

DESIGN REPORT SEWAGE PUMPING STATION

FOR THE PROPOSED

DOLBY PROPERTY NORTH

CITY OF SEAFORD
DELAWARE

PREPARED BY:



CIVIL ENGINEERING ASSOCIATES, LLC

55 West Main Street
Middletown, DE 19709
302-376-8833

DATE:

July 2023
Revised November 2023
Revised April 2024
Revised August 2024

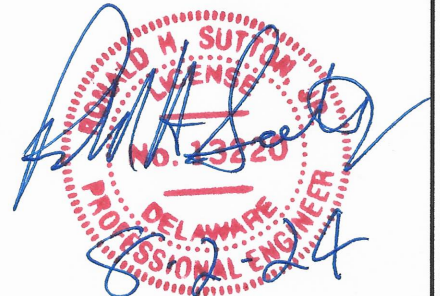


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I. INTRODUCTION

The Dolby Property North development is located on Old Furnace Road in the City of Seaford, Delaware. The development will consist of approximately 33.22 acres developed with 157 single family homes. The proposed pump station will service all of the proposed 157 single family homes within the City of Seaford. The sanitary sewer will be conveyed to this pump station via gravity mains.

This report will establish the design and construction standards to be incorporated into the new pump station.

II. SITE SELECTION

The pump station will be located at the southeastern corner of the property. This location is the most cost effective, as it will reduce the depth of the pump station and associated gravity lines. Easements will be provided where necessary for the gravity sewer and force main.

Access to the pump station will be provided by an asphalt drive. To maintain the Developer's vision for the development, the site will be further screened with landscaping and plantings.

III. DESIGN FLOW

The proposed development will produce the following flows:

DESCRIPTION	GPD/UNIT	ESTIMATED NO. OF UNITS	AVERAGE DAILY FLOW
Dolby Property North	250/EDU	157	39,250
		Total Avg. Daily Flow	39,250 GPD
		Peak/ Average Ratio	4
		Peak Hourly Flow Rate	109 GPM
		Design Flow Rate	109 GPM

IV. COLLECTION SYSTEM

The collection system associated with the proposed pump station will consist of new gravity sewer. The gravity sewer for the entire development will consist of approximately 4,896 linear feet of 8" diameter SDR-35 Integral Gasketed PVC Sewer Pipe and associated manholes and cleanouts.

IV. TRANSMISSION

The new forcemain line will consist of a 4" SDR-21 PVC pipe. The new forcemain line will exit to the southwest of the proposed pump station, run northwest along Old Furnace Road for approximately 1,842 feet where it will then turn and run to the southwest through the lands of Dolby A Jay Trustee (where the proposed Dolby Property South development is to take place in the future) and tie-into the existing sanitary sewer manhole. Once the Dolby Property South development is constructed, the forcemain will be rerouted to the closest gravity manhole within the southern development (approximately 420 linear feet northwest of the pump station). The remaining forcemain that was initially installed with the northern development will then be abandoned.

I. PROPOSED PUMPING STATION

A. Description

The proposed pump station will convey the wastewater collected from Dolby Property North. The pump station will consist of a concrete wet well, two submersible pumps on slide rails, a control panel, and an emergency generator.

B. Wet Well

The wet well will consist of an 8 foot inside diameter precast concrete structure. Heavy-duty aluminum access frames and covers will be provided for pump access and removal. An in-line axial vane type pump blower will provide positive ventilation.

Design based on peak or ultimate flow of 109 GPM and cycle time of 10 minutes. The volume required based on the flow and cycle time is given by the following equation:

$$V_{\min} = \frac{T_{\min} * Q_p}{4}$$

$$V_{\min} = [(10 \text{ min.}) * (109 \text{ GPM})] / 4 = 272.5 \text{ gallons} = 36.43 \text{ ft}^3$$

Using an inside diameter of 8 feet, the Area (A) = 50.27 ft²

$$\text{Min. Depth} = \frac{V_{\min}}{A}$$

$$\text{Min. Depth} = 36.43 \text{ ft}^3 / 50.27 \text{ ft}^2 = 0.72 \text{ feet}$$

The operating depth of the pump station will be 0.72 feet. This will provide an operating volume of 272.5 gallons.

C. Pumps

The pump station shall be a duplex unit with two submersible, solids handling sewage pumps. The pumps will be sized to handle the wastewater flows as described above.

The pumps shall be Myers Model WGX50(3PH), 5 HP, Grinder Pump. The operational point is 109 GPM at 60.00 ft of head. The pumps will be mounted on a rail system to enable the removal and replacement without entering the wet well.

APPENDIX A

PERFORMANCE CURVE & PUMP DATA

Item Number / Tags	: Duplex SPS	Size	: Myers - WG50/WGX50(3PH)
Service	: 3phase	Stages	: 1
Quantity	: 1 + 1 standby	Based on curve number	: SUB_G_V_AH_00003_B_2 Rev
Quote number	: OPP4369	Date last saved	: 2012-03-23
			: 07 Aug 2024 crh@sthinc.com

Operating Conditions

Flow, rated	: 109.0 USgpm
Differential head / pressure, rated (requested)	: 75.04 ft
Differential head / pressure, rated (actual)	: 75.90 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	: 3500 rpm
Impeller diameter, rated	: 5.25 in
Impeller diameter, maximum	: 5.25 in
Impeller diameter, minimum	: 3.75 in
Efficiency	: -
NPSH required / margin required	: - / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 37 / - Metric units
Minimum Continuous Stable Flow	: -
Head, maximum, rated diameter	: 90.81 ft
Head rise to shutoff	: 20.69 %
Flow, best eff. point	: -
Flow ratio, rated / BEP	: -
Diameter ratio (rated / max)	: 100.00 %
Head ratio (rated dia / max dia)	: 99.12 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Wastewater
Additional liquid description	: -
Solids diameter, max	: 0.00 in
Solids diameter limit	: 0.00 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

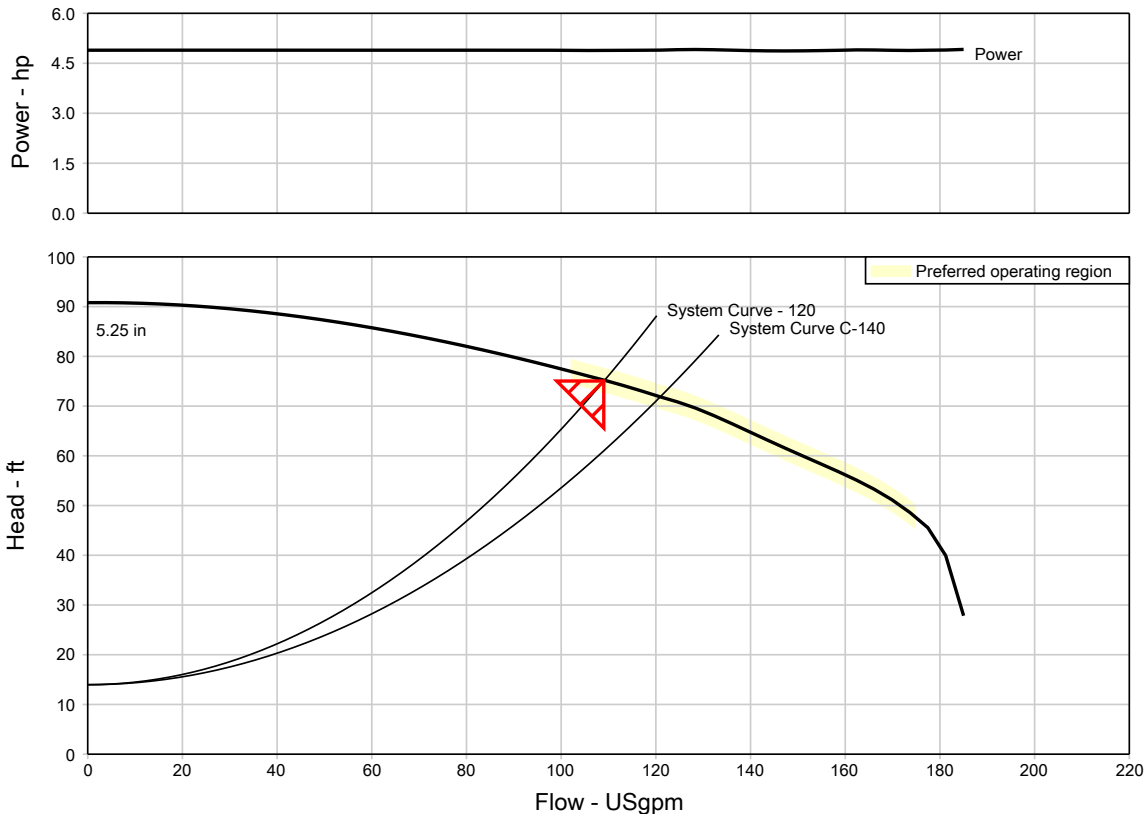
Material selected	: Standard
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Pressure Data

Maximum working pressure	: 39.30 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	: 2.07 hp
Power, rated	: 4.89 hp
Power, maximum, rated diameter	: 4.92 hp
Motor rating	: 5.00 hp / 3.73 kW (Fixed)



APPENDIX B

BUOYANCY CALCULATION

PROPOSED PUMP STATION WET WELL
 BUOYANCY CALCULATIONS
DOLBY PROPERTY NORTH
 CITY OF SEAFORD, Delaware

Top of Structure elevation:
 Invert of Structure:
 Groundwater Elevation:
 Wet Well Interior Diameter:

29.00
9.00
29.00
8.00

*Calculations assume ground water at grade level

DESCRIPTION	THICKNESS (FT)	HEIGHT (FT)	INSIDE AREA (SF)	OUTSIDE AREA (SF)	AREA DIFFERENCE (SF)	VOLUME (CU. FT.)	UNIT WEIGHT LBS/CF	WEIGHT (LBS)
Wet Well - Walls (<i>height = top to invert</i>)	0.67	20.00	50.24	68.48	18.24	364.80	150.00	54,719.84
Wet Well Top	1.00	N/A	N/A	188.00	0.00	188.00	150.00	28,200.00
Wet Well Floor	1.50	N/A		78.50	78.50	117.75	150.00	17,662.50
Soil above footer	1.00	20.00	68.48	100.95	32.47	649.35	105.00	68,181.96
TOTAL WEIGHT OF STRUCTURE AND SOIL:								168,764.30
Buoyancy Force - Wet Well	N/A	21.50	N/A	68.48	N/A	1472.32	62.40	91,872.70
Buoyancy Force- Footer	N/A	1.50	N/A	100.95	N/A	151.42	62.40	9,448.69
TOTAL BUOYANCY FORCE:								101,321.39
			Total Force Down =	168,764.30	LBS.			
			Total Force Up =	101,321.39	LBS.			
			Net Difference =	67,442.91	LBS. DOWN			
			Safety Factor =	1.67	Target Safety Factor = 1.5			

NOTES:

- 1) Forces calculated above do not include the weight of any equipment and/or hardware.
- 2) Forces calculated above do not include any soil resistance due to friction.
- 3) Weight of concrete = 150 lbs per cubic foot.
- 4) Weight of soil (saturated) is assumed to be 105 lbs per cubic foot.
- 5) Weight of water is 62.4 lbs per cubic foot.
- 6) Neither buoyant nor anchoring properties of influent pipe are accounted for.

APPENDIX C

WASTEWATER PUMP STATION & FORCE MAIN DESIGN CALCULATIONS

Design Pumping Flow Rate

Peaking Factor Calculation	
Service Area Population =	471
Peak Factor =	$\frac{18 + \sqrt{P}}{4 + \sqrt{P}}$
Calculated Peak Factor =	4.0
Design Peak Factor =	4.0

Determine Minimum Pump Rate		
Average Daily Flow =	39,250	GPD
Peak Flow =	157000	GPD
Minimum Pumping Rate Required =	109	GPM
Design Pumping Rate =	109	GPM

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DOLBY PROPERTY - NORTH
PUMP STATION CALCULATIONS

Cycle Time & Wet Well Geometry

Target Cycles Per Hour		
ADF	=	27 gpm
Pumping Rate	=	109 gpm
Time	=	10.0 min.
Cycles Per Hour =		6.0
<i>Check Cycles Per Hour:</i>		OK
<i>Check Cycles Per Hour:</i>		OK

Determine Wet well Diameter		
Required Volume =	204	Gallons
Pick Wet Well Diameter =	8.0	Ft
Pick Wet Well Cycle =	4.09	Vert. Ft
Volume in Cycle =	1538	Gallons

Vertical Datum Used: NAVD 88

Determine Wet Well Invert & Float Elevations	
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Wet well Dia. =		8.0	Ft
Top Elev=	29.00		
Gnd Elev=	28.50		
SS Invert In=	15.09		
Top of Pumps =	11.91		
Bottom Invert Elev* =	9.00		

Alarm =	15.09
Lag On =	14.09
Lead On =	13.09
Pumps Off =	12.00

*As required for complete submergence

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PUMP STATION CALCULATIONS

Force Main & Piping Design

Off-Site Force Main Data	
Design Pump Rate (gpm) =	109
Select Force Main Size (in) =	4
Velocity (fps) =	2.78
<i>Meets Minimum Velocity Requirement?</i>	OK
<i>Meets Maximum Velocity Requirement?</i>	OK
<i>Required Pump?</i>	Grinder Pump
Line Length (ft) =	3,411
Account for Minor Losses =	5%
Equiv Length (ft) =	3,582

Disregard on
this sheet.

Connection Point:	Existing City of Seaford Sanitary Sewer Manhole
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Pump Station Piping Data			
Design Pump Rate (gpm) =		109	
Pick Wet Well Piping Size (in) =		3.4	
Velocity (fps) =		3.85	
<i>Meets Minimum Velocity Requirement?</i>		OK > 2 FPS	
<i>Meets Maximum Velocity Requirement?</i>		OK < 8 FPS	
Item	Number of Fittings	L/D Ratio	Equivalent Length
45 bend	0	16	0.00
90 bend	2	30	17.00
22.5 bend	0	9	0.00
Discharge	1	60	17.00
Check valve	0	135	0.00
Valve	0	17	0.00
			0.00
			0.00
			0.00
Equivalent Fitting Length (ft) =		34	
Wet Well & Valve Vault Piping Length (ft) =		17	
Total Equivalent Pump Station Pipe Length (ft) =		51	
Equivalent Off-Site Diameter Length (ft) =		112	
Total Equivalent Force Main Length (ft) =		112	

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PUMP STATION CALCULATIONS

Force Main & Piping Design

Off-Site Force Main Data	
Design Pump Rate (gpm) =	109
Select Force Main Size (in) =	4
Velocity (fps) =	2.78
<i>Meets Minimum Velocity Requirement?</i>	OK
<i>Meets Maximum Velocity Requirement?</i>	OK
<i>Required Pump?</i>	Grinder Pump
Line Length (ft) =	3,411
Account for Minor Losses =	5%
Equiv Length (ft) =	3,582

Connection Point:	Existing City of Seaford Sanitary Sewer Manhole
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Pump Station Piping Data			
Design Pump Rate (gpm) =		109	
Pick Valve Vault Piping Size (in) =		4.22	
Velocity (fps) =		2.50	
<i>Meets Minimum Velocity Requirement?</i>		OK > 2 FPS	
<i>Meets Maximum Velocity Requirement?</i>		OK < 8 FPS	
Item	Number of Fittings	L/D Ratio	Equivalent Length
45 bend	0	16	0.00
90 bend	2	30	21.10
22.5 bend	0	9	0.00
Branch Tee Flow	1	60	21.10
Check valve	1	135	47.48
Valve	1	17	5.98
Flow Meter	1	0	0.00
			0.00
			0.00
Equivalent Fitting Length (ft) =		96	
Wet Well & Valve Vault Piping Length (ft) =		12	
Total Equivalent Pump Station Pipe Length (ft) =		108	
Equivalent Off-Site Diameter Length (ft) =		83	
Total Equivalent Force Main Length (ft) =		3777	



Selection Criteria
 Conditions of Service
 Product Lines

Selection Results

Configuration

Units Actions

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Operating Conditions

System Data

Head Loss Module

System #1

System #2

System #3

System #4

▼ Conditions

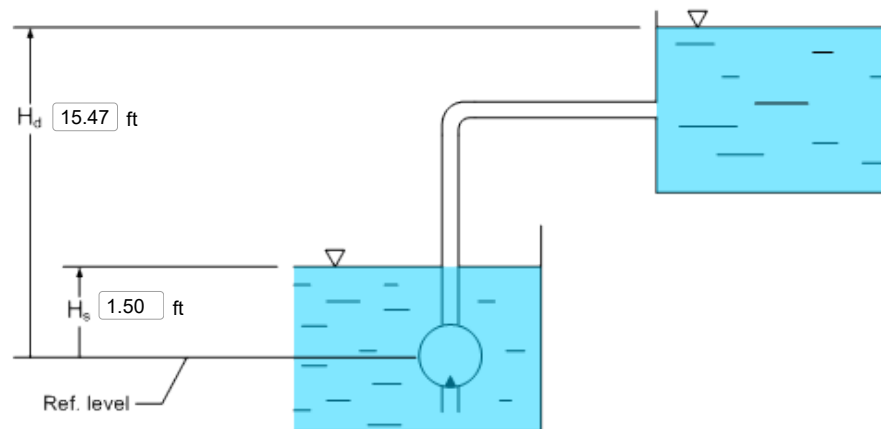
Friction calculation strategy: Darcy-Weisbach (Colebrook) Hazen-Williams

System type:

Nominal pipe size units:

System curve label / display: /

Flow, rated:



Liquid

Liquid type:

Additional Liquid Description:

Solids diameter, max: in

Max. desired operating temperature: deg F

Fluid density, rated / max: / SG

Viscosity, rated: cP

Vapor pressure: psi.a

Head loss : 61.07 ft Static head : 13.97 ft Total head : 75.04 ft NPSHa : 34.67 ft

[Transfer to Conditions of Service](#)

▼ Discharge [Add fitting](#)

Default nominal size: set @ "

(Recommended diameter = 3.50 in. Flow velocity = 3.63 ft/s)

Fitting Type	Options / Description	Qty	Nominal Size	Inner Dia. [d1] (in)	Inner Dia. [d2] (in)	Radius of Bend (in)	Degree	Pipe Length (or Equiv.) (ft)	Roughness (in)	Velocity (ft/s)	Re	C Factor	Loss Coeff. [K, Zeta]	Flow Coeff. [C _v , K _v] (USgpm/psi.g ^{0.5})	% of Flow	Head loss (ft)
Pipe	Cast Iron Class B	-	3"	3.12	-	-	-	14.00	-	-	-	100.00	-	-	100	0.68
Elbow	Bend with r/d=1	1	3"	3.00	-	0.12	90	-	-	4.95	-	-	0.36	-	100	0.14
User Defined	Pump Base Assembly	1	-	3.00	-	-	-	25.00	-	-	-	100.00	-	-	100	1.47
Transition	Sudden Enlargement	1	3"	3.00	4.10	-	-	-	-	4.95	-	-	0.22	-	100	0.08
Pipe	Cast Iron Class B	-	4"	4.10	-	-	-	15.00	-	-	-	100.00	-	-	100	0.19
Non-Return Valve	Straight Check Valve	1	4"	4.00	-	-	-	-	-	2.78	-	-	6.80	-	100	0.82
Isolating Valve	Globe Valve	1	4"	4.00	-	-	-	-	-	2.78	-	-	5.80	-	100	0.70
Elbow	Bend with r/d=1	2	4"	4.00	-	0.16	90	-	-	2.78	-	-	0.34	-	100	0.08
User Defined	Flow Meter	1	-	4.00	-	-	-	25.00	-	-	-	100.00	-	-	100	0.36
Pipe	HDPE DR11	-	4"	3.63	-	-	-	3,411.0	-	-	-	120.00	-	-	100	56.54

Total discharge: 61.07

Total head loss: 61.07



Selection Criteria
 Conditions of Service
 Product Lines

Selection Results

Configuration

Units Actions

Next >>

Operating Conditions

System Data

Head Loss Module

System #1

System #2

System #3

System #4

Conditions

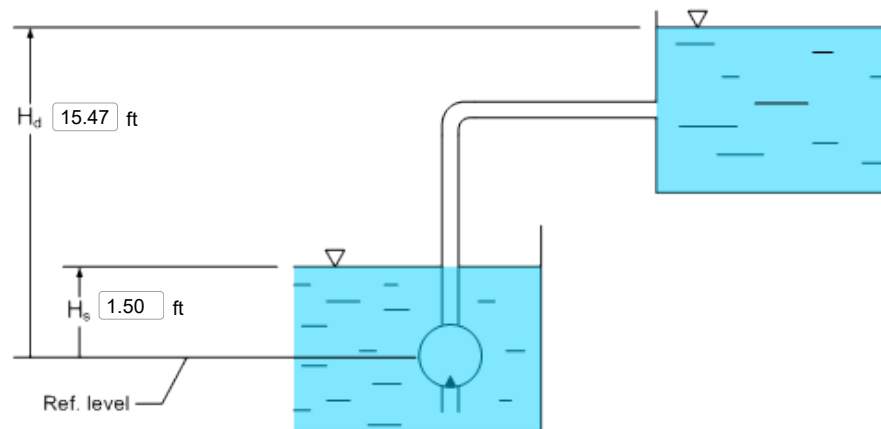
Friction calculation strategy: Darcy-Weisbach (Colebrook) Hazen-Williams

System type:

Nominal pipe size units:

System curve label / display: /

Flow, rated:



Liquid

Liquid type:

Additional Liquid Description:

Solids diameter, max: in

Max. desired operating temperature: deg F

Fluid density, rated / max: / SG

Viscosity, rated: cP

Vapor pressure: psi.a

Head loss : 47.03 ft Static head : 13.97 ft Total head : 61.00 ft NPSHa : 34.67 ft

[Transfer to Conditions of Service](#)

Discharge [Add fitting](#)

Default nominal size: set @

(Recommended diameter = 3.50 in. Flow velocity = 3.63 ft/s)

Fitting Type	Options / Description	Qty	Nominal Size	Inner Dia. [d1] (in)	Inner Dia. [d2] (in)	Radius of Bend (in)	Degree	Pipe Length (or Equiv.) (ft)	Roughness (in)	Velocity (ft/s)	Re	C Factor	Loss Coeff. [K, Zeta]	Flow Coeff. [C _v , K _v] (USgpm/psi.g ^{0.5})	% of Flow	Head loss (ft)
Pipe	Cast Iron Class B	-	3"	3.12	-	-	-	14.00	-	-	-	100.00	-	-	100	0.68
Elbow	Bend with r/d=1	1	3"	3.00	-	0.12	90	-	-	4.95	-	-	0.36	-	100	0.14
User Defined	Pump Base Assembly	1	-	3.00	-	-	-	25.00	-	-	-	100.00	-	-	100	1.47
Transition	Sudden Enlargement	1	3"	3.00	4.10	-	-	-	-	4.95	-	-	0.22	-	100	0.08
Pipe	Cast Iron Class B	-	4"	4.10	-	-	-	15.00	-	-	-	100.00	-	-	100	0.19
Non-Return Valve	Straight Check Valve	1	4"	4.00	-	-	-	-	-	2.78	-	-	6.80	-	100	0.82
Isolating Valve	Globe Valve	1	4"	4.00	-	-	-	-	-	2.78	-	-	5.80	-	100	0.70
Elbow	Bend with r/d=1	2	4"	4.00	-	0.16	90	-	-	2.78	-	-	0.34	-	100	0.08
User Defined	Flow Meter	1	-	4.00	-	-	-	25.00	-	-	-	100.00	-	-	100	0.36
Pipe	HDPE DR11	-	4"	3.63	-	-	-	3,411.0	-	-	-	140.00	-	-	100	42.50

Total discharge: 47.03

Total head loss: 47.03