling Potential
Stiff-Davis Index	=	1.017	<== Warning: Scaling Potential
Ratio [Ca][SO4] to Ksp(CaSO4)	=	2.69	<== Warning!
Ratio [Ca][F]^2 to Ksp(CaF2)	=	1.69	<== Warning!
Ratio [Ba][SO4] to Ksp(BaSO4)	=	41.88	<== Warning!
Ratio [Sr][SO4] to Ksp(SrSO4)	=	1.10	<== Warning!

DESIGN WARNINGS - PASS 1: None

APPROXIMATE PUMPING POWER REQUIREMENTS (kW)

Feed pumping power (w/FA) @65.0% efficiency	2.91
Interbank pumping power @65.0% efficiency	0.00

NOTE

This projection is the anticipated performance and is based on nominal properties of the elements, with manifold losses as included.

The fouling allowance option (if included) increases the required 'clean water' net driving pressure by the stated percentage. Program default values are estimates only, and may not be representative of the actual fouling potential of the water source.

This software is provided by Koch Membrane Systems, Inc as a service. The projections are based upon input by the User, and assume that sound engineering principles and practices have been followed.

This printout should not be considered a warranty or guarantee unless accompanied by a statement to that effect from Koch Membrane Systems, Inc.

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FEED STREAM SUMMARY

Stream	Name	Type	Percent of Total	Stream Flow Rate (USGPM)	Temperature Design (Deg F)	Temperature Average (Deg F)
1	Feed 1	Brackish Wel	100.0	20	77.0	77.0
2	Feed 2	Other	0.0	0	77.0	77.0
3	Feed 3	Other	0.0	0	77.0	77.0
4	Net Feed	Other	100.0	20	77.0	77.0
5	Treated Feed	Other	100.0	20	77.0	77.0

CHEMICAL ADDITION

To achieve the target pH in stream [5], 14.9 lb/day of 93.2% Sulfuric Acid (H2SO4) is required.

FEED STREAM COMPOSITIONS

Stream Number	1	2	3	4	5
Concentration	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Ca++	675.00	0.00	0.00	675.00	675.00
Mg++	85.13	0.00	0.00	85.13	85.13
Na+	1327.00	0.00	0.00	1327.00	1327.00
K+	4.07	0.00	0.00	4.07	4.07
NH4+	0.10	0.00	0.00	0.10	0.10
Sr++	6.22	0.00	0.00	6.22	6.22
Ba++	0.15	0.00	0.00	0.15	0.15
Fe++	0.45	0.00	0.00	0.45	0.45
Mn++	1.00	0.00	0.00	1.00	1.00
CO3--	0.00	0.00	0.00	0.00	0.13
HCO3-	292.00	0.00	0.00	292.00	220.02
SO4--	1303.00	0.00	0.00	1303.00	1359.66
Cl-	2364.00	0.00	0.00	2364.00	2364.00
NO3-	7.68	0.00	0.00	7.68	7.68
F-	1.53	0.00	0.00	1.53	1.53
SiO2	28.90	0.00	0.00	28.90	28.90
CO2	4.74	0.00	0.00	4.74	56.60
Sum of Ions	6096.23	0.00	0.00	6096.23	6081.04
TDS (180 C)	5947.65	0.00	0.00	5947.65	5969.09
pH	8.00	7.00	7.00	8.00	6.80
Hardness (as CaCO3)	2036.22	0.00	0.00	2036.22	2036.22
Osm Pressure (Psig)	51.62	0.00	0.00	51.62	51.35
Langlier Index	1.76	-7.00	-7.00	1.76	0.43
Stiff-Davis Index	1.32	---	---	1.32	0.00

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BYPASS STREAM SUMMARY

Stream	Name	Type	Percent of Total	Stream Flow Rate (USGPM)	Temperature Design (Deg F)	Temperature Average (Deg F)
1A	Feed 1 Bypass	Brackish Wel	---	0	77.0	77.0
2A	Feed 2 Bypass	Other	---	0	77.0	77.0
3A	Feed 3 Bypass	Other	---	0	77.0	77.0
15	Feed Bypass	Other	---	0	77.0	77.0

BYPASS STREAM COMPOSITIONS

Stream Number	1A	2A	3A	15
Concentration	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Ca++	675.00	0.00	0.00	0.00
Mg++	85.13	0.00	0.00	0.00
Na+	1327.00	0.00	0.00	0.00
K+	4.07	0.00	0.00	0.00
NH4+	0.10	0.00	0.00	0.00
Sr++	6.22	0.00	0.00	0.00
Ba++	0.15	0.00	0.00	0.00
Fe++	0.45	0.00	0.00	0.00
Mn++	1.00	0.00	0.00	0.00
CO3--	0.00	0.00	0.00	0.00
HCO3-	292.00	0.00	0.00	0.00
SO4--	1303.00	0.00	0.00	0.00
Cl-	2364.00	0.00	0.00	0.00
NO3-	7.68	0.00	0.00	0.00
F-	1.53	0.00	0.00	0.00
SiO2	28.90	0.00	0.00	0.00
CO2	4.74	0.00	0.00	0.00
Sum of Ions	6096.23	0.00	0.00	0.00
TDS (180 C)	5947.65	0.00	0.00	0.00
pH	8.00	7.00	7.00	7.00
Hardness (as CaCO3)	2036.22	0.00	0.00	0.00
Osm Pressure (Psig)	51.62	0.00	0.00	0.00
Langlier Index	1.76	-7.00	-7.00	-7.00
Stiff-Davis Index	1.32	---	---	---

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PRODUCT STREAM SUMMARY

Stream	Name	Stream Flow Rate (USGPM)	Temperature Design (Deg F)	Temperature Average (Deg F)
13	Permeate	14	77.0	77.0
14	Stripped Permeat	14	77.0	77.0
15	Feed Bypass	0	77.0	77.0
16	Blended Product	14	77.0	77.0
17	Treated Product	14	77.0	77.0

CHEMICAL ADDITION

No Chemical Treating

PRODUCT STREAM COMPOSITIONS

Stream Number	13	14	15	16	17
Concentration	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Ca++	11.12	11.12	0.00	11.12	11.12
Mg++	1.40	1.40	0.00	1.40	1.40
Na+	73.05	73.05	0.00	73.05	73.05
K+	0.28	0.28	0.00	0.28	0.28
NH4+	0.01	0.01	0.00	0.01	0.01
Sr++	0.10	0.10	0.00	0.10	0.10
Ba++	0.00	0.00	0.00	0.00	0.00
Fe++	0.01	0.01	0.00	0.01	0.01
Mn++	0.02	0.02	0.00	0.02	0.02
CO3--	0.00	0.00	0.00	0.00	0.00
HCO3-	18.04	18.04	0.00	18.04	18.04
SO4--	20.27	20.27	0.00	20.27	20.27
Cl-	110.63	110.63	0.00	110.63	110.63
NO3-	1.28	1.28	0.00	1.28	1.28
F-	0.04	0.04	0.00	0.04	0.04
SiO2	1.44	1.44	0.00	1.44	1.44
CO2	56.52	56.52	0.00	56.52	56.52
Sum of Ions	237.69	237.69	0.00	237.69	237.69
TDS (180 C)	228.51	228.51	0.00	228.51	228.51
pH	5.71	5.71	7.00	5.71	5.71
Hardness (as CaCO3)	33.54	33.54	0.00	33.54	33.54
Osm Pressure (Psig)	2.35	2.35	0.00	2.35	2.35
Langlier Index	-3.65	-3.65	-7.00	-3.65	-3.65
Stiff-Davis Index	---	---	---	---	---

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ELEMENT BY ELEMENT DATA - PASS 1

Bank	Element	Inlet Pressure (Psig)	Diff Pressure (Psig)	NDP (Psig)	Element Flux GFD	m Value	Beta	Permeate TDS (mg/L)
1	1	217.5	3.3	148.5	19.5	-0.022	1.075	44.2
1	2	214.1	2.8	138.5	18.0	-0.022	1.078	54.3
1	3	211.3	2.4	128.0	16.5	-0.022	1.080	67.7
1	4	209.0	2.0	116.8	14.9	-0.022	1.082	86.1
1	5	207.0	1.6	104.9	13.2	-0.022	1.082	111.8
1	6	205.4	1.4	92.4	11.4	-0.022	1.080	148.3
	Avg			121.5	15.6	-0.022	1.079	85.4
2	1	204.0	4.1	90.9	17.9	-0.022	1.072	316.4
2	2	200.0	3.5	77.4	14.8	-0.022	1.066	433.2
2	3	196.5	3.0	65.4	12.1	-0.022	1.059	594.1
2	4	193.4	2.7	55.3	9.8	-0.021	1.052	808.6
2	5	190.8	2.4	47.2	7.9	-0.021	1.045	1085.2
2	6	188.4	2.2	41.3	6.4	-0.021	1.039	1424.1
	Avg			62.9	11.5	-0.022	1.056	776.9