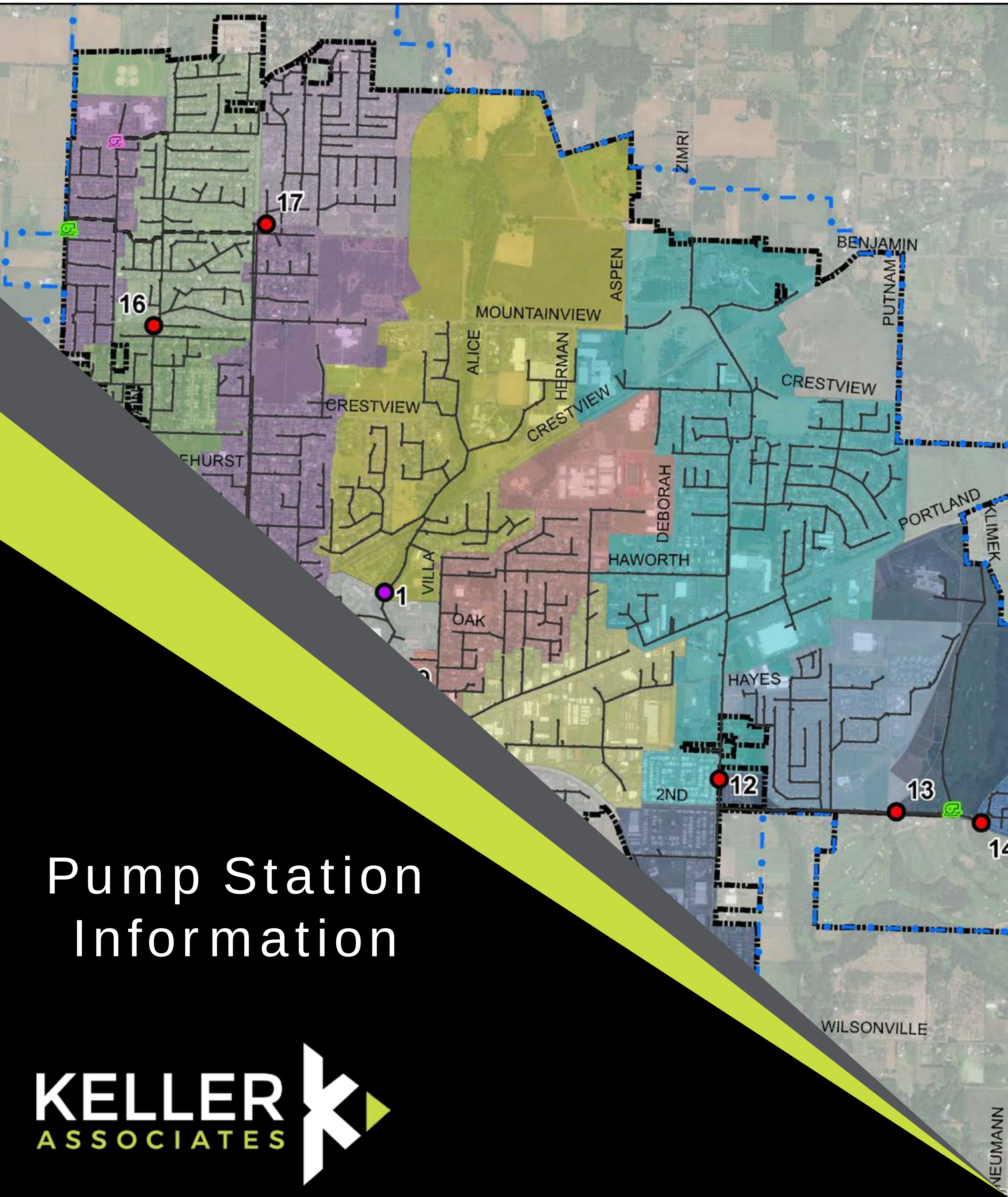
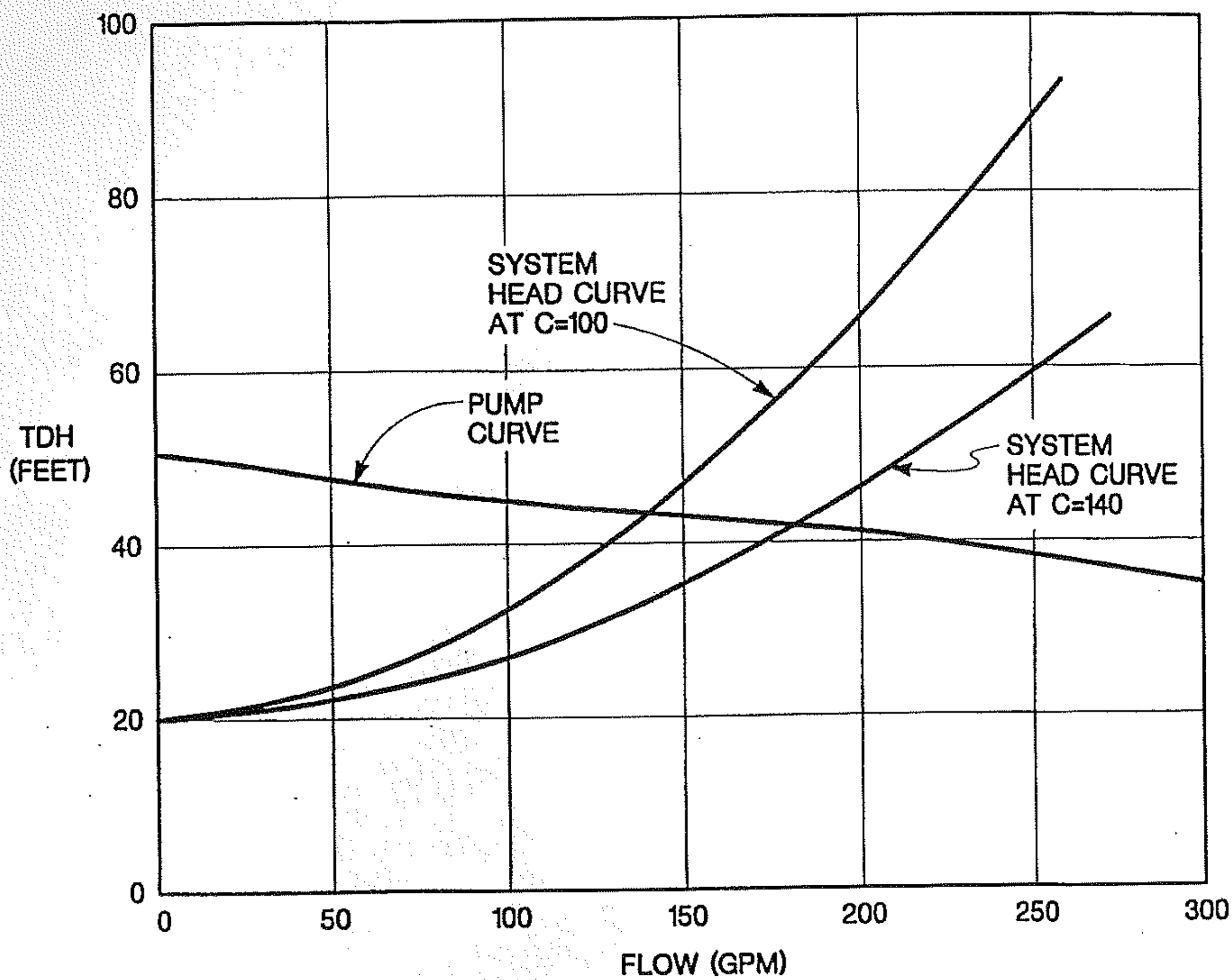
Appendix C



Pump Station Information



CITY OF NEWBERG

ANDREW STREET PUMP STATION SYSTEM CURVES

FLYGT	PERFORMANCE CURVE	PRODUCT CP3127.090	TYPE MT
DATE 2000-05-19	PROJECT Charles & Andrew Street Pump Sta	CURVE NO 63-434-00-2240	ISSUE 3

	1/1-LOAD	3/4-LOAD	1/2-LOAD
POWER FACTOR	0.88	0.85	0.77
EFFICIENCY	83.5 %	84.5 %	83.5 %
MOTOR DATA	—	—	—

RATED POWER	7.5	Hp
STARTING CURRENT ...	52	A
RATED CURRENT ...	9.6	A
RATED SPEED	1740	rpm
TOT.MOM.OF INERTIA ...	0.082	kgm2
NO. OF BLADES	1	

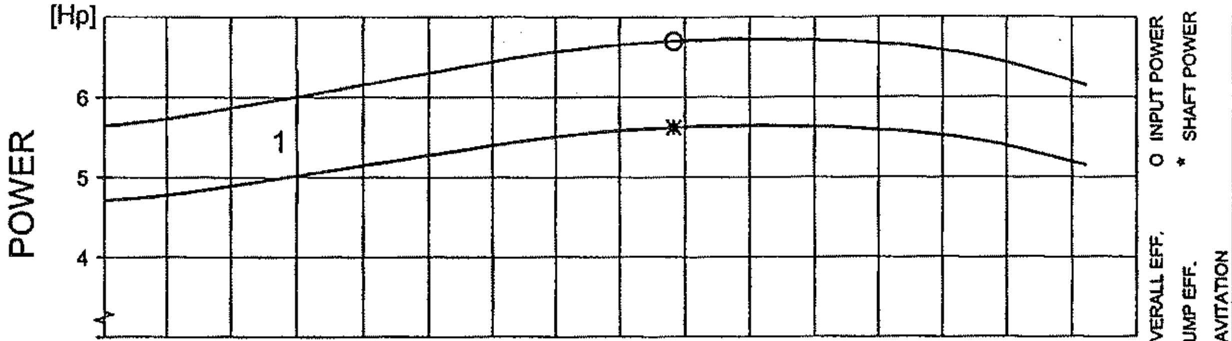
MOTOR #	STATOR	REV
21-10-4AL	12YSER	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	230 V	4

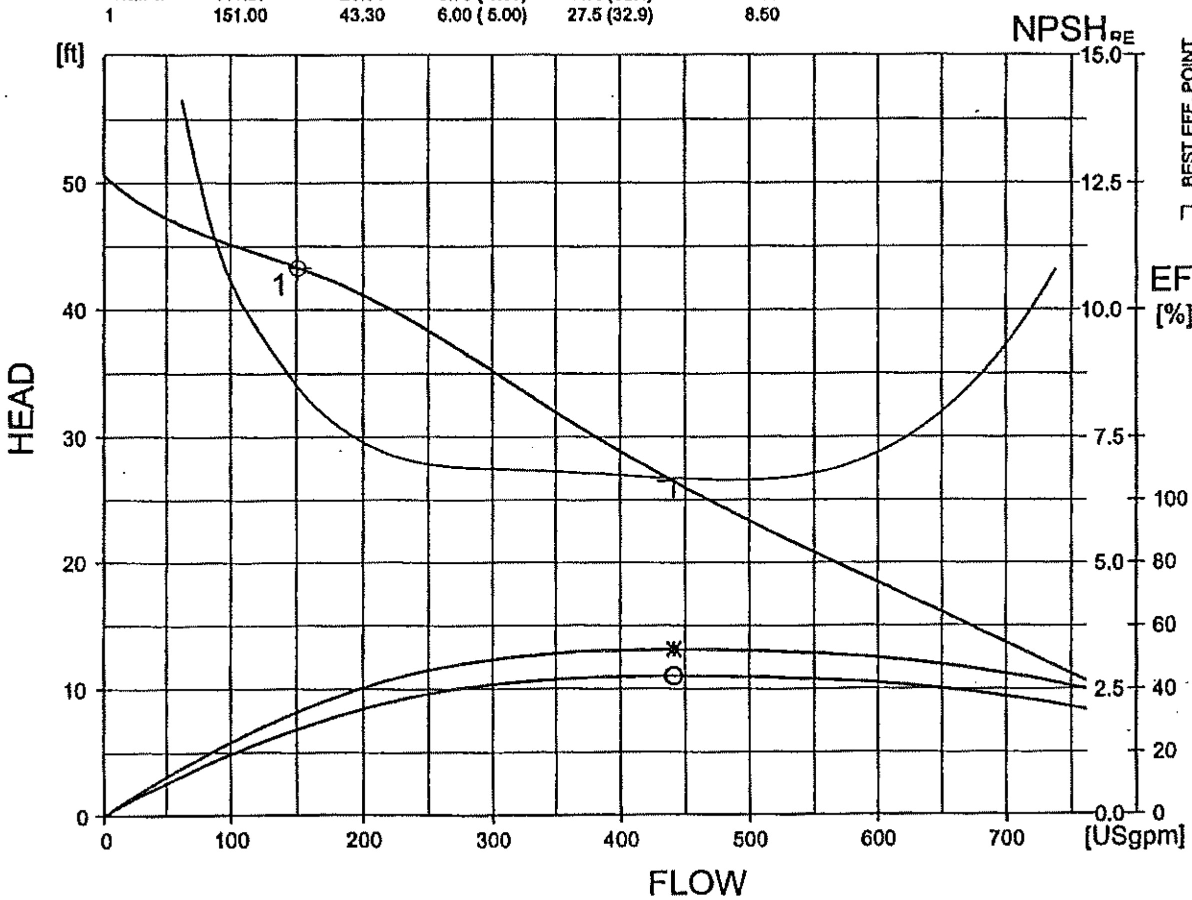
GEARTYPE	RATIO
---	---

COMMENTS

INLET/OUTLET	IMP. THROUGHLET
- /100 mm	80 mm



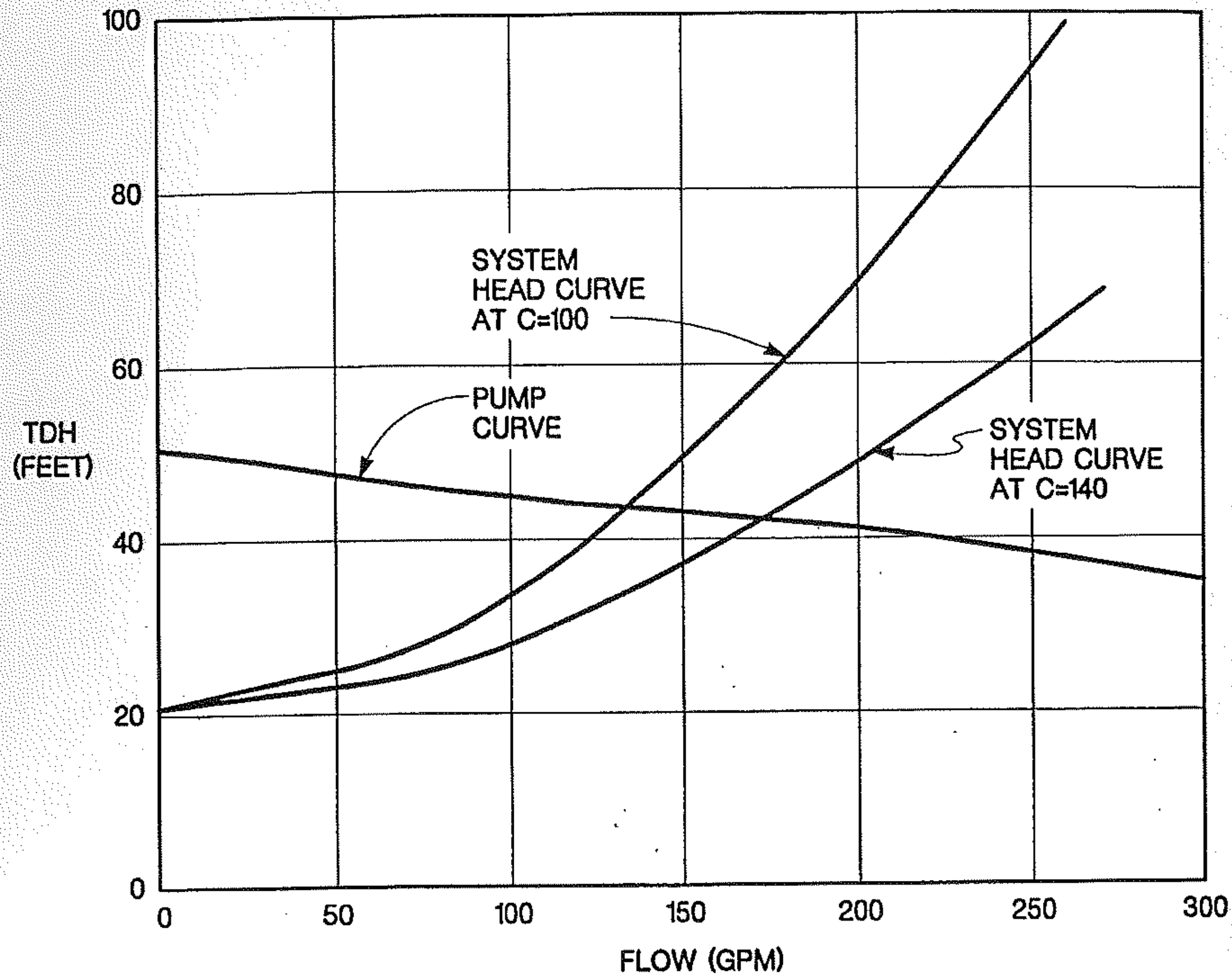
DUTY-POINT:	FLOW[USgpm]	HEAD[ft]	POWER[Hp]	EFF.[%]	NPSH[ft]	GUARANTEE
B.E.P.:	441.37	26.51	6.70 (5.63)	44.2 (52.6)	6.69	
1	151.00	43.30	6.00 (5.00)	27.5 (32.9)	8.50	



FLYPS 2.0 (1118)

Performance with clear water and ambient temp 40 °C

FLYGT CURVE



CITY OF NEWBERG

CHARLES STREET PUMP STATION SYSTEM CURVES

FLYGT	PERFORMANCE CURVE	PRODUCT CP3127.090	TYPE MT
DATE 2000-05-19	PROJECT Charles & Andrew Street Pump Sta	CURVE NO 63-434-00-2240	ISSUE 3

	1/1-LOAD	3/4-LOAD	1/2-LOAD
POWER FACTOR	0.88	0.85	0.77
EFFICIENCY	83.5 %	84.5 %	83.5 %
MOTOR DATA	—	—	—

RATED POWER	7.5	Hp
STARTING CURRENT ...	52	A
RATED CURRENT ...	9.6	A
RATED SPEED	1740	rpm
TOT.MOM.OF INERTIA ...	0.082	kgm2
NO. OF BLADES	1	

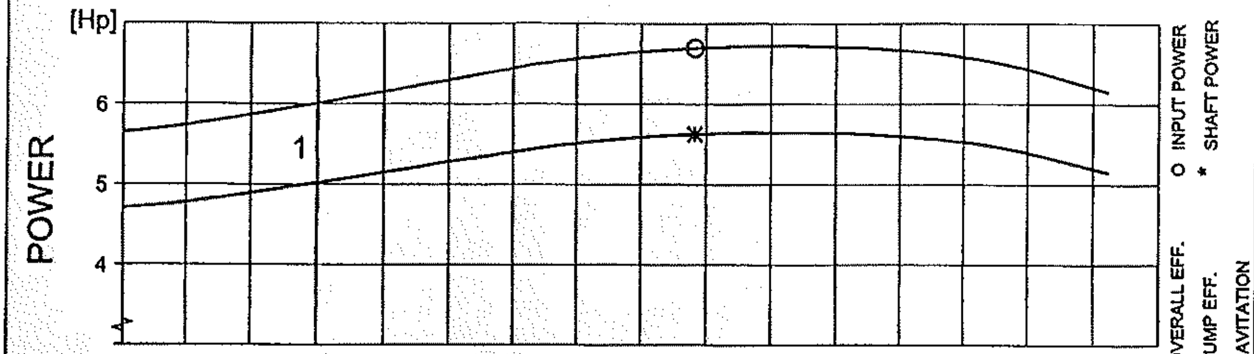
MOTOR #	STATOR	REV
21-10-4AL	12YSER	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	230 V	4

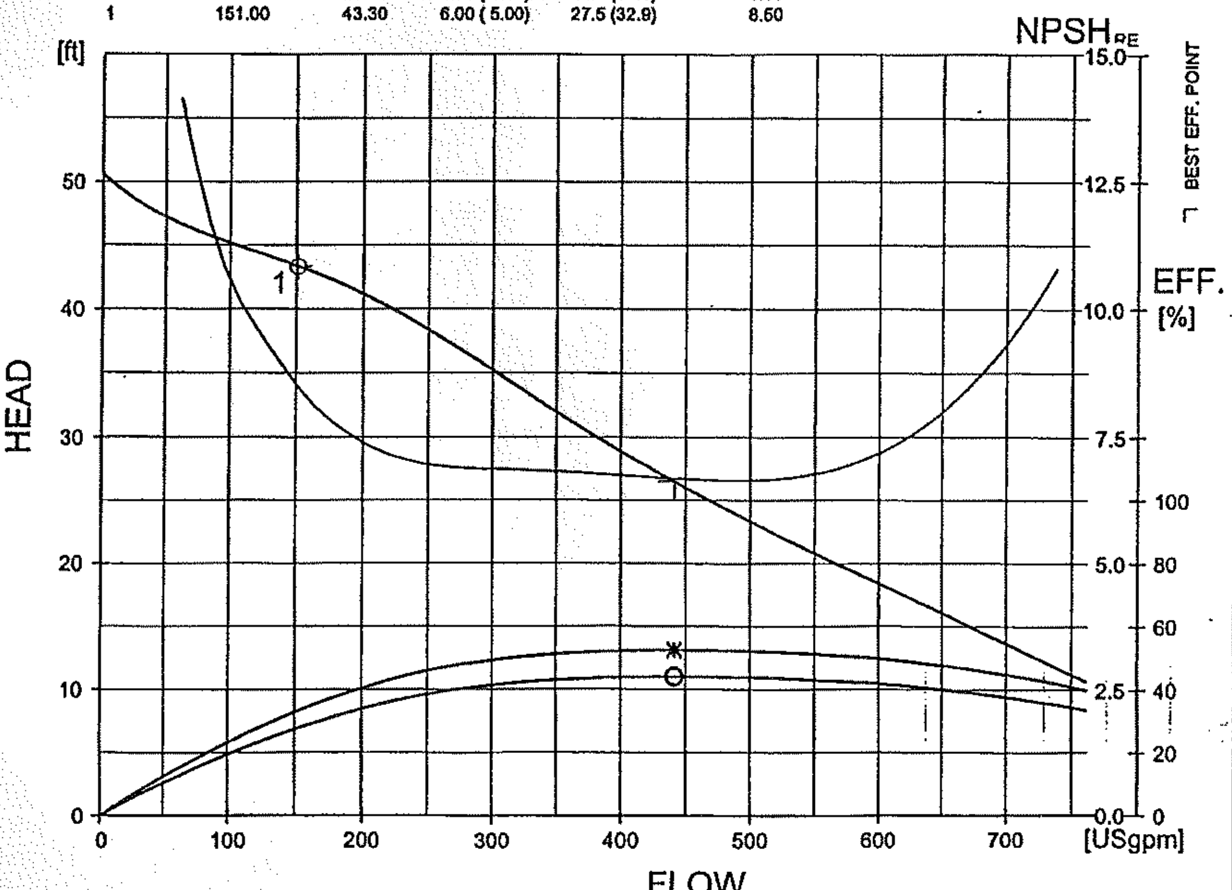
GEARTYPE	RATIO
---	---

COMMENTS

INLET/OUTLET	IMP. THROUGHLET
- /100 mm	80 mm



DUTY-POINT:	FLOW[USgpm]	HEAD[ft]	POWER[Hp]	EFF.[%]	NPSH[ft]	GUARANTEE
B.E.P.:	441.37	26.51	6.70 (5.63)	44.2 (52.6)	6.69	
1	151.00	43.30	6.00 (5.00)	27.5 (32.9)	8.50	

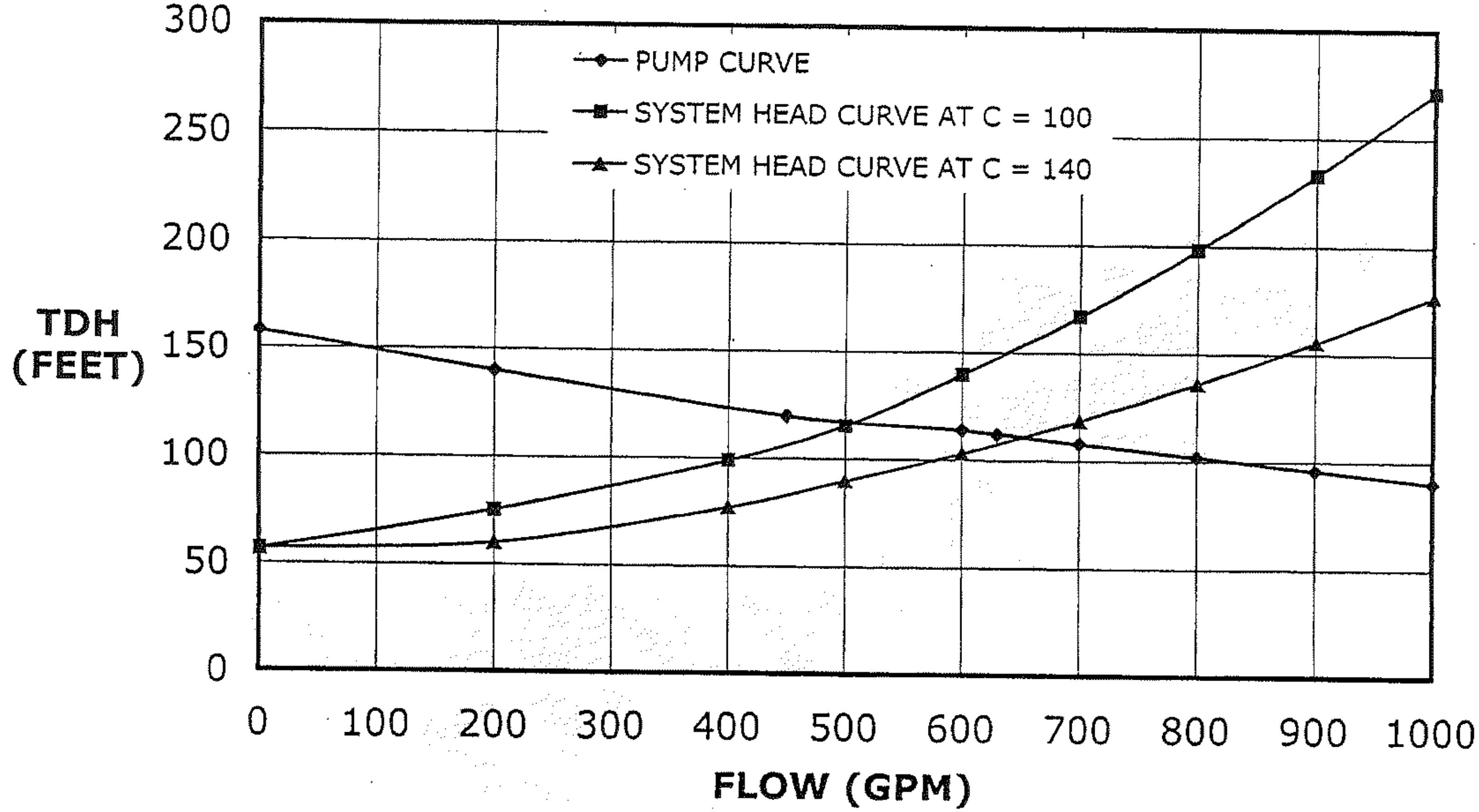


FLYPS 2.0 (1118)

Performance with clear water and ambient temp 40 °C

FLYGT CURVE

CITY OF NEWBERG
CHEHALEM DRIVE PUMP STATION
SYSTEM CURVES



FLYGT

PERFORMANCE CURVE

PRODUCT	TYPE
NP3171.090	HT

DATE	PROJECT	CURVE NO	ISSUE
2003-09-03	Newberg, Chehalem Dr. SPS	63-453-00-6050	2

	1/1-LOAD	3/4-LOAD	1/2-LOAD
POWER FACTOR	0.83	0.77	0.66
EFFICIENCY	89.5 %	90.5 %	90.0 %
MOTOR DATA	—	—	—

RATED POWER	30	hp
STARTING CURRENT ...	257	A
RATED CURRENT ...	38	A
RATED SPEED	1760	rpm
TOT.MOM.OF INERTIA ...	0.16	kgm2
NO. OF BLADES	2	

COMMENTS

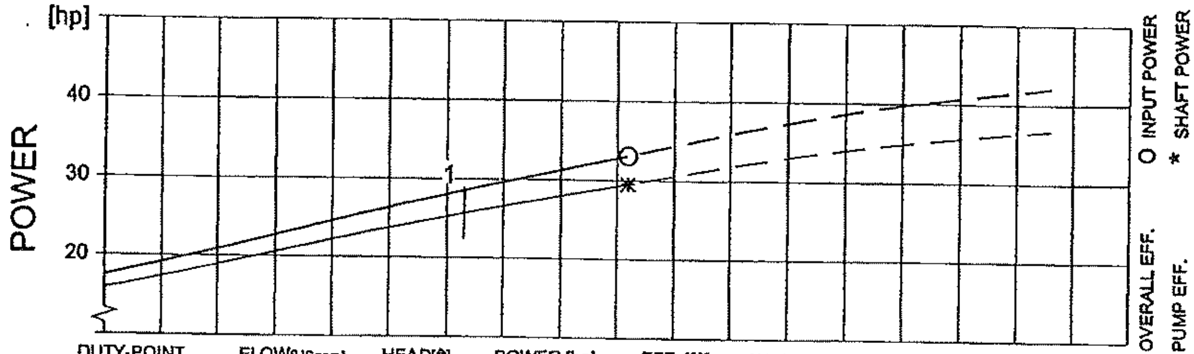
INLET/OUTLET	IMP. THROUGHLET
- /100 mm	—

IMPELLER DIAMETER: 286 mm

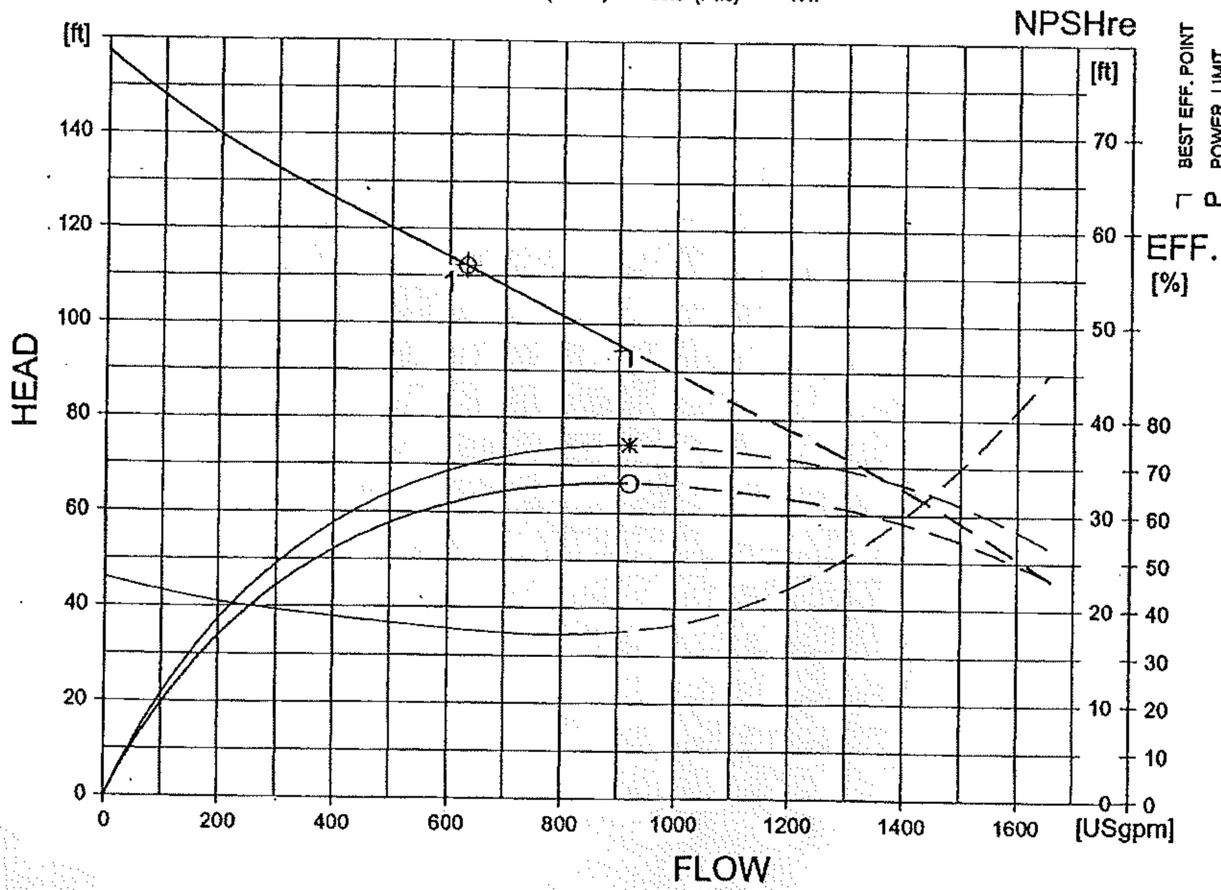
MOTOR #	STATOR	REV
25-17-4AA	07YSER	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	460 V	4

GEARTYPE	RATIO
—	—



DUTY-POINT	FLOW[USgpm]	HEAD[ft]	POWER [hp]	EFF. [%]	NPSHre[ft]
1	631	112	28.6 (25.7)	62.7 (69.8)	17.7
B.E.P.	920	94.3	33.2 (29.6)	66.3 (74.3)	17.7



FLYPS2.17 (20021016)

NPSHre = NPSH3% + min. operational margin

Performance with clear water and ambient temp 40 °C

FLYGT CURVE

PERFORMANCE CURVE

FLYGT

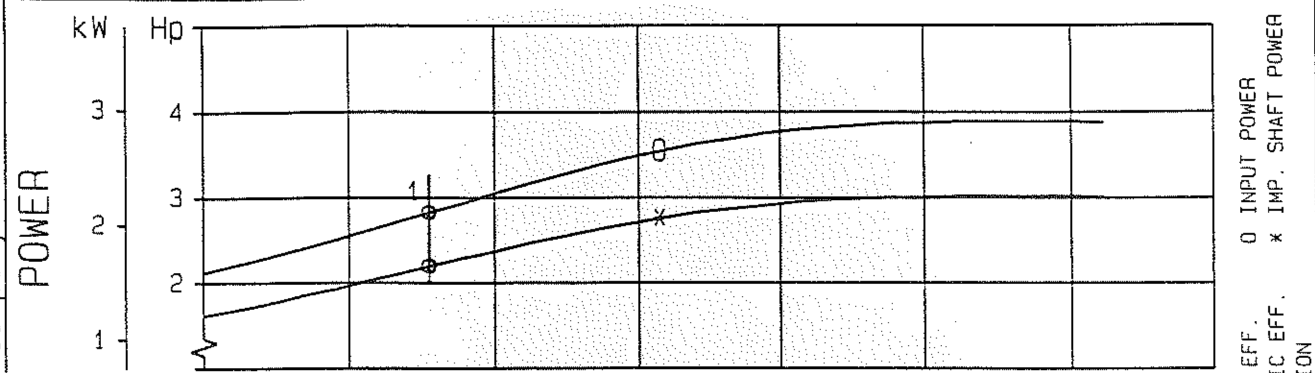
PRODUCT	CP3085.182
TYPE	MT
DATE	98-02-02
PROJECT	Creekside Lift Station
CURVE NO	63-434-00-5330
ISSUE	2

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS FI	0.80	0.73	0.61
MOTOR EFFICIENCY	77.6 %	77.8 %	74.8 %
GEAR EFFICIENCY	---	---	---

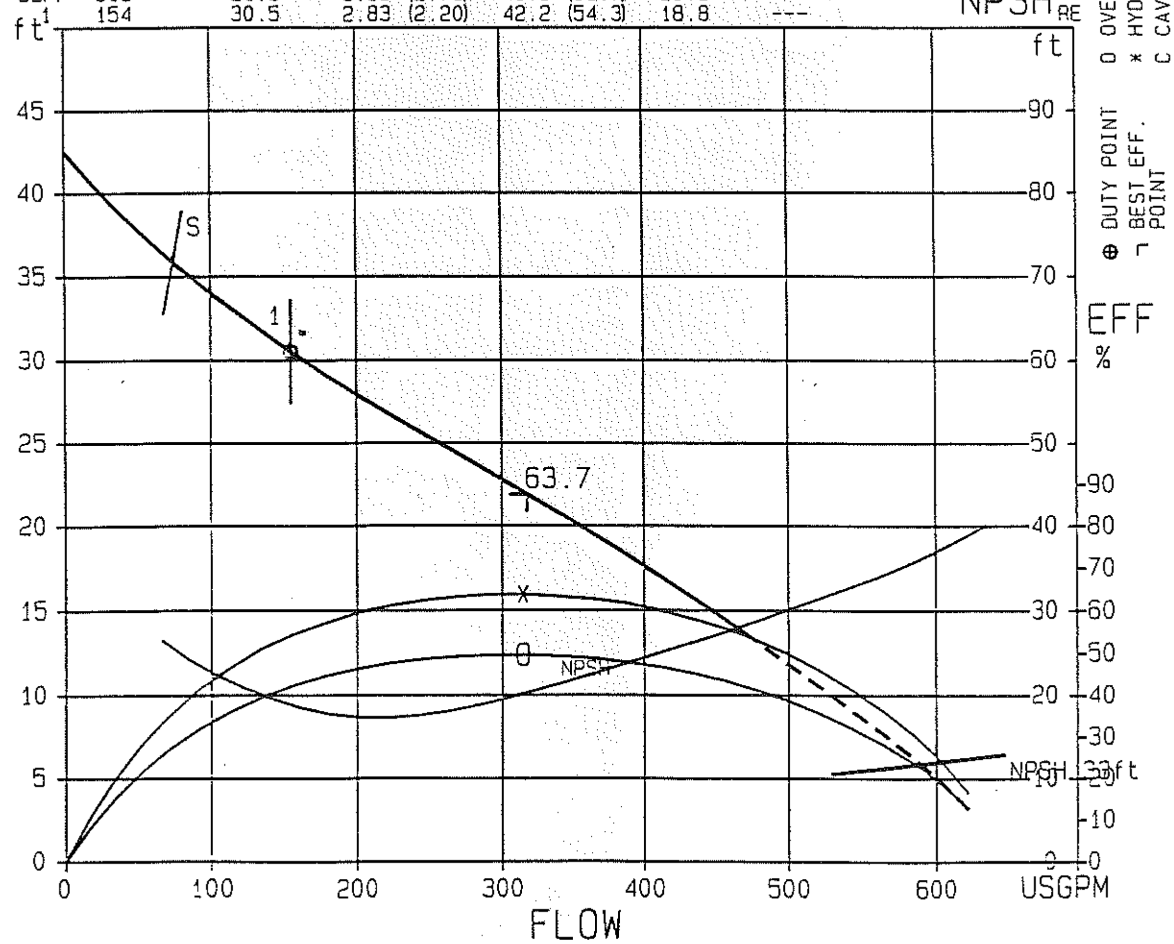
MOTOR SHAFT POWER	3.0 HP
STARTING CURRENT	24.0 A
RATED CURRENT	4.50 A
RATED SPEED	1710 RPM
TOT. MOM. OF INERTIA	0.807 LBF*FT
NO. OF BLADES	1
IMPELLER DIAMETER	--- MM
MOTORTYPE	15-10-4AL
STATOR	38D
REV	10
FREQ	60 HZ
PHASES	3
VOLTAGE	460 V
POLES	4
GEARTYPE	---
RATIO	---
OUTLET	4 INCH
IMP. THROUGHLET	3 INCH

COMMENTS
NEVA-CLOG

Roy Voskuil Queen Pump Company



DUTY-POINTS:	FLOW (USGPM)	HEAD (ft)	POWER (Hp)	EFF (%)	NPSH (ft)	GUARANTY
BEP:	318	21.9	3.55 (2.76)	49.5 (63.7)	20.5	---
1	154	30.5	2.83 (2.20)	42.2 (54.3)	18.8	---



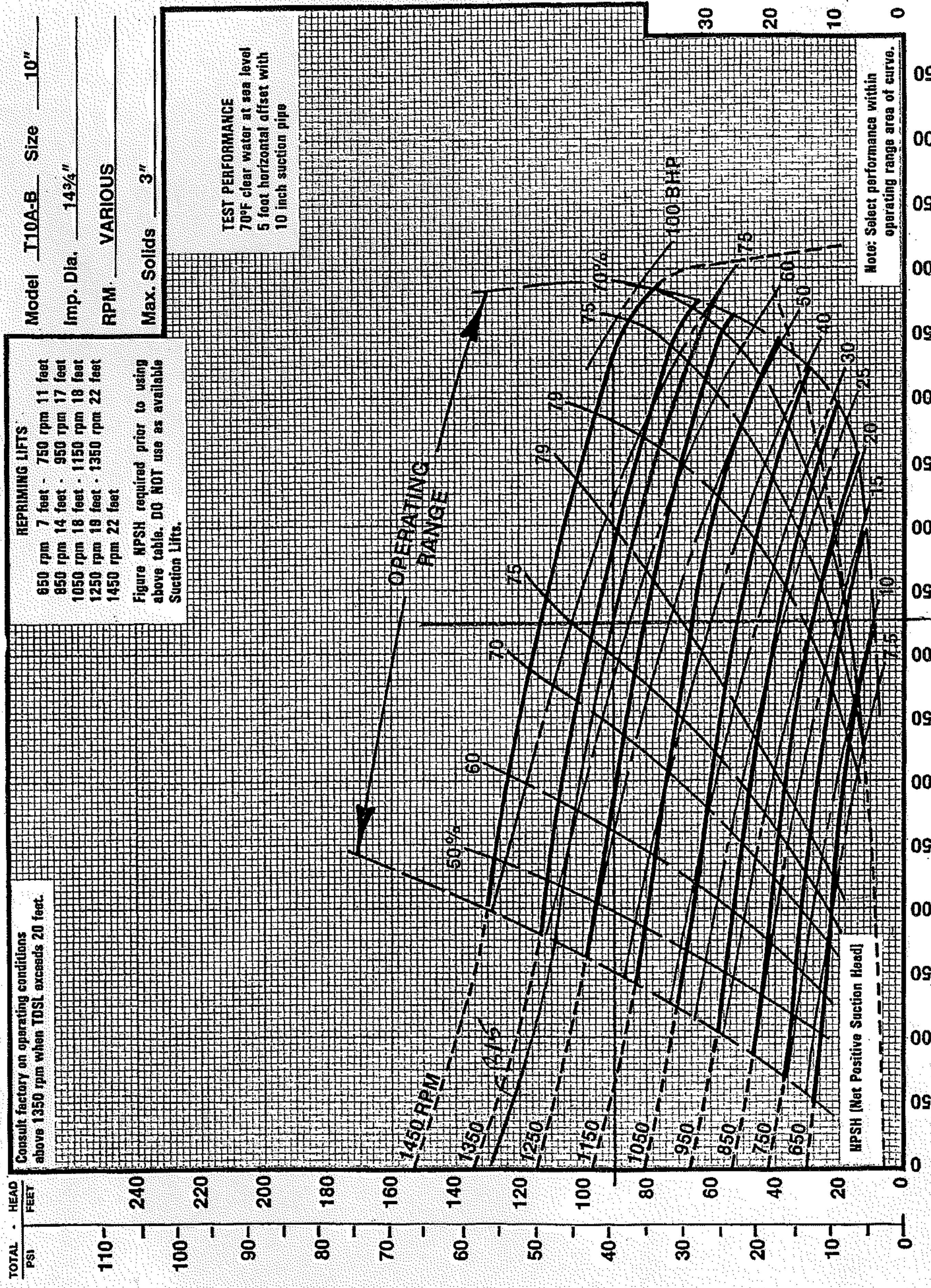
S: RISK FOR SEDIMENTATION AT VELOCITY BELOW 0.6 M/S
(STANDARD DIAM. 4 INCH)

FLYPS 1.2

CURVES SHOW PERFORMANCE WITH CLEAR WATER

FLYGT

DAYTON



Contact the factory on special applications or applications exceeding priming or other performance limitations indicated. For Pump Performance Certification Apply to the Company.

Fernwood

FLYGT

PERFORMANCE CURVE

PRODUCT	TYPE
CP3170.090	HT
CURVE NO 63-464-00-2350	ISSUE 2

DATE 2000-08-10

PROJECT

	1/1-LOAD	3/4-LOAD	1/2-LOAD
POWER FACTOR	0.90	0.88	0.83
EFFICIENCY	86.0 %	86.5 %	85.5 %
MOTOR DATA	—	—	—

COMMENTS

INLET/OUTLET: - /100 mm

IMP. THROUGHLET: 76 mm

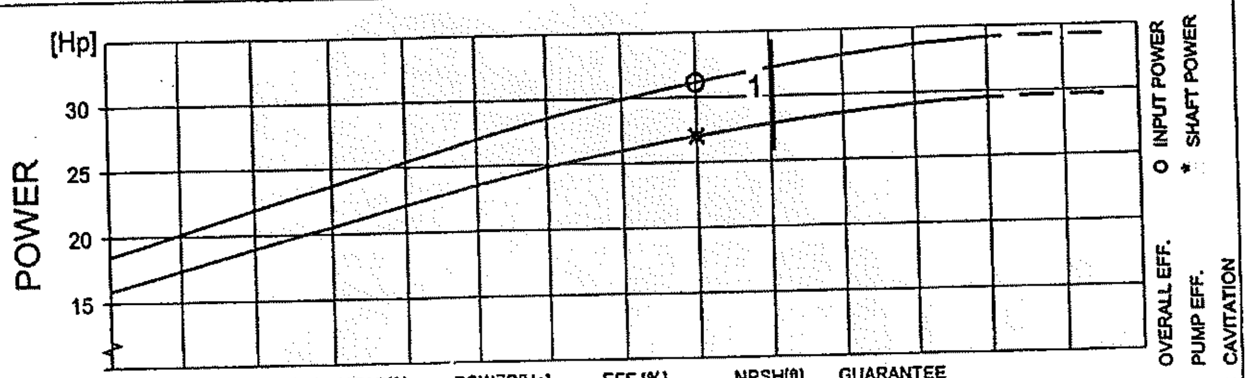
RATED POWER	30	Hp
STARTING CURRENT ...	221	A
RATED CURRENT ...	36	A
RATED SPEED	1750	rpm
TOT.MOM.OF INERTIA ...	0.29	kgm2
NO. OF BLADES	1	

IMPELLER DIAMETER 281 mm

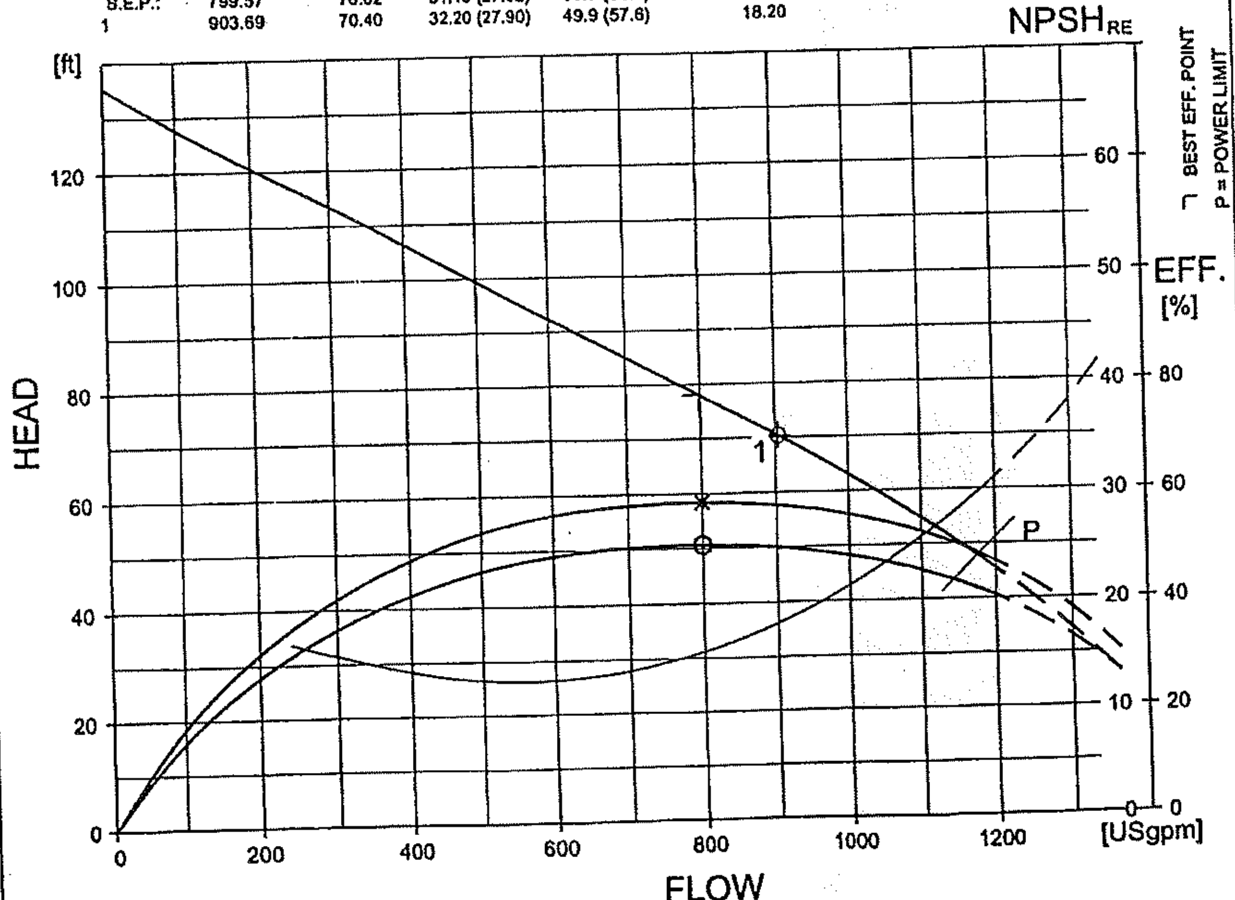
MOTOR #	STATOR	REV
27-20-4AA	37YSER	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	460 V	4

GEARTYPE	RATIO
—	—



DUTY-POINT:	FLOW[USgpm]	HEAD[ft]	POWER[Hp]	EFF.[%]	NPSH[ft]	GUARANTEE
S.E.P.:	799.57	78.02	31.15 (27.02)	50.7 (58.4)	15.61	
1	903.69	70.40	32.20 (27.90)	49.9 (57.6)	18.20	



FLYPS 2.0 (1118)

Performance with clear water and ambient temp 40 °C

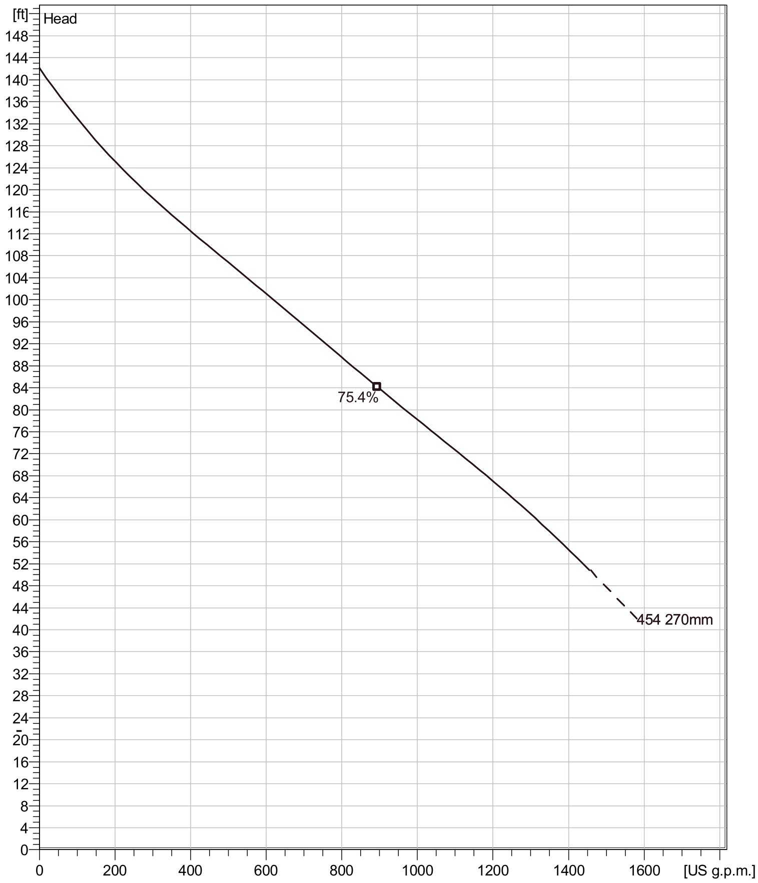
FLYGT CURVE

xylem

Fernwood

NP 3171 HT 3~ 454

Technical specification

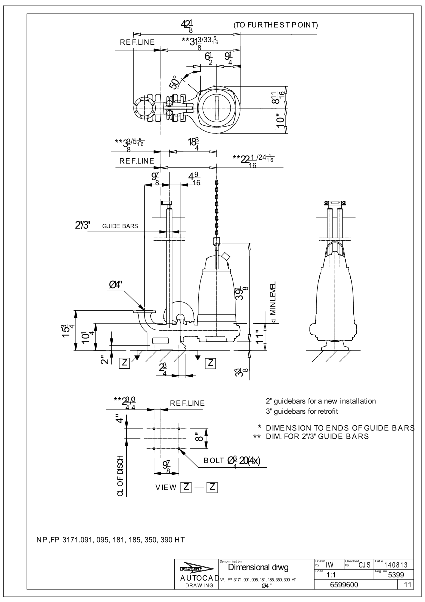


Water, pure

Curve ISO

Note: Picture might not correspond to the current configuration.

Installation: P - Semi permanent, Wet



General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Impeller

Impeller material	Hard-Iron ™
Discharge Flange Diameter	3 15/16 inch
Inlet diameter	3 15/16 inch
Impeller diameter	270 mm
Number of blades	2

Motor

Motor #	N3171.095 25-17-4AA-W 30hp
Approval	FM
Stator variant	1
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	30 hp
Rated current	36 A
Starting current	230 A
Rated speed	1755 rpm
Power factor	
1/1 Load	0.87
3/4 Load	0.83
1/2 Load	0.73
Motor efficiency	
1/1 Load	89.0 %
3/4 Load	90.0 %
1/2 Load	90.5 %

Configuration

Project	Project ID	Created by	Created on	Last update
			2017-02-27	

NP 3171 HT 3~ 454

Performance curve

Pump

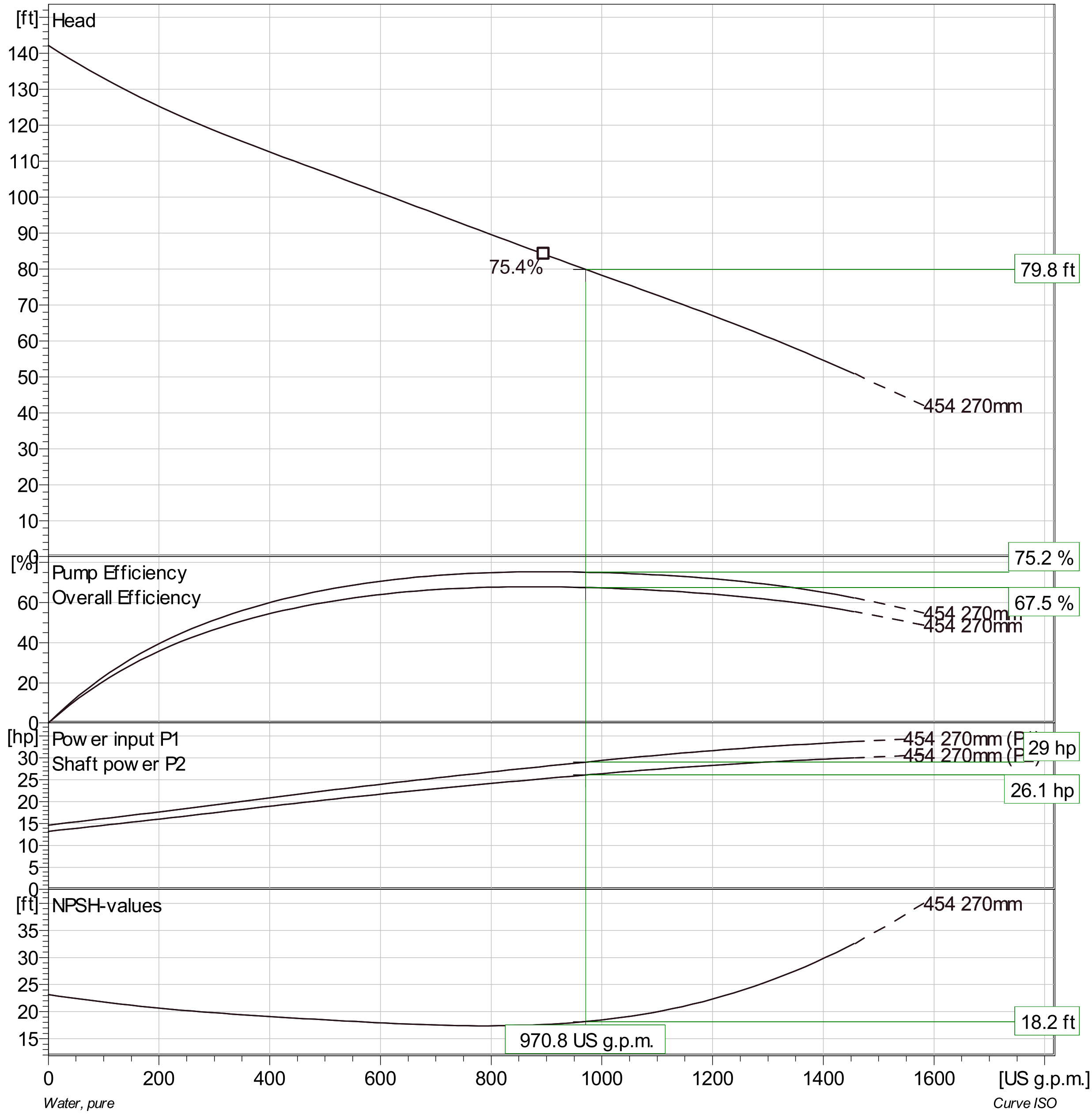
Discharge Flange Diameter	3 15/16 inch
Inlet diameter	100 mm
Impeller diameter	10 5/8"
Number of blades	2

Motor

Motor #	N3171.095 25-17-4AA-W 30hp
Approval	FM
Stator variant	1
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	30 hp
Rated current	36 A
Starting current	230 A
Rated speed	1755 rpm

Power factor	
1/1 Load	0.87
3/4 Load	0.83
1/2 Load	0.73

Motor efficiency	
1/1 Load	89.0 %
3/4 Load	90.0 %
1/2 Load	90.5 %

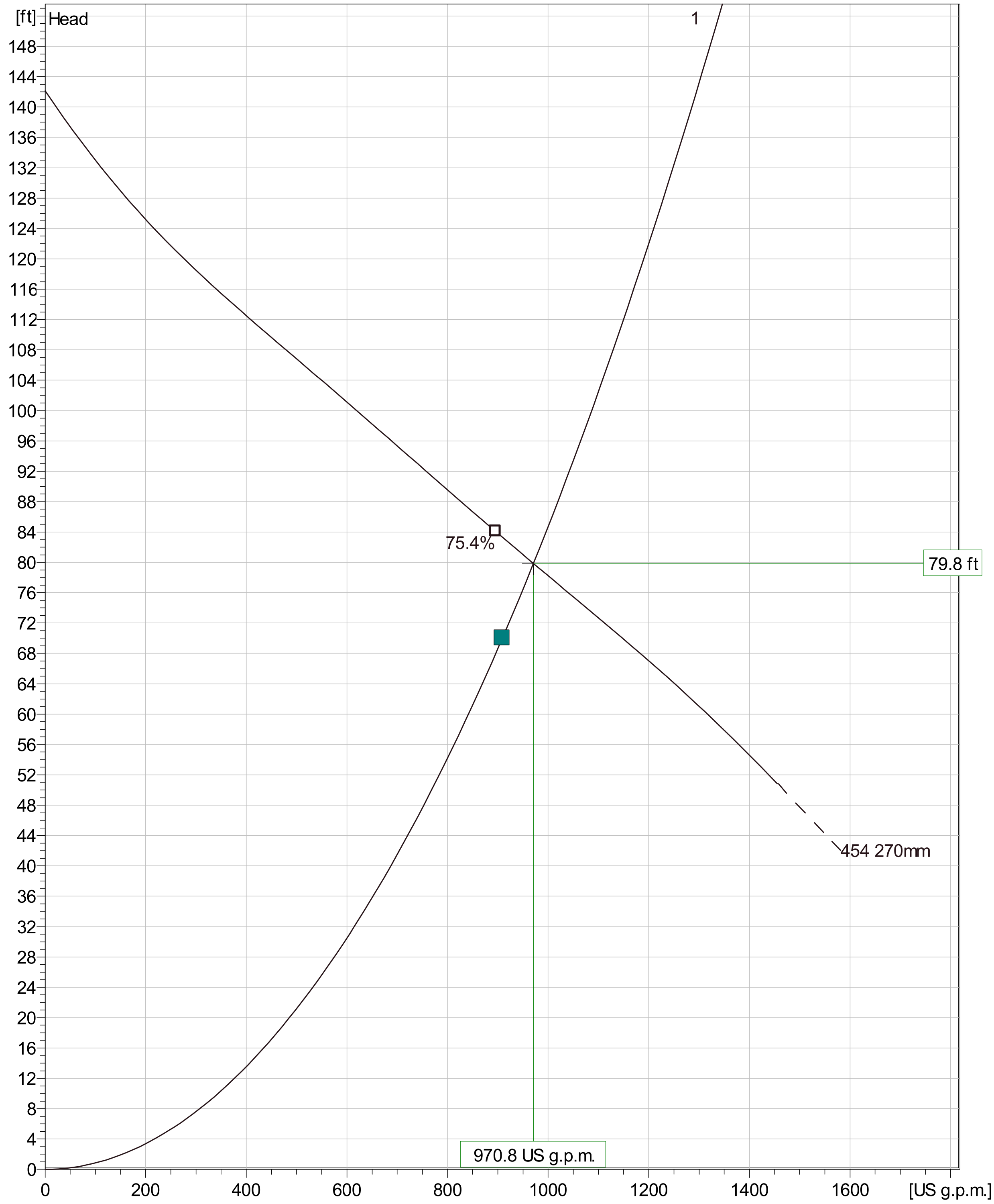


Duty point		Guarantee
Flow	Head	ISO_9906_Grade Grade
909 US g.p.m.	70 ft	No

Project	Project ID	Created by	Created on	Last update
			2017-02-27	

NP 3171 HT 3~ 454

Duty Analysis



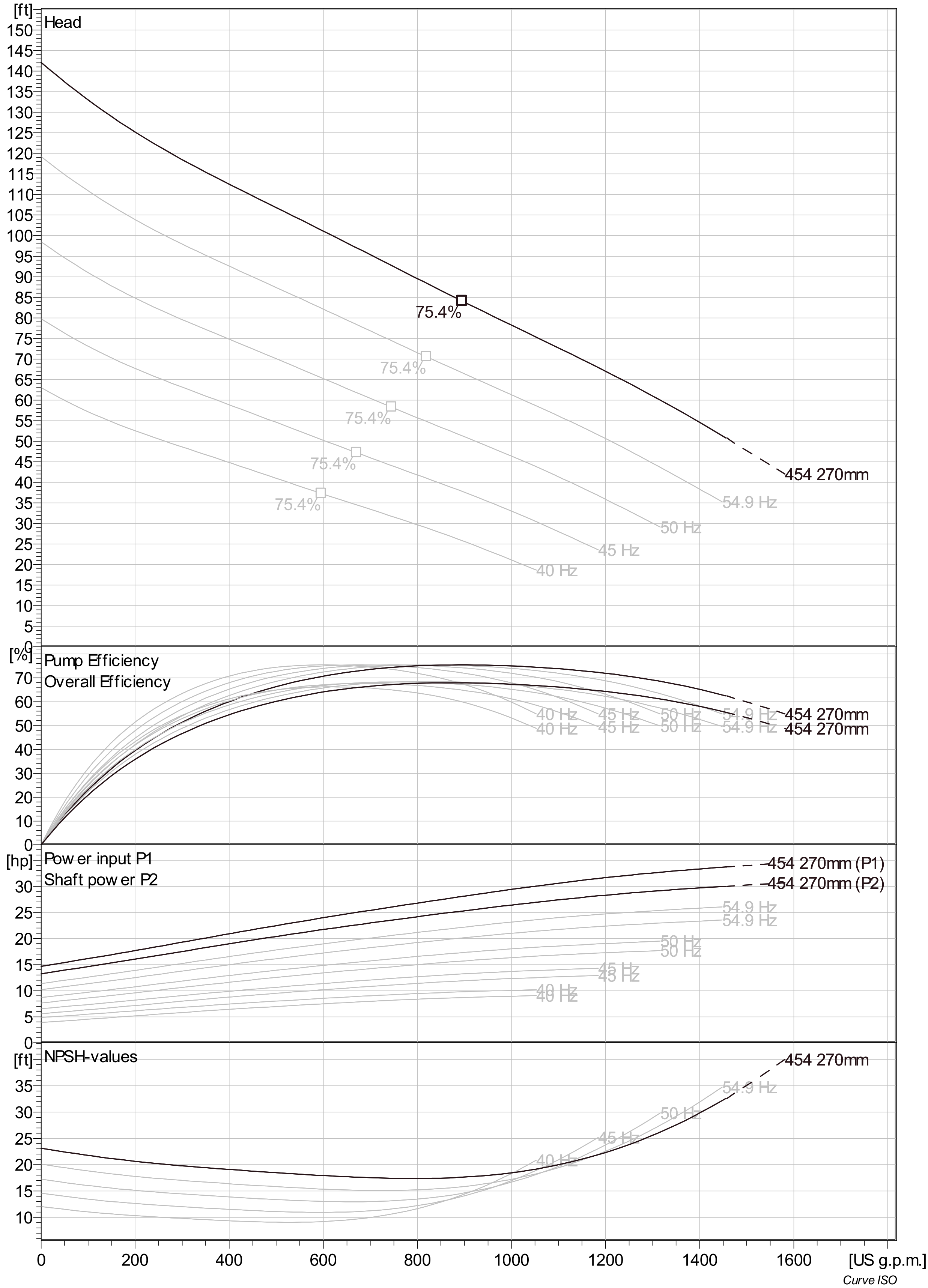
Water, pure
Curve issue 5
Curve ISO

Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
1	971 US g.p.m.	79.8 ft	26.1 hp	971 US g.p.m.	79.8 ft	26.1 hp	75.2 %	372 kWh/US MG	18.2 ft

Project	Project ID	Created by	Created on	Last update
			2017-02-27	

NP 3171 HT 3~ 454

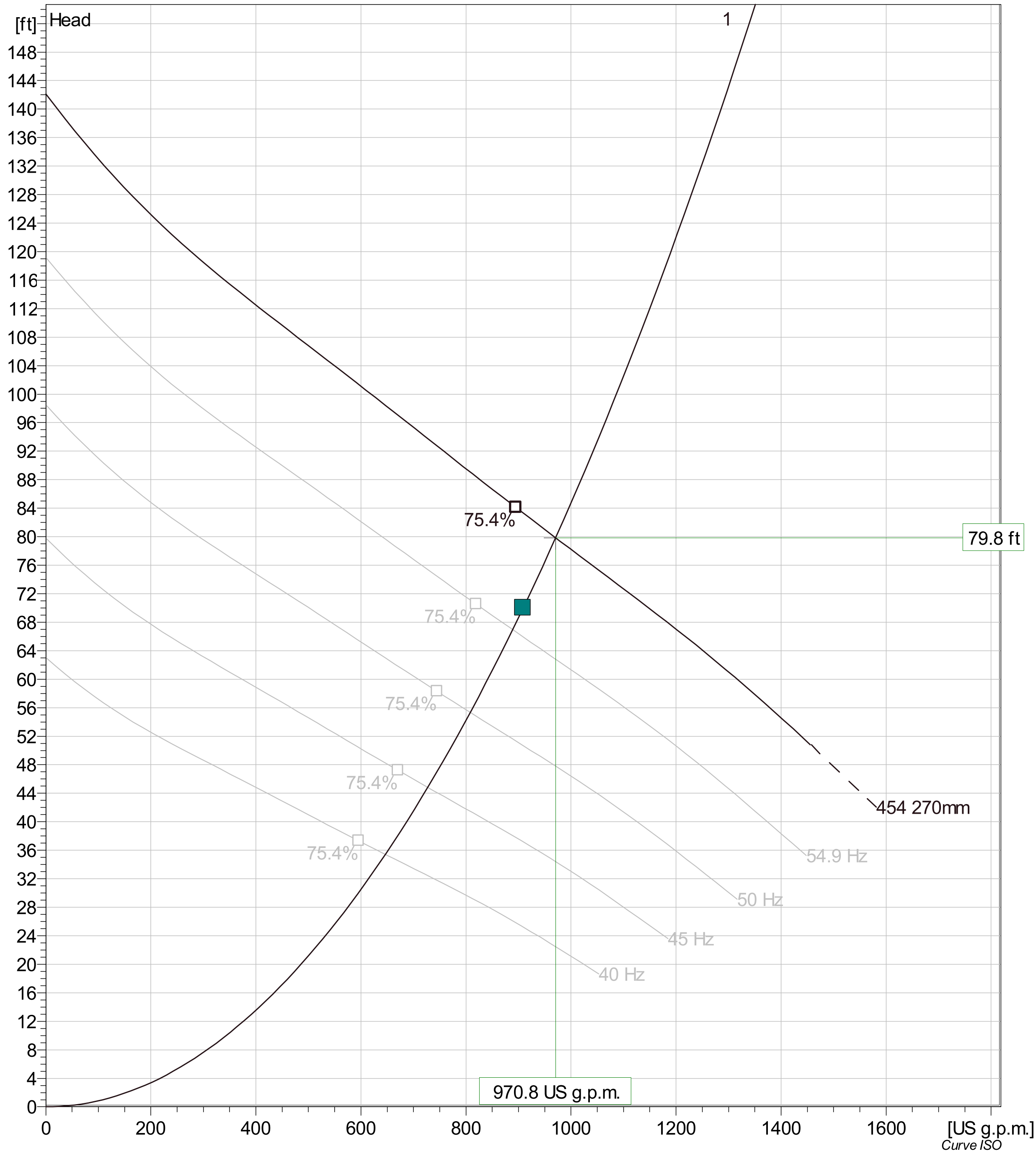
VFD Curve



Project	Project ID	Created by	Created on	Last update
			2017-02-27	

NP 3171 HT 3~ 454

VFD Analysis



Pumps running /System	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
1	60 Hz	971 US g.p.m.	79.8 ft	26.1 hp	971 US g.p.m.	79.8 ft	26.1 hp	75.2 %	372 kWh/US MG	18.2 ft
1	54.9 Hz	889 US g.p.m.	67 ft	20 hp	889 US g.p.m.	67 ft	20 hp	75.2 %	309 kWh/US MG	15.8 ft
1	50 Hz	808 US g.p.m.	55.3 ft	15.1 hp	808 US g.p.m.	55.3 ft	15.1 hp	75.2 %	256 kWh/US MG	13.5 ft
1	45 Hz	727 US g.p.m.	44.8 ft	11 hp	727 US g.p.m.	44.8 ft	11 hp	75.2 %	209 kWh/US MG	11.4 ft
1	40 Hz	647 US g.p.m.	35.4 ft	7.71 hp	647 US g.p.m.	35.4 ft	7.71 hp	75.2 %	168 kWh/US MG	9.48 ft

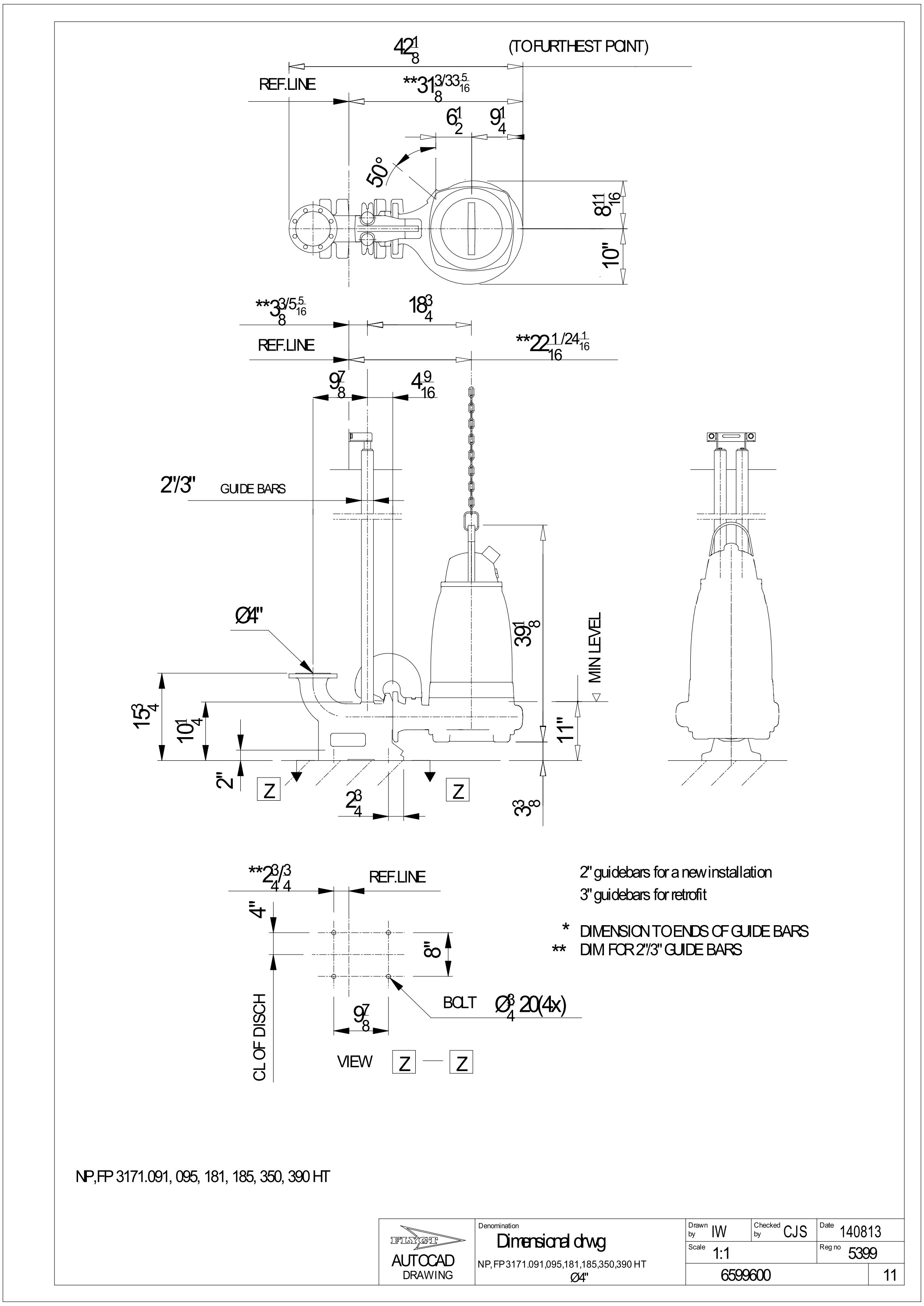
Project	Project ID	Created by	Created on	Last update
			2017-02-27	

xylem

NP 3171 HT 3~ 454

Dimensional drawing

FLYGT



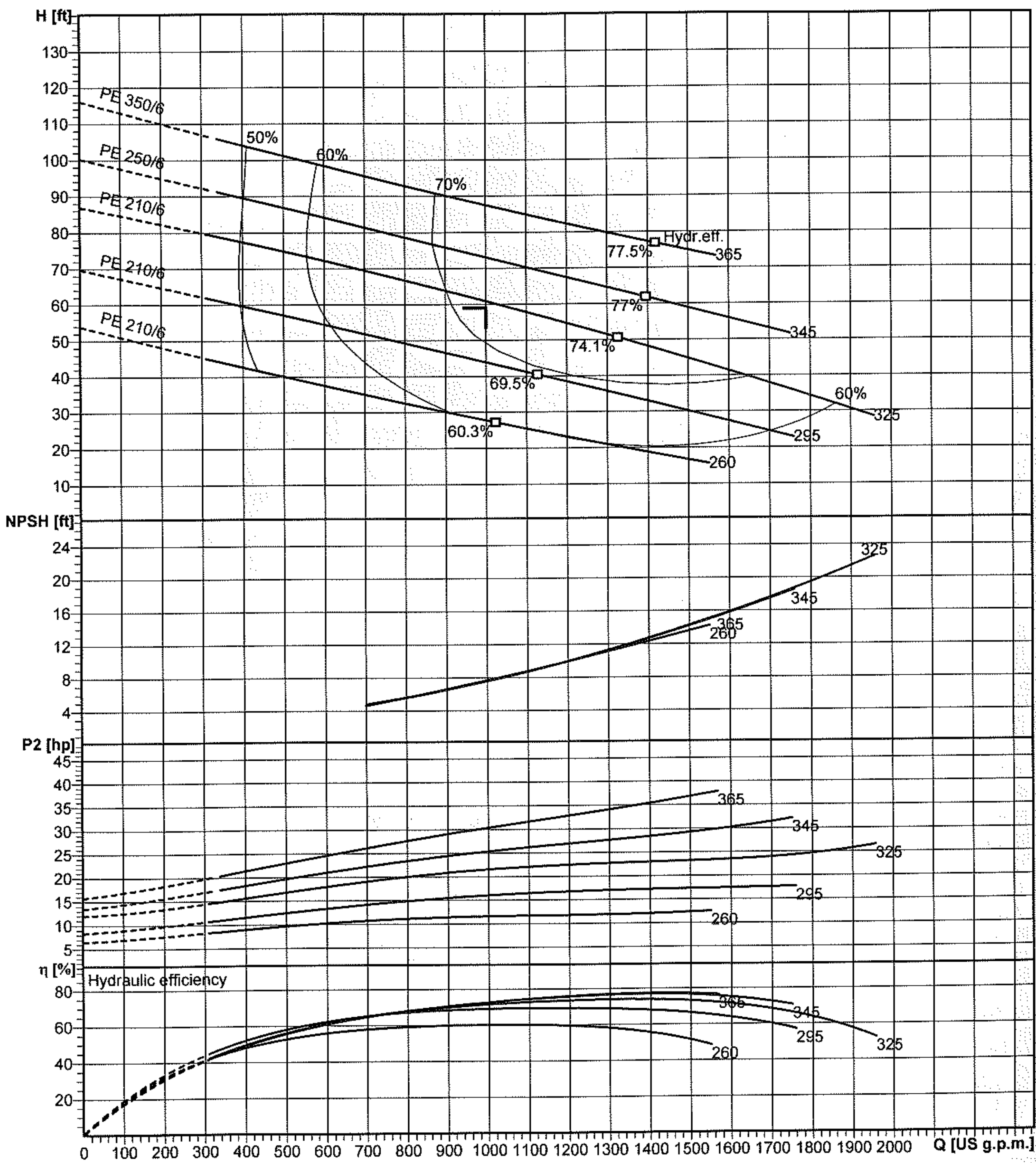
Project	Project ID	Created by	Created on	Last update
			2017-02-27	

240

Pump performance curves
XFP 150J-CH2 60 HZ

Curve number	
Reference curve	XFP 150J-CH2

			Discharge	Frequency 60 Hz
Density 62.43 lb/ft³	Viscosity 0.0000169 ft²/s	Testnorm Hydraulic Institute	Rated speed 1185 rpm	Date 2010-04-13
Flow 1012 US g.p.m.	Head 60.5 ft	Rated power 21.6 hp	Hydraulic efficiency 71.8 %	NPSH 7.7 ft



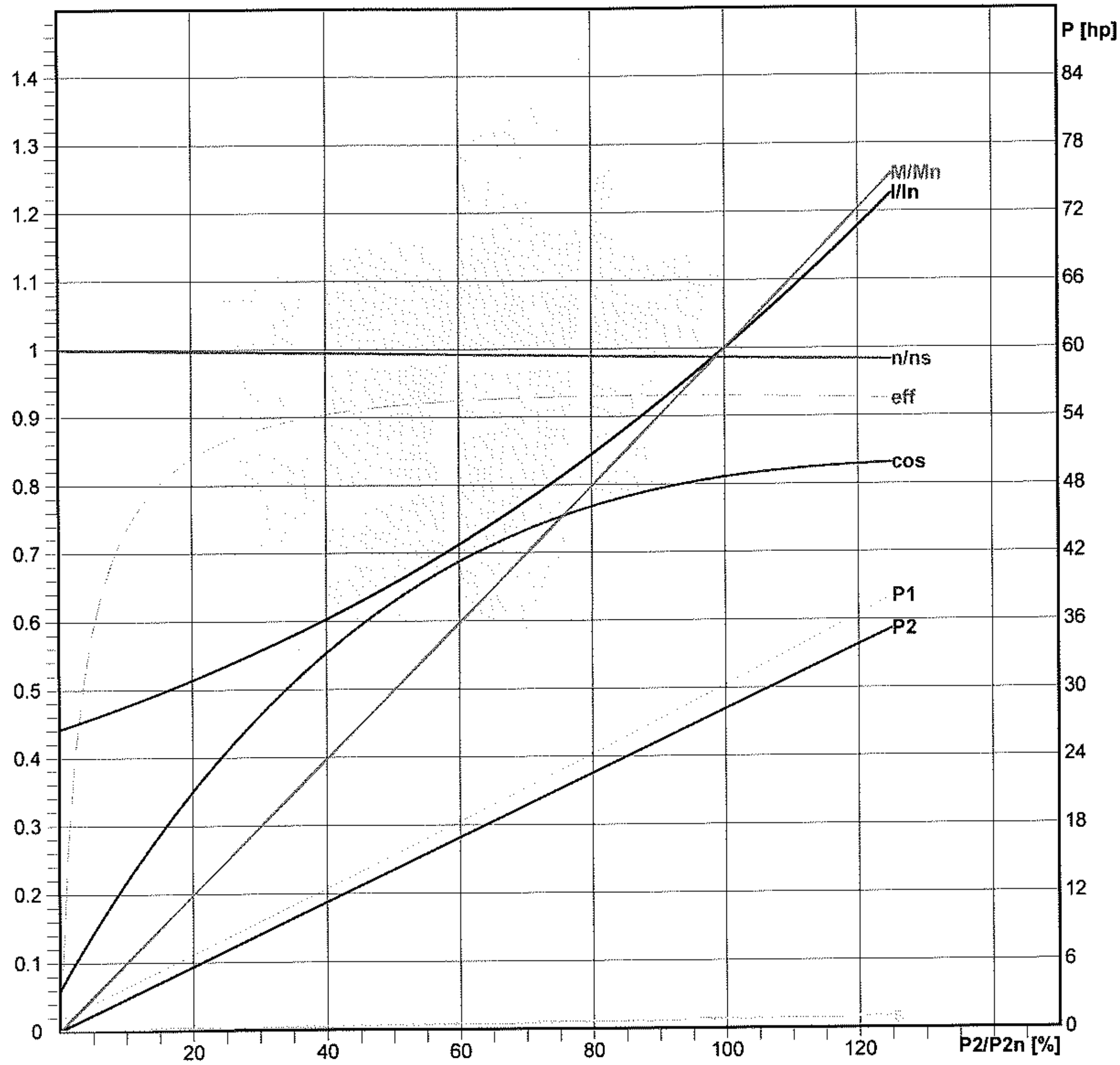
Impeller size	N° of vanes	Impeller	Solid size	Revision 2010-03-08
14.4..10.2 inch	2	2-vane channel impeller	3 1/8 x 3 7/8"	

ABSEL PRO 1.7.2 / 2007-02-07

Motor performance curve
PE 210/6

Frequency
60 Hz

Rated power	Service factor	Nominal speed	Number of poles	Rated voltage	Date
28.2 hp		1185 rpm	6	460 V	2010-04-13



Loading	No load	25 %	50 %	75 %	100 %	125 %
P1 [hp]	0.9888	8.141	15.36	22.73	30.28	38.06
P2 [hp]	0	7.04	14.08	21.12	28.16	35.2
I [A]	15.43	18.67	22.89	28.29	34.96	42.87
eff [%]	0	86.48	91.69	92.91	93	92.48
cos	0.05999	0.4081	0.6279	0.7521	0.8107	0.831
n [rpm]	1199	1196	1192	1188	1184	1179
M [lbf ft]	0	30.92	62.04	93.38	124.9	156.8
s [%]	0.08333	0.3333	0.6667	1	1.333	1.75

Tolerance according to VDE 0530 T1 12.84 for rated power

Starting current	Starting torque	Moment of inertia		
231 A	300 lbf ft	8.94 lb ft²		

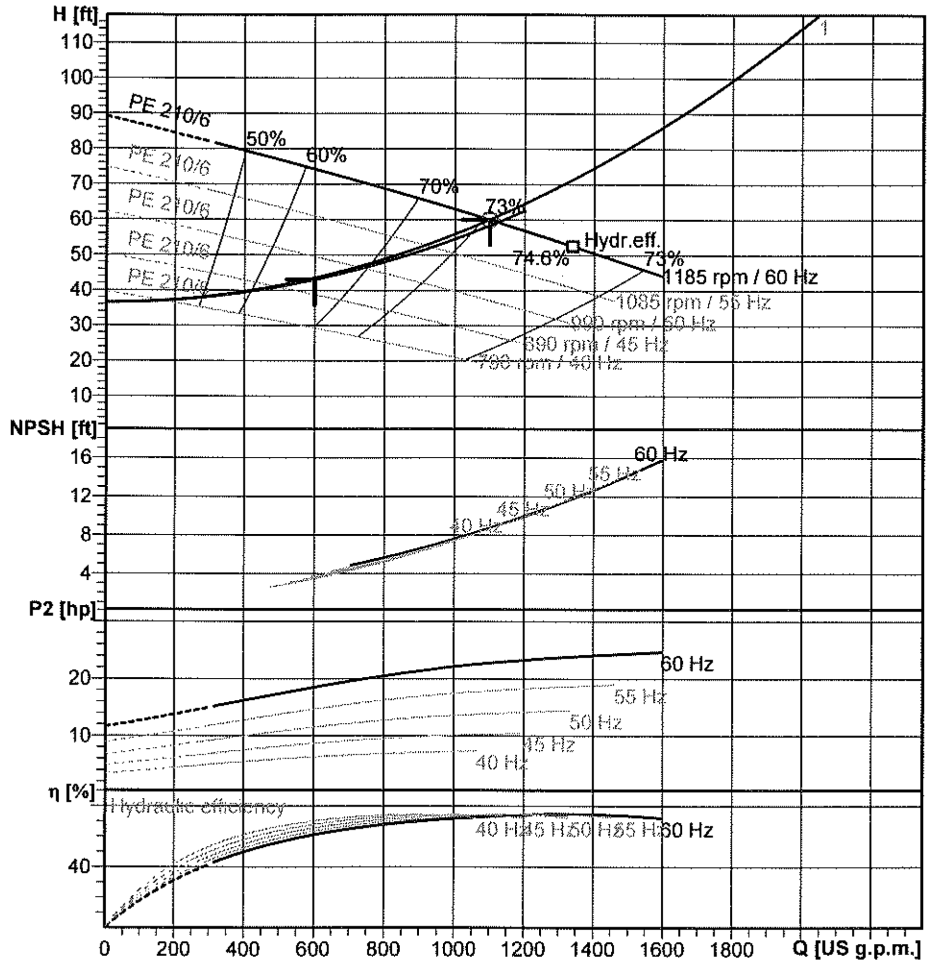
ABSEL PRO 1.7.2 / 2007-02-07

abs

We know how water works

240

XFP 150J-CH2 60 HZ



Testnorm
Hydraulic Institute

2009-11-10

Operating data specification			
Flow	1099 US g.p.m.	Head	60 ft
Static head	36.5 ft	Efficiency	73.2 %
Shaft power	22.7 hp	NPSH	8.7 ft
Fluid	Water	Temperature	39 °F
Nature of system	Single head pump	No. of pumps	1

Pump data			
Type	XFP 150J-CH2 60 HZ	Make	ABS
Series	XFP PE4-PE6	Impeller	2-vane channel impeller
N° of vanes	2	Impeller size	14.4..10.2 inch
Free passage	3 1/8 x 3 7/8"	Suction port	

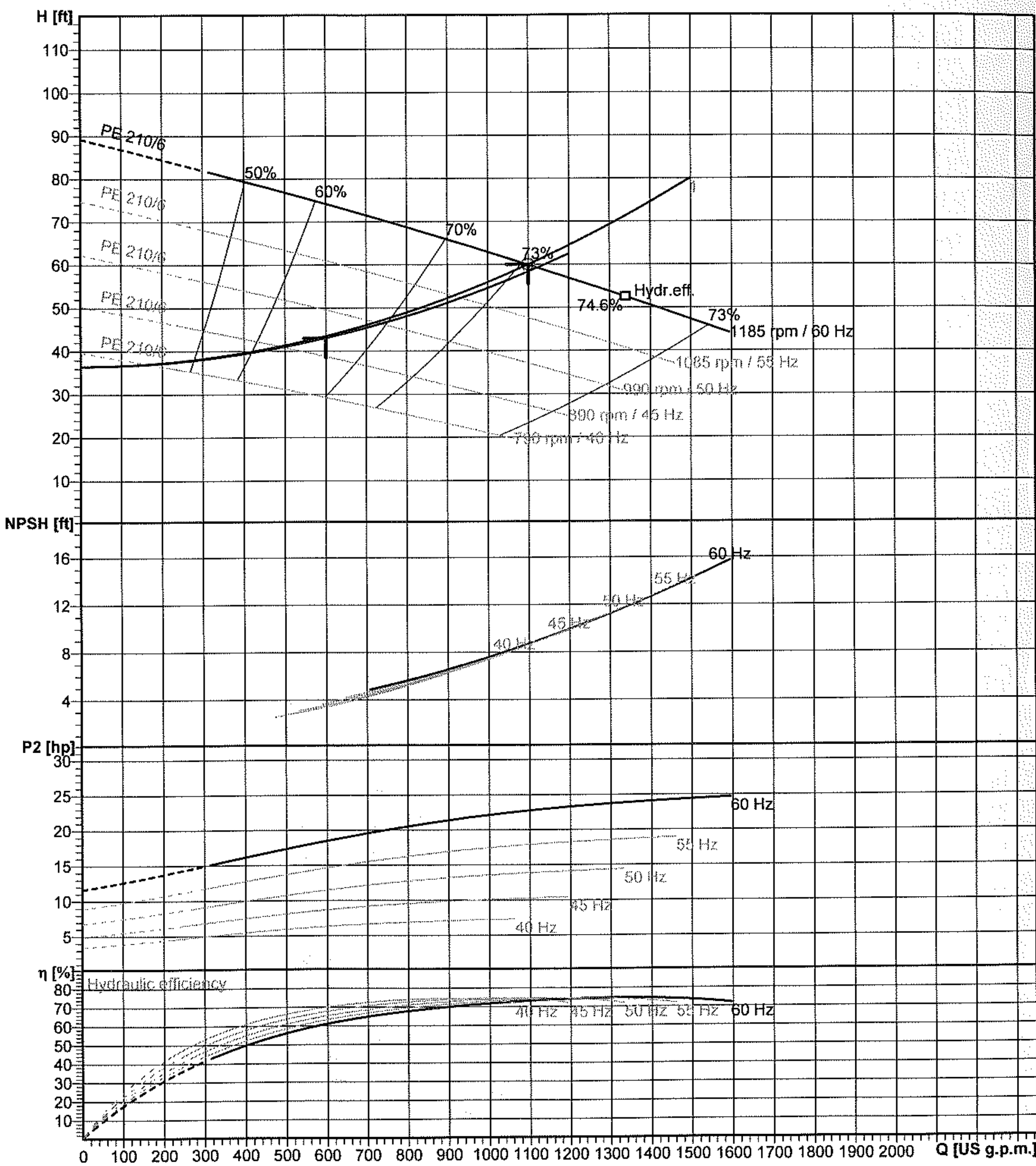
Motor data			
Rated voltage	460 V	Frequency	60 Hz
Rated power P2	28.2 hp	Nominal speed	1185 rpm
Number of poles	6	Efficiency	93 %
Power factor	0.811	Rated current	35 A
Starting current	231 A	Rated torque	125 lbf ft
Starting torque	300 lbf ft	Degree of protection	IP68
Insulation class	F		

abs

INITIAL

Pump performance curves
XFP 150J-CH2 60 HZ

			Curve number	
			Reference curve XFP 150J-CH2	
			Discharge	Frequency 60 Hz
Density 62.43 lb/ft³	Viscosity 0.0000169 ft²/s	Testnorm Hydraulic Institute	Rated speed 1185 rpm	Date 2010-02-05
Flow 1099 US g.p.m.	Head 60 ft	Rated power 22.7 hp	Hydraulic efficiency 73.2 %	NPSH 8.7 ft



Impeller size	N° of vanes	Impeller	Solid size	Revision 2009-11-10
14.4..10.2 inch	2	2-vane channel impeller	3 1/8 x 3 7/8"	

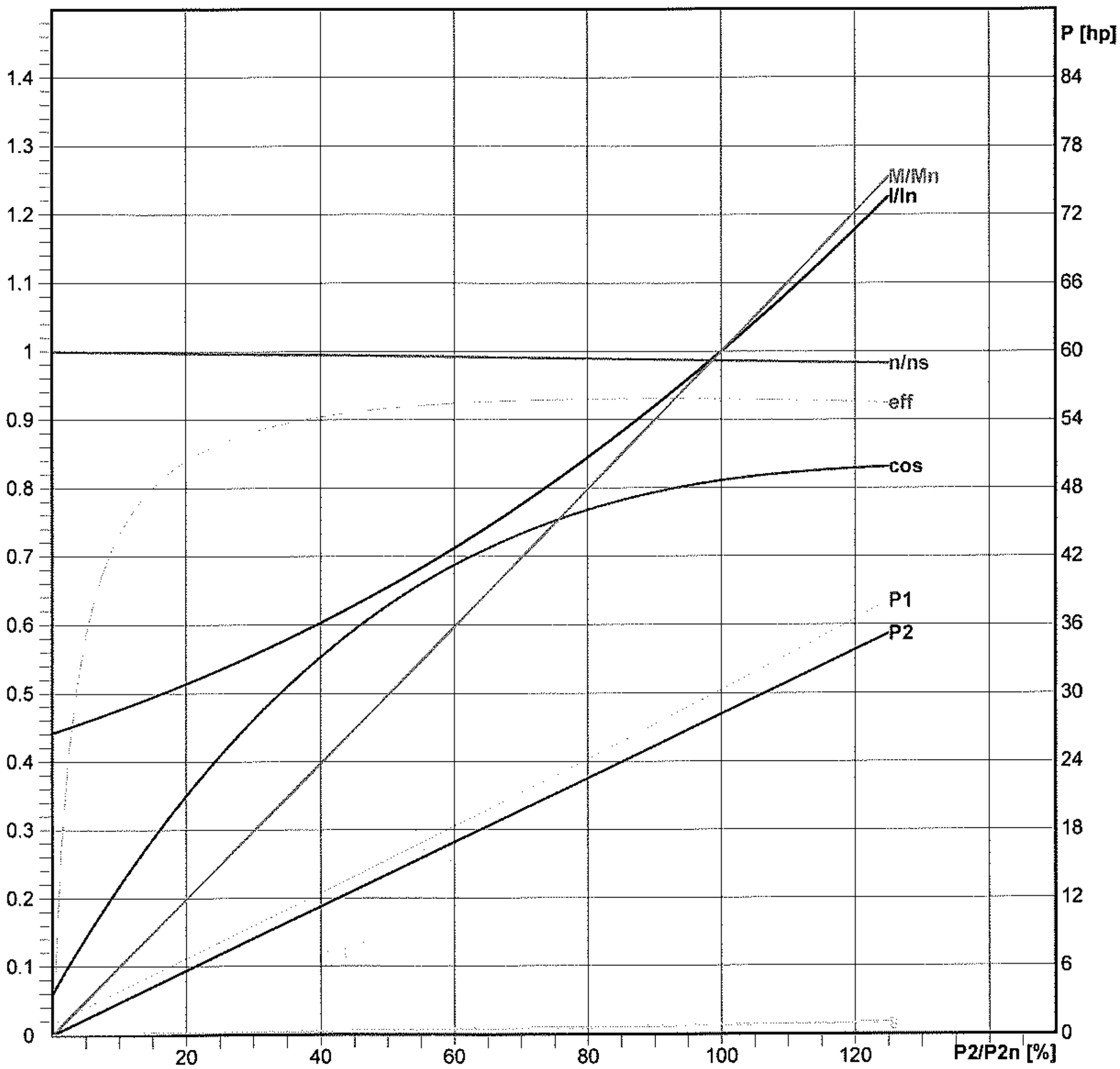
ABSEL PRO 1.7.2 / 2007-02-07

abs
We know how water works

Motor performance curve
PE 210/6

Frequency
60 Hz

Rated power	Service factor	Nominal speed	Number of poles	Rated voltage	Date
28.2 hp		1185 rpm	6	460 V	2010-02-05

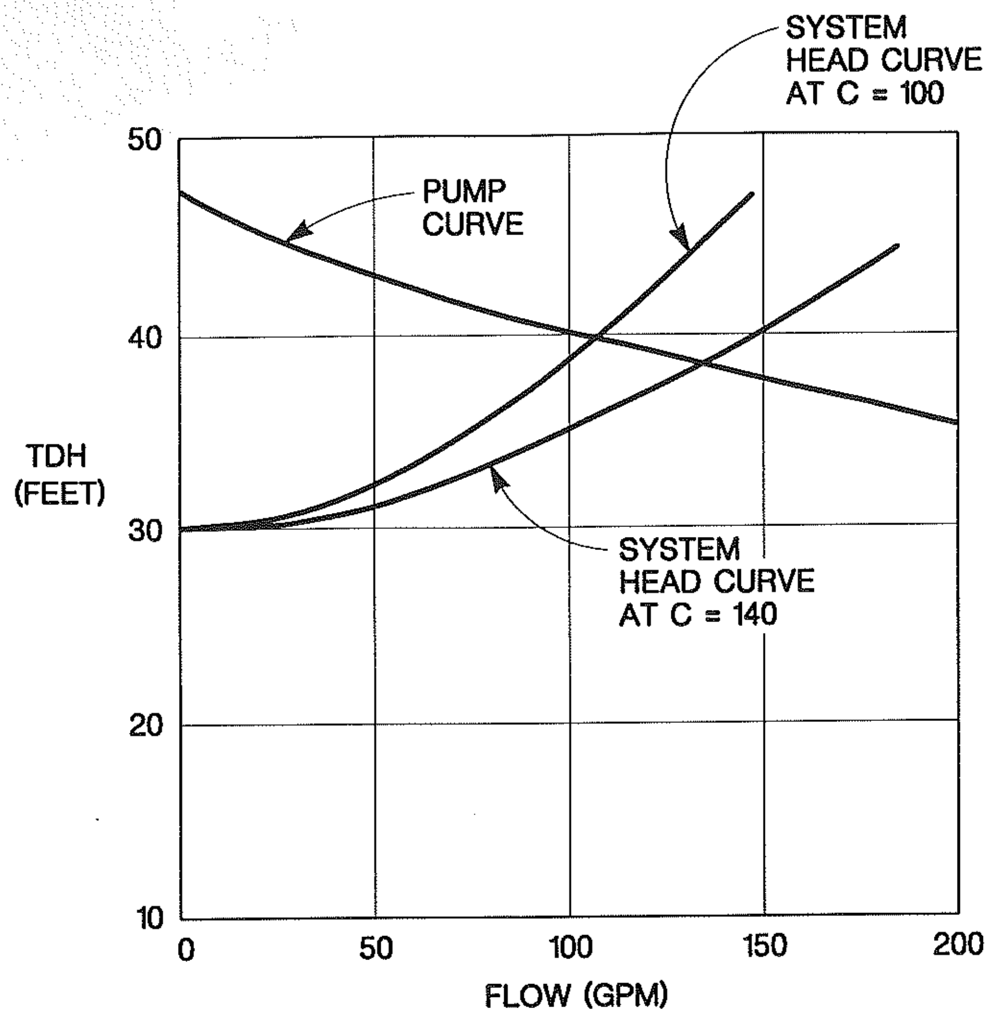


Loading	No load	25 %	50 %	75 %	100 %	125 %
P1 [hp]	0.9888	8.141	15.36	22.73	30.28	38.06
P2 [hp]	0	7.04	14.08	21.12	28.16	35.2
I [A]	15.43	18.67	22.89	28.29	34.96	42.87
eff [%]	0	86.48	91.69	92.91	93	92.48
cos	0.05999	0.4081	0.6279	0.7521	0.8107	0.831
n [rpm]	1199	1196	1192	1188	1184	1179
M [lbf ft]	0	30.92	62.04	93.38	124.9	156.8
s [%]	0.08333	0.3333	0.6667	1	1.333	1.75

Tolerance according to VDE 0530 T1 12.84 for rated power

Starting current	Starting torque	Moment of inertia		
231 A	300 lbf ft	8.94 lb ft²		

 ABSEL PRO 1.7.2 / 2007-02-07



CITY OF NEWBERG

SHERIDAN STREET PUMP STATION SYSTEM CURVES

FLYGT	PERFORMANCE CURVE	PRODUCT CP3102.090	TYPE MT
DATE 2000-05-22	PROJECT Sheridan Street Pump Station	CURVE NO 63-434-00-3730	ISSUE 1

	1/1-LOAD	3/4-LOAD	1/2-LOAD
POWER FACTOR	0.88	0.86	0.79
EFFICIENCY	81.0 %	82.5 %	81.5 %
MOTOR DATA	---	---	---

RATED POWER	5.0	Hp
STARTING CURRENT ...	31	A
RATED CURRENT ...	6.5	A
RATED SPEED	1715	rpm
TOT.MOM.OF INERTIA ...	0.36	kgm2
NO. OF BLADES	1	

COMMENTS

INLET/OUTLET: - /100 mm

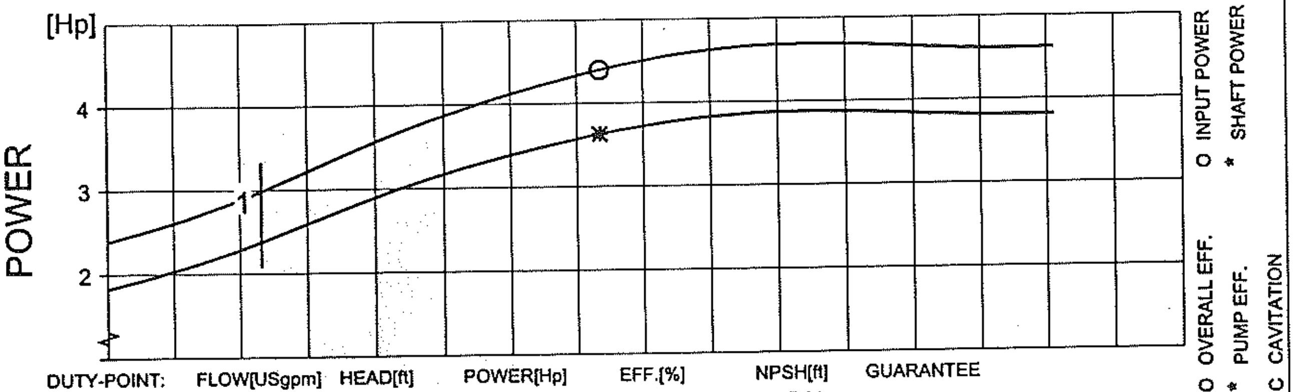
IMP. THROUGHLET: 76 mm

IMPELLER DIAMETER: 173 mm

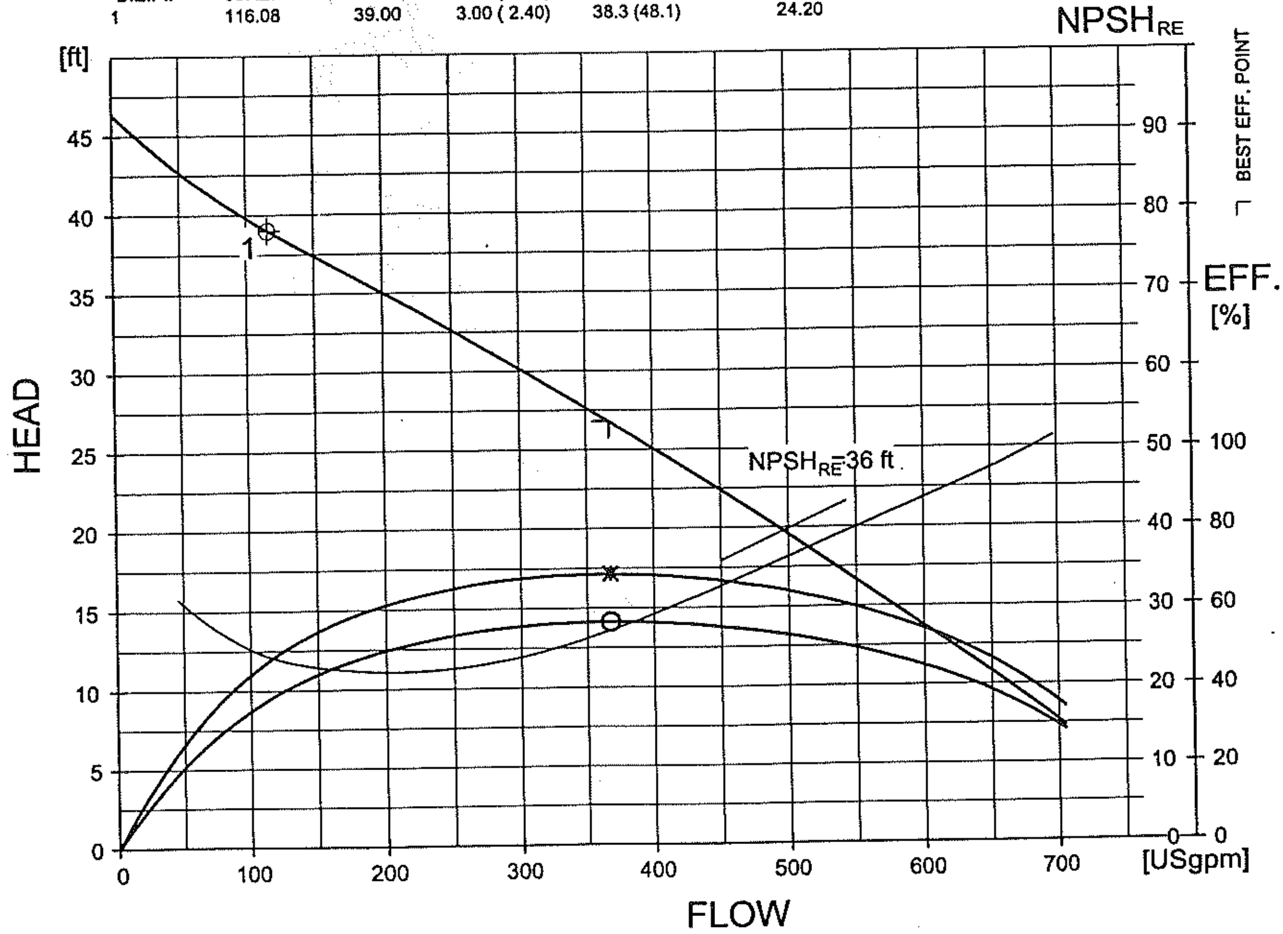
MOTOR #	STATOR	REV
18-11-4AL	12YSER	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	230 V	4

GEARTYPE	RATIO
---	---



DUTY-POINT:	FLOW[USgpm]	HEAD[ft]	POWER[Hp]	EFF.[%]	NPSH[ft]	GUARANTEE
B.E.P.:	367.27	26.79	4.40 (3.63)	56.6 (68.6)	27.24	
1	116.08	39.00	3.00 (2.40)	38.3 (48.1)	24.20	



FLYPS 2.0 (1118)

Performance with clear water and ambient temp 40 °C

FLYGT CURVE

Pump Station Check List Monthly

Month: Jan

Note all discrepancies or needs and write work requests	614 Andrew st.	922 Charles St.	1345 Creekside Ln.	618 Sheridan St.	830 Dayton Ave.	4501 E Fernwood RD.	2500 NE. Chehalem	HWY 240 319 W Illinois St.
Date	1/10/17	1/10/17	1/10/17	1/10/17	1/10/17	1/10/17	1/10/17	1/10/17
Operator Initials	ET/BS	ET/BS	ET/BS	BS/ET	BS/ET	BS/ET	BS/ET	ET/BS
Fire Extinguisher's	N/A	N/A	N/A	N/A	X	X	X	X
Check for no alarms, "Available" lights are lit	X	X	X	X	X	X	X	X
Check pump #1 operation	X	X	X	X	X	X	X	X
Pump #1 Hours	8069.3	7894	2576.7	911	27208	10024.3	3156.5	4871.3
Check pump #2 operation	X	X	X	X	X	X		X
Pump #2 Hours	7777.9	7368	2161.2	764.2	26290.1	9560.5	3064.9	4944.8
Check pump #3 operation	N/A	N/A	N/A	N/A	N/A	X	N/A	X
Pump #3 Hours	N/A	N/A	N/A	N/A	N/A	3565.7	N/A	4904.4
Check high level alarm operation	X	X	X	X	X	X	X	X
Check that flush valve operates correctly	X	X	X	X	N/A	X	X	N/A
Wetwell								X
Washdown wetwell piping and pump rails	X	X	X	X	N/A	X	X	X
Wash down level probe and float	X	X	X	X	Grease Air Relief Valves	X	X	X
Check for debris or heavy grease	X	X	X	X	X	X	X	X
Valve Vault and BFPD Box								
Clean vault and grating and fill "P" trap	X	X	N/A	X	N/A	X	X	X
Ensure no standing water or debris in vault	X	X	N/A	X	N/A	X	X	X
Check for leaking plumbing	X	X	X	X	N/A	X	X	X
Check heat tape on RP device in winter	X	X	N/A	X	N/A	X	X	X

	Andrews	Charles	Creekside	Sheridan	Dayton Ave.	Fernwood	Chehalem	HWY 240
Control Cabinet								
Cabinet heater working (ambient below 50F) Cabinet fan working (ambient above 80F)	X	X	X	X	X	X	X	X
Check for moisture in cabinet	X	X	X	X	X	X	X	X
Secure Area Before Leaving								
Trash picked up? Area clean?	X	X	X	X	X	X	X	X
Any vandalism or problems noted	X	X	X	X	X	X	X	X
Water shut off to BFP Device	X	X	N/A	X	N/A	N/A	X	X
Float and Multitrode probe in place	X	X	X	X	X	X	X	X
Pumps are in Auto? Breakers shut?	X	X	X	X	X	X	X	X
Everything is Locked	X	X	X	X	X	X	X	X
Generators								
Hour Reading	303.1	111.3	Check UPS Operation	Check UPS Operation	344.1	367.4	276.8	109.3
Fuel Level	N/A	*Full*			N/A	Full	Full	N/A
Oil Level	Ok	Ok			Ok	Good	Good	Good
Test Operation	X	X			**X**	X	X	X

Comments: generator is not working at this time waiting for pasts from onan

DAYTON AVENUE LIFT STATION REHABILITATION ALTERNATIVES LETTER REPORT

Prepared by RH2 Engineering, Inc.

Date: April 7, 2016

RH2 ENGINEERING, INC.
www.rh2.com
mailbox@rh2.com
1.800.720.8052

WASHINGTON LOCATIONS

BOTHELL
MAIN OFFICE
22722 29th Drive SE, Suite 210
Bothell, WA 98021

BELLINGHAM

EAST WENATCHEE

ISSAQUAH

RICHLAND

TACOMA

OREGON LOCATIONS

NORTHERN OREGON
MAIN OFFICE
6500 SW Macadam Ave. Suite 125
Portland, OR 97239

SOUTHERN OREGON
Medford

April 7, 2016

Mr. Jason Wuertz, P.E.
Project Manager
City of Newberg
Public Works Department
414 East First Street
Newberg, OR 97132

Sent via: *US Mail and E-Mail*

Subject: Dayton Avenue Lift Station Rehabilitation Alternatives Letter Report

Dear Mr. Wuertz:

As requested by the City of Newberg (City), RH2 Engineering Inc., (RH2) has completed its evaluation of the Dayton Avenue Lift Station's (Station) condition and hydraulic performance. This letter is intended to present the findings of this evaluation and to provide recommendations for remedial actions, including alternatives for both rehabilitating and replacing the Station.

Background

The City constructed the Dayton Avenue Lift Station in 1993 as a replacement for the 8th Street Lift Station. Designed as an above-grade, self-priming sewer pump station, the Station is equipped with two (2) 75-horsepower (hp) 10-inch Model T10A-B Gorman-Rupp self-priming centrifugal pumps. These pumps are located within a 320 square foot pump and electrical building located on top of a 12-foot-diameter, 10-foot deep wetwell. Operation of the Station is controlled with a Multitrode MultiSmart Pump Station Manager that is configured to operate based on the wetwell level as reported by an ultrasonic level sensor. The Station flow rate is calculated based on the pump run time, and change in wetwell level between pump start and stop. The wetwell is equipped with floats for pump on/off control and high level alarm. The Station is connected to the City's master supervisory control and data acquisition (SCADA) system which provides monitoring of station flows and alarm conditions. The Station is also equipped with a 125 kilowatt (kW), natural gas fueled, back-up generator that is located outdoors and adjacent to the building.

Sewage discharge from the Station is pumped into an approximately 4,000-foot-long, 12-inch-diameter force main that discharges into a receiving manhole, located near the intersection of East 9th Street and South River Street. The force main rises from an elevation of approximately 105 feet at the Station, to approximately 162 feet at the receiving manhole, and is equipped with two sewage air relief valves and one cleanout along the alignment. The force main pipe materials consists of both ductile iron and SDR 26 polyvinyl chloride (PVC). The majority of the force main, which originally served the 8th Street Lift Station, was upgraded in 1985. Approximately 650 feet of ductile iron force main was constructed as part of the Station upgrade in 1993.

According to Dayton Avenue Lift Station as-constructed record drawings, the design criteria listed indicates that each pump in the Station was originally intended to have a pumping capacity of 2,100 gallons per minute (gpm) at 90 feet total dynamic head (TDH). However, City operators have reported numerous instances where the actual pumping capacity has been greatly reduced, with observed pumping rates as low as 1,300 gpm. As a result of the reduced and/or erratic pumping capacity, as well as other factors, the Station has historically been prone to sewage overflows. In an effort to reduce loading on the Station, the City constructed the Highway 240 Lift Station in 2009 to transfer up to 600 gpm from the Station's basin to the neighboring basin (*City of Newberg Sewerage Master Plan Update 2007*, prepared by Brown and Caldwell, and revised in 2009). While this has helped to reduce the frequency of sewage overflows, the Station continues to have problems with poor performance and low reliability.

The City hired RH2 to evaluate the current condition and performance of the Station, and to recommend alternatives for rehabilitation and/or replacement of the Station to address these ongoing issues. This report summarizes these findings and recommendations.

Historical Station Flows and Overflows

According to City-provided overflow records, 15 overflow events occurred between 2005 and 2009, with 9 of these events occurring within 2006. Almost all overflow events during this period were attributed to high rain storm events, during which flows at the Newberg Wastewater Treatment Plant peaked between 13.0 and 20.5 million gallons per day (MGD). Between 2009 and 2012, the number of overflow events decreased to only four events, of which three events were attributed to a power or sensor failure, and only one event attributed to a high rainfall event. In 2015, overflow events occurred on December 7th and 17th, both of which are attributed to high rainfall events.

To evaluate the effect that either an increase/decrease in precipitation, and/or the construction of the Highway 240 Lift Station may have had on reducing the frequency of the overflow events at the Station, RH2 analyzed the precipitation data over this time period. As shown in **Table 1**, six of the seven rainfall-related overflow events occurred prior to the construction of the Highway 240 Lift Station. During this time, the average annual rainfall was generally less than the annual rainfall that has occurred since the Highway 240 Lift Station was constructed. In addition, seven of the top ten precipitation events have occurred since the Highway 240 Lift Station was constructed, only one of which resulted in an overflow event at the Dayton Avenue Lift Station.

Table 1
Historical Precipitation (Years 2005 through 2013)

Average Daily Precipitation (Inches)										
Month	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
1	0.06	**0.37**	0.12	0.24	0.19	0.22	0.15	**0.26**	0.07	0.19
2	0.02	0.08	0.18	0.08	0.08	0.13	0.16	0.11	0.06	0.10
3	0.14	0.12	0.10	0.15	0.13	0.18	**0.25**	**0.29**	0.08	0.16
4	0.10	0.08	0.07	0.10	0.08	0.13	0.18	0.13	0.07	0.10
5	0.13	0.09	0.03	0.05	0.12	0.15	0.15	0.12	0.14	0.11
6	0.07	0.03	0.03	0.04	0.02	0.11	0.04	0.10	0.04	0.05
7	0.02	0.00	0.02	0.00	0.01	0.01	0.04	0.03	0.00	0.01
8	0.01	0.00	0.02	0.05	0.01	0.00	0.00	0.00	0.02	0.01
9	0.08	0.03	0.08	0.01	0.06	0.07	0.04	0.00	**0.25**	0.07
10	0.11	0.04	0.17	0.05	0.12	0.19	0.08	0.22	0.03	0.11
11	0.18	**0.40**	0.16	0.17	0.24	0.20	0.21	**0.27**	0.11	0.21
12	**0.29**	0.20	0.24	0.14	0.18	**0.31**	0.12	**0.30**	0.07	0.20
Average	0.10	0.12	0.10	0.09	0.10	0.14	0.12	0.15	0.08	0.11

Data Source: Weather Underground (www.wunderground.com)

#.##	Average daily precipitation exceeds monthly average between 2005 and 2013.
#.##	Average daily rainfall within top 10-percent of all precipitation events between 2005 and 2013.
#.##	Reported overflow event related to rainfall event.

This analysis would suggest that the following statements are true:

1. The Highway 240 Lift Station has been effective at reducing flows to the Dayton Avenue Lift Station.
2. The current pumping capacity at the Dayton Avenue Lift Station appears to be sufficient to handle basin inflows.
3. The cause(s) of the overflows may be related to factors unrelated to the pumping capacity of the Station.

A further analysis of the lift station performance and pumping capacity is provided later in this report.

Condition Assessment

On July 23, 2015, RH2 conducted a condition assessment and performance testing of the Station and force main. The condition assessment included visual inspection of Station components and interviews with City operations staff regarding maintenance and operation of the Station. This assessment identified a number of deficiencies, which are summarized in **Table 2**, with a more detailed discussion of the condition of Station components to follow. The noted Station deficiencies provided in **Table 2** are assigned a priority ranking, ranging from 1 to 5, with 1 having the highest priority and 5 the lowest. **Table 2** also provides recommended remedial actions for the listed station deficiencies, which are separated into short-term and long-term improvements. Short-term improvements would address immediate needs to improve operation and reliability of the Station, while long-term improvements address long-term needs, including the recommended replacement of the Station. A more detailed discussion of the recommended remedial actions is provided in the last section of this report.

Table 2
Summary of Deficiencies and Recommended Actions

Summary of Deficiencies and Recommended Actions			
Lift Station Deficiencies	Priority Level	Recommended Action	
		Short-term Improvements	Long-term Improvements
The 3-way plug valve located at the pump discharge is broken. This results in the inability to isolate the pump station from the force main for routine maintenance and repairs.	1	Remove and replace existing 3-way plug valve with new full-port 3-way valve. Cut sheets for a replacement valve are included in the Attachments.	N/A
The Station has no means of isolation or bypass pumping for use in an emergency or during rehabilitation.	1	Provide bypass pumping port and isolation valve. See Preliminary Design Bypass Pumping Alternatives plan in the Attachments for details.	N/A
The Check Valves at Pump No. 1 and No. 2 are showing signs of leakage at the hinge pin.	1	Repair/replace check valve packing at the hinge pin.	N/A
The availability of spare parts for the pumps is limited.	2	N/A	Recommend eventual replacement of pumps with submersibles. See Conceptual Site Plan in the Attachments for details.
The ultrasonic level sensor readings do not appear to accurately represent values measured during drawdown testing.	2	Verify and adjust ultrasonic level sensor calibration, programming, and signal scaling.	Perform regular inspection and calibration of level sensing equipment.
Lift station experiences regular "brownouts" that have caused station programming and control problems.	2	Install temporary data logging power meter to monitor power quality and usage to better pinpoint source and cause of power sag.	Based on monitoring results, evaluate and install voltage sag protector or uninterruptible power supply (UPS) unit.
It appears that pump discharge flow is being recirculated back to the wetwell through the pump air release valve when the pump is operating at full capacity. The air release valve should close once the pumps have reached a fully primed condition.	4	Contact pump manufacturer and service/adjust air release valves so that valves close under fully primed conditions.	N/A
Pressure gauge installed along force main at Cleanout Man Hole is installed with a 0 to 60 psi range that exceeds the anticipated operating pressure at this point.	5	Recommend replacing gauge with 0 to 10 psi gauge to improve accuracy of gauge readings.	N/A
Suction side check valve and air valves have been know to stick open, resulting in loss of prime and reduced capacity.	3	Perform regular maintenance on suction side check valves and air release valves per manufacturer recommendation.	Recommend eventual replacement of pumps with submersibles. See Conceptual Site Plan in the Attachments for details.
The wetwell has limited capacity and only provides 0.12 hour average time to overflow (per original design). Size does not provide adequate response time should pump failure or loss of prime occur.	2	N/A	Recommend eventual replacement of pumps with submersibles. See Conceptual Site Plan in the Attachments for details.
According to as-built records, it appears that the last 1,350 lineal feet of force main is installed with a sag in the main with only a minor elevation difference between the upstream and downstream high points on either side of the sag. In RH2's experience, this type of condition often results in unstable hydraulic condition due to a siphoning effect that can occur under certain flow conditions. These conditions can affect pump performance. While it does not appear that this condition affected the pump performance during recent testing, it may help explain the anecdotal reports from operators of reduced and/or fluctuating pumping rates.	5	N/A	N/A
It appears that the system may be experiencing a minor increase in headloss (approximately 2 to 3 psi over new conditions). This increase may be due to pump wear, minor blockage, or corrosion within the force main.	4	N/A	Recommend installing pigging station and performing closed-circuit television (CCTV) investigation and pigging of the force main.

Pumps

The Station is equipped with two (2) 75-hp 10-inch Model T10A-B Gorman-Rupp self-priming centrifugal pumps with 14 ¾-inch impellers. The pumps are intended to operate at 2,100 gpm, with one running and one redundant during normal flows, alternating between pump cycles. During high flow periods, the two pumps are intended to operate in parallel at a combined capacity of 2,500 gpm. While originally designed to operate at a capacity of 2,100 gpm at 90 feet of TDH, the pumps have been observed to be operating at a significantly lower capacity, with pumping rates as low as approximately 1,300 gpm. This observation was confirmed during drawdown testing performed by RH2, results of which are presented in the **Capacity Assessment** section of this report. Further, City operators have reported that the pumps routinely lose prime and have experienced frequent clogging issues, which have resulted in the pumps overheating and Station overflows.

The pumps are installed with pressure gauge assemblies, containing both suction and discharge pressure gauges for each pump. Both gauge assemblies are original and of questionable condition. New 0 to 60 pounds per square inch (psi) discharge pressure gauges have been installed near the original gauge tap location and appear to be in good working condition. The suction side pressure gauges appear operational, but have not been confirmed to provide accurate readings.

Maintenance of the pumps is made difficult by the inability of the pumps to be isolated due to a broken 3-way plug valve at the pump discharge header. As a result, operators must rely on the discharge side check valves to hold back the contents of the force main to perform maintenance on the pumps. Due to safety concerns caused by the inability to isolate the pumps, routine maintenance and inspection of the condition of internal components, such as impellers, casing, wear plates, and clearances, have been deferred, possibly causing inefficient and unreliable pump performance. These issues, coupled with limited availability of spare parts for the pumps, have further increased the difficulty of properly maintaining the pumps.

Wetwell

The Station has a 12-foot-diameter, 10-foot-deep wetwell with approximately 6,500 gallons of storage capacity. According to the design criteria shown in the as-constructed records for the Station, the wetwell was intended to provide approximately 7 minutes of storage prior to overflow should pump failure occur. According to the pump manufacturer, under normal operating conditions the pumps are capable of self-priming in approximately 5 minutes. While this length of time may be adequate under normal operating conditions, it may be inadequate during higher than typical flows. In this instance, the limited wetwell capacity has been insufficient in providing adequate time to respond to and correct issues caused by poor pump operation, resulting in sewage overflows.

Aside from the limited capacity, the wetwell appears to be in good condition. Accumulation of fat, oils, and grease (FOG) does not appear to be a significant issue, and the City performs annual cleaning of the wetwell to remove grease and grit. Also, soluble sulfides and odor do not appear to be a significant problem in the wetwell. There is minor deterioration of the cement on the wetwell interior wall, but the wetwell remains in sound structural condition.

In 2008, the City retrofitted the wetwell and installed a "V" shaped plate at the influent pipe to break up the influent flow and minimize air entrainment in the wetwell. Prior to installation of the diverter plate, the Station had been experiencing significant problems with pump cavitation due to the influent drop into the wetwell, leading to air entrainment at the pump suction. Since installation of this diverter plate, it appears the problem with cavitation has been resolved.

Valves and Piping

The Station piping consists of 10-inch ductile iron suction, and 10- and 12-inch ductile iron discharge piping. There is a 10-inch plug valve and a flap check valve on the suction side of each pump. The flap check valves serve to keep the suction piping full and maintain pump prime. A 10-inch spring check valve is located on the discharge side of each pump. Air release valves are also located on the discharge side of the pumps, which are tapped into the upstream side of the swing check valve. The air release valves act to evacuate air and facilitate self-priming of the pumps. A 10-inch, 3-way plug valve is located where the pump discharges meet at a common header and serves as the Stations only means of isolation from the force main.

In general, the piping appears to be in satisfactory condition given the age of the Station, and RH2 observed no signs of significant corrosion. That said, several problems associated with valves at the Station were observed that require remedial action. The most urgent issue associated with the Station is the inability to isolate the Station from the force main for routine maintenance or repairs due to the broken 3-way plug valve at the pump discharge. Further, the Station does not have a bypass piping system that would allow for replacement of this valve or other Station rehabilitative measures. The installation of a bypass pumping system and replacement of this valve should be a top priority.

City operators note that on occasion, the suction side check valves will not seat properly, resulting in loss of prime. Additionally, the pump discharge air release valves have been known to not close properly once the pump has reached a fully primed condition, resulting in minor reductions in pumping capacity. RH2 observed signs of minor leakage at the hinge pin of the check valve on the discharge side of Pump No. 2. Repair of these valves should be addressed in future lift station maintenance.

Force Main

The Station discharge is pumped through an approximately 4,000-foot-long, 12-inch-diameter force main that discharges into a receiving manhole, located near the intersection of East 9th Street and South River Street. The force main rises from an elevation of approximately 105 feet at the Station, to approximately 162 feet at the receiving manhole, and is equipped with two sewage air relief valves and one cleanout along the alignment, as shown in **Figure 1**. Pressure gauges are also installed along the force main at the air relief valve and cleanout locations. The force main materials consist of both ductile iron and SDR 26 PVC pipe. The majority of the force main, which originally served the 8th Street Lift Station, was upgraded in 1985. Approximately 650 feet of ductile iron force main was constructed as part of the Station upgrade in 1993.

Figure 1
Force Main Alignment and Pressure Gauge Locations

According to City records, it appears that the air relief valves were last serviced or replaced in March, 2012. During the condition assessment and performance testing performed on July 23, 2015, City staff observed a minor amount of air and wastewater purging from the second air relief valve along the force main, suggesting it is operating as intended. No such observation was made at the first air relief valve and its condition is unclear.

The pressure gauges installed at the air relief valves, both with a 0 to 30 psi range, appear to be in good condition. The pressure gauge located at the cleanout manhole appears significantly older and is installed with a 0 to 60 psi range. In general, it is recommended that pressure gauges be installed so that the normal operating pressure falls within 25 to 75 percent of the gauge range. Since normal operating pressure at this location is around 4 psi, the installed gauge greatly exceeds this standard recommendation and compromises the accuracy of pressure readings taken at this point. It is recommended that this gauge be replaced with a 0 to 10 or 0 to 15 psi range gauge.

Finally, City staff have reported that, at times, the receiving manhole has been observed in a flooded condition when both pumps are operating in parallel. This would suggest that the receiving gravity sewer line may be undersized to convey higher pumped flows. RH2 did not observe this during the performance testing, and it is unclear if this is a normal or infrequent event. It is recommended that further evaluation and modeling of the downstream system be considered as part of any future design related to the Station or force main.

A more detailed discussion of the condition of the force main is provided in the **Hydraulic Analysis** section of this report.

Controls and Telemetry

Operation of the Station is controlled with a Multitrode MultiSmart Pump Station Manager that is configured to operate based on the wetwell level as reported by an ultrasonic level sensor. The Station flow rate is calculated based on the pump run time and the corresponding change in wetwell level between pump start and stop times. The wetwell is equipped with floats for pump on/off control and high level alarm. The Station is connected to the City's master SCADA system, which provides monitoring of station flows and alarm conditions.

In general, the control and telemetry equipment appear to be in good condition, with the exception of the ultrasonic level sensing equipment that did not accurately represent level measurements taken in the field during drawdown testing. Any inaccuracy in level measurement will result in inaccurate flow rate data calculated by the Multitrode MultiSmart Pump Station Manager and collected by the SCADA system. The effect of this inaccuracy in the analysis of Station operation and pumping is discussed in further detail in the **Capacity Assessment** section of this report. Although it is not clear as to what is causing the inaccuracy in the readings, possible causes can include sensor orientation, calibration, programming, and/or signal scaling. It is recommended that the sensor be serviced by a technician to verify proper calibration, installation, and integration with the control system.

Electrical

The Station has a 480-volt, 3-phase, 300-amp electrical service, as well as a 125 kW natural gas powered back-up generator. Although the Station electrical components and emergency back-up generator appear to be in good working order, the station does experience regular "brownouts," which have caused programming and control issues as well as sewage overflows. The source of these brownouts is not clearly understood at this time and a more detailed investigation may be warranted. It is recommended that a data logging power meter be temporarily installed to monitor power quality and usage to better pinpoint the source of these "brownouts." Based on the evaluation of the monitoring results, it may be appropriate to install either a voltage sag protection or an uninterruptible power supply (UPS) unit to help protect against intermittent drops in power supply. Alternatively, the collected data may be of use in working with Portland General Electric to identify potential power distribution issues that could be corrected.

Capacity Assessment

Pump Performance Testing

On July 23, 2015, RH2 and City staff performed drawdown testing to evaluate the current pumping capacity of the Station. The drawdown testing procedure involved field measurements of the "Pump On" and "Pump Off" levels, and recording the wetwell fill and drawdown time between pump cycles. Repeated tests were conducted for each pump to confirm results. Based on the as-constructed wetwell geometry and recorded field measurements, the discharge capacity for each pump was calculated, and is summarized in **Table 3**. Results from the drawdown test, including field measurements and calculations, are attached to this report.

Table 3
Pump Capacity Based on Drawdown Testing

Pump	Capacity (gpm)
No. 1	1,344
No. 2	1,347

As shown in **Table 3**, drawdown testing shows the current operating capacity of the station as approximately 1,350 gpm. This is consistent with flow rates observed and noted by City staff in the past, although higher flow rates have also been observed, as discussed in the **Pump Run Time/Cycle Analysis** section of this report.

Pump Run Time/Cycle Analysis

The City-provided SCADA data included the cycles per day for each pump, run time per day for each pump, and total daily flow for the Station. This data covered the 2012, 2013, and 2014 calendar years. RH2 analyzed the data provided to calculate the approximate instantaneous pump flow rates for each day as shown in **Figure 2**. The design and tested flow rate of 2,100 gpm and 1,350 gpm, respectively, are also shown for reference.

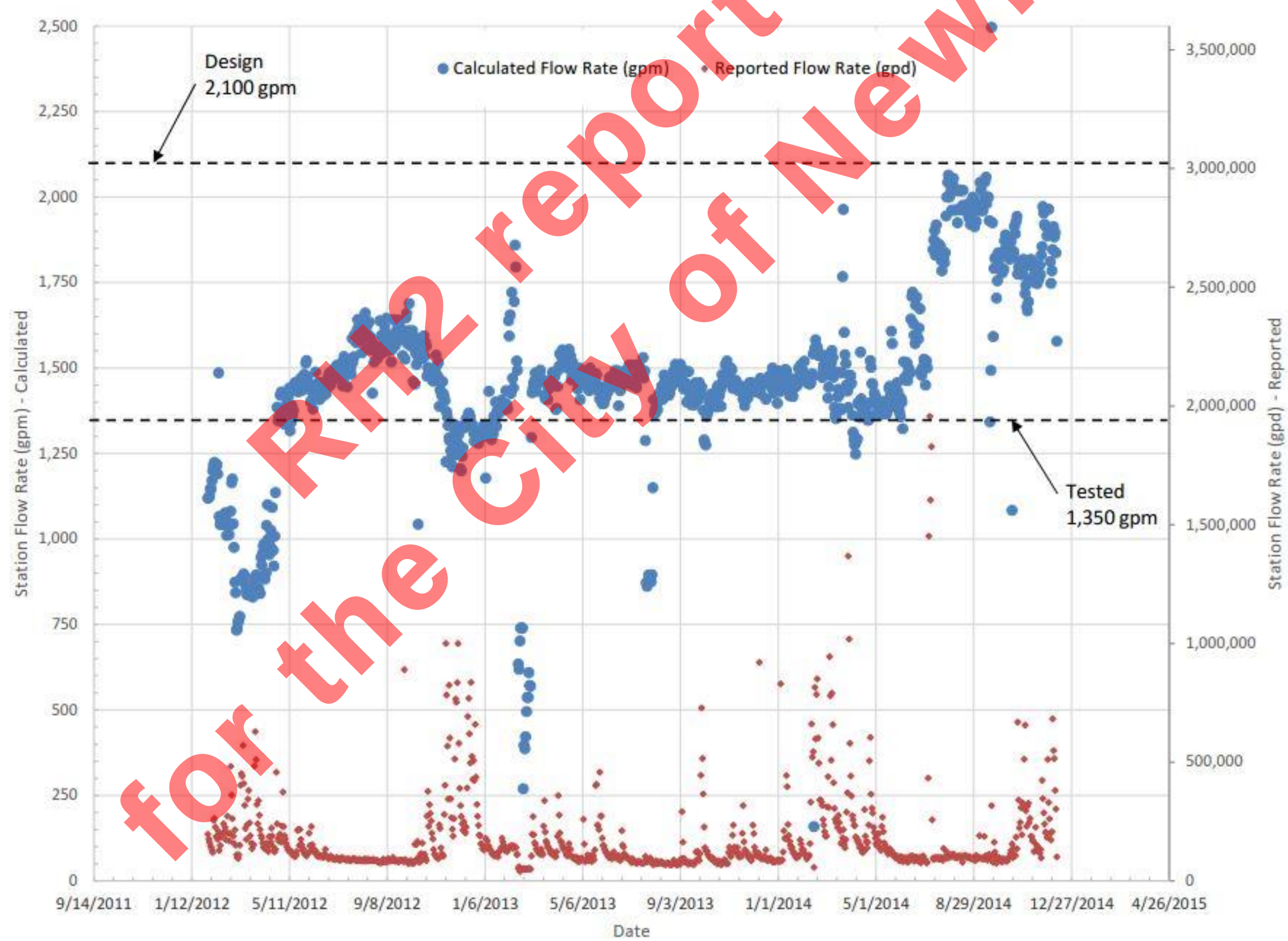


Figure 2
Historical Flow Rate (2012 to 2014)

As can be seen in **Figure 2**, the calculated flow rates vary considerably throughout the 3-year period encompassed by the data. This high variability in flow rates is likely do to inaccurate daily flow volumes provided by the SCADA data rather than actual variability of the pumps themselves. As the Station does not have a flow meter, daily flow volumes are calculated based on rates of change of level in the wetwell, pump run times, and pump starts as previously discussed. Since pump run times and pump starts are reliable, it is likely that the high variability seen in **Figure 2** is due to inaccurate level readings. As noted in the **Condition Assessment** section, it was observed that the level readings and pump flow rates displayed on the controller were not corresponding to levels measured in the field and tested flow rates, which tends to support this assessment.

Further, an analysis of the SCADA data was performed to determine the performance and operation of the individual pumps over the 3-year period, which is presented in **Table 4**. As shown in **Table 4**, it appears that Pump No. 1 and Pump No. 2 have historically been operating very similarly to each other. Particularly telling is the similarity in the average run time per cycle for each pump. This suggests that both pumps have operated at very similar rates over this period, which is consistent with drawdown testing results showing both pumps operating at about 1,350 gpm. This analysis indicates that the Station performance issues are likely not tied to a particular pump. Rather, it suggests that either the pumps are equally affected by other factors within the system, or that the pumps may be installed with a different belt configuration and operating at a lower speed.

Table 4
Individual Pump Run Time/Cycle Analysis

Item	Pump No. 1	Pump No. 2
Average Cycles/Day	33.1	33.1
Minimum Cycles/Day	13.0	13.0
Maximum Cycles/Day	122.0	122.0
Average Run Time/Day (min)	63.9	61.9
Minimum Run Time/Day (min)	21.0	18.0
Maximum Run Time/Day (min)	572.0	531.0
Average Run Time/Cycle (min)	1.8	1.7
Minimum Run Time/Cycle (min)	0.8	0.7
Maximum Run Time/Cycle (min)	8.3	7.6

Table 5 shows overall Station operation for the three-year period, as well as the performance for each individual year. An analysis of the operation over this period shows that the Station has operated fairly consistently. As shown in **Table 5**, the average run time per cycle has remained steady, suggesting that the Station capacity has also remained steady. The average starts per hour values show that the Station loading has remained fairly steady as well, with the exception of 2013, which had a drier than typical wet weather season.

Table 5
Analysis of Historical Station Operation

Item	Minimum	Maximum	Average
3 yr Historical Starts per Hour	0.5	5.1	1.4
2012 Starts per Hour	0.6	4.4	1.4
2013 Starts per Hour	0.6	3.9	1.1
2014 Starts per Hour	0.5	5.1	1.4
3 yr Historical Run Time/Cycle (min)	0.7	7.9	1.7
2012 Run Time/Cycle	1.4	7.9	1.7
2013 Run Time/Cycle	1.4	2.7	1.7
2014 Run Time/Cycle	0.7	5.0	1.7

Further, review of the three-year historical flow data shows that the Station received an average daily flow of about 0.17 MGD and peak day flow of about 1.5 MFD. The peak day flow of 1.5 MGD occurred on January 19, 2012, which also corresponds to the day of the maximum run time per day for each pump in **Table 4**. On this day, the pumps were operating a total of approximately 18.4 hours and could not keep up with the incoming flow, resulting in a sewage overflow. This was the only overflow event that occurred during the period encompassed by the SCADA data. While the Station was adequately handling average flows and most wet weather flows during this period, it was inadequate in handling this peak flow event.

Hydraulic Analysis

A system head curve for the Station was developed based on as-constructed records, assumed pipeline conditions, and the current operating capacity determined from drawdown testing. During the pump drawdown testing, pressure measurements were recorded at existing gauge locations along the force main alignment and at the pump discharge.

The measured pressure values were then compared to calculated pressure values based on the system head curve for new pipe conditions. The system head curve was then revised and validated to account for age and condition of the pipe by adjusting the roughness coefficient to match calculated pressures in the force main to measured field conditions. The calculated pressures differ from measured values by approximately 2 to 3 psi. This indicates that the system is experiencing a minor increase in headloss over original (new) conditions. The calculations for the system head curve are attached to this report. The system head curve, based on performance testing, was overlaid on the pump curve provided by the manufacturer, which can be seen in **Figure 3**.

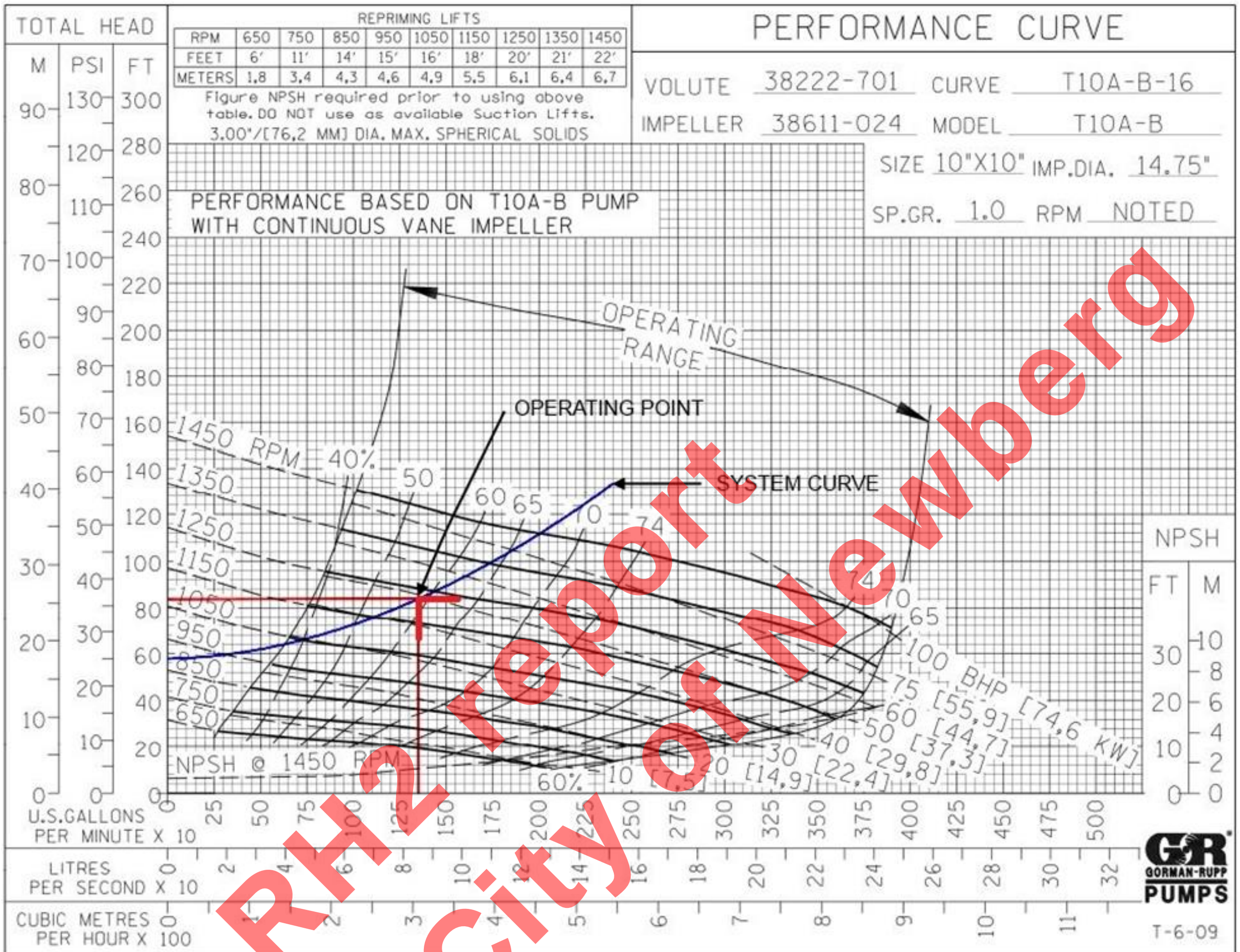


Figure 3
System and Pump Curves

The operating point of 1,350 gpm at a TDH of 84 feet obtained from the performance testing is also indicated in **Figure 3**. According to as-constructed records, the pumps are expected to be operating at a speed of 1,315 rotations per minute (rpm). However as shown in **Figure 3**, the system curve and performance testing data would suggest that the pumps are operating on the curve for a speed of approximately 1,250 rpm. A decrease in pumping capacity would typically indicate that the pumps are experiencing an increase in head in the system. However, this does not appear to be the case here as the pumps are operating at a lower head and lower capacity than originally designed. Although this may suggest that the pumps are operating at a lower speed than originally designed, the operating speeds of the pumps were field verified using a tachometer by City staff.

As previously discussed, the hydraulic analysis also shows that there is a minor increase in headloss over new conditions. This minor increase in headloss in the system could indicate a minor blockage or corrosion in the force main, although the TDH of the system is still less than that of the original design.

One possible cause of decreased capacity could be wear or damage to the impeller or casing due to the Station's history of problems with cavitation. According to email correspondence with the City and the pump supplier, the station was experiencing significant problems with cavitation due to the influent drop into the wetwell leading to air entrainment at the pump suction. To resolve this problem, the City installed a "V" shaped plate at the influent pipe to break up the influent flow and minimize air entrainment in the wetwell. Since installation of this diverter plate, it appears the problem with cavitation has been resolved, yet the pumps continue to perform poorly.

Also, according to as-constructed records, it appears that the last 1,350 lineal feet of force main is installed with a sag in the main, with only minor elevational differences between the upstream and downstream high points on either side of the sag. In RH2's experience, this type of condition often results in unstable hydraulic condition due to a siphoning effect that can occur under certain flow conditions. These conditions can affect pump performance. While it does not appear that this condition affected the pump performance during recent testing, it may help explain anecdotal reports from operators of reduced and/or fluctuating pumping rates; however, the siphoning effect would not be significant enough to account for the dramatic difference between the current operating capacity and the original design capacity.

Recommendations

Due to the configuration of the existing Station, it has been prone to a series of ongoing issues that affect the Station's maintainability, reliability, and performance. The following section presents two alternatives to address these issues: rehabilitation of the Station and replacement of the Station. The rehabilitative alternative includes short-term measures that could be implemented now to improve maintainability and operational reliability of the Station, yet this rehabilitative alternative does not address the long-term needs of the Station for several reasons. First, the use of above-grade self-priming pumps, coupled with the limited capacity of the wetwell, make the Station more prone to sewage overflows. Second, the availability of spare parts for the installed pumps is limited, making continued maintenance of the pumps increasingly difficult. Finally, due to the existing layout of the Station, retrofitting the Station in place with submersibles is not feasible. For these reasons, RH2 recommends the following short-term improvements be implemented with the intention of ultimately replacing the Station.

Station Rehabilitation Alternative

As previously discussed, the most urgent remedial action is to provide a means of bypass pumping to be able to take the Station offline for further maintenance and rehabilitative actions. The Bypass Pumping Alternatives Plan is attached to this report. The first alternative involves the installation of an Inserta-Valve and a tapping sleeve with the valve just downstream of where the future lift station connection would be. Once installed, the tapping tee and valve would serve as a connection point for bypass piping, as well as a pigging station, and the Inserta-Valve would serve as a means of isolating the Station from the force main. The second alternative would connect bypass piping to the upstream side of the existing butterfly valve at the abandoned 8th Street Lift Station site. Both alternatives would utilize a temporary, diesel-driven bypass pump drawing wastewater from the existing wetwell through the access opening.

Once bypass pumping is in place and the Station is isolated from the force main, further rehabilitative actions can be performed. These rehabilitative actions were previously summarized in **Table 2** and are presented below in order of need/urgency. These actions include:

- Removing and replacing the broken 3-way plug valve with a new full-port 3-way valve;
- Verifying and adjusting the ultrasonic level sensor orientation, calibration, programming, and signal scaling;
- Installing a temporary data logging power meter to monitor power quality and usage to better pinpoint the source and cause of the reoccurring "brownouts" at the Station;
- Servicing and repairing the other valves within the Station, including the suction side check valves, the air release valves, and the discharge side check valve for Pump No. 2; and
- Performing closed-circuit television inspection and pigging of the force main.

Station Replacement Alternative

As the Station rehabilitation alternative does not meet the long-term needs of the Station, the replacement of the Station is the preferred alternative. The existing configuration of the Station is not appropriate for the application, and RH2 recommends replacing the Station with a submersible configuration with a higher capacity wetwell.

The Dayton Avenue Lift Station Replacement Conceptual Site Plan is attached to this report, and shows a conceptual plan for replacing the Station with a new station on the existing property. The new lift station would be comprised of a new 12-foot-diameter, 20-foot-deep wetwell with triplex submersible pumps and a new valve/meter vault. The existing building and emergency generator would remain in place. The overflow of the new wetwell would be configured to utilize the existing Station for overflow storage and pumping. Due to the existing site layout and topography, the work would involve site regrading and retaining walls. Also, the influent 18-inch and 8-inch gravity sewers would be intercepted at new manholes and rerouted to the new wetwell.

As previously discussed and based on the information available, it appears that issues at the Station are more likely attributed to pump selection and Station reliability than a lack of pumping capacity. Even when operating at a lower capacity than intended in the original design, the Station has had only three overflow events due to wet weather in the last 3 years. Further, the City has taken steps to divert flows within the basin and has begun a multi-year infiltration and inflow reduction program that is anticipated to further stabilize Station inflows. Based on the information available at this time, RH2 expects that the future Station capacity would be in the range of 1,500 to 1,900 gpm. Due to the concern regarding the accuracy of the Station flow records, it may be beneficial to consider installing flow monitoring in the upstream manhole to obtain a better understanding of Station inflows for future pump selection. This should be done as part of the preliminary design of the Station replacement.

Table 6 provides an engineer's planning-level estimate for the replacement of the Dayton Avenue Lift Station.

Table 6
Engineer's Planning-level Estimate for Station Replacement Alternative

	Construct New Lift Station with Three Submersible Pumps	Matl Units	Total Cost
Construction			
1	Mobilization/Demo/Site Prep/Cleanup/Demobilization (7% of Construction Cost)	LS	$59,500
2	Temporary Erosion and Sedimentation Control	LS	$1,900
3	Site Work and Utilities	LS	$66,600
4	Structural	LS	$296,200
5	Mechanical	LS	$70,200
6	Pumps and Motors	LS	$132,000
7	Electrical and Automatic Control	LS	$282,100
	Subtotal		$908,500
	Contingency	25%	$227,200
	Construction Cost Subtotal		$1,136,000
Design & Permitting			
1	Engineering Design, Survey, & Permitting (15% of Construction Cost)		$170,400
2	Permitting Fees (5% of Construction Cost)		$56,800
3	Construction Administration (10% of Construction Cost)		$113,600
	Engineering & Permitting Subtotal		$341,000
	Total Project Cost		$1,477,000

This concludes RH2's evaluation of this facility and this letter report. If you have any questions or require additional information, please contact me by phone at (503) 246-0881 ext. 5360 or email at kpettibone@rh2.com.

Sincerely,

RH2 ENGINEERING, INC.

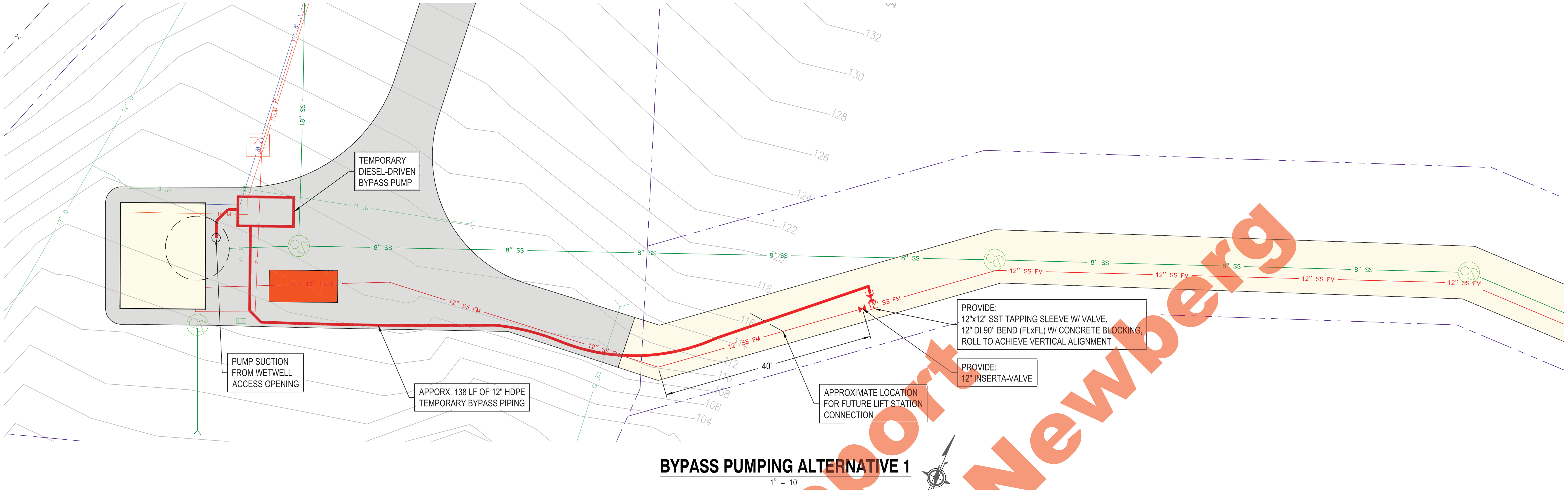
Kyle M. Pettibone, P.E.
Project Manager

REGISTERED PROFESSIONAL ENGINEER
88113
OREGON
SEPT. 10, 2013
KYLE PETTIBONE
EXPIRES 12/31/2016

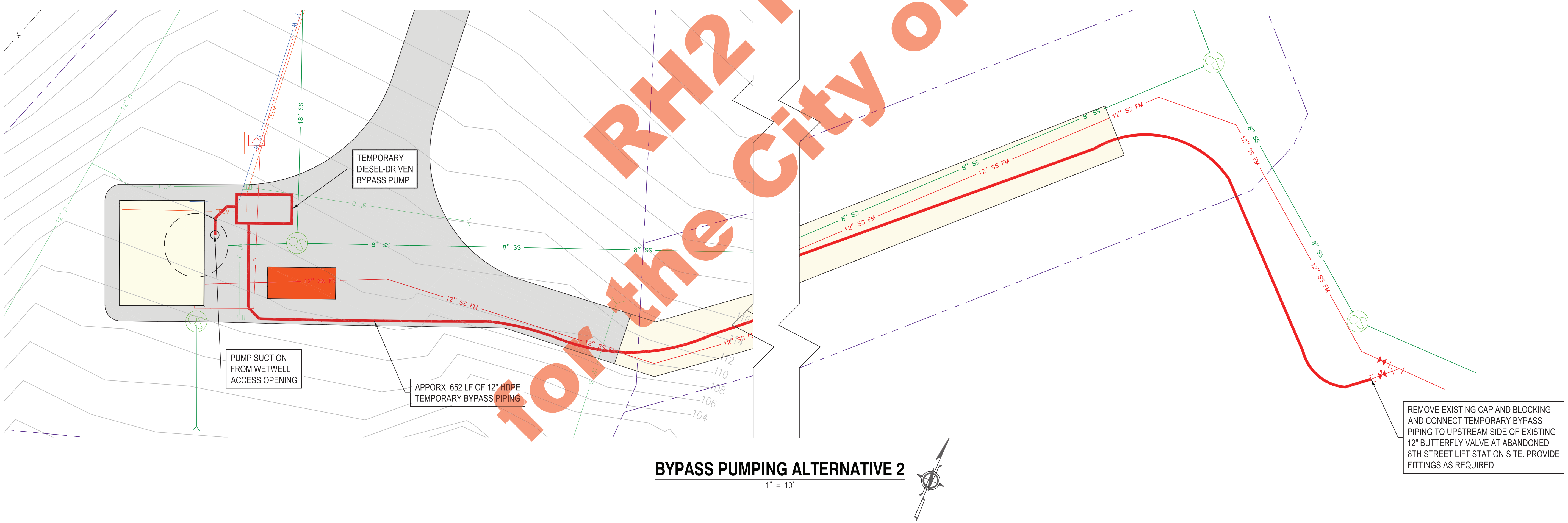
RLB/KMP/JB/sp/djc

Attachments:

- Preliminary Design Bypass Pumping Alternatives Plan
- Dayton Avenue Lift Station Replacement Conceptual Site Plan
- Drawdown Testing Results
- Hydraulic Calculations
- 3-way Plug Valve Cut Sheets



BYPASS PUMPING ALTERNATIVE 1
1" = 10'



BYPASS PUMPING ALTERNATIVE 2
1" = 10'

REGISTERED PROFESSIONAL ENGINEER
88113
OREGON
SEPT. 10, 2013
KYLE PETTIBONE
EXPIRES: 12/31/2016

RH2 ENGINEERS PLANNERS SCIENTISTS
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PORTLAND, OR
6500 SW Macadam Ave, Suite 125

City of Newberg

CITY OF NEWBERG
DAYTON AVENUE LIFT STATION
PRELIMINARY DESIGN
BYPASS PUMPING ALTERNATIVES

PRELIMINARY

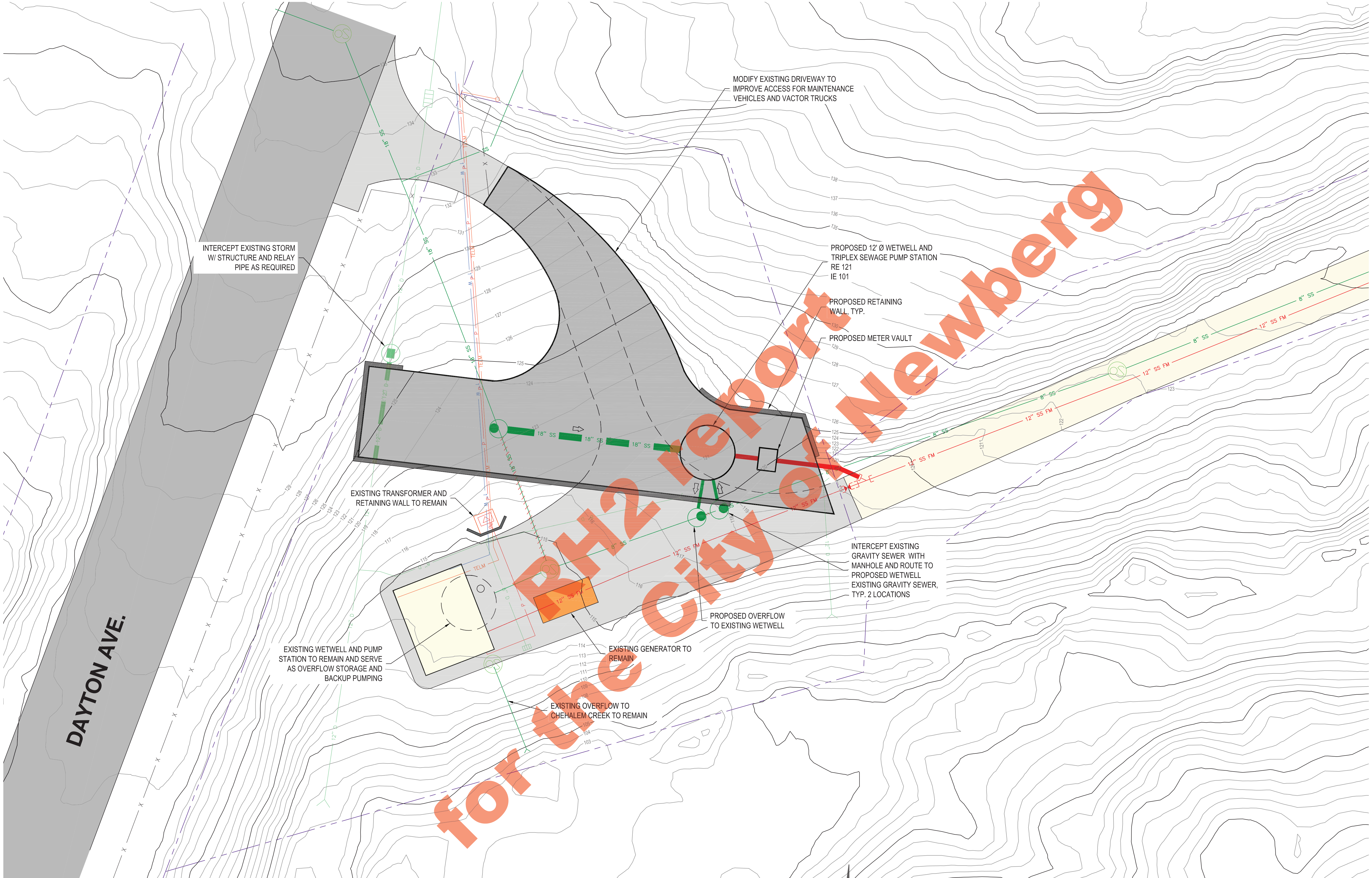
ENGINEER: JRB
REVIEWED: KMP
SAVE DATE: Aug 12, 2015
PLOT DATE: Aug 12, 2015
CLIENT: NEW
FILENAME: DAYTON-D-BYPASS PUMPING.DWG
JOB NO.: 814-136

REVISIONS

NO.	DATE	DESCRIPTION	BY	REVIEW

SCALE: SHOWN
0" 1" 2"
DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: C01
SHEET NO.: 1 / 3



CONCEPTUAL SITE PLAN

1" = 10'

CITY OF NEWBERG

DAYTON AVENUE LIFT STATION

PRELIMINARY DESIGN

CONCEPTUAL SITE PLAN

REGISTERED PROFESSIONAL ENGINEER 88113
OREGON SEPT. 10, 2013
KYLE PETTIBONE
EXPIRES: 12/31/2016

RH2 ENGINEERS PLANNERS SCIENTISTS
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www.rh2.com 1.800.720.8052
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6500 SW Macadam Ave, Suite 125

ENGINEER: JRB | SAVE DATE: Oct 6, 2015 | CLIENT: NEW | JOB NO.: 814-136

REVIEWED: KMP | PLOT DATE: Oct 8, 2015 | FILENAME: DAYTON-D-PROPOSED SITE.DWG

REVISIONS

NO.	DATE	DESCRIPTION	BY	REVIEW

SCALE: SHOWN

0" 1" 2"

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: C02 | SHEET NO.: 2 / 3

City of Newberg
Dayton Lift Station

Drawdown Testing

Drawdown Test Field Measurements (Pump 1)												
Pump 1	Wetwell Level @ T=Initial (ft)	T=Initial (min)	Wetwell Level @ T=Pump ON (ft)	T=Pump On (min)	Wetwell Level @ T=Pump Off (ft)	T=Pump Off (min)	Wetwell Level @ T=Final (ft)	T=Final (mm:ss)	Dynamic Pressure at pumps (psi)	Dynamic Pressure at 8th and Blaine (psi)	Dynamic Pressure at 9th and School (psi)	Dynamic Pressure at 9th and Meridian (psi)
Run No. 1	1.50	0	3.75	6.95	1.50	8.68	3.9	15.38	32	6.8	3.5	6
Run No. 2	1.5	0	3.75	6.70	1.50	8.49	3.9	15.43	32	6.8	3.5	6
Run No. 3	1.5	0	3.75	6.50	1.50	8.38	3.9	14.57	32	6.8	3.5	6
Notes:												

CALCULATIONS									
Pump 1	Initial Inflow Rate (gpm)	Final Inflow Rate (gpm)	Average Inflow Rate (gpm)	Inflow Volume (gal)	Δ Wetwell Volume (gal)	Pumped Volume (gal)	Pump Run Time (min)	Pump Capacity (gpm)	**Average Pump Capacity (gpm)**
Run No. 1	274	303	289	501	1904	2404	1.74	1386	
Run No. 2	284	293	288	516	1904	2420	1.79	1351	**1354.01**
Run No. 3	293	328	310	582	1904	2486	1.88	1325	

Drawdown Test Field Measurements (Pump 2)												
Pump 2	Wetwell Level @ T=Initial (ft)	T=Initial (mm:ss)	Wetwell Level @ T=Pump ON (ft)	T=Pump On (mm:ss)	Wetwell Level @ T=Pump Off (ft)	T=Pump Off (mm:ss)	Wetwell Level @ T=Final (ft)	T=Final (mm:ss)	Dynamic Pressure at pumps (psi)	Dynamic Pressure at 8th and Blaine (psi)	Dynamic Pressure at 9th and School (psi)	Dynamic Pressure at 9th and Meridian (psi)
Run No. 1	1.50	0	3.75	6.85	1.50	8.62	3.9	15.57	32	6.8	3.5	6
Run No. 2	1.5	0	3.75	6.70	1.50	8.51	3.9	15.37	32	6.8	3.5	6
Run No. 3	1.5	0	3.75	6.86	1.50	8.62	3.9	15.33	32	6.8	3.5	6
Notes:												

CALCULATIONS									
Pump 2	Initial Inflow Rate (gpm)	Final Inflow Rate (gpm)	Average Inflow Rate (gpm)	Inflow Volume (gal)	Δ Wetwell Volume (gal)	Pumped Volume (gal)	Pump Run Time (min)	Pump Capacity (gpm)	**Average Pump Capacity (gpm)**
Run No. 1	278	292	285	506	1904	2410	1.77	1358	
Run No. 2	284	296	290	526	1904	2430	1.81	1340	**1356.21**
Run No. 3	277	303	290	511	1904	2414	1.76	1371	

City of Newberg

Dayton Lift Station

Hydraulic Calculations

Summary of Minor Losses in Pump Station

Fitting Type	K- value	10" Suction # of Fittings	10" Suction Total K	12" Discharge # of Fittings	12" Discharge Total K
90° Bend	0.6	1	0.6	5	3
45° Bend	0.45	1	0.45		0
22.5° Bend	0.2		0		0
11.25° Bend	0.1		0		0
Wye/Tee - Thru Flo	0.26		0		0
Check Valve	1.3		0	1	1.3
3-Way Plug - Branch Flow	1.26		0	1	1.26
Plug Valve - Thru Flow	0.25	1	0.25		0
Pipe Entrance	0.04	1	0.04		0
Pipe Exit	1		0		0
Loss per 10ft of 10"/12" Pipe	0.05	12		18	
		Total K	**1.34**	**Total K**	**5.56**
		Minor Loss	**0.63 ft**	**Minor Loss**	**1.27 ft**

PRELIMINARY

Summary of Elevations

Elev. at Pump Suction	113.25
Elev. at Pumped Water Lvl	103.9
Elev. at High Pt	162.0
Elev. at Forcemain Start	104.5

Summary of Total Dynamic Head (Calculated)

Static Head	Hs		58.1
Dynamic Head	Hf		25.7
TDH Required (Calc)			84 ft @ 1350 gpm
			117 ft @ 2100 gpm
Calculated PSIg @ Pump		32 psi	74 ft See Note 1
Reported PSIg @ Pump		32 psi	74 ft See Note 2
Reported PSIg @ Pump		52 psi	120 ft See Note 3

1) Pipeline roughness coeff adjusted to match calc and reported PSIg

2) 0/60 gauge tapped in pump casing.

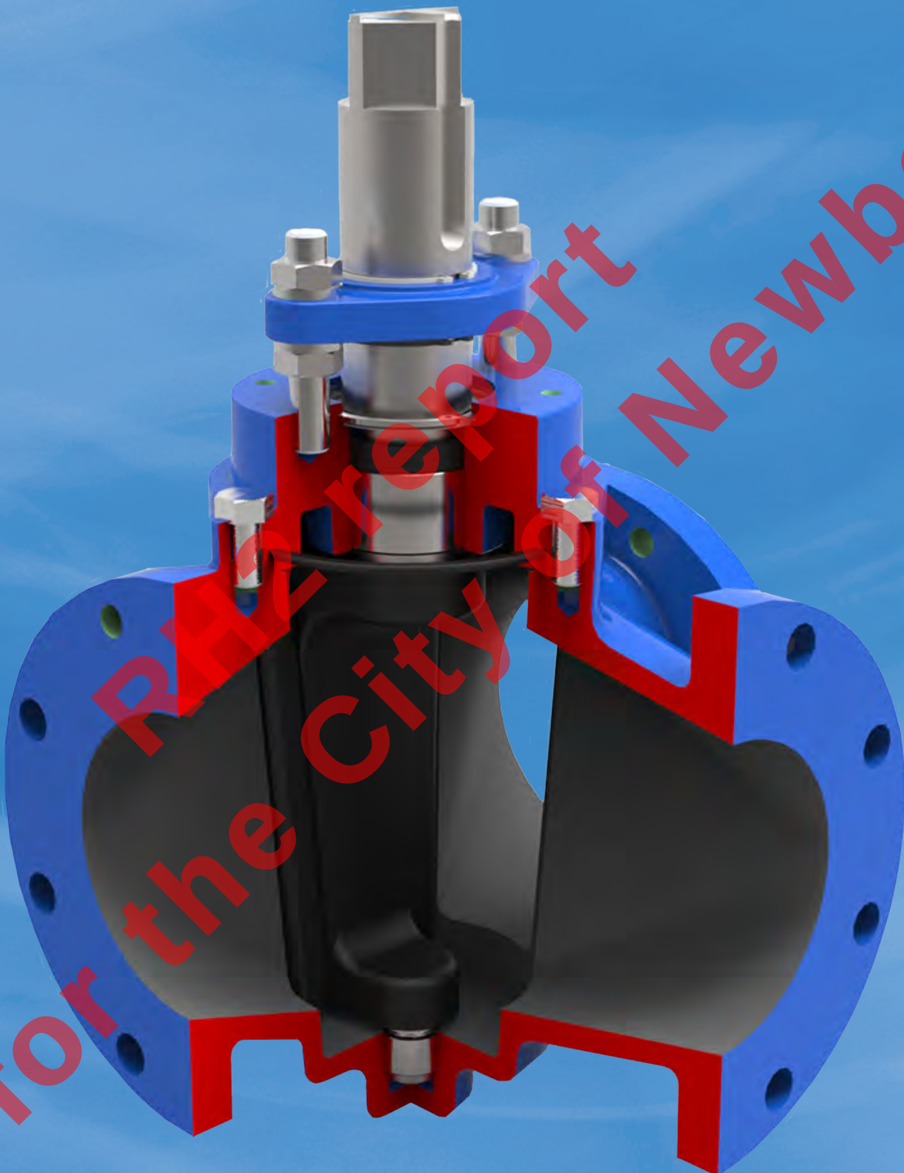
3) 0/60 gauge at Pump 2 discharge. Gauge at Pump 1 broken.

	Station Location			Minor Losses			Pipeline Losses			Forcemain Hydraulic Profile				
	CWE Station	KCM Station	Overall	Fitting/Component Description	Centerline Elevation (ft)	Minor Losses (ft)	Segment Pipe Length (ft)	Pipe Material	Pipe Losses (ft)	Elevation Gain (ft)	Cumulative Losses in Forcemain (ft)	Calculated Pressure in Forcemain (ft)	Calculated Pressure in Forcemain (psi)	Measured Gauge Pressure (psi)
Dayton Ave LS Forcemain	0+0		0+0	Start Forcemain	104.5		0	DI	0.00	0.00	0.00	81.92	35.52	
	0+35		0+35	22.5° Bend	105	0.05	35	DI	0.21	0.50	0.25	81.17	35.19	
	0+88		0+88	22.5° Bend	106	0.05	53	DI	0.31	1.50	0.61	79.82	34.60	
	1+56		1+56	22.5° Bend	112	0.05	68	DI	0.40	7.50	1.05	73.37	31.81	
	2+46		2+46	22.5° Bend	114	0.05	90	DI	0.53	9.50	1.62	70.80	30.69	
	2+93		2+93	22.5° Bend	114.5	0.05	47	DI	0.28	10.00	1.95	69.98	30.34	
	3+94		3+94	22.5° Bend	115	0.05	101	DI	0.59	10.50	2.58	68.84	29.84	
	5+84		5+84	45° Bend	115	0.10	190	DI	1.11	10.50	3.80	67.63	29.32	
	5+97		5+97	45° Bend	121	0.10	13	DI	0.08	16.50	3.98	61.45	26.64	
	6+42		6+42	22.5° Bend	123	0.05	45	DI	0.26	18.50	4.29	59.14	25.64	
	6+47		6+47	45° Bend	124	0.10	5	DI	0.03	19.50	4.42	58.01	25.15	
	6+57	0+37	6+57	Wye Connection	125.5	0.06	10	DI	0.06	21.00	4.54	56.39	24.45	
8th Street LS Forcemain		1+68	7+88	Transition to PVC	151		131	PVC SDR 26	0.77	46.50	5.30	30.12	13.06	
		11+17	17+37	90° Bend	161	0.15	949	PVC SDR 26	5.34	56.50	10.80	14.62	6.34	
		11+25	17+45	Air Relief Valve	161.25		8	PVC SDR 26	0.05	56.75	10.85	14.33	6.21	6.8
		14+10	20+30	90° Bend	161	0.15	285	PVC SDR 26	1.61	56.50	12.60	12.82	5.56	
		19+84	26+04	Air Relief Valve	161.5		574	PVC SDR 26	3.23	57.00	15.84	9.09	3.94	
		22+19	28+39	22.5° Bend	160.5	0.05	235	PVC SDR 26	1.32	56.00	17.21	8.71	3.78	3.5
		22+73	28+93	22.5° Bend	160.5	0.05	54	PVC SDR 26	0.30	56.00	17.57	8.36	3.62	
		29+70	35+90	Cleanout MH	156		697	PVC SDR 26	3.93	51.50	21.49	8.93	3.87	6.0
		32+67	38+87	11.25° Bend	161.5	0.03	297	PVC SDR 26	1.67	57.00	23.19	1.73	0.75	
		33+35	39+55	Pipe Exit	162	0.25	68	PVC SDR 26	0.38	57.50	23.82	0.60	0.26	
						Check:	3955	HL in pipe only	22.28					

Asbuilts show localized low point with only minor elevation gain between U/S and D/S high point.. Pipeline may be operating under siphon conditions during certain flow conditions that could cause unstable hydraulic conditions. This may explain anecdotal reports of reduced pumping flows by City operators. Gauge installed at Cleanout MH rated for 0/60 psi range may be affecting accuracy of measured reading.

MILLIKEN VALVE

ISO 9001 Certified



MILLCENTRIC®
100% Port 3-WAY PLUG VALVE

MILLIKEN VALVE

Milliken Valve offers the following for your water and wastewater needs:

- Eccentric Plug Valves
  - Series 601/600 Flanged & MJ
  - Series 601S Stainless Steel
  - Series 601RL Rubber Lined
  - Series 602 High Pressure
  - Series 613 Threaded End
  - Series 604 Three Way
  - Series 606 Grooved End
  - Series 611/610 Flanged & MJ
  - Series 625 UL/CGA Listed
- AWWA Swing Check Valves
- Wafer Check Valves
- Flex Check Valves
- Spring Loaded Check Valves
- AWWA Butterfly Valves
- General Service Butterfly Valves

Milliken Valve designs, develops, manufactures and markets plug valves and check valves which are available with various accessories, controls and actuators. These valves are used primarily in the water, wastewater and industrial markets.

Milliken Valve was founded over 25 years ago and manufactures the eccentric plug valve for water, wastewater and industrial applications. Milliken has grown consistently until it is now a leading manufacturer of high quality plug valves.

Milliken has a quality management system independently certified to ISO 9001.

A market leading, wide selection of plug valves is available for most water, wastewater and industrial applications:

Multiport 100% Port 3-Way Plug Valve

- 3-Way Valve 3" – 16", suitable for flow diversion and isolation.

Eccentric Plug Valve

- Size range ½" - 72"
- Pressure rating up to Class 250
- Rubber lined 3" and larger
- Glass lined 3" and larger
- Stainless steel ½" - 48"

Flex Check Valve

The eccentric plug valve is perfectly complemented by a soft-seated flexible-disc check valve in sizes 2" to 24" and is available with manual back-flushing device, position indicator and limit switch.

Swing Check Valve

Milliken Valve also has a wide selection of high quality metal or soft seated swing check valves in sizes 2" to 72" with accessories available for spring or weight assisted closing and air cushion or oil decelerator anti-slam devices under the respected CCNE brand.

MILLCENTRIC® 100% Port 3-way Plug Valve

Quality, reliability, safety and value are the Milliken criteria embodied in the Millcentric 100% Port 3-Way plug valve.

High quality manufacturing processes from advanced CAD engineering to CNC machining ensure reliable operation with high flow capability.

The Milliken 100% Port 3-Way plug valve is designed for regulation, diversion and isolation of water (clean or dirty) and sludge and slurries. The single tapered plug design can be arranged to provide a wide selection of flow configurations.

High flow and large solids passage are key features of the Milliken 100% Port 3-Way valve; a 3" round solid can pass through a 4" valve without compression.

Although the regular usage of a Milliken 3-Way valve is for flow diversion applications, the valve can provide tight shut-off, which is factory set when requested at order placement. (Not available with double-style plug or on 14" and 16" valves).

Body & Seat

The 3-Way valve body is a high integrity casting in cast iron ASTM A126 Class B. The precision machined, internal tapered surface of the body is the valve seat which is provided with a corrosion and erosion resistant epoxy coating. Other materials are available.

End Connections

The 3-flanges are to ASME/ANSI B16.1 Class 125 flat faced.

Certain sizes of valve require some tapped bolt holes because of limited access for nuts behind the flange, details are shown on page 5.

Plug

The ductile iron plug is totally encapsulated (3" thru 12") with a molded and vulcanized elastomer providing sealing and tight shut-off. For tight shut-off applications, it is advisable that the flow is against the rear of the plug. Tight shut-off not available with double-style plug or on 14" and 16" valves.

A large-diameter stem and upper and lower trunnion are integral with the plug casting. The upper end of the stem has a 2" square drive for wrench operation and also 2 keyways for maximum versatility when mounting gear operators. A cast marking on the end of the shaft indicates the plug face orientation.

The single style plug is standard in the Milliken 3-Way valve to provide straight-through and 90° flow paths. A double-style plug is optionally available upon request (not tight shut-off).

Bearings

The plug rotates in permanently lubricated, corrosion resistant stainless steel bearings in the body and bonnet.

Bonnet Seal

The bolted bonnet is assembled in a precision location in the body and uses superior 'O'-Ring sealing, with metal to metal contact, providing lower stress compared to traditional gaskets.

Stem Seal

Multiple self-adjusting U-cup seals provide positive stem sealing with trouble-free service.

Operation

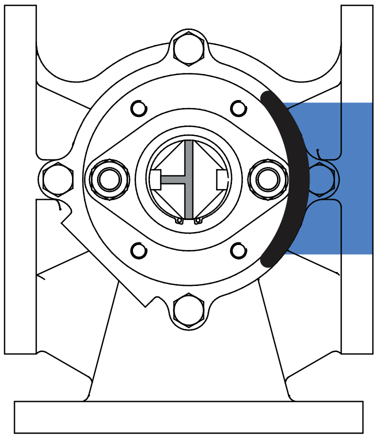
Manual operation by lever or gear available on all sizes. Chainwheel operation is also available.

Electric or pneumatic actuation is available on request.

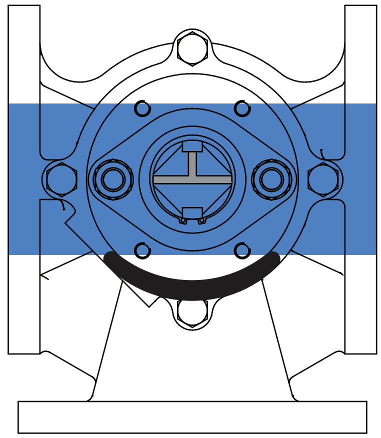
Coating

The valve interior and exterior surfaces are coated with 10-12 mils of 2-Part epoxy.

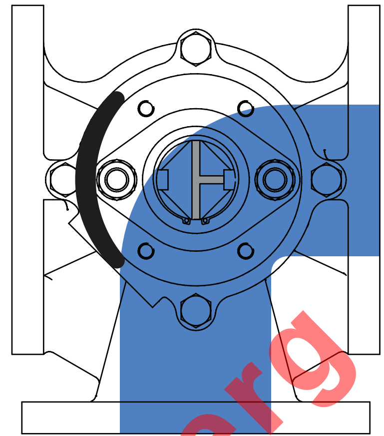
Available Flow Paths



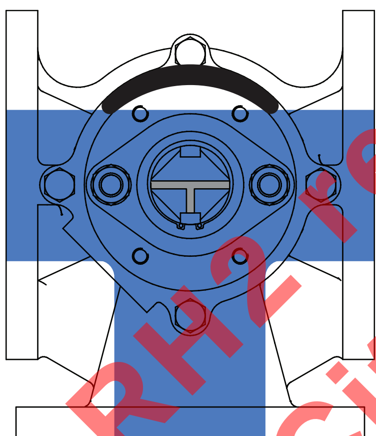
Valve in closed position*



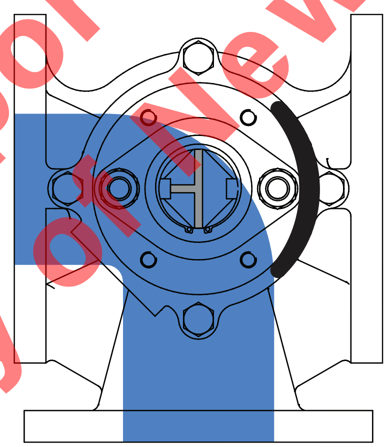
Flow straight through valve



Flow through 90° to side port



All 3 ports connected and open



Flow through 90° to side port

*It is advisable that the flow is against the rear side of the plug for tight shut-off applications. Not available with double-style plug.

Pressure/Temperature ratings

Flange rating to ASME/ANSI B16.1 Class 125, the maximum cold working pressure for all sizes is 175psi.

The operating temperature of the valve may depend on the elastomer used for the plug and seals. Refer to the elastomer selection guide on page 4.

Installation

The 3-Way valve can be installed in any orientation although it is advisable to have the valve stem vertical for ease of access.

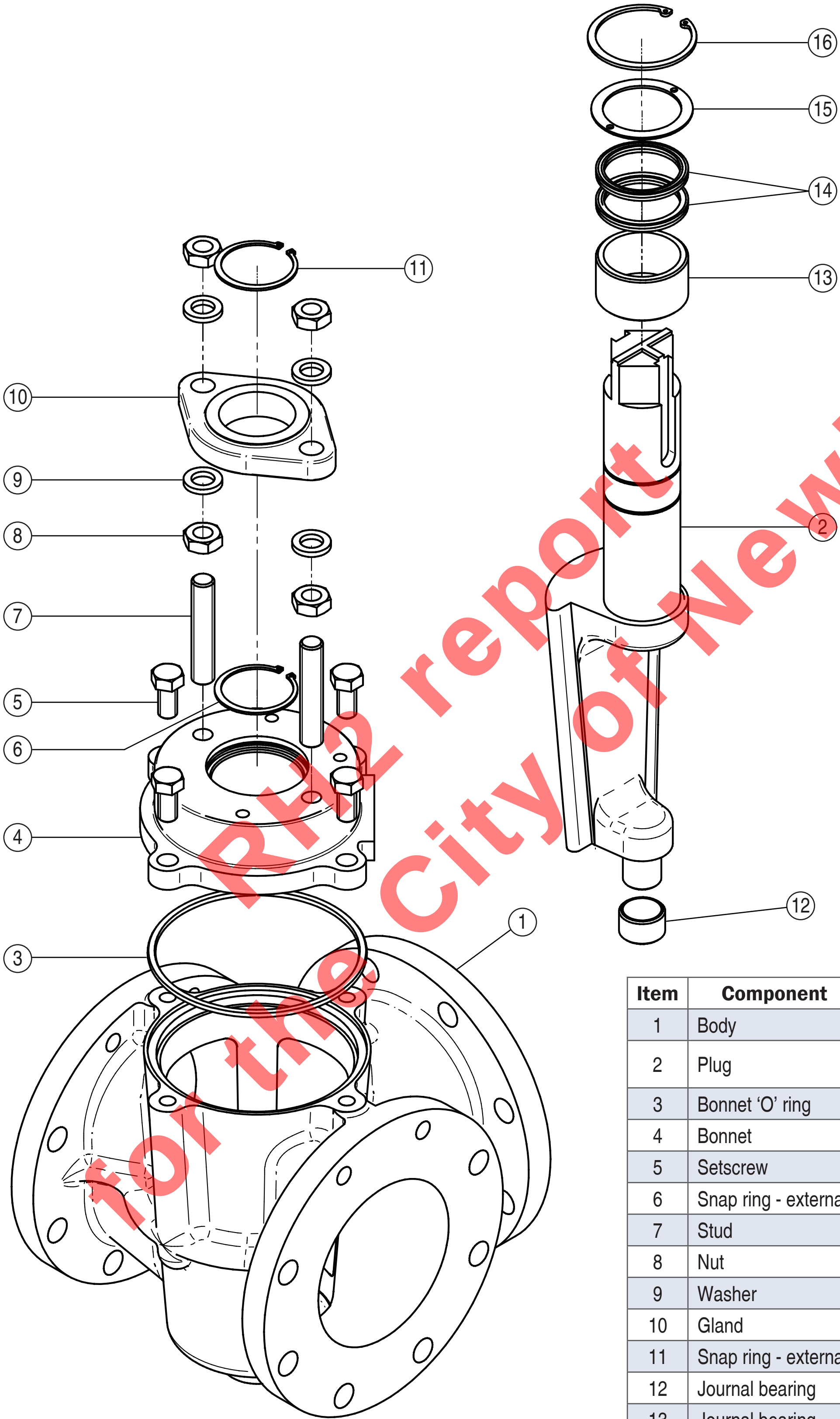
If the valve has been supplied for tight shut-off, the flow path and therefore the upstream pressure should be against the rear side of the plug.

In-Line Maintenance

In the unlikely event of gland leakage, the stem seals can be replaced without removing the bonnet. Access to the inside of the body for inspection or cleaning does not require removal of the valve from the line.

If wear should occur between the plug face and the seat, the plug can be adjusted externally.

Standard Materials of Construction - 3” to 16”



Item	Component	Material
1	Body	Cast iron A126 Class B
2	Plug	Ductile iron ASTM A536 Rubber coated
3	Bonnet ‘O’ ring	Elastomer as specified
4	Bonnet	Cast iron A126 Class B
5	Setscrew	Steel - zinc plated
6	Snap ring - external	Steel
7	Stud	Steel - zinc plated
8	Nut	Steel - zinc plated
9	Washer	Steel - zinc plated
10	Gland	Ductile iron ASTM A536
11	Snap ring - external	Steel
12	Journal bearing	Stainless Steel
13	Journal bearing	Stainless Steel
14	‘U’ cup seal	Elastomer as specified
15	Seal retaining ring	Brass
16	Snap ring - internal	Steel

Elastomers Available for MILLCENTRIC® 100% Port 3-Way Valves

■ NBR - Nitrile

A general purpose material sometimes referred to as BUNA N with a temperature range -20°F to 212°F. Used on sewage, water, air, hydrocarbon and mineral oils.

■ EPDM

An excellent polymer for use on chilled water through to LP steam applications, having a temperature range of -35°F to 250°F. Resistance to many acids, alkalies, detergents, phosphate esters, alcohols and glycols is an added benefit. Use on hydrocarbons <u>must</u> be avoided.

■ CR - Neoprene

This versatile material shows outstanding resistance to abrasion and ozone. Chemical resistance to a wide range of petroleum based products and dilute acids and alkalies. Temperature range -20°F to 225°F.

■ FKM - Viton®

Retention of mechanical properties at high temperature is an important feature of this elastomer: temperature range is -10°F to 300°F. It also has excellent resistance to oils, fuels, lubricants and most mineral acids and aromatic hydrocarbons. NOT suitable for water or steam applications.

Pressure Rating

Size	**Drilling**	**Pressure**
3" to 16"	Class 125	175 psig

Body (Shell) Hydrotest = 1.5 x rated pressure
Seat hydrotest = 1.0 x rated pressure (for tight shut-off applications only)

Ordering Information

Valve Types	**Designation**
Class 125 Flanged Cast Iron	604
Class 125 Flanged Ductile Iron	614
Class 125 Flanged 316 Stainless Steel	604S

Seat

Epoxy (604/614)	E
Stainless Steel (604S)	S

Elastomer Trim

EPDM	0
Nitrile (Buna)	1
Viton	2
Neoprene	3

Gear Operators

Gearbox complete with handwheel	AGHW

Available in 90°, 180°, 270° and 360° configurations.

Style

Available port positions as shown on page 8.
The style can be factory set and should be requested at time of order.

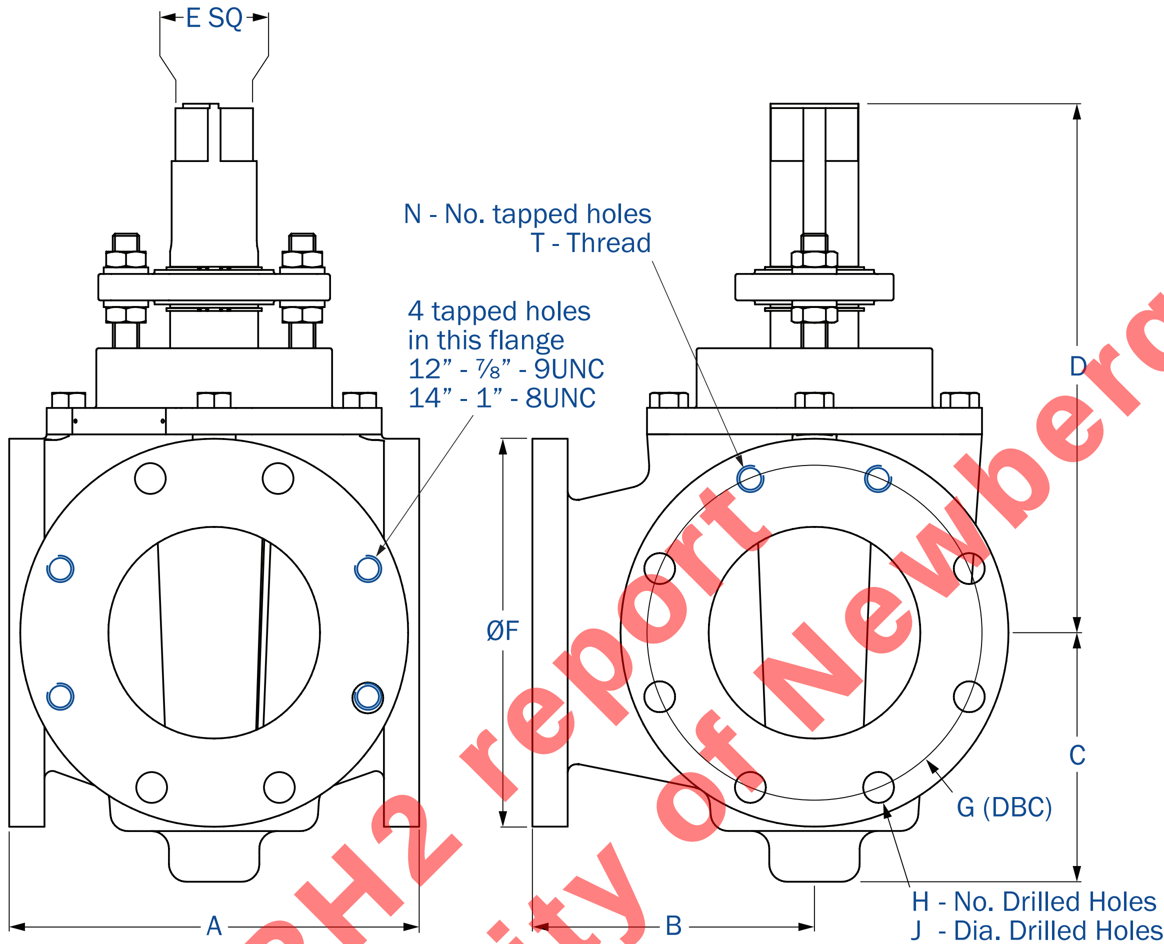
■ Elastomer Selection Chart

Service	Elastomer	Average Useful Temperature Range	Service	Elastomer	Average Useful Temperature Range	Service	Elastomer	Average Useful Temperature Range
Acetone	EPDM	-35°F to 250°F	Caustic Soda	EPDM	-35°F to 250°F	Oil Animal	Nitrile	-20°F to 212°F
Air	EPDM	-35°F to 250°F	Cement Slurry	EPDM	-35°F to 250°F	Oil Mobil Therm Light	Viton	10°F to 250°F
Air w/Oil	Nitrile	0°F to 212°F	Copper Sulphate	EPDM	-35°F to 250°F	Oil Mobil Therm 600	Viton	10°F to 250°F
Alcohol, Amyl	EPDM	0°F to 212°F	Creosote (Coal)	Nitrile	-20°F to 212°F	Oil Mobil Therm 603	Nitrile	-20°F to 212°F
Alcohol, Aromatic	Viton	10°F to 250°F	Coal Slurry	Nitrile	-20°F to 212°F	Oil Lubricating	Nitrile	-20°F to 212°F
Alcohol, Butyl	Neoprene	-20°F to 225°F	Diesel Fuel No. 3	Nitrile	-20°F to 212°F	Oil Vegetable	Nitrile	-20°F to 212°F
Alcohol, Denatured	Nitrile	-20°F to 212°F	Diethylene Glycol	EPDM	-35°F to 250°F	Paint Latex	Nitrile	-20°F to 212°F
Alcohol, Ethyl	EPDM	-35°F to 250°F	Ethylene Glycol	EPDM	-35°F to 250°F	Phosphate Ester	EPDM	-35°F to 250°F
Alcohol, Grain	Nitrile	-20°F to 212°F	Fatty Acid	Nitrile	-20°F to 212°F	Propane	Nitrile	-20°F to 212°F
Alcohol, Isospropyl	Neoprene	-20°F to 225°F	Fuel Oil No. 2	Nitrile	-20°F to 212°F	Rape Seed Oil	EPDM	-35°F to 250°F
Alcohol, Methyl	EPDM	-35°F to 250°F	Fertilizer Liquid ($H_4N_2O_2$)	EPDM	-35°F to 250°F	Sewage with Oil	Nitrile	-20°F to 212°F
Ammonia, Anhydrous	Neoprene	-20°F to 225°F	Gasoline Keg	Nitrile	-20°F to 212°F	Sodium Hydroxide 20%	EPDM	-35°F to 250°F
Ammonia, Nitrate	EPDM	-35°F to 250°F	Gas Natural	Nitrile	-20°F to 212°F	Starch	EPDM	-35°F to 250°F
Ammonia, Water	EPDM	-35°F to 250°F	Glue Animal	Nitrile	-20°F to 212°F	Steam 250°F	EPDM	-35°F to 250°F
Animal Fats	Nitrile	-20°F to 212°F	Green Liquor	EPDM	-35°F to 250°F	Stoddard Solvent	Nitrile	-20°F to 80°F
Black Liquor	EPDM	-35°F to 250°F	Hydraulic oil	Nitrile	-20°F to 212°F	Sulphuric Acid 10% 50%	Neoprene	-20°F to 158°F
Blast Furnace Gas	Neoprene	-20°F to 225°F	Hydrogen	Nitrile	-20°F to 212°F	Sulphuric Acid 100%	Viton	10°F to 300°F
Butane	Nitrile	-20°F to 212°F	JP4 JP5	Viton	0°F to 300°F	Trichlorethylene Dry	Viton	10°F to 300°F
Bunker Oil "C"	Nitrile	-20°F to 212°F	Kerosene	Nitrile	-20°F to 212°F	Triethanol Amine	EPDM	-35°F to 250°F
Calcium Chloride	EPDM	-35°F to 250°F	Ketone	EPDM	-35°F to 250°F	Varnish	Viton	10°F to 300°F
Carbon Dioxide	EPDM	-35°F to 250°F	Lime Slurry	EPDM	-35°F to 250°F	Water, Fresh	EPDM	-35°F to 250°F
Carbon Monoxide (Cold)	Neoprene	-20°F to 150°F	Methane	Nitrile	-20°F to 212°F	Water, Salt	EPDM	-35°F to 250°F
Carbon Monoxide (Hot)	Viton	10°F to 300°F	Methyl Ethyl Ketone	EPDM	-35°F to 250°F	Xylene	Viton	10°F to 300°F
Carbon Tetrachloride	Viton	10°F to 300°F	Naptha (Berzin)	Nitrile	-20°F to 212°F			

NOTE: Above elastomer/temperature chart are guidelines only. See Milliken Compatibility Chart for specific applications.

Viton® is a registered trademark of Du Pont

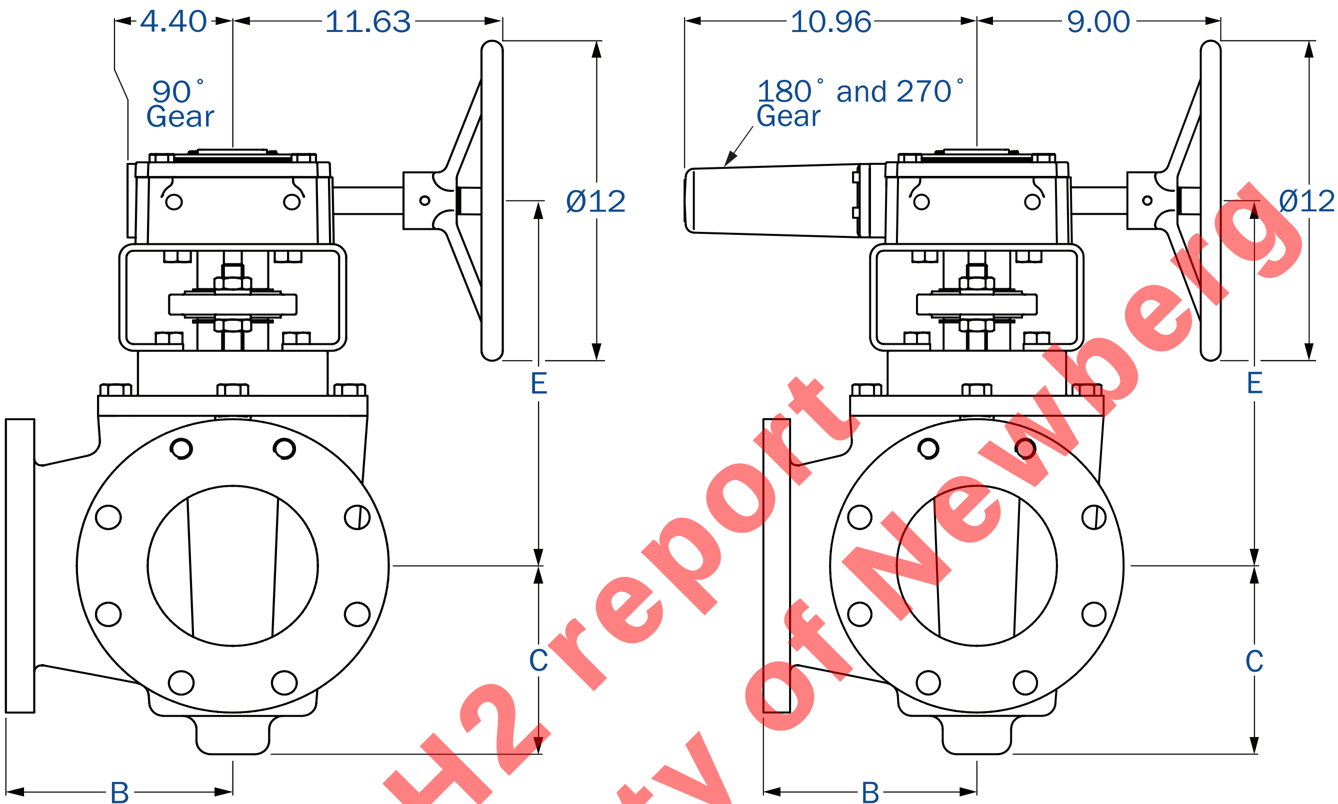
Series 604 MILLCENTRIC® 100% Port 3-Way Plug Valve



Flanged End - Fig. 604 - Class 125								
Dimensions in	Nominal Valve Size							
	3"	4"	6"	8"	10"	12"	14"	16"
A	8	9.88	11.63	13.88	16.75	19	21	23.75
B	5.5	6.5	8	9	11	11.56	12.5	15.13
C	4.81	5.94	7.06	10.94	10.94	12.88	14.19	14.75
D	9.04	13.36	15.04	18.69	18.69	21.20	21.10	22.00
E	1*	2	2	2	2	2	2	2
F	7.50	9.00	11.00	13.50	16.00	19.00	21.00	23.50
G	6.00	7.50	9.50	11.75	14.25	17.00	18.75	21.25
H	4	6	6	4	12	12	10	16
J	0.75	0.75	0.88	0.88	1	1	1.13	1.13
N	-	2	2	4	-	-	2	-
T	-	⅝" - 11 UNC	¾" - 10 UNC	¾" - 10 UNC	-	-	1" - 8 UNC	-
Weight - lb	65	120	170	325	380	475	850	970

Note: Drawings are for information purposes only; please request certified drawings before preparing piping drawings.
* Adaptor available to convert to 2" Nut.

Series 604AGHW MILLCENTRIC® 100% Port 3-Way Plug Valve



Flanged End - Fig. 604AGHW - Class 125							
Dimensions in	Nominal Valve Size						
	4”	6”	8”	10”	12”	14”	16”
A*	9.88	11.63	13.88	16.75	19	21	23.75
B	6.50	8	9	11	11.56	12.50	15.13
C	5.94	7.06	10.94	10.94	12.88	14.19	14.75
E	12.94	14.06	17.75	17.75	19.50	20.38	21.06
Weight - lb	200	250	405	460	555	937	1053

Note: 3” gear operated valve details upon request.
Drawings are for information purposes only; please request certified drawings before preparing piping drawings.
* Face to face dimension and flange drilling see page 5.

Accessories

Wrench

Wrench operators are available for all sizes (for tight shut-off, we recommend the use of a gear operator).

Power operation

Pneumatic, electric and hydraulic operation is available, complete with limit switches and solenoid valves when required.

Styling Ring (for wrench operated valves)

The valve may be ordered with the plug positions pre-set at the factory to suit the port flow requirements. This is achieved by fitting a styling ring to the valve stem.

Gear operators

Gear operators are available for all sizes.

They can be provided with 90°, 180° or 270° travel and are fitted with travel stops. 360° travel is also available.

Locking device

Factory fitted locking devices are available for wrench operated and gear operated valves.

Double-style plug

To provide 90º flow paths only, a double-style plug is available which operates through 90º travel and isolates either straight-through port (Style A90 only).

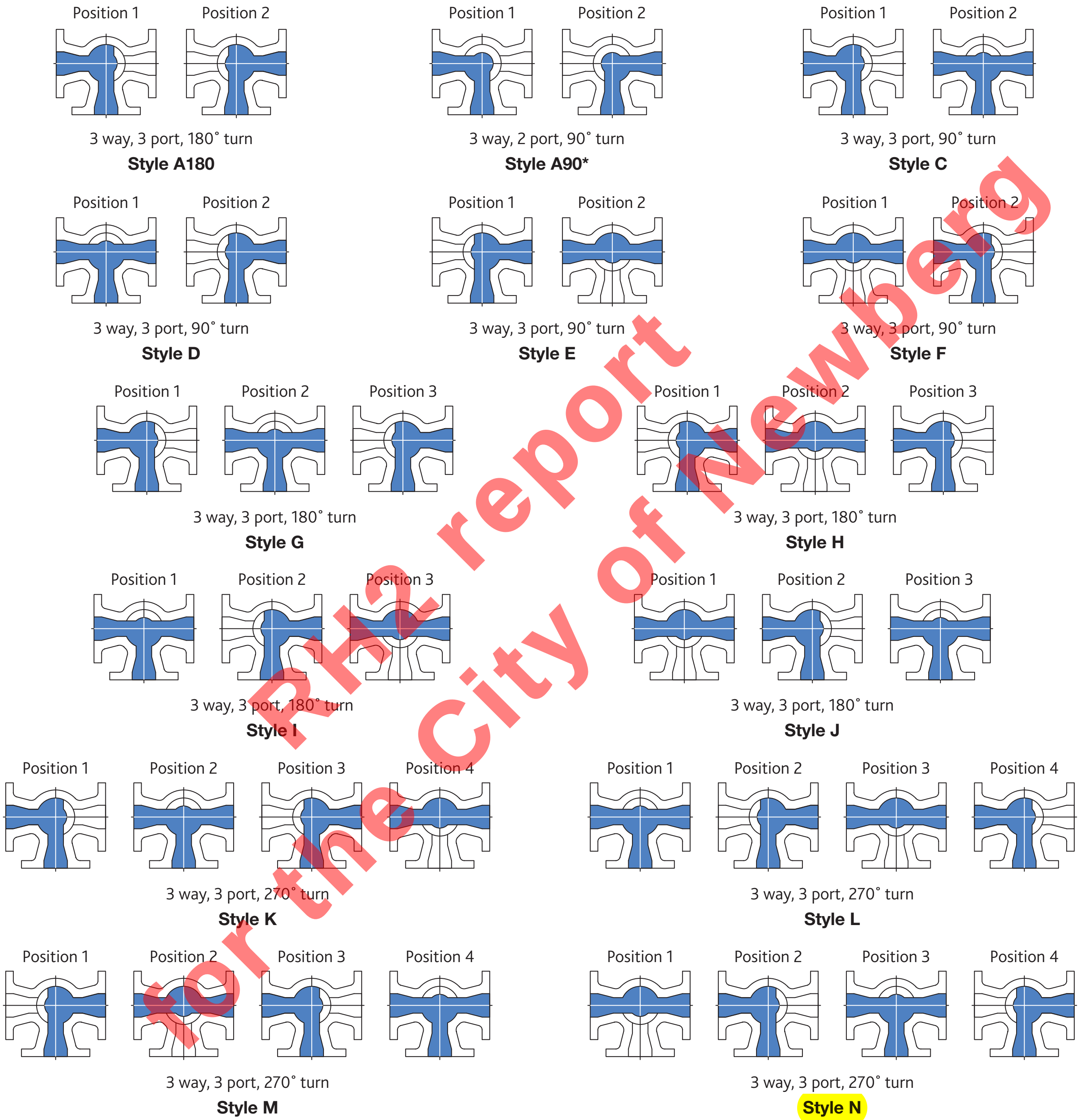
Styling Ring

Gear Operator

Shown with 180°/270° Gear

3-Way Valve Port Positions

Three-Way Valve Port Positions
Viewed from above



* Requires Double-Style Plug. Not tight shut-off. Consult Milliken for special pricing and availability.

HOW TO ORDER

When ordering 3-Way Valves, specify style letter of the port position required.

Technical Specification

MILLCENTRIC® 100% Port 3-Way Plug Valves

Valves shall be of the 100% Port 3-Way non-lubricated concentric type with a totally encapsulated plug. The elastomer shall be suitable for the service intended.

Valve flanges shall comply with ASME/ANSI B16.1 Class 125, including facing, drilling and thickness. Valves shall be designed for a maximum working pressure of 175 CWP.

The valve body and bonnet shall be in cast iron to ASTM A126 Class B and the plug shall be ductile iron to ASTM A536 Grade 65-45-12. The axial position of the plug shall be held by the adjustable gland, and the valve shall operate without the need to lift the plug prior to turning.

Replaceable sleeve-type bearings, manufactured in oil-impregnated stainless steel shall be fitted in the body and bonnet. Stem seals shall be self-adjusting U-cup type and be replaceable without removing the bonnet from the valve.

The valve stem shall be provided with a 2" square nut for use with removable levers or extended T-handles. Wrench operated valves shall be capable of being converted to gear or automated operation without removing the bonnet from the valve.

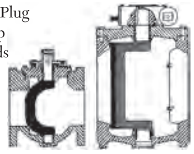
Where required, gear operators shall be of heavy duty construction with a ductile iron quadrant supported by upper and lower oil-impregnated bronze bearings. The worm gear and shaft shall be manufactured in hardened steel and run in high efficiency roller bearings. Gear operators shall require single handwheel operation only.

100% Port 3-Way plug valves shall be Millcentric Series 604 as manufactured by Milliken Valve - Bethlehem, Pennsylvania.

Series 600/601
Eccentric Plug Valve

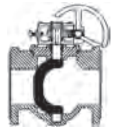
Flanged and MJ

Welded Nickel Seat
Stainless Steel Bearings
ANSI-B16.1 Flanges
Solid Ductile Iron Plug
Low Pressure Drop
Flanged & MJ Ends
Sizes 2"-72" FL
Sizes 3"-48" MJ



Series 601S
Eccentric Plug Valve

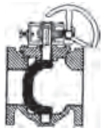
All Stainless Steel Construction
ANSI B16.5 Class 150 Flanges
Low Pressure Drop
Size: 1/2"-24"



Series 601RL
Eccentric Plug Valve

Rubber Lined

Soft Rubber Lining
Stainless Steel Bearings
ANSI B16.1 Flanges
Solid Ductile Iron Plug
Low Pressure Drop
Sizes 3"-54"



Series 602
Eccentric Plug Valve

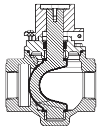
High Pressure

Welded Nickel Seat
Stainless Steel Bearings
ANSI B16.1 Class 250 Flanges
Solid Ductile Iron Plug
Low Pressure Drop
Sizes 2½"-54"

Series 613A
Eccentric Plug Valve

Threaded End

Ductile Iron Construction
Round Port
Stainless Steel Bearings
Low Pressure Drop
Memory Stop
NPT End Connections
Sizes ½"-2"



Series 604
100% Port 3 Way Plug Valve

Three Way Valve

Solid Ductile Iron Plug
Stainless Steel Bearings
Low Pressure Drop
Lift & Turn NOT Required
High Solids & Flow Capacity
Sizes 3"-16"

Series 606
Eccentric Plug Valve

Grooved End

Welded Nickel Seat
Stainless Steel Bearings
AWWA C-606 Grooved
Solid Ductile Iron Plug
Low Pressure Drop
Ductile or Steel Pipe
Sizes 3"-24"

Series 611/610
Eccentric Plug Valve

Flanged and MJ

Ductile Iron Body
ANSI B16.1 Flanges
MJ AWWA C111
Welded Nickel Seat
Solid Ductile Iron Plug
Low Pressure Drop
Sizes 2"-72" FL
Sizes 3"-48" MJ

Model 625
Eccentric Plug Valve

Available in Threaded and Flanged Ends
Rated for 175 psi
Sizes ½"-4"
UL/CGA Listed

Series 600FP/601FP
Eccentric Plug Valve

Full/100% Port
Welded Nickel Seat
Stainless Steel Bearings
ANSI-B16.1 Flanges
Solid Ductile Iron Plug
Low Pressure Drop
Flanged & MJ Ends
Sizes 2”-48” FL
Sizes 3”-48” MJ

Figure 396/397
General Service Butterfly Valve

Complies with MSS SP 67
Ductile Iron Body
DI-NP Disc
Other Materials Upon Request
Wrench or Gear
Operated Available
2"-48" Size Range

Figure 510A/511A
AWWA Butterfly Valve

Complies with AWWA C-504
Class 150B Flanged or MJ
Cast iron body and disc
Seat in body
Flow through disc on 24" and larger
Epoxy Paint on all sizes standard 3" -72"

Series 8500
AWWA Swing Check

Full waterway
Ductile Iron Construction
Weight or Spring
Air Cushion
SS body seat ring
Buna disc insert
Sizes 3"-24"

Series 8000
AWWA Swing Check

Full waterway
Weight or Spring
Bronze/SS Body Seat Ring
Bronze/Buna/EPDM disc insert
Sizes 2"-36"

Series 9000
AWWA Swing Check

Clear waterway
Weight or Spring
Air or Oil Cushion
Bronze/SS Body seat ring
Bronze/Buna/EPDM disc insert
Sizes 3"-72"

Model 720A
Wafer Check Valve

Center Guided
Check Valve
Rated for 250 psi
SS Disc/EPDM Seat
Sizes 2"-12"

Series 700
Wafer Check Valve

Wafer Check Valve

ANSI Class 125/150
High Flow Capacity
Narrow Face-to-Face
Sizes 3"-12"
316 SS Internals
Disc Position Indicator

Figure 851
Flex Check

Million Cycle Certification
Complete Ductile Iron Construction
250 psi Pressure Rating
Fully Epoxy Lined Interior
No Internal Shafts, Bearings or Bushings
No External Levers, Weights or Springs
Mechanical Indicator (3"-16")
2"-24" Size Range
Backflush Devices
Proximity Switches

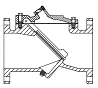
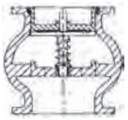


Figure 740A
Double Disc Check Valve

Wafer pattern check valve rated for 250 psi. Available in sizes 2"-48" with a SS Disc/EPDM Seat

Figure 821A
Globe Style Check Valve

Center guided check valve. SS Disc/EPDM Seat and is available in sizes 2"-36".



MILLIKEN
VALVE

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