

Prepared by:  
 George Butler Associates, Inc.  
 8207 Melrose Drive  
 Lenexa, Kansas

## System Curve Calculations DW - Two Pumps

Prepared for:  
 City of Harrisonville, MO

Project Name: <b>Harrisonville Pump Station to WWTP</b>												Prepared By: SCK	
												Date: 1/30/2001	
<b>HEAD LOSS DETERMINATION -</b>													
System Curve from PS to WWTP (Two Dry Weather)													
<b>Section 1</b>	Discharge from pump to 8/12" increaser elbow						<b>Section 5</b>						
<b>Section 2</b>	From 8/12" increaser elbow to 12" header						<b>Section 6</b>						
<b>Section 3</b>	From 12" header to discharge at treatment plant						<b>Section 7</b>						
<b>Section 4</b>													
<b>Water Elevation in Wet Well:</b>	848.5 (Pump off elevation)						<b>Normal Absolute Pressure on Liquid Surface (ft.):</b>						33.0792
<b>FM Discharge Elevation:</b>	868.5						<b>Vapor Pressure of Liquid (ft.):</b>						0.783
<b>Total Static Head (ft.):</b>	20						<b>Center Line of Volute Elevation:</b>						844.3
							<b>Static Suction Head (ft.):</b>						4.2
	<b>Section 1</b>		<b>Section 2</b>		<b>Section 3</b>		<b>Section 4</b>		<b>Section 5</b>		<b>Section 6</b>		
<b>Kinematic Viscosity (ft<sup>2</sup>/sec)</b>	1.22E-05		1.22E-05		1.22E-05		1.22E-05		1.22E-05		1.22E-05		
<b>Absolute Roughness (in)</b>	0.0015		0.0015		0.0075								
<b>True Pipe Diameter (in)</b>	8.3		12.39		12.12								
<b>Roughness/Diameter</b>	0.000180723		0.00012107		0.0006188		#DIV/0!		#DIV/0!		#DIV/0!		
<b>Nominal Pipe Diameter (in)</b>	8.00		12.00		12.00								
<b>Area of Pipe (ft<sup>2</sup>)</b>	0.38		0.84		0.80		0.00		0.00		0.00		
<b>Length Of Pipe (ft)</b>	14.00		85.00		880.00								
	Quantity		Eq Length		Quantity		Eq Length		Quantity		Eq Length		
<b>Fitting or Valve</b>													
Angle Valve	0.00		0.00		0.00		0.00		0.00		0.00		
Swing Check Valve	0.00		1.00 49.70		0.00		0.00		0.00		0.00		
Gate Valve Wide Open	0.00		0.00		0.00		0.00		0.00		0.00		
Plug Valve	0.00		2.00 80.00		0.00		0.00		0.00		0.00		
Butterfly Valve	0.00		0.00		0.00		0.00		0.00		0.00		
Globe Valve	0.00		0.00		0.00		0.00		0.00		0.00		
Standard Elbow	2.00 40.00		1.00 29.80		0.00		0.00		0.00		0.00		
Long Swing Elbow	0.00		0.00		0.00		0.00		0.00		0.00		
45 Degree Elbow	0.00		0.00		8.00 127.20		0.00		0.00		0.00		
22.5 Degree Bend	0.00		2.00 16.92		0.00		0.00		0.00		0.00		
Flow Through Tee	0.00		0.00		0.00		0.00		0.00		0.00		
Branch Tee	0.00		2.00 119.40		0.00		0.00		0.00		0.00		
<b>Sudden Contraction</b>													
d/D = 0.25	0.00		0.00		0.00		0.00		0.00		0.00		
d/D = 0.50	0.00		0.00		0.00		0.00		0.00		0.00		
d/D = 0.75	0.00		0.00		0.00		0.00		0.00		0.00		
<b>Sudden Enlargement</b>													
d/D = 0.25	0.00		0.00		0.00		0.00		0.00		0.00		
d/D = 0.50	1.00 26.67		0.00		0.00		0.00		0.00		0.00		
d/D = 0.75	0.00		0.00		0.00		0.00		0.00		0.00		
<b>Total Eq. Length</b>	<b>80.67</b>		<b>380.82</b>		<b>1007.20</b>		<b>0.00</b>		<b>0.00</b>		<b>0.00</b>		

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	Section 1					Section 2					Section 3				
Q (gpm)	Q1(gpm)	V1 (ft/s)	Reynolds #	f	h1 (ft)	Q2(gpm)	V2 (ft/s)	Reynolds #	f	h2 (ft)	Q3(gpm)	V3 (ft/s)	Reynolds #	f	h3 (ft)
0	0	0.00	3.36E+00	3.07825	0.00	0	0.00	1.13E+00	0.49247	0.00	0	0.00	2.30E+00	1.33353	0.00
500	250	1.48	8.41E+04	0.01947	0.08	250	0.67	5.63E+04	0.02074	0.05	500	1.39	1.15E+05	0.02058	0.62
1000	500	2.97	1.68E+05	0.01741	0.28	500	1.33	1.13E+05	0.01818	0.18	1000	2.78	2.30E+05	0.01932	2.31
1500	750	4.45	2.52E+05	0.01649	0.59	750	2.00	1.69E+05	0.01699	0.39	1500	4.17	3.45E+05	0.01882	5.07
2000	1000	5.93	3.36E+05	0.01595	1.02	1000	2.66	2.25E+05	0.01627	0.66	2000	5.56	4.60E+05	0.01855	8.89
2500	1250	7.41	4.20E+05	0.01558	1.55	1250	3.33	2.82E+05	0.01577	1.00	2500	6.95	5.76E+05	0.01837	13.75
3000	1500	8.90	5.04E+05	0.01532	2.19	1500	3.99	3.38E+05	0.01540	1.41	3000	8.34	6.91E+05	0.01825	19.67
3500	1750	10.38	5.88E+05	0.01511	2.95	1750	4.66	3.94E+05	0.01511	1.88	3500	9.73	8.06E+05	0.01816	26.65
4000	2000	11.86	6.72E+05	0.01495	3.81	2000	5.32	4.50E+05	0.01488	2.41	4000	11.12	9.21E+05	0.01809	34.67
4500	2250	13.34	7.56E+05	0.01482	4.78	2250	5.99	5.07E+05	0.01469	3.02	4500	12.51	1.04E+06	0.01804	43.75
	Section 4					Section 5					Section 6				
	Q4(gpm)	V4 (ft/s)	Reynolds #	f	h4 (ft)	Q5(gpm)	V5 (ft/s)	Reynolds #	f	h5 (ft)	Q1(gpm)	V1 (ft/s)	Reynolds #	f	h(ft)
0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	250	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
1000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
1500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	750	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	2000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	2500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1250	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	3000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	3500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1750	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	4000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	2000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	4500	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	2250	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Ent. Vel.	Ent Loss		Exit Vel	Ex. Loss	TDH (ft)	NPSHa								
0	0.00	0.00		0.00	0.00	20.00	36.50								
500	1.48	0.01		1.39	0.03	20.75	36.41								
1000	2.97	0.03		2.78	0.12	22.78	36.18								
1500	4.45	0.08		4.17	0.27	26.05	35.83								
2000	5.93	0.14		5.56	0.48	30.56	35.34								
2500	7.41	0.21		6.95	0.75	36.30	34.73								
3000	8.90	0.31		8.34	1.08	43.27	33.99								
3500	10.38	0.42		9.73	1.47	51.47	33.13								
4000	11.86	0.55		11.12	1.92	60.90	32.14								
4500	13.34	0.69		12.51	2.43	71.55	31.03								