Memo

To: Bernie Marshall, Superintendent

From: Raymond Willis, P.E.

CC: *David Hale, Omni Properties, LLC*

Date: December 17, 2020

Re: *Summer Street Development, Walpole*, MA

As requested, Onsite Engineering has prepared this memorandum to detail the preliminary design of the sewage collection system servicing the proposed Summer Street development located in Walpole, Massachusetts. The collection system, as currently proposed, utilizes a combination of gravity collection sewer and three (3) sewage pump stations, which are connected to a common force main system. The common force main from the pump stations would connect to a segment of gravity sewer located at the entrance to the site, which would then flow by gravity to the Town's sewage collection system within Summer Street.

The gravity collection system within the site consists of four (4) sewer service areas. For each service area, we inventoried the number of connected uses to determine the anticipated average day sewage generation, the maximum day sewage generation, and the peak hour flow rate. The average and maximum day sewage generation are based on design flow criteria established in 310 CMR 15.000, Title 5, which uses a 2 to 1 relationship between the maximum day and average day sewage generation. For this project, in order to calculate the peak hour flow rate, we utilized Title 5 design flow criteria to determine the maximum day sewage generation and then used that information in conjunction with the "Relation of Extreme Discharges on Maximum and Minimum Days to the Average Daily Discharge of Domestic Sewage" graph from Technical Release 16 (TR-16) prepared by the New England Interstate Water Pollution Control Commission (NEIWPPC), which is the industry standard protocol to complete exercises such as this to determine the remaining flow criteria for the sewer system.

Using the aforementioned graph, we first determined the ratios between peak hour, maximum day and average day flows for a system of this size. From the graph, those ratios are 5.6 to 3 to 1 respectively. It is important to note that in TR-16, at flows less than 100,000 gallons per day, the peak day to average day flow ratio is 3 to 1, which is not as conservative as the required Title 5 ratio noted above. Therefore, since Title 5 maximum day flow is a more conservative approach than that of the TR-16 method, we had to adjust the peak hour to average day ratio in order keep the maximum day to average day ratio at no more than 2 to 1. Therefore, the Title 5 adjusted peak hour to average day flow ratio was calculated to be 3.7 to 1 rather than 5.6 to 1.

Using the Proposed Subdivision/Overall Plan as a basemap (PDF attached), we have annotated the drawings accordingly to designate the four service areas described herein. A summary of these service areas are as follows:

Service Area #1
Calculated Title 5 Design Flow: 49,940 gallons
Maximum Day Flow: 49,940 gallons
Average Day Flow: 24,970 gallons per day
Peak Hour Flow Rate: 64.2 gallons per minute

Pump Station Criteria

- 8 foot inside diameter wet well
- Triplex submersible pump system
- 126 gpm target pumping rate

Service Area #2
Calculated Title 5 Design Flow: 5,720 gallons
Maximum Day Flow: 5,720 gallons
Average Day Flow: 2,860 gallons per day
Peak Hour Flow Rate: 7.3 gallons per minute

Pump Station Criteria

- 5 foot inside diameter wet well
- Duplex submersible pump system
- 90 gpm target pumping rate

Service Area #3
Calculated Title 5 Design Flow: 3,300 gallons
Maximum Day Flow: 3,300 gallons
Average Day Flow: 1,650 gallons per day
Peak Hour Flow Rate: 4.2 gallons per minute

Pump Station Criteria

- 5 foot inside diameter wet well
- Duplex submersible pump system
- 115 gpm target pumping rate

Service Area #4
Calculated Title 5 Design Flow: 1,430 gallons
Maximum Day Flow: 1,430 gallons
Average Day Flow: 715 gallons per day
Peak Hour Flow: 1.8 gallons per minute

Overall Site
Calculated Title 5 Design Flow: 60,390 gallons
Maximum Day Flow: 60,390 gallons
Average Day Flow: 30,195 gallons per day
Peak Hour Flow Rate: 77.6 gallons per minute

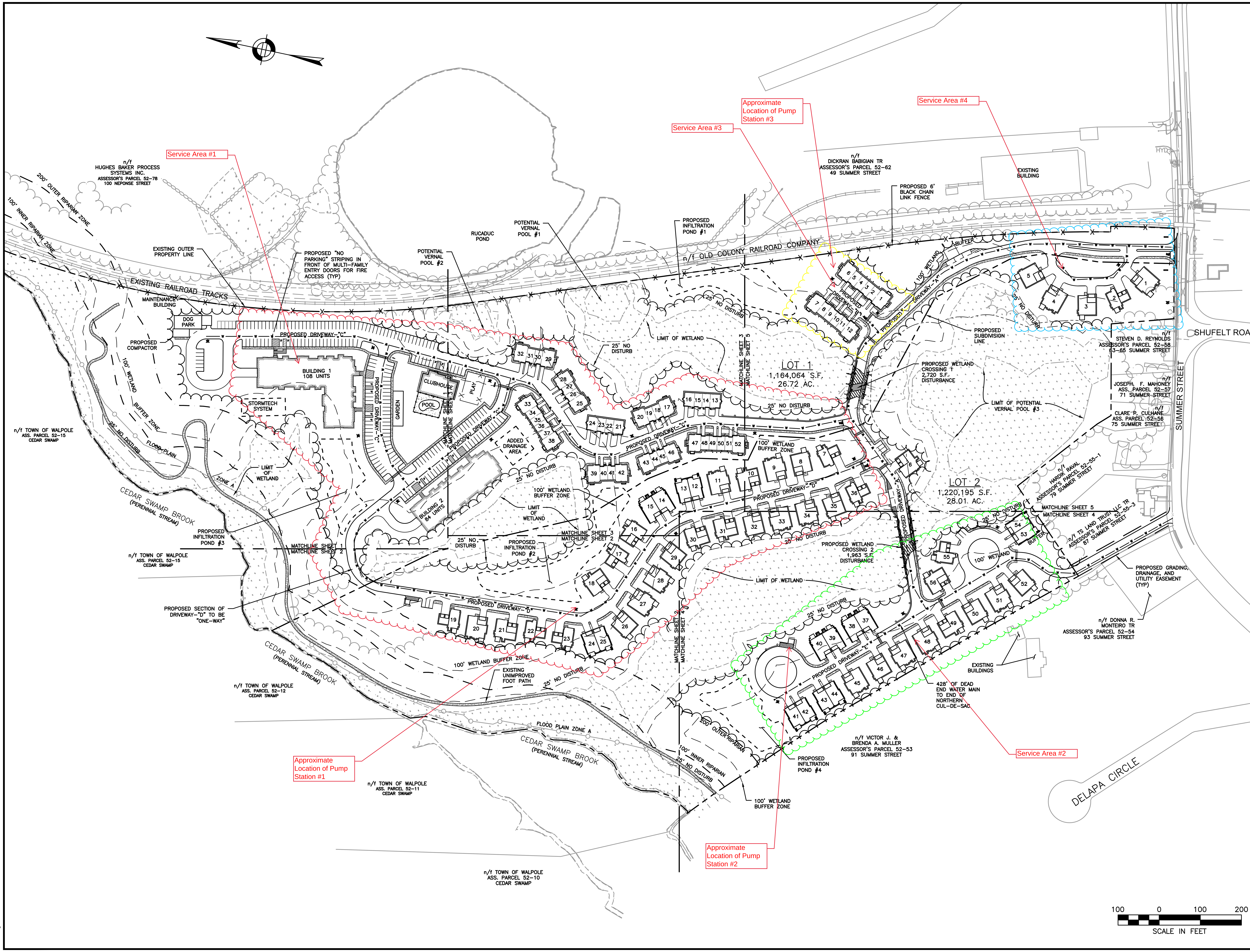
Based on existing site topography, proposed site grading, and the location of the municipal sewer connection, the as proposed configuration of the sewage pump stations' force main piping is consistent with design strategies used for low pressure sewage collection systems, which are widely used throughout New England and the United States. A distinct advantage to configuring the force mains in this manner is that it reduces the overall length of force main required, therefore, reducing the sewage's detention time in the force main system.

Given this design strategy, we requested that the pump system manufacturer prepare a model of the sewage pump station operations. As summarized in modeling reports prepared by Pentair, based on Pentair's experience under normal operating conditions, it is anticipated that two of the three pump stations would be in operation at a given time. Under this operation scenario, Pentair modeled (reports attached) the largest pump station (Pump Station #1) running with each smaller pump station (Pump Station #2 and Pump Station #3) running as well. In addition, Pentair modeled the anticipated flow rates from the possible scenario of all three stations in simultaneous operation, if such an event would occur. The results of these analyses are as follows:

Pump Station #1 and Pump Station #2 simultaneous operation: 224 gpm
Pump Station #1 and Pump Station #3 simultaneous operation: 181 gpm
Pump Station #1, Pump Station #2, and Pump Station #3 simultaneous operation: 252 gpm

In summary, based on the preliminary design information we have at this time, the volume of sewage generated by the site is anticipated to be 30,195 gallons per day on average, with a maximum day sewage generation of 60,390 gallons. The corresponding peak hour flow rate associated with the entire site is calculated to be approximately 77.6 gpm. The flow rates into the municipal sewer system associated with the operation of the pump stations are anticipated to range from 90 gpm (if the service area 2 station were running alone) up to 224 gpm under the simultaneous operation of the two larger pump stations from service areas 1 and 2. Under the limited occurrence scenario of all three pump stations operating simultaneously, the estimated flow rate from the site would be approximately 252 gpm.

Upon your review of this preliminary design memorandum, if you have any questions or require any additional information, please feel free to contact me at rwillis@onsite-eng.com or at (508) 553-0616, ext 701.



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PREPARED FOR:
55 BH LLC
6 LYBERTY WAY, SUITE 203
WESTFORD, MA 01886

PROPOSED MULTIFAMILY DEVELOPMENT
SUMMER STREET
WALPOLE, MA

REVISIONS:

NO	BY	DATE	DESCRIPTION
1	PB	5/1/20	REV. SITE PLANS
2	PB	6/29/20	REV. 200' GRADING
3	PB	9/14/20	REV. DETAILS
4	PB	10/14/20	REV. LAYOUT
5	PB	12/10/20	EMERGENCY ACCESS

SITE PLAN

PROPOSED SUBDIVISION / OVERALL PLAN

DATE: JANUARY 10, 2020
PROJECT NUMBER: 19097
DESIGNED BY: PB/KE/KF
DRAWN BY: PB/KF
CHECKED BY: KE

C.10

12/9/2020 M:\19097\CURRENT\19097 - site prep-overall-openspace.dwg
Patrick Bogie

LPS Design Report Guide

Determining Number of Pumps to Run/Model on LPS Layout:

The numbers of pumps to run/model on the LPS layout are determined from the following equation:

$$\frac{(\text{Total Houses}) \times (\text{Gallons per Day per House}) \times (\text{Peak Factor})}{\left(24\frac{\text{Hours}}{\text{Day}}\right) \times (60\text{ Min.})} = \textbf{Design GPM}$$

$$\frac{\text{Design GPM}}{\text{Pump Average GPM} *} = \textbf{Number of Pumps to Run/Model}$$

*Pump Average GPM is 10 for Positive Displacement Pumps and 25 for Centrifugal Pumps

Definition of Terms:

Node Name: Software utilizes "nodes" to signify various types of items within the system. Nodes are referenced on supplied map entitled "Node Names." The following designations are used for different kinds of nodes.

J= Junction Node
O= Pump
R= Reservoir, Lift Station, Treatment Plant

Pipe Name: Identify pipe section connecting two nodes defined as P-1, 2, 3 etc. Pipe are referenced on supplied map entitled "Pipe Names."
Start Node: Node where pipe section starts.
End Node: Node where pipe section ends.
Node Elevation: Elevation of node above sea level. Elevations are determined by converting Easting/Northing coordinates from supplied customer map through CoordTrans to assign elevations to each node.
Node Pressure: Pressure of node given in pounds per square inch.
Pressure Head: The height of a column of fluid of specific weight. This is what the pump must overcome to function.
Length: Distance of pipe between two junction nodes.
Diameter: Nominal pipe diameters are given in the report. The below table shows the actual pipe diameter for the different types of pipe.

Nominal Pipe Dia.	SDR 21 / SDR 26	SCHED 40	DR-9	DR-11
1.25	1.556	1.38	1.27	1.34
1.5	1.754	1.61	1.453	1.533
2	2.193	2.067	1.815	1.917
2.5	2.655	2.489		
3	3.43	3.068	2.675	2.826
4	4.154	4.026	3.44	3.633
5			4.253	4.49
6	6.115	6.08	5.065	5.349
8	7.961	7.981	6.594	6.963
10	9.924	10.02	8.219	8.679
12	11.77	11.938	9.746	10.293

Flowrate: Amount of water in gallons per minute flowing through the pipeline.
Velocity: Given in feet per sec. This is how fast the water is traveling through the pipeline.

Attached Maps:

All attached maps are formatted to 34"x 44." While these maps can be printed on standard 8 ½ x 11, we recommend the larger print form for visual clarity. These maps can be printed by request if necessary equipment is not available to produce plots of this size.

Walpole, MA.

Formula to Determine Number of Pumps to Run Simultaneously at Peak Flow
(Based on Ohio EPA Design Standards)

$$Peak\ Factor\ x\ Average\ Daily\ Flow = \boldsymbol{Peak\ Hourly\ Design\ Flow}\ (\boldsymbol{GPD})$$

Peak factor is calculated using the following equation.

$$\frac{3.33\ x\ 24\ hours}{Run - off\ period\ (hours)} = \boldsymbol{Peak\ Factor}$$

(this peak factor used unless specified otherwise by engineer)

The average daily flow is calculated using the following equation.

$$Number\ of\ Units\ x\ Gallons\ per\ Day\ per\ Unit = \boldsymbol{Average\ Daily\ Flow}\ (\boldsymbol{GPD})$$

The Peak Hourly Design Flow can then be calculated and is then converted to GPM by the following equation.

$$\frac{Peak\ Hourly\ Design\ Flow\ (GPD)}{24\ Hours/_{Day} \times 60\ Minutes/_{Hour}} = \boldsymbol{Daily\ GPM}$$

By dividing the Daily GPM by the average flow of the pumps selected for the system, the number of pumps running at one time can be determined.

$$\frac{Daily\ GPM}{Average\ GPM\ of\ Pump} = \boldsymbol{Total\ Number\ of\ Pumps\ to\ Run\ Simultaneously}$$

The number of pumps calculated above, are placed in the system in the worst case locations. These locations would include areas with the greatest elevation change and the ends of the force main. Additional pumps may be placed in system to verify operation of pumps in multiple areas.

Walpole, MA.

Peak Factor = 3.33
Daily Flow per Lot = 12254 Avg. GPD
Pump Chosen to Simulate: Myers VS50 & VS30 (Avg. GPM = 75)

Average Daily Flow

$$3\ EDU's\ x\ 12254\ Avg.GPD = \mathbf{36762\ GPD}$$

Peak Hourly Design Flow

$$3.33\ x\ 36762\ GPD = \mathbf{122417.46\ GPD}$$

Daily Flow

$$\frac{122417.46\ GPD}{24\ Hours/_{Day} \times 60\ Minutes/_{Hour}} = \mathbf{85.01\ GPM}$$

Number of Pumps to Run Simultaneously

$$\frac{85.01\ GPM}{75\ GPM} = \mathbf{Approximately\ 2\ pump(s)\ to\ run\ simulatenously\ at\ peak\ flow}$$

Pipe Material Chosen: SDR-21

C-Factor: 120

A percentage of total pumps shown on model. 2 pump(s) picked to run in model.

Walpole, MA.

Node Analysis

Node Name	Node Elevation (ft)	Pressure Head (ft)	Node Pressure (psi)
J-5	211.6	38.7	16.8
J-7	212.3	41.5	18.0
R-1	225.5	0.0	0.0
O-VB-1	214.6	41.4	17.9
O-VB-2	210.1	43.7	19.0
O-VB-3	206.5	45.2	19.6
O-Pump-1	200.1	67.3	29.2
O-Pump-2	213.9	42.1	18.3
O-Pump-3	204.4	49.4	21.4
I-VB-1	214.6	41.4	17.9
I-VB-2	210.1	43.7	19.0
I-VB-3	206.5	45.2	19.6

Node Analysis Complete

Walpole, MA.

Pipeline Analysis

Pipe Type: SDR-21 C-Factor: 120

Pipe Name	Start Node	End Node	Length (ft)	Diameter (in)	FlowRate (gpm)	Velocity (ft/s)	Head Loss (ft)
P-1	O-Pump-3	I-VB-2	571.7	3.2	0.0	0.0	0.0
P-2	O-Pump-2	J-5	172.7	3.2	109.0	4.5	5.7
P-3	J-5	R-1	676.3	4.1	224.1	5.6	24.8
P-4	O-Pump-1	I-VB-1	1070.4	4.1	115.1	2.9	11.4
P-5	J-7	I-VB-3	201.9	4.1	115.1	2.9	2.2
P-6	O-VB-1	J-7	201.5	4.1	115.1	2.9	2.2
P-7	O-VB-2	J-7	325.6	3.2	0.0	0.0	0.0
P-8	O-VB-3	J-5	125.7	4.1	115.1	2.9	1.3

Pipeline Analysis Complete

Walpole, MA.

Pump Analysis

Pump Name	Pump Type	Flowrate (gpm)	Pump Elevation (ft)	Pump Head (ft)	Pump Pressure (psi)	Notes
Pump-1	VS50	115.1	200.1	67.3	29.2	
Pump-2	VS30	109.0	213.9	42.1	18.3	
Pump-3	VS30	0.0	204.4	49.4	21.4	Pump off

Pump Analysis Complete

Walpole, MA.

Item Inventory

Pipes

Pipe Type	Pipe Diamter (in)	Number	Total Length (ft)	Notes
SDR-21	3	3	1070	
SDR-21	4	5	2276	
Total		**8**	**3346**	

Pumps

Pump Type	Number	Notes
VS50	3	5HP - 3 Phase pumps (1 Triplex)
VS30	4	3HP - 1 Phase Pumps (2 Duplex)

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Walpole, MA.

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O-VB-2	210.1	44.4	19.3
O-VB-3	206.5	39.0	16.9
O-Pump-1	200.1	64.6	28.0
O-Pump-2	213.9	28.5	12.3
O-Pump-3	204.4	57.1	24.8
I-VB-1	214.6	38.2	16.5
I-VB-2	210.1	44.4	19.3
I-VB-3	206.5	39.0	16.9

Node Analysis Complete

Walpole, MA.

Pipeline Analysis

Pipe Type: SDR-21 C-Factor: 120

Pipe Name	Start Node	End Node	Length (ft)	Diameter (in)	FlowRate (gpm)	Velocity (ft/s)	Head Loss (ft)
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P-2	O-Pump-2	J-5	172.7	3.2	0.0	0.0	0.0
P-3	J-5	R-1	676.3	4.1	181.8	4.5	16.9
P-4	O-Pump-1	I-VB-1	1070.4	4.1	117.7	2.9	11.9
P-5	J-7	I-VB-3	201.9	4.1	181.8	4.5	5.0
P-6	O-VB-1	J-7	201.5	4.1	117.7	2.9	2.3
P-7	O-VB-2	J-7	325.6	3.2	64.1	2.6	4.0
P-8	O-VB-3	J-5	125.7	4.1	181.8	4.5	3.1

Pipeline Analysis Complete

Walpole, MA.

Pump Analysis

Pump Name	Pump Type	Flowrate (gpm)	Pump Elevation (ft)	Pump Head (ft)	Pump Pressure (psi)	Notes
Pump-1	VS50	117.7	200.1	64.6	28.0	
Pump-2	VS30	0.0	213.9	28.5	12.3	Pump off
Pump-3	VS30	64.1	204.4	57.1	24.8	

Pump Analysis Complete

Walpole, MA.

Item Inventory

Pipes

Pipe Type	Pipe Diamter (in)	Number	Total Length (ft)	Notes
SDR-21	3	3	1070	
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Total		**8**	**3346**	

Pumps

Pump Type	Number	Notes
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VS30	4	3HP - 1 Phase Pumps (2 Duplex)