Anclote Harbor Lift Station Design Memorandum

Tarpon Springs, FL

Prepared for:

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Houston, TX 77081

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145062001

Executive Summary

On March 19, 2019, Morgan Group Development, LLC (Client) authorized Kimley-Horn and Associates, Inc. (Kimley-Horn) to provide professional engineering services to entitle, design, and permit a phased multi-family project in the City of Tarpon Springs, Florida. The project site is located at the southeast corner of US 19 and the Anclote River and is approximately 74 acres in size consisting of wetlands and 49 acres of uplands. Phase 1 of this project is currently scheduled for 404 apartment units. Included in these services is the design of a private lift station for the site. The design also includes a private force main that connects the lift station to the City of Tarpon Springs sewer system at the intersection of Live Oak Street and Safford Avenue near the City's Wastewater Treatment Plant. The lift station's location is within the proposed development site. The proposed force main is a 6-inch force main that connects to the on-site lift station and then extends off-site to travel south along US 19 before turning west on Live Oak Street and connecting to the City of Tarpon Springs system at Safford Avenue. The lift station and force main were designed in accordance with the following parameters:

- The average daily flow (ADF) was calculated using estimated flow rates for the dwelling units and unit loads based on the Florida Administrative Code (FAC) for the proposed residential development.
- Summary of Design Criteria:
    - Average Daily Flow: 60.9 GPM
    - Peaking Factor: 4.0
    - Peak Hour Flow: 244 GPM
- Proposed Lift Station Design Parameters:
    - Design Point: 280 GPM @ 105' TDH
    - Pump Selection: (2) Hydromatic S4K (15 HP)
    - Wet Well Diameter: 6 FT
    - Operating Range: 2 FT
    - Velocity in Force Main: 3.18 ft/s

The overall proposed system design includes the following:

1. Construction of approximately 7,650 LF of private 6" Force Main and connection to the existing City of Tarpon Springs 8" Force Main at Safford Avenue
2. Complete construction of the private Lift Station and Site including:
    a. 15' Driveway
    b. Chain Link fence surrounding the proposed site
    c. Swing Gate

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Introduction

The Anclote Harbor development is planned to introduce approximately 404 residential units at the southeast corner of US 19 and the Anclote River. To support this increase in flow from the new residential development, a private on-site lift station will be constructed. Included in the design of the lift station is a private on-site 6" force main and private off-site force main extension. The off-site extension will connect the private force main and lift station to the City of Tarpon Springs sewer system. This connection will be located at Live Oak Street and Safford Avenue near the City's Wastewater Treatment Plant. The lift station will also connect to a private on-site 8" and 10" gravity main system that services only the residential development.

Existing System Conditions

Currently, the City of Tarpon Springs has a sanitary sewer system consisting of a gravity main and force main along Live Oak Street that flow west and connect to the City's Wastewater Treatment Plant located at Safford Ave and Pine Street. The proposed private force main extension will follow a similar path to the City's 6" force main along Live Oak Street until they connect at Live Oak Street and Safford Avenue.

Lift Station Design and Pump Selection

The overall proposed system design includes the following:

1. Construction of approximately 7,650 LF of private 6" Force Main and connection to the existing City of Tarpon Springs 8" Force Main at Safford Avenue
2. Complete construction of the private Lift Station and Site including:
    a. 15' Driveway
    b. Chain Link fence surrounding the proposed site
    c. Swing Gate

Sewer Calculations

As a basis for design, the proposed ADF was selected by analyzing the estimated flow rates as calculated in the Concurrency Report. To estimate the expected flows from the proposed development, the Florida Administrative Code estimated Sewer Flows (F.A.C. 64E-6.008) values for a residential property were used. See **Table 1** below.

Table 1: Estimated Development Flows

Residential Units	Unit Load (GPD)	Total Count	Estimated Flow Rate (GPD)
Dwelling Units ≤ 750 sq. ft	100	8	800
Dwelling Units 751 to 1,200 sq. ft	200	336	67,200
Dwelling Units 1,201 to 2,250 sq. ft	300	60	18,00
Leasing Office per 100 sq. ft of Floor Space	15	11,500 sq. ft/100 sq. ft	1,725
		Total Estimated ADF	87,725

The flow rate from the proposed development site was calculated based on the square footage and

number of bedrooms for each residential unit expected for the development per F.A.C. 64E-6.008. A total summary of the proposed ADF, Peaking Factor, and Peak Hour Flow is shown below in **Table 2**.

Table 2: Flow Summary

Design Criteria	Flow (GPM)
Average Daily Flow (ADF)	60.9
Peaking Factor	4.0
Peak Hour Flow (PHF)	244

The peak flow was then used as the basis for the design point of the lift station pumps. The total dynamic head (TDH) was also calculated to assure that the pump will be able to pump against the proposed conditions. The equivalent length method was used to determine the friction loss due to the pipe and appurtenances, and a Hazen Williams coefficient of 120 was assumed. This friction loss was then added to the total static head to develop a system curve of the flow versus the TDH. From this system curve, a design point was selected of 280 gallons per minute (GPM) at 105-FT TDH.

Once a design point was selected, calculations were performed to size the proposed wet well to ensure all the cycle times were according to FDEP regulations and manufacturer's recommendations. It was determined that a 6-foot wet well with 2 feet allotted for operating depth would be adequate to keep minimum cycle times below 30 minutes and to ensure the number of pump starts would not be more than the manufacturer's recommendations. In addition, a 6-foot diameter wet well was also chosen to provide adequate space for the size of the selected pumps.

Based on the results of the calculations detailed above, two 15-HP Hydromatic S4K Submersible Pumps were selected for the lift station design. All calculations are shown in **Appendix A** and the pump information is shown in **Appendix B**.

A summary of the calculated data is shown below:

- Summary of Design Criteria:
  - Average Daily Flow: 60.9 GPM
  - Peaking Factor: 4.0
  - Peak Hour Flow: 244 GPM
  - Hazen Williams C-factor: 120
- Proposed Lift Station Design Parameters:
  - Design Point: 280 GPM @ 105' TDH
  - Pump Selection: (2) Hydromatic S4K
  - Horsepower: 15 HP
  - Velocity in Force Main: 3.18 ft/s
  - Wet Well Diameter: 6 FT
  - Operating Range: 2 FT
  - Depth of Wet Well: 13.80 FT
  - Elevations:
    - Rim: 9.5 FT
    - Pipe Invert: -4.30 FT

- Bottom of Wet Well: -10.80 FT
- Lead Pump On: -5.80 FT
- Pumps Off: -7.80 FT

Force Main Design

Due to the increase in flow from the proposed development and new private lift station, a new private force main was designed to be constructed and connect to the existing City of Tarpon Springs 8" Force Main at Safford Avenue and Live Oak Street. This on-site force main and off-site extension along US 19 and Live Oak Street will allow for the flow from the proposed development to connect to the existing City of Tarpon Springs sewer system. Based on the lift station velocity calculations, a 6-inch diameter Force Main is recommended to be used throughout the development and off-site extension. The velocity must not be less than 2 feet per second and may not exceed 8 feet per second at peak-hour flow. This force main will begin at the location of the proposed lift station on-site, extend off-site at US 19, flow west on Live Oak Street, and connect to the City's 8" force main at Safford Ave.

APPENDIX A:
Flow Calculations and System Pump Curves

Project Name: Anclote Harbor Lift Station and Force Main
Location: Tarpon Springs, Florida
KHA Project Number: **145062001**
Engineer: **JWW**
Revised:

LIFT STATION CALCULATIONS

A. Flow Estimate

1.

Description	Flow Amount (GPD)	Count	Flow (GPD)
Proposed Development			
Dwelling Units ≤ 750 sq. ft	100	8	800
Dwelling Units 751 to 1,200 sq. ft	200	336	67,200
Dwelling Units 1,201 to 2,250 sq. ft	300	60	18,000
Leasing Office per 100 sq. ft of Floor Space	15	115	1,725
		Total	**87,725**

TOTAL= **87,725** GPD (ADF)

Average = $\frac{87{,}725 \text{ GPD}}{24 \text{ Hours} \times 60 \text{ Min./Hour}}$ = 60.9 GPM = ADF

2. Peak Flows

ADF Range (MGD)		Peak Factor
From	to	
0	100,000	4
100,000	250,000	3.5
250,000	1,000,000	3
1,000,000	5,000,000	2.5

a peaking factor of **4** is used.

Peak flow = 60.9 GPM x 4 = 244 GPM

B. Equivalent lengths of pipe

(Based on Submersible Sewage Pumping Systems Handbook, Second Edition)

Fitting	Equivalent Feet of Pipe				
	Pipe Size (inches)				
	2	4	6	8	10
Gate Valve	1	2.3	3.5	4.5	5.7
Plug Valve	3	6.2	9.3	12.2	15.4
Check Valve	13	27	40	53	67
Tee	11	22	33	43	56
45 Degree	3	5	7.7	10	13
90 Degree	6	11	16	21	26
Reducer	3	4	5	8	10

1a. Equivalent lengths of pipe

Internal Piping

Pipe	**48**	LF of	**4**	DIP force main		=	48 LF
Gate Valve	**1**	-	**4**	Gate Valve (open) x	2.3 LF	=	2 LF
Plug Valve	**1**	-	**4**	Plug Valve (open) x	6.2 LF	=	6 LF
Check Valve	**1**	-	**4**	Check Valve (open) x	27 LF	=	27 LF
Tee	**1**	-	**4**	Tees x	22 LF	=	22 LF
45 Degree	**2**	-	**4**	45 degree elbows x	5 LF	=	10 LF
90 Degree	**3**	-	**4**	90 degree elbows x	11 LF	=	33 LF
Reducer	**1**	-	**4**	Reducers x	4 LF	=	4 LF
			Equivalent length of	**4**	**pipe based on C = 120**		**153 LF**

External Piping

Pipe	**7650**	LF of	**6**	PVC force main		=	7,650 LF
Gate Valve	**0**	-	**6**	Gate Valve (open) x	3.5 LF	=	0 LF
Plug Valve	**8**	-	**6**	Plug Valve (open) x	9.3 LF	=	74 LF
Check Valve	**0**	-	**6**	Check Valve (open) x	40 LF	=	0 LF
Tee	**0**	-	**6**	Tees x	33 LF	=	0 LF
45 Degree	**15**	-	**6**	45 degree elbows x	7.7 LF	=	116 LF
90 Degree	**0**	-	**6**	90 degree elbows x	16 LF	=	0 LF
Reducer	**0**	-	**6**	Reducers x	5 LF	=	0 LF
			Equivalent length of	**6**	**pipe based on C = 120**		**7,840 LF**

C. Static Head

Highest Point of Force Main **23.00** FT NAVD

Low Water Level In Wetwell **-8.73** FT NAVD

Total Static Head 31.73 FT

D. Head in receiving force main.

Receiving force main pressure **0.00** psi / 0.433 = 0.00 FT of head

Ties into Gravity System

E. System Head Curve

Pipe Classifiaction	Inside Diameter (in)	C Factor	Equiv. Length (ft)
DIP	4.00	120	153
PVC	6.00	120	7,840

SYSTEM CURVE DATA POINTS

Flow (GPM)	Velocity (FPS)	Friction Loss(ft)	Static Head(ft)	TDH
0	0.00	0.00	31.73	31.73
50	0.57	3.02	31.73	34.75
100	1.13	10.90	31.73	42.63
150	1.70	23.07	31.73	54.80
200	2.27	39.28	31.73	71.01
280	3.18	73.20	31.73	104.94
330	3.74	99.21	31.73	130.94
380	4.31	128.79	31.73	160.52
430	4.88	161.88	31.73	193.62

F. CYCLE TIME ANALYSIS

$$T = \frac{V_{op}}{Q - S} + \frac{V_{op}}{S}$$

Average conditions: Desire to pump out wetwell every 10-15 minutes to prevent septic conditions(30 minutes max, as stated in 10 State Standards)
Recommended that each motor be started no more than three (3) times per hour (two pumps = 6 cycles)

Where T = Cycle Time (min.)
V_{op} = Volume of Operating Range (gal.)
Q = Pumping Rate (GPM)
S = Incoming Flow (GPM)

Assume : **6** ft diameter wetwell and **2** ft of operating range (H_1)

H1 = "Lead Pump On" elevation minus "Pump Off" elevation

2 number of pumps

V_{op} = 423.57 gal. $V_{op} = Pi * r^2 * H_1$

Q = **280** GPM

Average Flow

S = 60.92 GPM (ADF) 87725 GPD

$T = V_{op}/(Q-S) + V_{op}/S$

$T = \frac{423.57}{Q - 60.92} + \frac{423.57}{60.92}$ = **8.89 min.** ← **280 GPM**

$RT = V_{op}/(Q - S)$

$RT = \frac{423.57}{Q - 60.92}$ = **1.93 min.** ← **280 GPM**

Minimum Flow

S = 40.82 GPM (Minimum Flow) 0.67 (min. factor) 58,776 GPD

$T = \frac{423.57}{Q - 40.82} + \frac{423.57}{40.82}$ = **12.15 min.** ← **280 GPM**

$RT = \frac{423.57}{Q - 40.82}$ = **1.77 min.** ← **280 GPM**

Peak Flow

S = 244 GPM (Peak Flow) 4.00 (peak factor) 350,900 GPD

$T = \frac{423.57}{Q - 243.68} + \frac{423.57}{243.68}$ = **13.40 min.** ← **280 GPM**

RT = 423.57 / Q - 243.68 = **11.66 min.** ← **280 GPM**

Velocity at pumping rate of 280 gpm in the 6.00 inch force main is **3.18 fps**
Number of cycles per hour per pump during average daily flow **3.38 cycles**
Number of cycles per hour per pump during peak flow **2.24 cycles**

G.

Diameter of Pump Inlet (in) d = 6

H (x) = 1.4 Round = **3.00** (To Submerge Pump)

H (min) = **2** (Operating Range)

H (lag) = **0.5** (>= 6" Per 10 State Standards)

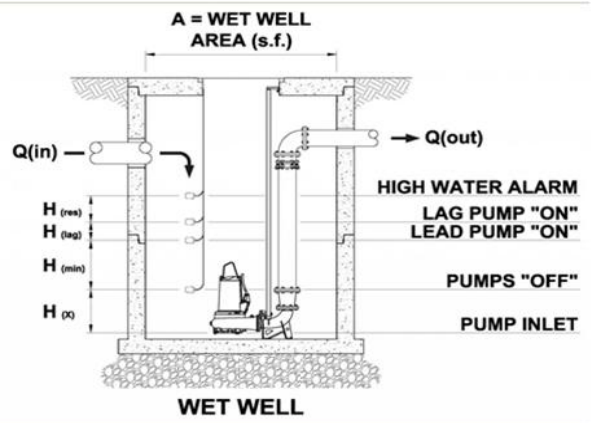
H (res) = **0.5** (>= 6" Per 10 State Standards)

Invert to
H (res) = **0.5**

Float Elevations

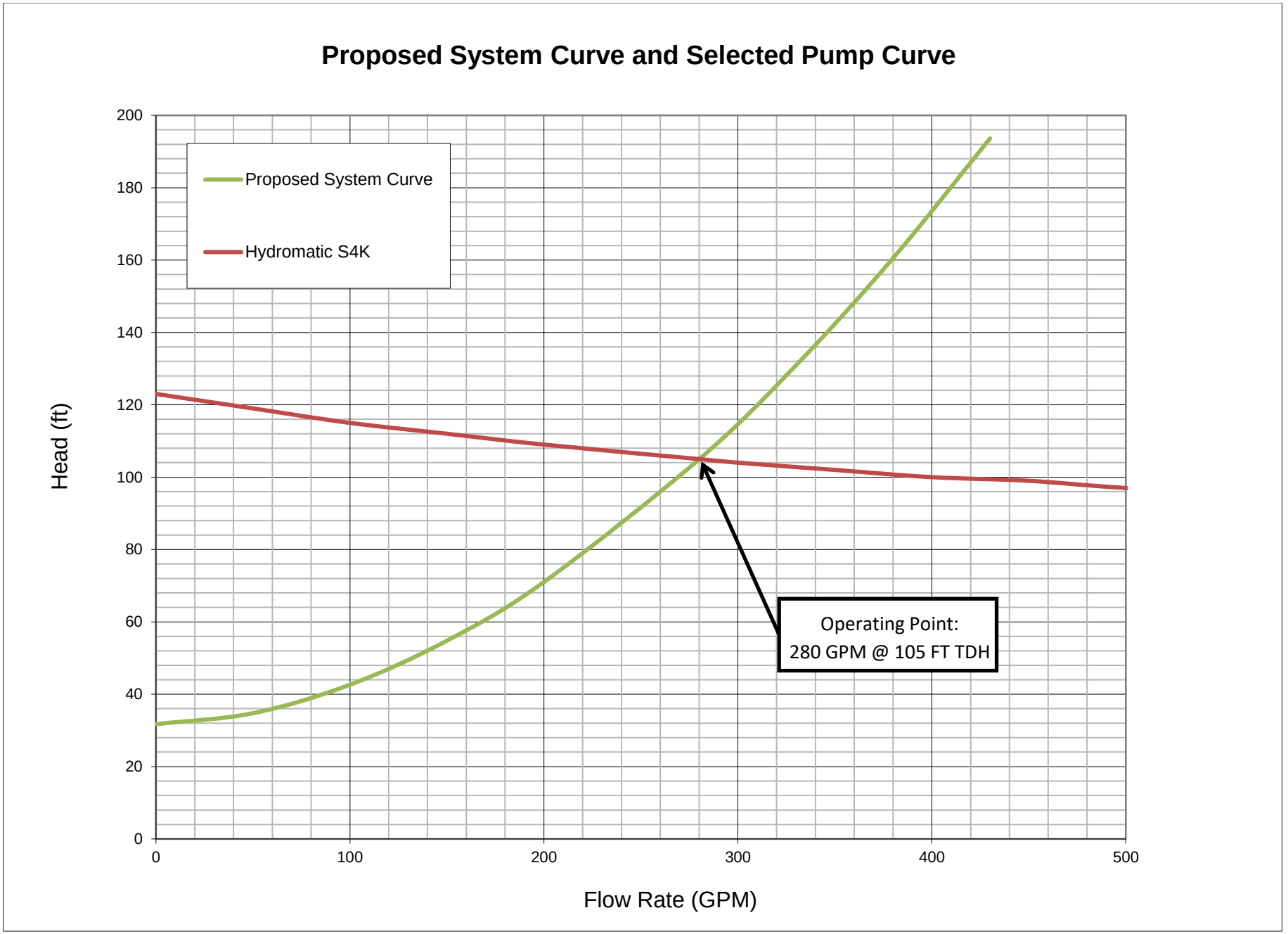
Bottom of Wetwell	-10.804
Pump Off Elevation	-7.804
Lead On	-5.804
Both Pumps On	-5.304
High Level Alarm	-4.804
Invert Elevation	-4.304
Rim Elevation	9.500
Depth	13.804

FLOAT CALCULATIONS



$$H_{(X)} = D(1 + 2.3F_D)$$

$$F_D = \frac{V}{(gD)^{0.5}}$$


Proposed System Curve and Selected Pump Curve
Proposed System Curve
Hydromatic S4K
Operating Point:
280 GPM @ 105 FT TDH
Head (ft)
Flow Rate (GPM)
0
20
40
60
80
100
120
140
160
180
200
0
100
200
300
400
500

APPENDIX B:
Hydromatic S4K Pump Information

Customer :
Project name :

Pump Performance Datasheet

Encompass 2.0 - 21.3.1

Item number	: Default	Size	: Hydromatic - S4K
Service	:	Stages	: 1
Quantity	: 1	Based on curve number	: SUB_S_E_AH_00011_E_4 Rev 2012-03-23
Quote number	:	Date last saved	: 13 Sep 2021 11:57 AM

Operating Conditions

Flow, rated	: 280.0 USgpm
Differential head / pressure, rated (requested)	: 105.0 ft
Differential head / pressure, rated (actual)	: 108.0 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed criteria	: Synchronous
Speed, rated	: 1750 rpm
Impeller diameter, rated	: 10.38 in
Impeller diameter, maximum	: 12.00 in
Impeller diameter, minimum	: 8.50 in
Efficiency	: 53.31 %
NPSH required / margin required	: - / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 28 / - Metric units
Minimum Continuous Stable Flow	: 150.2 USgpm
Head, maximum, rated diameter	: 123.3 ft
Head rise to shutoff	: 17.41 %
Flow, best eff. point	: 689.3 USgpm
Flow ratio, rated / BEP	: 40.62 %
Diameter ratio (rated / max)	: 86.46 %
Head ratio (rated dia / max dia)	: 69.33 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids diameter limit	: 3.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

Material selected	: Standard

Pressure Data

Maximum working pressure	: 53.35 psi.g
Maximum allowable working pressure	: N/A
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: N/A

Driver & Power Data (@Max density)

Driver sizing specification	: Rated power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 7.42 hp
Power, rated	: 13.92 hp
Power, maximum, rated diameter	: 26.27 hp
Minimum recommended motor rating	: 15.00 hp / 11.19 kW