

HYDRAULIC DESIGN COVER SHEET

CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/22/2021**

REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Obstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

AREA SUMMARY	
AREA NO: Sys 1-Area 1	DESCRIPTION: Shop
AREA NO: Sys 1-Area 2	DESCRIPTION: Classrooms
AREA NO: Sys 2-Area 1	DESCRIPTION: Offices
AREA NO: Sys 2-Area 2	DESCRIPTION: Entry Vestibule
AREA NO: Sys 2-Area 3	DESCRIPTION: Mechanical and Storage Rooms
AREA NO: Sys 3-Area 1	DESCRIPTION: Auxiliary Gym
AREA NO: Sys 3-Area 2	DESCRIPTION: Band Room
AREA NO: Sys 3-Area 3	DESCRIPTION: Competition Gym
AREA NO: Sys 3-Area 4	DESCRIPTION: Stage
AREA NO: Sys 3-Area 5	DESCRIPTION: Mechanical Room
AREA NO: Sys 3-Area 6	DESCRIPTION: Mechanical Room
AREA NO: Sys 4-Area 1	DESCRIPTION: Art Lab
AREA NO: Sys 4-Area 2	DESCRIPTION: Studio
AREA NO: Sys 5-Area 1	DESCRIPTION: Studio

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

NOTES:	PE STAMP
--------	----------



From: dstacy aegisfirepro.com <dstacy@aegisfirepro.com>
Sent: Wednesday, November 25, 2020 11:34 AM
To: Bryce Purviance
Cc: 'John Hansen'
Subject: Fw: Hydrant Flow Test Results - New School SE Bailey Road, Lee's Summit

Bryce,

Below is the flow test info.

also use this job #14524

Dennis Stacy

Aegis Fire Protection, LLC
13415 W 98th St. Lenexa, KS 66215
Mobile: (913) 515-3160
Office: (913) 825-0343 Ext: 1012
Fax: (913) 322-4475
dstacy@aegisfirepro.com

From: srock aegisfirepro.com <srock@aegisfirepro.com>
Sent: Wednesday, November 25, 2020 11:20 AM
To: dstacy aegisfirepro.com <dstacy@aegisfirepro.com>; rstevens aegisfirepro.com <rstevens@aegisfirepro.com>
Subject: Fwd: Hydrant Flow Test Results - New School SE Bailey Road, Lee's Summit

Flow test for the Lee Summit school attached below.

Steve Rock
Aegis Fire Protection LLC
13415 W 98th Street
Lenexa Kansas, 66215
Cell # 913-237-6022
srock@aegisfirepro.com

Begin forwarded message:

From: Ryan McCormick <Ryan.McCormick@cityofls.net>
Date: November 25, 2020 at 11:14:18 AM CST
To: "srock aegisfirepro.com" <srock@aegisfirepro.com>
Subject: Hydrant Flow Test Results - New School SE Bailey Road, Lee's Summit

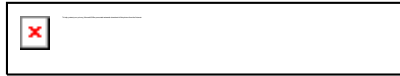
Hydrant Flow Test 3/19/2020

Static PSI = 78
Residual PSI = 45

Flow GPM = 1650



Ryan McCormick | Operations Technician
1200 SE Hamblen Road | Lee's Summit, MO 64081
816.969.1900 | lswater.net | Ryan.McCormick@cityofls.net



CONFIDENTIALITY NOTICE: "This electronic message transmission (including any accompanying attachments) from www.cityofls.net is intended solely for the person or entity for its intended recipient(s) and may contain information that is confidential, privileged, or otherwise protected from disclosure. The information contained is intended solely for the use of the individual(s), organization(s) or entity(ies) named above. If you have received this transmission but are not the intended recipient, you are hereby notified that any disclosure, copying, distribution or use of the contents of this message is strictly prohibited. If you have received this e-mail in error, please contact sender immediately by Reply e-mail and delete/destroy the original message and all copies."

Although this e-mail and any attachments are believed to be free of any virus or other defect that might negatively affect any computer system into which it is received and opened, it is the responsibility of the recipient to ensure that it is virus free and no responsibility is accepted by the sender for any loss or damage arising in any way in the event that such a virus or defect exists.



HYDRAULIC DESIGN COVER SHEET

AREA: **System 1 – Area 1 Shop**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/16/2021**
LATEST REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Obstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 1 – Area 1	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 14'-7"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK3501
K-FACTOR: 8.0	TEMPERATURE (°F): 200

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Ordinary Hazard Group 2
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.20	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 115	TOTAL SPRINKLERS OPERATING: 16
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 250
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 384.40	PRESSURE REQ'D (PSI): 53.044
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 634.40	PRESSURE REQ'D (PSI): 56.424
AREA SAFETY MARGIN (PSI): 17.27		

NOTES:
3-13-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500
Drawing :
Location :
Remote Area :
Contract :
Data File : Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 f

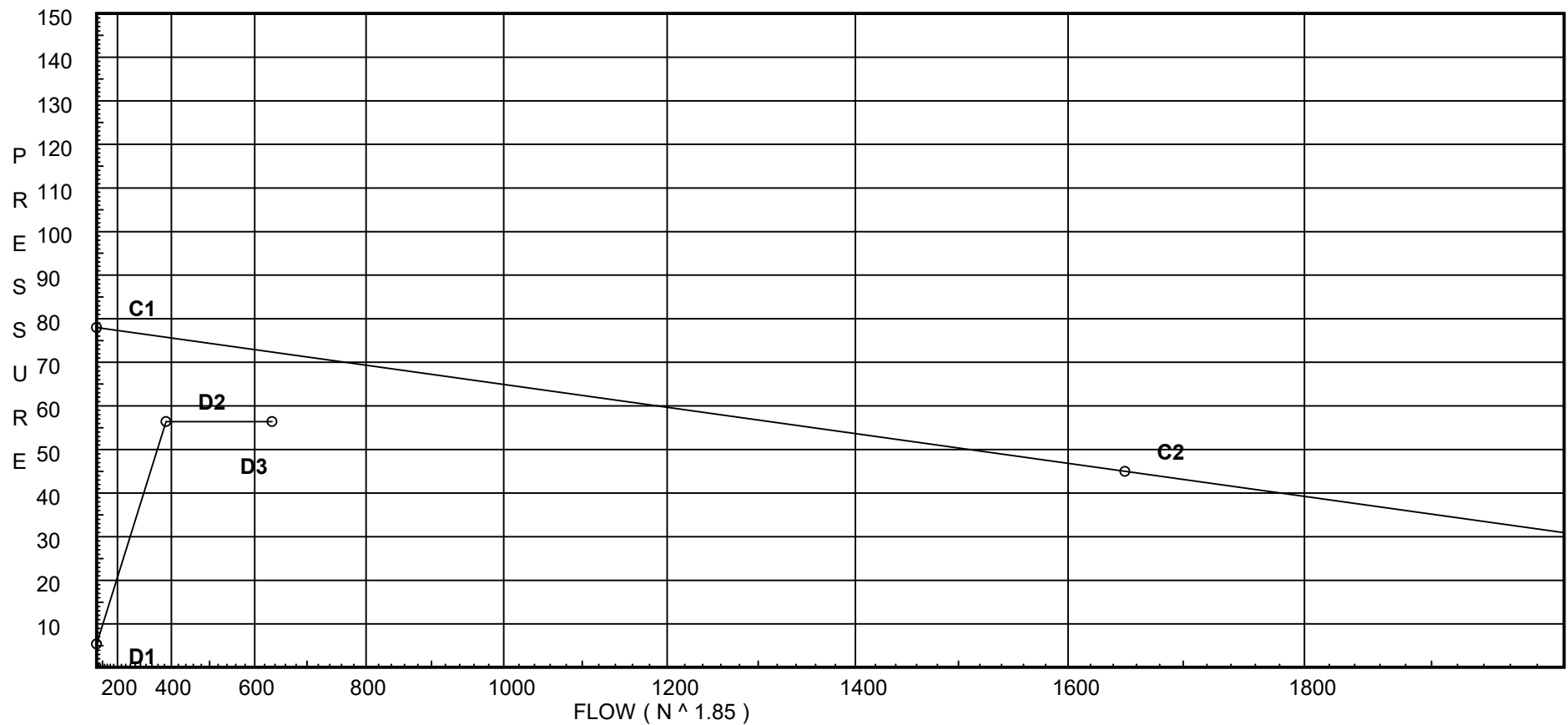
Water Supply Curve C

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500

Page 1
Date

City Water Supply:
C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:
D1 - Elevation : 5.362
D2 - System Flow : 384.405
D2 - System Pressure : 56.424
Hose (Demand) : 250
D3 - System Demand : 634.405
Safety Margin : 15.946



Fittings Used Summary

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
DP01	10.0	11.2	8.68	na	33.0	0.1	330	7.0
EQ01	10.88		9.25	na				
101	12.38		11.23	na				
A01	12.38	8	8.76	na	23.67	0.2	115	7.0
A2	12.38	8	8.36	na	23.13	0.2	115	7.0
A3	12.38	8	8.27	na	23.0	0.2	115	7.0
A4	12.38	8	8.28	na	23.02	0.2	115	7.0
A5	12.38	8	8.52	na	23.36	0.2	115	7.0
A6	12.38	8	9.18	na	24.24	0.2	115	7.0
102	12.38		11.37	na				
A7	12.38	8	8.88	na	23.83	0.2	115	7.0
A8	12.38	8	8.48	na	23.29	0.2	115	7.0
A9	12.38	8	8.38	na	23.17	0.2	115	7.0
A10	12.38	8	8.4	na	23.18	0.2	115	7.0
A11	12.38	8	8.65	na	23.53	0.2	115	7.0
A12	12.38	8	9.32	na	24.42	0.2	115	7.0
103	12.38		11.89	na				
A13	12.38	8	10.25	na	25.61	0.2	115	7.0
A14	12.38	8	10.15	na	25.49	0.2	115	7.0
A15	12.38	8	10.18	na	25.52	0.2	115	7.0
A16	12.38	8	10.5	na	25.93	0.2	115	7.0
104	12.38		13.65	na				
105	10.38		19.25	na				
106	10.38		20.55	na				
107	10.38		21.23	na				
108	10.38		21.47	na				
109	10.38		21.73	na				
110	10.38		21.94	na				
111	10.38		22.22	na				
112	10.38		22.71	na				
121	10.38		19.51	na				
122	10.38		20.62	na				
123	10.38		21.1	na				
124	10.38		22.66	na				
125	10.38		22.99	na				
131	12.38		12.54	na				
132	12.38		12.74	na				
133	12.38		13.46	na				
141	10.38		23.48	na				
142	10.38		24.36	na				
134	10.38		19.5	na				
151	10.38		23.9	na				
152	10.38		25.38	na				
153	10.38		26.24	na				
113	9.88		23.84	na				
126	9.88		24.46	na				
127	9.88		24.56	na				
128	9.88		24.91	na				
129	9.88		25.26	na				
143	10.38		26.77	na				
154	10.38		30.14	na				
TR1	10.38		42.68	na				
BR1	3.0		51.5	na				
BR2	3.0		51.51	na				
BR5	3.0		51.53	na				
BR4	3.0		51.54	na				
BR3	3.0		51.73	na				
UG	0.0		53.04	na				
HOSE	0.0		56.42	na	250.0			
TEST	0.0		56.42	na				

The maximum velocity is 12.56 and it occurs in the pipe between nodes 133 and 134

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500

Page 4
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
DP01 to EQ01	33.00 33.0	1.049 120.0 0.3288	E	2.0 0.0 0.0	0.880 2.000 2.880	8.681 -0.381 0.947			K Factor = 11.20 Vel = 12.25	
	0.0 33.00						9.247		K Factor = 10.85	
101 to A01	-63.86 -63.86	1.682 120.0 -0.1118	T	9.9 0.0 0.0	12.260 9.900 22.160	11.233 0.0 -2.478			Vel = 9.22	
A01 to A2	23.67 -40.19	1.682 120.0 -0.0474		0.0 0.0 0.0	8.330 0.0 8.330	8.755 0.0 -0.395			K Factor = 8.00 Vel = 5.80	
A2 to A3	23.13 -17.06	1.682 120.0 -0.0097		0.0 0.0 0.0	9.670 0.0 9.670	8.360 0.0 -0.094			K Factor = 8.00 Vel = 2.46	
A3 to A4	23.00 5.94	1.682 120.0 0.0013		0.0 0.0 0.0	9.210 0.0 9.210	8.266 0.0 0.012			K Factor = 8.00 Vel = 0.86	
A4 to A5	23.02 28.96	1.682 120.0 0.0259		0.0 0.0 0.0	9.500 0.0 9.500	8.278 0.0 0.246			K Factor = 8.00 Vel = 4.18	
A5 to A6	23.36 52.32	1.682 120.0 0.0774		0.0 0.0 0.0	8.500 0.0 8.500	8.524 0.0 0.658			K Factor = 8.00 Vel = 7.55	
A6 to 131	24.24 76.56	1.682 120.0 0.1564	T	9.9 0.0 0.0	11.580 9.900 21.480	9.182 0.0 3.360			K Factor = 8.00 Vel = 11.05	
	0.0 76.56						12.542		K Factor = 21.62	
102 to A7	-64.14 -64.14	1.682 120.0 -0.1127	T	9.9 0.0 0.0	12.260 9.900 22.160	11.374 0.0 -2.498			Vel = 9.26	
A7 to A8	23.83 -40.31	1.682 120.0 -0.0478		0.0 0.0 0.0	8.330 0.0 8.330	8.876 0.0 -0.398			K Factor = 8.00 Vel = 5.82	
A8 to A9	23.30 -17.01	1.682 120.0 -0.0096		0.0 0.0 0.0	9.670 0.0 9.670	8.478 0.0 -0.093			K Factor = 8.00 Vel = 2.46	
A9 to A10	23.16 6.15	1.682 120.0 0.0014		0.0 0.0 0.0	9.210 0.0 9.210	8.385 0.0 0.013			K Factor = 8.00 Vel = 0.89	
A10 to A11	23.18 29.33	1.682 120.0 0.0265		0.0 0.0 0.0	9.500 0.0 9.500	8.398 0.0 0.252			K Factor = 8.00 Vel = 4.23	
A11 to A12	23.53 52.86	1.682 120.0 0.0788		0.0 0.0 0.0	8.500 0.0 8.500	8.650 0.0 0.670			K Factor = 8.00 Vel = 7.63	
A12 to 132	24.43 77.29	1.682 120.0 0.1592	T	9.9 0.0 0.0	11.580 9.900 21.480	9.320 0.0 3.419			K Factor = 8.00 Vel = 11.16	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500

Page 5
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 77.29					12.739			K Factor = 21.65	
103 to A13	-42.92 -42.92	1.682 120.0 -0.0536	T	9.9 0.0 0.0	20.590 9.900 30.490	11.886 0.0 -1.634			Vel = 6.20	
A13 to A14	25.62 -17.3	1.682 120.0 -0.0100		0.0 0.0 0.0	9.670 0.0 9.670	10.252 0.0 -0.097			K Factor = 8.00	
A14 to A15	25.49 8.19	1.682 120.0 0.0025		0.0 0.0 0.0	9.210 0.0 9.210	10.155 0.0 0.023			Vel = 1.18	
A15 to A16	25.52 33.71	1.682 120.0 0.0343		0.0 0.0 0.0	9.500 0.0 9.500	10.178 0.0 0.326			K Factor = 8.00	
A16 to 133	25.93 59.64	1.682 120.0 0.0985	T	9.9 0.0 0.0	20.080 9.900 29.980	10.504 0.0 2.954			K Factor = 8.00	
	0.0 59.64					13.458			K Factor = 16.26	
101 to 102	63.86 63.86	2.635 120.0 0.0125		0.0 0.0 0.0	11.250 0.0 11.250	11.233 0.0 0.141			Vel = 3.76	
102 to 103	64.14 128.0	2.635 120.0 0.0455		0.0 0.0 0.0	11.250 0.0 11.250	11.374 0.0 0.512			Vel = 7.53	
103 to 104	42.92 170.92	2.635 120.0 0.0777	E	8.237 0.0 0.0	14.480 8.237 22.717	11.886 0.0 1.764			Vel = 10.06	
104 to 105	0.0 170.92	2.635 120.0 0.0776	4E T	32.948 16.474 0.0	11.500 49.422 60.922	13.650 0.866 4.730			Vel = 10.06	
105 to 106	-67.56 103.36	2.635 120.0 0.0306		0.0 0.0 0.0	42.710 0.0 42.710	19.246 0.0 1.308			Vel = 6.08	
106 to 107	0.0 103.36	2.635 120.0 0.0306	2E	16.474 0.0 0.0	5.510 16.474 21.984	20.554 0.0 0.673			Vel = 6.08	
107 to 108	0.0 103.36	2.635 120.0 0.0307		0.0 0.0 0.0	7.830 0.0 7.830	21.227 0.0 0.240			Vel = 6.08	
108 to 109	0.0 103.36	2.635 120.0 0.0306		0.0 0.0 0.0	8.490 0.0 8.490	21.467 0.0 0.260			Vel = 6.08	
109 to 110	0.0 103.36	2.635 120.0 0.0305		0.0 0.0 0.0	6.850 0.0 6.850	21.727 0.0 0.209			Vel = 6.08	
110 to 111	0.0 103.36	2.635 120.0 0.0307		0.0 0.0 0.0	9.150 0.0 9.150	21.936 0.0 0.281			Vel = 6.08	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
111 to 112	0.0 103.36	2.635 120.0 0.0306		0.0 0.0 0.0	16.000 0.0 16.000	22.217 0.0 0.489				
								Vel =	6.08	
112 to 113	0.0 103.36	2.635 120.0 0.0306	2E	16.474 0.0 0.0	13.420 16.474 29.894	22.706 0.217 0.915				
								Vel =	6.08	
	0.0 103.36					23.838		K Factor =	21.17	
121 to 122	84.88	2.635 120.0 0.0213	T 2E	16.474 16.474 0.0	18.930 32.948 51.878	19.512 0.0 1.104			Vel =	4.99
122 to 123	0.0 84.88	2.635 120.0 0.0213	E	8.237 0.0 0.0	14.700 8.237 22.937	20.616 0.0 0.488			Vel =	4.99
123 to 124	0.0 84.88	2.635 120.0 0.0213	E	8.237 0.0 0.0	65.120 8.237 73.357	21.104 0.0 1.560			Vel =	4.99
124 to 125	0.0 84.88	2.635 120.0 0.0212	E	8.237 0.0 0.0	7.200 8.237 15.437	22.664 0.0 0.328			Vel =	4.99
125 to 126	0.0 84.88	2.635 120.0 0.0213	2E T	16.474 16.474 0.0	26.020 32.948 58.968	22.992 0.217 1.254			Vel =	4.99
	0.0 84.88					24.463		K Factor =	17.16	
131 to 132	76.56	2.635 120.0 0.0175		0.0 0.0 0.0	11.250 0.0 11.250	12.542 0.0 0.197			Vel =	4.50
132 to 133	77.29 153.85	2.635 120.0 0.0639		0.0 0.0 0.0	11.250 0.0 11.250	12.739 0.0 0.719			Vel =	9.05
133 to 134	59.64 213.49	2.635 120.0 0.1172	E T	8.237 16.474 0.0	19.470 24.711 44.181	13.458 0.866 5.177			Vel =	12.56
	0.0 213.49					19.501		K Factor =	48.34	
141 to 142	83.31	2.635 120.0 0.0205	T E	16.474 8.237 0.0	18.070 24.711 42.781	23.478 0.0 0.879			Vel =	4.90
142 to 143	0.0 83.31	2.635 120.0 0.0206	E T	8.237 16.474 0.0	92.940 24.711 117.651	24.357 0.0 2.418			Vel =	4.90
	0.0 83.31					26.775		K Factor =	16.10	
105 to 121	67.56	3.26 120.0 0.0049	T	20.159 0.0 0.0	33.630 20.159 53.789	19.246 0.0 0.266			Vel =	2.60

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500

Page 7
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
121 to 134	-84.88 -17.32	3.26 120.0 -0.0004		0.0 0.0 0.0	28.910 0.0 28.910	19.512 0.0 -0.011				
								Vel =	0.67	
134 to 141	213.48 196.16	3.26 120.0 0.0355	4E	37.631 0.0 0.0	74.310 37.631 111.941	19.501 0.0 3.977				
								Vel =	7.54	
141 to 151	-83.30 112.86	3.26 120.0 0.0128		0.0 0.0 0.0	32.990 0.0 32.990	23.478 0.0 0.422				
								Vel =	4.34	
151 to 152	0.0 112.86	2.635 120.0 0.0360	T	16.474 0.0 0.0	24.560 16.474 41.034	23.900 0.0 1.478				
								Vel =	6.64	
152 to 153	0.0 112.86	2.635 120.0 0.0360	E	8.237 0.0 0.0	15.750 8.237 23.987	25.378 0.0 0.864				
								Vel =	6.64	
153 to 154	0.0 112.86	2.635 120.0 0.0360	E T	8.237 16.474 0.0	83.350 24.711 108.061	26.242 0.0 3.894				
								Vel =	6.64	
	0.0 112.86					30.136		K Factor =	20.56	
113 to 126	103.36 103.36	3.26 120.0 0.0109		0.0 0.0 0.0	57.540 0.0 57.540	23.838 0.0 0.625				
								Vel =	3.97	
126 to 127	84.88 188.24	3.26 120.0 0.0329		0.0 0.0 0.0	3.010 0.0 3.010	24.463 0.0 0.099				
								Vel =	7.24	
127 to 128	0.0 188.24	3.26 120.0 0.0330		0.0 0.0 0.0	10.460 0.0 10.460	24.562 0.0 0.345				
								Vel =	7.24	
128 to 129	0.0 188.24	3.26 120.0 0.0328		0.0 0.0 0.0	10.870 0.0 10.870	24.907 0.0 0.357				
								Vel =	7.24	
129 to 143	0.0 188.24	3.26 120.0 0.0329	2E	18.815 0.0 0.0	33.630 18.815 52.445	25.264 -0.217 1.728				
								Vel =	7.24	
143 to 154	83.31 271.55	3.26 120.0 0.0648		0.0 0.0 0.0	51.830 0.0 51.830	26.775 0.0 3.361				
								Vel =	10.44	
154 to TR1	112.85 384.4	4.26 120.0 0.0335	6E	79.002 0.0 0.0	295.110 79.002 374.112	30.136 0.0 12.539				
								Vel =	8.65	
TR1 to BR1	0.0 384.4	4.26 120.0 0.0335	B S T Fsp	15.8 28.968 26.334 0.0	7.380 71.102 78.482	42.675 6.196 2.631		* * Fixed Loss = 3		
								Vel =	8.65	
BR1 to BR2	0.0 384.4	6.357 120.0 0.0048		0.0 0.0 0.0	2.500 0.0 2.500	51.502 0.0 0.012				
								Vel =	3.89	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 1 - 0.20 for 1500

Page 8
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv. Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
BR2 to BR5	0.0 384.4	6.357 120.0 0.0048	0.0 0.0 0.0	2.500 0.0 2.500	51.514 0.0 0.012			Vel = 3.89	
BR5 to BR4	0.0 384.4	6.357 120.0 0.0048	0.0 0.0 0.0	2.500 0.0 2.500	51.526 0.0 0.012			Vel = 3.89	
BR4 to BR3	0.0 384.4	6.357 120.0 0.0048	T 37.72 0.0 0.0	2.500 37.720 40.220	51.538 0.0 0.192			Vel = 3.89	
BR3 to UG	0.0 384.4	6.357 120.0 0.0050	0.0 0.0 0.0	3.000 0.0 3.000	51.730 1.299 0.015			Vel = 3.89	
UG to HOSE	0.0 384.4	6.16 140.0 0.0042	G 4.304 E 20.084 T 43.037 Zfb 0.0	75.000 67.425 142.425	53.044 2.779 0.595			* * Fixed Loss = 2.779 Vel = 4.14	
HOSE to TEST	250.00 634.4	6.16 140.0 0.0120	0.0 0.0 0.0	0.500 0.0 0.500	56.418 0.0 0.006			Qa = 250 Vel = 6.83	
	0.0 634.40				56.424			K Factor = 84.46	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 1 – Area 2 Classrooms**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/16/2021**
LATEST REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Unobstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 1 – Area 2	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 10'-0"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK636
K-FACTOR: 11.2	TEMPERATURE (°F): 155

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Light Hazard
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.10	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 330	TOTAL SPRINKLERS OPERATING: 9
MIN. FLOW PER HEAD (GPM): 33	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 100
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 331.91	PRESSURE REQ'D (PSI): 56.304
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 431.91	PRESSURE REQ'D (PSI): 59.602
AREA SAFETY MARGIN (PSI): 15.63		

NOTES:
3-13-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500
Drawing :
Location :
Remote Area :
Contract :
Data File : Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 f

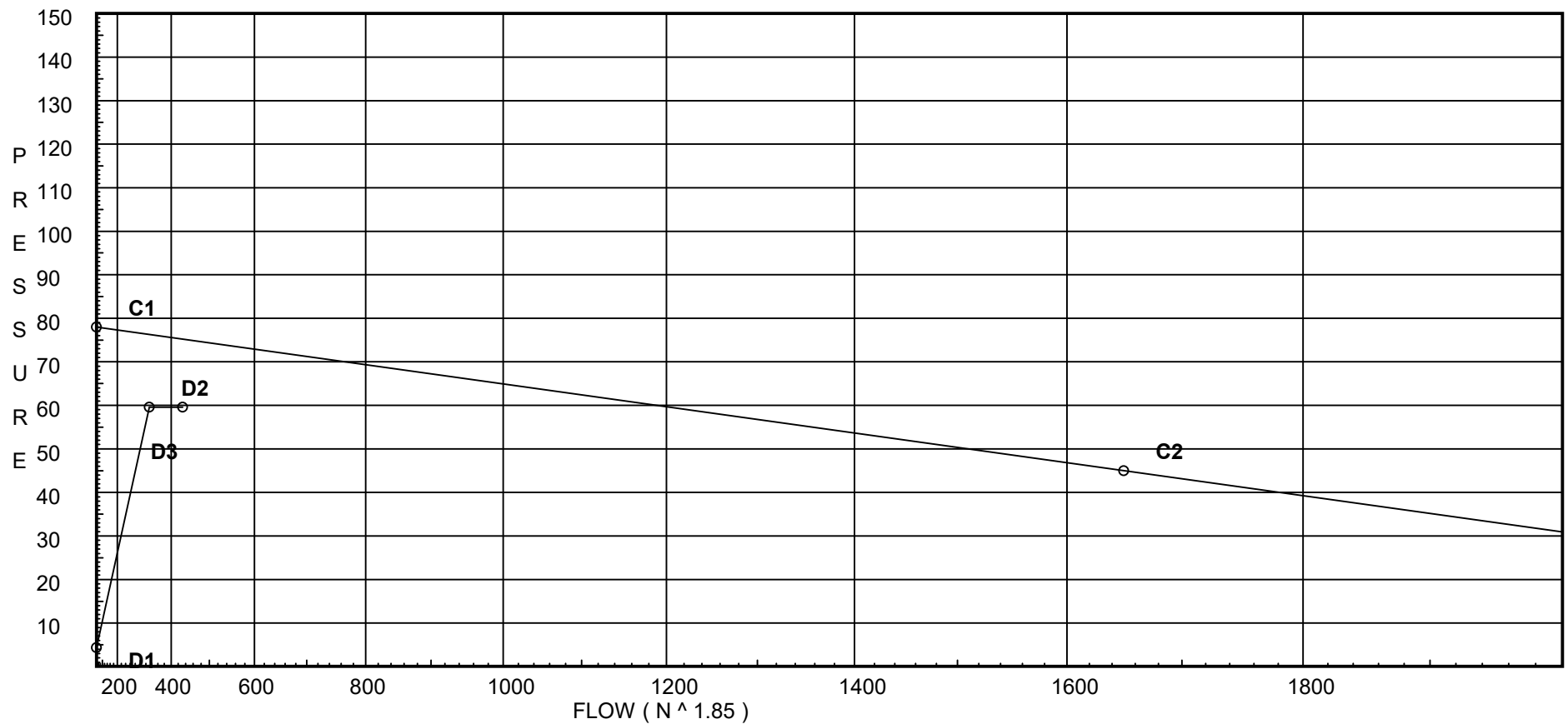
Water Supply Curve C

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 1
Date

City Water Supply:
C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:
D1 - Elevation : 4.331
D2 - System Flow : 331.913
D2 - System Pressure : 59.602
Hose (Demand) : 100
D3 - System Demand : 431.913
Safety Margin : 15.633



Fittings Used Summary

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
101	12.38		29.64	na				
A01	12.38		29.75	na				
A2	12.38		29.79	na				
A3	12.38		29.84	na				
A4	12.38		29.88	na				
A5	12.38		29.93	na				
A6	12.38		29.97	na				
102	12.38		29.63	na				
A7	12.38		29.74	na				
A8	12.38		29.79	na				
A9	12.38		29.84	na				
A10	12.38		29.88	na				
A11	12.38		29.93	na				
A12	12.38		29.97	na				
103	12.38		29.61	na				
A13	12.38		29.78	na				
A14	12.38		29.83	na				
A15	12.38		29.89	na				
A16	12.38		29.94	na				
A21	10.0	11.2	8.68	na	33.0	0.1	330	7.0
A22	10.0	11.2	9.4	na	34.34	0.1	330	7.0
A23	10.0	11.2	11.32	na	37.68	0.1	330	7.0
A24	10.0	11.2	9.74	na	34.95	0.1	330	7.0
A25	10.0	11.2	10.54	na	36.37	0.1	330	7.0
A26	10.0	11.2	14.03	na	41.96	0.1	330	7.0
A27	10.0	11.2	9.64	na	34.78	0.1	330	7.0
A28	10.0	11.2	10.6	na	36.46	0.1	330	7.0
A29	10.0	11.2	14.32	na	42.38	0.1	330	7.0
21A	10.38		16.08	na				
22A	10.38		17.37	na				
23A	10.38		20.81	na				
24A	10.38		17.98	na				
25A	10.38		19.42	na				
27A	10.38		17.81	na				
28A	10.38		19.52	na				
104	12.38		29.51	na				
105	10.38		30.1	na				
106	10.38		27.21	na				
107	10.38		25.72	na				
108	10.38		25.65	na				
109	10.38		25.66	na				
110	10.38		25.73	na				
111	10.38		26.16	na				
112	10.38		27.44	na				
121	10.38		30.9	na				
122	10.38		31.02	na				
123	10.38		31.08	na				
124	10.38		31.26	na				
125	10.38		31.29	na				
131	12.38		30.08	na				
132	12.38		30.08	na				
133	12.38		30.11	na				
141	10.38		33.1	na				
142	10.38		33.4	na				
134	10.38		31.17	na				
151	10.38		33.35	na				
152	10.38		34.23	na				
153	10.38		34.74	na				
113	9.88		30.03	na				
126	9.88		31.65	na				
127	9.88		31.76	na				
128	9.88		32.15	na				

Flow Summary - Standard

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 4
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
129	9.88		32.54	na				
143	10.38		34.25	na				
154	10.38		37.06	na				
TR1	10.38		46.62	na				
BR1	3.0		54.82	na				
BR2	3.0		54.83	na				
BR5	3.0		54.84	na				
BR4	3.0		54.85	na				
BR3	3.0		54.99	na				
UG	0.0		56.3	na				
HOSE	0.0		59.6	na	100.0			
TEST	0.0		59.6	na				

The maximum velocity is 22.53 and it occurs in the pipe between nodes 23A and 107

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 5
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
101 to A01	11.85 11.85	1.682 120.0 0.0049	T	9.9 0.0 0.0	12.260 9.900 22.160	29.638 0.0 0.109			Vel = 1.71	
A01 to A2	0.0 11.85	1.682 120.0 0.0050		0.0 0.0 0.0	8.330 0.0 8.330	29.747 0.0 0.042			Vel = 1.71	
A2 to A3	0.0 11.85	1.682 120.0 0.0049		0.0 0.0 0.0	9.670 0.0 9.670	29.789 0.0 0.047			Vel = 1.71	
A3 to A4	0.0 11.85	1.682 120.0 0.0050		0.0 0.0 0.0	9.210 0.0 9.210	29.836 0.0 0.046			Vel = 1.71	
A4 to A5	0.0 11.85	1.682 120.0 0.0049		0.0 0.0 0.0	9.500 0.0 9.500	29.882 0.0 0.047			Vel = 1.71	
A5 to A6	0.0 11.85	1.682 120.0 0.0049		0.0 0.0 0.0	8.500 0.0 8.500	29.929 0.0 0.042			Vel = 1.71	
A6 to 131	0.0 11.85	1.682 120.0 0.0050	T	9.9 0.0 0.0	11.580 9.900 21.480	29.971 0.0 0.107			Vel = 1.71	
	0.0 11.85					30.078			K Factor = 2.16	
102 to A7	12.03 12.03	1.682 120.0 0.0051	T	9.9 0.0 0.0	12.260 9.900 22.160	29.631 0.0 0.113			Vel = 1.74	
A7 to A8	0.0 12.03	1.682 120.0 0.0052		0.0 0.0 0.0	8.330 0.0 8.330	29.744 0.0 0.043			Vel = 1.74	
A8 to A9	0.0 12.03	1.682 120.0 0.0051		0.0 0.0 0.0	9.670 0.0 9.670	29.787 0.0 0.049			Vel = 1.74	
A9 to A10	0.0 12.03	1.682 120.0 0.0051		0.0 0.0 0.0	9.210 0.0 9.210	29.836 0.0 0.047			Vel = 1.74	
A10 to A11	0.0 12.03	1.682 120.0 0.0051		0.0 0.0 0.0	9.500 0.0 9.500	29.883 0.0 0.048			Vel = 1.74	
A11 to A12	0.0 12.03	1.682 120.0 0.0052		0.0 0.0 0.0	8.500 0.0 8.500	29.931 0.0 0.044			Vel = 1.74	
A12 to 132	0.0 12.03	1.682 120.0 0.0051	T	9.9 0.0 0.0	11.580 9.900 21.480	29.975 0.0 0.109			Vel = 1.74	
	0.0 12.03					30.084			K Factor = 2.19	
103 to A13	12.67 12.67	1.682 120.0 0.0056	T	9.9 0.0 0.0	20.590 9.900 30.490	29.608 0.0 0.172			Vel = 1.83	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
A13 to A14	0.0 12.67	1.682 120.0 0.0056		0.0 0.0 0.0	9.670 0.0 9.670	29.780 0.0 0.054			Vel = 1.83	
A14 to A15	0.0 12.67	1.682 120.0 0.0055		0.0 0.0 0.0	9.210 0.0 9.210	29.834 0.0 0.051			Vel = 1.83	
A15 to A16	0.0 12.67	1.682 120.0 0.0057		0.0 0.0 0.0	9.500 0.0 9.500	29.885 0.0 0.054			Vel = 1.83	
A16 to 133	0.0 12.67	1.682 120.0 0.0056	T	9.9 0.0 0.0	20.080 9.900 29.980	29.939 0.0 0.168			Vel = 1.83	
	0.0 12.67					30.107			K Factor = 2.31	
A21 to 21A	33.00 33.0	1.049 120.0 0.3287	T Eq	5.0 17.0 0.0	1.000 22.000 23.000	8.681 -0.165 7.560			K Factor = 11.20 Vel = 12.25	
	0.0 33.00					16.076			K Factor = 8.23	
A22 to 22A	34.34 34.34	1.049 120.0 0.3537	T Eq	5.0 17.0 0.0	1.000 22.000 23.000	9.401 -0.165 8.136			K Factor = 11.20 Vel = 12.75	
	0.0 34.34					17.372			K Factor = 8.24	
A23 to 23A	37.68 37.68	1.049 120.0 0.4200	T Eq	5.0 17.0 0.0	1.000 22.000 23.000	11.316 -0.165 9.659			K Factor = 11.20 Vel = 13.99	
	0.0 37.68					20.810			K Factor = 8.26	
A24 to 24A	34.95 34.95	1.049 120.0 0.3655	T Eq	5.0 17.0 0.0	1.000 22.000 23.000	9.740 -0.165 8.407			K Factor = 11.20 Vel = 12.97	
	0.0 34.95					17.982			K Factor = 8.24	
A25 to 25A	36.37 36.37	1.049 120.0 0.3933	T Eq	5.0 17.0 0.0	1.000 22.000 23.000	10.542 -0.165 9.047			K Factor = 11.20 Vel = 13.50	
	0.0 36.37					19.424			K Factor = 8.25	
A26 to 109	41.96 41.96	1.049 120.0 0.5125	T Eq	5.0 17.0 0.0	1.000 22.000 23.000	14.034 -0.165 11.787			K Factor = 11.20 Vel = 15.58	
	0.0 41.96					25.656			K Factor = 8.28	
A27 to 27A	34.78 34.78	1.049 120.0 0.3622	T Eq	5.0 17.0 0.0	1.000 22.000 23.000	9.643 -0.165 8.330			K Factor = 11.20 Vel = 12.91	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 7
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 34.78					17.808			K Factor = 8.24	
A28 to 28A	36.46	1.049 120.0	T Eq	5.0 17.0	1.000 22.000	10.597 -0.165			K Factor = 11.20	
	36.46	0.3953		0.0	23.000	9.091			Vel = 13.53	
	0.0 36.46					19.523			K Factor = 8.25	
A29 to 111	42.38	1.049 120.0	T Eq	5.0 17.0	1.000 22.000	14.320 -0.165			K Factor = 11.20	
	42.38	0.5221		0.0	23.000	12.009			Vel = 15.73	
	0.0 42.38					26.164			K Factor = 8.29	
21A to 22A	33.00	1.38 120.0		0.0 0.0	15.000 0.0	16.076 0.0				
	33.0	0.0864		0.0	15.000	1.296			Vel = 7.08	
22A to 23A	34.34	1.38 120.0		0.0 0.0	10.630 0.0	17.372 0.0				
	67.34	0.3234		0.0	10.630	3.438			Vel = 14.44	
23A to 107	37.68	1.38 120.0	T	6.0 0.0	0.670 6.000	20.810 0.0				
	105.02	0.7358		0.0	6.670	4.908			Vel = 22.53	
	0.0 105.02					25.718			K Factor = 20.71	
24A to 25A	34.95	1.38 120.0		0.0 0.0	15.000 0.0	17.982 0.0				
	34.95	0.0961		0.0	15.000	1.442			Vel = 7.50	
25A to 108	36.37	1.38 120.0	T	6.0 0.0	11.300 6.000	19.424 0.0				
	71.32	0.3597		0.0	17.300	6.222			Vel = 15.30	
	0.0 71.32					25.646			K Factor = 14.08	
27A to 28A	34.78	1.38 120.0		0.0 0.0	18.000 0.0	17.808 0.0				
	34.78	0.0953		0.0	18.000	1.715			Vel = 7.46	
28A to 110	36.46	1.38 120.0	T	6.0 0.0	11.300 6.000	19.523 0.0				
	71.24	0.3589		0.0	17.300	6.209			Vel = 15.28	
	0.0 71.24					25.732			K Factor = 14.04	
101 to 102	-11.85	2.635 120.0		0.0 0.0	11.250 0.0	29.638 0.0				
	-11.85	-0.0006		0.0	11.250	-0.007			Vel = 0.70	
102 to 103	-12.02	2.635 120.0		0.0 0.0	11.250 0.0	29.631 0.0				
	-23.87	-0.0020		0.0	11.250	-0.023			Vel = 1.40	
103 to 104	-12.67	2.635 120.0	E	8.237 0.0	14.480 8.237	29.608 0.0				
	-36.54	-0.0044		0.0	22.717	-0.101			Vel = 2.15	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 8
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
104 to 105	0.0 -36.54	2.635 120.0 -0.0045	4E T	32.948 16.474 0.0	11.500 49.422 60.922	29.507 0.866 -0.273			Vel = 2.15	
105 to 106	-122.23 -158.77	2.635 120.0 -0.0677		0.0 0.0 0.0	42.710 0.0 42.710	30.100 0.0 -2.893			Vel = 9.34	
106 to 107	0.0 -158.77	2.635 120.0 -0.0677	2E	16.474 0.0 0.0	5.510 16.474 21.984	27.207 0.0 -1.489			Vel = 9.34	
107 to 108	105.01 -53.76	2.635 120.0 -0.0092		0.0 0.0 0.0	7.830 0.0 7.830	25.718 0.0 -0.072			Vel = 3.16	
108 to 109	71.32 17.56	2.635 120.0 0.0012		0.0 0.0 0.0	8.490 0.0 8.490	25.646 0.0 0.010			Vel = 1.03	
109 to 110	41.96 59.52	2.635 120.0 0.0111		0.0 0.0 0.0	6.850 0.0 6.850	25.656 0.0 0.076			Vel = 3.50	
110 to 111	71.24 130.76	2.635 120.0 0.0472		0.0 0.0 0.0	9.150 0.0 9.150	25.732 0.0 0.432			Vel = 7.69	
111 to 112	42.38 173.14	2.635 120.0 0.0796		0.0 0.0 0.0	16.000 0.0 16.000	26.164 0.0 1.273			Vel = 10.19	
112 to 113	0.0 173.14	2.635 120.0 0.0795	2E	16.474 0.0 0.0	13.420 16.474 29.894	27.437 0.217 2.377			Vel = 10.19	
	0.0 173.14					30.031			K Factor = 31.59	
121 to 122	26.25 26.25	2.635 120.0 0.0024	T 2E	16.474 16.474 0.0	18.930 32.948 51.878	30.897 0.0 0.126			Vel = 1.54	
122 to 123	0.0 26.25	2.635 120.0 0.0024	E	8.237 0.0 0.0	14.700 8.237 22.937	31.023 0.0 0.056			Vel = 1.54	
123 to 124	0.0 26.25	2.635 120.0 0.0024	E	8.237 0.0 0.0	65.120 8.237 73.357	31.079 0.0 0.178			Vel = 1.54	
124 to 125	0.0 26.25	2.635 120.0 0.0024	E	8.237 0.0 0.0	7.200 8.237 15.437	31.257 0.0 0.037			Vel = 1.54	
125 to 126	0.0 26.25	2.635 120.0 0.0024	2E T	16.474 16.474 0.0	26.020 32.948 58.968	31.294 0.217 0.143			Vel = 1.54	
	0.0 26.25					31.654			K Factor = 4.67	
131 to 132	11.85 11.85	2.635 120.0 0.0005		0.0 0.0 0.0	11.250 0.0 11.250	30.078 0.0 0.006			Vel = 0.70	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 9
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
132 to 133	12.02 23.87	2.635 120.0 0.0020		0.0 0.0 0.0	11.250 0.0 11.250	30.084 0.0 0.023				Vel = 1.40
133 to 134	12.67 36.54	2.635 120.0 0.0045	E T	8.237 16.474 0.0	19.470 24.711 44.181	30.107 0.866 0.198				Vel = 2.15
	0.0 36.54					31.171				K Factor = 6.54
141 to 142	47.22 47.22	2.635 120.0 0.0072	T E	16.474 8.237 0.0	18.070 24.711 42.781	33.096 0.0 0.308				Vel = 2.78
142 to 143	0.0 47.22	2.635 120.0 0.0072	E T	8.237 16.474 0.0	92.940 24.711 117.651	33.404 0.0 0.845				Vel = 2.78
	0.0 47.22					34.249				K Factor = 8.07
105 to 121	122.23 122.23	3.26 120.0 0.0148	T	20.159 0.0 0.0	33.630 20.159 53.789	30.100 0.0 0.797				Vel = 4.70
121 to 134	-26.26 95.97	3.26 120.0 0.0095		0.0 0.0 0.0	28.910 0.0 28.910	30.897 0.0 0.274				Vel = 3.69
134 to 141	36.55 132.52	3.26 120.0 0.0172	4E	37.631 0.0 0.0	74.310 37.631 111.941	31.171 0.0 1.925				Vel = 5.09
141 to 151	-47.22 85.3	3.26 120.0 0.0076		0.0 0.0 0.0	32.990 0.0 32.990	33.096 0.0 0.251				Vel = 3.28
151 to 152	0.0 85.3	2.635 120.0 0.0215	T	16.474 0.0 0.0	24.560 16.474 41.034	33.347 0.0 0.881				Vel = 5.02
152 to 153	0.0 85.3	2.635 120.0 0.0215	E	8.237 0.0 0.0	15.750 8.237 23.987	34.228 0.0 0.515				Vel = 5.02
153 to 154	0.0 85.3	2.635 120.0 0.0215	E T	8.237 16.474 0.0	83.350 24.711 108.061	34.743 0.0 2.319				Vel = 5.02
	0.0 85.30					37.062				K Factor = 14.01
113 to 126	173.14 173.14	3.26 120.0 0.0282		0.0 0.0 0.0	57.540 0.0 57.540	30.031 0.0 1.623				Vel = 6.66
126 to 127	26.26 199.4	3.26 120.0 0.0365		0.0 0.0 0.0	3.010 0.0 3.010	31.654 0.0 0.110				Vel = 7.66
127 to 128	0.0 199.4	3.26 120.0 0.0366		0.0 0.0 0.0	10.460 0.0 10.460	31.764 0.0 0.383				Vel = 7.66

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Sys 1 - Level 1 Area 2 - 0.10 for 1500

Page 10
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv. Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
128 to 129	0.0 199.4	3.26 120.0 0.0366		0.0 0.0 10.870	32.147 0.0 0.398			Vel = 7.66	
129 to 143	0.0 199.4	3.26 120.0 0.0366	2E	18.815 0.0 52.445	33.630 18.815 -0.217 1.921	32.545		Vel = 7.66	
143 to 154	47.22 246.62	3.26 120.0 0.0543		0.0 0.0 51.830	34.249 0.0 2.813			Vel = 9.48	
154 to TR1	85.29 331.91	4.26 120.0 0.0255	6E	79.002 0.0 374.112	295.110 79.002 0.0 9.557	37.062		Vel = 7.47	
TR1 to BR1	0.0 331.91	4.26 120.0 0.0255	B S T Fsp	15.8 28.968 26.334 0.0	7.380 71.102 78.482	46.619 6.196 2.005		* * Fixed Loss = 3 Vel = 7.47	
BR1 to BR2	0.0 331.91	6.357 120.0 0.0036		0.0 0.0 2.500	54.820 0.0 0.009			Vel = 3.36	
BR2 to BR5	0.0 331.91	6.357 120.0 0.0036		0.0 0.0 2.500	54.829 0.0 0.009			Vel = 3.36	
BR5 to BR4	0.0 331.91	6.357 120.0 0.0036		0.0 0.0 2.500	54.838 0.0 0.009			Vel = 3.36	
BR4 to BR3	0.0 331.91	6.357 120.0 0.0037	T	37.72 0.0 40.220	2.500 37.720 0.147	54.847		Vel = 3.36	
BR3 to UG	0.0 331.91	6.357 120.0 0.0037		0.0 0.0 3.000	54.994 1.299 0.011			Vel = 3.36	
UG to HOSE	0.0 331.91	6.16 140.0 0.0032	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	56.304 2.842 0.453		* * Fixed Loss = 2.842 Vel = 3.57	
HOSE to TEST	100.00 431.91	6.16 140.0 0.0060		0.0 0.0 0.500	59.599 0.0 0.003			Qa = 100 Vel = 4.65	
	0.0 431.91				59.602			K Factor = 55.95	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 2 – Area 1 Offices**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/16/2021**
LATEST REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Unobstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 2 – Area 1	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 10'-0" & 9'-0"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK4621 & VK636
K-FACTOR: 5.6 & 11.2	TEMPERATURE (°F): 155

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Light Hazard
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.10	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 180 & 330	TOTAL SPRINKLERS OPERATING: 13
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 100
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 320.19	PRESSURE REQ'D (PSI): 59.853
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 420.19	PRESSURE REQ'D (PSI): 63.136
AREA SAFETY MARGIN (PSI): 12.236		

NOTES:
3-13-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : Lee's Summit Middle School - Level 1 - System 2 - Area 1
Drawing :
Location :
Remote Area :
Contract :
Data File : Lee's Summit Middle School - Level 1 - System 2 - Area 1 Off

Water Supply Curve C

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

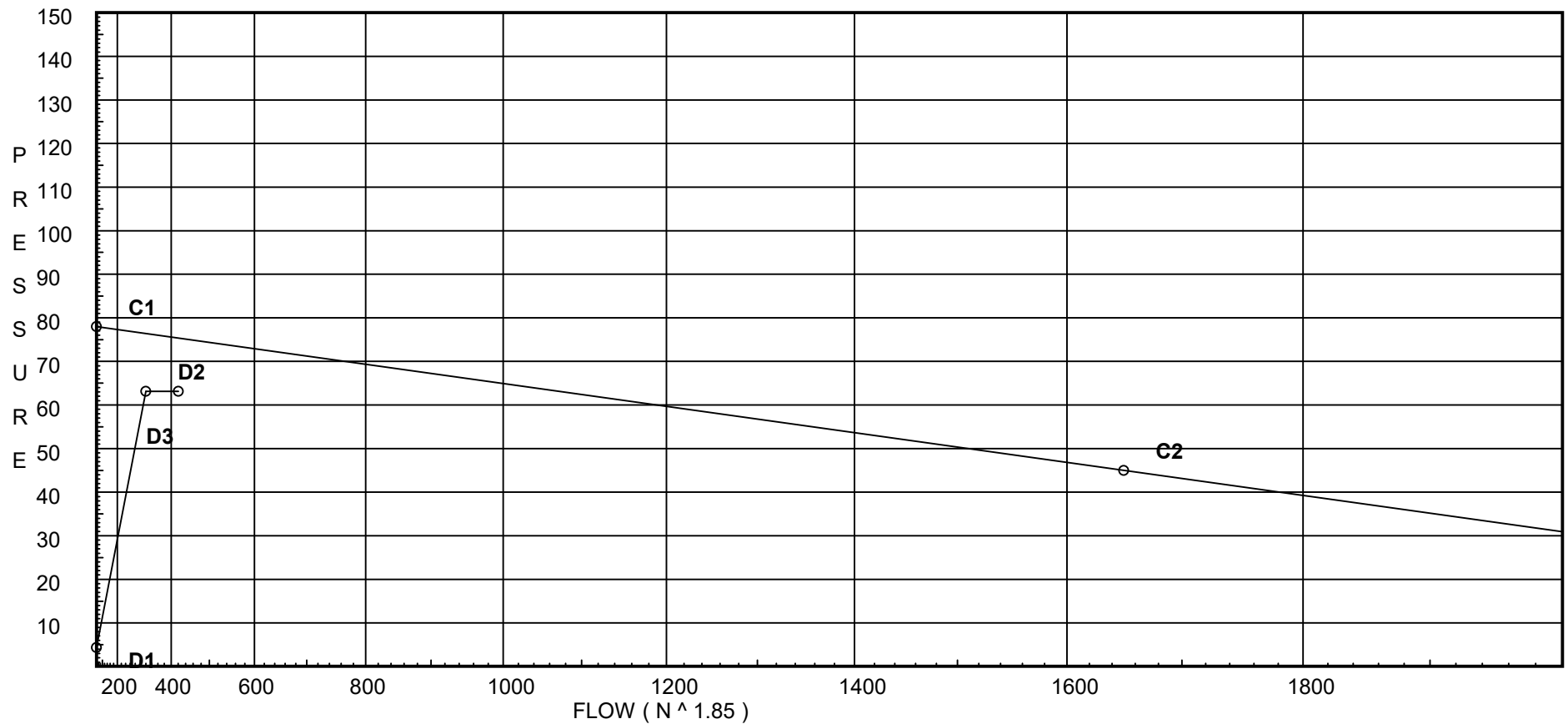
Page 1
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 4.331
D2 - System Flow : 320.19
D2 - System Pressure : 63.136
Hose (Demand) : 100
D3 - System Demand : 420.19
Safety Margin : 12.236



Fittings Used Summary

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
B1	10.0	5.6	11.82	na	19.26	0.1	180	7.0
B2	10.0	5.6	12.22	na	19.58	0.1	180	7.0
B3	10.0	11.2	8.68	na	33.0	0.1	330	7.0
B4	10.0	5.6	15.94	na	22.36	0.1	180	7.0
1B	10.38		14.43	na				
2B	10.38		14.91	na				
3B	10.38		16.01	na				
4B	10.38		19.42	na				
201	10.38		25.69	na				
B5	10.0	11.2	14.4	na	42.49	0.1	330	7.0
B6	10.0	5.6	10.52	na	18.16	0.1	180	7.0
B7	10.0	5.6	10.84	na	18.44	0.1	180	7.0
B8	10.0	5.6	10.91	na	18.49	0.1	180	7.0
B9	10.0	5.6	12.02	na	19.42	0.1	180	7.0
B10	10.0	5.6	15.12	na	21.77	0.1	180	7.0
6B	10.38		13.08	na				
7B	10.38		13.28	na				
8B	10.38		13.7	na				
9B	10.38		14.74	na				
10B	10.38		18.52	na				
B11	10.0	11.2	11.35	na	37.73	0.1	330	7.0
11B	10.38		20.9	na				
B12	10.0	5.6	19.35	na	24.64	0.1	180	7.0
B13	10.0	5.6	19.69	na	24.85	0.1	180	7.0
12B	10.38		23.59	na				
13B	10.38		24.0	na				
202	10.38		25.71	na				
203	10.38		25.71	na				
204	10.38		25.77	na				
205	10.38		25.82	na				
206	10.38		26.63	na				
207	10.38		27.67	na				
208	10.38		27.74	na				
209	10.38		27.84	na				
210	10.38		27.87	na				
211	33.0		18.31	na				
212	33.0		18.34	na				
213	33.0		18.38	na				
R23	34.0		18.21	na				
214	34.0		20.28	na				
215	33.0		20.97	na				
216	10.38		31.05	na				
5B	10.38		26.34	na				
221	10.38		29.77	na				
220	10.38		36.19	na				
219	10.38		37.11	na				
261	10.38		44.08	na				
262	12.667		43.45	na				
263	12.667		44.3	na				
264	13.417		44.73	na				
265	11.38		46.74	na				
217	10.38		31.21	na				
218	10.38		37.69	na				
247	10.38		44.54	na				
246	10.38		47.16	na				
266	10.38		48.11	na				
245	10.38		48.72	na				
251	10.38		48.76	na				
252	10.38		49.5	na				
TR2	10.38		50.32	na				
BR2	3.0		58.39	na				
BR3	3.0		58.55	na				

Flow Summary - Standard

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

Page 4
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
UG	0.0		59.85	na				
HOSE	0.0		63.13	na	100.0			
TEST	0.0		63.14	na				

The maximum velocity is 18.92 and it occurs in the pipe between nodes 10B and 203

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

Page 5
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
B1 to 1B	19.26 19.26	1.097 120.0 0.0976	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	11.824 -0.165 2.767			K Factor = 5.60	
	0.0 19.26						14.426		K Factor = 5.07	
B2 to 2B	19.58 19.58	1.097 120.0 0.1006	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	12.225 -0.165 2.854			K Factor = 5.60	
	0.0 19.58						14.914		K Factor = 5.07	
B3 to 3B	33.00 33.0	1.097 120.0 0.2643	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	8.681 -0.165 7.495			K Factor = 11.20	
	0.0 33.00						16.011		K Factor = 8.25	
B4 to 4B	22.36 22.36	1.097 120.0 0.1286	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	15.937 -0.165 3.647			K Factor = 5.60	
	0.0 22.36						19.419		K Factor = 5.07	
1B to 2B	19.26 19.26	1.442 120.0 0.0258	2E	7.432 0.0 0.0	11.500 7.432 18.932	14.426 0.0 0.488				Vel = 3.78
2B to 3B	19.58 38.84	1.442 120.0 0.0942		0.0 0.0 0.0	11.640 0.0 11.640	14.914 0.0 1.097				Vel = 7.63
3B to 4B	33.00 71.84	1.442 120.0 0.2943		0.0 0.0 0.0	11.580 0.0 11.580	16.011 0.0 3.408				Vel = 14.11
4B to 201	22.35 94.19	1.442 120.0 0.4857	T	7.432 0.0 0.0	5.480 7.432 12.912	19.419 0.0 6.272				Vel = 18.50
201 to 202	0.0 94.19	3.26 120.0 0.0093		0.0 0.0 0.0	1.830 0.0 1.830	25.691 0.0 0.017				Vel = 3.62
	0.0 94.19						25.708		K Factor = 18.58	
B5 to 5B	42.50 42.5	1.097 120.0 0.4220	T Eq	6.217 21.139 0.0	1.330 27.356 28.686	14.396 -0.165 12.105			K Factor = 11.20	
	0.0 42.50						26.336		K Factor = 8.28	
B6 to 6B	18.16 18.16	1.097 120.0 0.0876	T Eq	6.217 21.139 0.0	3.740 27.356 31.096	10.520 -0.165 2.724			K Factor = 5.60	
	0.0 18.16						13.079		K Factor = 5.02	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
B7 to 7B	18.44 18.44	1.097 120.0 0.0901	T Eq	6.217 21.139 0.0	1.490 27.356 28.846	10.845 -0.165 2.598			K Factor = 5.60 Vel = 6.26	
	0.0 18.44						13.278		K Factor = 5.06	
B8 to 8B	18.49 18.49	1.097 120.0 0.0905	T Eq	6.217 21.139 0.0	5.310 27.356 32.666	10.906 -0.165 2.957			K Factor = 5.60 Vel = 6.28	
	0.0 18.49						13.698		K Factor = 5.00	
B9 to 9B	19.42 19.42	1.097 120.0 0.0991	T Eq	6.217 21.139 0.0	1.780 27.356 29.136	12.021 -0.165 2.887			K Factor = 5.60 Vel = 6.59	
	0.0 19.42						14.743		K Factor = 5.06	
B10 to 10B	21.77 21.77	1.097 120.0 0.1225	T Eq	6.217 21.139 0.0	1.780 27.356 29.136	15.118 -0.165 3.569			K Factor = 5.60 Vel = 7.39	
	0.0 21.77						18.522		K Factor = 5.06	
6B to 7B	18.16 18.16	1.442 120.0 0.0231		0.0 0.0 0.0	8.630 0.0 8.630	13.079 0.0 0.199			Vel = 3.57	
7B to 8B	18.45 36.61	1.442 120.0 0.0845		0.0 0.0 0.0	4.970 0.0 4.970	13.278 0.0 0.420			Vel = 7.19	
8B to 9B	18.49 55.1	1.442 120.0 0.1802		0.0 0.0 0.0	5.800 0.0 5.800	13.698 0.0 1.045			Vel = 10.82	
9B to 10B	19.41 74.51	1.442 120.0 0.3149		0.0 0.0 0.0	12.000 0.0 12.000	14.743 0.0 3.779			Vel = 14.64	
10B to 203	21.78 96.29	1.442 120.0 0.5059	T	7.432 0.0 0.0	6.770 7.432 14.202	18.522 0.0 7.185			Vel = 18.92	
	0.0 96.29						25.707		K Factor = 18.99	
B11 to 11B	37.73 37.73	1.097 120.0 0.3387	T Eq	6.217 21.139 0.0	1.330 27.356 28.686	11.349 -0.165 9.715			K Factor = 11.20 Vel = 12.81	
11B to 204	0.0 37.73	1.097 120.0 0.3387	E T	2.487 6.217 0.0	5.670 8.704 14.374	20.899 0.0 4.868			Vel = 12.81	
	0.0 37.73						25.767		K Factor = 7.43	
B12 to 12B	24.64 24.64	1.097 120.0 0.1539	T Eq	6.217 21.139 0.0	1.250 27.356 28.606	19.353 -0.165 4.403			K Factor = 5.60 Vel = 8.36	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

Page 7
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 24.64					23.591			K Factor = 5.07	
B13 to 13B	24.85	1.097 120.0	T Eq	6.217 21.139	1.250 27.356	19.689 -0.165			K Factor = 5.60	
	24.85	0.1564		0.0	28.606	4.473			Vel = 8.44	
	0.0 24.85					23.997			K Factor = 5.07	
12B to 13B	24.64	1.442 120.0		0.0 0.0	10.000 0.0	23.591 0.0				
	24.64	0.0406		0.0	10.000	0.406			Vel = 4.84	
13B to 205	24.84	1.442 120.0	T	7.432 0.0	4.910 7.432	23.997 0.0				
	49.48	0.1476		0.0	12.342	1.822			Vel = 9.72	
	0.0 49.48					25.819			K Factor = 9.74	
202 to 203	-4.98	3.26 120.0		0.0 0.0	11.080 0.0	25.708 0.0				
	-4.98	-0.0001		0.0	11.080	-0.001			Vel = 0.19	
203 to 204	96.29	3.26 120.0		0.0 0.0	6.920 0.0	25.707 0.0				
	91.31	0.0087		0.0	6.920	0.060			Vel = 3.51	
204 to 205	37.73	3.26 120.0		0.0 0.0	3.200 0.0	25.767 0.0				
	129.04	0.0162		0.0	3.200	0.052			Vel = 4.96	
205 to 206	49.48	3.26 120.0		0.0 0.0	27.190 0.0	25.819 0.0				
	178.52	0.0299		0.0	27.190	0.812			Vel = 6.86	
206 to 207	0.0	3.26 120.0	2E	18.815 0.0	15.940 18.815	26.631 0.0				
	178.52	0.0298		0.0	34.755	1.037			Vel = 6.86	
207 to 208	-130.93	3.26 120.0	E	9.408 0.0	16.960 9.408	27.668 0.0				
	47.59	0.0026		0.0	26.368	0.068			Vel = 1.83	
208 to 209	0.0	3.26 120.0	2E	18.815 0.0	20.830 18.815	27.736 0.0				
	47.59	0.0026		0.0	39.645	0.103			Vel = 1.83	
209 to 210	0.0	3.26 120.0		0.0 0.0	10.480 0.0	27.839 0.0				
	47.59	0.0026		0.0	10.480	0.027			Vel = 1.83	
210 to 211	0.0	3.26 120.0	4E T	37.631 20.159	36.910 57.790	27.866 -9.797				
	47.59	0.0026		0.0	94.700	0.245			Vel = 1.83	
211 to 212	0.0	3.26 120.0		0.0 0.0	11.170 0.0	18.314 0.0				
	47.59	0.0026		0.0	11.170	0.029			Vel = 1.83	
212 to 213	0.0	3.26 120.0		0.0 0.0	14.650 0.0	18.343 0.0				
	47.59	0.0026		0.0	14.650	0.038			Vel = 1.83	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

Page 8
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
213 to R23	0.0 47.59	2.157 120.0 0.0193	T	12.307 0.0 0.0	1.000 12.307 13.307	18.381 -0.433 0.257			Vel = 4.18	
R23 to 214	0.0 47.59	2.157 120.0 0.0193	2T	24.613 0.0 0.0	82.670 24.613 107.283	18.205 0.0 2.074			Vel = 4.18	
214 to 215	0.0 47.59	2.157 120.0 0.0194	T	12.307 0.0 0.0	1.000 12.307 13.307	20.279 0.433 0.258			Vel = 4.18	
215 to 216	0.0 47.59	3.26 120.0 0.0026	3E	28.223 0.0 0.0	83.370 28.223 111.593	20.970 9.797 0.288			Vel = 1.83	
216 to 217	0.0 47.59	3.26 120.0 0.0026	E T	9.408 20.159 0.0	29.700 29.567 59.267	31.055 0.0 0.153			Vel = 1.83	
	0.0 47.59					31.208			K Factor = 8.52	
202 to 5B	99.17 99.17	2.635 120.0 0.0284	T	16.474 0.0 0.0	5.670 16.474 22.144	25.708 0.0 0.628			Vel = 5.83	
5B to 221	42.50 141.67	2.635 120.0 0.0549	3E	24.711 0.0 0.0	37.930 24.711 62.641	26.336 0.0 3.436			Vel = 8.34	
221 to 220	0.0 141.67	2.635 120.0 0.0549	4E	32.948 0.0 0.0	84.070 32.948 117.018	29.772 0.0 6.421			Vel = 8.34	
220 to 219	0.0 141.67	3.26 120.0 0.0195	E	9.408 0.0 0.0	37.500 9.408 46.908	36.193 0.0 0.913			Vel = 5.45	
219 to 218	0.0 141.67	3.26 120.0 0.0194	E	9.408 0.0 0.0	20.620 9.408 30.028	37.106 0.0 0.584			Vel = 5.45	
	0.0 141.67					37.690			K Factor = 23.08	
261 to 262	132.34 132.34	3.26 120.0 0.0171	2E	18.815 0.0 0.0	2.292 18.815 21.107	44.076 -0.990 0.361			Vel = 5.09	
262 to 263	0.0 132.34	3.26 120.0 0.0172	E	9.408 0.0 0.0	40.188 9.408 49.596	43.447 0.0 0.851			Vel = 5.09	
263 to 264	0.0 132.34	3.26 120.0 0.0172	2E	18.815 0.0 0.0	25.396 18.815 44.211	44.298 -0.325 0.759			Vel = 5.09	
264 to 265	0.0 132.34	3.26 120.0 0.0172	3E	28.223 0.0 0.0	37.562 28.223 65.785	44.732 0.882 1.129			Vel = 5.09	
265 to 266	0.0 132.34	3.26 120.0 0.0171	E T	9.408 20.159 0.0	24.667 29.567 54.234	46.743 0.433 0.930			Vel = 5.09	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 1

Page 9
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv. Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 132.34				48.106			K Factor = 19.08	
207 to 217	130.93	2.635 120.0 0.0474	T	16.474 0.0 0.0	58.170 16.474 74.644	27.668 0.0 3.540		Vel = 7.70	
217 to 218	47.59	2.635 120.0 0.0842	2E T	16.474 16.474 0.0	44.070 32.948 77.018	31.208 0.0 6.482		Vel = 10.50	
218 to 261	141.67	3.26 120.0 0.0880	2E T	18.815 20.159 0.0	33.625 38.974 72.599	37.690 0.0 6.386		Vel = 12.31	
261 to 247	-132.34	3.26 120.0 0.0327	E	9.408 0.0 0.0	4.792 9.408 14.200	44.076 0.0 0.465		Vel = 7.22	
247 to 246	0.0	3.26 120.0 0.0328	E	9.408 0.0 0.0	70.542 9.408 79.950	44.541 0.0 2.622		Vel = 7.22	
246 to 266	0.0	3.26 120.0 0.0328		0.0 0.0 0.0	28.750 0.0 28.750	47.163 0.0 0.943		Vel = 7.22	
266 to 245	132.34	4.26 120.0 0.0239		0.0 0.0 0.0	25.500 0.0 25.500	48.106 0.0 0.610		Vel = 7.21	
245 to 251	0.0	4.26 120.0 0.0239		0.0 0.0 0.0	1.970 0.0 1.970	48.716 0.0 0.047		Vel = 7.21	
251 to 252	0.0	4.26 120.0 0.0239	E	13.167 0.0 0.0	17.550 13.167 30.717	48.763 0.0 0.734		Vel = 7.21	
252 to TR2	0.0	4.26 120.0 0.0239	2E	26.334 0.0 0.0	8.130 26.334 34.464	49.497 0.0 0.824		Vel = 7.21	
TR2 to BR2	0.0	4.26 120.0 0.0239	B S T Fsp	15.8 28.968 26.334 0.0	7.380 71.102 78.482	50.321 6.196 1.876		* * Fixed Loss = 3 Vel = 7.21	
BR2 to BR3	0.0	6.357 120.0 0.0034	T	37.72 0.0 0.0	7.500 37.720 45.220	58.393 0.0 0.154		Vel = 3.24	
BR3 to UG	0.0	6.357 120.0 0.0035		0.0 0.0 0.0	2.000 0.0 2.000	58.547 1.299 0.007		Vel = 3.24	
UG to HOSE	0.0	6.16 140.0 0.0030	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	59.853 2.856 0.425		* * Fixed Loss = 2.856 Vel = 3.45	
HOSE to TEST	100.00	6.16 140.0 0.0040		0.0 0.0 0.0	0.500 0.0 0.500	63.134 0.0 0.002		Qa = 100 Vel = 4.52	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 2 – Area 2 Entry Vestibule**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/16/2021**
LATEST REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Unobstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 2 – Area 2	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 34'-2"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK300
K-FACTOR: 5.6	TEMPERATURE (°F): 155

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Light Hazard
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.10	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 210	TOTAL SPRINKLERS OPERATING: 11
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 100
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 248.16	PRESSURE REQ'D (PSI): 59.950
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 348.16	PRESSURE REQ'D (PSI): 63.159
AREA SAFETY MARGIN (PSI): 12.985		

NOTES:
3-13-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : Lee's Summit Middle School - Level 1 - System 2 - Area 2
Drawing :
Location :
Remote Area :
Contract :
Data File : Lee's Summit Middle School - Level 1 - System 2 - Area 2 Ent

Water Supply Curve C

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 2

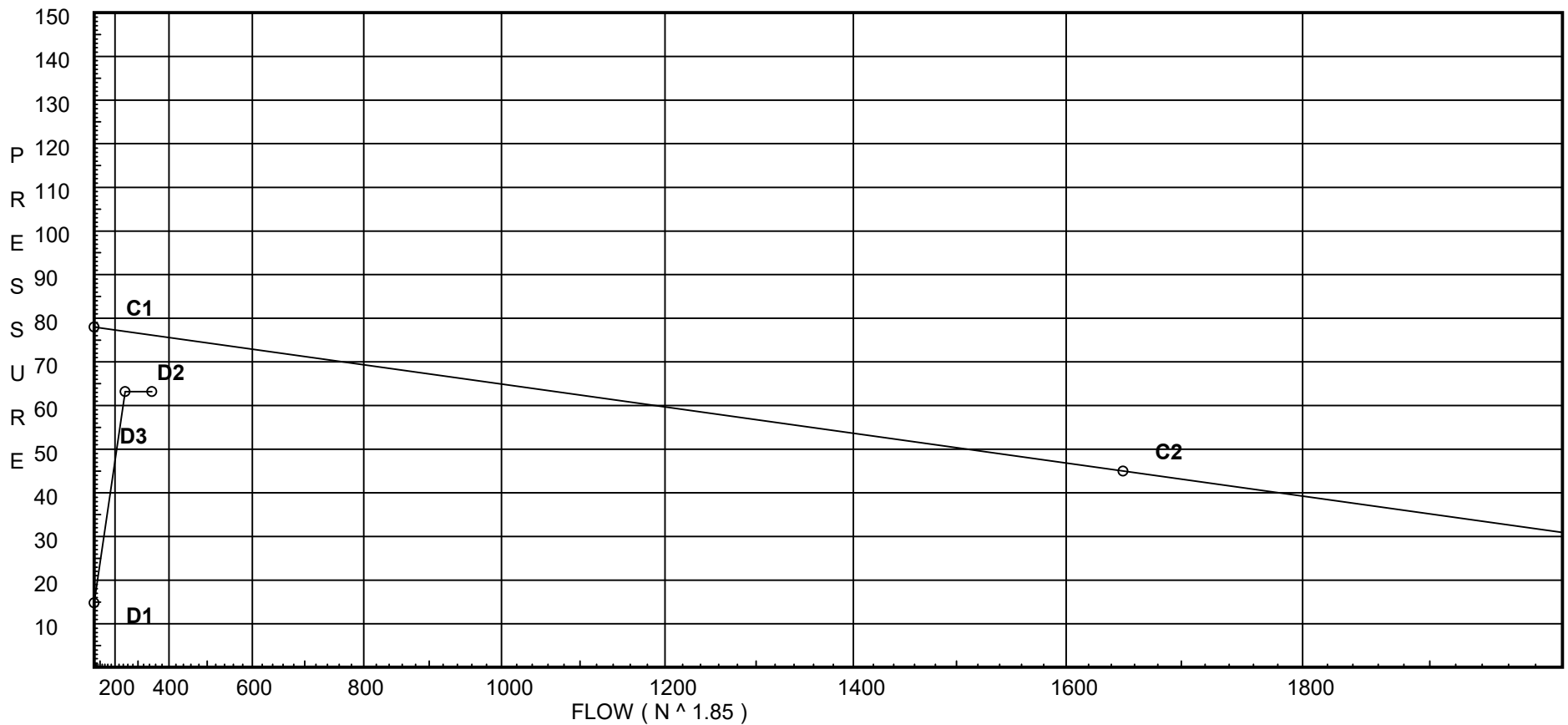
Page 1
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 14.799
D2 - System Flow : 248.16
D2 - System Pressure : 63.159
Hose (Demand) : 100
D3 - System Demand : 348.16
Safety Margin : 12.985



Fittings Used Summary

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 2

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 2

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
B21	34.17	5.6	14.06	na	21.0	0.1	210	7.0
B22	34.17	5.6	14.18	na	21.09	0.1	210	7.0
B23	34.17	5.6	14.96	na	21.66	0.1	210	7.0
B24	34.17	5.6	16.63	na	22.84	0.1	210	7.0
R21	34.17		19.52	na				
B25	34.0	5.6	16.52	na	22.76	0.1	210	7.0
25B	34.0		17.12	na				
B26	34.0	5.6	17.37	na	23.34	0.1	210	7.0
B27	34.0	5.6	18.28	na	23.95	0.1	210	7.0
R22	34.0		20.24	na				
B28	34.0	5.6	15.71	na	22.2	0.1	210	7.0
B29	34.0	5.6	15.95	na	22.36	0.1	210	7.0
B30	34.0	5.6	16.7	na	22.88	0.1	210	7.0
B31	34.0	5.6	18.5	na	24.08	0.1	210	7.0
202	10.38		37.58	na				
203	10.38		37.48	na				
204	10.38		37.42	na				
205	10.38		37.39	na				
206	10.38		37.15	na				
207	10.38		36.84	na				
208	10.38		36.09	na				
209	10.38		34.97	na				
210	10.38		34.68	na				
211	33.0		22.21	na				
212	33.0		22.12	na				
213	33.0		22.11	na				
R23	34.0		21.64	na				
214	34.0		26.44	na				
215	33.0		27.47	na				
216	10.38		37.93	na				
5B	10.38		38.13	na				
221	10.38		39.7	na				
220	10.38		42.62	na				
219	10.38		43.04	na				
261	10.38		47.29	na				
262	12.667		46.6	na				
263	12.667		47.05	na				
264	13.417		47.2	na				
265	11.38		48.79	na				
217	10.38		38.28	na				
218	10.38		43.31	na				
247	10.38		47.58	na				
246	10.38		49.21	na				
266	10.38		49.8	na				
245	10.38		50.18	na				
251	10.38		50.21	na				
252	10.38		50.67	na				
TR2	10.38		51.18	na				
BR2	3.0		58.55	na				
BR3	3.0		58.65	na				
UG	0.0		59.95	na				
HOSE	0.0		63.16	na	100.0			
TEST	0.0		63.16	na				

The maximum velocity is 13.22 and it occurs in the pipe between nodes B31 and R23

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 2

Page 4
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
B21 to B22	21.00 21.0	1.682 120.0 0.0144		0.0 0.0 0.0	8.500 0.0 8.500	14.062 0.0 0.122			K Factor = 5.60 Vel = 3.03	
B22 to B23	21.09 42.09	1.682 120.0 0.0517		0.0 0.0 0.0	15.000 0.0 15.000	14.184 0.0 0.776			K Factor = 5.60 Vel = 6.08	
B23 to B24	21.66 63.75	1.682 120.0 0.1115		0.0 0.0 0.0	15.000 0.0 15.000	14.960 0.0 1.672			K Factor = 5.60 Vel = 9.20	
B24 to R21	22.84 86.59	1.682 120.0 0.1964	T	9.9 0.0 0.0	4.830 9.900 14.730	16.632 0.0 2.893			K Factor = 5.60 Vel = 12.50	
R21 to 211	0.0 86.59	1.682 120.0 0.1964	T	9.9 0.0 0.0	1.170 9.900 11.070	19.525 0.507 2.174			Vel = 12.50	
	0.0 86.59					22.206			K Factor = 18.38	
B25 to 25B	22.76 22.76	1.097 120.0 0.1331	E	2.487 0.0 0.0	2.000 2.487 4.487	16.521 0.0 0.597			K Factor = 5.60 Vel = 7.73	
25B to B26	0.0 22.76	1.682 120.0 0.0166		0.0 0.0 0.0	15.000 0.0 15.000	17.118 0.0 0.249			Vel = 3.29	
B26 to B27	23.34 46.1	1.682 120.0 0.0611		0.0 0.0 0.0	15.000 0.0 15.000	17.367 0.0 0.917			K Factor = 5.60 Vel = 6.66	
B27 to R22	23.94 70.04	1.682 120.0 0.1327	T	9.9 0.0 0.0	4.830 9.900 14.730	18.284 0.0 1.955			K Factor = 5.60 Vel = 10.11	
R22 to 212	0.0 70.04	1.682 120.0 0.1327	T	9.9 0.0 0.0	1.000 9.900 10.900	20.239 0.433 1.446			Vel = 10.11	
	0.0 70.04					22.118			K Factor = 14.89	
B28 to B29	22.20 22.2	1.682 120.0 0.0159		0.0 0.0 0.0	14.860 0.0 14.860	15.712 0.0 0.236			K Factor = 5.60 Vel = 3.21	
B29 to B30	22.36 44.56	1.682 120.0 0.0575		0.0 0.0 0.0	13.020 0.0 13.020	15.948 0.0 0.748			K Factor = 5.60 Vel = 6.43	
B30 to B31	22.88 67.44	1.682 120.0 0.1237		0.0 0.0 0.0	14.550 0.0 14.550	16.696 0.0 1.800			K Factor = 5.60 Vel = 9.74	
B31 to R23	24.09 91.53	1.682 120.0 0.2176	T	9.9 0.0 0.0	4.560 9.900 14.460	18.496 0.0 3.147			K Factor = 5.60 Vel = 13.22	
	0.0 91.53					21.643			K Factor = 19.67	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 2

Page 5
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
202 to 203	-92.64	3.26 120.0 -0.0089		0.0 0.0 0.0	11.080 0.0 11.080	37.577 0.0 -0.099				
								Vel =	3.56	
203 to 204	0.0	3.26 120.0 -0.0088		0.0 0.0 0.0	6.920 0.0 6.920	37.478 0.0 -0.061				
								Vel =	3.56	
204 to 205	0.0	3.26 120.0 -0.0087		0.0 0.0 0.0	3.200 0.0 3.200	37.417 0.0 -0.028				
								Vel =	3.56	
205 to 206	0.0	3.26 120.0 -0.0089		0.0 0.0 0.0	27.190 0.0 27.190	37.389 0.0 -0.242				
								Vel =	3.56	
206 to 207	0.0	3.26 120.0 -0.0089	2E	18.815 0.0 0.0	15.940 18.815 34.755	37.147 0.0 -0.308				
								Vel =	3.56	
207 to 208	-80.66	3.26 120.0 -0.0283	E	9.408 0.0 0.0	16.960 9.408 26.368	36.839 0.0 -0.745				
								Vel =	6.66	
208 to 209	0.0	3.26 120.0 -0.0283	2E	18.815 0.0 0.0	20.830 18.815 39.645	36.094 0.0 -1.120				
								Vel =	6.66	
209 to 210	0.0	3.26 120.0 -0.0282		0.0 0.0 0.0	10.480 0.0 10.480	34.974 0.0 -0.296				
								Vel =	6.66	
210 to 211	0.0	3.26 120.0 -0.0282	4E T	37.631 20.159 0.0	36.910 57.790 94.700	34.678 -9.797 -2.675				
								Vel =	6.66	
211 to 212	86.59	3.26 120.0 -0.0079		0.0 0.0 0.0	11.170 0.0 11.170	22.206 0.0 -0.088				
								Vel =	3.33	
212 to 213	70.05	3.26 120.0 -0.0003		0.0 0.0 0.0	14.650 0.0 14.650	22.118 0.0 -0.005				
								Vel =	0.64	
213 to R23	0.0	2.157 120.0 -0.0028	T	12.307 0.0 0.0	1.000 12.307 13.307	22.113 -0.433 -0.037				
								Vel =	1.46	
R23 to 214	91.52	2.157 120.0 0.0447	2T	24.613 0.0 0.0	82.670 24.613 107.283	21.643 0.0 4.794				
								Vel =	6.57	
214 to 215	0.0	2.157 120.0 0.0447	T	12.307 0.0 0.0	1.000 12.307 13.307	26.437 0.433 0.595				
								Vel =	6.57	
215 to 216	0.0	3.26 120.0 0.0060	3E	28.223 0.0 0.0	83.370 28.223 111.593	27.465 9.797 0.667				
								Vel =	2.88	
216 to 217	0.0	3.26 120.0 0.0060	E T	9.408 20.159 0.0	29.700 29.567 59.267	37.929 0.0 0.355				
								Vel =	2.88	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 2

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 74.86					38.284			K Factor = 12.10	
202 to 5B	92.64	2.635 120.0	T	16.474 0.0	5.670 16.474	37.577 0.0				
5B to 221	92.64	0.0250		0.0	22.144	0.553			Vel = 5.45	
5B to 221	0.0	2.635 120.0	3E	24.711 0.0	37.930 24.711	38.130 0.0				
221 to 220	92.64	0.0250		0.0	62.641	1.567			Vel = 5.45	
221 to 220	0.0	2.635 120.0	4E	32.948 0.0	84.070 32.948	39.697 0.0				
220 to 219	92.64	0.0250		0.0	117.018	2.926			Vel = 5.45	
220 to 219	0.0	3.26 120.0	E	9.408 0.0	37.500 9.408	42.623 0.0				
219 to 218	92.64	0.0089		0.0	46.908	0.416			Vel = 3.56	
219 to 218	0.0	3.26 120.0	E	9.408 0.0	20.620 9.408	43.039 0.0				
218	92.64	0.0089		0.0	30.028	0.266			Vel = 3.56	
	0.0 92.64					43.305			K Factor = 14.08	
261 to 262	102.72	3.26 120.0	2E	18.815 0.0	9.000 18.815	47.291 -0.990				
262 to 263	102.72	0.0107		0.0	27.815	0.298			Vel = 3.95	
262 to 263	0.0	3.26 120.0	E	9.408 0.0	32.420 9.408	46.599 0.0				
263 to 264	102.72	0.0107		0.0	41.828	0.449			Vel = 3.95	
263 to 264	0.0	3.26 120.0	2E	18.815 0.0	25.396 18.815	47.048 -0.325				
264 to 265	102.72	0.0107		0.0	44.211	0.475			Vel = 3.95	
264 to 265	0.0	3.26 120.0	3E	28.223 0.0	37.562 28.223	47.198 0.882				
265 to 266	102.72	0.0107		0.0	65.785	0.706			Vel = 3.95	
265 to 266	0.0	3.26 120.0	E T	9.408 20.159	24.667 29.567	48.786 0.433				
266	102.72	0.0107		0.0	54.234	0.582			Vel = 3.95	
	0.0 102.72					49.801			K Factor = 14.56	
207 to 217	80.65	2.635 120.0	T	16.474 0.0	58.170 16.474	36.839 0.0				
217 to 218	80.65	0.0194		0.0	74.644	1.445			Vel = 4.74	
217 to 218	74.87	2.635 120.0	2E T	16.474 16.474	44.070 32.948	38.284 0.0				
218 to 261	155.52	0.0652		0.0	77.018	5.021			Vel = 9.15	
218 to 261	92.64	3.26 120.0	2E T	18.815 20.159	33.625 38.974	43.305 0.0				
261 to 247	248.16	0.0549		0.0	72.599	3.986			Vel = 9.54	
261 to 247	-102.72	3.26 120.0	E	9.408 0.0	4.792 9.408	47.291 0.0				
247	145.44	0.0204		0.0	14.200	0.290			Vel = 5.59	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 2

Page 7
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv. Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
247 to 246	0.0 145.44	3.26 120.0 0.0204	E	9.408 0.0 0.0	70.542 9.408 79.950	47.581 0.0 1.633		Vel = 5.59	
246 to 266	0.0 145.44	3.26 120.0 0.0204		0.0 0.0 0.0	28.750 0.0 28.750	49.214 0.0 0.587		Vel = 5.59	
266 to 245	102.72 248.16	4.26 120.0 0.0149		0.0 0.0 0.0	25.500 0.0 25.500	49.801 0.0 0.381		Vel = 5.59	
245 to 251	0.0 248.16	4.26 120.0 0.0147		0.0 0.0 0.0	1.970 0.0 1.970	50.182 0.0 0.029		Vel = 5.59	
251 to 252	0.0 248.16	4.26 120.0 0.0149	E	13.167 0.0 0.0	17.550 13.167 30.717	50.211 0.0 0.458		Vel = 5.59	
252 to TR2	0.0 248.16	4.26 120.0 0.0149	2E	26.334 0.0 0.0	8.130 26.334 34.464	50.669 0.0 0.514		Vel = 5.59	
TR2 to BR2	0.0 248.16	4.26 120.0 0.0149	B S T Fsp	15.8 28.968 26.334 0.0	7.380 71.102 78.482	51.183 6.196 1.171		* * Fixed Loss = 3 Vel = 5.59	
BR2 to BR3	0.0 248.16	6.357 120.0 0.0021	T	37.72 0.0 0.0	7.500 37.720 45.220	58.550 0.0 0.096		Vel = 2.51	
BR3 to UG	0.0 248.16	6.357 120.0 0.0025		0.0 0.0 0.0	2.000 0.0 2.000	58.646 1.299 0.005		Vel = 2.51	
UG to HOSE	0.0 248.16	6.16 140.0 0.0019	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	59.950 2.942 0.266		* * Fixed Loss = 2.942 Vel = 2.67	
HOSE to TEST	100.00 348.16	6.16 140.0 0.0020		0.0 0.0 0.0	0.500 0.0 0.500	63.158 0.0 0.001		Qa = 100 Vel = 3.75	
	0.0 348.16					63.159		K Factor = 43.81	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 2 – Area 3 Mechanical & Storage Rooms**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/16/2021**
LATEST REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Unobstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 2 – Area 3	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 15'-11"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK3501
K-FACTOR: 8.0	TEMPERATURE (°F): Storage: 155, Mech Rm: 286

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Ordinary Hazard Group 2
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.20	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 110	TOTAL SPRINKLERS OPERATING: 20
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI): 7
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 250
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 516.32	PRESSURE REQ'D (PSI): 52.194
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 766.32	PRESSURE REQ'D (PSI): 55.987
AREA SAFETY MARGIN (PSI): 14.027		

NOTES:
3-13-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : Lee's Summit Middle School - Level 1 - System 2 - Area 3
Drawing :
Location :
Remote Area :
Contract :
Data File : Lee's Summit Middle School - Level 1 - System 2 - Area 3 Mec

Water Supply Curve C

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 3

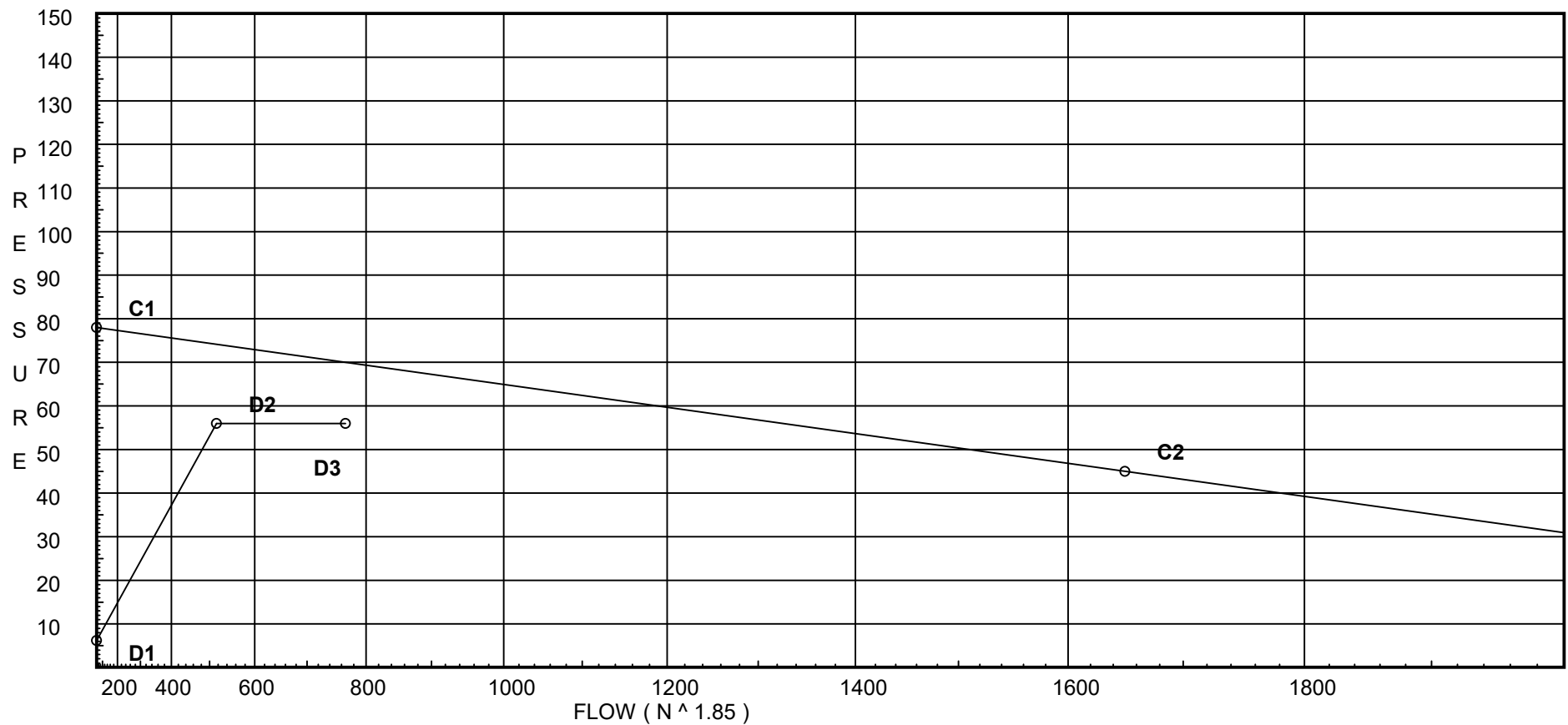
Page 1
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 6.154
D2 - System Flow : 516.324
D2 - System Pressure : 55.987
Hose (Demand) : 250
D3 - System Demand : 766.324
Safety Margin : 14.027



Fittings Used Summary

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 3

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 3

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
SP07	14.88	8	7.56	na	22.0	0.2	110	7.0
EQ07	13.21		9.27	na				
SP06	14.88	8	7.56	na	22.0	0.2	110	7.0
EQ06	14.21		8.25	na				
SP05	14.88	8	7.56	na	22.0	0.2	110	7.0
EQ05	14.21		8.71	na				
B41	14.88	8	11.54	na	27.18	0.2	110	7.0
B42	14.88	8	11.73	na	27.4	0.2	110	7.0
B43	14.88	8	12.41	na	28.18	0.2	110	7.0
R41	14.88		14.58	na				
B44	13.21	K = K @ EQ07	15.33	na	28.29			
B45	13.21	K = K @ EQ07	15.51	na	28.46			
B46	14.88	8	11.72	na	27.39	0.2	110	7.0
B47	14.88	8	11.91	na	27.61	0.2	110	7.0
B48	14.88	8	12.6	na	28.4	0.2	110	7.0
R42	14.88		14.81	na				
B49	13.21	K = K @ EQ07	15.55	na	28.49			
B50	13.21	K = K @ EQ07	15.74	na	28.66			
B51	14.21	K = K @ EQ06	8.58	na	22.44			
B52	14.21	K = K @ EQ05	8.71	na	22.0			
B53	14.21	K = K @ EQ05	9.12	na	22.51			
B54	14.21	K = K @ EQ05	9.81	na	23.35			
B55	14.21	K = K @ EQ05	11.99	na	25.81			
R43	14.21		12.39	na				
B56	14.21	K = K @ EQ06	9.2	na	23.23			
B57	14.21	K = K @ EQ05	9.34	na	22.77			
B58	14.21	K = K @ EQ05	9.77	na	23.3			
B59	14.21	K = K @ EQ05	10.51	na	24.16			
B60	14.21	K = K @ EQ05	12.84	na	26.7			
R44	14.21		13.25	na				
241	13.21		15.61	na				
242	13.21		15.84	na				
243	13.21		16.5	na				
244	13.21		17.61	na				
245	10.38		35.88	na				
251	10.38		36.0	na				
252	10.38		37.78	na				
TR2	10.38		39.77	na				
BR2	3.0		50.51	na				
BR3	3.0		50.88	na				
UG	0.0		52.19	na				
HOSE	0.0		55.98	na	250.0			
TEST	0.0		55.99	na				

The maximum velocity is 19.85 and it occurs in the pipe between nodes 244 and 245

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 3

Page 4
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
SP07 to EQ07	22.00 22.0	1.097 120.0 0.1249	T	6.217 0.0 0.0	1.670 6.217 7.887	7.562 0.723 0.985			K Factor = 8.00	
	0.0 22.00						9.270		K Factor = 7.23	
SP06 to EQ06	22.00 22.0	1.097 120.0 0.1251	E	2.487 0.0 0.0	0.670 2.487 3.157	7.562 0.290 0.395			K Factor = 8.00	
	0.0 22.00						8.247		K Factor = 7.66	
SP05 to EQ05	22.00 22.0	1.097 120.0 0.1249	T	6.217 0.0 0.0	0.670 6.217 6.887	7.562 0.290 0.860			K Factor = 8.00	
	0.0 22.00						8.712		K Factor = 7.45	
B41 to B42	27.18 27.18	1.682 120.0 0.0230		0.0 0.0 0.0	8.170 0.0 8.170	11.539 0.0 0.188			K Factor = 8.00	
B42 to B43	27.39 54.57	1.682 120.0 0.0836		0.0 0.0 0.0	8.170 0.0 8.170	11.727 0.0 0.683			K Factor = 8.00	
B43 to R41	28.18 82.75	1.682 120.0 0.1806	E	4.95 0.0 0.0	7.080 4.950 12.030	12.410 0.0 2.173			K Factor = 8.00	
R41 to 241	0.0 82.75	1.682 120.0 0.1808		0.0 0.0 0.0	1.670 0.0 1.670	14.583 0.723 0.302			Vel = 11.95	
	0.0 82.75						15.608		K Factor = 20.95	
B44 to B45	28.29 28.29	1.682 120.0 0.0248		0.0 0.0 0.0	7.350 0.0 7.350	15.329 0.0 0.182			K Factor @ node EQ07	
B45 to 241	28.46 56.75	1.682 120.0 0.0898		0.0 0.0 0.0	1.080 0.0 1.080	15.511 0.0 0.097			K Factor @ node EQ07	
	0.0 56.75						15.608		K Factor = 14.36	
B46 to B47	27.39 27.39	1.682 120.0 0.0234		0.0 0.0 0.0	8.170 0.0 8.170	11.718 0.0 0.191			K Factor = 8.00	
B47 to B48	27.60 54.99	1.682 120.0 0.0848		0.0 0.0 0.0	8.170 0.0 8.170	11.909 0.0 0.693			K Factor = 8.00	
B48 to R42	28.40 83.39	1.682 120.0 0.1832	E	4.95 0.0 0.0	7.080 4.950 12.030	12.602 0.0 2.204			K Factor = 8.00	
R42 to 242	0.0 83.39	1.682 120.0 0.1832		0.0 0.0 0.0	1.670 0.0 1.670	14.806 0.723 0.306			Vel = 12.04	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 3

Page 5
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 83.39					15.835			K Factor = 20.96	
B49 to B50	28.49	1.682 120.0		0.0 0.0	7.350 0.0	15.552 0.0			K Factor @ node EQ07	
B50 to 242	28.49	0.0252		0.0	7.350	0.185			Vel = 4.11	
B50 to 242	28.67	1.682 120.0		0.0 0.0	1.080 0.0	15.737 0.0			K Factor @ node EQ07	
	57.16	0.0907		0.0	1.080	0.098			Vel = 8.25	
	0.0 57.16					15.835			K Factor = 14.36	
B51 to B52	22.44	1.682 120.0		0.0 0.0	8.170 0.0	8.580 0.0			K Factor @ node EQ06	
B52 to B53	22.44	0.0162		0.0	8.170	0.132			Vel = 3.24	
B52 to B53	22.00	1.682 120.0		0.0 0.0	7.090 0.0	8.712 0.0			K Factor @ node EQ05	
	44.44	0.0573		0.0	7.090	0.406			Vel = 6.42	
B53 to B54	22.51	1.682 120.0		0.0 0.0	5.680 0.0	9.118 0.0			K Factor @ node EQ05	
	66.95	0.1220		0.0	5.680	0.693			Vel = 9.67	
B54 to R43	23.34	1.682 120.0	T	9.9 0.0	2.230 9.900	9.811 0.0			K Factor @ node EQ05	
	90.29	0.2123		0.0	12.130	2.575			Vel = 13.04	
	0.0 90.29					12.386			K Factor = 25.66	
B55 to R43	25.81	1.682 120.0	T	9.9 0.0	8.770 9.900	11.995 0.0			K Factor @ node EQ05	
	25.81	0.0209		0.0	18.670	0.391			Vel = 3.73	
R43 to 243	90.30	1.682 120.0	T	9.9 0.0	1.000 9.900	12.386 0.433				
	116.11	0.3379		0.0	10.900	3.683			Vel = 16.77	
	0.0 116.11					16.502			K Factor = 28.58	
B56 to B57	23.23	1.682 120.0		0.0 0.0	8.170 0.0	9.196 0.0			K Factor @ node EQ06	
B57 to B58	23.23	0.0173		0.0	8.170	0.141			Vel = 3.35	
B57 to B58	22.78	1.682 120.0		0.0 0.0	7.090 0.0	9.337 0.0			K Factor @ node EQ05	
	46.01	0.0609		0.0	7.090	0.432			Vel = 6.64	
B58 to B59	23.29	1.682 120.0		0.0 0.0	5.680 0.0	9.769 0.0			K Factor @ node EQ05	
	69.3	0.1301		0.0	5.680	0.739			Vel = 10.01	
B59 to R44	24.16	1.682 120.0	T	9.9 0.0	2.230 9.900	10.508 0.0			K Factor @ node EQ05	
	93.46	0.2262		0.0	12.130	2.744			Vel = 13.49	
	0.0 93.46					13.252			K Factor = 25.67	
B60 to R44	26.70	1.682 120.0	T	9.9 0.0	8.770 9.900	12.836 0.0			K Factor @ node EQ05	
	26.7	0.0223		0.0	18.670	0.416			Vel = 3.86	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Level 1 - System 2 - Area 3

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
R44 to 244	93.47 120.17	1.682 120.0 0.3602	T	9.9 0.0 0.0	1.000 9.900 10.900	13.252 0.433 3.926				Vel = 17.35
	0.0 120.17					17.611			K Factor = 28.64	
241 to 242	139.50 139.5	3.26 120.0 0.0189		0.0 0.0 0.0	12.000 0.0 12.000	15.608 0.0 0.227				Vel = 5.36
242 to 243	140.55 280.05	3.26 120.0 0.0686		0.0 0.0 0.0	9.720 0.0 9.720	15.835 0.0 0.667				Vel = 10.76
243 to 244	116.11 396.16	3.26 120.0 0.1305		0.0 0.0 0.0	8.500 0.0 8.500	16.502 0.0 1.109				Vel = 15.23
244 to 245	120.16 516.32	3.26 120.0 0.2129	3E T	28.223 20.159 0.0	31.690 48.382 80.072	17.611 1.226 17.047				Vel = 19.85
	0.0 516.32					35.884			K Factor = 86.19	
245 to 251	516.32 516.32	4.26 120.0 0.0579		0.0 0.0 0.0	1.970 0.0 1.970	35.884 0.0 0.114				Vel = 11.62
251 to 252	0.0 516.32	4.26 120.0 0.0579	E	13.167 0.0 0.0	17.550 13.167 30.717	35.998 0.0 1.778				Vel = 11.62
252 to TR2	0.0 516.32	4.26 120.0 0.0578	2E	26.334 0.0 0.0	8.130 26.334 34.464	37.776 0.0 1.993				Vel = 11.62
TR2 to BR2	0.0 516.32	4.26 120.0 0.0579	B S T Fsp	15.8 28.968 26.334 0.0	7.380 71.102 78.482	39.769 6.196 4.541			* * Fixed Loss = 3 Vel = 11.62	
BR2 to BR3	0.0 516.32	6.357 120.0 0.0082	T	37.72 0.0 0.0	7.500 37.720 45.220	50.506 0.0 0.373				Vel = 5.22
BR3 to UG	0.0 516.32	6.357 120.0 0.0080		0.0 0.0 0.0	2.000 0.0 2.000	50.879 1.299 0.016				Vel = 5.22
UG to HOSE	0.0 516.32	6.16 140.0 0.0072	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	52.194 2.757 1.028			* * Fixed Loss = 2.757 Vel = 5.56	
HOSE to TEST	250.00 766.32	6.16 140.0 0.0160		0.0 0.0 0.0	0.500 0.0 0.500	55.979 0.0 0.008			Qa = 250 Vel = 8.25	
	0.0 766.32					55.987			K Factor = 102.42	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 3 – Area 1 Auxiliary Gym**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/22/2021**
LATEST REVISION DATE:

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Obstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 3 – Area 1	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 27'-8"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK300
K-FACTOR: 5.6	TEMPERATURE (°F): 155

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Light Hazard
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.10	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 180	TOTAL SPRINKLERS OPERATING: 11
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 100
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 204.08	PRESSURE REQ'D (PSI): 40.586
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 304.08	PRESSURE REQ'D (PSI): 43.767
AREA SAFETY MARGIN (PSI): 32.79		

NOTES:

PE STAMP

Water Supply Curve C

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

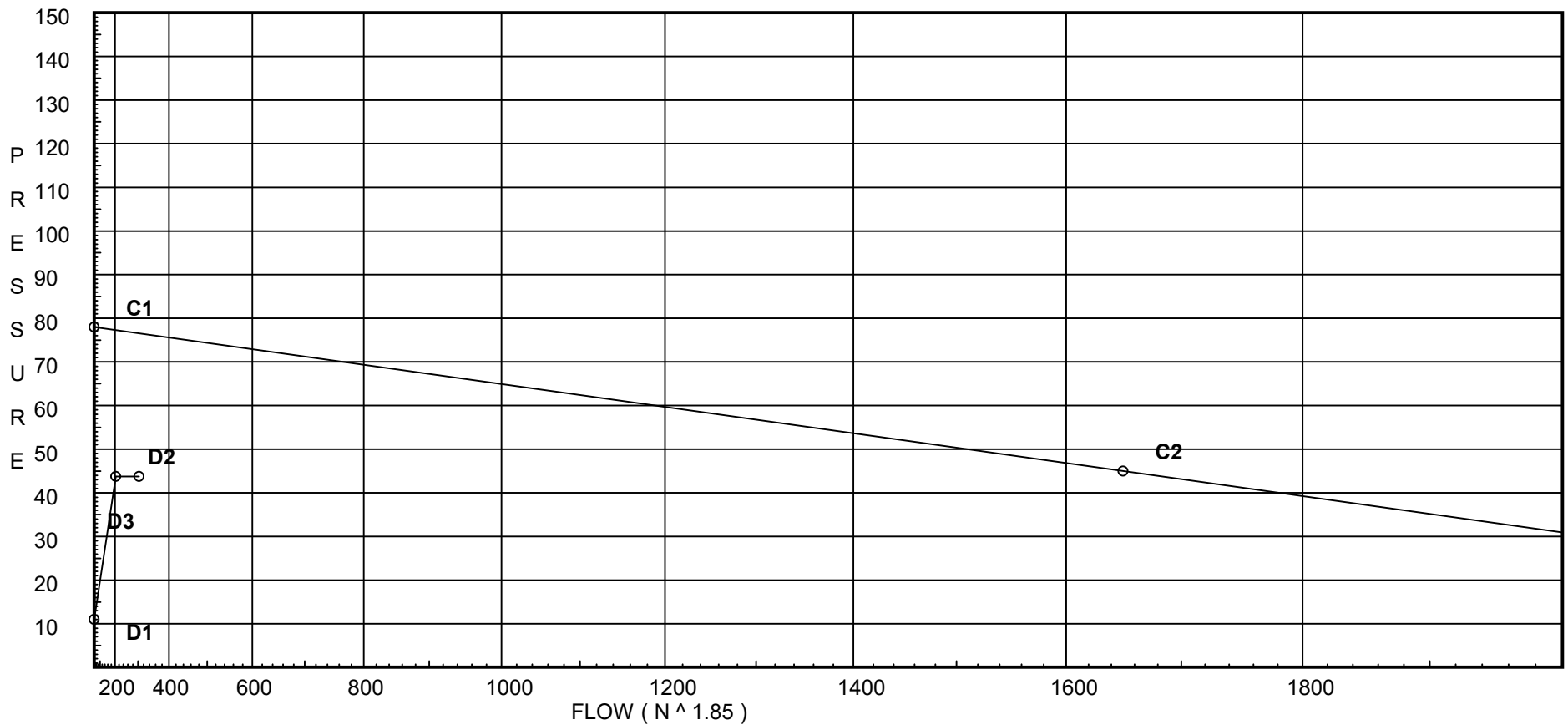
Page 2
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 11.009
D2 - System Flow : 204.082
D2 - System Pressure : 43.767
Hose (Demand) : 100
D3 - System Demand : 304.082
Safety Margin : 32.788



Fittings Used Summary

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 3
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 4
Date

SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
TEST	78.0	45	1650.0	76.556	304.08	43.767

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
352	10.67		30.08		
7	22.38		25.23		
C77	22.47		25.26		
C78	22.47		25.29		
C79	22.47		25.33		
C80	22.47		25.37		
C81	22.47		25.41		
8	22.37		25.5		
372	10.67		30.76		
C73	22.32		25.34		
C74	22.32		25.38		
C75	22.32		25.42		
C76	22.32		25.46		
350	10.67		30.08		
C69	22.1		25.43		
C70	22.1		25.46		
C71	22.1		25.5		
C72	22.1		25.53		
29	10.67		30.1		
C61	21.96		25.42		
C62	21.96		25.45		
C63	21.96		25.47		
C64	21.96		25.52		
C65	21.96		25.56		
C66	21.96		25.61		
C67	21.96		25.62		
C68	21.96		25.66		
322	14.4		24.44		
25	16.07		23.74		
323	14.13		24.86		
26	15.8		24.15		
324	13.9		25.18		
27	15.56		24.48		
325	13.63		25.48		
28	15.3		24.8		
326	10.67		26.99		
327	10.67		27.12		
328	10.67		27.13		
24	10.67		27.14		
309	26.45		16.7		
310	10.67		25.9		
311	10.67		26.02		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 5
Date

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
312	10.67		26.23		
313	10.67		26.54		
314	10.67		26.85		
315	10.67		27.28		
319	10.67		27.46		
318	10.67		27.47		
317	10.67		27.49		
316	10.67		27.59		
331	10.67		27.63		
332	10.67		28.0		
333	10.67		28.1		
334	10.67		28.16		
335	10.67		28.27		
336	10.67		28.82		
337	10.67		29.36		
390	10.67		29.48		
391	10.67		29.75		
392	10.67		30.18		
393	10.67		30.68		
382	25.08		14.73		
C5	25.08	5.6	10.79	18.4	
C4	25.08	5.6	10.38	18.04	
C3	25.08	5.6	10.34	18.01	
C2	25.08	5.6	10.44	18.1	
C1	25.08	5.6	11.01	18.58	
383	25.42		14.83		
C10	25.42	5.6	10.8	18.4	
C9	25.42	5.6	10.37	18.04	
C8	25.42	5.6	10.33	18.0	
C7	25.42	5.6	10.42	18.08	
C6	25.42	5.6	10.97	18.54	
384	25.75		15.56		
C11	25.75	5.6	15.29	21.9	
385	26.09		16.43		
387	27.29		17.2		
386	27.29		16.95		
388	27.29		19.15		
389	10.67		27.98		
308	26.45		16.52		
307	26.43		16.4		
306	26.33		16.33		
305	26.09		16.17		
304	25.75		15.88		
303	25.42		15.77		
302	25.08		15.92		
301	24.92		16.28		
321	24.92		16.53		
341	31.43		21.28		
C41	31.43		21.37		
C42	31.43		21.4		
C43	31.43		21.43		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 6
Date

NODE ANALYSIS (cont.)

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
C44	31.43		21.47		
342	31.12		21.41		
C45	31.12		21.5		
C46	31.12		21.54		
C47	31.12		21.57		
C48	31.12		21.6		
343	30.81		21.55		
344	30.5		21.68		
345	30.19		21.8		
346	29.88		21.92		
347	29.88		21.9		
348	29.88		21.88		
349	10.67		30.1		
351	10.67		30.07		
361	31.43		21.56		
362	31.12		21.69		
363	30.81		21.83		
364	30.5		21.97		
365	30.19		22.11		
366	29.88		22.26		
367	29.57		22.41		
368	29.42		22.5		
369	10.67		30.74		
370	10.67		30.76		
371	10.67		30.76		
394	10.67		30.91		
395	10.67		30.96		
396	10.67		31.63		
TR3	10.38		32.27		
BR3	3.0		39.28		
UG	0.0		40.59		
HOSE	0.0		43.77	100.0	
TEST	0.0		43.77		

Final Calculations - Hazen-Williams - 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 7
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
352 to 7	10.67 22.38		26.52 26.52	2.5 2.635	T 4E	16.474 32.948 0.0	38.920 49.422 88.342	120 -5.072 0.219		Vel = 1.56	
7 to C77	22.38 22.47		-19.70 6.82	1.25 1.442	T E	7.432 3.716 0.0	8.150 11.148 19.298	120 -0.039 0.072		Vel = 1.34	
C77 to C78	22.47 22.47		0.0 6.82	1.25 1.442		0.0 0.0 0.0	8.250 0.0 8.250	120 0.0 0.032		Vel = 1.34	
C78 to C79	22.47 22.47		0.0 6.82	1.25 1.442		0.0 0.0 0.0	10.750 0.0 10.750	120 0.0 0.040		Vel = 1.34	
C79 to C80	22.47 22.47		0.0 6.82	1.25 1.442		0.0 0.0 0.0	10.750 0.0 10.750	120 0.0 0.041		Vel = 1.34	
C80 to C81	22.47 22.47		0.0 6.82	1.25 1.442		0.0 0.0 0.0	10.250 0.0 10.250	120 0.0 0.039		Vel = 1.34	
C81 to 8	22.47 22.37		0.0 6.82	1.25 1.442	E	3.716 0.0 0.0	7.570 3.716 11.286	120 0.043 0.042		Vel = 1.34	
8 to 372	22.37 10.67		19.70 26.52	2.5 2.635	2T E	32.948 8.237 0.0	37.330 41.185 78.515	120 5.067 0.195		Vel = 1.56	
372 to 371	10.67 10.670		0.0 26.52	3 3.26		0.0 0.0 0.0	7.430 0.0 7.430	120 0.0 0.006		Vel = 1.02	
371			0.0 26.52					30.764		K Factor = 4.78	
7 to C73	22.38 22.32		19.70 19.7	2 2.157	2E	12.307 0.0 0.0	10.010 12.307 22.317	120 0.026 0.084		Vel = 1.73	
C73 to C74	22.32 22.32		0.0 19.7	2 2.157		0.0 0.0 0.0	10.890 0.0 10.890	120 0.0 0.041		Vel = 1.73	
C74 to C75	22.32 22.32		0.0 19.7	2 2.157		0.0 0.0 0.0	11.000 0.0 11.000	120 0.0 0.042		Vel = 1.73	
C75 to C76	22.32 22.32		0.0 19.7	2 2.157		0.0 0.0 0.0	9.920 0.0 9.920	120 0.0 0.037		Vel = 1.73	
C76 to 8	22.32 22.37		0.0 19.7	2 2.157	E	6.153 0.0 0.0	10.230 6.153 16.383	120 -0.022 0.062		Vel = 1.73	
8			0.0 19.70					25.496		K Factor = 3.90	
350 to C69	10.67 22.1		18.19 18.19	2 2.157	5E T	30.767 12.307 0.0	47.210 43.074 90.284	120 -4.950 0.294		Vel = 1.60	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 8
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C69 to C70	22.1 22.1		0.0 18.19	2 2.157	0.0 0.0	10.890 0.0	120 0.0032	25.428 0.035		Vel = 1.60	
C70 to C71	22.1 22.1		0.0 18.19	2 2.157	0.0 0.0	11.000 0.0	120 0.0033	25.463 0.036		Vel = 1.60	
C71 to C72	22.1 22.1		0.0 18.19	2 2.157	0.0 0.0	9.920 0.0	120 0.0033	25.499 0.033		Vel = 1.60	
C72 to 370	22.1 10.67		0.0 18.19	2 2.157	4E T 24.613 12.307 0.0	48.290 36.920 85.210	120 0.0033	25.532 4.950 0.278		Vel = 1.60	
370			0.0 18.19					30.760		K Factor = 3.28	
29 to C61	10.67 21.96		9.94 9.94	1.5 1.682	4E T 19.799 9.9 0.0	27.690 29.699 57.389	120 0.0036	30.101 -4.890 0.206		Vel = 1.44	
C61 to C62	21.96 21.96		0.0 9.94	1.5 1.682	0.0 0.0	9.500 0.0	120 0.0036	25.417 0.034		Vel = 1.44	
C62 to C63	21.96 21.96		0.0 9.94	1.5 1.682	0.0 0.0	5.480 0.0	120 0.0035	25.451 0.019		Vel = 1.44	
C63 to C64	21.96 21.96		0.0 9.94	1.5 1.682	0.0 0.0	12.670 0.0	120 0.0036	25.470 0.046		Vel = 1.44	
C64 to C65	21.96 21.96		0.0 9.94	1.5 1.682	0.0 0.0	12.670 0.0	120 0.0036	25.516 0.045		Vel = 1.44	
C65 to C66	21.96 21.96		0.0 9.94	1.5 1.682	0.0 0.0	12.670 0.0	120 0.0036	25.561 0.045		Vel = 1.44	
C66 to C67	21.96 21.96		0.0 9.94	1.5 1.682	0.0 0.0	3.540 0.0	120 0.0037	25.606 0.013		Vel = 1.44	
C67 to C68	21.96 21.96		0.0 9.94	1.5 1.682	0.0 0.0	11.050 0.0	120 0.0036	25.619 0.040		Vel = 1.44	
C68 to 369	21.96 10.67		0.0 9.94	1.5 1.682	3E T 14.849 9.9 0.0	28.330 24.749 53.079	120 0.0036	25.659 4.890 0.189		Vel = 1.44	
369			0.0 9.94					30.738		K Factor = 1.79	
322 to 25	14.4 16.07		4.46 4.46	1.25 1.38	T 6.0 0.0	1.670 6.000 7.670	120 0.0022	24.442 -0.723 0.017		Vel = 0.96	
25 to 312	16.07 10.67		0.0 4.46	1.25 1.442	2T 2E 14.864 7.432 0.0	70.390 22.296 92.686	120 0.0017	23.736 2.339 0.159		Vel = 0.88	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 9
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
312			0.0 4.46					26.234		K Factor = 0.87	
323 to 26	14.13 15.8		4.50 4.5	1.25 1.38	T 2T 2E	6.0 0.0 0.0	1.670 6.000 7.670	120 -0.723 0.017		Vel = 0.97	
26 to 313	15.8 10.67		0.0 4.5	1.25 1.442	2T 2E	14.864 7.432 0.0	70.120 22.296 92.416	120 2.222 0.161		Vel = 0.88	
313			0.0 4.50					26.536		K Factor = 0.87	
324 to 27	13.9 15.56		5.69 5.69	1.25 1.38	T 2T 2E	6.0 0.0 0.0	1.670 6.000 7.670	120 -0.719 0.025		Vel = 1.22	
27 to 314	15.56 10.67		0.0 5.69	1.25 1.442	2T 2E	14.864 7.432 0.0	69.890 22.296 92.186	120 2.118 0.249		Vel = 1.12	
314			0.0 5.69					26.850		K Factor = 1.10	
325 to 28	13.63 15.3		8.01 8.01	1.25 1.38	T 2T 2E	6.0 0.0 0.0	1.670 6.000 7.670	120 -0.723 0.048		Vel = 1.72	
28 to 315	15.3 10.67		0.0 8.01	1.25 1.442	2T 2E	14.864 7.432 0.0	69.610 22.296 91.906	120 2.005 0.467		Vel = 1.57	
315			0.0 8.01					27.276		K Factor = 1.53	
326 to 316	10.67 10.67		9.90 9.9	1.25 1.442	2T	14.864 0.0 0.0	64.990 14.864 79.854	120 0.0 0.601		Vel = 1.94	
316			0.0 9.90					27.592		K Factor = 1.88	
327 to 317	10.67 10.67		6.18 6.18	1.25 1.442	2T 6E	14.864 22.296 0.0	81.040 37.160 118.200	120 0.0 0.372		Vel = 1.21	
317			0.0 6.18					27.488		K Factor = 1.18	
328 to 318	10.67 10.67		6.09 6.09	1.25 1.442	2T 5E	14.864 18.58 0.0	75.670 33.444 109.114	120 0.0 0.335		Vel = 1.20	
318			0.0 6.09					27.465		K Factor = 1.16	
24 to 319	10.67 10.67		6.17 6.17	1.25 1.442	2T 4E	14.864 14.864 0.0	73.150 29.728 102.878	120 0.0 0.323		Vel = 1.21	
319			0.0 6.17					27.459		K Factor = 1.18	
309 to 310	26.450 10.67		42.34 42.34	1.5 1.682	3E T	14.849 9.9 0.0	20.500 24.749 45.249	120 6.834 2.367		Vel = 6.11	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 10
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
310 to 311	10.67 10.67		0.0 42.34	2 2.157	0.0 0.0	7.770 0.0	120 0.0156	25.899 0.0			
311 to 312	10.67 10.67		0.0 42.34	2 2.157	6.153 0.0	7.590 6.153	120 0.0156	26.020 0.0	Vel =	3.72	
312 to 313	10.67 10.67		4.46 46.8	2 2.157	0.0 0.0	16.150 16.150	120 0.0187	26.234 0.0	Vel =	4.11	
313 to 314	10.67 10.67		4.50 51.3	2 2.157	0.0 0.0	14.130 14.130	120 0.0222	26.536 0.0	Vel =	4.50	
314 to 315	10.67 10.67		5.70 57.0	2 2.157	0.0 0.0	15.790 15.790	120 0.0270	26.850 0.0	Vel =	5.00	
315 to 331	10.67 10.67		8.01 65.01	2 2.157	0.0 0.0	10.340 10.340	120 0.0344	27.276 0.0	Vel =	5.71	
331			0.0 65.01					27.632	K Factor =	12.37	
319 to 318	10.67 10.67		6.17 6.17	2 2.157	0.0 0.0	14.040 14.040	120 0.0004	27.459 0.0	Vel =	0.54	
318 to 317	10.67 10.67		6.10 12.27	2 2.157	0.0 0.0	14.500 14.500	120 0.0016	27.465 0.0	Vel =	1.08	
317 to 316	10.67 10.67		6.18 18.45	2 2.157	12.307 0.0	18.670 12.307	120 0.0034	27.488 0.0	Vel =	1.62	
316 to 331	10.67 10.67		9.91 28.36	2 2.157	0.0 0.0	5.470 5.470	120 0.0073	27.592 0.0	Vel =	2.49	
331 to 332	10.67 10.67		65.00 93.36	3 3.26	20.159 0.0	20.680 20.159	120 0.0090	27.632 0.0	Vel =	3.59	
332 to 333	10.67 10.67		0.0 93.36	3 3.26	0.0 0.0	11.340 11.340	120 0.0090	28.000 0.0	Vel =	3.59	
333 to 334	10.67 10.67		0.0 93.36	3 3.26	0.0 0.0	6.580 6.580	120 0.0090	28.102 0.0	Vel =	3.59	
334 to 335	10.67 10.67		0.0 93.36	3 3.26	0.0 0.0	11.740 11.740	120 0.0089	28.161 0.0	Vel =	3.59	
335 to 336	10.67 10.67		0.0 93.36	3 3.26	37.631 0.0	23.680 37.631	120 0.0090	28.266 0.0	Vel =	3.59	
336 to 337	10.67 10.67		0.0 93.36	3 3.26	0.0 0.0	60.650 60.650	120 0.0090	28.818 0.0	Vel =	3.59	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 11
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
337 to 351	10.67 10.67		0.0 93.36	3 3.26	2T 40.319 0.0 0.0	38.360 40.319 78.679	120 0.0090	29.364 0.0 0.708		Vel = 3.59	
351			0.0 93.36					30.072		K Factor = 17.02	
390 to 391	10.67 10.67		110.72 110.72	3 3.26	0.0 0.0 0.0	21.550 0.0 21.550	120 0.0123	29.483 0.0 0.266		Vel = 4.26	
391 to 392	10.67 10.67		0.0 110.72	3 3.26	2E 18.815 0.0 0.0	16.480 18.815 35.295	120 0.0124	29.749 0.0 0.436		Vel = 4.26	
392 to 393	10.67 10.67		-12.17 98.55	3 3.26	E 9.408 0.0 0.0	40.180 9.408 49.588	120 0.0099	30.185 0.0 0.493		Vel = 3.79	
393 to 394	10.67 10.67		0.0 98.55	3 3.26	E 9.408 0.0 0.0	13.820 9.408 23.228	120 0.0099	30.678 0.0 0.231		Vel = 3.79	
394			0.0 98.55					30.909		K Factor = 17.73	
392 to 395	10.67 10.67		12.17 12.17	1.5 1.682	2T 4E 19.799 19.799 0.0	110.010 39.598 149.608	120 0.0052	30.185 0.0 0.779		Vel = 1.76	
395			0.0 12.17					30.964		K Factor = 2.19	
382 to C5	25.08 25.08		-43.12 -43.12	1.25 1.442	T 7.432 0.0 0.0	27.000 7.432 34.432	120 -0.1145	14.732 0.0 -3.941		Vel = 8.47	
C5 to C4	25.08 25.08	5.60	18.39 -24.73	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0410	10.791 0.0 -0.410		Vel = 4.86	
C4 to C3	25.08 25.08	5.60	18.04 -6.69	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0036	10.381 0.0 -0.036		Vel = 1.31	
C3 to C2	25.08 25.08	5.60	18.02 11.33	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 0.0097	10.345 0.0 0.097		Vel = 2.23	
C2 to C1	25.08 25.08	5.60	18.09 29.42	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 0.0564	10.442 0.0 0.564		Vel = 5.78	
C1 to 302	25.08 25.08	5.60	18.58 48.0	1.25 1.442	T 7.432 0.0 0.0	27.750 7.432 35.182	120 0.1396	11.006 0.0 4.910		Vel = 9.43	
302			0.0 48.00					15.916		K Factor = 12.03	
383 to C10	25.42 25.42		-43.64 -43.64	1.25 1.442	T 7.432 0.0 0.0	27.000 7.432 34.432	120 -0.1170	14.827 0.0 -4.029		Vel = 8.57	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 12
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C10 to C9	25.42 25.42	5.60	18.41 -25.23	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0425	10.798 0.0 -0.425		Vel = 4.96	
C9 to C8	25.42 25.42	5.60	18.03 -7.2	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0041	10.373 0.0 -0.041		Vel = 1.41	
C8 to C7	25.42 25.42	5.60	18.00 10.8	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 0.0088	10.332 0.0 0.088		Vel = 2.12	
C7 to C6	25.42 25.42	5.60	18.08 28.88	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 0.0545	10.420 0.0 0.545		Vel = 5.67	
C6 to 303	25.42 25.42	5.60	18.54 47.42	1.25 1.442	T 7.432 0.0 0.0	27.750 7.432 35.182	120 0.1365	10.965 0.0 4.802		Vel = 9.32	
303			0.0 47.42					15.767		K Factor = 11.94	
384 to C11	25.75 25.75		-6.69 -6.69	1.25 1.442	T 7.432 0.0	67.000 7.432 74.432	120 -0.0036	15.564 0.0 -0.271		Vel = 1.31	
C11 to 304	25.75 25.75	5.60	21.90 15.21	1.25 1.442	T 7.432 0.0 0.0	27.750 7.432 35.182	120 0.0167	15.293 0.0 0.586		Vel = 2.99	
304			0.0 15.21					15.879		K Factor = 3.82	
385 to 305	26.090 26.09		-5.26 -5.26	1.25 1.442	2T 14.864 0.0 0.0	94.750 14.864 109.614	120 -0.0023	16.428 0.0 -0.256		Vel = 1.03	
305			0.0 -5.26					16.172		K Factor = -1.31	
387 to 307	27.290 26.43		-12.01 -12.01	1.25 1.442	2T 14.864 0.0 0.0	94.750 14.864 109.614	120 -0.0108	17.202 0.372 -1.179		Vel = 2.36	
307			0.0 -12.01					16.395		K Factor = -2.97	
382 to 383	25.08 25.42		43.12 43.12	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0161	14.732 -0.147 0.242		Vel = 3.79	
383 to 384	25.42 25.75		43.64 86.76	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0587	14.827 -0.143 0.880		Vel = 7.62	
384 to 385	25.75 26.09		6.69 93.45	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0674	15.564 -0.147 1.011		Vel = 8.20	
385 to 386	26.090 27.290		5.26 98.71	2 2.157	0.0 0.0 0.0	14.000 0.0 14.000	120 0.0745	16.428 -0.520 1.043		Vel = 8.67	
386 to 387	27.290 27.290		0.0 98.71	1.5 1.682	0.0 0.0 0.0	1.000 0.0 1.000	120 0.2510	16.951 0.0 0.251		Vel = 14.25	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 13
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
387 to 388	27.290 27.290		12.01 110.72	1.5 1.682	0.0 0.0 0.0	6.290 0.0 6.290	120 0.3095	17.202 0.0 1.947		Vel = 15.99	
388 to 389	27.290 10.670		0.0 110.72	2.5 2.635	2E 0.0 0.0	16.474 16.474 47.054	120 0.0348	19.149 7.198 1.636		Vel = 6.51	
389 to 390	10.670 10.67		0.0 110.72	2.5 2.635	2E 0.0 0.0	16.474 16.474 43.144	120 0.0348	27.983 0.0 1.500		Vel = 6.51	
390			0.0 110.72					29.483		K Factor = 20.39	
309 to 308	26.450 26.450		-42.34 -42.34	2 2.157	0.0 0.0 0.0	11.580 0.0 11.580	120 -0.0155	16.698 0.0 -0.180		Vel = 3.72	
308 to 307	26.450 26.43		0.0 -42.34	2 2.157	E 0.0 0.0	6.153 6.153 8.443	120 -0.0156	16.518 0.009 -0.132		Vel = 3.72	
307 to 306	26.43 26.33		-12.01 -54.35	2 2.157	0.0 0.0 0.0	4.540 0.0 4.540	120 -0.0247	16.395 0.043 -0.112		Vel = 4.77	
306 to 305	26.33 26.09		0.0 -54.35	2 2.157	0.0 0.0 0.0	10.460 0.0 10.460	120 -0.0247	16.326 0.104 -0.258		Vel = 4.77	
305 to 304	26.09 25.75		-5.26 -59.61	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 -0.0293	16.172 0.147 -0.440		Vel = 5.23	
304 to 303	25.75 25.42		15.21 -44.4	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 -0.0170	15.879 0.143 -0.255		Vel = 3.90	
303 to 302	25.42 25.08		47.42 3.02	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0001	15.767 0.147 0.002		Vel = 0.27	
302 to 301	25.08 24.92		48.00 51.02	2 2.157	E 0.0 0.0	6.153 7.040 6.153 13.193	120 0.0220	15.916 0.069 0.290		Vel = 4.48	
301 to 321	24.92 24.920		0.0 51.02	2 2.157	0.0 0.0 0.0	11.580 0.0 11.580	120 0.0220	16.275 0.0 0.255		Vel = 4.48	
321 to 322	24.920 14.4		0.0 51.02	1.5 1.682	4E 0.0 0.0	19.799 19.799 45.466	120 0.0738	16.530 4.556 3.356		Vel = 7.37	
322 to 323	14.4 14.13		-4.46 46.56	2 2.157	0.0 0.0 0.0	16.160 0.0 16.160	120 0.0186	24.442 0.117 0.300		Vel = 4.09	
323 to 324	14.13 13.9		-4.50 42.06	2 2.157	0.0 0.0 0.0	14.150 0.0 14.150	120 0.0154	24.859 0.100 0.218		Vel = 3.69	
324 to 325	13.9 13.63		-5.70 36.36	2 2.157	0.0 0.0 0.0	15.770 0.0 15.770	120 0.0117	25.177 0.117 0.185		Vel = 3.19	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 14
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
325 to 326	13.63 10.67		-8.00 28.36	2 2.157	2E 12.307 0.0	18.680 12.307 30.987	120 0.0074	25.479 1.282 0.230		Vel = 2.49	
326 to 327	10.67 10.67		-9.91 18.45	2 2.157	2E 12.307 0.0	24.990 12.307 37.297	120 0.0034	26.991 0.0 0.125		Vel = 1.62	
327 to 328	10.67 10.67		-6.18 12.27	2 2.157	0.0 0.0 0.0	9.500 0.0 9.500	120 0.0015	27.116 0.0 0.014		Vel = 1.08	
328 to 24	10.67 10.67		-6.10 6.17	2 2.157	0.0 0.0 0.0	12.000 0.0 12.000	120 0.0005	27.130 0.0 0.006		Vel = 0.54	
24			0.0 6.17					27.136		K Factor = 1.18	
341 to C41	31.43 31.43		5.24 5.24	1.25 1.442	T 7.432 0.0	30.830 7.432 38.262	120 0.0023	21.280 0.0 0.089		Vel = 1.03	
C41 to C42	31.43 31.430		0.0 5.24	1.25 1.442	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0023	21.369 0.0 0.035		Vel = 1.03	
C42 to C43	31.430 31.43		0.0 5.24	1.25 1.442	0.0 0.0 0.0	13.000 0.0 13.000	120 0.0023	21.404 0.0 0.030		Vel = 1.03	
C43 to C44	31.43 31.43		0.0 5.24	1.25 1.442	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0023	21.434 0.0 0.035		Vel = 1.03	
C44 to 361	31.43 31.43		0.0 5.24	1.25 1.442	T 7.432 0.0	30.830 7.432 38.262	120 0.0023	21.469 0.0 0.089		Vel = 1.03	
361			0.0 5.24					21.558		K Factor = 1.13	
342 to C45	31.12 31.12		5.26 5.26	1.25 1.442	T 7.432 0.0	30.830 7.432 38.262	120 0.0023	21.414 0.0 0.089		Vel = 1.03	
C45 to C46	31.12 31.12		0.0 5.26	1.25 1.442	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0023	21.503 0.0 0.035		Vel = 1.03	
C46 to C47	31.12 31.12		0.0 5.26	1.25 1.442	0.0 0.0 0.0	13.000 0.0 13.000	120 0.0024	21.538 0.0 0.031		Vel = 1.03	
C47 to C48	31.12 31.12		0.0 5.26	1.25 1.442	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0023	21.569 0.0 0.035		Vel = 1.03	
C48 to 362	31.12 31.12		0.0 5.26	1.25 1.442	T 7.432 0.0	30.830 7.432 38.262	120 0.0023	21.604 0.0 0.089		Vel = 1.03	
362			0.0 5.26					21.693		K Factor = 1.13	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 15
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
343 to 363	30.81 30.81		5.30 5.3	1.25 1.442	2T 0.0	14.864 14.864	120 0.0024	21.546 0.0		Vel = 1.04	
363			0.0 5.30					21.829		K Factor = 1.13	
344 to 364	30.5 30.5		5.40 5.4	1.25 1.442	2T 0.0	14.864 14.864	120 0.0024	21.676 0.0		Vel = 1.06	
364			0.0 5.40					21.968		K Factor = 1.15	
345 to 365	30.19 30.19		5.56 5.56	1.25 1.442	2T 0.0	14.864 14.864	120 0.0026	21.802 0.0		Vel = 1.09	
365			0.0 5.56					22.111		K Factor = 1.18	
346 to 366	29.88 29.88		5.80 5.8	1.25 1.442	2T 0.0	14.864 14.864	120 0.0028	21.923 0.0		Vel = 1.14	
366			0.0 5.80					22.258		K Factor = 1.23	
347 to 367	29.880 29.57		6.14 6.14	1.25 1.442	2T 0.0	14.864 14.864	120 0.0031	21.905 0.134		Vel = 1.21	
367			0.0 6.14					22.410		K Factor = 1.30	
341 to 342	31.43 31.12		-5.24 -5.24	3 3.26	0.0 0.0	14.250 0.0	120 0	21.280 0.134		Vel = 0.20	
342 to 343	31.12 30.81		-5.26 -10.5	3 3.26	0.0 0.0	14.250 0.0	120 -0.0001	21.414 0.134		Vel = 0.40	
343 to 344	30.81 30.5		-5.30 -15.8	3 3.26	0.0 0.0	14.250 14.250	120 -0.0003	21.546 0.134		Vel = 0.61	
344 to 345	30.5 30.19		-5.40 -21.2	3 3.26	0.0 0.0	14.250 14.250	120 -0.0006	21.676 0.134		Vel = 0.81	
345 to 346	30.19 29.88		-5.56 -26.76	3 3.26	0.0 0.0	14.250 14.250	120 -0.0009	21.802 0.134		Vel = 1.03	
346 to 347	29.88 29.880		-5.81 -32.57	3 3.26	0.0 0.0	14.250 14.250	120 -0.0013	21.923 0.0		Vel = 1.25	
347 to 348	29.880 29.880		-6.13 -38.7	3 3.26	E 0.0	9.408 9.408	120 -0.0018	21.905 0.0		Vel = 1.49	
348 to 349	29.880 10.67		0.0 -38.7	3 3.26	3E 0.0	28.223 28.223	120 -0.0018	21.876 8.320		Vel = 1.49	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 16
Date

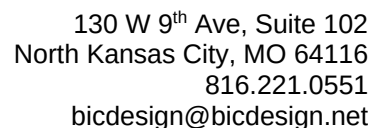
Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
349 to 29	10.67 10.67		0.0 -38.7	3 3.26	0.0 0.0	0.990 0.0	120 -0.0010	30.102 0.0			
29 to 350	10.67 10.67		-9.94 -48.64	3 3.26	0.0 0.0	6.380 0.0	120 -0.0027	30.101 0.0		Vel = 1.49	
350 to 351	10.67 10.67		-18.20 -66.84	3 3.26	0.0 0.0	2.450 0.0	120 -0.0049	30.084 0.0		Vel = 1.87	
351 to 352	10.67 10.67		93.36 26.52	3 3.26	0.0 0.0	8.010 8.010	120 0.0009	30.072 0.0		Vel = 2.57	
352			0.0 26.52					30.079		K Factor = 4.84	
361 to 362	31.43 31.12		5.24 5.24	3 3.26	0.0 0.0	14.250 0.0	120 0.0001	21.558 0.134		Vel = 0.20	
362 to 363	31.12 30.81		5.26 10.5	3 3.26	0.0 0.0	14.250 0.0	120 0.0001	21.693 0.134		Vel = 0.40	
363 to 364	30.81 30.5		5.30 15.8	3 3.26	0.0 0.0	14.250 0.0	120 0.0004	21.829 0.134		Vel = 0.61	
364 to 365	30.5 30.19		5.40 21.2	3 3.26	0.0 0.0	14.250 0.0	120 0.0006	21.968 0.134		Vel = 0.81	
365 to 366	30.19 29.88		5.56 26.76	3 3.26	0.0 0.0	14.250 0.0	120 0.0009	22.111 0.134		Vel = 1.03	
366 to 367	29.88 29.57		5.81 32.57	3 3.26	0.0 0.0	14.250 0.0	120 0.0013	22.258 0.134		Vel = 1.25	
367 to 368	29.57 29.42		6.13 38.7	3 3.26	E 0.0	9.408 9.408	120 0.0018	22.410 0.065		Vel = 1.49	
368 to 369	29.42 10.67		0.0 38.7	3 3.26	4E 0.0	37.631 37.631	120 0.0017	22.504 8.121		Vel = 1.49	
369 to 370	10.67 10.67		9.94 48.64	3 3.26	0.0 0.0	8.000 0.0	120 0.0028	30.738 0.0		Vel = 1.87	
370 to 371	10.67 10.670		18.20 66.84	3 3.26	0.0 0.0	0.920 0.920	120 0.0043	30.760 0.0		Vel = 2.57	
371 to 394	10.670 10.67		26.52 93.36	4 4.26	T 0.0	26.334 26.334	120 0.0025	30.764 0.0		Vel = 2.10	
			0.0								

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Aux Gym Area 1 - 0.10 for 1500

Page 17
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
394			93.36					30.909		K Factor = 16.79	
394 to 395	10.67 10.67		191.91 191.91	4 4.26	0.0 0.0	6.000 0.0	120 0.0092	30.909 0.0		Vel = 4.32	
395 to 396	10.67 10.67		12.17 204.08	4 4.26	E 0.0	13.167 13.167	120 0.0104	30.964 0.0		Vel = 4.59	
396 to TR3	10.67 10.380		0.0 204.08	4 4.26	2E 0.0	26.334 26.334	120 0.0104	31.632 0.126		Vel = 4.59	
TR3 to BR3	10.380 3		0.0 204.08	4 4.26	B S T Fsp	15.8 28.968 26.334 0.0	120 0.0104	32.272 6.196 0.816		* * Fixed Loss = 3 Vel = 4.59	
BR3 to UG	3 0		0.0 204.08	6 6.357		0.0 0.0	120 0.0015	39.284 1.299		Vel = 2.06	
UG to HOSE	0 0		0.0 204.08	6 6.16	G E T Zfb	4.304 20.084 43.037 0.0	140 0.0013	40.586 2.995 0.185		* * Fixed Loss = 2.995 Vel = 2.20	
HOSE to TEST	0 0	H100	100.00 304.08	6 6.16		0.0 0.0	140 0.0020	43.766 0.0		Vel = 3.27	
TEST			0.0 304.08					43.767		K Factor = 45.96	



Water Supply Curve C

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

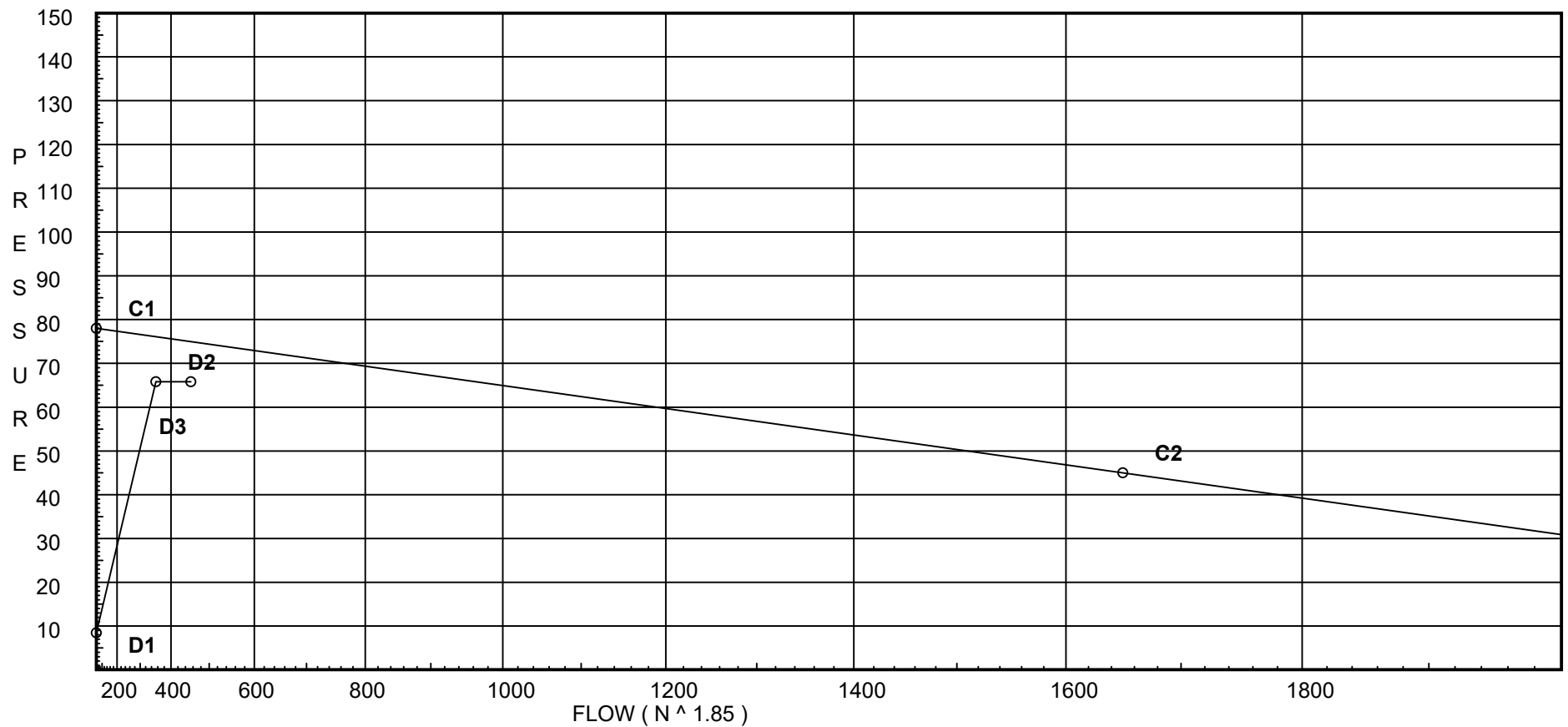
Page 2
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 8.445
D2 - System Flow : 354.429
D2 - System Pressure : 65.803
Hose (Demand) : 100
D3 - System Demand : 454.429
Safety Margin : 9.160



Fittings Used Summary

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 3
Date

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 4
Date

SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
TEST	78.0	45	1650.0	74.963	454.43	65.803

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
C21	19.5	5.6	10.48	18.13	
C22	19.5	5.6	10.61	18.24	
C23	19.5	5.6	10.99	18.56	
C24	19.5	5.6	11.83	19.26	
C25	19.5	5.6	13.26	20.39	
19	19.88		13.02		
15	19.88		13.19		
16	19.88		13.66		
17	19.88		14.7		
18	19.88		16.47		
C26	19.5	5.6	10.39	18.05	
C27	19.5	5.6	10.5	18.15	
C28	19.5	5.6	10.88	18.47	
C29	19.5	5.6	11.71	19.17	
C30	19.5	5.6	13.13	20.29	
9	19.88		12.92		
3	19.88		13.06		
4	19.88		13.52		
5	19.88		14.56		
6	19.88		16.31		
C31	19.5	5.6	10.63	18.26	
C32	19.5	5.6	10.72	18.34	
C33	19.5	5.6	11.1	18.66	
C34	19.5	5.6	11.95	19.36	
C35	19.5	5.6	13.4	20.5	
14	19.88		13.21		
10	19.88		13.33		
11	19.88		13.8		
12	19.88		14.85		
13	19.88		16.64		
406	10.67		31.76		
C36	19.5	5.6	9.0	16.8	
C37	19.5	5.6	9.21	16.99	
C38	19.5	5.6	10.01	17.72	
C39	19.5	5.6	11.63	19.1	
23	20.67		10.85		
20	20.67		11.11		
21	20.67		12.1		
22	20.67		14.11		
352	10.67		43.99		
7	22.38		40.27		
C77	22.47		40.68		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 5
Date

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
C78	22.47		40.88		
C79	22.47		41.13		
C80	22.47		41.38		
C81	22.47		41.62		
8	22.37		41.93		
372	10.67		48.2		
C73	22.32		40.82		
C74	22.32		41.07		
C75	22.32		41.33		
C76	22.32		41.56		
350	10.67		44.02		
C69	22.1		40.89		
C70	22.1		41.11		
C71	22.1		41.34		
C72	22.1		41.54		
29	10.67		44.12		
C61	21.96		40.51		
C62	21.96		40.72		
C63	21.96		40.84		
C64	21.96		41.12		
C65	21.96		41.4		
C66	21.96		41.69		
C67	21.96		41.76		
C68	21.96		42.01		
322	14.4		33.15		
25	16.07		32.41		
323	14.13		32.92		
26	15.8		32.19		
324	13.9		32.77		
27	15.56		32.02		
325	13.63		32.67		
28	15.3		31.89		
326	10.67		33.67		
327	10.67		33.53		
328	10.67		33.51		
24	10.67		33.5		
309	26.45		31.7		
310	10.67		35.16		
311	10.67		34.98		
312	10.67		34.68		
313	10.67		34.28		
314	10.67		33.88		
315	10.67		33.35		
319	10.67		33.12		
318	10.67		33.11		
317	10.67		33.08		
316	10.67		32.96		
331	10.67		32.91		
332	10.67		32.46		
333	10.67		32.45		
334	10.67		32.47		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 6
Date

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
335	10.67		32.75		
336	10.67		36.17		
337	10.67		39.55		
390	10.67		47.87		
391	10.67		48.11		
392	10.67		48.5		
393	10.67		48.93		
382	25.08		35.55		
C5	25.08		34.65		
C4	25.08		34.38		
C3	25.08		34.12		
C2	25.08		33.86		
C1	25.08		33.59		
383	25.42		35.46		
C10	25.42		34.58		
C9	25.42		34.33		
C8	25.42		34.07		
C7	25.42		33.82		
C6	25.42		33.56		
384	25.75		35.52		
C11	25.75		33.51		
385	26.09		35.79		
387	27.29		36.14		
386	27.29		35.98		
388	27.29		37.88		
389	10.67		46.54		
308	26.45		31.96		
307	26.43		32.15		
306	26.33		32.23		
305	26.09		32.4		
304	25.75		32.55		
303	25.42		32.67		
302	25.08		32.66		
301	24.92		32.43		
321	24.92		32.16		
341	31.43		36.19		
C41	31.43		36.74		
C42	31.43		36.96		
C43	31.43		37.15		
C44	31.43		37.36		
342	31.12		36.32		
C45	31.12		36.88		
C46	31.12		37.09		
C47	31.12		37.28		
C48	31.12		37.5		
343	30.81		36.44		
344	30.5		36.55		
345	30.19		36.63		
346	29.88		36.69		
347	29.88		36.57		
348	29.88		36.4		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 7
Date

NODE ANALYSIS (cont.)

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
349	10.67		44.13		
351	10.67		43.94		
361	31.43		37.91		
362	31.12		38.05		
363	30.81		38.2		
364	30.5		38.36		
365	30.19		38.55		
366	29.88		38.76		
367	29.57		39.01		
368	29.42		39.25		
369	10.67		48.08		
370	10.67		48.21		
371	10.67		48.24		
394	10.67		49.13		
395	10.67		49.3		
396	10.67		51.15		
TR3	10.38		52.7		
BR3	3.0		61.16		
UG	0.0		62.47		
HOSE	0.0		65.8	100.0	
TEST	0.0		65.8		

Final Calculations - Hazen-Williams - 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 8
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C21 to 19	19.500 19.88	5.60	18.13 18.13	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.713			
			0.0 18.13						Vel = 6.73		
19								13.024	K Factor = 5.02		
C22 to 15	19.500 19.88	5.60	18.24 18.24	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.745			
			0.0 18.24						Vel = 6.77		
15								13.192	K Factor = 5.02		
C23 to 16	19.500 19.88	5.60	18.56 18.56	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.834			
			0.0 18.56						Vel = 6.89		
16								13.656	K Factor = 5.02		
C24 to 17	19.500 19.88	5.60	19.26 19.26	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 3.035			
			0.0 19.26						Vel = 7.15		
17								14.703	K Factor = 5.02		
C25 to 18	19.500 19.88	5.60	20.39 20.39	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 3.373			
			0.0 20.39						Vel = 7.57		
18								16.469	K Factor = 5.02		
19 to 15	19.88 19.88		18.13 18.13	1.5 1.61		0.0 0.0 0.0	12.500 0.0 12.500	120 0.0 0.0134	13.024 0.0 0.168		
									Vel = 2.86		
15 to 16	19.88 19.88		18.24 36.37	1.5 1.61		0.0 0.0 0.0	9.500 0.0 9.500	120 0.0 0.0488	13.192 0.0 0.464		
									Vel = 5.73		
16 to 17	19.88 19.88		18.56 54.93	1.5 1.61		0.0 0.0 0.0	10.000 0.0 10.000	120 0.0 0.1047	13.656 0.0 1.047		
									Vel = 8.66		
17 to 18	19.88 19.88		19.26 74.19	1.5 1.61		0.0 0.0 0.0	9.670 0.0 9.670	120 0.0 0.1826	14.703 0.0 1.766		
									Vel = 11.69		
18 to 335	19.88 10.67		20.40 94.59	1.5 1.61	2E T	8.0 8.0 0.0	26.930 16.000 42.930	120 3.989 0.2862	16.469 3.989 12.287		
			0.0 94.59						Vel = 14.91		
335								32.745	K Factor = 16.53		
C26 to 9	19.500 19.88	5.60	18.05 18.05	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.692			
			0.0 18.05						Vel = 6.70		
9								12.918	K Factor = 5.02		
C27 to 3	19.500 19.88	5.60	18.15 18.15	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.719			
									Vel = 6.74		

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 9
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
3			0.0 18.15					13.058		K Factor = 5.02	
C28 to 4	19.500 19.88	5.60	18.47 18.47	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.807		Vel = 6.86	
4			0.0 18.47					13.518		K Factor = 5.02	
C29 to 5	19.500 19.88	5.60	19.17 19.17	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 3.007		Vel = 7.12	
5			0.0 19.17					14.556		K Factor = 5.02	
C30 to 6	19.500 19.88	5.60	20.29 20.29	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 3.342		Vel = 7.53	
6			0.0 20.29					16.307		K Factor = 5.02	
9 to 3	19.88 19.88		18.05 18.05	1.5 1.61		0.0 0.0 0.0	10.500 0.0 10.500	120 0.0 0.0133		Vel = 2.84	
3 to 4	19.88 19.88		18.15 36.2	1.5 1.61		0.0 0.0 0.0	9.500 0.0 9.500	120 0.0 0.0484		Vel = 5.70	
4 to 5	19.88 19.88		18.47 54.67	1.5 1.61		0.0 0.0 0.0	10.000 0.0 10.000	120 0.0 0.1038		Vel = 8.62	
5 to 6	19.88 19.88		19.17 73.84	1.5 1.61		0.0 0.0 0.0	9.670 0.0 9.670	120 0.0 0.1811		Vel = 11.64	
6 to 334	19.88 10.67		20.29 94.13	1.5 1.61	2E T	8.0 8.0 0.0	26.930 16.000 42.930	120 3.989 0.2836		Vel = 14.83	
334			0.0 94.13					32.473		K Factor = 16.52	
C31 to 14	19.500 19.88	5.60	18.26 18.26	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.748		Vel = 6.78	
14			0.0 18.26					13.210		K Factor = 5.02	
C32 to 10	19.500 19.88	5.60	18.34 18.34	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.771		Vel = 6.81	
10			0.0 18.34					13.326		K Factor = 5.02	
C33 to 11	19.500 19.88	5.60	18.66 18.66	1 1.049	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120 -0.165 2.861		Vel = 6.93	
			0.0								

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 10
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
11			18.66					13.795		K Factor = 5.02	
C34 to 12	19.500 19.88	5.60	19.36	1	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120	11.954 -0.165 3.065		Vel = 7.19
12			0.0 19.36					14.854		K Factor = 5.02	
C35 to 13	19.500 19.88	5.60	20.50	1	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120	13.398 -0.165 3.405		Vel = 7.61
13			0.0 20.50					16.638		K Factor = 5.03	
14 to 10	19.88 19.88		18.26	1.5		0.0 0.0 0.0	8.500 0.0 8.500	120	13.210 0.0 0.116		Vel = 2.88
10 to 11	19.88 19.88		18.33	1.5		0.0 0.0 0.0	9.500 0.0 9.500	120	13.326 0.0 0.469		Vel = 5.77
11 to 12	19.88 19.88		18.66	1.5		0.0 0.0 0.0	10.000 0.0 10.000	120	13.795 0.0 1.059		Vel = 8.71
12 to 13	19.88 19.88		19.36	1.5		0.0 0.0 0.0	9.670 0.0 9.670	120	14.854 0.0 1.784		Vel = 11.76
13 to 406	19.88 10.67		20.50	1.5	3E T	12.0 8.0 0.0	18.490 20.000 38.490	120	16.638 3.989 11.129		Vel = 14.99
406			0.0 95.11					31.756		K Factor = 16.88	
406 to 333	10.67 10.67		95.11	2.5	T	16.474 0.0 0.0	9.780 16.474 26.254	120	31.756 0.0 0.689		Vel = 5.60
333			0.0 95.11					32.445		K Factor = 16.70	
C36 to 23	19.500 20.67	5.60	16.80	1	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120	9.000 -0.507 2.357		Vel = 6.24
23			0.0 16.80					10.850		K Factor = 5.10	
C37 to 20	19.500 20.67	5.60	16.99	1	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120	9.210 -0.507 2.407		Vel = 6.31
20			0.0 16.99					11.110		K Factor = 5.10	
C38 to 21	19.500 20.67	5.60	17.72	1	E T Eq	2.0 5.0 17.0	1.000 24.000 25.000	120	10.010 -0.507 2.601		Vel = 6.58
21			0.0 17.72					12.104		K Factor = 5.09	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 11
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C39 to 22	19.500 20.67	5.60	19.10 19.1	1 1.049	E T Eql 2.0 5.0 17.0	1.000 24.000 25.000	120 0.1195	11.627 -0.507 2.987		Vel = 7.09	
22			0.0 19.10					14.107		K Factor = 5.09	
23 to 20	20.67 20.67		16.80 16.8	1.25 1.38	0.0 0.0 0.0	10.500 0.0 10.500	120 0.0248	10.850 0.0 0.260		Vel = 3.60	
20 to 21	20.67 20.67		16.99 33.79	1.25 1.38	0.0 0.0 0.0	11.000 0.0 11.000	120 0.0904	11.110 0.0 0.994		Vel = 7.25	
21 to 22	20.67 20.67		17.72 51.51	1.25 1.38	0.0 0.0 0.0	10.170 0.0 10.170	120 0.1970	12.104 0.0 2.003		Vel = 11.05	
22 to 332	20.67 10.67		19.10 70.61	1.25 1.38	2E T 6.0 6.0 0.0	27.720 12.000 39.720	120 0.3530	14.107 4.331 14.023		Vel = 15.15	
332			0.0 70.61					32.461		K Factor = 12.39	
352 to 7	10.67 22.38		71.13 71.13	2.5 2.635	T 4E 16.474 32.948 0.0	38.920 49.422 88.342	120 0.0153	43.986 -5.072 1.355		Vel = 4.18	
7 to C77	22.38 22.47		-52.83 18.3	1.25 1.442	T E 7.432 3.716 0.0	8.150 11.148 19.298	120 0.0234	40.269 -0.039 0.452		Vel = 3.60	
C77 to C78	22.47 22.47		0.0 18.3	1.25 1.442	0.0 0.0 0.0	8.250 0.0 8.250	120 0.0235	40.682 0.0 0.194		Vel = 3.60	
C78 to C79	22.47 22.47		0.0 18.3	1.25 1.442	0.0 0.0 0.0	10.750 0.0 10.750	120 0.0234	40.876 0.0 0.252		Vel = 3.60	
C79 to C80	22.47 22.47		0.0 18.3	1.25 1.442	0.0 0.0 0.0	10.750 0.0 10.750	120 0.0234	41.128 0.0 0.252		Vel = 3.60	
C80 to C81	22.47 22.47		0.0 18.3	1.25 1.442	0.0 0.0 0.0	10.250 0.0 10.250	120 0.0234	41.380 0.0 0.240		Vel = 3.60	
C81 to 8	22.47 22.37		0.0 18.3	1.25 1.442	E 0.0 0.0	7.570 3.716 11.286	120 0.0235	41.620 0.043 0.265		Vel = 3.60	
8 to 372	22.37 10.67		52.83 71.13	2.5 2.635	2T E 32.948 8.237 0.0	37.330 41.185 78.515	120 0.0153	41.928 5.067 1.204		Vel = 4.18	
372 to 371	10.67 10.670		0.0 71.13	3 3.26	0.0 0.0 0.0	7.430 0.0 7.430	120 0.0055	48.199 0.0 0.041		Vel = 2.73	
371			0.0 71.13					48.240		K Factor = 10.24	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 12
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
7 to C73	22.38 22.32		52.84 52.84	2 2.157	2E 0.0	12.307 12.307	120 0.0235	40.269 0.026			
C73 to C74	22.32 22.32		0.0 52.84	2 2.157	0.0 0.0	10.890 10.890	120 0.0234	40.819 0.255	Vel =	4.64	
C74 to C75	22.32 22.32		0.0 52.84	2 2.157	0.0 0.0	11.000 11.000	120 0.0235	41.074 0.258	Vel =	4.64	
C75 to C76	22.32 22.32		0.0 52.84	2 2.157	0.0 0.0	9.920 9.920	120 0.0235	41.332 0.233	Vel =	4.64	
C76 to 8	22.32 22.37		0.0 52.84	2 2.157	E 0.0	6.153 6.153	120 0.0235	41.565 -0.022	Vel =	4.64	
8			0.0 52.84					41.928	K Factor =	8.16	
350 to C69	10.67 22.1		48.79 48.79	2 2.157	5E T	30.767 12.307	120 0.0202	44.016 -4.950	Vel =	4.28	
C69 to C70	22.1 22.1		0.0 48.79	2 2.157	0.0 0.0	10.890 10.890	120 0.0203	40.893 0.221	Vel =	4.28	
C70 to C71	22.1 22.1		0.0 48.79	2 2.157	0.0 0.0	11.000 11.000	120 0.0202	41.114 0.222	Vel =	4.28	
C71 to C72	22.1 22.1		0.0 48.79	2 2.157	0.0 0.0	9.920 9.920	120 0.0203	41.336 0.201	Vel =	4.28	
C72 to 370	22.1 10.67		0.0 48.79	2 2.157	4E T	24.613 12.307	120 0.0202	41.537 4.950	Vel =	4.28	
370			0.0 48.79					48.212	K Factor =	7.03	
29 to C61	10.67 21.96		26.66 26.66	1.5 1.682	4E T	19.799 9.9	120 0.0222	44.122 -4.890	Vel =	3.85	
C61 to C62	21.96 21.96		0.0 26.66	1.5 1.682	0.0 0.0	9.500 9.500	120 0.0222	40.508 0.211	Vel =	3.85	
C62 to C63	21.96 21.96		0.0 26.66	1.5 1.682	0.0 0.0	5.480 5.480	120 0.0223	40.719 0.122	Vel =	3.85	
C63 to C64	21.96 21.96		0.0 26.66	1.5 1.682	0.0 0.0	12.670 12.670	120 0.0222	40.841 0.281	Vel =	3.85	
C64 to C65	21.96 21.96		0.0 26.66	1.5 1.682	0.0 0.0	12.670 12.670	120 0.0223	41.122 0.282	Vel =	3.85	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 13
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C65 to C66	21.96 21.96		0.0 26.66	1.5 1.682	0.0 0.0	12.670 0.0	120 0.0222	41.404 0.0			
					0.0	12.670	0.0222	0.281	Vel =	3.85	
C66 to C67	21.96 21.96		0.0 26.66	1.5 1.682	0.0 0.0	3.540 0.0	120 0.0223	41.685 0.0			
					0.0	3.540	0.0223	0.079	Vel =	3.85	
C67 to C68	21.96 21.96		0.0 26.66	1.5 1.682	0.0 0.0	11.050 0.0	120 0.0222	41.764 0.0			
					0.0	11.050	0.0222	0.245	Vel =	3.85	
C68 to 369	21.96 10.67		0.0 26.66	1.5 1.682	3E T 9.9	14.849 24.749	120 0.0222	42.009 4.890			
					0.0	53.079	0.0222	1.179	Vel =	3.85	
369			0.0 26.66					48.078	K Factor =	3.84	
322 to 25	14.4 16.07		-2.99 -2.99	1.25 1.38	T 0.0	6.0 6.000	120 -0.0010	33.145 -0.723			
					0.0	7.670	-0.0010	-0.008	Vel =	0.64	
25 to 312	16.07 10.67		0.0 -2.99	1.25 1.442	2T 2E 7.432	14.864 22.296	120 -0.0008	32.414 2.339			
					0.0	92.686	-0.0008	-0.076	Vel =	0.59	
312			0.0 -2.99					34.677	K Factor =	-0.51	
323 to 26	14.13 15.8		-4.01 -4.01	1.25 1.38	T 0.0	6.0 6.000	120 -0.0018	32.924 -0.723			
					0.0	7.670	-0.0018	-0.014	Vel =	0.86	
26 to 313	15.8 10.67		0.0 -4.01	1.25 1.442	2T 2E 7.432	14.864 22.296	120 -0.0014	32.187 2.222			
					0.0	92.416	-0.0014	-0.131	Vel =	0.79	
313			0.0 -4.01					34.278	K Factor =	-0.68	
324 to 27	13.9 15.56		-5.84 -5.84	1.25 1.38	T 0.0	6.0 6.000	120 -0.0035	32.769 -0.719			
					0.0	7.670	-0.0035	-0.027	Vel =	1.25	
27 to 314	15.56 10.67		0.0 -5.84	1.25 1.442	2T 2E 7.432	14.864 22.296	120 -0.0028	32.023 2.118			
					0.0	92.186	-0.0028	-0.261	Vel =	1.15	
314			0.0 -5.84					33.880	K Factor =	-1.00	
325 to 28	13.63 15.3		-8.69 -8.69	1.25 1.38	T 0.0	6.0 6.000	120 -0.0073	32.666 -0.723			
					0.0	7.670	-0.0073	-0.056	Vel =	1.86	
28 to 315	15.3 10.67		0.0 -8.69	1.25 1.442	2T 2E 7.432	14.864 22.296	120 -0.0059	31.887 2.005			
					0.0	91.906	-0.0059	-0.543	Vel =	1.71	
315			0.0 -8.69					33.349	K Factor =	-1.50	
326 to 316	10.67 10.67		-10.89 -10.89	1.25 1.442	2T 0.0	14.864 14.864	120 -0.0090	33.675 0.0			
					0.0	79.854	-0.0090	-0.717	Vel =	2.14	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 14
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
316			0.0 -10.89					32.958		K Factor = -1.90	
327 to 317	10.67 10.67		-6.80 -6.8	1.25 1.442	2T 6E	14.864 22.296 0.0	81.040 37.160 118.200	120 0.0 -0.0038	33.526 0.0 -0.444		Vel = 1.34
317			0.0 -6.80					33.082		K Factor = -1.18	
328 to 318	10.67 10.67		-6.70 -6.7	1.25 1.442	2T 5E	14.864 18.58 0.0	75.670 33.444 109.114	120 0.0 -0.0037	33.508 0.0 -0.399		Vel = 1.32
318			0.0 -6.70					33.109		K Factor = -1.16	
24 to 319	10.67 10.67		-6.79 -6.79	1.25 1.442	2T 4E	14.864 14.864 0.0	73.150 29.728 102.878	120 0.0 -0.0038	33.502 0.0 -0.386		Vel = 1.33
319			0.0 -6.79					33.116		K Factor = -1.18	
309 to 310	26.450 10.67		-51.33 -51.33	1.5 1.682	3E T	14.849 9.9 0.0	20.500 24.749 45.249	120 6.834 -0.0747	31.699 6.834 -3.378		Vel = 7.41
310 to 311	10.67 10.67		0.0 -51.33	2 2.157		0.0 0.0 0.0	7.770 0.0 7.770	120 0.0 -0.0223	35.155 0.0 -0.173		Vel = 4.51
311 to 312	10.67 10.67		0.0 -51.33	2 2.157	E	6.153 0.0 0.0	7.590 6.153 13.743	120 0.0 -0.0222	34.982 0.0 -0.305		Vel = 4.51
312 to 313	10.67 10.67		-3.00 -54.33	2 2.157		0.0 0.0 0.0	16.150 0.0 16.150	120 0.0 -0.0247	34.677 0.0 -0.399		Vel = 4.77
313 to 314	10.67 10.67		-4.01 -58.34	2 2.157		0.0 0.0 0.0	14.130 0.0 14.130	120 0.0 -0.0282	34.278 0.0 -0.398		Vel = 5.12
314 to 315	10.67 10.67		-5.84 -64.18	2 2.157		0.0 0.0 0.0	15.790 0.0 15.790	120 0.0 -0.0336	33.880 0.0 -0.531		Vel = 5.63
315 to 331	10.67 10.67		-8.69 -72.87	2 2.157		0.0 0.0 0.0	10.340 0.0 10.340	120 0.0 -0.0425	33.349 0.0 -0.439		Vel = 6.40
331			0.0 -72.87					32.910		K Factor = -12.70	
319 to 318	10.67 10.67		-6.79 -6.79	2 2.157		0.0 0.0 0.0	14.040 0.0 14.040	120 0.0 -0.0005	33.116 0.0 -0.007		Vel = 0.60
318 to 317	10.67 10.67		-6.70 -13.49	2 2.157		0.0 0.0 0.0	14.500 0.0 14.500	120 0.0 -0.0019	33.109 0.0 -0.027		Vel = 1.18
317 to 316	10.67 10.67		-6.80 -20.29	2 2.157	2E	12.307 0.0 0.0	18.670 12.307 30.977	120 0.0 -0.0040	33.082 0.0 -0.124		Vel = 1.78

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 15
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
316 to 331	10.67 10.67		-10.89 -31.18	2 2.157	0.0 0.0 0.0	5.470 0.0 5.470	120 -0.0088	32.958 0.0 -0.048		Vel = 2.74	
331 to 332	10.67 10.67		-72.87 -104.05	3 3.26	T 20.159 0.0 0.0	20.680 20.159 40.839	120 -0.0110	32.910 0.0 -0.449		Vel = 4.00	
332 to 333	10.67 10.67		70.61 -33.44	3 3.26	0.0 0.0 0.0	11.340 0.0 11.340	120 -0.0014	32.461 0.0 -0.016		Vel = 1.29	
333 to 334	10.67 10.67		95.10 61.66	3 3.26	0.0 0.0 0.0	6.580 0.0 6.580	120 0.0043	32.445 0.0 0.028		Vel = 2.37	
334 to 335	10.67 10.67		94.13 155.79	3 3.26	0.0 0.0 0.0	11.740 0.0 11.740	120 0.0232	32.473 0.0 0.272		Vel = 5.99	
335 to 336	10.67 10.67		94.59 250.38	3 3.26	4E 37.631 0.0 0.0	23.680 37.631 61.311	120 0.0558	32.745 0.0 3.422		Vel = 9.62	
336 to 337	10.67 10.67		0.0 250.38	3 3.26	0.0 0.0 0.0	60.650 0.0 60.650	120 0.0558	36.167 0.0 3.384		Vel = 9.62	
337 to 351	10.67 10.67		0.0 250.38	3 3.26	2T 40.319 0.0 0.0	38.360 40.319 78.679	120 0.0558	39.551 0.0 4.391		Vel = 9.62	
351			0.0 250.38					43.942		K Factor = 37.77	
390 to 391	10.67 10.67		104.05 104.05	3 3.26	0.0 0.0 0.0	21.550 0.0 21.550	120 0.0110	47.874 0.0 0.238		Vel = 4.00	
391 to 392	10.67 10.67		0.0 104.05	3 3.26	2E 18.815 0.0 0.0	16.480 18.815 35.295	120 0.0110	48.112 0.0 0.388		Vel = 4.00	
392 to 393	10.67 10.67		-12.31 91.74	3 3.26	E 9.408 0.0 0.0	40.180 9.408 49.588	120 0.0087	48.500 0.0 0.431		Vel = 3.53	
393 to 394	10.67 10.67		0.0 91.74	3 3.26	E 9.408 0.0 0.0	13.820 9.408 23.228	120 0.0087	48.931 0.0 0.203		Vel = 3.53	
394			0.0 91.74					49.134		K Factor = 13.09	
392 to 395	10.67 10.67		12.31 12.31	1.5 1.682	2T 4E 19.799 19.799 0.0	110.010 39.598 149.608	120 0.0053	48.500 0.0 0.796		Vel = 1.78	
395			0.0 12.31					49.296		K Factor = 1.75	
382 to C5	25.08 25.08		-19.50 -19.5	1.25 1.442	T 7.432 0.0 0.0	27.000 7.432 34.432	120 -0.0264	35.555 0.0 -0.908		Vel = 3.83	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 16
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C5 to C4	25.08 25.08		0.0 -19.5	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0264	34.647 0.0		Vel = 3.83	
C4 to C3	25.08 25.08		0.0 -19.5	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0263	34.383 0.0		Vel = 3.83	
C3 to C2	25.08 25.08		0.0 -19.5	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0264	34.120 0.0		Vel = 3.83	
C2 to C1	25.08 25.08		0.0 -19.5	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0264	33.856 0.0		Vel = 3.83	
C1 to 302	25.08 25.08		0.0 -19.5	1.25 1.442	T 7.432 0.0	27.750 7.432	120 -0.0263	33.592 0.0		Vel = 3.83	
302			0.0 -19.50					32.665		K Factor = -3.41	
383 to C10	25.42 25.42		-19.16 -19.16	1.25 1.442	T 7.432 0.0	27.000 7.432	120 -0.0255	35.463 0.0		Vel = 3.76	
C10 to C9	25.42 25.42		0.0 -19.16	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0255	34.585 0.0		Vel = 3.76	
C9 to C8	25.42 25.42		0.0 -19.16	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0256	34.330 0.0		Vel = 3.76	
C8 to C7	25.42 25.42		0.0 -19.16	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0255	34.074 0.0		Vel = 3.76	
C7 to C6	25.42 25.42		0.0 -19.16	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0255	33.819 0.0		Vel = 3.76	
C6 to 303	25.42 25.42		0.0 -19.16	1.25 1.442	T 7.432 0.0	27.750 7.432	120 -0.0255	33.564 0.0		Vel = 3.76	
303			0.0 -19.16					32.667		K Factor = -3.35	
384 to C11	25.75 25.75		-19.76 -19.76	1.25 1.442	T 7.432 0.0	67.000 7.432	120 -0.0270	35.518 0.0		Vel = 3.88	
C11 to 304	25.75 25.75		0.0 -19.76	1.25 1.442	T 7.432 0.0	27.750 7.432	120 -0.0270	33.505 0.0		Vel = 3.88	
304			0.0 -19.76					32.554		K Factor = -3.46	
385 to 305	26.090 26.09		-21.26 -21.26	1.25 1.442	2T 14.864 0.0	94.750 14.864	120 -0.0310	35.794 0.0		Vel = 4.18	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 17
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
305			0.0 -21.26					32.401		K Factor = -3.73	
387 to 307	27.290 26.43		-24.37 -24.37	1.25 1.442	2T 0.0 0.0	14.864 14.864 109.614	120 -0.0398	36.145 0.372 -4.364		Vel = 4.79	
307			0.0 -24.37					32.153		K Factor = -4.30	
382 to 383	25.08 25.42		19.50 19.5	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0037	35.555 -0.147 0.055		Vel = 1.71	
383 to 384	25.42 25.75		19.15 38.65	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0132	35.463 -0.143 0.198		Vel = 3.39	
384 to 385	25.75 26.09		19.77 58.42	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0282	35.518 -0.147 0.423		Vel = 5.13	
385 to 386	26.090 27.290		21.26 79.68	2 2.157	0.0 0.0 0.0	14.000 0.0 14.000	120 0.0501	35.794 -0.520 0.702		Vel = 7.00	
386 to 387	27.290 27.290		0.0 79.68	1.5 1.682	0.0 0.0 0.0	1.000 0.0 1.000	120 0.1690	35.976 0.0 0.169		Vel = 11.51	
387 to 388	27.290 27.290		24.37 104.05	1.5 1.682	0.0 0.0 0.0	6.290 0.0 6.290	120 0.2758	36.145 0.0 1.735		Vel = 15.02	
388 to 389	27.290 10.670		0.0 104.05	2.5 2.635	2E 0.0 0.0	16.474 16.474 47.054	120 0.0310	37.880 7.198 1.459		Vel = 6.12	
389 to 390	10.670 10.67		0.0 104.05	2.5 2.635	2E 0.0 0.0	16.474 16.474 43.144	120 0.0310	46.537 0.0 1.337		Vel = 6.12	
390			0.0 104.05					47.874		K Factor = 15.04	
309 to 308	26.450 26.450		51.33 51.33	2 2.157	0.0 0.0 0.0	11.580 0.0 11.580	120 0.0222	31.699 0.0 0.257		Vel = 4.51	
308 to 307	26.450 26.43		0.0 51.33	2 2.157	E 0.0 0.0	6.153 6.153 8.443	120 0.0223	31.956 0.009 0.188		Vel = 4.51	
307 to 306	26.43 26.33		-24.37 26.96	2 2.157	0.0 0.0 0.0	4.540 0.0 4.540	120 0.0068	32.153 0.043 0.031		Vel = 2.37	
306 to 305	26.33 26.09		0.0 26.96	2 2.157	0.0 0.0 0.0	10.460 0.0 10.460	120 0.0067	32.227 0.104 0.070		Vel = 2.37	
305 to 304	26.09 25.75		-21.26 5.7	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0004	32.401 0.147 0.006		Vel = 0.50	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 18
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
304 to 303	25.75 25.42		-19.77 -14.07	2 2.157	0.0 0.0	15.000 0.0	120 -0.0020	32.554 0.143			
303 to 302	25.42 25.08		-19.15 -33.22	2 2.157	0.0 0.0	15.000 15.000	120 -0.0099	32.667 0.147		Vel = 1.24	
302 to 301	25.08 24.92		-19.50 -52.72	2 2.157	E 0.0	6.153 6.153	120 -0.0233	32.665 0.069		Vel = 2.92	
301 to 321	24.92 24.920		0.0 -52.72	2 2.157	0.0 0.0	11.580 11.580	120 -0.0233	32.426 0.0		Vel = 4.63	
321 to 322	24.920 14.4		0.0 -52.72	1.5 1.682	4E 0.0	19.799 19.799	120 -0.0785	32.156 4.556		Vel = 4.63	
322 to 323	14.4 14.13		2.99 -49.73	2 2.157	0.0 0.0	16.160 16.160	120 -0.0209	33.145 0.117		Vel = 7.61	
323 to 324	14.13 13.9		4.02 -45.71	2 2.157	0.0 0.0	14.150 14.150	120 -0.0180	32.924 0.100		Vel = 4.37	
324 to 325	13.9 13.63		5.84 -39.87	2 2.157	0.0 0.0	15.770 15.770	120 -0.0140	32.769 0.117		Vel = 4.01	
325 to 326	13.63 10.67		8.69 -31.18	2 2.157	2E 0.0	12.307 12.307	120 -0.0088	32.666 1.282		Vel = 3.50	
326 to 327	10.67 10.67		10.89 -20.29	2 2.157	2E 0.0	12.307 12.307	120 -0.0040	33.675 0.0		Vel = 2.74	
327 to 328	10.67 10.67		6.80 -13.49	2 2.157	0.0 0.0	9.500 9.500	120 -0.0019	33.526 0.0		Vel = 1.78	
328 to 24	10.67 10.67		6.70 -6.79	2 2.157	0.0 0.0	12.000 12.000	120 -0.0005	33.508 0.0		Vel = 1.18	
24 to 341	10.67 31.43		0.0 14.06					33.502		Vel = 0.60	
341 to C41	31.43 31.43		-6.79 14.06							K Factor = -1.17	
C41 to C42	31.43 31.430		0.0 14.06	1.25 1.442	T 0.0	7.432 7.432	120 0.0144	36.192 0.0		Vel = 2.76	
C42 to C43	31.430 31.43		0.0 14.06	1.25 1.442	0.0 0.0	15.000 15.000	120 0.0144	36.743 0.0		Vel = 2.76	
C43 to C44	31.43 31.43		0.0 14.06	1.25 1.442	0.0 0.0	13.000 13.000	120 0.0144	36.959 0.0		Vel = 2.76	
C44	31.43		0.0	1.25	0.0	15.000	120	37.146		Vel = 2.76	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 19
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C44 to 361	31.43 31.43		0.0 14.06	1.25 1.442	T 0.0	7.432 7.432	30.830 38.262	120 0.0144	37.362 0.0	Vel = 2.76	
361			0.0 14.06						37.913	K Factor = 2.28	
342 to C45	31.12 31.12		14.10 14.1	1.25 1.442	T 0.0	7.432 7.432	30.830 38.262	120 0.0145	36.322 0.0	Vel = 2.77	
C45 to C46	31.12 31.12		0.0 14.1	1.25 1.442	0.0 0.0	15.000 0.0	15.000 15.000	120 0.0144	36.876 0.0	Vel = 2.77	
C46 to C47	31.12 31.12		0.0 14.1	1.25 1.442	0.0 0.0	13.000 0.0	13.000 13.000	120 0.0145	37.092 0.0	Vel = 2.77	
C47 to C48	31.12 31.12		0.0 14.1	1.25 1.442	0.0 0.0	15.000 0.0	15.000 15.000	120 0.0145	37.281 0.0	Vel = 2.77	
C48 to 362	31.12 31.12		0.0 14.1	1.25 1.442	T 0.0	7.432 7.432	30.830 38.262	120 0.0145	37.498 0.0	Vel = 2.77	
362			0.0 14.10						38.051	K Factor = 2.29	
343 to 363	30.81 30.81		14.22 14.22	1.25 1.442	2T 0.0	14.864 14.864	104.660 119.524	120 0.0147	36.442 0.0	Vel = 2.79	
363			0.0 14.22						38.199	K Factor = 2.30	
344 to 364	30.5 30.5		14.48 14.48	1.25 1.442	2T 0.0	14.864 14.864	104.660 119.524	120 0.0152	36.547 0.0	Vel = 2.84	
364			0.0 14.48						38.363	K Factor = 2.34	
345 to 365	30.19 30.19		14.91 14.91	1.25 1.442	2T 0.0	14.864 14.864	104.660 119.524	120 0.0161	36.630 0.0	Vel = 2.93	
365			0.0 14.91						38.549	K Factor = 2.40	
346 to 366	29.88 29.88		15.56 15.56	1.25 1.442	2T 0.0	14.864 14.864	104.660 119.524	120 0.0174	36.685 0.0	Vel = 3.06	
366			0.0 15.56						38.762	K Factor = 2.50	
347 to 367	29.880 29.57		16.46 16.46	1.25 1.442	2T 0.0	14.864 14.864	104.660 119.524	120 0.0193	36.572 0.134	Vel = 3.23	
367			0.0 16.46						39.010	K Factor = 2.64	
341 to 342	31.43 31.12		-14.06 -14.06	3 3.26	0.0 0.0	14.250 0.0	120 -0.0003	36.192 0.134	0.004	Vel = 0.54	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 20
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
342 to 343	31.12 30.81		-14.10 -28.16	3 3.26	0.0 0.0	14.250 0.0	120 -0.0010	36.322 0.134			
343 to 344	30.81 30.5		-14.22 -42.38	3 3.26	0.0 0.0	14.250 14.250	120 -0.0020	36.442 0.134	Vel =	1.08	
344 to 345	30.5 30.19		-14.48 -56.86	3 3.26	0.0 0.0	14.250 14.250	120 -0.0036	36.547 0.134	Vel =	2.19	
345 to 346	30.19 29.88		-14.91 -71.77	3 3.26	0.0 0.0	14.250 14.250	120 -0.0055	36.630 0.134	Vel =	2.76	
346 to 347	29.88 29.880		-15.56 -87.33	3 3.26	0.0 0.0	14.250 14.250	120 -0.0079	36.685 0.0	Vel =	3.36	
347 to 348	29.880 29.880		-16.46 -103.79	3 3.26	E 0.0	9.408 9.408	120 -0.0109	36.572 0.0	Vel =	3.99	
348 to 349	29.880 10.67		0.0 -103.79	3 3.26	3E 0.0	28.223 28.223	120 -0.0110	36.396 8.320	Vel =	3.99	
349 to 29	10.67 10.67		0.0 -103.79	3 3.26	0.0 0.0	0.990 0.990	120 -0.0111	44.133 0.0	Vel =	3.99	
29 to 350	10.67 10.67		-26.66 -130.45	3 3.26	0.0 0.0	6.380 6.380	120 -0.0166	44.122 0.0	Vel =	5.01	
350 to 351	10.67 10.67		-48.79 -179.24	3 3.26	0.0 0.0	2.450 2.450	120 -0.0302	44.016 0.0	Vel =	6.89	
351 to 352	10.67 10.67		250.37 71.13	3 3.26	0.0 0.0	8.010 8.010	120 0.0055	43.942 0.0	Vel =	2.73	
352			0.0 71.13					43.986	K Factor =	10.72	
361 to 362	31.43 31.12		14.06 14.06	3 3.26	0.0 0.0	14.250 14.250	120 0.0003	37.913 0.134	Vel =	0.54	
362 to 363	31.12 30.81		14.10 28.16	3 3.26	0.0 0.0	14.250 14.250	120 0.0010	38.051 0.134	Vel =	1.08	
363 to 364	30.81 30.5		14.22 42.38	3 3.26	0.0 0.0	14.250 14.250	120 0.0021	38.199 0.134	Vel =	1.63	
364 to 365	30.5 30.19		14.48 56.86	3 3.26	0.0 0.0	14.250 14.250	120 0.0036	38.363 0.134	Vel =	2.19	
365 to 366	30.19 29.88		14.91 71.77	3 3.26	0.0 0.0	14.250 14.250	120 0.0055	38.549 0.134	Vel =	2.76	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Band Area 2 - 0.10 for 1500

Page 21
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
366 to 367	29.88 29.57		15.56 87.33	3 3.26		0.0 0.0 14.250	120	38.762 0.134 0.114		Vel = 3.36	
367 to 368	29.57 29.42		16.46 103.79	3 3.26	E 0.0 0.0	9.408 9.408 16.068	120	39.010 0.065 0.175		Vel = 3.99	
368 to 369	29.42 10.67		0.0 103.79	3 3.26	4E 0.0 0.0	37.631 37.631 64.631	120	39.250 8.121 0.707		Vel = 3.99	
369 to 370	10.67 10.67		26.66 130.45	3 3.26		0.0 0.0 8.000	120	48.078 0.0 0.134		Vel = 5.01	
370 to 371	10.67 10.670		48.79 179.24	3 3.26		0.0 0.0 0.920	120	48.212 0.0 0.028		Vel = 6.89	
371 to 394	10.670 10.67		71.14 250.38	4 4.26	T 0.0 0.0	26.334 26.334 58.959	120	48.240 0.0 0.894		Vel = 5.64	
394			0.0 250.38					49.134		K Factor = 35.72	
394 to 395	10.67 10.67		342.12 342.12	4 4.26		0.0 0.0 6.000	120	49.134 0.0 0.162		Vel = 7.70	
395 to 396	10.67 10.67		12.31 354.43	4 4.26	E 0.0 0.0	13.167 13.167 64.307	120	49.296 0.0 1.855		Vel = 7.98	
396 to TR3	10.67 10.380		0.0 354.43	4 4.26	2E 0.0 0.0	26.334 26.334 49.514	120	51.151 0.126 1.427		Vel = 7.98	
TR3 to BR3	10.380 3		0.0 354.43	4 4.26	B S T Fsp 0.0	15.8 28.968 26.334 0.0	120	52.704 6.196 2.264		** Fixed Loss = 3 Vel = 7.98	
BR3 to UG	3 0		0.0 354.43	6 6.357		0.0 0.0 2.000	120	61.164 1.299 0.009		Vel = 3.58	
UG to HOSE	0 0		0.0 354.43	6 6.16	G E T Zfb 0.0	4.304 20.084 43.037 0.0	140	62.472 2.815 0.513		** Fixed Loss = 2.815 Vel = 3.82	
HOSE to TEST	0 0	H100	100.00 454.43	6 6.16		0.0 0.0 0.500	140	65.800 0.0 0.003		Vel = 4.89	
TEST			0.0 454.43					65.803		K Factor = 56.02	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 3 – Area 3 Competition Gym**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/22/2021**
LATEST REVISION DATE:

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Unobstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 3 – Area 3	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 23'-8"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK300
K-FACTOR: 5.6	TEMPERATURE (°F): 155

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Light Hazard
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.10	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 180	TOTAL SPRINKLERS OPERATING: 8
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 100
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 181.79	PRESSURE REQ'D (PSI): 41.879
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 281.79	PRESSURE REQ'D (PSI): 45.209
AREA SAFETY MARGIN (PSI): 31.54		

NOTES:

PE STAMP

Water Supply Curve C

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

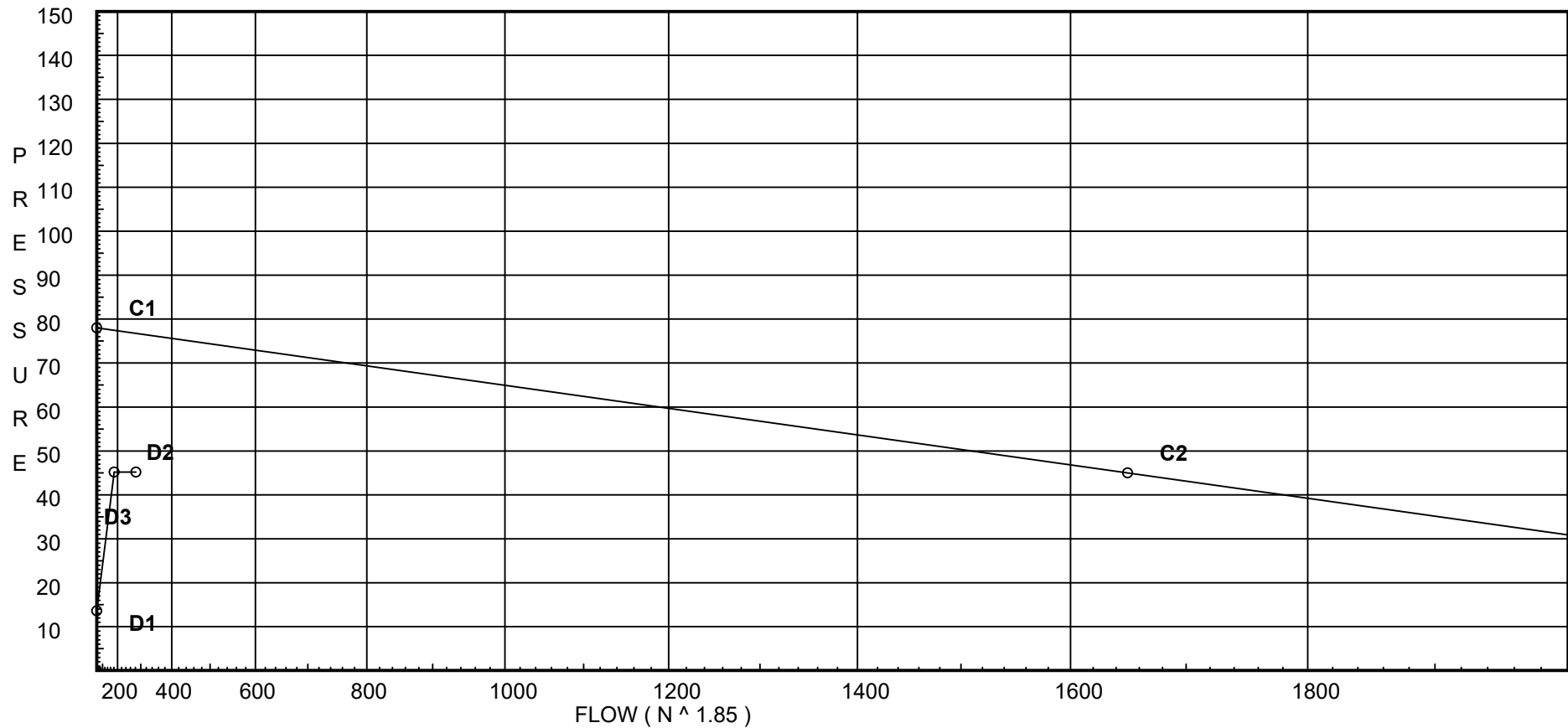
Page 2
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 13.612
D2 - System Flow : 181.786
D2 - System Pressure : 45.209
Hose (Demand) : 100
D3 - System Demand : 281.786
Safety Margin : 31.536



Fittings Used Summary

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 3
Date

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 4
Date

SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
TEST	78.0	45	1650.0	76.745	281.79	45.209

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
352	10.67		31.51		
7	22.38		26.66		
C77	22.47		26.7		
C78	22.47		26.73		
C79	22.47		26.77		
C80	22.47		26.81		
C81	22.47		26.85		
8	22.37		26.93		
372	10.67		32.2		
C73	22.32		26.77		
C74	22.32		26.81		
C75	22.32		26.86		
C76	22.32		26.89		
350	10.67		31.5		
C69	22.1		26.85		
C70	22.1		26.88		
C71	22.1		26.92		
C72	22.1		26.95		
29	10.67		31.47		
C61	21.96		26.78		
C62	21.96		26.81		
C63	21.96		26.83		
C64	21.96		26.87		
C65	21.96		26.92		
C66	21.96		26.96		
C67	21.96		26.97		
C68	21.96		27.01		
322	14.4		30.16		
25	16.07		29.44		
323	14.13		30.26		
26	15.8		29.54		
324	13.9		30.35		
27	15.56		29.63		
325	13.63		30.45		
28	15.3		29.72		
326	10.67		31.72		
327	10.67		31.71		
328	10.67		31.71		
24	10.67		31.71		
309	26.45		25.16		
310	10.67		31.8		
311	10.67		31.79		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 5
Date

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
312	10.67		31.77		
313	10.67		31.75		
314	10.67		31.73		
315	10.67		31.7		
319	10.67		31.69		
318	10.67		31.69		
317	10.67		31.68		
316	10.67		31.68		
331	10.67		31.67		
332	10.67		31.65		
333	10.67		31.64		
334	10.67		31.64		
335	10.67		31.63		
336	10.67		31.59		
337	10.67		31.55		
390	10.67		32.53		
391	10.67		32.54		
392	10.67		32.56		
393	10.67		32.58		
382	25.08		25.94		
C5	25.08		25.89		
C4	25.08		25.87		
C3	25.08		25.86		
C2	25.08		25.84		
C1	25.08		25.83		
383	25.42		25.79		
C10	25.42		25.74		
C9	25.42		25.73		
C8	25.42		25.72		
C7	25.42		25.7		
C6	25.42		25.69		
384	25.75		25.66		
C11	25.75		25.55		
385	26.09		25.54		
387	27.29		25.07		
386	27.29		25.06		
388	27.29		25.17		
389	10.67		32.45		
308	26.45		25.17		
307	26.43		25.19		
306	26.33		25.24		
305	26.09		25.35		
304	25.75		25.49		
303	25.42		25.64		
302	25.08		25.77		
301	24.92		25.83		
321	24.92		25.81		
341	31.43		21.45		
C41	31.43	5.6	16.65	22.85	
C42	31.43	5.6	16.14	22.5	
C43	31.43	5.6	16.14	22.5	

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 6
Date

NODE ANALYSIS (cont.)

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
C44	31.43	5.6	16.66	22.86	
342	31.12		21.61		
C45	31.12	5.6	16.79	22.94	
C46	31.12	5.6	16.27	22.59	
C47	31.12	5.6	16.27	22.59	
C48	31.12	5.6	16.79	22.95	
343	30.81		21.87		
344	30.5		22.12		
345	30.19		22.37		
346	29.88		22.61		
347	29.88		22.7		
348	29.88		22.81		
349	10.67		31.46		
351	10.67		31.5		
361	31.43		21.49		
362	31.12		21.66		
363	30.81		21.91		
364	30.5		22.18		
365	30.19		22.44		
366	29.88		22.72		
367	29.57		23.0		
368	29.42		23.24		
369	10.67		32.08		
370	10.67		32.19		
371	10.67		32.2		
394	10.67		32.59		
395	10.67		32.64		
396	10.67		33.18		
TR3	10.38		33.72		
BR3	3.0		40.58		
UG	0.0		41.88		
HOSE	0.0		45.21	100.0	
TEST	0.0		45.21		

Final Calculations - Hazen-Williams - 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 7
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
352 to 7	10.67 22.38		26.68 26.68	2.5 2.635	T 4E 0.0	16.474 32.948 0.0	38.920 49.422 88.342	120 -5.072 0.221			
7 to C77	22.38 22.47		-19.82 6.86	1.25 1.442	T E 0.0	7.432 3.716 0.0	8.150 11.148 19.298	120 -0.039 0.074	Vel =	1.57	
C77 to C78	22.47 22.47		0.0 6.86	1.25 1.442	0.0 0.0 0.0	8.250 0.0 8.250	120 0.0 0.0038	26.696 0.0 0.031			Vel = 1.35
C78 to C79	22.47 22.47		0.0 6.86	1.25 1.442	0.0 0.0 0.0	10.750 0.0 10.750	120 0.0 0.0038	26.727 0.0 0.041			Vel = 1.35
C79 to C80	22.47 22.47		0.0 6.86	1.25 1.442	0.0 0.0 0.0	10.750 0.0 10.750	120 0.0 0.0038	26.768 0.0 0.041			Vel = 1.35
C80 to C81	22.47 22.47		0.0 6.86	1.25 1.442	0.0 0.0 0.0	10.250 0.0 10.250	120 0.0 0.0038	26.809 0.0 0.039			Vel = 1.35
C81 to 8	22.47 22.37		0.0 6.86	1.25 1.442	E 0.0 0.0	3.716 3.716 0.0	7.570 3.716 11.286	120 0.043 0.044			Vel = 1.35
8 to 372	22.37 10.67		19.82 26.68	2.5 2.635	2T E 0.0	32.948 8.237 0.0	37.330 41.185 78.515	120 5.067 0.196			Vel = 1.57
372 to 371	10.67 10.670		0.0 26.68	3 3.26	0.0 0.0 0.0	7.430 0.0 7.430	120 0.0 0.0009	32.198 0.0 0.007			Vel = 1.03
371			0.0 26.68					32.205		K Factor =	4.70
7 to C73	22.38 22.32		19.82 19.82	2 2.157	2E 0.0 0.0	12.307 0.0 22.317	10.010 12.307 22.317	120 0.026 0.085			Vel = 1.74
C73 to C74	22.32 22.32		0.0 19.82	2 2.157	0.0 0.0 0.0	10.890 0.0 10.890	120 0.0 0.0039	26.772 0.0 0.042			Vel = 1.74
C74 to C75	22.32 22.32		0.0 19.82	2 2.157	0.0 0.0 0.0	11.000 0.0 11.000	120 0.0 0.0038	26.814 0.0 0.042			Vel = 1.74
C75 to C76	22.32 22.32		0.0 19.82	2 2.157	0.0 0.0 0.0	9.920 0.0 9.920	120 0.0 0.0038	26.856 0.0 0.038			Vel = 1.74
C76 to 8	22.32 22.37		0.0 19.82	2 2.157	E 0.0 0.0	6.153 0.0 16.383	10.230 6.153 16.383	120 -0.022 0.063			Vel = 1.74
8			0.0 19.82					26.935		K Factor =	3.82
350 to C69	10.67 22.1		18.40 18.4	2 2.157	5E T 0.0	30.767 12.307 0.0	47.210 43.074 90.284	120 -4.950 0.301			Vel = 1.62

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 8
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C69 to C70	22.1 22.1		0.0 18.4	2 2.157	0.0 0.0	10.890 0.0	120 0.0033	26.849 0.036		Vel = 1.62	
C70 to C71	22.1 22.1		0.0 18.4	2 2.157	0.0 0.0	11.000 0.0	120 0.0034	26.885 0.037		Vel = 1.62	
C71 to C72	22.1 22.1		0.0 18.4	2 2.157	0.0 0.0	9.920 0.0	120 0.0033	26.922 0.033		Vel = 1.62	
C72 to 370	22.1 10.67		0.0 18.4	2 2.157	4E T 24.613 12.307 0.0	48.290 36.920 85.210	120 0.0033	26.955 4.950 0.284		Vel = 1.62	
370			0.0 18.40					32.189		K Factor = 3.24	
29 to C61	10.67 21.96		9.77 9.77	1.5 1.682	4E T 19.799 9.9 0.0	27.690 29.699 57.389	120 0.0035	31.467 -4.890 0.199		Vel = 1.41	
C61 to C62	21.96 21.96		0.0 9.77	1.5 1.682	0.0 0.0	9.500 0.0	120 0.0035	26.776 0.033		Vel = 1.41	
C62 to C63	21.96 21.96		0.0 9.77	1.5 1.682	0.0 0.0	5.480 0.0	120 0.0035	26.809 0.019		Vel = 1.41	
C63 to C64	21.96 21.96		0.0 9.77	1.5 1.682	0.0 0.0	12.670 0.0	120 0.0035	26.828 0.044		Vel = 1.41	
C64 to C65	21.96 21.96		0.0 9.77	1.5 1.682	0.0 0.0	12.670 0.0	120 0.0035	26.872 0.044		Vel = 1.41	
C65 to C66	21.96 21.96		0.0 9.77	1.5 1.682	0.0 0.0	12.670 0.0	120 0.0035	26.916 0.044		Vel = 1.41	
C66 to C67	21.96 21.96		0.0 9.77	1.5 1.682	0.0 0.0	3.540 0.0	120 0.0034	26.960 0.012		Vel = 1.41	
C67 to C68	21.96 21.96		0.0 9.77	1.5 1.682	0.0 0.0	11.050 0.0	120 0.0034	26.972 0.038		Vel = 1.41	
C68 to 369	21.96 10.67		0.0 9.77	1.5 1.682	3E T 14.849 9.9 0.0	28.330 24.749 53.079	120 0.0035	27.010 4.890 0.184		Vel = 1.41	
369			0.0 9.77					32.084		K Factor = 1.72	
322 to 25	14.4 16.07		-0.64 -0.64	1.25 1.38	T 6.0 0.0	1.670 6.000 7.670	120 -0.0001	30.164 -0.723 -0.001		Vel = 0.14	
25 to 312	16.07 10.67		0.0 -0.64	1.25 1.442	2T 2E 14.864 7.432 0.0	70.390 22.296 92.686	120 0	29.440 2.339 -0.004		Vel = 0.13	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 9
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
312			0.0 -0.64					31.775		K Factor = -0.11	
323 to 26	14.13 15.8		-0.85 -0.85	1.25 1.38	T 0.0	6.0 6.000	120 -0.0001	30.262 -0.723			
26 to 313	15.8 10.67		0.0 -0.85	1.25 1.442	2T 2E 0.0	14.864 7.432 92.416	120 -0.0001	29.538 2.222 -0.008		Vel = 0.18	
313			0.0 -0.85					31.752		K Factor = -0.15	
324 to 27	13.9 15.56		-1.24 -1.24	1.25 1.38	T 0.0	6.0 6.000	120 -0.0003	30.347 -0.719			
27 to 314	15.56 10.67		0.0 -1.24	1.25 1.442	2T 2E 0.0	14.864 7.432 92.186	120 -0.0002	29.626 2.118 -0.015		Vel = 0.27	
314			0.0 -1.24					31.729		K Factor = -0.22	
325 to 28	13.63 15.3		-1.85 -1.85	1.25 1.38	T 0.0	6.0 6.000	120 -0.0004	30.451 -0.723			
28 to 315	15.3 10.67		0.0 -1.85	1.25 1.442	2T 2E 0.0	14.864 7.432 91.906	120 -0.0003	29.725 2.005 -0.031		Vel = 0.40	
315			0.0 -1.85					31.699		K Factor = -0.33	
326 to 316	10.67 10.67		-2.31 -2.31	1.25 1.442	2T 0.0	14.864 14.864	120 -0.0005	31.718 0.0			
316			0.0 -2.31					31.677		K Factor = -0.41	
327 to 317	10.67 10.67		-1.44 -1.44	1.25 1.442	2T 6E 0.0	14.864 22.296 118.200	120 -0.0002	31.709 0.0 -0.025		Vel = 0.28	
317			0.0 -1.44					31.684		K Factor = -0.26	
328 to 318	10.67 10.67		-1.42 -1.42	1.25 1.442	2T 5E 0.0	14.864 18.58 109.114	120 -0.0002	31.708 0.0 -0.022			
318			0.0 -1.42					31.686		K Factor = -0.25	
24 to 319	10.67 10.67		-1.44 -1.44	1.25 1.442	2T 4E 0.0	14.864 14.864 102.878	120 -0.0002	31.708 0.0 -0.022		Vel = 0.28	
319			0.0 -1.44					31.686		K Factor = -0.26	
309 to 310	26.450 10.67		-10.90 -10.9	1.5 1.682	3E T 0.0	14.849 9.9 45.249	120 -0.0042	25.160 6.834 -0.192		Vel = 1.57	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 10
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
310 to 311	10.67 10.67		0.0 -10.9	2 2.157	0.0 0.0	7.770 0.0	120 -0.0013	31.802 0.0			
311 to 312	10.67 10.67		0.0 -10.9	2 2.157	E 0.0	6.153 6.153	120 -0.0012	31.792 0.0	Vel =	0.96	
312 to 313	10.67 10.67		-0.64 -11.54	2 2.157	0.0 0.0	16.150 0.0	120 -0.0014	31.775 0.0	Vel =	1.01	
313 to 314	10.67 10.67		-0.85 -12.39	2 2.157	0.0 0.0	14.130 0.0	120 -0.0016	31.752 0.0	Vel =	1.09	
314 to 315	10.67 10.67		-1.24 -13.63	2 2.157	0.0 0.0	15.790 0.0	120 -0.0019	31.729 0.0	Vel =	1.20	
315 to 331	10.67 10.67		-1.84 -15.47	2 2.157	0.0 0.0	10.340 0.0	120 -0.0024	31.699 0.0	Vel =	1.36	
331			0.0 -15.47					31.674	K Factor =	-2.75	
319 to 318	10.67 10.67		-1.44 -1.44	2 2.157	0.0 0.0	14.040 0.0	120 0	31.686 0.0	Vel =	0.13	
318 to 317	10.67 10.67		-1.43 -2.87	2 2.157	0.0 0.0	14.500 0.0	120 -0.0001	31.686 0.0	Vel =	0.25	
317 to 316	10.67 10.67		-1.44 -4.31	2 2.157	2E 0.0	12.307 12.307	120 -0.0002	31.684 0.0	Vel =	0.38	
316 to 331	10.67 10.67		-2.31 -6.62	2 2.157	0.0 0.0	5.470 0.0	120 -0.0005	31.677 0.0	Vel =	0.58	
331 to 332	10.67 10.67		-15.48 -22.1	3 3.26	T 0.0	20.159 20.159	120 -0.0006	31.674 0.0	Vel =	0.85	
332 to 333	10.67 10.67		0.0 -22.1	3 3.26	0.0 0.0	11.340 0.0	120 -0.0006	31.649 0.0	Vel =	0.85	
333 to 334	10.67 10.67		0.0 -22.1	3 3.26	0.0 0.0	6.580 0.0	120 -0.0008	31.642 0.0	Vel =	0.85	
334 to 335	10.67 10.67		0.0 -22.1	3 3.26	0.0 0.0	11.740 0.0	120 -0.0006	31.637 0.0	Vel =	0.85	
335 to 336	10.67 10.67		0.0 -22.1	3 3.26	4E 0.0	37.631 37.631	120 -0.0006	31.630 0.0	Vel =	0.85	
336 to 337	10.67 10.67		0.0 -22.1	3 3.26	0.0 0.0	60.650 0.0	120 -0.0006	31.592 0.0	Vel =	0.85	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 11
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
337 to 351	10.67 10.67		0.0 -22.1	3 3.26	2T 40.319 0.0 0.0	38.360 40.319 78.679	120 -0.0006	31.554 0.0 -0.049		Vel = 0.85	
351			0.0 -22.10					31.505		K Factor = -3.94	
390 to 391	10.67 10.67		22.10 22.1	3 3.26	0.0 0.0 0.0	21.550 0.0 21.550	120 0.0006	32.526 0.0 0.013		Vel = 0.85	
391 to 392	10.67 10.67		0.0 22.1	3 3.26	2E 18.815 0.0 0.0	16.480 18.815 35.295	120 0.0006	32.539 0.0 0.022		Vel = 0.85	
392 to 393	10.67 10.67		-3.59 18.51	3 3.26	E 9.408 0.0 0.0	40.180 9.408 49.588	120 0.0005	32.561 0.0 0.023		Vel = 0.71	
393 to 394	10.67 10.67		0.0 18.51	3 3.26	E 9.408 0.0 0.0	13.820 9.408 23.228	120 0.0004	32.584 0.0 0.010		Vel = 0.71	
394			0.0 18.51					32.594		K Factor = 3.24	
392 to 395	10.67 10.67		3.59 3.59	1.5 1.682	2T 4E 19.799 19.799 0.0	110.010 39.598 149.608	120 0.0005	32.561 0.0 0.081		Vel = 0.52	
395			0.0 3.59					32.642		K Factor = 0.63	
382 to C5	25.08 25.08		-4.14 -4.14	1.25 1.442	T 7.432 0.0 0.0	27.000 7.432 34.432	120 -0.0015	25.939 0.0 -0.052		Vel = 0.81	
C5 to C4	25.08 25.08		0.0 -4.14	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0015	25.887 0.0 -0.015		Vel = 0.81	
C4 to C3	25.08 25.08		0.0 -4.14	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0015	25.872 0.0 -0.015		Vel = 0.81	
C3 to C2	25.08 25.08		0.0 -4.14	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0015	25.857 0.0 -0.015		Vel = 0.81	
C2 to C1	25.08 25.08		0.0 -4.14	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0015	25.842 0.0 -0.015		Vel = 0.81	
C1 to 302	25.08 25.08		0.0 -4.14	1.25 1.442	T 7.432 0.0 0.0	27.750 7.432 35.182	120 -0.0015	25.827 0.0 -0.053		Vel = 0.81	
302			0.0 -4.14					25.774		K Factor = -0.82	
383 to C10	25.42 25.42		-4.07 -4.07	1.25 1.442	T 7.432 0.0 0.0	27.000 7.432 34.432	120 -0.0015	25.795 0.0 -0.050		Vel = 0.80	
C10 to C9	25.42 25.42		0.0 -4.07	1.25 1.442	0.0 0.0 0.0	10.000 0.0 10.000	120 -0.0015	25.745 0.0 -0.015		Vel = 0.80	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 12
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C9 to C8	25.42 25.42		0.0 -4.07	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0014	25.730 0.0		Vel = 0.80	
C8 to C7	25.42 25.42		0.0 -4.07	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0015	25.716 0.0		Vel = 0.80	
C7 to C6	25.42 25.42		0.0 -4.07	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0014	25.701 0.0		Vel = 0.80	
C6 to 303	25.42 25.42		0.0 -4.07	1.25 1.442	T 0.0	7.432 7.432	120 -0.0014	25.687 0.0		Vel = 0.80	
303			0.0 -4.07					25.636		K Factor = -0.80	
384 to C11	25.75 25.75		-4.20 -4.2	1.25 1.442	T 0.0	7.432 7.432	120 -0.0015	25.663 0.0		Vel = 0.83	
C11 to 304	25.75 25.75		0.0 -4.2	1.25 1.442	T 0.0	7.432 7.432	120 -0.0015	25.548 0.0		Vel = 0.83	
304			0.0 -4.20					25.494		K Factor = -0.83	
385 to 305	26.090 26.09		-4.52 -4.52	1.25 1.442	2T 0.0	14.864 14.864	120 -0.0018	25.540 0.0		Vel = 0.89	
305			0.0 -4.52					25.347		K Factor = -0.90	
387 to 307	27.290 26.43		-5.17 -5.17	1.25 1.442	2T 0.0	14.864 14.864	120 -0.0023	25.070 0.372		Vel = 1.02	
307			0.0 -5.17					25.194		K Factor = -1.03	
382 to 383	25.08 25.42		4.14 4.14	2 2.157	0.0 0.0	15.000 15.000	120 0.0002	25.939 0.003		Vel = 0.36	
383 to 384	25.42 25.75		4.07 8.21	2 2.157	0.0 0.0	15.000 15.000	120 0.0007	25.795 0.011		Vel = 0.72	
384 to 385	25.75 26.09		4.20 12.41	2 2.157	0.0 0.0	15.000 15.000	120 0.0016	25.663 0.024		Vel = 1.09	
385 to 386	26.090 27.290		4.51 16.92	2 2.157	0.0 0.0	14.000 14.000	120 0.0029	25.540 0.040		Vel = 1.49	
386 to 387	27.290 27.290		0.0 16.92	1.5 1.682	0.0 0.0	1.000 1.000	120 0.0100	25.060 0.010		Vel = 2.44	
387 to 388	27.290 27.290		5.18 22.1	1.5 1.682	0.0 0.0	6.290 6.290	120 0.0156	25.070 0.098		Vel = 3.19	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 13
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
388 to 389	27.290 10.670		0.0 22.1	2.5 2.635	2E 0.0	16.474 16.474	120 0.0018	25.168 7.198			
389 to 390	10.670 10.67		0.0 22.1	2.5 2.635	2E 0.0	16.474 16.474	120 0.0018	32.450 0.0	Vel = 1.30		
390			0.0 22.10					32.526	K Factor = 3.88		
309 to 308	26.450 26.450		10.90 10.9	2 2.157	0.0 0.0	11.580 0.0	120 0.0012	25.160 0.0	Vel = 0.96		
308 to 307	26.450 26.43		0.0 10.9	2 2.157	E 0.0	6.153 6.153	120 0.0013	25.174 0.009	Vel = 0.96		
307 to 306	26.43 26.33		-5.17 5.73	2 2.157	0.0 0.0	4.540 4.540	120 0.0004	25.194 0.043	Vel = 0.50		
306 to 305	26.33 26.09		0.0 5.73	2 2.157	0.0 0.0	10.460 0.0	120 0.0004	25.239 0.104	Vel = 0.50		
305 to 304	26.09 25.75		-4.52 1.21	2 2.157	0.0 0.0	15.000 0.0	120 0	25.347 0.147	Vel = 0.11		
304 to 303	25.75 25.42		-4.20 -2.99	2 2.157	0.0 0.0	15.000 0.0	120 -0.0001	25.494 0.143	Vel = 0.26		
303 to 302	25.42 25.08		-4.06 -7.05	2 2.157	0.0 0.0	15.000 0.0	120 -0.0006	25.636 0.147	Vel = 0.62		
302 to 301	25.08 24.92		-4.15 -11.2	2 2.157	E 0.0	6.153 6.153	120 -0.0013	25.774 0.069	Vel = 0.98		
301 to 321	24.92 24.920		0.0 -11.2	2 2.157	0.0 0.0	11.580 11.580	120 -0.0013	25.826 0.0	Vel = 0.98		
321 to 322	24.920 14.4		0.0 -11.2	1.5 1.682	4E 0.0	25.667 19.799	120 -0.0045	25.811 4.556	Vel = 1.62		
322 to 323	14.4 14.13		0.64 -10.56	2 2.157	0.0 0.0	16.160 0.0	120 -0.0012	30.164 0.117	Vel = 0.93		
323 to 324	14.13 13.9		0.85 -9.71	2 2.157	0.0 0.0	14.150 14.150	120 -0.0011	30.262 0.100	Vel = 0.85		
324 to 325	13.9 13.63		1.24 -8.47	2 2.157	0.0 0.0	15.770 15.770	120 -0.0008	30.347 0.117	Vel = 0.74		
325 to 326	13.63 10.67		1.85 -6.62	2 2.157	2E 0.0	12.307 12.307	120 -0.0005	30.451 1.282	Vel = 0.58		

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 14
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
326 to 327	10.67 10.67		2.31 -4.31	2 2.157	2E 0.0	12.307 12.307	120 -0.0002	31.718 0.0			
327 to 328	10.67 10.67		1.44 -2.87	2 2.157	0.0 0.0	9.500 9.500	120 -0.0001	31.709 0.0		Vel = 0.38	
328 to 24	10.67 10.67		1.43 -1.44	2 2.157	0.0 0.0	12.000 12.000	120 0	31.708 0.0		Vel = 0.25	
24			0.0 -1.44					31.708		Vel = 0.13	
341 to C41	31.43 31.43		-45.27 -45.27	1.25 1.442	T 0.0	7.432 7.432	120 -0.1252	21.446 0.0		K Factor = -0.26	
C41 to C42	31.43 31.430	5.60	22.86 -22.41	1.25 1.442	0.0 0.0	15.000 15.000	120 -0.0341	16.655 0.0		Vel = 8.89	
C42 to C43	31.430 31.43	5.60	22.50 0.09	1.25 1.442	0.0 0.0	13.000 13.000	120 0	16.143 0.0		Vel = 4.40	
C43 to C44	31.43 31.43	5.60	22.50 22.59	1.25 1.442	0.0 0.0	15.000 15.000	120 0.0346	16.143 0.0		Vel = 0.02	
C44 to 361	31.43 31.43	5.60	22.86 45.45	1.25 1.442	T 0.0	7.432 7.432	120 0.1262	16.662 0.0		Vel = 4.44	
361			0.0 45.45					21.489		Vel = 8.93	
342 to C45	31.12 31.12		-45.45 -45.45	1.25 1.442	T 0.0	7.432 7.432	120 -0.1262	21.614 0.0		K Factor = 9.80	
C45 to C46	31.12 31.12	5.60	22.95 -22.5	1.25 1.442	0.0 0.0	15.000 15.000	120 -0.0343	16.787 0.0		Vel = 8.93	
C46 to C47	31.12 31.12	5.60	22.59 0.09	1.25 1.442	0.0 0.0	13.000 13.000	120 0	16.272 0.0		Vel = 4.42	
C47 to C48	31.12 31.12	5.60	22.59 22.68	1.25 1.442	0.0 0.0	15.000 15.000	120 0.0349	16.272 0.0		Vel = 0.02	
C48 to 362	31.12 31.12	5.60	22.95 45.63	1.25 1.442	T 0.0	7.432 7.432	120 0.1271	16.795 0.0		Vel = 4.46	
362			0.0 45.63					21.657		Vel = 8.96	
343 to 363	30.81 30.81		1.93 1.93	1.25 1.442	2T 0.0	14.864 14.864	120 0.0004	21.870 0.0		K Factor = 9.81	
					0.0	119.524		0.044		Vel = 0.38	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 15
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
363			0.0 1.93					21.914		K Factor = 0.41	
344 to 364	30.5 30.5		2.17 2.17	1.25 1.442	2T 0.0	14.864 14.864	120 0.0005	22.121 0.054			Vel = 0.43
364			0.0 2.17					22.175		K Factor = 0.46	
345 to 365	30.19 30.19		2.60 2.6	1.25 1.442	2T 0.0	14.864 14.864	120 0.0006	22.367 0.075			Vel = 0.51
365			0.0 2.60					22.442		K Factor = 0.55	
346 to 366	29.88 29.88		3.18 3.18	1.25 1.442	2T 0.0	14.864 14.864	120 0.0009	22.606 0.110			Vel = 0.62
366			0.0 3.18					22.716		K Factor = 0.67	
347 to 367	29.880 29.57		3.89 3.89	1.25 1.442	2T 0.0	14.864 14.864	120 0.0013	22.705 0.134			Vel = 0.76
367			0.0 3.89					22.999		K Factor = 0.81	
341 to 342	31.43 31.12		45.27 45.27	3 3.26	0.0 0.0	14.250 14.250	120 0.0024	21.446 0.134			Vel = 1.74
342 to 343	31.12 30.81		45.44 90.71	3 3.26	0.0 0.0	14.250 14.250	120 0.0086	21.614 0.122			Vel = 3.49
343 to 344	30.81 30.5		-1.93 88.78	3 3.26	0.0 0.0	14.250 14.250	120 0.0082	21.870 0.117			Vel = 3.41
344 to 345	30.5 30.19		-2.17 86.61	3 3.26	0.0 0.0	14.250 14.250	120 0.0079	22.121 0.112			Vel = 3.33
345 to 346	30.19 29.88		-2.60 84.01	3 3.26	0.0 0.0	14.250 14.250	120 0.0074	22.367 0.105			Vel = 3.23
346 to 347	29.88 29.880		-3.17 80.84	3 3.26	0.0 0.0	14.250 14.250	120 0.0069	22.606 0.099			Vel = 3.11
347 to 348	29.880 29.880		-3.89 76.95	3 3.26	E 0.0	9.408 16.078	120 0.0063	22.705 0.101			Vel = 2.96
348 to 349	29.880 10.67		0.0 76.95	3 3.26	3E 0.0	28.223 53.223	120 0.0063	22.806 0.334			Vel = 2.96
349 to 29	10.67 10.67		0.0 76.95	3 3.26	0.0 0.0	0.990 0.990	120 0.0071	31.460 0.007			Vel = 2.96

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 16
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
29 to 350	10.67 10.67		-9.77 67.18	3 3.26	0.0 0.0	6.380 0.0	120 0.0049	31.467 0.0			
350 to 351	10.67 10.67		-18.40 48.78	3 3.26	0.0 0.0	2.450 0.0	120 0.0029	31.498 0.0	Vel =	2.58	
351 to 352	10.67 10.67		-22.10 26.68	3 3.26	0.0 0.0	8.010 0.0	120 0.0009	31.505 0.0	Vel =	1.87	
352			0.0 26.68					31.512	K Factor =	4.75	
361 to 362	31.43 31.12		45.45 45.45	3 3.26	0.0 0.0	14.250 0.0	120 0.0024	21.489 0.134	Vel =	1.75	
362 to 363	31.12 30.81		45.62 91.07	3 3.26	0.0 0.0	14.250 0.0	120 0.0086	21.657 0.134	Vel =	3.50	
363 to 364	30.81 30.5		1.94 93.01	3 3.26	0.0 0.0	14.250 0.0	120 0.0089	21.914 0.134	Vel =	3.58	
364 to 365	30.5 30.19		2.17 95.18	3 3.26	0.0 0.0	14.250 0.0	120 0.0093	22.175 0.134	Vel =	3.66	
365 to 366	30.19 29.88		2.59 97.77	3 3.26	0.0 0.0	14.250 0.0	120 0.0098	22.442 0.134	Vel =	3.76	
366 to 367	29.88 29.57		3.18 100.95	3 3.26	0.0 0.0	14.250 0.0	120 0.0105	22.716 0.134	Vel =	3.88	
367 to 368	29.57 29.42		3.89 104.84	3 3.26	E 0.0	9.408 9.408	120 0.0111	22.999 0.065	Vel =	4.03	
368 to 369	29.42 10.67		0.0 104.84	3 3.26	4E 0.0	37.631 37.631	120 0.0111	23.243 8.121	Vel =	4.03	
369 to 370	10.67 10.67		9.76 114.6	3 3.26	0.0 0.0	8.000 0.0	120 0.0131	32.084 0.0	Vel =	4.40	
370 to 371	10.67 10.670		18.41 133.01	3 3.26	0.0 0.0	0.920 0.0	120 0.0174	32.189 0.0	Vel =	5.11	
371 to 394	10.670 10.67		26.68 159.69	4 4.26	T 0.0	26.334 26.334	120 0.0066	32.205 0.0	Vel =	3.59	
394			0.0 159.69					32.594	K Factor =	27.97	
394 to 395	10.67 10.67		178.20 178.2	4 4.26	0.0 0.0	6.000 6.000	120 0.0080	32.594 0.0	Vel =	4.01	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Comp Gym Area 3 - 0.10 for 1500

Page 17
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
395 to 396	10.67 10.67		3.59 181.79	4 4.26	E 0.0	13.167 13.167	120 0.0084	32.642 0.0			
396 to TR3	10.67 10.380		0.0 181.79	4 4.26	2E 0.0	26.334 26.334	120 0.0084	33.182 0.126		Vel = 4.09	
TR3 to BR3	10.380 3		0.0 181.79	4 4.26	B S T Fsp 0.0	15.8 28.968 26.334 0.0	120 0.0084	33.723 6.196 0.658		* * Fixed Loss = 3 Vel = 4.09	
BR3 to UG	3 0		0.0 181.79	6 6.357		0.0 0.0	120 0.0015	40.577 1.299		Vel = 1.84	
UG to HOSE	0 0		0.0 181.79	6 6.16	G E T Zfb 0.0	4.304 20.084 43.037 0.0	140 0.0010	41.879 3.180 0.149		* * Fixed Loss = 3.18 Vel = 1.96	
HOSE to TEST	0 0	H100	100.00 281.79	6 6.16		0.0 0.0	140 0.0020	45.208 0.0		Vel = 3.03	
TEST			0.0 281.79					45.209		K Factor = 41.91	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 3 – Area 4 Stage**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/22/2021**
LATEST REVISION DATE:

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Unobstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 3 – Area 4	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 24'-6"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK300 & VK302
K-FACTOR: 5.6	TEMPERATURE (°F): 200

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Ordinary Hazard Group 2
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.20	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 130	TOTAL SPRINKLERS OPERATING: 21
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 250
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 513.33	PRESSURE REQ'D (PSI): 56.340
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 763.33	PRESSURE REQ'D (PSI): 60.119
AREA SAFETY MARGIN (PSI): 9.95		

NOTES:

PE STAMP

Water Supply Curve C

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

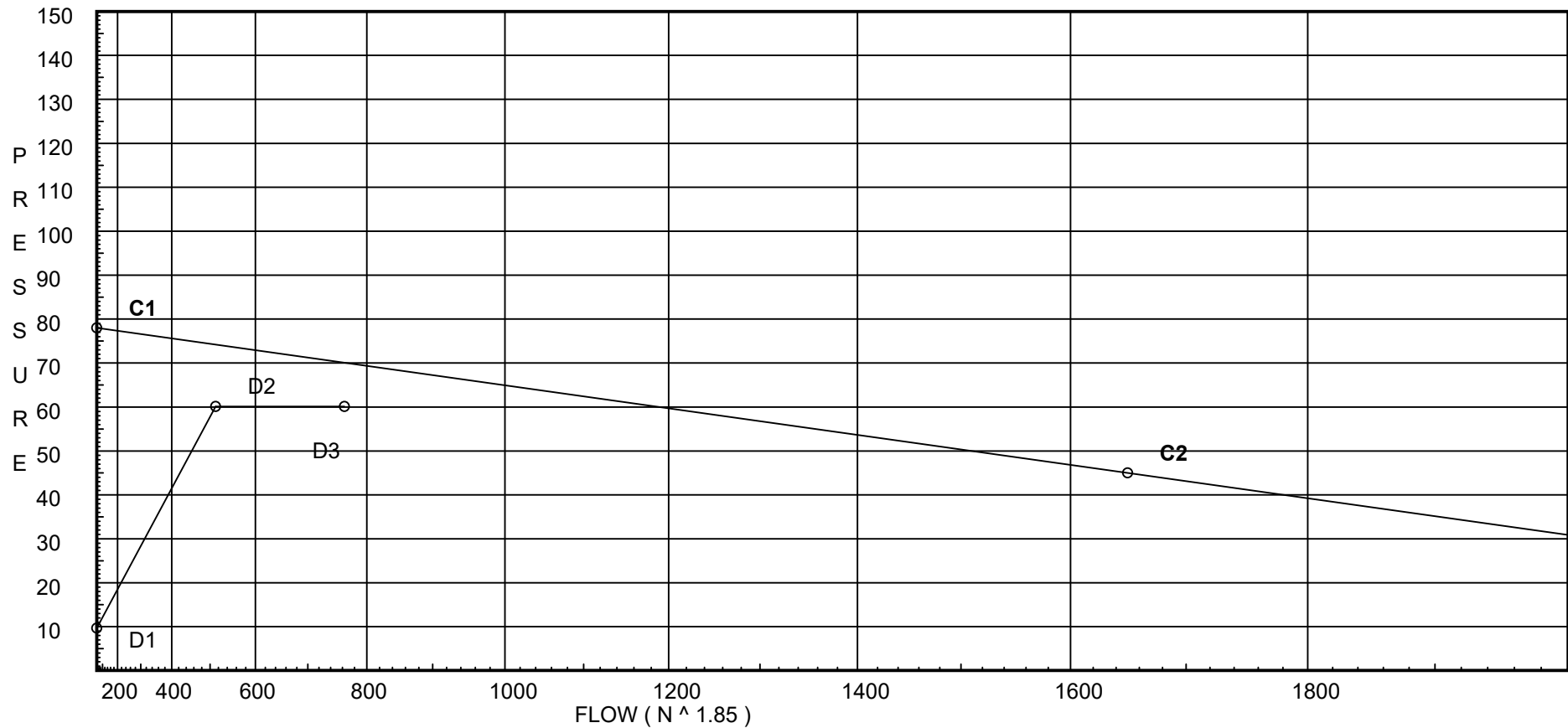
Page 2
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 9.667
D2 - System Flow : 513.329
D2 - System Pressure : 60.119
Hose (Demand) : 250
D3 - System Demand : 763.329
Safety Margin : 9.953



Fittings Used Summary

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 3
Date

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 4
Date

SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
TEST	78.0	45	1650.0	70.072	763.33	60.119

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
DP04	17.5	5.6	12.76	20.0	
EQ04	21.96		12.05		
DP05	17.5	5.6	12.76	20.0	
EQ05	22.47		11.9		
SP06	22.88	5.6	12.76	20.0	
EQ06	21.96		13.92		
SP07	22.99	5.6	21.56	26.0	
EQ07	22.32		23.05		
SP08	22.77	5.6	21.56	26.0	
EQ08	22.1		23.05		
SP09	22.63	5.6	12.76	20.0	
EQ09	21.96		13.78		
352	10.67		29.72		
7	22.38		23.11		
C77	22.47	5.8	19.59	25.66	K=K @ EQ05
C78	22.47	5.8	19.12	25.35	K=K @ EQ05
C79	22.47	5.8	19.11	25.34	K=K @ EQ05
C80	22.47	5.8	19.44	25.56	K=K @ EQ05
C81	22.47	5.8	20.8	26.44	K=K @ EQ05
8	22.37		24.29		
372	10.67		34.54		
C73	22.32	5.42	23.05	26.0	K=K @ EQ07
C74	22.32	5.42	23.05	26.0	K=K @ EQ07
C75	22.32	5.42	23.15	26.06	K=K @ EQ07
C76	22.32	5.42	23.42	26.21	K=K @ EQ07
350	10.67		29.77		
C69	22.1	5.42	24.41	26.76	K=K @ EQ08
C70	22.1	5.42	24.42	26.76	K=K @ EQ08
C71	22.1	5.42	24.52	26.82	K=K @ EQ08
C72	22.1	5.42	24.8	26.97	K=K @ EQ08
29	10.67		29.77		
C61	21.96	5.36	15.7	21.24	K=K @ EQ06
C62	21.96	5.36	14.86	20.66	K=K @ EQ06
C63	21.96	5.76	14.65	22.05	K=K @ EQ04
C64	21.96	5.76	14.57	21.99	K=K @ EQ04
C65	21.96	5.76	14.6	22.01	K=K @ EQ04
C66	21.96	5.76	14.96	22.28	K=K @ EQ04
C67	21.96	5.39	15.24	21.03	K=K @ EQ09
C68	21.96	5.39	16.85	22.12	K=K @ EQ09
322	14.4		30.06		
25	16.07		29.34		
323	14.13		30.05		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 5
Date

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
26	15.8		29.32		
324	13.9		30.04		
27	15.56		29.31		
325	13.63		30.07		
28	15.3		29.33		
326	10.67		31.25		
327	10.67		31.19		
328	10.67		31.18		
24	10.67		31.18		
309	26.45		26.31		
310	10.67		31.83		
311	10.67		31.76		
312	10.67		31.64		
313	10.67		31.48		
314	10.67		31.33		
315	10.67		31.12		
319	10.67		31.03		
318	10.67		31.02		
317	10.67		31.01		
316	10.67		30.96		
331	10.67		30.94		
332	10.67		30.77		
333	10.67		30.72		
334	10.67		30.69		
335	10.67		30.64		
336	10.67		30.37		
337	10.67		30.11		
390	10.67		36.89		
391	10.67		36.98		
392	10.67		37.14		
393	10.67		37.29		
382	25.08		28.24		
C5	25.08		27.88		
C4	25.08		27.78		
C3	25.08		27.68		
C2	25.08		27.57		
C1	25.08		27.47		
383	25.42		28.12		
C10	25.42		27.77		
C9	25.42		27.67		
C8	25.42		27.57		
C7	25.42		27.47		
C6	25.42		27.37		
384	25.75		28.05		
C11	25.75		27.26		
385	26.09		28.07		
387	27.29		27.9		
386	27.29		27.83		
388	27.29		28.59		
389	10.67		36.36		
308	26.45		26.46		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 6
Date

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
307	26.43		26.55		
306	26.33		26.6		
305	26.09		26.73		
304	25.75		26.88		
303	25.42		27.01		
302	25.08		27.1		
301	24.92		27.05		
321	24.92		26.94		
341	31.43		22.0		
C41	31.43		22.64		
C42	31.43		22.89		
C43	31.43		23.1		
C44	31.43		23.35		
342	31.12		22.13		
C45	31.12		22.77		
C46	31.12		23.02		
C47	31.12		23.24		
C48	31.12		23.49		
343	30.81		22.25		
344	30.5		22.35		
345	30.19		22.43		
346	29.88		22.47		
347	29.88		22.34		
348	29.88		22.14		
349	10.67		29.79		
351	10.67		29.77		
361	31.43		23.99		
362	31.12		24.13		
363	30.81		24.28		
364	30.5		24.45		
365	30.19		24.64		
366	29.88		24.86		
367	29.57		25.13		
368	29.42		25.4		
369	10.67		34.33		
370	10.67		34.65		
371	10.67		34.72		
394	10.67		37.37		
395	10.67		37.7		
396	10.67		41.38		
TR3	10.38		44.34		
BR3	3.0		55.02		
UG	0.0		56.34		
HOSE	0.0		60.11	250.0	
TEST	0.0		60.12		

Final Calculations - Hazen-Williams - 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 7
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
DP04 to EQ04	17.5 21.96	5.60	20.00 20.0	1 1.049	T 0.0 0.0	4.460 5.000 9.460	120 0.1301	12.755 -1.932 1.231		Vel = 7.42	
EQ04			0.0 20.00					12.054		K Factor = 5.76	
DP05 to EQ05	17.5 22.47	5.60	20.00 20.0	1 1.049	T 0.0 0.0	4.970 5.000 9.970	120 0.1302	12.755 -2.153 1.298		Vel = 7.42	
EQ05			0.0 20.00					11.900		K Factor = 5.80	
SP06 to EQ06	22.88 21.96	5.60	20.00 20.0	1 1.049	T 0.0 0.0	0.920 5.000 5.920	120 0.1302	12.755 0.398 0.771		Vel = 7.42	
EQ06			0.0 20.00					13.924		K Factor = 5.36	
SP07 to EQ07	22.99 22.32	5.60	26.00 26.0	1 1.049	T 0.0 0.0	0.670 5.000 5.670	120 0.2115	21.556 0.290 1.199		Vel = 9.65	
EQ07			0.0 26.00					23.045		K Factor = 5.42	
SP08 to EQ08	22.77 22.1	5.60	26.00 26.0	1 1.049	T 0.0 0.0	0.670 5.000 5.670	120 0.2115	21.556 0.290 1.199		Vel = 9.65	
EQ08			0.0 26.00					23.045		K Factor = 5.42	
SP09 to EQ09	22.63 21.96	5.60	20.00 20.0	1 1.049	T 0.0 0.0	0.670 5.000 5.670	120 0.1302	12.755 0.290 0.738		Vel = 7.42	
EQ09			0.0 20.00					13.783		K Factor = 5.39	
352 to 7	10.67 22.38		-76.00 -76.0	2.5 2.635	T 4E 0.0	16.474 32.948 0.0	120 -0.0173	29.716 -5.072 -1.531		Vel = 4.47	
7 to C77	22.38 22.47		20.85 -55.15	1.25 1.442	T E 0.0	7.432 3.716 0.0	120 -0.1804	23.113 -0.039 -3.482		Vel = 10.83	
C77 to C78	22.47 22.47	5.8	25.67 -29.48	1.25 1.442		0.0 0.0 0.0	120 -0.0566	19.592 0.0 -0.467		K = K @ EQ05 Vel = 5.79	
C78 to C79	22.47 22.47	5.8	25.35 -4.13	1.25 1.442		0.0 0.0 0.0	120 -0.0015	19.125 0.0 -0.016		K = K @ EQ05 Vel = 0.81	
C79 to C80	22.47 22.47	5.8	25.35 21.22	1.25 1.442		0.0 0.0 0.0	120 0.0308	19.109 0.0 0.331		K = K @ EQ05 Vel = 4.17	
C80 to C81	22.47 22.47	5.8	25.56 46.78	1.25 1.442		0.0 0.0 0.0	120 0.1331	19.440 0.0 1.364		K = K @ EQ05 Vel = 9.19	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 8
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C81 to 8	22.47 22.37	5.8	26.44 73.22	1.25 1.442	E 0.0	3.716 3.716	120	20.804 0.043		K = K @ EQ05	
8 to 372	22.37 10.67		83.42 156.64	2.5 2.635	2T E	32.948 8.237	120	24.288 5.067		Vel = 14.38	
372 to 371	10.67 10.670		0.0 156.64	3 3.26		0.0 0.0	120	34.543 0.0		Vel = 9.22	
371			0.0 156.64			7.430 7.430	0.0234	0.174		Vel = 6.02	
7 to C73	22.38 22.32		-20.85 -20.85	2 2.157	2E	12.307 0.0	120	23.113 0.026		K Factor = 26.58	
C73 to C74	22.32 22.32	5.42	26.00 5.15	2 2.157		0.0 0.0	120	23.045 0.0		Vel = 1.83	
C74 to C75	22.32 22.32	5.42	26.00 31.15	2 2.157		0.0 0.0	120	23.049 0.0		K = K @ EQ07	
C75 to C76	22.32 22.32	5.42	26.06 57.21	2 2.157		0.0 0.0	120	23.146 0.0		Vel = 0.45	
C76 to 8	22.32 22.37	5.42	26.21 83.42	2 2.157	E	6.153 0.0	120	23.415 -0.022		K = K @ EQ07	
8			0.0 83.42			10.230 16.383	0.0546	0.895		Vel = 5.02	
350 to C69	10.67 22.1		-21.55 -21.55	2 2.157	5E T	30.767 12.307	120	29.766 -4.950		K Factor = 16.93	
C69 to C70	22.1 22.1	5.42	26.76 5.21	2 2.157		0.0 0.0	120	24.412 0.0		Vel = 1.89	
C70 to C71	22.1 22.1	5.42	26.76 31.97	2 2.157		0.0 0.0	120	24.416 0.0		K = K @ EQ08	
C71 to C72	22.1 22.1	5.42	26.82 58.79	2 2.157		0.0 0.0	120	24.518 0.0		Vel = 0.46	
C72 to 370	22.1 10.67	5.42	26.97 85.76	2 2.157	4E T	24.613 12.307	120	24.801 4.950		K = K @ EQ08	
370			0.0 85.76			48.290 85.210	0.0575	4.897		Vel = 7.53	
29 to C61	10.67 21.96		-77.51 -77.51	1.5 1.682	4E T	19.799 9.9	120	29.775 -4.890		K Factor = 14.57	
						57.389	-0.1600	-9.184		Vel = 11.19	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 9
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C61 to C62	21.96 21.96	5.36	21.23 -56.28	1.5 1.682	0.0 0.0 0.0	9.500 0.0 9.500	120 -0.0885	15.701 0.0 -0.841	K = K @ EQ06 Vel = 8.13		
C62 to C63	21.96 21.96	5.36	20.67 -35.61	1.5 1.682	0.0 0.0 0.0	5.480 0.0 5.480	120 -0.0380	14.860 0.0 -0.208	K = K @ EQ06 Vel = 5.14		
C63 to C64	21.96 21.96	5.76	22.05 -13.56	1.5 1.682	0.0 0.0 0.0	12.670 0.0 12.670	120 -0.0064	14.652 0.0 -0.081	K = K @ EQ04 Vel = 1.96		
C64 to C65	21.96 21.96	5.76	21.98 8.42	1.5 1.682	0.0 0.0 0.0	12.670 0.0 12.670	120 0.0026	14.571 0.0 0.033	K = K @ EQ04 Vel = 1.22		
C65 to C66	21.96 21.96	5.76	22.02 30.44	1.5 1.682	0.0 0.0 0.0	12.670 0.0 12.670	120 0.0284	14.604 0.0 0.360	K = K @ EQ04 Vel = 4.40		
C66 to C67	21.96 21.96	5.76	22.28 52.72	1.5 1.682	0.0 0.0 0.0	3.540 0.0 3.540	120 0.0785	14.964 0.0 0.278	K = K @ EQ04 Vel = 7.61		
C67 to C68	21.96 21.96	5.39	21.03 73.75	1.5 1.682	0.0 0.0 0.0	11.050 0.0 11.050	120 0.1460	15.242 0.0 1.613	K = K @ EQ09 Vel = 10.65		
C68 to 369	21.96 10.67	5.39	22.12 95.87	1.5 1.682	3E T 0.0	14.849 9.9 53.079	28.330 24.749 0.2371	120 16.855 4.890 12.586	K = K @ EQ09 Vel = 13.84		
369			0.0 95.87					34.331	K Factor = 16.36		
322 to 25	14.4 16.07		-1.94 -1.94	1.25 1.38	T 0.0 0.0	1.670 6.000 7.670	120 -0.0005	30.063 -0.723 -0.004	Vel = 0.42		
25 to 312	16.07 10.67		0.0 -1.94	1.25 1.442	2T 2E 0.0	14.864 7.432 92.686	70.390 22.296 -0.0004	120 29.336 2.339 -0.034	Vel = 0.38		
312			0.0 -1.94					31.641	K Factor = -0.34		
323 to 26	14.13 15.8		-2.48 -2.48	1.25 1.38	T 0.0 0.0	1.670 6.000 7.670	120 -0.0008	30.045 -0.723 -0.006	Vel = 0.53		
26 to 313	15.8 10.67		0.0 -2.48	1.25 1.442	2T 2E 0.0	14.864 7.432 92.416	70.120 22.296 -0.0006	120 29.316 2.222 -0.054	Vel = 0.49		
313			0.0 -2.48					31.484	K Factor = -0.44		
324 to 27	13.9 15.56		-3.56 -3.56	1.25 1.38	T 0.0 0.0	1.670 6.000 7.670	120 -0.0014	30.044 -0.719 -0.011	Vel = 0.76		
27 to 314	15.56 10.67		0.0 -3.56	1.25 1.442	2T 2E 0.0	14.864 7.432 92.186	69.890 22.296 -0.0011	120 29.314 2.118 -0.105	Vel = 0.70		

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 10
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
314			0.0 -3.56					31.327		K Factor = -0.64	
325 to 28	13.63 15.3		-5.27	1.25	T 0.0	6.0 6.000	120	30.074 -0.723			
28 to 315	15.3 10.67		-5.27	1.38	0.0	7.670	-0.0030	-0.023		Vel = 1.13	
28 to 315	15.3 10.67		0.0	1.25	2T 2E 0.0	14.864 7.432 91.906	120	29.328 2.005 -0.215		Vel = 1.04	
315			0.0 -5.27					31.118		K Factor = -0.94	
326 to 316	10.67 10.67		-6.60	1.25	2T 0.0	14.864 14.864	120	31.247 0.0			
316			-6.6	1.442	0.0	79.854	-0.0036	-0.284		Vel = 1.30	
316			0.0 -6.60					30.963		K Factor = -1.19	
327 to 317	10.67 10.67		-4.12	1.25	2T 6E 0.0	14.864 22.296 118.200	120	31.188 0.0 -0.176		Vel = 0.81	
317			0.0 -4.12					31.012		K Factor = -0.74	
328 to 318	10.67 10.67		-4.06	1.25	2T 5E 0.0	14.864 18.58 109.114	120	31.181 0.0 -0.158		Vel = 0.80	
318			0.0 -4.06					31.023		K Factor = -0.73	
24 to 319	10.67 10.67		-4.12	1.25	2T 4E 0.0	14.864 14.864 102.878	120	31.179 0.0 -0.153		Vel = 0.81	
319			0.0 -4.12					31.026		K Factor = -0.74	
309 to 310	26.450 10.67		-30.86	1.5	3E T 0.0	14.849 9.9 45.249	120	26.311 6.834 -1.317		Vel = 4.46	
310 to 311	10.67 10.67		0.0	2	0.0	7.770	120	31.828 0.0			
311 to 312	10.67 10.67		-30.86	2.157	0.0	7.770	-0.0088	-0.068		Vel = 2.71	
311 to 312	10.67 10.67		0.0	2	E 0.0	6.153 6.153	120	31.760 0.0			
312 to 313	10.67 10.67		-30.86	2.157	0.0	13.743	-0.0087	-0.119		Vel = 2.71	
312 to 313	10.67 10.67		-1.93	2	0.0	16.150	120	31.641 0.0			
313 to 314	10.67 10.67		-32.79	2.157	0.0	16.150	-0.0097	-0.157		Vel = 2.88	
313 to 314	10.67 10.67		-2.49	2	0.0	14.130	120	31.484 0.0			
314 to 315	10.67 10.67		-35.28	2.157	0.0	14.130	-0.0111	-0.157		Vel = 3.10	
314 to 315	10.67 10.67		-3.56	2	0.0	15.790	120	31.327 0.0			
315			-38.84	2.157	0.0	15.790	-0.0132	-0.209		Vel = 3.41	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 11
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
315 to 331	10.67 10.67		-5.28 -44.12	2 2.157	0.0 0.0	10.340 0.0	120 -0.0168	31.118 0.0			
			0.0 -44.12					30.944		K Factor = -7.93	
319 to 318	10.67 10.67		-4.12 -4.12	2 2.157	0.0 0.0	14.040 0.0	120 -0.0002	31.026 0.0			
								-0.003		Vel = 0.36	
318 to 317	10.67 10.67		-4.06 -8.18	2 2.157	0.0 0.0	14.500 0.0	120 -0.0008	31.023 0.0			
								-0.011		Vel = 0.72	
317 to 316	10.67 10.67		-4.12 -12.3	2 2.157	12.307 0.0	18.670 12.307	120 -0.0016	31.012 0.0			
								-0.049		Vel = 1.08	
316 to 331	10.67 10.67		-6.61 -18.91	2 2.157	0.0 0.0	5.470 0.0	120 -0.0035	30.963 0.0			
								-0.019		Vel = 1.66	
331 to 332	10.67 10.67		-44.11 -63.02	3 3.26	20.159 0.0	20.680 20.159	120 -0.0043	30.944 0.0			
								-0.177		Vel = 2.42	
332 to 333	10.67 10.67		0.0 -63.02	3 3.26	0.0 0.0	11.340 0.0	120 -0.0044	30.767 0.0			
								-0.050		Vel = 2.42	
333 to 334	10.67 10.67		0.0 -63.02	3 3.26	0.0 0.0	6.580 0.0	120 -0.0043	30.717 0.0			
								-0.028		Vel = 2.42	
334 to 335	10.67 10.67		0.0 -63.02	3 3.26	0.0 0.0	11.740 0.0	120 -0.0043	30.689 0.0			
								-0.051		Vel = 2.42	
335 to 336	10.67 10.67		0.0 -63.02	3 3.26	37.631 0.0	23.680 37.631	120 -0.0044	30.638 0.0			
								-0.267		Vel = 2.42	
336 to 337	10.67 10.67		0.0 -63.02	3 3.26	0.0 0.0	60.650 0.0	120 -0.0044	30.371 0.0			
								-0.264		Vel = 2.42	
337 to 351	10.67 10.67		0.0 -63.02	3 3.26	40.319 0.0	38.360 40.319	120 -0.0043	30.107 0.0			
								-0.342		Vel = 2.42	
351			0.0 -63.02					29.765		K Factor = -11.55	
390 to 391	10.67 10.67		63.02 63.02	3 3.26	0.0 0.0	21.550 0.0	120 0.0044	36.889 0.0			
								0.094		Vel = 2.42	
391 to 392	10.67 10.67		0.0 63.02	3 3.26	18.815 0.0	16.480 18.815	120 0.0044	36.983 0.0			
								0.154		Vel = 2.42	
392 to 393	10.67 10.67		-10.17 52.85	3 3.26	9.408 0.0	40.180 9.408	120 0.0031	37.137 0.0			
								0.155		Vel = 2.03	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 12
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
393 to 394	10.67 10.67		0.0 52.85	3 3.26	E 0.0	9.408 9.408	120 0.0031	37.292 0.0			
			0.0						Vel =	2.03	
394			52.85					37.365	K Factor =	8.65	
392 to 395	10.67 10.67		10.18 10.18	1.5 1.682	2T 4E 0.0	19.799 19.799 149.608	120 0.0037	37.137 0.0			
			0.0						Vel =	1.47	
395			10.18					37.696	K Factor =	1.66	
382 to C5	25.08 25.08		-11.82 -11.82	1.25 1.442	T 0.0	7.432 7.432	120 -0.0105	28.244 0.0			
			0.0			10.000		27.884	Vel =	2.32	
C5 to C4	25.08 25.08		0.0 -11.82	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0104	27.884 0.0			
			-11.82			10.000		-0.104	Vel =	2.32	
C4 to C3	25.08 25.08		0.0 -11.82	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0104	27.780 0.0			
			-11.82			10.000		-0.104	Vel =	2.32	
C3 to C2	25.08 25.08		0.0 -11.82	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0105	27.676 0.0			
			-11.82			10.000		-0.105	Vel =	2.32	
C2 to C1	25.08 25.08		0.0 -11.82	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0104	27.571 0.0			
			-11.82			10.000		-0.104	Vel =	2.32	
C1 to 302	25.08 25.08		0.0 -11.82	1.25 1.442	T 0.0	7.432 7.432	120 -0.0104	27.467 0.0			
			-11.82			35.182		-0.367	Vel =	2.32	
302			0.0					27.100	K Factor =	-2.27	
383 to C10	25.42 25.42		-11.60 -11.6	1.25 1.442	T 0.0	7.432 7.432	120 -0.0101	28.119 0.0			
			-11.6			34.432		-0.348	Vel =	2.28	
C10 to C9	25.42 25.42		0.0 -11.6	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0101	27.771 0.0			
			-11.6			10.000		-0.101	Vel =	2.28	
C9 to C8	25.42 25.42		0.0 -11.6	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0101	27.670 0.0			
			-11.6			10.000		-0.101	Vel =	2.28	
C8 to C7	25.42 25.42		0.0 -11.6	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0101	27.569 0.0			
			-11.6			10.000		-0.101	Vel =	2.28	
C7 to C6	25.42 25.42		0.0 -11.6	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0100	27.468 0.0			
			-11.6			10.000		-0.100	Vel =	2.28	
C6 to 303	25.42 25.42		0.0 -11.6	1.25 1.442	T 0.0	7.432 7.432	120 -0.0101	27.368 0.0			
			-11.6			35.182		-0.356	Vel =	2.28	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 13
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
303			0.0 -11.60					27.012		K Factor = -2.23	
384 to C11	25.75 25.75		-11.97 -11.97	1.25 1.442	T T	7.432 0.0 7.432	120 -0.0107	28.054 0.0 -0.796		Vel = 2.35	
C11 to 304	25.75 25.75		0.0 -11.97	1.25 1.442	T T	7.432 0.0 7.432	120 -0.0107	27.258 0.0 -0.376		Vel = 2.35	
304			0.0 -11.97					26.882		K Factor = -2.31	
385 to 305	26.090 26.09		-12.88 -12.88	1.25 1.442	2T T	14.864 0.0 14.864	120 -0.0122	28.074 0.0 -1.341		Vel = 2.53	
305			0.0 -12.88					26.733		K Factor = -2.49	
387 to 307	27.290 26.43		-14.75 -14.75	1.25 1.442	2T T	14.864 0.0 14.864	120 -0.0157	27.899 0.372 -1.725		Vel = 2.90	
307			0.0 -14.75					26.546		K Factor = -2.86	
382 to 383	25.08 25.42		11.82 11.82	2 2.157		0.0 0.0 0.0	120 0.0015	28.244 -0.147 0.022		Vel = 1.04	
383 to 384	25.42 25.75		11.60 23.42	2 2.157		0.0 0.0 0.0	120 0.0052	28.119 -0.143 0.078		Vel = 2.06	
384 to 385	25.75 26.09		11.97 35.39	2 2.157		0.0 0.0 0.0	120 0.0111	28.054 -0.147 0.167		Vel = 3.11	
385 to 386	26.090 27.290		12.88 48.27	2 2.157		0.0 0.0 0.0	120 0.0199	28.074 -0.520 0.278		Vel = 4.24	
386 to 387	27.290 27.290		0.0 48.27	1.5 1.682		0.0 0.0 0.0	120 0.0670	27.832 0.0 0.067		Vel = 6.97	
387 to 388	27.290 27.290		14.75 63.02	1.5 1.682		0.0 0.0 0.0	120 0.1091	27.899 0.0 0.686		Vel = 9.10	
388 to 389	27.290 10.670		0.0 63.02	2.5 2.635	2E T	16.474 0.0 16.474	120 0.0123	28.585 7.198 0.577		Vel = 3.71	
389 to 390	10.670 10.67		0.0 63.02	2.5 2.635	2E T	16.474 0.0 16.474	120 0.0123	36.360 0.0 0.529		Vel = 3.71	
390			0.0 63.02					36.889		K Factor = 10.38	
309 to 308	26.450 26.450		30.86 30.86	2 2.157	E T	6.153 0.0 6.153	120 0.0087	26.311 0.0 0.154		Vel = 2.71	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 14
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
308 to 307	26.450 26.43		0.0 30.86	2 2.157	E 0.0	6.153 6.153	120 0.0085	26.465 0.009			
307 to 306	26.43 26.33		-14.76 16.1	2 2.157	0.0 0.0	4.540 4.540	120 0.0029	26.546 0.043	Vel =	2.71	
306 to 305	26.33 26.09		0.0 16.1	2 2.157	0.0 0.0	10.460 10.460	120 0.0026	26.602 0.104	Vel =	1.41	
305 to 304	26.09 25.75		-12.87 3.23	2 2.157	0.0 0.0	15.000 15.000	120 0.0001	26.733 0.147	Vel =	0.28	
304 to 303	25.75 25.42		-11.97 -8.74	2 2.157	0.0 0.0	15.000 15.000	120 -0.0009	26.882 0.143	Vel =	0.77	
303 to 302	25.42 25.08		-11.61 -20.35	2 2.157	0.0 0.0	15.000 15.000	120 -0.0039	27.012 0.147	Vel =	1.79	
302 to 301	25.08 24.92		-11.82 -32.17	2 2.157	E 0.0	6.153 6.153	120 -0.0094	27.100 0.069	Vel =	2.82	
301 to 321	24.92 24.920		0.0 -32.17	2 2.157	0.0 0.0	11.580 11.580	120 -0.0093	27.045 0.0	Vel =	2.82	
321 to 322	24.920 14.4		0.0 -32.17	1.5 1.682	4E 0.0	19.799 19.799	120 -0.0315	26.937 4.556	Vel =	4.65	
322 to 323	14.4 14.13		1.94 -30.23	2 2.157	0.0 0.0	16.160 16.160	120 -0.0084	30.063 0.117	Vel =	2.65	
323 to 324	14.13 13.9		2.48 -27.75	2 2.157	0.0 0.0	14.150 14.150	120 -0.0071	30.045 0.100	Vel =	2.44	
324 to 325	13.9 13.63		3.57 -24.18	2 2.157	0.0 0.0	15.770 15.770	120 -0.0055	30.044 0.117	Vel =	2.12	
325 to 326	13.63 10.67		5.27 -18.91	2 2.157	2E 0.0	12.307 12.307	120 -0.0035	30.074 1.282	Vel =	1.66	
326 to 327	10.67 10.67		6.61 -12.3	2 2.157	2E 0.0	12.307 12.307	120 -0.0016	31.247 0.0	Vel =	1.08	
327 to 328	10.67 10.67		4.12 -8.18	2 2.157	0.0 0.0	9.500 9.500	120 -0.0007	31.188 0.0	Vel =	0.72	
328 to 24	10.67 10.67		4.06 -4.12	2 2.157	0.0 0.0	12.000 12.000	120 -0.0002	31.181 0.0	Vel =	0.36	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 15
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
24			0.0 -4.12					31.179		K Factor = -0.74	
341 to C41	31.43 31.43		15.18	1.25	T 0.0	7.432 7.432	120	22.005 0.0			
C41 to C42	31.43 31.430		15.18	1.442	0.0	38.262	0.0166	0.635	Vel =	2.98	
C42 to C43	31.430 31.43		0.0	1.25	0.0	15.000	120	22.640 0.0			
C43 to C44	31.43 31.43		15.18	1.442	0.0	15.000	0.0165	0.248	Vel =	2.98	
C44 to 361	31.430 31.43		0.0	1.25	0.0	13.000	120	22.888 0.0			
361			15.18	1.442	0.0	13.000	0.0166	0.216	Vel =	2.98	
C43 to C44	31.43 31.43		0.0	1.25	0.0	15.000	120	23.104 0.0			
C44 to 361	31.43 31.43		15.18	1.442	0.0	15.000	0.0166	0.249	Vel =	2.98	
361			0.0 15.18					23.988		K Factor = 3.10	
342 to C45	31.12 31.12		15.22	1.25	T 0.0	7.432 7.432	120	22.135 0.0			
C45 to C46	31.12 31.12		15.22	1.442	0.0	38.262	0.0166	0.637	Vel =	2.99	
C46 to C47	31.12 31.12		0.0	1.25	0.0	15.000	120	22.772 0.0			
C47 to C48	31.12 31.12		15.22	1.442	0.0	15.000	0.0167	0.250	Vel =	2.99	
C48 to 362	31.12 31.12		0.0	1.25	0.0	13.000	120	23.022 0.0			
362			15.22	1.442	0.0	13.000	0.0167	0.217	Vel =	2.99	
C47 to C48	31.12 31.12		0.0	1.25	0.0	15.000	120	23.239 0.0			
C48 to 362	31.12 31.12		15.22	1.442	0.0	15.000	0.0167	0.250	Vel =	2.99	
362			0.0 15.22					24.126		K Factor = 3.10	
343 to 363	30.81 30.81		15.35	1.25	2T 0.0	14.864 14.864	120	22.253 0.0			
363			15.35	1.442	0.0	119.524	0.0169	2.024	Vel =	3.02	
363			0.0 15.35					24.277		K Factor = 3.12	
344 to 364	30.5 30.5		15.63	1.25	2T 0.0	14.864 14.864	120	22.353 0.0			
364			15.63	1.442	0.0	119.524	0.0175	2.092	Vel =	3.07	
364			0.0 15.63					24.445		K Factor = 3.16	
345 to 365	30.19 30.19		16.10	1.25	2T 0.0	14.864 14.864	120	22.428 0.0			
365			16.1	1.442	0.0	119.524	0.0185	2.211	Vel =	3.16	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 16
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
365			0.0 16.10					24.639		K Factor = 3.24	
346 to 366	29.88 29.88		16.80 16.8	1.25 1.442	2T 0.0	14.864 14.864	120 0.0200	22.472 0.0		Vel = 3.30	
366			0.0 16.80					24.864		K Factor = 3.37	
347 to 367	29.880 29.57		17.77 17.77	1.25 1.442	2T 0.0	14.864 14.864	120 0.0222	22.341 0.134		Vel = 3.49	
367			0.0 17.77					25.128		K Factor = 3.54	
341 to 342	31.43 31.12		-15.18 -15.18	3 3.26	0.0 0.0	14.250 0.0	120 -0.0003	22.005 0.134		Vel = 0.58	
342 to 343	31.12 30.81		-15.22 -30.4	3 3.26	0.0 0.0	14.250 0.0	120 -0.0011	22.135 0.134		Vel = 1.17	
343 to 344	30.81 30.5		-15.35 -45.75	3 3.26	0.0 0.0	14.250 14.250	120 -0.0024	22.253 0.134		Vel = 1.76	
344 to 345	30.5 30.19		-15.62 -61.37	3 3.26	0.0 0.0	14.250 14.250	120 -0.0041	22.353 0.134		Vel = 2.36	
345 to 346	30.19 29.88		-16.10 -77.47	3 3.26	0.0 0.0	14.250 14.250	120 -0.0063	22.428 0.134		Vel = 2.98	
346 to 347	29.88 29.880		-16.80 -94.27	3 3.26	0.0 0.0	14.250 14.250	120 -0.0092	22.472 0.0		Vel = 3.62	
347 to 348	29.880 29.880		-17.77 -112.04	3 3.26	E 0.0	9.408 9.408	120 -0.0126	22.341 0.0		Vel = 4.31	
348 to 349	29.880 10.67		0.0 -112.04	3 3.26	3E 0.0	28.223 28.223	120 -0.0126	22.138 8.320		Vel = 4.31	
349 to 29	10.67 10.67		0.0 -112.04	3 3.26	0.0 0.0	0.990 0.990	120 -0.0121	29.787 0.0		Vel = 4.31	
29 to 350	10.67 10.67		77.52 -34.52	3 3.26	0.0 0.0	6.380 6.380	120 -0.0014	29.775 0.0		Vel = 1.33	
350 to 351	10.67 10.67		21.55 -12.97	3 3.26	0.0 0.0	2.450 2.450	120 -0.0004	29.766 0.0		Vel = 0.50	
351 to 352	10.67 10.67		-63.03 -76.0	3 3.26	0.0 0.0	8.010 8.010	120 -0.0061	29.765 0.0		Vel = 2.92	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 17
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
352			0.0 -76.00					29.716		K Factor = -13.94	
361 to 362	31.43 31.12		15.18	3	0.0 0.0	14.250 0.0	120	23.988 0.134			
362 to 363	31.12 30.81		15.18	3.26	0.0 0.0	14.250 0.0	0.0003	0.004 0.134	Vel =	0.58	
362 to 363	31.12 30.81		15.22	3	0.0 0.0	14.250 0.0	120	24.126 0.134			
363 to 364	30.81 30.5		30.4	3.26	0.0 0.0	14.250 0.0	0.0012	0.017 0.134	Vel =	1.17	
363 to 364	30.81 30.5		15.35	3	0.0 0.0	14.250 0.0	120	24.277 0.134			
364 to 365	30.5 30.19		45.75	3.26	0.0 0.0	14.250 0.0	0.0024	0.034 0.134	Vel =	1.76	
364 to 365	30.5 30.19		15.62	3	0.0 0.0	14.250 0.0	120	24.445 0.134			
365 to 366	30.19 29.88		61.37	3.26	0.0 0.0	14.250 0.0	0.0042	0.060 0.134	Vel =	2.36	
365 to 366	30.19 29.88		16.10	3	0.0 0.0	14.250 0.0	120	24.639 0.134			
366 to 367	29.88 29.57		77.47	3.26	0.0 0.0	14.250 0.0	0.0064	0.091 0.134	Vel =	2.98	
366 to 367	29.88 29.57		16.80	3	0.0 0.0	14.250 0.0	120	24.864 0.134			
367 to 368	29.57 29.42		94.27	3.26	0.0 0.0	14.250 0.0	0.0091	0.130 0.065	Vel =	3.62	
367 to 368	29.57 29.42		17.77	3	E 9.408 0.0	6.660 9.408	120	25.128 0.065			
368 to 369	29.42 10.67		112.04	3.26	0.0	16.068	0.0126	0.203	Vel =	4.31	
368 to 369	29.42 10.67		0.0	3	4E 37.631 0.0	27.000 37.631	120	25.396 8.121			
369 to 370	10.67 10.67		112.04	3.26	0.0	64.631	0.0126	0.814	Vel =	4.31	
369 to 370	10.67 10.67		95.87	3	0.0 0.0	8.000 0.0	120	34.331 0.0			
370 to 371	10.67 10.67		207.91	3.26	0.0	8.000	0.0396	0.317	Vel =	7.99	
370 to 371	10.67 10.67		85.76	3	0.0 0.0	0.920 0.0	120	34.648 0.0			
371 to 371	10.670 10.670		293.67	3.26	0.0	0.920	0.0750	0.069	Vel =	11.29	
371 to 394	10.670 10.67		156.64	4	T 26.334 0.0	32.625 26.334	120	34.717 0.0			
394	10.67		450.31	4.26	0.0	58.959	0.0449	2.648	Vel =	10.14	
394			0.0 450.31					37.365		K Factor = 73.67	
394 to 395	10.67 10.67		503.15	4	0.0 0.0	6.000 0.0	120	37.365 0.0			
395 to 396	10.67 10.67		503.15	4.26	0.0	6.000	0.0552	0.331	Vel =	11.33	
395 to 396	10.67 10.67		10.18	4	E 13.167 0.0	51.140 13.167	120	37.696 0.0			
396 to 396	10.67 10.67		513.33	4.26	0.0	64.307	0.0572	3.681	Vel =	11.55	
396 to TR3	10.67 10.380		0.0	4	2E 26.334 0.0	23.180 26.334	120	41.377 0.126			
TR3 to BR3	10.380 3		513.33	4.26	0.0	49.514	0.0572	2.833	Vel =	11.55	
TR3 to BR3	10.380 3		0.0	4	B 15.8 S 28.968 T 26.334	7.380 71.102 78.482	120	44.336 6.196 4.492	* * Fixed Loss = 3		
BR3	3		513.33	4.26	T	26.334	0.0572	4.492	Vel =	11.55	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Stage Area 4 - 0.20 for the stage

Page 18
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
					Fsp	0.0					
BR3 to UG	3 0		0.0 513.33	6 6.357		0.0 0.0 0.0	2.000 0.0 2.000	120 1.299 0.017			
									Vel =	5.19	
UG to HOSE	0 0		0.0 513.33	6 6.16	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	140 2.754 1.017			
									* * Fixed Loss =	2.754	
									Vel =	5.53	
HOSE to TEST	0 0	H250	250.00 763.33	6 6.16		0.0 0.0 0.0	0.500 0.0 0.500	140 0.0 0.0160	60.111 0.0 0.008		
									Vel =	8.22	
TEST			0.0 763.33								
								60.119	K Factor =	98.45	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 3 – Area 5 Mech Room**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/22/2021**
LATEST REVISION DATE:

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Obstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 3 – Area 5	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 16'-0"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK300
K-FACTOR: 5.6	TEMPERATURE (°F): 286

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Ordinary Hazard Group 1
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.15	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 120	TOTAL SPRINKLERS OPERATING: 12
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 250
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 253.60	PRESSURE REQ'D (PSI): 57.066
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 503.60	PRESSURE REQ'D (PSI): 60.281
AREA SAFETY MARGIN (PSI): 14.05		

NOTES:

PE STAMP

Water Supply Curve C

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

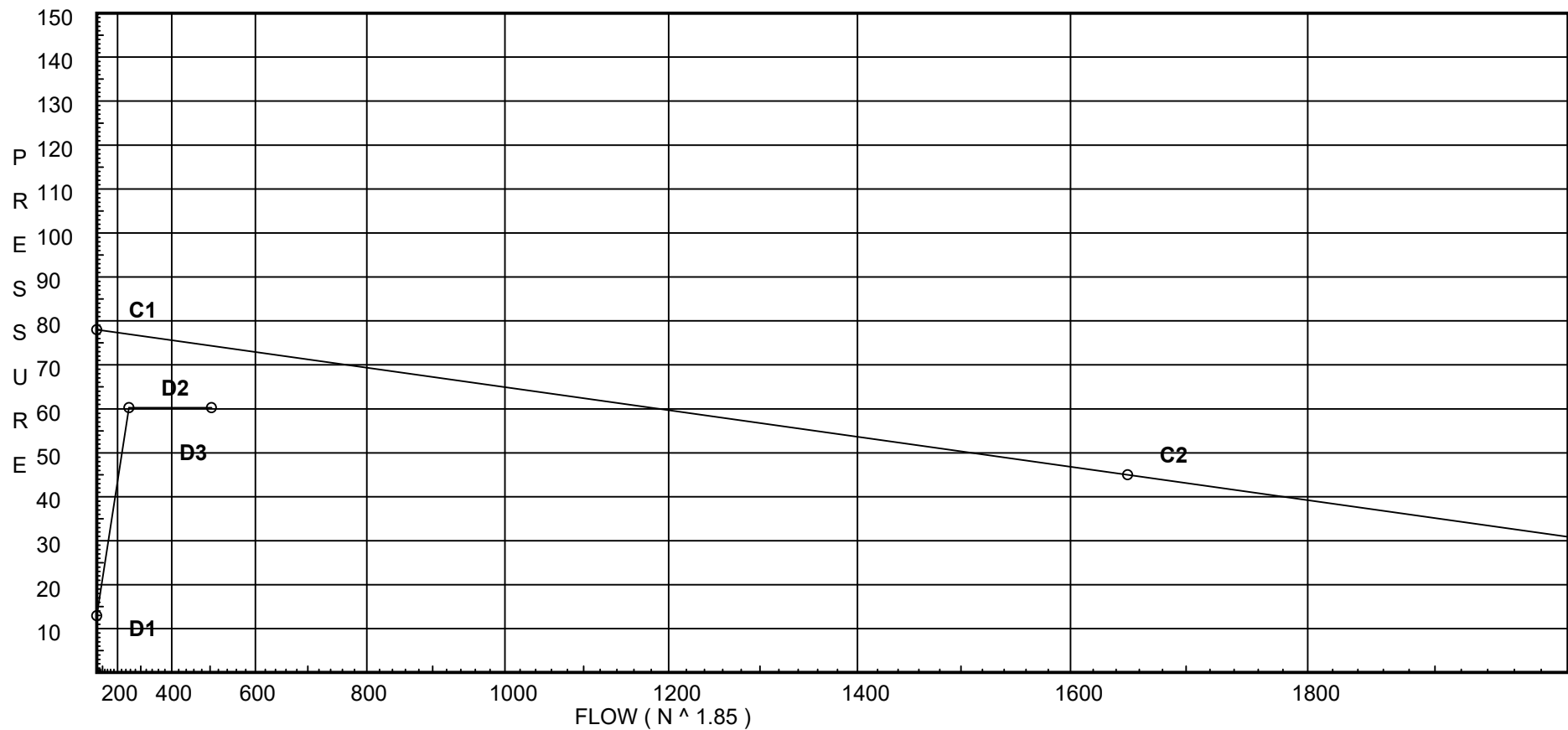
Page 2
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 12.950
D2 - System Flow : 253.603
D2 - System Pressure : 60.281
Hose (Demand) : 250
D3 - System Demand : 503.603
Safety Margin : 14.046



Fittings Used Summary

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 3
Date

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 4
Date

SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
TEST	78.0	45	1650.0	74.327	503.6	60.281

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
406	10.67		32.86		
352	10.67		43.63		
7	22.38		39.28		
C77	22.47		39.48		
C78	22.47		39.58		
C79	22.47		39.71		
C80	22.47		39.85		
C81	22.47		39.98		
8	22.37		40.16		
372	10.67		45.87		
C73	22.32		39.58		
C74	22.32		39.72		
C75	22.32		39.85		
C76	22.32		39.98		
350	10.67		43.64		
C69	22.1		39.66		
C70	22.1		39.78		
C71	22.1		39.9		
C72	22.1		40.01		
29	10.67		43.7		
C61	21.96		39.49		
C62	21.96		39.6		
C63	21.96		39.66		
C64	21.96		39.81		
C65	21.96		39.96		
C66	21.96		40.11		
C67	21.96		40.16		
C68	21.96		40.29		
322	14.4		36.82		
25	16.07		36.09		
323	14.13		36.75		
26	15.8		36.02		
324	13.9		36.71		
27	15.56		35.97		
325	13.63		36.7		
28	15.3		35.95		
326	10.67		37.83		
327	10.67		37.75		
328	10.67		37.74		
24	10.67		37.74		
309	26.45		33.68		
310	10.67		38.65		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 5
Date

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
311	10.67		38.55		
312	10.67		38.39		
313	10.67		38.17		
314	10.67		37.95		
315	10.67		37.65		
319	10.67		37.52		
318	10.67		37.52		
317	10.67		37.51		
316	10.67		37.44		
331	10.67		37.41		
332	10.67		37.16		
333	10.67		37.09		
334	10.67		37.29		
335	10.67		37.64		
336	10.67		39.46		
337	10.67		41.26		
390	10.67		45.67		
391	10.67		45.8		
392	10.67		46.02		
393	10.67		46.26		
382	25.08		36.08		
C5	25.08		35.57		
C4	25.08		35.43		
C3	25.08		35.28		
C2	25.08		35.14		
C1	25.08		34.99		
383	25.42		35.96		
C10	25.42		35.47		
C9	25.42		35.33		
C8	25.42		35.19		
C7	25.42		35.05		
C6	25.42		34.91		
384	25.75		35.92		
C11	25.75		34.81		
385	26.09		36.01		
387	27.29		35.97		
386	27.29		35.88		
388	27.29		36.93		
389	10.67		44.93		
308	26.45		33.82		
307	26.43		33.93		
306	26.33		34.0		
305	26.09		34.14		
304	25.75		34.29		
303	25.42		34.41		
302	25.08		34.48		
301	24.92		34.38		
321	24.92		34.23		
341	31.43		35.27		
C41	31.43		35.57		
C42	31.43		35.68		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 6
Date

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
C43	31.43		35.78		
C44	31.43		35.9		
342	31.12		35.4		
C45	31.12		35.7		
C46	31.12		35.81		
C47	31.12		35.91		
C48	31.12		36.03		
343	30.81		35.53		
344	30.5		35.65		
345	30.19		35.76		
346	29.88		35.85		
347	29.88		35.79		
348	29.88		35.69		
349	10.67		43.7		
351	10.67		43.6		
361	31.43		36.19		
362	31.12		36.33		
363	30.81		36.47		
364	30.5		36.62		
365	30.19		36.78		
366	29.88		36.95		
367	29.57		37.15		
368	29.42		37.31		
369	10.67		45.81		
370	10.67		45.88		
371	10.67		45.89		
AREA	0.0		23.28		
C86	29.9	5.6	14.85	21.58	
C87	29.9	5.6	15.17	21.81	
C88	29.9	5.6	16.39	22.67	
C89	29.71	5.6	15.08	21.74	
C90	29.71	5.6	15.4	21.97	
C91	29.71	5.6	15.77	22.24	
C92	29.51	5.6	15.68	22.18	
C93	29.51	5.6	16.02	22.41	
C94	29.9	5.6	10.33	18.0	
C95	29.71	5.6	10.6	18.24	
C96	29.51	5.6	12.49	19.79	
94C	29.9		10.43		
95C	29.71		10.87		
96C	29.51		12.6		
C97	29.51	5.6	14.01	20.96	
401	29.9		16.77		
402	29.71		17.02		
403	29.51		17.7		
404	29.51		19.94		
405	10.67		32.62		
394	10.67		46.37		
395	10.67		46.45		
396	10.67		47.45		
TR3	10.38		48.35		

Flow Summary - NFPA 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 7
Date

NODE ANALYSIS (cont.)

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
BR3	3.0		55.76		
UG	0.0		57.07		
HOSE	0.0		60.28	250.0	
TEST	0.0		60.28		

Final Calculations - Hazen-Williams - 2007

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 8
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
406 to 333	10.67 10.67		253.60 253.6	2.5 2.635	T 0.0 0.0	16.474 16.474 26.254	120 0.1611	32.863 0.0 4.230			
			0.0 253.60						Vel = 14.92		
333								37.093		K Factor = 41.64	
352 to 7	10.67 22.38		50.61 50.61	2.5 2.635	T 4E 0.0	16.474 32.948 88.342	120 0.0082	43.625 -5.072 0.723			Vel = 2.98
7 to C77	22.38 22.47		-37.59 13.02	1.25 1.442	T E 0.0	7.432 3.716 19.298	120 0.0125	39.276 -0.039 0.241			Vel = 2.56
C77 to C78	22.47 22.47		0.0 13.02	1.25 1.442	0.0 0.0 0.0	8.250 0.0 8.250	120 0.0124	39.478 0.0 0.102			Vel = 2.56
C78 to C79	22.47 22.47		0.0 13.02	1.25 1.442	0.0 0.0 0.0	10.750 0.0 10.750	120 0.0126	39.580 0.0 0.135			Vel = 2.56
C79 to C80	22.47 22.47		0.0 13.02	1.25 1.442	0.0 0.0 0.0	10.750 0.0 10.750	120 0.0125	39.715 0.0 0.134			Vel = 2.56
C80 to C81	22.47 22.47		0.0 13.02	1.25 1.442	0.0 0.0 0.0	10.250 0.0 10.250	120 0.0125	39.849 0.0 0.128			Vel = 2.56
C81 to 8	22.47 22.37		0.0 13.02	1.25 1.442	E 0.0 0.0	3.716 7.570 3.716 11.286	120 0.0125	39.977 0.043 0.141			Vel = 2.56
8 to 372	22.37 10.67		37.59 50.61	2.5 2.635	2T E 0.0	32.948 8.237 78.515	120 0.0082	40.161 5.067 0.642			Vel = 2.98
372 to 371	10.67 10.670		0.0 50.61	3 3.26	0.0 0.0 0.0	7.430 0.0 7.430	120 0.0028	45.870 0.0 0.021			Vel = 1.95
371			0.0 50.61					45.891		K Factor = 7.47	
7 to C73	22.38 22.32		37.59 37.59	2 2.157	2E 0.0 0.0	12.307 12.307 22.317	120 0.0125	39.276 0.026 0.278			Vel = 3.30
C73 to C74	22.32 22.32		0.0 37.59	2 2.157	0.0 0.0 0.0	10.890 0.0 10.890	120 0.0125	39.580 0.0 0.136			Vel = 3.30
C74 to C75	22.32 22.32		0.0 37.59	2 2.157	0.0 0.0 0.0	11.000 0.0 11.000	120 0.0125	39.716 0.0 0.138			Vel = 3.30
C75 to C76	22.32 22.32		0.0 37.59	2 2.157	0.0 0.0 0.0	9.920 0.0 9.920	120 0.0125	39.854 0.0 0.124			Vel = 3.30
C76 to 8	22.32 22.37		0.0 37.59	2 2.157	E 0.0 0.0	6.153 6.153 16.383	120 0.0125	39.978 -0.022 0.205			Vel = 3.30

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 9
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
8			0.0 37.59					40.161		K Factor = 5.93	
350 to C69	10.67 22.1		34.71	2	5E T 30.767 12.307 0.0	47.210 43.074 90.284	120	43.641 -4.950 0.973		Vel = 3.05	
C69 to C70	22.1 22.1		0.0	2	0.0 0.0 0.0	10.890 0.0 10.890	120	39.664 0.0 0.118		Vel = 3.05	
C70 to C71	22.1 22.1		0.0	2	0.0 0.0 0.0	11.000 0.0 11.000	120	39.782 0.0 0.118		Vel = 3.05	
C71 to C72	22.1 22.1		0.0	2	0.0 0.0 0.0	9.920 0.0 9.920	120	39.900 0.0 0.108		Vel = 3.05	
C72 to 370	22.1 10.67		0.0	2	4E T 24.613 12.307 0.0	48.290 36.920 85.210	120	40.008 4.950 0.918		Vel = 3.05	
370			0.0 34.71					45.876		K Factor = 5.12	
29 to C61	10.67 21.96		18.97	1.5	4E T 19.799 9.9 0.0	27.690 29.699 57.389	120	43.698 -4.890 0.680		Vel = 2.74	
C61 to C62	21.96 21.96		0.0	1.5	0.0 0.0 0.0	9.500 0.0 9.500	120	39.488 0.0 0.112		Vel = 2.74	
C62 to C63	21.96 21.96		0.0	1.5	0.0 0.0 0.0	5.480 0.0 5.480	120	39.600 0.0 0.065		Vel = 2.74	
C63 to C64	21.96 21.96		0.0	1.5	0.0 0.0 0.0	12.670 0.0 12.670	120	39.665 0.0 0.150		Vel = 2.74	
C64 to C65	21.96 21.96		0.0	1.5	0.0 0.0 0.0	12.670 0.0 12.670	120	39.815 0.0 0.150		Vel = 2.74	
C65 to C66	21.96 21.96		0.0	1.5	0.0 0.0 0.0	12.670 0.0 12.670	120	39.965 0.0 0.150		Vel = 2.74	
C66 to C67	21.96 21.96		0.0	1.5	0.0 0.0 0.0	3.540 0.0 3.540	120	40.115 0.0 0.042		Vel = 2.74	
C67 to C68	21.96 21.96		0.0	1.5	0.0 0.0 0.0	11.050 0.0 11.050	120	40.157 0.0 0.131		Vel = 2.74	
C68 to 369	21.96 10.67		0.0	1.5	3E T 14.849 9.9 0.0	28.330 24.749 53.079	120	40.288 4.890 0.627		Vel = 2.74	
369			0.0 18.97					45.805		K Factor = 2.80	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 10
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
322 to 25	14.4 16.07		-2.17 -2.17	1.25 1.38	T 0.0	6.0 0.0	1.670 6.000	120 -0.723			
25 to 312	16.07 10.67		0.0 -2.17	1.25 1.442	2T 2E 0.0	14.864 7.432 0.0	70.390 22.296 92.686	120 2.339 -0.042	Vel = 0.47		
312			0.0 -2.17					38.386	K Factor = -0.35		
323 to 26	14.13 15.8		-2.91 -2.91	1.25 1.38	T 0.0	6.0 0.0	1.670 6.000	120 -0.723			
26 to 313	15.8 10.67		0.0 -2.91	1.25 1.442	2T 2E 0.0	14.864 7.432 0.0	70.120 22.296 92.416	120 2.222 -0.073	Vel = 0.62		
313			0.0 -2.91					38.165	K Factor = -0.47		
324 to 27	13.9 15.56		-4.24 -4.24	1.25 1.38	T 0.0	6.0 0.0	1.670 6.000	120 -0.719			
27 to 314	15.56 10.67		0.0 -4.24	1.25 1.442	2T 2E 0.0	14.864 7.432 0.0	69.890 22.296 92.186	120 2.118 -0.144	Vel = 0.91		
314			0.0 -4.24					37.946	K Factor = -0.69		
325 to 28	13.63 15.3		-6.30 -6.3	1.25 1.38	T 0.0	6.0 0.0	1.670 6.000	120 -0.723			
28 to 315	15.3 10.67		0.0 -6.3	1.25 1.442	2T 2E 0.0	14.864 7.432 0.0	69.610 22.296 91.906	120 2.005 -0.299	Vel = 1.35		
315			0.0 -6.30					37.653	K Factor = -1.03		
326 to 316	10.67 10.67		-7.90 -7.9	1.25 1.442	2T 0.0	14.864 0.0	64.990 14.864	120 0.0			
316			0.0 -7.90					37.437	K Factor = -1.29		
327 to 317	10.67 10.67		-4.93 -4.93	1.25 1.442	2T 6E 0.0	14.864 22.296 0.0	81.040 37.160 118.200	120 0.0 -0.245	Vel = 0.97		
317			0.0 -4.93					37.505	K Factor = -0.81		
328 to 318	10.67 10.67		-4.86 -4.86	1.25 1.442	2T 5E 0.0	14.864 18.58 0.0	75.670 33.444 109.114	120 0.0 -0.220	Vel = 0.95		
318			0.0 -4.86					37.520	K Factor = -0.79		
24 to 319	10.67 10.67		-4.92 -4.92	1.25 1.442	2T 4E 0.0	14.864 14.864 0.0	73.150 29.728 102.878	120 0.0 -0.213	Vel = 0.97		

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 11
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
319			0.0 -4.92					37.524		K Factor = -0.80	
309 to 310	26.450 10.67		-37.23	1.5	3E T	14.849 9.9	20.500 24.749	120 6.834			
310 to 311	10.67 10.67		-37.23	1.682		0.0	45.249	-0.0412	-1.864	Vel = 5.38	
310 to 311	10.67 10.67		0.0	2		0.0	7.770	120	38.650		
311 to 312	10.67 10.67		-37.23	2.157		0.0	7.770	-0.0124	-0.096	Vel = 3.27	
311 to 312	10.67 10.67		0.0	2	E	6.153 0.0	7.590 6.153	120 0.0	38.554		
312 to 313	10.67 10.67		-37.23	2.157		0.0	13.743	-0.0122	-0.168	Vel = 3.27	
312 to 313	10.67 10.67		-2.17	2		0.0	16.150	120	38.386		
313 to 314	10.67 10.67		-39.4	2.157		0.0	16.150	-0.0137	-0.221	Vel = 3.46	
313 to 314	10.67 10.67		-2.92	2		0.0	14.130	120	38.165		
314 to 315	10.67 10.67		-42.32	2.157		0.0	14.130	-0.0155	-0.219	Vel = 3.72	
314 to 315	10.67 10.67		-4.23	2		0.0	15.790	120	37.946		
315 to 331	10.67 10.67		-46.55	2.157		0.0	15.790	-0.0186	-0.293	Vel = 4.09	
315 to 331	10.67 10.67		-6.31	2		0.0	10.340	120	37.653		
331			-52.86	2.157		0.0	10.340	-0.0235	-0.243	Vel = 4.64	
331			0.0 -52.86					37.410		K Factor = -8.64	
319 to 318	10.67 10.67		-4.92	2		0.0	14.040	120	37.524		
318 to 317	10.67 10.67		-4.92	2.157		0.0	14.040	-0.0003	-0.004	Vel = 0.43	
318 to 317	10.67 10.67		-4.87	2		0.0	14.500	120	37.520		
317 to 316	10.67 10.67		-9.79	2.157		0.0	14.500	-0.0010	-0.015	Vel = 0.86	
317 to 316	10.67 10.67		-4.93	2	2E	12.307 0.0	18.670 12.307	120 0.0	37.505		
316 to 331	10.67 10.67		-14.72	2.157		0.0	30.977	-0.0022	-0.068	Vel = 1.29	
316 to 331	10.67 10.67		-7.90	2		0.0	5.470	120	37.437		
331			-22.62	2.157		0.0	5.470	-0.0049	-0.027	Vel = 1.99	
331 to 332	10.67 10.67		-52.85	3	T	20.159 0.0	20.680 20.159	120 0.0	37.410		
332 to 333	10.67 10.67		-75.47	3.26		0.0	40.839	-0.0061	-0.248	Vel = 2.90	
332 to 333	10.67 10.67		0.0	3		0.0	11.340	120	37.162		
333 to 334	10.67 10.67		-75.47	3.26		0.0	11.340	-0.0061	-0.069	Vel = 2.90	
333 to 334	10.67 10.67		253.60	3		0.0	6.580	120	37.093		
334 to 335	10.67 10.67		178.13	3.26		0.0	6.580	0.0298	0.196	Vel = 6.85	
334 to 335	10.67 10.67		0.0	3		0.0	11.740	120	37.289		
335			178.13	3.26		0.0	11.740	0.0297	0.349	Vel = 6.85	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 12
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
335 to 336	10.67 10.67		0.0 178.13	3 3.26	4E 0.0	37.631 37.631	120 0.0297	37.638 0.0			
336 to 337	10.67 10.67		0.0 178.13	3 3.26	0.0 0.0	60.650 60.650	120 0.0297	39.460 1.803	Vel =	6.85	
337 to 351	10.67 10.67		0.0 178.13	3 3.26	2T 0.0	40.319 40.319	120 0.0297	41.263 0.0	Vel =	6.85	
351			0.0 178.13			78.679		2.339	Vel =	6.85	
351								43.602	K Factor =	26.98	
390 to 391	10.67 10.67		75.47 75.47	3 3.26	0.0 0.0	21.550 0.0	120 0.0061	45.672 0.0	Vel =	2.90	
391 to 392	10.67 10.67		0.0 75.47	3 3.26	2E 0.0	18.815 18.815	120 0.0061	45.803 0.0	Vel =	2.90	
392 to 393	10.67 10.67		-8.91 66.56	3 3.26	E 0.0	9.408 9.408	120 0.0048	46.017 0.0	Vel =	2.56	
393 to 394	10.67 10.67		0.0 66.56	3 3.26	E 0.0	9.408 23.228	120 0.0048	46.256 0.0	Vel =	2.56	
394			0.0 66.56					46.368	K Factor =	9.77	
392 to 395	10.67 10.67		8.91 8.91	1.5 1.682	2T 4E 0.0	19.799 19.799 149.608	120 0.0029	46.017 0.0 0.438	Vel =	1.29	
395			0.0 8.91					46.455	K Factor =	1.31	
382 to C5	25.08 25.08		-14.14 -14.14	1.25 1.442	T 0.0	7.432 7.432	120 -0.0146	36.075 0.0	Vel =	2.78	
C5 to C4	25.08 25.08		0.0 -14.14	1.25 1.442	0.0 0.0	10.000 10.000	120 -0.0146	35.574 0.0	Vel =	2.78	
C4 to C3	25.08 25.08		0.0 -14.14	1.25 1.442	0.0 0.0	10.000 10.000	120 -0.0145	35.428 0.0	Vel =	2.78	
C3 to C2	25.08 25.08		0.0 -14.14	1.25 1.442	0.0 0.0	10.000 10.000	120 -0.0146	35.283 0.0	Vel =	2.78	
C2 to C1	25.08 25.08		0.0 -14.14	1.25 1.442	0.0 0.0	10.000 10.000	120 -0.0145	35.137 0.0	Vel =	2.78	
C1 to 302	25.08 25.08		0.0 -14.14	1.25 1.442	T 0.0	7.432 7.432	120 -0.0146	34.992 0.0	Vel =	2.78	
302						35.182		-0.512			

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 13
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
302			0.0 -14.14					34.480		K Factor = -2.41	
383 to C10	25.42 25.42		-13.89 -13.89	1.25 1.442	T 0.0	7.432 7.432	120 -0.0141	35.958 0.0		Vel = 2.73	
C10 to C9	25.42 25.42		0.0 -13.89	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0141	35.474 0.0		Vel = 2.73	
C9 to C8	25.42 25.42		0.0 -13.89	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0141	35.333 0.0		Vel = 2.73	
C8 to C7	25.42 25.42		0.0 -13.89	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0141	35.192 0.0		Vel = 2.73	
C7 to C6	25.42 25.42		0.0 -13.89	1.25 1.442	0.0 0.0	10.000 0.0	120 -0.0141	35.051 0.0		Vel = 2.73	
C6 to 303	25.42 25.42		0.0 -13.89	1.25 1.442	T 0.0	7.432 7.432	120 -0.0141	34.910 0.0		Vel = 2.73	
303			0.0 -13.89					34.415		K Factor = -2.37	
384 to C11	25.75 25.75		-14.34 -14.34	1.25 1.442	T 0.0	7.432 7.432	120 -0.0149	35.924 0.0		Vel = 2.82	
C11 to 304	25.75 25.75		0.0 -14.34	1.25 1.442	T 0.0	7.432 7.432	120 -0.0150	34.814 0.0		Vel = 2.82	
304			0.0 -14.34					34.288		K Factor = -2.45	
385 to 305	26.090 26.09		-15.42 -15.42	1.25 1.442	2T 0.0	14.864 14.864	120 -0.0171	36.011 0.0		Vel = 3.03	
305			0.0 -15.42					34.138		K Factor = -2.64	
387 to 307	27.290 26.43		-17.67 -17.67	1.25 1.442	2T 0.0	14.864 14.864	120 -0.0220	35.972 0.372		Vel = 3.47	
307			0.0 -17.67					33.935		K Factor = -3.03	
382 to 383	25.08 25.42		14.14 14.14	2 2.157	0.0 0.0	15.000 0.0	120 0.0020	36.075 -0.147		Vel = 1.24	
383 to 384	25.42 25.75		13.90 28.04	2 2.157	0.0 0.0	15.000 0.0	120 0.0073	35.958 -0.143		Vel = 2.46	
384 to 385	25.75 26.09		14.33 42.37	2 2.157	0.0 0.0	15.000 0.0	120 0.0156	35.924 -0.147		Vel = 3.72	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 14
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
385 to 386	26.090 27.290		15.43 57.8	2 2.157	0.0 0.0 0.0	14.000 0.0 14.000	120 0.0277	36.011 -0.520 0.388		Vel = 5.07	
386 to 387	27.290 27.290		0.0 57.8	1.5 1.682	0.0 0.0 0.0	1.000 0.0 1.000	120 0.0930	35.879 0.0 0.093		Vel = 8.35	
387 to 388	27.290 27.290		17.67 75.47	1.5 1.682	0.0 0.0 0.0	6.290 0.0 6.290	120 0.1523	35.972 0.0 0.958		Vel = 10.90	
388 to 389	27.290 10.670		0.0 75.47	2.5 2.635	2E 0.0 0.0	16.474 16.474 47.054	120 0.0171	36.930 7.198 0.806		Vel = 4.44	
389 to 390	10.670 10.67		0.0 75.47	2.5 2.635	2E 0.0 0.0	16.474 16.474 43.144	120 0.0171	44.934 0.0 0.738		Vel = 4.44	
390			0.0 75.47					45.672		K Factor = 11.17	
309 to 308	26.450 26.450		37.23 37.23	2 2.157	0.0 0.0 0.0	11.580 0.0 11.580	120 0.0123	33.680 0.0 0.143		Vel = 3.27	
308 to 307	26.450 26.43		0.0 37.23	2 2.157	E 0.0 0.0	6.153 6.153 8.443	120 0.0122	33.823 0.009 0.103		Vel = 3.27	
307 to 306	26.43 26.33		-17.67 19.56	2 2.157	0.0 0.0 0.0	4.540 0.0 4.540	120 0.0037	33.935 0.043 0.017		Vel = 1.72	
306 to 305	26.33 26.09		0.0 19.56	2 2.157	0.0 0.0 0.0	10.460 0.0 10.460	120 0.0037	33.995 0.104 0.039		Vel = 1.72	
305 to 304	26.09 25.75		-15.43 4.13	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 0.0002	34.138 0.147 0.003		Vel = 0.36	
304 to 303	25.75 25.42		-14.33 -10.2	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 -0.0011	34.288 0.143 -0.016		Vel = 0.90	
303 to 302	25.42 25.08		-13.90 -24.1	2 2.157	0.0 0.0 0.0	15.000 0.0 15.000	120 -0.0055	34.415 0.147 -0.082		Vel = 2.12	
302 to 301	25.08 24.92		-14.14 -38.24	2 2.157	E 0.0 0.0	6.153 7.040 6.153 13.193	120 -0.0129	34.480 0.069 -0.170		Vel = 3.36	
301 to 321	24.92 24.920		0.0 -38.24	2 2.157	0.0 0.0 0.0	11.580 0.0 11.580	120 -0.0130	34.379 0.0 -0.150		Vel = 3.36	
321 to 322	24.920 14.4		0.0 -38.24	1.5 1.682	4E 0.0 0.0	19.799 19.799 45.466	120 -0.0433	34.229 4.556 -1.968		Vel = 5.52	
322 to 323	14.4 14.13		2.17 -36.07	2 2.157	0.0 0.0 0.0	16.160 0.0 16.160	120 -0.0116	36.817 0.117 -0.188		Vel = 3.17	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 15
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
323 to 324	14.13 13.9		2.91 -33.16	2 2.157		0.0 0.0 14.150	120 -0.0099	36.746 0.100 -0.140		Vel = 2.91	
324 to 325	13.9 13.63		4.24 -28.92	2 2.157		0.0 0.0 15.770	120 -0.0077	36.706 0.117 -0.121		Vel = 2.54	
325 to 326	13.63 10.67		6.30 -22.62	2 2.157	2E 12.307 0.0	18.680 12.307 30.987	120 -0.0049	36.702 1.282 -0.152		Vel = 1.99	
326 to 327	10.67 10.67		7.90 -14.72	2 2.157	2E 12.307 0.0	24.990 12.307 37.297	120 -0.0022	37.832 0.0 -0.082		Vel = 1.29	
327 to 328	10.67 10.67		4.93 -9.79	2 2.157		0.0 0.0 9.500	120 -0.0011	37.750 0.0 -0.010		Vel = 0.86	
328 to 24	10.67 10.67		4.87 -4.92	2 2.157		0.0 0.0 12.000	120 -0.0002	37.740 0.0 -0.003		Vel = 0.43	
24			0.0 -4.92					37.737		K Factor = -0.80	
341 to C41	31.43 31.43		10.00 10.0	1.25 1.442	T 7.432 0.0	30.830 7.432 38.262	120 0.0077	35.272 0.0 0.293		Vel = 1.96	
C41 to C42	31.43 31.430		0.0 10.0	1.25 1.442		0.0 0.0 15.000	120 0.0077	35.565 0.0 0.115		Vel = 1.96	
C42 to C43	31.430 31.43		0.0 10.0	1.25 1.442		0.0 0.0 13.000	120 0.0077	35.680 0.0 0.100		Vel = 1.96	
C43 to C44	31.43 31.43		0.0 10.0	1.25 1.442		0.0 0.0 15.000	120 0.0077	35.780 0.0 0.115		Vel = 1.96	
C44 to 361	31.43 31.43		0.0 10.0	1.25 1.442	T 7.432 0.0	30.830 7.432 38.262	120 0.0077	35.895 0.0 0.294		Vel = 1.96	
361			0.0 10.00					36.189		K Factor = 1.66	
342 to C45	31.12 31.12		10.03 10.03	1.25 1.442	T 7.432 0.0	30.830 7.432 38.262	120 0.0077	35.404 0.0 0.295		Vel = 1.97	
C45 to C46	31.12 31.12		0.0 10.03	1.25 1.442		0.0 0.0 15.000	120 0.0077	35.699 0.0 0.115		Vel = 1.97	
C46 to C47	31.12 31.12		0.0 10.03	1.25 1.442		0.0 0.0 13.000	120 0.0078	35.814 0.0 0.101		Vel = 1.97	
C47 to C48	31.12 31.12		0.0 10.03	1.25 1.442		0.0 0.0 15.000	120 0.0077	35.915 0.0 0.115		Vel = 1.97	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 16
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
C48 to 362	31.12 31.12		0.0 10.03	1.25 1.442	T 0.0	7.432 7.432	120 0.0077	36.030 0.0			
362			0.0 10.03					36.325	Vel =	1.97	
362									K Factor =	1.66	
343 to 363	30.81 30.81		10.12 10.12	1.25 1.442	2T 0.0	14.864 14.864	120 0.0078	35.531 0.0			
363			0.0 10.12					0.936	Vel =	1.99	
363								36.467	K Factor =	1.68	
344 to 364	30.5 30.5		10.30 10.3	1.25 1.442	2T 0.0	14.864 14.864	120 0.0081	35.649 0.0			
364			0.0 10.30					0.968	Vel =	2.02	
364								36.617	K Factor =	1.70	
345 to 365	30.19 30.19		10.61 10.61	1.25 1.442	2T 0.0	14.864 14.864	120 0.0086	35.756 0.0			
365			0.0 10.61					1.022	Vel =	2.08	
365								36.778	K Factor =	1.75	
346 to 366	29.88 29.88		11.07 11.07	1.25 1.442	2T 0.0	14.864 14.864	120 0.0093	35.848 0.0			
366			0.0 11.07					1.107	Vel =	2.17	
366								36.955	K Factor =	1.82	
347 to 367	29.880 29.57		11.71 11.71	1.25 1.442	2T 0.0	14.864 14.864	120 0.0103	35.788 0.134			
367			0.0 11.71					1.227	Vel =	2.30	
367								37.149	K Factor =	1.92	
341 to 342	31.43 31.12		-10.00 -10.0	3 3.26		0.0 0.0	120 -0.0001	35.272 0.134			
342								-0.002	Vel =	0.38	
342 to 343	31.12 30.81		-10.03 -20.03	3 3.26		0.0 0.0	120 -0.0005	35.404 0.134			
343								-0.007	Vel =	0.77	
343 to 344	30.81 30.5		-10.12 -30.15	3 3.26		0.0 0.0	120 -0.0011	35.531 0.134			
344								-0.016	Vel =	1.16	
344 to 345	30.5 30.19		-10.30 -40.45	3 3.26		0.0 0.0	120 -0.0019	35.649 0.134			
345								-0.027	Vel =	1.55	
345 to 346	30.19 29.88		-10.61 -51.06	3 3.26		0.0 0.0	120 -0.0029	35.756 0.134			
346								-0.042	Vel =	1.96	
346 to 347	29.88 29.880		-11.07 -62.13	3 3.26		0.0 0.0	120 -0.0042	35.848 0.0			
347								-0.060	Vel =	2.39	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 17
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
347 to 348	29.880 29.880		-11.71 -73.84	3 3.26	E 0.0	9.408 9.408	120 -0.0058	35.788 0.0			
					0.0	16.078		-0.094	Vel =	2.84	
348 to 349	29.880 10.67		0.0 -73.84	3 3.26	3E 0.0	28.223 28.223	120 -0.0058	35.694 8.320			
					0.0	53.223		-0.310	Vel =	2.84	
349 to 29	10.67 10.67		0.0 -73.84	3 3.26	0.0 0.0	0.990 0.0	120 -0.0061	43.704 0.0			
					0.0	0.990		-0.006	Vel =	2.84	
29 to 350	10.67 10.67		-18.97 -92.81	3 3.26	0.0 0.0	6.380 0.0	120 -0.0089	43.698 0.0			
					0.0	6.380		-0.057	Vel =	3.57	
350 to 351	10.67 10.67		-34.71 -127.52	3 3.26	0.0 0.0	2.450 0.0	120 -0.0159	43.641 0.0			
					0.0	2.450		-0.039	Vel =	4.90	
351 to 352	10.67 10.67		178.13 50.61	3 3.26	0.0 0.0	8.010 0.0	120 0.0029	43.602 0.0			
					0.0	8.010		0.023	Vel =	1.95	
352			0.0 50.61					43.625	K Factor =	7.66	
361 to 362	31.43 31.12		10.00 10.0	3 3.26	0.0 0.0	14.250 0.0	120 0.0001	36.189 0.134			
					0.0	14.250		0.002	Vel =	0.38	
362 to 363	31.12 30.81		10.03 20.03	3 3.26	0.0 0.0	14.250 0.0	120 0.0006	36.325 0.134			
					0.0	14.250		0.008	Vel =	0.77	
363 to 364	30.81 30.5		10.12 30.15	3 3.26	0.0 0.0	14.250 0.0	120 0.0011	36.467 0.134			
					0.0	14.250		0.016	Vel =	1.16	
364 to 365	30.5 30.19		10.30 40.45	3 3.26	0.0 0.0	14.250 0.0	120 0.0019	36.617 0.134			
					0.0	14.250		0.027	Vel =	1.55	
365 to 366	30.19 29.88		10.61 51.06	3 3.26	0.0 0.0	14.250 0.0	120 0.0030	36.778 0.134			
					0.0	14.250		0.043	Vel =	1.96	
366 to 367	29.88 29.57		11.07 62.13	3 3.26	0.0 0.0	14.250 0.0	120 0.0042	36.955 0.134			
					0.0	14.250		0.060	Vel =	2.39	
367 to 368	29.57 29.42		11.71 73.84	3 3.26	E 0.0	9.408 9.408	120 0.0059	37.149 0.065			
					0.0	16.068		0.094	Vel =	2.84	
368 to 369	29.42 10.67		0.0 73.84	3 3.26	4E 0.0	37.631 37.631	120 0.0058	37.308 8.121			
					0.0	64.631		0.376	Vel =	2.84	
369 to 370	10.67 10.67		18.97 92.81	3 3.26	0.0 0.0	8.000 0.0	120 0.0089	45.805 0.0			
					0.0	8.000		0.071	Vel =	3.57	
370 to 371	10.67 10.670		34.71 127.52	3 3.26	0.0 0.0	0.920 0.920	120 0.0163	45.876 0.0			
					0.0	0.920		0.015	Vel =	4.90	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 18
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
371 to 394	10.670 10.67		50.61 178.13	4 4.26	T 0.0	26.334 26.334	120 0.0081	45.891 0.0			
			0.0			58.959		0.477	Vel =	4.01	
394			178.13					46.368	K Factor =	26.16	
C86 to C87	29.9 29.9	5.60	21.58 21.58	1.25 1.442	0.0 0.0	10.000 0.0	120 0.0318	14.855 0.318		Vel =	4.24
C87 to 401	29.9 29.9	5.60	21.82 43.4	1.25 1.442	T 0.0	7.432 7.432	120 0.1158	15.173 0.0		Vel =	8.53
			0.0			13.832		1.602			
401			43.40					16.775	K Factor =	10.60	
C88 to 401	29.9 29.9	5.60	22.67 22.67	1.25 1.442	T 0.0	7.432 7.432	120 0.0349	16.390 0.0		Vel =	4.45
			0.0			11.032		0.385			
401			22.67					16.775	K Factor =	5.54	
C89 to C90	29.71 29.71	5.60	21.74 21.74	1.25 1.442	0.0 0.0	10.000 0.0	120 0.0322	15.076 0.322		Vel =	4.27
C90 to 402	29.71 29.71	5.60	21.98 43.72	1.25 1.442	T 0.0	7.432 7.432	120 0.1174	15.398 0.0		Vel =	8.59
			0.0			13.832		1.624			
402			43.72					17.022	K Factor =	10.60	
C91 to 402	29.71 29.71	5.60	22.24 22.24	1 1.097	T 0.0	6.217 6.217	120 0.1273	15.772 0.0		Vel =	7.55
			0.0			9.817		1.250			
402			22.24					17.022	K Factor =	5.39	
C92 to C93	29.51 29.51	5.60	22.18 22.18	1.25 1.442	0.0 0.0	10.000 0.0	120 0.0334	15.684 0.334		Vel =	4.36
C93 to 403	29.51 29.51	5.60	22.41 44.59	1.25 1.442	T 0.0	7.432 7.432	120 0.1218	16.018 0.0		Vel =	8.76
			0.0			13.832		1.685			
403			44.59					17.703	K Factor =	10.60	
C94 to 94C	29.9 29.9	5.60	18.00 18.0	1.25 1.442	0.0 0.0	4.220 4.220	120 0.0227	10.332 0.0		Vel =	3.54
			0.0					0.096			
94C			18.00					10.428	K Factor =	5.57	
C95 to 95C	29.71 29.71	5.60	18.24 18.24	1.25 1.442	T 0.0	7.432 7.432	120 0.0233	10.604 0.0		Vel =	3.58
			0.0			11.642		0.271			
			0.0								

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 19
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
95C			18.24					10.875		K Factor = 5.53	
C96 to 96C	29.51 29.51	5.60	19.79	1.25	0.0 0.0	4.220 0.0	120	12.486 0.0			
			19.79	1.442	0.0	4.220	0.0273	0.115		Vel = 3.89	
96C			0.0 19.79					12.601		K Factor = 5.57	
94C to 95C	29.9 29.71		18.00	1.25	E 0.0	3.716 3.716	120	10.428 0.082			
			18.0	1.442	0.0	16.046	0.0227	0.365		Vel = 3.54	
95C to 96C	29.71 29.51		18.24	1.25	T 0.0	7.432 7.432	120	10.875 0.087			
			36.24	1.442	0.0	19.762	0.0829	1.639		Vel = 7.12	
96C to C97	29.51 29.51		19.78	1.25	0.0 0.0	7.600 0.0	120	12.601 0.0			
			56.02	1.442	0.0	7.600	0.1858	1.412		Vel = 11.01	
C97 to 403	29.51 29.51	5.60	20.97	1.25	T 0.0	7.432 7.432	120	14.013 0.0			
			76.99	1.442	0.0	11.032	0.3345	3.690		Vel = 15.12	
403			0.0 76.99					17.703		K Factor = 18.30	
401 to 402	29.9 29.71		66.07	2.5	0.0 0.0	12.330 0.0	120	16.775 0.082			
			66.07	2.635	0.0	12.330	0.0134	0.165		Vel = 3.89	
402 to 403	29.71 29.51		65.96	2.5	0.0 0.0	12.330 0.0	120	17.022 0.087			
			132.03	2.635	0.0	12.330	0.0482	0.594		Vel = 7.77	
403 to 404	29.51 29.510		121.57	2.5	E 0.0	8.237 8.237	120	17.703 0.0			
			253.6	2.635	0.0	13.887	0.1611	2.237		Vel = 14.92	
404 to 405	29.510 10.670		0.0	2.5	E 0.0	8.237 8.237	120	19.940 8.160			
			253.6	2.635	0.0	28.067	0.1611	4.522		Vel = 14.92	
405 to 406	10.670 10.67		0.0	2.5	0.0 0.0	1.500 0.0	120	32.622 0.0			
			253.6	2.635	0.0	1.500	0.1607	0.241		Vel = 14.92	
406			0.0 253.60					32.863		K Factor = 44.24	
394 to 395	10.67 10.67		244.69	4	0.0 0.0	6.000 0.0	120	46.368 0.0			
			244.69	4.26	0.0	6.000	0.0145	0.087		Vel = 5.51	
395 to 396	10.67 10.67		8.91	4	E 0.0	13.167 13.167	120	46.455 0.0			
			253.6	4.26	0.0	64.307	0.0155	0.998		Vel = 5.71	
396 to TR3	10.67 10.380		0.0	4	2E 0.0	26.334 26.334	120	47.453 0.126			
			253.6	4.26	0.0	49.514	0.0155	0.769		Vel = 5.71	
TR3 to BR3	10.380 3		0.0	4	B S T	15.8 28.968 26.334	120	48.348 6.196 1.219		* * Fixed Loss = 3	
			253.6	4.26			0.0155			Vel = 5.71	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 5 - 0.15 for Room

Page 20
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
					Fsp	0.0					
BR3 to UG	3 0		0.0 253.6	6 6.357		0.0 0.0 0.0	2.000 0.0 2.000	120 1.299 0.0020	55.763 1.299 0.004	Vel =	2.56
UG to HOSE	0 0		0.0 253.6	6 6.16	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	140 2.935 0.0019	57.066 2.935 0.277	* * Fixed Loss = 2.935 Vel =	2.73
HOSE to TEST	0 0	H250	250.00 503.6	6 6.16		0.0 0.0 0.0	0.500 0.0 0.500	140 0.0 0.0060	60.278 0.0 0.003	Vel =	5.42
TEST			0.0 503.60						60.281	K Factor =	64.86

HYDRAULIC DESIGN COVER SHEET

AREA: **System 3 – Area 6 Mech Room**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/22/2021**
LATEST REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Obstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 3 – Area 6	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 16'-0"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK300
K-FACTOR: 5.6	TEMPERATURE (°F): 286

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Ordinary Hazard Group 1
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.15	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 120	TOTAL SPRINKLERS OPERATING: 14
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 250
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 273.77	PRESSURE REQ'D (PSI): 60.055
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 523.77	PRESSURE REQ'D (PSI): 63.288
AREA SAFETY MARGIN (PSI): 10.762		

NOTES:
3-13-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500
Drawing :
Location :
Remote Area :
Contract :
Data File : L S Middle School - Level 1 - System 3 - Area 6 Mech Room -

Water Supply Curve C

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

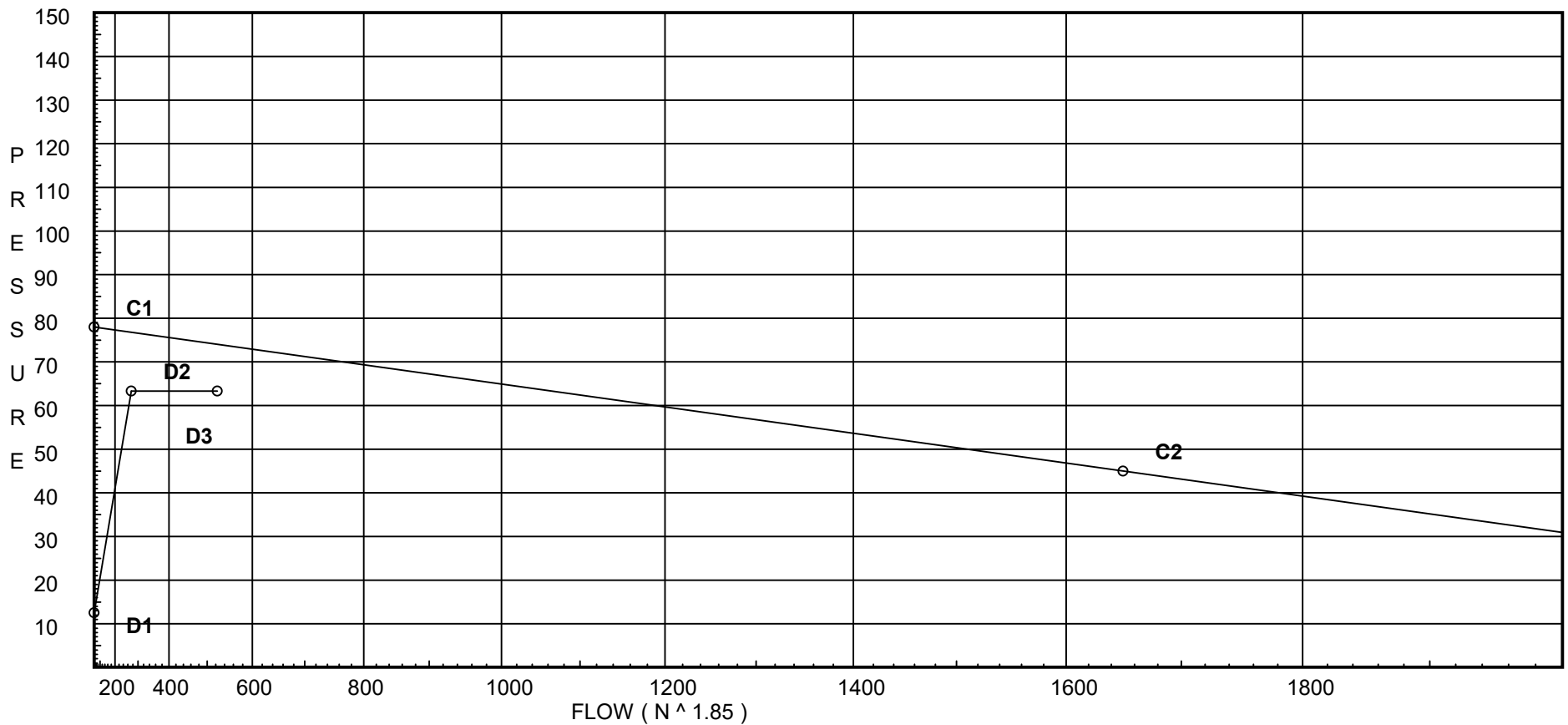
Page 1
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 12.508
D2 - System Flow : 273.771
D2 - System Pressure : 63.288
Hose (Demand) : 250
D3 - System Demand : 523.771
Safety Margin : 10.762



Fittings Used Summary

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
352	10.67		48.61	na				
7	22.38		43.61	na				
C77	22.47		43.6	na				
C78	22.47		43.61	na				
C79	22.47		43.63	na				
C80	22.47		43.64	na				
C81	22.47		43.65	na				
8	22.37		43.71	na				
372	10.67		48.85	na				
C73	22.32		43.67	na				
C74	22.32		43.68	na				
C75	22.32		43.7	na				
C76	22.32		43.71	na				
350	10.67		48.61	na				
C69	22.1		43.76	na				
C70	22.1		43.78	na				
C71	22.1		43.79	na				
C72	22.1		43.8	na				
29	10.67		48.62	na				
C61	21.96		43.8	na				
C62	21.96		43.81	na				
C63	21.96		43.82	na				
C64	21.96		43.83	na				
C65	21.96		43.85	na				
C66	21.96		43.87	na				
C67	21.96		43.87	na				
C68	21.96		43.88	na				
322	14.4		45.63	na				
25	16.07		44.91	na				
323	14.13		45.84	na				
26	15.8		45.12	na				
324	13.9		46.01	na				
27	15.56		45.3	na				
325	13.63		46.19	na				
28	15.3		45.48	na				
326	10.67		47.55	na				
327	10.67		47.59	na				
328	10.67		47.59	na				
24	10.67		47.6	na				
309	26.45		39.67	na				
310	10.67		47.08	na				
311	10.67		47.14	na				
312	10.67		47.25	na				
313	10.67		47.37	na				
314	10.67		47.48	na				
315	10.67		47.64	na				
319	10.67		47.7	na				
318	10.67		47.71	na				
317	10.67		47.71	na				
316	10.67		47.75	na				
331	10.67		47.76	na				
332	10.67		47.89	na				
333	10.67		47.92	na				
334	10.67		47.94	na				
335	10.67		47.98	na				
336	10.67		48.17	na				
337	10.67		48.36	na				
390	10.67		43.76	na				
391	10.67		44.72	na				
392	10.67		46.28	na				
393	10.67		48.06	na				
382	25.08		39.25	na				

Flow Summary - Standard

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 4
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
C5	25.08		39.5	na				
C4	25.08		39.57	na				
C3	25.08		39.65	na				
C2	25.08		39.72	na				
C1	25.08		39.79	na				
383	25.42		39.08	na				
C10	25.42		39.33	na				
C9	25.42		39.4	na				
C8	25.42		39.48	na				
C7	25.42		39.55	na				
C6	25.42		39.62	na				
384	25.75		38.89	na				
C11	25.75		39.46	na				
385	26.09		38.62	na				
387	27.29		37.85	na				
386	27.29		37.9	na				
388	27.29		37.36	na				
389	10.67		44.14	na				
308	26.45		39.54	na				
307	26.43		39.48	na				
306	26.33		39.51	na				
305	26.09		39.59	na				
304	25.75		39.73	na				
303	25.42		39.87	na				
302	25.08		40.05	na				
301	24.92		40.19	na				
321	24.92		40.26	na				
341	31.43		39.69	na				
C41	31.43		39.72	na				
C42	31.43		39.73	na				
C43	31.43		39.74	na				
C44	31.43		39.75	na				
342	31.12		39.82	na				
C45	31.12		39.85	na				
C46	31.12		39.86	na				
C47	31.12		39.87	na				
C48	31.12		39.89	na				
343	30.81		39.95	na				
344	30.5		40.09	na				
345	30.19		40.22	na				
346	29.88		40.35	na				
347	29.88		40.34	na				
348	29.88		40.33	na				
349	10.67		48.62	na				
351	10.67		48.61	na				
361	31.43		39.78	na				
362	31.12		39.92	na				
363	30.81		40.05	na				
364	30.5		40.19	na				
365	30.19		40.32	na				
366	29.88		40.46	na				
367	29.57		40.6	na				
368	29.42		40.68	na				
369	10.67		48.84	na				
370	10.67		48.85	na				
371	10.67		48.85	na				
AREA	0.0		22.84	na				
D1	28.88	5.6	10.33	na	18.0	0.15	120	7.0
D2	28.88	5.6	10.56	na	18.2	0.15	120	7.0
D3	28.88	5.6	11.39	na	18.9	0.15	120	7.0
D4	28.88	5.6	12.08	na	19.47	0.15	120	7.0
D5	28.88	5.6	12.35	na	19.68	0.15	120	7.0

Flow Summary - Standard

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 5
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
D6	28.64	5.6	10.64	na	18.27	0.15	120	7.0
D7	28.64	5.6	10.87	na	18.47	0.15	120	7.0
D8	28.64	5.6	11.72	na	19.17	0.15	120	7.0
D9	28.64	5.6	13.09	na	20.26	0.15	120	7.0
D10	28.64	5.6	13.23	na	20.37	0.15	120	7.0
D11	28.38	5.6	13.62	na	20.66	0.15	120	7.0
D12	28.38	5.6	13.91	na	20.89	0.15	120	7.0
D13	28.38	5.6	13.55	na	20.62	0.15	120	7.0
D14	28.38	5.6	13.84	na	20.84	0.15	120	7.0
411	28.88		13.57	na				
412	28.64		13.96	na				
413	28.38		15.2	na				
414	28.13		17.51	na				
415	28.13		21.1	na				
416	12.71		32.17	na				
417	12.71		36.52	na				
394	10.67		48.9	na				
395	10.67		48.99	na				
396	10.67		50.14	na				
TR3	10.38		51.15	na				
BR3	3.0		58.75	na				
UG	0.0		60.06	na				
HOSE	0.0		63.28	na	250.0			
TEST	0.0		63.29	na				

The maximum velocity is 16.11 and it occurs in the pipe between nodes 413 and 414

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
352 to 7	14.97	2.635 120.0	T 4E	16.474 32.948	38.920 49.422	48.610 -5.072				
	14.97	0.0009		0.0	88.342	0.076		Vel =	0.88	
7 to C77	-11.12	1.442 120.0	T E	7.432 3.716	8.150 11.148	43.614 -0.039				
	3.85	0.0013		0.0	19.298	0.026		Vel =	0.76	
C77 to C78	0.0	1.442 120.0		0.0 0.0	8.250 0.0	43.601 0.0				
	3.85	0.0013		0.0	8.250	0.011		Vel =	0.76	
C78 to C79	0.0	1.442 120.0		0.0 0.0	10.750 0.0	43.612 0.0				
	3.85	0.0013		0.0	10.750	0.014		Vel =	0.76	
C79 to C80	0.0	1.442 120.0		0.0 0.0	10.750 0.0	43.626 0.0				
	3.85	0.0013		0.0	10.750	0.014		Vel =	0.76	
C80 to C81	0.0	1.442 120.0		0.0 0.0	10.250 0.0	43.640 0.0				
	3.85	0.0013		0.0	10.250	0.013		Vel =	0.76	
C81 to 8	0.0	1.442 120.0	E	3.716 0.0	7.570 3.716	43.653 0.043				
	3.85	0.0013		0.0	11.286	0.015		Vel =	0.76	
8 to 372	11.12	2.635 120.0	2T E	32.948 8.237	37.330 41.185	43.711 5.067				
	14.97	0.0009		0.0	78.515	0.068		Vel =	0.88	
372 to 371	0.0	3.26 120.0		0.0 0.0	7.430 0.0	48.846 0.0				
	14.97	0.0003		0.0	7.430	0.002		Vel =	0.58	
	0.0 14.97					48.848		K Factor =	2.14	
7 to C73	11.12	2.157 120.0	2E	12.307 0.0	10.010 12.307	43.614 0.026				
	11.12	0.0013		0.0	22.317	0.030		Vel =	0.98	
C73 to C74	0.0	2.157 120.0		0.0 0.0	10.890 0.0	43.670 0.0				
	11.12	0.0013		0.0	10.890	0.014		Vel =	0.98	
C74 to C75	0.0	2.157 120.0		0.0 0.0	11.000 0.0	43.684 0.0				
	11.12	0.0013		0.0	11.000	0.014		Vel =	0.98	
C75 to C76	0.0	2.157 120.0		0.0 0.0	9.920 0.0	43.698 0.0				
	11.12	0.0013		0.0	9.920	0.013		Vel =	0.98	
C76 to 8	0.0	2.157 120.0	E	6.153 0.0	10.230 6.153	43.711 -0.022				
	11.12	0.0013		0.0	16.383	0.022		Vel =	0.98	
	0.0 11.12					43.711		K Factor =	1.68	
350 to C69	10.27	2.157 120.0	5E T	30.767 12.307	47.210 43.074	48.612 -4.950				
	10.27	0.0011		0.0	90.284	0.102		Vel =	0.90	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 7
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
C69 to C70	0.0 10.27	2.157 120.0 0.0011		0.0 0.0 0.0	10.890 0.0 10.890	43.764 0.0 0.012			Vel = 0.90	
C70 to C71	0.0 10.27	2.157 120.0 0.0011		0.0 0.0 0.0	11.000 0.0 11.000	43.776 0.0 0.012			Vel = 0.90	
C71 to C72	0.0 10.27	2.157 120.0 0.0012		0.0 0.0 0.0	9.920 0.0 9.920	43.788 0.0 0.012			Vel = 0.90	
C72 to 370	0.0 10.27	2.157 120.0 0.0011	4E T	24.613 12.307 0.0	48.290 36.920 85.210	43.800 4.950 0.097			Vel = 0.90	
	0.0 10.27					48.847			K Factor = 1.47	
29 to C61	5.61	1.682 120.0 0.0012	4E T	19.799 9.9 0.0	27.690 29.699 57.389	48.618 -4.890 0.071			Vel = 0.81	
C61 to C62	0.0 5.61	1.682 120.0 0.0013		0.0 0.0 0.0	9.500 0.0 9.500	43.799 0.0 0.012			Vel = 0.81	
C62 to C63	0.0 5.61	1.682 120.0 0.0013		0.0 0.0 0.0	5.480 0.0 5.480	43.811 0.0 0.007			Vel = 0.81	
C63 to C64	0.0 5.61	1.682 120.0 0.0013		0.0 0.0 0.0	12.670 0.0 12.670	43.818 0.0 0.016			Vel = 0.81	
C64 to C65	0.0 5.61	1.682 120.0 0.0013		0.0 0.0 0.0	12.670 0.0 12.670	43.834 0.0 0.016			Vel = 0.81	
C65 to C66	0.0 5.61	1.682 120.0 0.0012		0.0 0.0 0.0	12.670 0.0 12.670	43.850 0.0 0.015			Vel = 0.81	
C66 to C67	0.0 5.61	1.682 120.0 0.0014		0.0 0.0 0.0	3.540 0.0 3.540	43.865 0.0 0.005			Vel = 0.81	
C67 to C68	0.0 5.61	1.682 120.0 0.0012		0.0 0.0 0.0	11.050 0.0 11.050	43.870 0.0 0.013			Vel = 0.81	
C68 to 369	0.0 5.61	1.682 120.0 0.0012	3E T	14.849 9.9 0.0	28.330 24.749 53.079	43.883 4.890 0.066			Vel = 0.81	
	0.0 5.61					48.839			K Factor = 0.80	
322 to 25	-0.47 -0.47	1.38 120.0 -0.0001	T	6.0 0.0 0.0	1.670 6.000 7.670	45.635 -0.723 -0.001			Vel = 0.10	
25 to 312	0.0 -0.47	1.442 120.0 0.0	2T 2E	14.864 7.432 0.0	70.390 22.296 92.686	44.911 2.339 -0.002			Vel = 0.09	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 8
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 -0.47					47.248			K Factor = -0.07	
323 to 26	1.61	1.38 120.0	T	6.0 0.0	1.670 6.000	45.842 -0.723				
	1.61	0.0003		0.0	7.670	0.002			Vel = 0.35	
26 to 313	0.0	1.442 120.0	2T 2E	14.864 7.432	70.120 22.296	45.121 2.222				
	1.61	0.0003		0.0	92.416	0.024			Vel = 0.32	
	0.0 1.61					47.367			K Factor = 0.23	
324 to 27	2.77	1.38 120.0	T	6.0 0.0	1.670 6.000	46.011 -0.719				
	2.77	0.0009		0.0	7.670	0.007			Vel = 0.59	
27 to 314	0.0	1.442 120.0	2T 2E	14.864 7.432	69.890 22.296	45.299 2.118				
	2.77	0.0007		0.0	92.186	0.066			Vel = 0.54	
	0.0 2.77					47.483			K Factor = 0.40	
325 to 28	4.32	1.38 120.0	T	6.0 0.0	1.670 6.000	46.189 -0.723				
	4.32	0.0021		0.0	7.670	0.016			Vel = 0.93	
28 to 315	0.0	1.442 120.0	2T 2E	14.864 7.432	69.610 22.296	45.482 2.005				
	4.32	0.0016		0.0	91.906	0.149			Vel = 0.85	
	0.0 4.32					47.636			K Factor = 0.63	
326 to 316	5.46	1.442 120.0	2T	14.864 0.0	64.990 14.864	47.548 0.0				
	5.46	0.0025		0.0	79.854	0.200			Vel = 1.07	
	0.0 5.46					47.748			K Factor = 0.79	
327 to 317	3.41	1.442 120.0	2T 6E	14.864 22.296	81.040 37.160	47.590 0.0				
	3.41	0.0010		0.0	118.200	0.123			Vel = 0.67	
	0.0 3.41					47.713			K Factor = 0.49	
328 to 318	3.36	1.442 120.0	2T 5E	14.864 18.58	75.670 33.444	47.594 0.0				
	3.36	0.0010		0.0	109.114	0.112			Vel = 0.66	
	0.0 3.36					47.706			K Factor = 0.49	
24 to 319	3.41	1.442 120.0	2T 4E	14.864 14.864	73.150 29.728	47.596 0.0				
	3.41	0.0010		0.0	102.878	0.108			Vel = 0.67	
	0.0 3.41					47.704			K Factor = 0.49	
309 to 310	28.81	1.682 120.0	E T	4.95 9.9	7.700 14.850	39.670 6.834				
	28.81	0.0257		0.0	22.550	0.579			Vel = 4.16	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 9
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
310 to 311	0.0 28.81	2.157 120.0 0.0076		0.0 0.0 0.0	7.770 0.0 7.770	47.083 0.0 0.059				
								Vel =	2.53	
311 to 312	0.0 28.81	2.157 120.0 0.0077	E	6.153 0.0 0.0	7.590 6.153 13.743	47.142 0.0 0.106				
								Vel =	2.53	
312 to 313	-0.47 28.34	2.157 120.0 0.0074		0.0 0.0 0.0	16.150 0.0 16.150	47.248 0.0 0.119				
								Vel =	2.49	
313 to 314	1.61 29.95	2.157 120.0 0.0082		0.0 0.0 0.0	14.130 0.0 14.130	47.367 0.0 0.116				
								Vel =	2.63	
314 to 315	2.77 32.72	2.157 120.0 0.0097		0.0 0.0 0.0	15.790 0.0 15.790	47.483 0.0 0.153				
								Vel =	2.87	
315 to 331	4.32 37.04	2.157 120.0 0.0121		0.0 0.0 0.0	10.340 0.0 10.340	47.636 0.0 0.125				
	0.0 37.04					47.761		K Factor =	5.36	
319 to 318	3.41 3.41	2.157 120.0 0.0001		0.0 0.0 0.0	14.040 0.0 14.040	47.704 0.0 0.002				
								Vel =	0.30	
318 to 317	3.36 6.77	2.157 120.0 0.0005		0.0 0.0 0.0	14.500 0.0 14.500	47.706 0.0 0.007				
								Vel =	0.59	
317 to 316	3.41 10.18	2.157 120.0 0.0011	2E	12.307 0.0 0.0	18.670 12.307 30.977	47.713 0.0 0.035				
								Vel =	0.89	
316 to 331	5.46 15.64	2.157 120.0 0.0024		0.0 0.0 0.0	5.470 0.0 5.470	47.748 0.0 0.013				
								Vel =	1.37	
331 to 332	37.04 52.68	3.26 120.0 0.0031	T	20.159 0.0 0.0	20.680 20.159 40.839	47.761 0.0 0.128				
								Vel =	2.02	
332 to 333	0.0 52.68	3.26 120.0 0.0031		0.0 0.0 0.0	11.340 0.0 11.340	47.889 0.0 0.035				
								Vel =	2.02	
333 to 334	0.0 52.68	3.26 120.0 0.0032		0.0 0.0 0.0	6.580 0.0 6.580	47.924 0.0 0.021				
								Vel =	2.02	
334 to 335	0.0 52.68	3.26 120.0 0.0032		0.0 0.0 0.0	11.740 0.0 11.740	47.945 0.0 0.037				
								Vel =	2.02	
335 to 336	0.0 52.68	3.26 120.0 0.0031	4E	37.631 0.0 0.0	23.680 37.631 61.311	47.982 0.0 0.191				
								Vel =	2.02	
336 to 337	0.0 52.68	3.26 120.0 0.0031		0.0 0.0 0.0	60.650 0.0 60.650	48.173 0.0 0.189				
								Vel =	2.02	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 10
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
337 to 351	0.0 52.68	3.26 120.0 0.0031	2T	40.319 0.0 0.0	38.360 40.319 78.679	48.362 0.0 0.246			Vel = 2.02	
	0.0 52.68					48.608			K Factor = 7.56	
390 to 391	221.09 221.09	3.26 120.0 0.0444		0.0 0.0 0.0	21.550 0.0 21.550	43.764 0.0 0.956			Vel = 8.50	
391 to 392	0.0 221.09	3.26 120.0 0.0443	2E	18.815 0.0 0.0	16.480 18.815 35.295	44.720 0.0 1.564			Vel = 8.50	
392 to 393	-23.85 197.24	3.26 120.0 0.0359	E	9.408 0.0 0.0	40.180 9.408 49.588	46.284 0.0 1.780			Vel = 7.58	
393 to 394	0.0 197.24	3.26 120.0 0.0359	E	9.408 0.0 0.0	13.820 9.408 23.228	48.064 0.0 0.834			Vel = 7.58	
	0.0 197.24					48.898			K Factor = 28.21	
392 to 395	23.85 23.85	1.682 120.0 0.0181	2T 4E	19.799 19.799 0.0	110.010 39.598 149.608	46.284 0.0 2.705			Vel = 3.44	
	0.0 23.85					48.989			K Factor = 3.41	
382 to C5	9.78 9.78	1.442 120.0 0.0074	T	7.432 0.0 0.0	27.000 7.432 34.432	39.246 0.0 0.254			Vel = 1.92	
C5 to C4	0.0 9.78	1.442 120.0 0.0073		0.0 0.0 0.0	10.000 0.0 10.000	39.500 0.0 0.073			Vel = 1.92	
C4 to C3	0.0 9.78	1.442 120.0 0.0073		0.0 0.0 0.0	10.000 0.0 10.000	39.573 0.0 0.073			Vel = 1.92	
C3 to C2	0.0 9.78	1.442 120.0 0.0074		0.0 0.0 0.0	10.000 0.0 10.000	39.646 0.0 0.074			Vel = 1.92	
C2 to C1	0.0 9.78	1.442 120.0 0.0074		0.0 0.0 0.0	10.000 0.0 10.000	39.720 0.0 0.074			Vel = 1.92	
C1 to 302	0.0 9.78	1.442 120.0 0.0073	T	7.432 0.0 0.0	27.750 7.432 35.182	39.794 0.0 0.258			Vel = 1.92	
	0.0 9.78					40.052			K Factor = 1.55	
383 to C10	9.68 9.68	1.442 120.0 0.0072	T	7.432 0.0 0.0	27.000 7.432 34.432	39.084 0.0 0.248			Vel = 1.90	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 11
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv. Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
C10 to C9	0.0 9.68	1.442 120.0 0.0072	0.0 0.0 0.0	10.000 0.0 10.000	39.332 0.0 0.072			Vel = 1.90	
C9 to C8	0.0 9.68	1.442 120.0 0.0072	0.0 0.0 0.0	10.000 0.0 10.000	39.404 0.0 0.072			Vel = 1.90	
C8 to C7	0.0 9.68	1.442 120.0 0.0072	0.0 0.0 0.0	10.000 0.0 10.000	39.476 0.0 0.072			Vel = 1.90	
C7 to C6	0.0 9.68	1.442 120.0 0.0073	0.0 0.0 0.0	10.000 0.0 10.000	39.548 0.0 0.073			Vel = 1.90	
C6 to 303	0.0 9.68	1.442 120.0 0.0072	T 7.432 0.0 0.0	27.750 7.432 35.182	39.621 0.0 0.253			Vel = 1.90	
	0.0 9.68				39.874			K Factor = 1.53	
384 to C11	10.02 10.02	1.442 120.0 0.0077	T 7.432 0.0 0.0	67.000 7.432 74.432	38.885 0.0 0.573			Vel = 1.97	
C11 to 304	0.0 10.02	1.442 120.0 0.0077	T 7.432 0.0 0.0	27.750 7.432 35.182	39.458 0.0 0.270			Vel = 1.97	
	0.0 10.02				39.728			K Factor = 1.59	
385 to 305	10.79 10.79	1.442 120.0 0.0088	2T 14.864 0.0 0.0	94.750 14.864 109.614	38.619 0.0 0.967			Vel = 2.12	
	0.0 10.79				39.586			K Factor = 1.71	
387 to 307	12.42 12.42	1.442 120.0 0.0114	2T 14.864 0.0 0.0	94.750 14.864 109.614	37.853 0.372 1.254			Vel = 2.44	
	0.0 12.42				39.479			K Factor = 1.98	
382 to 383	-9.78 -9.78	2.157 120.0 -0.0010	0.0 0.0 0.0	15.000 0.0 15.000	39.246 -0.147 -0.015			Vel = 0.86	
383 to 384	-9.67 -19.45	2.157 120.0 -0.0037	0.0 0.0 0.0	15.000 0.0 15.000	39.084 -0.143 -0.056			Vel = 1.71	
384 to 385	-10.02 -29.47	2.157 120.0 -0.0079	0.0 0.0 0.0	15.000 0.0 15.000	38.885 -0.147 -0.119			Vel = 2.59	
385 to 386	-10.79 -40.26	2.157 120.0 -0.0142	0.0 0.0 0.0	14.000 0.0 14.000	38.619 -0.520 -0.199			Vel = 3.53	
386 to 387	0.0 -40.26	1.682 120.0 -0.0470	0.0 0.0 0.0	1.000 0.0 1.000	37.900 0.0 -0.047			Vel = 5.81	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 12
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
387 to 388	-12.42 -52.68	1.682 120.0 -0.0784		0.0 0.0 0.0	6.290 0.0 6.290	37.853 0.0 -0.493				
								Vel =	7.61	
388 to 389	0.0 -52.68	2.635 120.0 -0.0088	2E	16.474 0.0 0.0	30.580 16.474 47.054	37.360 7.198 -0.414				
								Vel =	3.10	
389 to 390	0.0 -52.68	2.635 120.0 -0.0088	2E	16.474 0.0 0.0	26.670 16.474 43.144	44.144 0.0 -0.380				
								Vel =	3.10	
	0.0 -52.68					43.764		K Factor =	-7.96	
309 to 308	-28.81 -28.81	2.157 120.0 -0.0076	E	6.153 0.0 0.0	11.580 6.153 17.733	39.670 0.0 -0.135				
								Vel =	2.53	
308 to 307	0.0 -28.81	2.157 120.0 -0.0077	E	6.153 0.0 0.0	2.290 6.153 8.443	39.535 0.009 -0.065				
								Vel =	2.53	
307 to 306	12.42 -16.39	2.157 120.0 -0.0026		0.0 0.0 0.0	4.540 0.0 4.540	39.479 0.043 -0.012				
								Vel =	1.44	
306 to 305	0.0 -16.39	2.157 120.0 -0.0027		0.0 0.0 0.0	10.460 0.0 10.460	39.510 0.104 -0.028				
								Vel =	1.44	
305 to 304	10.79 -5.6	2.157 120.0 -0.0003		0.0 0.0 0.0	15.000 0.0 15.000	39.586 0.147 -0.005				
								Vel =	0.49	
304 to 303	10.02 4.42	2.157 120.0 0.0002		0.0 0.0 0.0	15.000 0.0 15.000	39.728 0.143 0.003				
								Vel =	0.39	
303 to 302	9.68 14.1	2.157 120.0 0.0021		0.0 0.0 0.0	15.000 0.0 15.000	39.874 0.147 0.031				
								Vel =	1.24	
302 to 301	9.77 23.87	2.157 120.0 0.0055	E	6.153 0.0 0.0	7.040 6.153 13.193	40.052 0.069 0.072				
								Vel =	2.10	
301 to 321	0.0 23.87	2.157 120.0 0.0054		0.0 0.0 0.0	11.580 0.0 11.580	40.193 0.0 0.062				
								Vel =	2.10	
321 to 322	0.0 23.87	1.682 120.0 0.0181	4E	19.799 0.0 0.0	25.667 19.799 45.466	40.255 4.556 0.824				
								Vel =	3.45	
322 to 323	0.47 24.34	2.157 120.0 0.0056		0.0 0.0 0.0	16.160 0.0 16.160	45.635 0.117 0.090				
								Vel =	2.14	
323 to 324	-1.61 22.73	2.157 120.0 0.0049		0.0 0.0 0.0	14.150 0.0 14.150	45.842 0.100 0.069				
								Vel =	2.00	
324 to 325	-2.77 19.96	2.157 120.0 0.0039		0.0 0.0 0.0	15.770 0.0 15.770	46.011 0.117 0.061				
								Vel =	1.75	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 13
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
325 to 326	-4.32 15.64	2.157 120.0 0.0025	2E	12.307 0.0 0.0	18.680 12.307 30.987	46.189 1.282 0.077		Vel = 1.37		
326 to 327	-5.46 10.18	2.157 120.0 0.0011	2E	12.307 0.0 0.0	24.990 12.307 37.297	47.548 0.0 0.042		Vel = 0.89		
327 to 328	-3.41 6.77	2.157 120.0 0.0004		0.0 0.0 0.0	9.500 0.0 9.500	47.590 0.0 0.004		Vel = 0.59		
328 to 24	-3.36 3.41	2.157 120.0 0.0002		0.0 0.0 0.0	12.000 0.0 12.000	47.594 0.0 0.002		Vel = 0.30		
	0.0 3.41					47.596		K Factor = 0.49		
341 to C41	2.96	1.442 120.0 0.0008	T	7.432 0.0 0.0	30.830 7.432 38.262	39.686 0.0 0.031		Vel = 0.58		
C41 to C42	0.0	1.442 120.0 0.0008		0.0 0.0 0.0	15.000 0.0 15.000	39.717 0.0 0.012		Vel = 0.58		
C42 to C43	0.0	1.442 120.0 0.0008		0.0 0.0 0.0	13.000 0.0 13.000	39.729 0.0 0.010		Vel = 0.58		
C43 to C44	0.0	1.442 120.0 0.0008		0.0 0.0 0.0	15.000 0.0 15.000	39.739 0.0 0.012		Vel = 0.58		
C44 to 361	0.0	1.442 120.0 0.0008	T	7.432 0.0 0.0	30.830 7.432 38.262	39.751 0.0 0.031		Vel = 0.58		
	0.0 2.96					39.782		K Factor = 0.47		
342 to C45	2.97	1.442 120.0 0.0008	T	7.432 0.0 0.0	30.830 7.432 38.262	39.820 0.0 0.031		Vel = 0.58		
C45 to C46	0.0	1.442 120.0 0.0008		0.0 0.0 0.0	15.000 0.0 15.000	39.851 0.0 0.012		Vel = 0.58		
C46 to C47	0.0	1.442 120.0 0.0008		0.0 0.0 0.0	13.000 0.0 13.000	39.863 0.0 0.011		Vel = 0.58		
C47 to C48	0.0	1.442 120.0 0.0008		0.0 0.0 0.0	15.000 0.0 15.000	39.874 0.0 0.012		Vel = 0.58		
C48 to 362	0.0	1.442 120.0 0.0008	T	7.432 0.0 0.0	30.830 7.432 38.262	39.886 0.0 0.031		Vel = 0.58		
	0.0 2.97					39.917		K Factor = 0.47		

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 14
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
343 to 363	2.99 2.99	1.442 120.0 0.0008	2T	14.864 0.0 0.0	104.660 14.864 119.524	39.954 0.0 0.098				Vel = 0.59
	0.0 2.99					40.052			K Factor =	0.47
344 to 364	3.05 3.05	1.442 120.0 0.0009	2T	14.864 0.0 0.0	104.660 14.864 119.524	40.086 0.0 0.102				Vel = 0.60
	0.0 3.05					40.188			K Factor =	0.48
345 to 365	3.14 3.14	1.442 120.0 0.0009	2T	14.864 0.0 0.0	104.660 14.864 119.524	40.218 0.0 0.107				Vel = 0.62
	0.0 3.14					40.325			K Factor =	0.49
346 to 366	3.27 3.27	1.442 120.0 0.0010	2T	14.864 0.0 0.0	104.660 14.864 119.524	40.347 0.0 0.117				Vel = 0.64
	0.0 3.27					40.464			K Factor =	0.51
347 to 367	3.46 3.46	1.442 120.0 0.0011	2T	14.864 0.0 0.0	104.660 14.864 119.524	40.341 0.134 0.129				Vel = 0.68
	0.0 3.46					40.604			K Factor =	0.54
341 to 342	-2.96 -2.96	3.26 120.0 0.0		0.0 0.0 0.0	14.250 0.0 14.250	39.686 0.134 0.0				Vel = 0.11
342 to 343	-2.97 -5.93	3.26 120.0 0.0		0.0 0.0 0.0	14.250 0.0 14.250	39.820 0.134 0.0				Vel = 0.23
343 to 344	-2.99 -8.92	3.26 120.0 -0.0001		0.0 0.0 0.0	14.250 0.0 14.250	39.954 0.134 -0.002				Vel = 0.34
344 to 345	-3.04 -11.96	3.26 120.0 -0.0001		0.0 0.0 0.0	14.250 0.0 14.250	40.086 0.134 -0.002				Vel = 0.46
345 to 346	-3.14 -15.1	3.26 120.0 -0.0004		0.0 0.0 0.0	14.250 0.0 14.250	40.218 0.134 -0.005				Vel = 0.58
346 to 347	-3.28 -18.38	3.26 120.0 -0.0004		0.0 0.0 0.0	14.250 0.0 14.250	40.347 0.0 -0.006				Vel = 0.71
347 to 348	-3.46 -21.84	3.26 120.0 -0.0006	E	9.408 0.0 0.0	6.670 9.408 16.078	40.341 0.0 -0.010				Vel = 0.84
348 to 349	0.0 -21.84	3.26 120.0 -0.0006	3E	28.223 0.0 0.0	25.000 28.223 53.223	40.331 8.320 -0.033				Vel = 0.84

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 15
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
349 to 29	0.0 -21.84	3.26 120.0 0.0		0.0 0.0 0.0	0.990 0.0 0.990	48.618 0.0 0.0				
								Vel =	0.84	
29 to 350	-5.61 -27.45	3.26 120.0 -0.0009		0.0 0.0 0.0	6.380 0.0 6.380	48.618 0.0 -0.006				
								Vel =	1.06	
350 to 351	-10.26 -37.71	3.26 120.0 -0.0016		0.0 0.0 0.0	2.450 0.0 2.450	48.612 0.0 -0.004				
								Vel =	1.45	
351 to 352	52.68 14.97	3.26 120.0 0.0002		0.0 0.0 0.0	8.010 0.0 8.010	48.608 0.0 0.002				
								Vel =	0.58	
	0.0 14.97					48.610		K Factor =	2.15	
361 to 362	2.96 2.96	3.26 120.0 0.0001		0.0 0.0 0.0	14.250 0.0 14.250	39.782 0.134 0.001				
								Vel =	0.11	
362 to 363	2.97 5.93	3.26 120.0 0.0001		0.0 0.0 0.0	14.250 0.0 14.250	39.917 0.134 0.001				
								Vel =	0.23	
363 to 364	2.99 8.92	3.26 120.0 0.0001		0.0 0.0 0.0	14.250 0.0 14.250	40.052 0.134 0.002				
								Vel =	0.34	
364 to 365	3.04 11.96	3.26 120.0 0.0002		0.0 0.0 0.0	14.250 0.0 14.250	40.188 0.134 0.003				
								Vel =	0.46	
365 to 366	3.14 15.1	3.26 120.0 0.0004		0.0 0.0 0.0	14.250 0.0 14.250	40.325 0.134 0.005				
								Vel =	0.58	
366 to 367	3.28 18.38	3.26 120.0 0.0004		0.0 0.0 0.0	14.250 0.0 14.250	40.464 0.134 0.006				
								Vel =	0.71	
367 to 368	3.46 21.84	3.26 120.0 0.0006	E	9.408 0.0 0.0	6.660 9.408 16.068	40.604 0.065 0.010				
								Vel =	0.84	
368 to 369	0.0 21.84	3.26 120.0 0.0006	4E	37.631 0.0 0.0	27.000 37.631 64.631	40.679 8.121 0.039				
								Vel =	0.84	
369 to 370	5.61 27.45	3.26 120.0 0.0010		0.0 0.0 0.0	8.000 0.0 8.000	48.839 0.0 0.008				
								Vel =	1.06	
370 to 371	10.26 37.71	3.26 120.0 0.0011		0.0 0.0 0.0	0.920 0.0 0.920	48.847 0.0 0.001				
								Vel =	1.45	
371 to 394	14.97 52.68	4.26 120.0 0.0008	T	26.334 0.0 0.0	32.625 26.334 58.959	48.848 0.0 0.050				
								Vel =	1.19	
	0.0									

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 16
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	52.68					48.898			K Factor = 7.53	
D1 to D2	18.00 18.0	1.442 120.0 0.0227		0.0 0.0 0.0	10.000 0.0 10.000	10.332 0.0 0.227			K Factor = 5.60	
D2 to D3	18.20 36.2	1.442 120.0 0.0828		0.0 0.0 0.0	10.000 0.0 10.000	10.559 0.0 0.828			K Factor = 5.60	
D3 to 411	18.89 55.09	1.442 120.0 0.1801	T	7.432 0.0 0.0	4.670 7.432 12.102	11.387 0.0 2.180			K Factor = 5.60	
	0.0 55.09					13.567			K Factor = 14.96	
D4 to D5	19.47 19.47	1.442 120.0 0.0263		0.0 0.0 0.0	10.000 0.0 10.000	12.083 0.0 0.263			K Factor = 5.60	
D5 to 411	19.67 39.14	1.442 120.0 0.0957	T	7.432 0.0 0.0	5.330 7.432 12.762	12.346 0.0 1.221			K Factor = 5.60	
	0.0 39.14					13.567			K Factor = 10.63	
D6 to D7	18.27 18.27	1.442 120.0 0.0234		0.0 0.0 0.0	10.000 0.0 10.000	10.639 0.0 0.234			K Factor = 5.60	
D7 to D8	18.46 36.73	1.442 120.0 0.0851		0.0 0.0 0.0	10.000 0.0 10.000	10.873 0.0 0.851			K Factor = 5.60	
D8 to 412	19.18 55.91	1.442 120.0 0.1850	T	7.432 0.0 0.0	4.670 7.432 12.102	11.724 0.0 2.239			K Factor = 5.60	
	0.0 55.91					13.963			K Factor = 14.96	
D9 to D10	20.26 20.26	1.682 120.0 0.0134		0.0 0.0 0.0	10.000 0.0 10.000	13.092 0.0 0.134			K Factor = 5.60	
D10 to 412	20.37 40.63	1.682 120.0 0.0484	T	9.9 0.0 0.0	5.330 9.900 15.230	13.226 0.0 0.737			K Factor = 5.60	
	0.0 40.63					13.963			K Factor = 10.87	
D11 to D12	20.66 20.66	1.442 120.0 0.0293		0.0 0.0 0.0	10.000 0.0 10.000	13.616 0.0 0.293			K Factor = 5.60	
D12 to 413	20.89 41.55	1.442 120.0 0.1068	T	7.432 0.0 0.0	4.670 7.432 12.102	13.909 0.0 1.293			K Factor = 5.60	
	0.0 41.55					15.202			K Factor = 10.66	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 17
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
D13 to D14	20.62 20.62	1.442 120.0 0.0292		0.0 0.0 0.0	10.000 0.0 10.000	13.552 0.0 0.292			K Factor = 5.60 Vel = 4.05	
D14 to 413	20.83 41.45	1.442 120.0 0.1064	T	7.432 0.0 0.0	5.330 7.432 12.762	13.844 0.0 1.358			K Factor = 5.60 Vel = 8.14	
	0.0 41.45					15.202			K Factor = 10.63	
411 to 412	94.24 94.24	2.635 120.0 0.0257		0.0 0.0 0.0	11.340 0.0 11.340	13.567 0.104 0.292			Vel = 5.54	
412 to 413	96.53 190.77	2.635 120.0 0.0951		0.0 0.0 0.0	11.840 0.0 11.840	13.963 0.113 1.126			Vel = 11.22	
413 to 414	83.00 273.77	2.635 120.0 0.1856		0.0 0.0 0.0	11.840 0.0 11.840	15.202 0.108 2.198			Vel = 16.11	
414 to 415	0.0 273.77	2.635 120.0 0.1856	E	8.237 0.0 0.0	11.120 8.237 19.357	17.508 0.0 3.593			Vel = 16.11	
415 to 416	0.0 273.77	2.635 120.0 0.1857	E	8.237 0.0 0.0	15.420 8.237 23.657	21.101 6.678 4.392			Vel = 16.11	
416 to 417	0.0 273.77	2.635 120.0 0.1856	T	16.474 0.0 0.0	6.960 16.474 23.434	32.171 0.0 4.350			Vel = 16.11	
417 to 390	0.0 273.77	2.635 120.0 0.1856	T	16.474 0.0 0.0	17.790 16.474 34.264	36.521 0.884 6.359			Vel = 16.11	
	0.0 273.77					43.764			K Factor = 41.38	
394 to 395	249.92 249.92	4.26 120.0 0.0152		0.0 0.0 0.0	6.000 0.0 6.000	48.898 0.0 0.091			Vel = 5.63	
395 to 396	23.85 273.77	4.26 120.0 0.0179	E	13.167 0.0 0.0	51.140 13.167 64.307	48.989 0.0 1.150			Vel = 6.16	
396 to TR3	0.0 273.77	4.26 120.0 0.0179	2E	26.334 0.0 0.0	23.180 26.334 49.514	50.139 0.126 0.886			Vel = 6.16	
TR3 to BR3	0.0 273.77	4.26 120.0 0.0179	B S T Fsp	15.8 28.968 26.334 0.0	7.380 71.102 78.482	51.151 6.196 1.404		** Fixed Loss = 3 Vel = 6.16		
BR3 to UG	0.0 273.77	6.357 120.0 0.0025		0.0 0.0 0.0	2.000 0.0 2.000	58.751 1.299 0.005			Vel = 2.77	
UG to HOSE	0.0 273.77	6.16 140.0 0.0022	G E T	4.304 20.084 43.037	75.000 67.425 142.425	60.055 2.911 0.318		** Fixed Loss = 2.911 Vel = 2.95		

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School - Level 1 - System 3 - Mech Room Area 6 - 0.15 for 1500

Page 18
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
			Zfb	0.0						
HOSE	250.00	6.16		0.0	0.500	63.284			Qa = 250	
to		140.0		0.0	0.0	0.0				
TEST	523.77	0.0080		0.0	0.500	0.004			Vel = 5.64	
	0.0									
	523.77					63.288			K Factor = 65.84	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 4 – Area 1 Art Lab**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/16/2021**
LATEST REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Unobstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 4 – Area 1	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 15'-2" & 10'-0"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK300 & VK464
K-FACTOR: 5.6 & 8.0	TEMPERATURE (°F): 155

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Light Hazard & OH2
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.10 & .20	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 190 & 130	TOTAL SPRINKLERS OPERATING: 15
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 100
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 324.76	PRESSURE REQ'D (PSI): 61.852
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 424.76	PRESSURE REQ'D (PSI): 65.141
AREA SAFETY MARGIN (PSI): 10.178		

NOTES:
3-13-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500
Drawing :
Location :
Remote Area :
Contract :
Data File : L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10

Water Supply Curve C

BIC Design Company
L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500

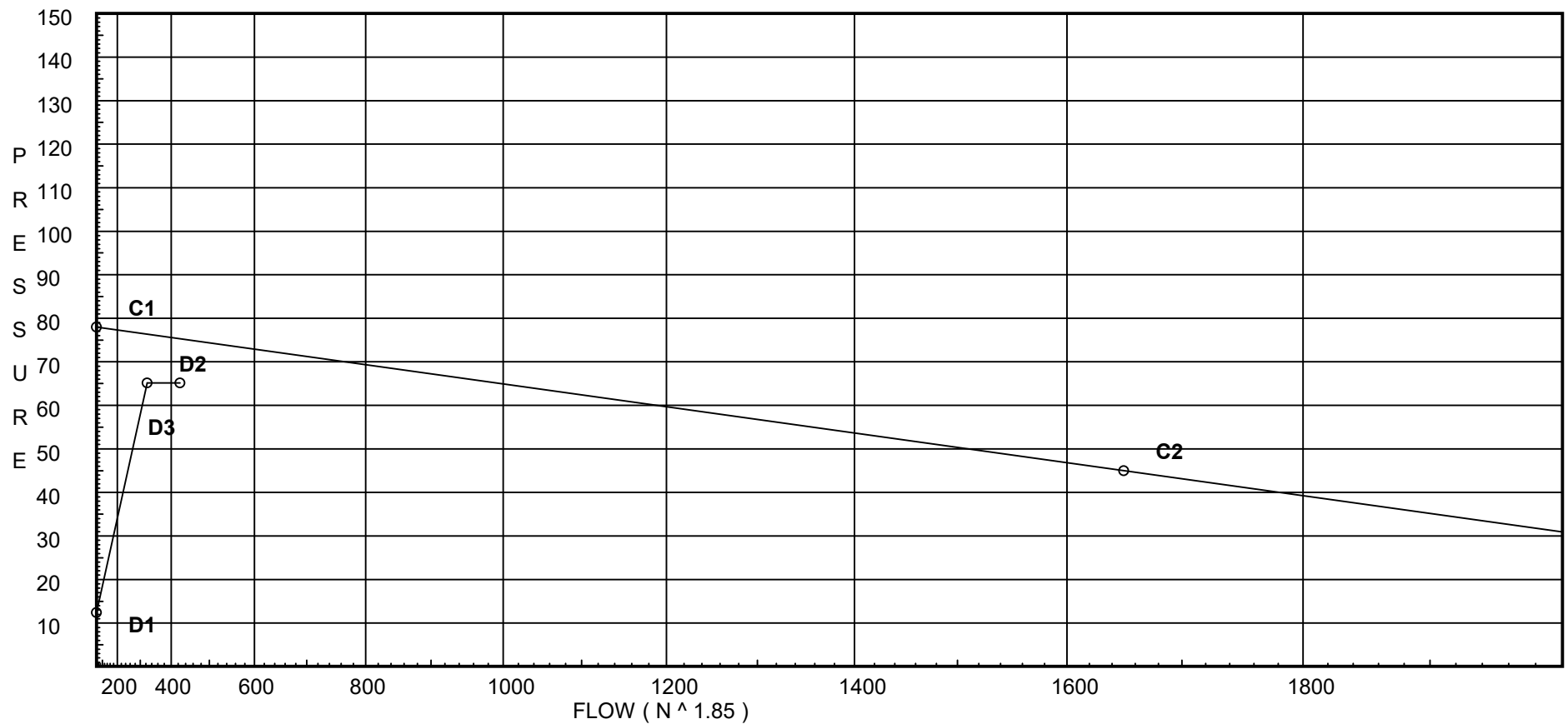
Page 1
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 12.395
D2 - System Flow : 324.757
D2 - System Pressure : 65.141
Hose (Demand) : 100
D3 - System Demand : 424.757
Safety Margin : 10.178



Fittings Used Summary

BIC Design Company
L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
SP03	29.12	5.6	11.51	na	19.0	0.1	190	7.0
EQ03	28.12		12.63	na				
D1	28.12	K = K @ EQ03	13.36	na	19.54			
D2	28.12	K = K @ EQ03	13.66	na	19.76			
D3	28.12	K = K @ EQ03	14.62	na	20.44			
D5	28.62	8	10.56	na	26.0	0.2	130	7.0
D6	28.12	K = K @ EQ03	16.22	na	21.53			
D7	28.12	K = K @ EQ03	16.45	na	21.68			
D8	28.12	K = K @ EQ03	13.26	na	19.47			
D9	28.12	K = K @ EQ03	13.55	na	19.68			
D10	28.12	K = K @ EQ03	14.09	na	20.07			
401	28.12		17.46	na				
5D	28.12		17.46	na				
D4	28.12	K = K @ EQ03	17.63	na	22.45			
403	28.12		17.78	na				
D13	28.12	K = K @ EQ03	17.66	na	22.46			
D12	28.12	K = K @ EQ03	17.66	na	22.47			
D11	28.12	K = K @ EQ03	17.78	na	22.54			
404	28.12		19.01	na				
D15	28.12	K = K @ EQ03	19.01	na	23.31			
D14	28.12	K = K @ EQ03	19.09	na	23.36			
402	28.12		17.54	na				
405	28.12		21.39	na				
406	25.38		26.37	na				
407	25.38		27.14	na				
421	28.12		22.5	na				
423	28.12		22.6	na				
424	28.12		22.99	na				
426	25.38		27.21	na				
427	25.38		28.81	na				
431	25.38		29.57	na				
432	25.38		29.57	na				
433	25.38		29.56	na				
434	25.38		29.51	na				
435	25.38		29.81	na				
441	25.38		29.74	na				
442	25.38		29.75	na				
443	25.38		29.76	na				
444	25.38		29.78	na				
445	25.38		29.81	na				
446	25.38		31.17	na				
447	25.38		32.44	na				
425	25.38		27.21	na				
408	25.38		28.47	na				
413	25.38		28.65	na				
428	25.38		29.15	na				
436	25.38		30.42	na				
448	25.38		32.94	na				
449	25.38		33.44	na				
450	25.38		37.45	na				
451	25.38		37.83	na				
452	11.042		44.71	na				
TR4	11.042		52.13	na				
BR4	3.0		60.54	na				
BR3	3.0		60.55	na				
UG	0.0		61.85	na				
HOSE	0.0		65.14	na	100.0			
TEST	0.0		65.14	na				

The maximum velocity is 11.74 and it occurs in the pipe between nodes D3 and 401

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500

Page 4
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
SP03 to EQ03	19.00 19.0	1.097 120.0 0.0952	T	6.217 0.0 0.0	1.000 6.217 7.217	11.512 0.433 0.687			K Factor = 5.60	
	0.0 19.00						12.632		K Factor = 5.35	
D1 to D2	19.54 19.54	1.442 120.0 0.0265		0.0 0.0 0.0	11.170 0.0 11.170	13.364 0.0 0.296			K Factor @ node EQ03	
									Vel = 3.84	
D2 to D3	19.76 19.76	1.442 120.0 0.0965		0.0 0.0 0.0	9.970 0.0 9.970	13.660 0.0 0.962			K Factor @ node EQ03	
									Vel = 7.72	
D3 to 401	20.44 59.74	1.442 120.0 0.2092	T	7.432 0.0 0.0	6.140 7.432 13.572	14.622 0.0 2.839			K Factor @ node EQ03	
	0.0 59.74						17.461		K Factor = 14.30	
D5 to 5D	26.00 26.0	1.097 120.0 0.1700	3E T Eq	7.461 6.217 21.139	4.470 34.817 39.287	10.562 0.217 6.680			K Factor = 8.00	
	0.0 26.00						17.459		K Factor = 6.22	
D6 to D7	21.53 21.53	1.442 120.0 0.0317		0.0 0.0 0.0	7.500 0.0 7.500	16.215 0.0 0.238			K Factor @ node EQ03	
									Vel = 4.23	
D7 to 402	21.68 43.21	1.442 120.0 0.1149	T	7.432 0.0 0.0	2.040 7.432 9.472	16.453 0.0 1.088			K Factor @ node EQ03	
	0.0 43.21						17.541		K Factor = 10.32	
D8 to D9	19.47 19.47	1.442 120.0 0.0263		0.0 0.0 0.0	11.170 0.0 11.170	13.258 0.0 0.294			K Factor @ node EQ03	
									Vel = 3.82	
D9 to D10	19.68 39.15	1.442 120.0 0.0956		0.0 0.0 0.0	5.660 0.0 5.660	13.552 0.0 0.541			K Factor @ node EQ03	
									Vel = 7.69	
D10 to 403	20.06 59.21	1.442 120.0 0.2058	T	7.432 0.0 0.0	10.460 7.432 17.892	14.093 0.0 3.683			K Factor @ node EQ03	
	0.0 59.21						17.776		K Factor = 14.04	
401 to 5D	-1.63 -1.63	1.682 120.0 -0.0001	T	9.9 0.0 0.0	5.490 9.900 15.390	17.461 0.0 -0.002				Vel = 0.24
5D to D4	26.00 24.37	1.682 120.0 0.0188		0.0 0.0 0.0	9.090 0.0 9.090	17.459 0.0 0.171				Vel = 3.52
D4 to 421	22.45 46.82	1.682 120.0 0.0630	2T	19.799 0.0 0.0	57.580 19.799 77.379	17.630 0.0 4.873			K Factor @ node EQ03	
									Vel = 6.76	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500

Page 5
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 46.82					22.503			K Factor = 9.87	
403 to D13	-17.35	1.682 120.0	T	9.9 0.0	2.040 9.900	17.776 0.0				
D13 to D12	-17.35	-0.0101		0.0	11.940	-0.120			Vel = 2.51	
D13 to D12	22.46	1.682 120.0		0.0 0.0	7.500 0.0	17.656 0.0			K Factor @ node EQ03	
D12 to D11	5.11	0.0011		0.0	7.500	0.008			Vel = 0.74	
D12 to D11	22.47	1.682 120.0		0.0 0.0	5.040 0.0	17.664 0.0			K Factor @ node EQ03	
D11 to 423	27.58	0.0236		0.0	5.040	0.119			Vel = 3.98	
D11 to 423	22.54	1.682 120.0	T	9.9 0.0	57.580 9.900	17.783 0.0			K Factor @ node EQ03	
	50.12	0.0714		0.0	67.480	4.821			Vel = 7.24	
	0.0 50.12					22.604			K Factor = 10.54	
404 to D15	-1.92	1.682 120.0	T	9.9 0.0	9.540 9.900	19.015 0.0				
D15 to D14	-1.92	-0.0002		0.0	19.440	-0.003			Vel = 0.28	
D15 to D14	23.31	1.682 120.0		0.0 0.0	5.040 0.0	19.012 0.0			K Factor @ node EQ03	
D14 to 424	21.39	0.0147		0.0	5.040	0.074			Vel = 3.09	
D14 to 424	23.35	1.682 120.0	T	9.9 0.0	57.580 9.900	19.086 0.0			K Factor @ node EQ03	
	44.74	0.0579		0.0	67.480	3.908			Vel = 6.46	
	0.0 44.74					22.994			K Factor = 9.33	
401 to 402	61.38	2.635 120.0		0.0 0.0	6.830 0.0	17.461 0.0				
402 to 403	61.38	0.0117		0.0	6.830	0.080			Vel = 3.61	
402 to 403	43.21	2.635 120.0		0.0 0.0	7.500 0.0	17.541 0.0				
403 to 404	104.59	0.0313		0.0	7.500	0.235			Vel = 6.15	
403 to 404	76.56	2.635 120.0		0.0 0.0	14.330 0.0	17.776 0.0				
404 to 405	181.15	0.0865		0.0	14.330	1.239			Vel = 10.66	
404 to 405	1.92	2.635 120.0	2E	16.474 0.0	10.430 16.474	19.015 0.0				
405 to 406	183.07	0.0882		0.0	26.904	2.372			Vel = 10.77	
405 to 406	0.0	2.635 120.0	3E	24.711 0.0	18.390 24.711	21.387 1.187				
406 to 407	183.07	0.0882		0.0	43.101	3.800			Vel = 10.77	
406 to 407	-99.57	2.635 120.0		0.0 0.0	37.210 0.0	26.374 0.0				
407 to 408	83.5	0.0206		0.0	37.210	0.767			Vel = 4.91	
407 to 408	0.0	2.635 120.0		0.0 0.0	64.330 0.0	27.141 0.0				
	83.5	0.0206		0.0	64.330	1.328			Vel = 4.91	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 83.50					28.469			K Factor = 15.65	
421 to 423	46.82	2.635 120.0		0.0 0.0	14.330 0.0	22.503 0.0			Vel = 2.75	
423 to 424	46.82	0.0070		0.0	14.330	0.101				
423 to 424	50.12	2.635 120.0		0.0 0.0	14.330 0.0	22.604 0.0			Vel = 5.70	
424 to 425	96.94	0.0272		0.0	14.330	0.390				
424 to 425	44.74	2.635 120.0	2E T	16.474 16.474	22.240 32.948	22.994 1.187			Vel = 8.34	
	141.68	0.0549		0.0	55.188	3.028				
	0.0 141.68					27.209			K Factor = 27.16	
426 to 427	77.93	2.635 120.0	T	16.474 0.0	71.870 16.474	27.206 0.0			Vel = 4.58	
427 to 428	77.93	0.0182		0.0	88.344	1.604				
427 to 428	0.0	3.26 120.0	T	20.159 0.0	32.360 20.159	28.810 0.0			Vel = 3.00	
	77.93	0.0065		0.0	52.519	0.339				
	0.0 77.93					29.149			K Factor = 14.43	
431 to 441	6.45	1.682 120.0	2T 2E	19.799 9.9	76.420 29.699	29.573 0.0			Vel = 0.93	
	6.45	0.0016		0.0	106.119	0.171				
	0.0 6.45					29.744			K Factor = 1.18	
432 to 442	6.17	1.682 120.0	2T 4E	19.799 19.799	79.570 39.598	29.570 0.0			Vel = 0.89	
	6.17	0.0015		0.0	119.168	0.177				
	0.0 6.17					29.747			K Factor = 1.13	
433 to 443	6.54	1.682 120.0	2T 4E	19.799 19.799	78.840 39.598	29.563 0.0			Vel = 0.94	
	6.54	0.0016		0.0	118.438	0.195				
	0.0 6.54					29.758			K Factor = 1.20	
431 to 432	-6.45	2.635 120.0		0.0 0.0	18.080 0.0	29.573 0.0			Vel = 0.38	
432 to 433	-6.45	-0.0002		0.0	18.080	-0.003				
432 to 433	-6.18	2.635 120.0		0.0 0.0	11.580 0.0	29.570 0.0			Vel = 0.74	
433 to 434	-12.63	-0.0006		0.0	11.580	-0.007				
433 to 434	-6.53	2.635 120.0	T	16.474 0.0	19.360 16.474	29.563 0.0			Vel = 1.13	
434 to 435	-19.16	-0.0014		0.0	35.834	-0.049				
434 to 435	90.17	3.26 120.0	T	20.159 0.0	33.610 20.159	29.514 0.0			Vel = 2.73	
	71.01	0.0054		0.0	53.769	0.292				

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500

Page 7
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
435 to 436	0.0 71.01	3.26 120.0 0.0054	2E T	18.815 20.159 0.0	75.130 38.974 114.104	29.806 0.0 0.619				Vel = 2.73
	0.0 71.01					30.425			K Factor = 12.87	
441 to 442	6.45 6.45	2.635 120.0 0.0002		0.0 0.0 0.0	14.000 0.0 14.000	29.744 0.0 0.003				Vel = 0.38
442 to 443	6.18 12.63	2.635 120.0 0.0006		0.0 0.0 0.0	18.080 0.0 18.080	29.747 0.0 0.011				Vel = 0.74
443 to 444	6.53 19.16	2.635 120.0 0.0014		0.0 0.0 0.0	12.940 0.0 12.940	29.758 0.0 0.018				Vel = 1.13
444 to 445	0.0 19.16	2.635 120.0 0.0013	E	8.237 0.0 0.0	20.090 8.237 28.327	29.776 0.0 0.038				Vel = 1.13
445 to 446	73.15 92.31	2.635 120.0 0.0248	T	16.474 0.0 0.0	38.120 16.474 54.594	29.814 0.0 1.356				Vel = 5.43
446 to 447	0.0 92.31	2.635 120.0 0.0248	2E	16.474 0.0 0.0	34.450 16.474 50.924	31.170 0.0 1.265				Vel = 5.43
447 to 448	0.0 92.31	3.26 120.0 0.0088	T	20.159 0.0 0.0	36.840 20.159 56.999	32.435 0.0 0.503				Vel = 3.55
	0.0 92.31					32.938			K Factor = 16.08	
406 to 426	99.57 99.57	3.26 120.0 0.0101	T	20.159 0.0 0.0	62.000 20.159 82.159	26.374 0.0 0.832				Vel = 3.83
426 to 425	-77.93 21.64	3.26 120.0 0.0007		0.0 0.0 0.0	4.580 0.0 4.580	27.206 0.0 0.003				Vel = 0.83
425 to 434	141.68 163.32	3.26 120.0 0.0253	4E	37.631 0.0 0.0	53.420 37.631 91.051	27.209 0.0 2.305				Vel = 6.28
434 to 445	-90.17 73.15	3.26 120.0 0.0057		0.0 0.0 0.0	52.330 0.0 52.330	29.514 0.0 0.300				Vel = 2.81
	0.0 73.15					29.814			K Factor = 13.40	
408 to 413	83.50 83.5	3.26 120.0 0.0073	E	9.408 0.0 0.0	14.750 9.408 24.158	28.469 0.0 0.177				Vel = 3.21
413 to 428	0.0 83.5	3.26 120.0 0.0073	2E	18.815 0.0 0.0	49.930 18.815 68.745	28.646 0.0 0.503				Vel = 3.21

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 1 Art Lab - 0.10 for 1500

Page 8
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
428 to 436	77.93 161.43	3.26 120.0 0.0248		0.0 0.0 0.0	51.490 0.0 51.490	29.149 0.0 1.276				
								Vel =	6.20	
436 to 448	71.01 232.44	3.26 120.0 0.0486		0.0 0.0 0.0	51.670 0.0 51.670	30.425 0.0 2.513				
								Vel =	8.93	
448 to 449	92.32 324.76	4.26 120.0 0.0245		0.0 0.0 0.0	20.670 0.0 20.670	32.938 0.0 0.507				
								Vel =	7.31	
449 to 450	0.0 324.76	4.26 120.0 0.0245	3E	39.501 0.0 0.0	123.730 39.501 163.231	33.445 0.0 4.005				
								Vel =	7.31	
450 to 451	0.0 324.76	4.26 120.0 0.0245	E	13.167 0.0 0.0	2.160 13.167 15.327	37.450 0.0 0.376				
								Vel =	7.31	
451 to 452	0.0 324.76	4.26 120.0 0.0245	E	13.167 0.0 0.0	14.333 13.167 27.500	37.826 6.210 0.674				
								Vel =	7.31	
452 to TR4	0.0 324.76	4.26 120.0 0.0245	10E	131.671 0.0 0.0	170.667 131.671 302.338	44.710 0.0 7.419				
								Vel =	7.31	
TR4 to BR4	0.0 324.76	4.26 120.0 0.0245	B S T Fsp	15.8 28.968 26.334 0.0	7.380 71.102 78.482	52.129 6.483 1.926		* * Fixed Loss = 3		
								Vel =	7.31	
BR4 to BR3	0.0 324.76	6.357 120.0 0.0032		0.0 0.0 0.0	2.500 0.0 2.500	60.538 0.0 0.008				
								Vel =	3.28	
BR3 to UG	0.0 324.76	6.357 120.0 0.0035		0.0 0.0 0.0	2.000 0.0 2.000	60.546 1.299 0.007				
								Vel =	3.28	
UG to HOSE	0.0 324.76	6.16 140.0 0.0031	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	61.852 2.850 0.437		* * Fixed Loss = 2.85		
								Vel =	3.50	
HOSE to TEST	100.00 424.76	6.16 140.0 0.0040		0.0 0.0 0.0	0.500 0.0 0.500	65.139 0.0 0.002		Qa = 100		
								Vel =	4.57	
	0.0 424.76					65.141		K Factor =	52.63	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 4 – Area 2 Studio**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/16/2021**
LATEST REVISION DATE: **03/13/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Unobstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 4 – Area 2	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 10'-0"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK636
K-FACTOR: 11.2	TEMPERATURE (°F): 155

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Light Hazard
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.10	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 330	TOTAL SPRINKLERS OPERATING: 8
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 0	OUTSIDE HOSE ALLOWANCE (GPM): 100
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 277.72	PRESSURE REQ'D (PSI): 59.556
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 377.72	PRESSURE REQ'D (PSI): 62.791
AREA SAFETY MARGIN (PSI): 13.052		

NOTES:
3-13-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500
Drawing :
Location :
Remote Area :
Contract :
Data File : L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10

Water Supply Curve C

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

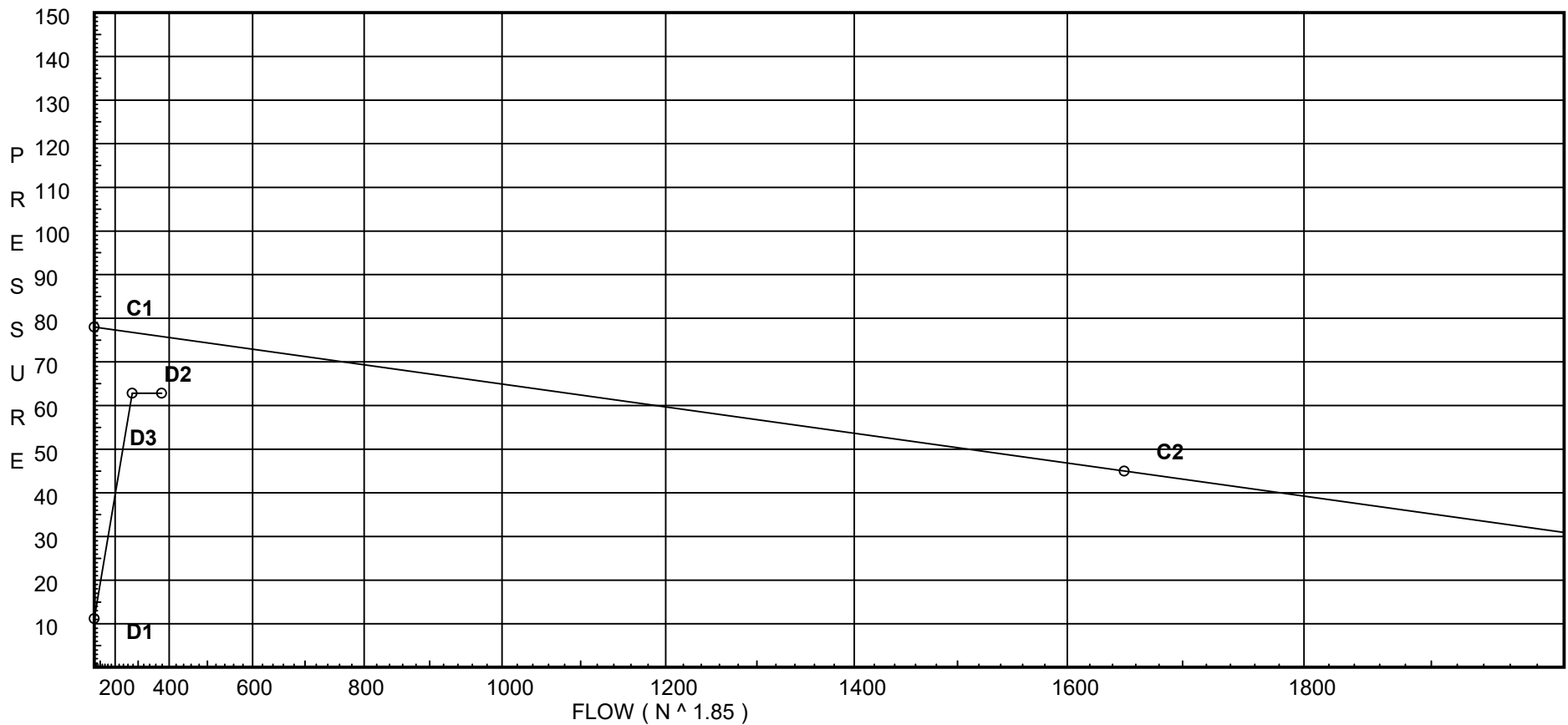
Page 1
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 11.209
D2 - System Flow : 277.718
D2 - System Pressure : 62.791
Hose (Demand) : 100
D3 - System Demand : 377.718
Safety Margin : 13.052



Fittings Used Summary

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
DP02	25.0	11.2	8.68	na	33.0	0.1	330	7.0
EQ02	25.88		9.19	na				
401	28.12		29.72	na				
5D	28.12		29.75	na				
D4	28.12		29.76	na				
403	28.12		29.72	na				
D13	28.12		29.74	na				
D12	28.12		29.76	na				
D11	28.12		29.77	na				
404	28.12		29.71	na				
D15	28.12		29.75	na				
D14	28.12		29.76	na				
402	28.12		29.72	na				
405	28.12		29.67	na				
406	25.38		30.79	na				
407	25.38		30.03	na				
421	28.12		29.89	na				
423	28.12		29.89	na				
424	28.12		29.9	na				
426	25.38		31.14	na				
427	25.38		30.99	na				
D21	25.88	11.2	8.68	na	33.0	0.1	330	7.0
D22	25.88	11.2	9.13	na	33.84	0.1	330	7.0
21D	25.38		17.05	na				
22D	25.38		17.89	na				
D23	25.88	11.2	9.59	na	34.69	0.1	330	7.0
D24	25.88	11.2	10.25	na	35.86	0.1	330	7.0
23D	25.38		18.75	na				
24D	25.38		19.98	na				
D25	25.88	11.2	9.06	na	33.71	0.1	330	7.0
D26	25.88	11.2	9.52	na	34.56	0.1	330	7.0
25D	25.38		17.75	na				
26D	25.38		18.62	na				
D27	25.88	11.2	10.01	na	35.43	0.1	330	7.0
D28	25.88	11.2	10.69	na	36.62	0.1	330	7.0
27D	25.38		19.52	na				
28D	25.38		20.79	na				
411	25.38		22.44	na				
412	25.38		23.35	na				
431	25.38		32.23	na				
432	25.38		32.23	na				
433	25.38		32.22	na				
434	25.38		32.19	na				
435	25.38		32.26	na				
441	25.38		32.34	na				
442	25.38		32.34	na				
443	25.38		32.35	na				
444	25.38		32.36	na				
445	25.38		32.38	na				
446	25.38		33.25	na				
447	25.38		34.07	na				
425	25.38		31.17	na				
408	25.38		28.72	na				
413	25.38		28.54	na				
428	25.38		30.95	na				
436	25.38		32.4	na				
448	25.38		34.39	na				
449	25.38		34.77	na				
450	25.38		37.77	na				
451	25.38		38.05	na				
452	11.042		44.77	na				
TR4	11.042		50.32	na				

Flow Summary - Standard

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 4
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
BR4	3.0		58.24	na				
BR3	3.0		58.25	na				
UG	0.0		59.56	na				
HOSE	0.0		62.79	na	100.0			
TEST	0.0		62.79	na				

The maximum velocity is 16.34 and it occurs in the pipe between nodes 412 and 413

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 5
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
DP02 to EQ02	33.00 33.0	1.097 120.0 0.2643	E	2.487 0.0 0.0	0.880 2.487 3.367	8.681 -0.381 0.890			K Factor = 11.20 Vel = 11.20	
	0.0 33.00						9.190		K Factor = 10.89	
401 to 5D	6.43 6.43	1.682 120.0 0.0016	T	9.9 0.0 0.0	5.490 9.900 15.390	29.724 0.0 0.025			Vel = 0.93	
5D to D4	0.0 6.43	1.682 120.0 0.0017		0.0 0.0 0.0	9.090 0.0 9.090	29.749 0.0 0.015			Vel = 0.93	
D4 to 421	0.0 6.43	1.682 120.0 0.0016	2T	19.799 0.0 0.0	57.580 19.799 77.379	29.764 0.0 0.124			Vel = 0.93	
	0.0 6.43						29.888		K Factor = 1.18	
403 to D13	6.91 6.91	1.682 120.0 0.0018	T	9.9 0.0 0.0	2.040 9.900 11.940	29.722 0.0 0.022			Vel = 1.00	
D13 to D12	0.0 6.91	1.682 120.0 0.0019		0.0 0.0 0.0	7.500 0.0 7.500	29.744 0.0 0.014			Vel = 1.00	
D12 to D11	0.0 6.91	1.682 120.0 0.0018		0.0 0.0 0.0	5.040 0.0 5.040	29.758 0.0 0.009			Vel = 1.00	
D11 to 423	0.0 6.91	1.682 120.0 0.0018	T	9.9 0.0 0.0	57.580 9.900 67.480	29.767 0.0 0.123			Vel = 1.00	
	0.0 6.91						29.890		K Factor = 1.26	
404 to D15	7.34 7.34	1.682 120.0 0.0021	T	9.9 0.0 0.0	9.540 9.900 19.440	29.712 0.0 0.040			Vel = 1.06	
D15 to D14	0.0 7.34	1.682 120.0 0.0020		0.0 0.0 0.0	5.040 0.0 5.040	29.752 0.0 0.010			Vel = 1.06	
D14 to 424	0.0 7.34	1.682 120.0 0.0020	T	9.9 0.0 0.0	57.580 9.900 67.480	29.762 0.0 0.138			Vel = 1.06	
	0.0 7.34						29.900		K Factor = 1.34	
401 to 402	-6.43 -6.43	2.635 120.0 -0.0001		0.0 0.0 0.0	6.830 0.0 6.830	29.724 0.0 -0.001			Vel = 0.38	
402 to 403	0.0 -6.43	2.635 120.0 -0.0001		0.0 0.0 0.0	7.500 0.0 7.500	29.723 0.0 -0.001			Vel = 0.38	
403 to 404	-6.92 -13.35	2.635 120.0 -0.0007		0.0 0.0 0.0	14.330 0.0 14.330	29.722 0.0 -0.010			Vel = 0.79	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
404 to 405	-7.34 -20.69	2.635 120.0 -0.0016	2E	16.474 0.0 0.0	10.430 16.474 26.904	29.712 0.0 -0.042			Vel = 1.22	
405 to 406	0.0 -20.69	2.635 120.0 -0.0016	3E	24.711 0.0 0.0	18.390 24.711 43.101	29.670 1.187 -0.068			Vel = 1.22	
406 to 407	-62.30 -82.99	2.635 120.0 -0.0204		0.0 0.0 0.0	37.210 0.0 37.210	30.789 0.0 -0.759			Vel = 4.88	
407 to 408	0.0 -82.99	2.635 120.0 -0.0204		0.0 0.0 0.0	64.330 0.0 64.330	30.030 0.0 -1.312			Vel = 4.88	
	0.0 -82.99					28.718			K Factor = -15.49	
421 to 423	6.43 6.43	2.635 120.0 0.0001		0.0 0.0 0.0	14.330 0.0 14.330	29.888 0.0 0.002			Vel = 0.38	
423 to 424	6.92 13.35	2.635 120.0 0.0007		0.0 0.0 0.0	14.330 0.0 14.330	29.890 0.0 0.010			Vel = 0.79	
424 to 425	7.34 20.69	2.635 120.0 0.0016	2E T	16.474 16.474 0.0	22.240 32.948 55.188	29.900 1.187 0.086			Vel = 1.22	
	0.0 20.69					31.173			K Factor = 3.71	
426 to 427	-21.93 -21.93	2.635 120.0 -0.0017	T	16.474 0.0 0.0	71.870 16.474 88.344	31.139 0.0 -0.154			Vel = 1.29	
427 to 428	0.0 -21.93	3.26 120.0 -0.0006	T	20.159 0.0 0.0	32.360 20.159 52.519	30.985 0.0 -0.032			Vel = 0.84	
	0.0 -21.93					30.953			K Factor = -3.94	
D21 to 21D	33.00 33.0	1.097 120.0 0.2643	E T Eq	2.487 6.217 21.139	1.000 29.843 30.843	8.681 0.217 8.152			K Factor = 11.20 Vel = 11.20	
	0.0 33.00					17.050			K Factor = 7.99	
D22 to 22D	33.84 33.84	1.097 120.0 0.2769	E T Eq	2.487 6.217 21.139	1.000 29.843 30.843	9.130 0.217 8.540			K Factor = 11.20 Vel = 11.49	
	0.0 33.84					17.887			K Factor = 8.00	
21D to 22D	33.00 33.0	1.442 120.0 0.0697		0.0 0.0 0.0	12.000 0.0 12.000	17.050 0.0 0.837			Vel = 6.48	
22D to 411	33.84 66.84	1.442 120.0 0.2575	T	7.432 0.0 0.0	10.240 7.432 17.672	17.887 0.0 4.551			Vel = 13.13	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 7
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 66.84					22.438			K Factor = 14.11	
D23 to 23D	34.69	1.097 120.0	E T Eq	2.487 6.217 21.139	1.000 29.843 30.843	9.594 0.217 8.940			K Factor = 11.20	
	34.69	0.2899							Vel = 11.78	
	0.0 34.69					18.751			K Factor = 8.01	
D24 to 24D	35.86	1.097 120.0	E T Eq	2.487 6.217 21.139	1.000 29.843 30.843	10.252 0.217 9.507			K Factor = 11.20	
	35.86	0.3082							Vel = 12.17	
	0.0 35.86					19.976			K Factor = 8.02	
23D to 24D	34.69	1.442 120.0		0.0 0.0 0.0	16.000 0.0 16.000	18.751 0.0 1.225				
	34.69	0.0766							Vel = 6.81	
24D to 411	35.86	1.442 120.0	T	7.432 0.0 0.0	1.220 7.432 8.652	19.976 0.0 2.462				
	70.55	0.2846							Vel = 13.86	
	0.0 70.55					22.438			K Factor = 14.89	
D25 to 25D	33.71	1.097 120.0	E T Eq	2.487 6.217 21.139	1.000 29.843 30.843	9.057 0.217 8.477			K Factor = 11.20	
	33.71	0.2748							Vel = 11.44	
	0.0 33.71					17.751			K Factor = 8.00	
D26 to 26D	34.56	1.097 120.0	E T Eq	2.487 6.217 21.139	1.000 29.843 30.843	9.524 0.217 8.881			K Factor = 11.20	
	34.56	0.2879							Vel = 11.73	
	0.0 34.56					18.622			K Factor = 8.01	
25D to 26D	33.71	1.442 120.0		0.0 0.0 0.0	12.000 0.0 12.000	17.751 0.0 0.871				
	33.71	0.0726							Vel = 6.62	
26D to 412	34.56	1.442 120.0	T	7.432 0.0 0.0	10.240 7.432 17.672	18.622 0.0 4.732				
	68.27	0.2678							Vel = 13.41	
	0.0 68.27					23.354			K Factor = 14.13	
D27 to 27D	35.43	1.097 120.0	E T Eq	2.487 6.217 21.139	1.000 29.843 30.843	10.007 0.217 9.297			K Factor = 11.20	
	35.43	0.3014							Vel = 12.03	
	0.0 35.43					19.521			K Factor = 8.02	
D28 to 28D	36.62	1.097 120.0	E T Eq	2.487 6.217 21.139	1.000 29.843 30.843	10.693 0.217 9.884			K Factor = 11.20	
	36.62	0.3205							Vel = 12.43	
	0.0									

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 8
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	36.62					20.794			K Factor = 8.03	
27D to 28D	35.43	1.442 120.0		0.0	16.000	19.521 0.0				
28D to 412	35.43	0.0796		0.0	16.000	1.273			Vel = 6.96	
28D to 412	36.62	1.442 120.0	T	7.432	1.220 7.432	20.794 0.0				
	72.05	0.2959		0.0	8.652	2.560			Vel = 14.15	
	0.0 72.05					23.354			K Factor = 14.91	
411 to 412	137.39	2.635 120.0		0.0	17.670	22.438 0.0				
412 to 413	137.39	0.0518		0.0	17.670	0.916			Vel = 8.08	
412 to 413	140.33	2.635 120.0	T	16.474	10.750 16.474	23.354 0.0				
	277.72	0.1906		0.0	27.224	5.189			Vel = 16.34	
	0.0 277.72					28.543			K Factor = 51.98	
431 to 441	5.08	1.682 120.0	2T 2E	19.799 9.9	76.420 29.699	32.228 0.0				
	5.08	0.0010		0.0	106.119	0.110			Vel = 0.73	
	0.0 5.08					32.338			K Factor = 0.89	
432 to 442	4.86	1.682 120.0	2T 4E	19.799 19.799	79.570 39.598	32.225 0.0				
	4.86	0.0010		0.0	119.168	0.114			Vel = 0.70	
	0.0 4.86					32.339			K Factor = 0.85	
433 to 443	5.15	1.682 120.0	2T 4E	19.799 19.799	78.840 39.598	32.221 0.0				
	5.15	0.0011		0.0	118.438	0.125			Vel = 0.74	
	0.0 5.15					32.346			K Factor = 0.91	
431 to 432	-5.08	2.635 120.0		0.0	18.080	32.228 0.0				
432 to 433	-5.08	-0.0002		0.0	18.080	-0.003			Vel = 0.30	
432 to 433	-4.87	2.635 120.0		0.0	11.580	32.225 0.0				
433 to 434	-9.95	-0.0003		0.0	11.580	-0.004			Vel = 0.59	
433 to 434	-5.15	2.635 120.0	T	16.474	19.360 16.474	32.221 0.0				
	-15.1	-0.0009		0.0	35.834	-0.031			Vel = 0.89	
434 to 435	47.28	3.26 120.0	T	20.159	33.610 20.159	32.190 0.0				
	32.18	0.0012		0.0	53.769	0.067			Vel = 1.24	
435 to 436	0.0	3.26 120.0	2E T	18.815 20.159	75.130 38.974	32.257 0.0				
	32.18	0.0013		0.0	114.104	0.143			Vel = 1.24	

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 9
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 32.18					32.400			K Factor = 5.65	
441 to 442	5.08	2.635 120.0		0.0	14.000 0.0	32.338 0.0			Vel = 0.30	
442 to 443	5.08	0.0001		0.0	14.000	0.001				
442 to 443	4.87	2.635 120.0		0.0	18.080 0.0	32.339 0.0			Vel = 0.59	
443 to 444	9.95	0.0004		0.0	18.080	0.007				
443 to 444	5.15	2.635 120.0		0.0	12.940 0.0	32.346 0.0			Vel = 0.89	
444 to 445	15.1	0.0009		0.0	12.940	0.012				
444 to 445	0.0	2.635 120.0	E	8.237 0.0	20.090 8.237	32.358 0.0			Vel = 0.89	
445 to 446	15.1	0.0008		0.0	28.327	0.024				
445 to 446	57.63	2.635 120.0	T	16.474 0.0	38.120 16.474	32.382 0.0			Vel = 4.28	
446 to 447	72.73	0.0160		0.0	54.594	0.873				
446 to 447	0.0	2.635 120.0	2E	16.474 0.0	34.450 16.474	33.255 0.0			Vel = 4.28	
447 to 448	72.73	0.0160		0.0	50.924	0.814				
447 to 448	0.0	3.26 120.0	T	20.159 0.0	36.840 20.159	34.069 0.0			Vel = 2.80	
448	72.73	0.0057		0.0	56.999	0.323				
	0.0 72.73					34.392			K Factor = 12.40	
406 to 426	62.29	3.26 120.0	T	20.159 0.0	62.000 20.159	30.789 0.0			Vel = 2.39	
426 to 425	62.29	0.0043		0.0	82.159	0.350				
426 to 425	21.93	3.26 120.0		0.0	4.580 0.0	31.139 0.0			Vel = 3.24	
425 to 434	84.22	0.0074		0.0	4.580	0.034				
425 to 434	20.69	3.26 120.0	4E	37.631 0.0	53.420 37.631	31.173 0.0			Vel = 4.03	
434 to 445	104.91	0.0112		0.0	91.051	1.017				
434 to 445	-47.28	3.26 120.0		0.0	52.330 0.0	32.190 0.0			Vel = 2.22	
445	57.63	0.0037		0.0	52.330	0.192				
	0.0 57.63					32.382			K Factor = 10.13	
408 to 413	-82.99	3.26 120.0	E	9.408 0.0	14.750 9.408	28.718 0.0			Vel = 3.19	
413 to 428	-82.99	-0.0072		0.0	24.158	-0.175				
413 to 428	277.72	3.26 120.0	2E	18.815 0.0	49.930 18.815	28.543 0.0			Vel = 7.48	
428 to 436	194.73	0.0351		0.0	68.745	2.410				
428 to 436	-21.92	3.26 120.0		0.0	51.490 0.0	30.953 0.0			Vel = 6.64	
436	172.81	0.0281		0.0	51.490	1.447				

Final Calculations - Hazen-Williams

BIC Design Company
L S Middle School Level 2 - System 4 - Area 2 Studio - 0.10 for 1500

Page 10
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
436 to 448	32.18 204.99	3.26 120.0 0.0386		0.0 0.0 0.0	51.670 0.0 51.670	32.400 0.0 1.992				
								Vel =	7.88	
448 to 449	72.73 277.72	4.26 120.0 0.0184		0.0 0.0 0.0	20.670 0.0 20.670	34.392 0.0 0.380				
								Vel =	6.25	
449 to 450	0.0 277.72	4.26 120.0 0.0184	3E	39.501 0.0 0.0	123.730 39.501 163.231	34.772 0.0 2.998				
								Vel =	6.25	
450 to 451	0.0 277.72	4.26 120.0 0.0184	E	13.167 0.0 0.0	2.160 13.167 15.327	37.770 0.0 0.282				
								Vel =	6.25	
451 to 452	0.0 277.72	4.26 120.0 0.0183	E	13.167 0.0 0.0	14.333 13.167 27.500	38.052 6.210 0.504				
								Vel =	6.25	
452 to TR4	0.0 277.72	4.26 120.0 0.0184	10E	131.671 0.0 0.0	170.667 131.671 302.338	44.766 0.0 5.554				
								Vel =	6.25	
TR4 to BR4	0.0 277.72	4.26 120.0 0.0184	B S T Fsp	15.8 28.968 26.334 0.0	7.380 71.102 78.482	50.320 6.483 1.442		* * Fixed Loss = 3		
								Vel =	6.25	
BR4 to BR3	0.0 277.72	6.357 120.0 0.0024		0.0 0.0 0.0	2.500 0.0 2.500	58.245 0.0 0.006				
								Vel =	2.81	
BR3 to UG	0.0 277.72	6.357 120.0 0.0030		0.0 0.0 0.0	2.000 0.0 2.000	58.251 1.299 0.006				
								Vel =	2.81	
UG to HOSE	0.0 277.72	6.16 140.0 0.0023	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	59.556 2.906 0.327		* * Fixed Loss = 2.906		
								Vel =	2.99	
HOSE to TEST	100.00 377.72	6.16 140.0 0.0040		0.0 0.0 0.0	0.500 0.0 0.500	62.789 0.0 0.002		Qa = 100		
								Vel =	4.07	
	0.0 377.72					62.791		K Factor =	47.67	

HYDRAULIC DESIGN COVER SHEET

AREA: **System 5 – Area 1 Studio**
CALCULATED BY: **M. Kumar Sheth**

ORIGINAL DATE: **02/16/2021**
LATEST REVISION DATE: **03/14/2021**

JOB INFORMATION	
JOB NAME: Lee's Summit Middle School #4	
ADDRESS: 1001 SE Bailey Rd	CITY, STATE: Lee's Summit, MO
BUILDING INFO: New Building	CONSTRUCTION: Non-Combustible, Obstructed
CONTRACTOR: Aegis Fire Protection, LLC	CONTRACT #: 14524

WATER SUPPLY INFORMATION	
FLOW TEST? Yes	PUMP? No
DATE: 03/19/2020	RATED CAPACITY (GPM):
STATIC PRESSURE (PSI): 78	RATED PRESSURE (PSI):
RESIDUAL PRESSURE (PSI): 45	ELEVATION:
FLOW (GPM): 1650	PUMP MOTOR TYPE:
ELEVATION: Same as Fin Flr	TANK? No
LOCATION: SE Bailey Rd, Lee's Summit, MO	CAPACITY (GALLONS):
SOURCE: Aegis	ELEVATION:

OPERATING AREA INFORMATION		
AREA #: System 5 – Area 1	SYSTEM TYPE: Wet	SHEET NUMBER:
CEILING HEIGHT: 15'-2" & 10'-0"	STORAGE HEIGHT:	QR SPRINKLER DISCOUNT: No

SPRINKLER INFORMATION	
BRAND: Viking	MODEL: SIN: VK300, VK4621, & VK636
K-FACTOR: 5.6, 5.6, & 11.2	TEMPERATURE (°F): 155

SYSTEM DESIGN INFORMATION	
DESIGN PER: NFPA 13, 2016	HAZARD CLASSIFICATION: Light Hazard
DESIGN CRITERIA:	
DENSITY (GPM/SQ FT): 0.10	OPERATING AREA (SQ FT): 1500
AREA PER SPRINKLER (SQ FT): 180, 180, & 330	TOTAL SPRINKLERS OPERATING: 14
MIN. FLOW PER HEAD (GPM):	MIN. PRESSURE PER HEAD (PSI):
INSIDE HOSE ALLOWANCE (GPM): 50	OUTSIDE HOSE ALLOWANCE (GPM): 50
OVERHEAD PIPING C-FACTOR: 120	UNDERGROUND PIPING C-FACTOR: 140

CALCULATION SUMMARY		
DEMAND @: Underground Entrance	FLOW REQ'D (GPM): 354.49	PRESSURE REQ'D (PSI): 60.499
DEMAND @: Conn to City Main	FLOW REQ'D (GPM): 404.49	PRESSURE REQ'D (PSI): 63.830
AREA SAFETY MARGIN (PSI): 11.722		

NOTES:
3-14-21 Per Engineer's Comments

PE STAMP



BIC Design Company
130 W. 9th Ave.
Suite #102
N. Kansas City, Mo. 64116
816-221-0551

Job Name : Lee's Summit Middle School - Floor 2 - System 5 - Area 1
Drawing :
Location :
Remote Area :
Contract :
Data File : L S Middle School Level 2 - System 5 - Area 1 Studio - 0.10

Water Supply Curve C

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

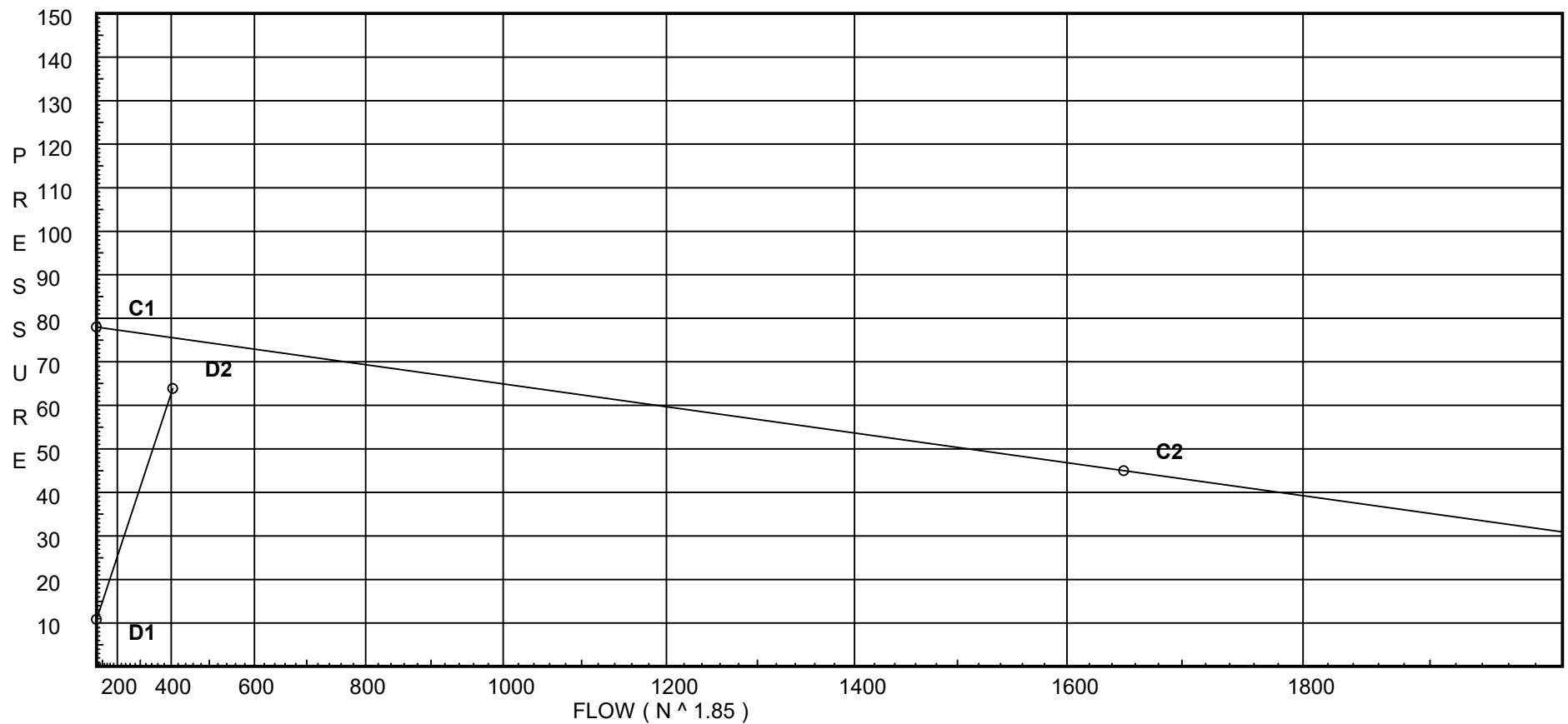
Page 1
Date

City Water Supply:

C1 - Static Pressure : 78
C2 - Residual Pressure: 45
C2 - Residual Flow : 1650

Demand:

D1 - Elevation : 10.827
D2 - System Flow : 404.489
D2 - System Pressure : 63.830
Hose (Demand) :
D3 - System Demand : 404.489
Safety Margin : 11.722



Fittings Used Summary

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zfb	Febco 850	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Page 3
Date

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
SP04	28.29	5.6	10.33	na	18.0	0.1	180	7.0
EQ04	27.29		11.39	na				
SP03	28.58	5.6	10.33	na	18.0	0.1	180	7.0
EQ03	27.58		11.39	na				
E1	25.0	5.6	15.85	na	22.3	0.1	180	7.0
501	25.38		25.9	na				
1E	25.38		19.32	na				
E2	27.29	K = K @ EQ04	16.87	na	21.91			
E3	27.29	K = K @ EQ04	16.81	na	21.87			
E4	27.29	K = K @ EQ04	16.92	na	21.94			
5E	25.38		19.84	na				
E5	25.0	11.2	10.82	na	36.84	0.1	330	7.0
E6	25.0	5.6	10.41	na	18.07	0.1	180	7.0
502	25.38		25.95	na				
505	25.38		14.47	na				
6E	25.38	K = K @ EQ03	12.7	na	19.01			
E7	27.58		11.55	na				
E8	27.58	K = K @ EQ03	11.47	na	18.07			
E9	27.58	K = K @ EQ03	11.52	na	18.11			
506	25.38		13.64	na				
14E	25.38		16.9	na				
E14	25.0	11.2	9.17	na	33.92	0.1	330	7.0
E10	25.0	5.6	10.69	na	18.31	0.1	180	7.0
E11	25.0	5.6	10.33	na	18.0	0.1	180	7.0
E12	25.0	5.6	10.33	na	18.0	0.1	180	7.0
E13	25.0	5.6	10.5	na	18.15	0.1	180	7.0
10E	25.38		13.04	na				
11E	25.38		12.61	na				
12E	25.38		12.61	na				
13E	25.38		12.82	na				
503	25.38		26.16	na				
525	25.38		27.72	na				
526	25.38		28.16	na				
527	25.38		29.03	na				
511	25.38		24.22	na				
512	25.38		24.32	na				
513	25.38		24.61	na				
514	25.38		24.95	na	50.0			
515	25.38		25.87	na				
521	25.38		27.11	na				
528	25.38		31.39	na				
504	25.38		27.01	na				
531	25.38		27.11	na				
532	25.38		27.11	na				
533	25.38		27.11	na				
534	25.38		27.14	na				
535	25.38		27.59	na				
536	25.38		28.2	na				
537	25.38		28.63	na				
538	25.38		29.11	na				
539	25.38		29.77	na				
540	25.38		31.36	na				
541	25.38		33.21	na				
542	25.38		33.49	na				
543	25.38		33.97	na				
544	25.38		34.37	na				
545	9.38		42.15	na				
TR5	11.042		50.25	na				
BR5	3.0		59.02	na				
BR4	3.0		59.03	na				
BR3	3.0		59.19	na				
UG	0.0		60.5	na				

Flow Summary - Standard

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
HOSE	0.0		63.83	na	50.0			
TEST	0.0		63.83	na				

The maximum velocity is 18.72 and it occurs in the pipe between nodes 14E and 512

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Page 5
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
SP04 to EQ04	18.00 18.0 0.0 18.00	1.097 120.0 0.0860	T	6.217 0.0 0.0	1.000 6.217 7.217	10.332 0.433 0.621			K Factor = 5.60 Vel = 6.11	
						11.386			K Factor = 5.33	
SP03 to EQ03	18.00 18.0 0.0 18.00	1.097 120.0 0.0860	T	6.217 0.0 0.0	1.000 6.217 7.217	10.332 0.433 0.621			K Factor = 5.60 Vel = 6.11	
						11.386			K Factor = 5.33	
E1 to 1E	22.30 22.3 0.0 22.30	1.097 120.0 0.1280	T Eq1	6.217 21.139 0.0	1.000 27.356 28.356	15.853 -0.165 3.629			K Factor = 5.60 Vel = 7.57	
						19.317			K Factor = 5.07	
501 to 1E	-53.20 -53.2 0.0 22.30	1.442 120.0 -0.1688	T 2E	7.432 7.432 0.0	24.130 14.864 38.994	25.900 0.0 -6.583			Vel = 10.45	
1E to E2	22.30 22.3 0.0 22.30	1.442 120.0 -0.0618	3E	11.148 0.0 0.0	15.120 11.148 26.268	19.317 -0.827 -1.624			Vel = 6.07	
E2 to E3	21.90 21.9 0.0 21.90	1.442 120.0 -0.0063		0.0 0.0 0.0	9.330 0.0 9.330	16.866 0.0 -0.059			K Factor @ node EQ04 Vel = 1.77	
E3 to E4	21.87 21.8 0.0 21.87	1.442 120.0 0.0122		0.0 0.0 0.0	9.330 0.0 9.330	16.807 0.0 0.114			K Factor @ node EQ04 Vel = 2.53	
E4 to 5E	21.95 21.9 0.0 21.95	1.442 120.0 0.0771	3E	11.148 0.0 0.0	16.010 11.148 27.158	16.921 0.827 2.093			K Factor @ node EQ04 Vel = 6.84	
5E to 511	36.84 36.8 0.0 36.84	1.442 120.0 0.2929	T	7.432 0.0 0.0	7.530 7.432 14.962	19.841 0.0 4.383			Vel = 14.08	
						24.224			K Factor = 14.56	
E5 to 5E	36.84 36.8 0.0 36.84	1.097 120.0 0.3240	T Eq1	6.217 21.139 0.0	1.000 27.356 28.356	10.819 -0.165 9.187			K Factor = 11.20 Vel = 12.51	
						19.841			K Factor = 8.27	
E6 to 6E	18.07 18.0 0.0 18.07	1.097 120.0 0.0867	T Eq1	6.217 21.139 0.0	1.000 27.356 28.356	10.409 -0.165 2.459			K Factor = 5.60 Vel = 6.13	
						12.703			K Factor = 5.07	
502 to 505	-84.35 -84.3 0.0 -84.35	1.442 120.0 -0.3960	2T	14.864 0.0 0.0	14.120 14.864 28.984	25.950 0.0 -11.478			Vel = 16.57	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Page 6
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv. Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
505 to 6E	37.22 -47.13	1.442 120.0 -0.1350	E	3.716 0.0 0.0	9.390 3.716 13.106	14.472 0.0 -1.769		Vel = 9.26	
6E to E7	37.08 -10.05	1.442 120.0 -0.0077	3E	11.148 0.0 0.0	15.380 11.148 26.528	12.703 -0.953 -0.205		K Factor @ node EQ03	
E7 to E8	0.0 -10.05	1.442 120.0 -0.0077		0.0 0.0 0.0	9.330 0.0 9.330	11.545 0.0 -0.072		Vel = 1.97	
E8 to E9	18.07 8.02	1.442 120.0 0.0050		0.0 0.0 0.0	9.330 0.0 9.330	11.473 0.0 0.047		K Factor @ node EQ03	
E9 to 506	18.10 26.12	1.442 120.0 0.0453	3E	11.148 0.0 0.0	14.570 11.148 25.718	11.520 0.953 1.165		K Factor @ node EQ03	
506 to 14E	35.24 61.36	1.442 120.0 0.2198	T	7.432 0.0 0.0	7.390 7.432 14.822	13.638 0.0 3.258		Vel = 12.05	
14E to 512	33.92 95.28	1.442 120.0 0.4963	T	7.432 0.0 0.0	7.530 7.432 14.962	16.896 0.0 7.425		Vel = 18.72	
	0.0 95.28					24.321		K Factor = 19.32	
E14 to 14E	33.92 33.92	1.097 120.0 0.2781	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	9.174 -0.165 7.887		K Factor = 11.20	
	0.0 33.92					16.896		K Factor = 8.25	
E10 to 10E	18.31 18.31	1.097 120.0 0.0889	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	10.688 -0.165 2.521		K Factor = 5.60	
	0.0 18.31					13.044		K Factor = 5.07	
E11 to 11E	18.00 18.0	1.097 120.0 0.0862	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	10.332 -0.165 2.443		K Factor = 5.60	
	0.0 18.00					12.610		K Factor = 5.07	
E12 to 12E	18.00 18.0	1.097 120.0 0.0861	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	10.332 -0.165 2.442		K Factor = 5.60	
	0.0 18.00					12.609		K Factor = 5.07	
E13 to 13E	18.15 18.15	1.097 120.0 0.0875	T Eq	6.217 21.139 0.0	1.000 27.356 28.356	10.501 -0.165 2.480		K Factor = 5.60	
	0.0							Vel = 6.16	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Page 7
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	18.15					12.816		K Factor =	5.07	
505 to 10E	-37.22	1.442 120.0 -0.0871	E	3.716 0.0 0.0	12.670 3.716 16.386	14.472 0.0 -1.428		Vel =	7.31	
10E to 11E	18.31	1.442 120.0 -0.0249	2E	7.432 0.0 0.0	9.970 7.432 17.402	13.044 0.0 -0.434		Vel =	3.71	
11E to 12E	18.00	1.442 120.0 -0.0001		0.0 0.0 0.0	10.880 0.0 10.880	12.610 0.0 -0.001		Vel =	0.18	
12E to 13E	18.00	1.442 120.0 0.0207		0.0 0.0 0.0	10.000 0.0 10.000	12.609 0.0 0.207		Vel =	3.36	
13E to 506	18.15	1.442 120.0 0.0788	E	3.716 0.0 0.0	6.720 3.716 10.436	12.816 0.0 0.822		Vel =	6.92	
	0.0 35.24					13.638		K Factor =	9.54	
503 to 513	-12.46	1.442 120.0 -0.0115	3T 9E	22.296 33.444 0.0	78.830 55.740 134.570	26.156 0.0 -1.548		Vel =	2.45	
	0.0 -12.46					24.608		K Factor =	-2.51	
525 to 535	-4.75	1.442 120.0 -0.0019	2T	14.864 0.0 0.0	52.450 14.864 67.314	27.722 0.0 -0.130		Vel =	0.93	
	0.0 -4.75					27.592		K Factor =	-0.90	
526 to 536	2.57	1.442 120.0 0.0006	2T	14.864 0.0 0.0	52.450 14.864 67.314	28.160 0.0 0.042		Vel =	0.50	
	0.0 2.57					28.202		K Factor =	0.48	
527 to 537	-6.97	1.442 120.0 -0.0039	3T 3E	22.296 11.148 0.0	68.890 33.444 102.334	29.028 0.0 -0.402		Vel =	1.37	
	0.0 -6.97					28.626		K Factor =	-1.30	
501 to 502	53.20	3.26 120.0 0.0031		0.0 0.0 0.0	16.000 0.0 16.000	25.900 0.0 0.050		Vel =	2.04	
502 to 503	84.35	3.26 120.0 0.0184		0.0 0.0 0.0	11.170 0.0 11.170	25.950 0.0 0.206		Vel =	5.29	
503 to 504	12.45	3.26 120.0 0.0216	T	20.159 0.0 0.0	19.530 20.159 39.689	26.156 0.0 0.859		Vel =	5.77	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Page 8
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 150.00					27.015			K Factor = 28.86	
511 to 512	71.66	3.26 120.0		0.0	17.670 0.0	24.224 0.0				
512 to 513	71.66	0.0055		0.0	17.670	0.097			Vel = 2.75	
512 to 513	95.28	3.26 120.0		0.0	10.880 0.0	24.321 0.0				
513 to 514	166.94	0.0264		0.0	10.880	0.287			Vel = 6.42	
513 to 514	-12.45	3.26 120.0		0.0	14.833 0.0	24.608 0.0				
514 to 515	154.49	0.0229		0.0	14.833	0.339			Vel = 5.94	
514 to 515	50.00	3.26 120.0	E	9.408 0.0	14.550 9.408	24.947 0.0			Qa = 50.00	
515 to 533	204.49	0.0384		0.0	23.958	0.919			Vel = 7.86	
515 to 533	0.0	3.26 120.0	E T	9.408 20.159	2.820 29.567	25.866 0.0				
	0.0 204.49			0.0	32.387	1.243			Vel = 7.86	
	0.0 204.49					27.109			K Factor = 39.27	
521 to 525	156.68	3.26 120.0	T	20.159 0.0	5.800 20.159	27.114 0.0				
525 to 526	156.68	0.0234		0.0	25.959	0.608			Vel = 6.02	
525 to 526	4.75	3.26 120.0		0.0	17.670 0.0	27.722 0.0				
526 to 527	161.43	0.0248		0.0	17.670	0.438			Vel = 6.20	
526 to 527	-2.57	3.26 120.0	2E	18.815 0.0	17.270 18.815	28.160 0.0				
527 to 528	158.86	0.0241		0.0	36.085	0.868			Vel = 6.11	
527 to 528	6.98	3.26 120.0	T	20.159 0.0	70.680 20.159	29.028 0.0				
528 to 541	165.84	0.0260		0.0	90.839	2.366			Vel = 6.37	
528 to 541	0.0	3.26 120.0		0.0	69.870 0.0	31.394 0.0				
	165.84	0.0260		0.0	69.870	1.820			Vel = 6.37	
	0.0 165.84					33.214			K Factor = 28.78	
504 to 521	150.00	3.26 120.0		0.0	4.580 0.0	27.015 0.0				
521 to 531	150.0	0.0216		0.0	4.580	0.099			Vel = 5.77	
521 to 531	-156.68	3.26 120.0		0.0	46.950 0.0	27.114 0.0				
531 to 532	-6.68	-0.0001		0.0	46.950	-0.003			Vel = 0.26	
531 to 532	0.0	3.26 120.0	E	9.408 0.0	2.820 9.408	27.111 0.0				
532 to 533	-6.68	-0.0001		0.0	12.228	-0.001			Vel = 0.26	
532 to 533	0.0	3.26 120.0	E	9.408 0.0	4.500 9.408	27.110 0.0				
	-6.68	-0.0001		0.0	13.908	-0.001			Vel = 0.26	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Page 9
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
533 to 534	204.49 197.81	3.26 120.0 0.0360		0.0 0.0 0.0	1.000 0.0 1.000	27.109 0.0 0.036				
								Vel =	7.60	
534 to 535	0.0 197.81	3.26 120.0 0.0361	E	9.408 0.0 0.0	2.990 9.408 12.398	27.145 0.0 0.447				
								Vel =	7.60	
535 to 536	-4.75 193.06	3.26 120.0 0.0345		0.0 0.0 0.0	17.670 0.0 17.670	27.592 0.0 0.610				
								Vel =	7.42	
536 to 537	2.56 195.62	3.26 120.0 0.0354		0.0 0.0 0.0	11.990 0.0 11.990	28.202 0.0 0.424				
								Vel =	7.52	
537 to 538	-6.97 188.65	3.26 120.0 0.0331		0.0 0.0 0.0	14.730 0.0 14.730	28.626 0.0 0.487				
								Vel =	7.25	
538 to 539	0.0 188.65	3.26 120.0 0.0330	E	9.408 0.0 0.0	10.550 9.408 19.958	29.113 0.0 0.659				
								Vel =	7.25	
539 to 540	0.0 188.65	3.26 120.0 0.0331	E T	9.408 20.159 0.0	18.570 29.567 48.137	29.772 0.0 1.592				
								Vel =	7.25	
540 to 541	0.0 188.65	3.26 120.0 0.0331	T	20.159 0.0 0.0	35.800 20.159 55.959	31.364 0.0 1.850				
								Vel =	7.25	
541 to 542	165.84 354.49	4.26 120.0 0.0288		0.0 0.0 0.0	9.500 0.0 9.500	33.214 0.0 0.274				
								Vel =	7.98	
542 to 543	0.0 354.49	4.26 120.0 0.0288	E	13.167 0.0 0.0	3.660 13.167 16.827	33.488 0.0 0.485				
								Vel =	7.98	
543 to 544	0.0 354.49	4.26 120.0 0.0289	E	13.167 0.0 0.0	0.730 13.167 13.897	33.973 0.0 0.401				
								Vel =	7.98	
544 to 545	0.0 354.49	4.26 120.0 0.0288	E	13.167 0.0 0.0	16.000 13.167 29.167	34.374 6.930 0.841				
								Vel =	7.98	
545 to TR5	0.0 354.49	4.26 120.0 0.0289	11E	144.838 0.0 0.0	161.000 144.838 305.838	42.145 -0.720 8.825				
								Vel =	7.98	
TR5 to BR5	0.0 354.49	4.26 120.0 0.0288	B S T Fsp	15.8 28.968 26.334 0.0	8.042 71.102 79.144	50.250 6.483 2.283				
								* * Fixed Loss = 3		
								Vel =	7.98	
BR5 to BR4	0.0 354.49	6.357 120.0 0.0044		0.0 0.0 0.0	2.500 0.0 2.500	59.016 0.0 0.011				
								Vel =	3.58	
BR4 to BR3	0.0 354.49	6.357 120.0 0.0041	T	37.72 0.0 0.0	2.500 37.720 40.220	59.027 0.0 0.165				
								Vel =	3.58	

Final Calculations - Hazen-Williams

BIC Design Company
Lee's Summit Middle School - Floor 2 - System 5 - Area 1

Page 10
Date

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
BR3 to UG	0.0 354.49	6.357 120.0 0.0040		0.0 0.0 0.0	2.000 0.0 2.000	59.192 1.299 0.008				
UG to HOSE	0.0 354.49	6.16 140.0 0.0036	G E T Zfb	4.304 20.084 43.037 0.0	75.000 67.425 142.425	60.499 2.815 0.513			* * Fixed Loss = 2.815 Vel = 3.82	
HOSE to TEST	50.00 404.49	6.16 140.0 0.0060		0.0 0.0 0.0	0.500 0.0 0.500	63.827 0.0 0.003			Qa = 50.00 Vel = 4.35	
	0.0 404.49					63.830			K Factor = 50.63	