APPENDIX SCA

MIDDLETOWN SEWER CAPACITY ANALYSIS

21000 SANTA CLARA ROAD SUBDIVISION

SANITARY SEWER IMPACT ANALYSIS

DECEMBER 2019

INTRODUCTION

This study was conducted to determine the current capacity of the sewer system downstream of the proposed development as well as the proposed sewer impact from the 21000 Santa Clara Road Development. The existing downstream system is composed of two (2) pump stations and 6" and 8" gravity trunk lines.

EXISTING AND PROPOSED CONDITIONS

The existing site located at 21000 Santa Clara Road is composed of undeveloped land and has no discharge to the adjacent sewer system. There is a pump station (PS #2) located at the north east corner of the property. On the eastern edge of the property and 8" PVC sewer line (Line 1) runs from south to north, discharging into PS #2. On the north edge of the property is a 6" PVC line (Line 7) which runs from west to east, discharging into PS #2. East of the property there is an additional sewer line (Line 3), which is also 8" PVC and discharges into PS #2. PS #2 discharges in to 6" PVC force main, which runs to the west and into Pump Station #3 (PS #3), which discharges into another force main and runs to the treatment plant.

The proposed development at 21000 Santa Clara Road will have 50 new single-family units. All of these units will discharge into Line 1, the 8" sewer line which runs on the east side of the property. These 50 units will connect through two (2) new manholes along the 8" line, each of which will have half of the developments proposed discharge.

See attached maps for the "Existing Sewer Network" and the "Proposed Subdivision Utilities".

Design Analysis

Existing flows entering PS#2 and PS #3 for Dry weather flow are distributed per the following tables (Existing Dry Weather Distribution Tables). This table shows the lines discharging into the pump station, what estimated dry weather flows each pipe carries, and what percent of the flow to each pump station the pipe contributes: (See tables on next page)

Following the table are a series of calculations using Manning's Equation to determine the pipe capacity and the Hazen-Williams equations, in conjunction with system design information, to determine the pump flow rates. Previously collected record data for the pump station run times was also used to determine the existing system demands.

Existing Dry Weather Distribution Tables

		# ESD_1	gal/day_2	ft^3/day	% of PS#2	% of PS#3
Lines to PS#2	**Line #1**	113	23,730	3,172	19.32%	16.92%
	Line #3	468	98,280	13,138	80.00%	70.06%
	Line #7	4	840	112	0.68%	0.60%
Line to PS#3	**Line #8**	83	17,430	2,330		12.43%

Total PS #2	585	122,850	16,423
Total PS #3	668	140,280	18,753

Notes:
1 - From 2006 LACOSAN records, drawings, and aerial photography
2 - 210 gpd per ESD from LACOSAN standards

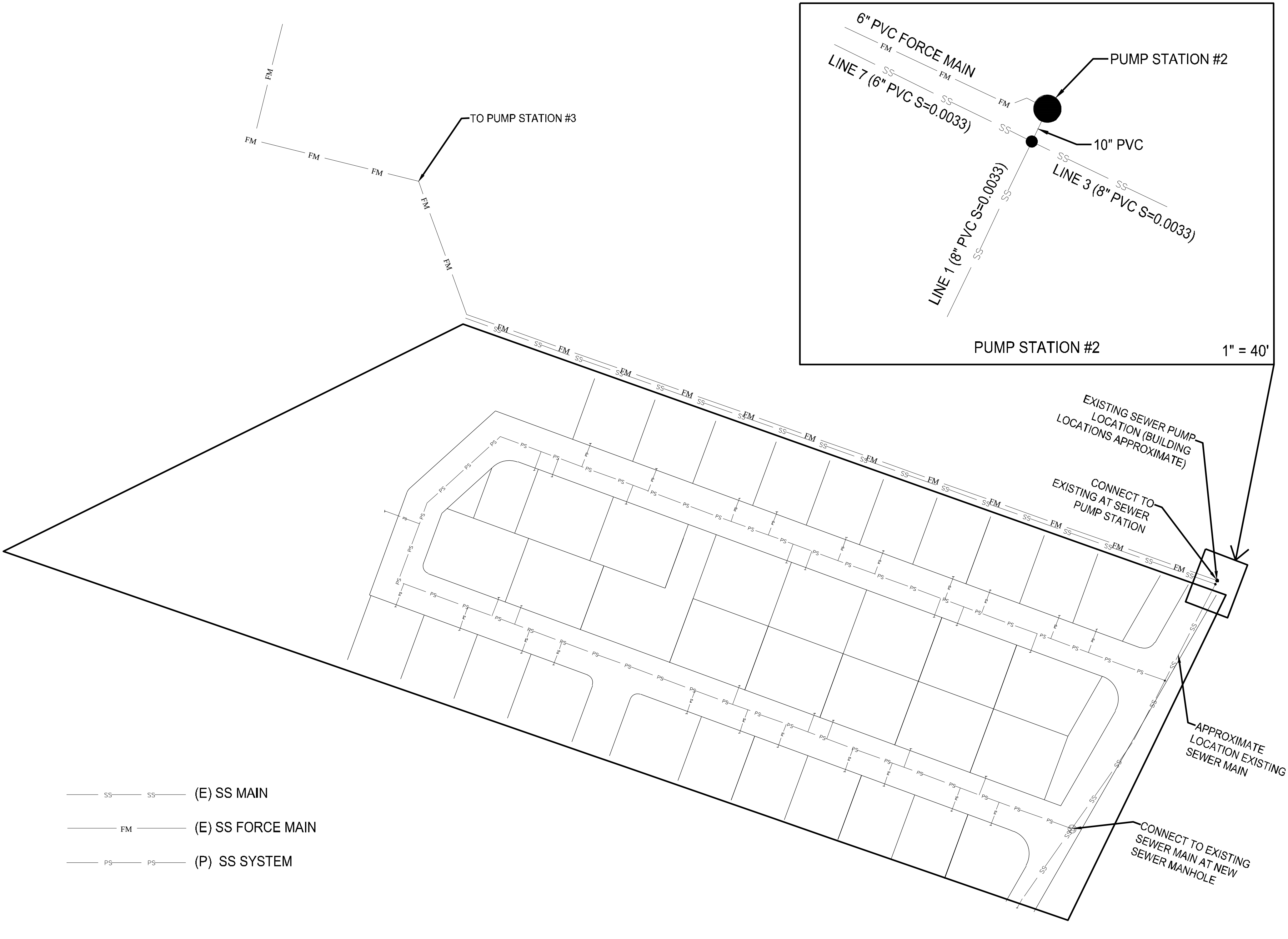
Proposed Additional Dry Weather Flow from Development

	# ESD_1	gal/day_2	ft^3/day	% of PS#2	% of PS#3
New Flow to Line #1	50	10,500	1,404	8.55%	7.49%

Proposed Dry Weather Flow post Development

		# ESD_1	gal/day_2	ft^3/day	% of PS#2	% of PS#3
Lines to PS#2	**Line #1**	163	34,230	4,576	25.67%	22.70%
	Line #3	468	98,280	13,138	73.70%	65.18%
	Line #7	4	840	112	0.63%	0.56%
Line to PS#3	**Line #8**	83	17,430	2,330		11.56%

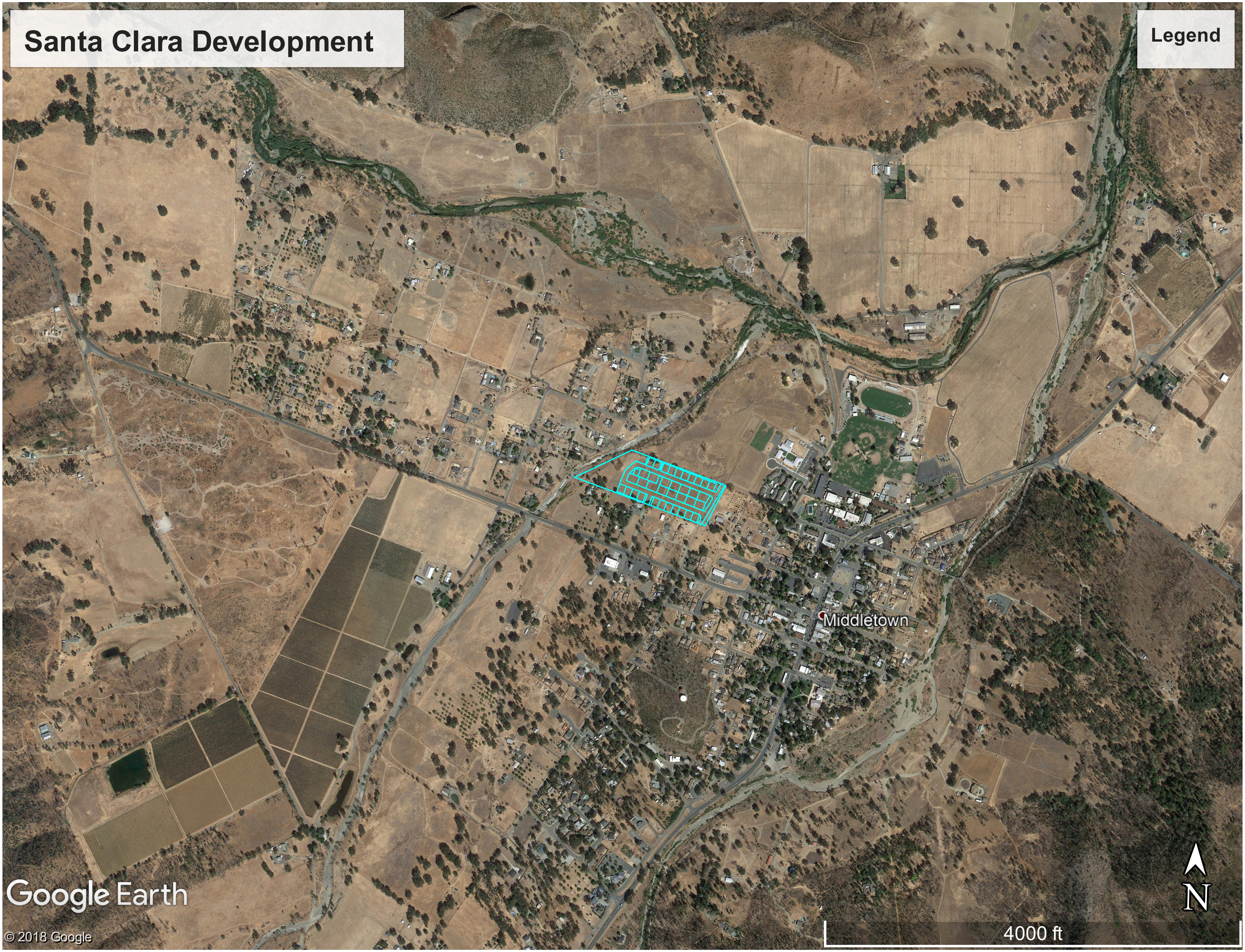
Total PS #2	635	133,350	17,826
Total PS #3	718	150,780	20,156



SANTA CLARA DEVELOPMENT

1" = 150'

Santa Clara Development



EXISTING DEMANDS ON SYSTEM

Dry-Weather
6/6/06 – 6/11/06

Pump Station #2

Pump 1 - 8.2hrs / 5 days = 1.64hrs/day
Pump 2 - 8.4hrs / 5 days = 1.68hrs/day

Existing Usage – 3.32hrs / 24hrs = **13.83%**

Pump Station #3

Pump 1 – 9.8hrs / 5 days = 1.96hrs/day
Pump 2 – 8.9hrs / 5 days = 1.78hrs/day

Existing Usage - 3.74hrs / 24hrs = **15.58%**

Wet-Weather
10yr Event (12/30/06 – 1/3/06)

Pump Station #2

Pump 1 - 29hrs / 4 days = 7.25hrs/day
Pump 2 - 33hrs / 4 days = 8.25hrs/day

Existing Usage @ 10yr event - 15.5hrs / 24hrs = **64.58%**

Pump Station #3

Pump 1 – 26.9hrs / 4 days = 6.73hrs/day
Pump 2 – 27.9hrs / 4 days = 6.98hrs/day

Existing Usage @ 10yr event – 13.71hrs / 24hrs = **57.13%**

PUMP PERFORMANCE

Hazen-Williams Friction Loss Equation (Solved for Friction Loss)

Variables

Q = Quantity (cfs)
V = Velocity (ft/s)
D = Pipe Diameter (ft)
A = Pipe Area (ft)
L = Pipe Length (ft)
C = Hazen-Williams Coefficient (from table below)
Z1 – Z2 = Elevation Difference (ft)
g = Acceleration due to gravity (32.174 ft/s^2)
k = Unit conversion factor (1.318 for English units)
K_m = Minor Loss Coefficient (from table below)
h_f = Major (friction) Loss (ft)
h_m = Minor Loss (ft)

Equations

$$h_f = L\left[\frac{V}{k\,C}\left(\frac{4}{D}\right)^{0.63}\right]^{1/0.54} \qquad h_m = K_m \frac{V^2}{2g} \qquad Q = VA \qquad A = \frac{\pi}{4}D^2$$

Pump Station #2

Q = 1.1898 ft^3/s
V = 6.0594ft/s
D = 0.5ft
A = 0.1963ft^2
L = 1726ft
C = 145(PVC)
Z1 - Z2 = 6.55ft
K_m = 7.05
h_f = 32.73ft
h_m = 4.02ft

Pump Station #3

Q = 1.4009 ft^3/s
V = 4.0128ft/s
D = 0.6667ft
A = 0.3491ft^2
L = 10783ft
C = 145(PVC)
Z1 - Z2 = 57ft
K_m = 8.1
h_f = 68.15ft
h_m = 2.03ft

Table of Hazen-Williams Coefficients

Material	C	Material	C
Asbestos Cement	140	Copper	130-140
Brass	130-140	Galvanized iron	120
Brick sewer	100	Glass	140
Cast-Iron:		Lead	130-140
New, unlined	130	Plastic	140-150
10 yr. old	107-113	*Steel:*	
20 yr. old	89-100	Coal-tar enamel lined	145-150
30 yr. old	75-90	New unlined	140-150
40 yr. old	64-83	Riveted	110
Concrete/Concrete-lined:			
Steel forms	140	Tin	130
Wooden forms	120	Vitrif. clay (good condition)	110-140
Centrifugally spun	135	Wood stave (avg. condition)	120

<u>Table of Minor Loss Coefficients (Km is unit-less)</u>

Fitting	Km	**Fitting**	**Km**
Valves:		*Elbows:*	
Globe, fully open	10	Regular 90°, flanged	0.3
Angle, fully open	2	Regular 90°, threaded	1.5
Gate, fully open	0.15	Long radius 90°, flanged	0.2
Gate 1/4 closed	0.26	Long radius 90°, threaded	0.7
Gate, 1/2 closed	2.1	Long radius 45°, threaded	0.2
Gate, 3/4 closed	17	Regular 45°, threaded	0.4
Swing check, forward flow	2		
Swing check, backward flow	infinity	*Tees:*	
		Line flow, flanged	0.2
180° return bends:		Line flow, threaded	0.9
Flanged	0.2	Branch flow, flanged	1.0
Threaded	1.5	Branch flow, threaded	2.0
Pipe Entrance (Reservoir to Pipe):		*Pipe Exit (Pipe to Reservoir)*	
Square Connection	0.5	Square Connection	1.0
Rounded Connection	0.2	Rounded Connection	1.0
Re-entrant (pipe juts into tank)	1.0	Re-entrant (pipe juts into tank)	1.0

#2

PERFORMANCE CURVE

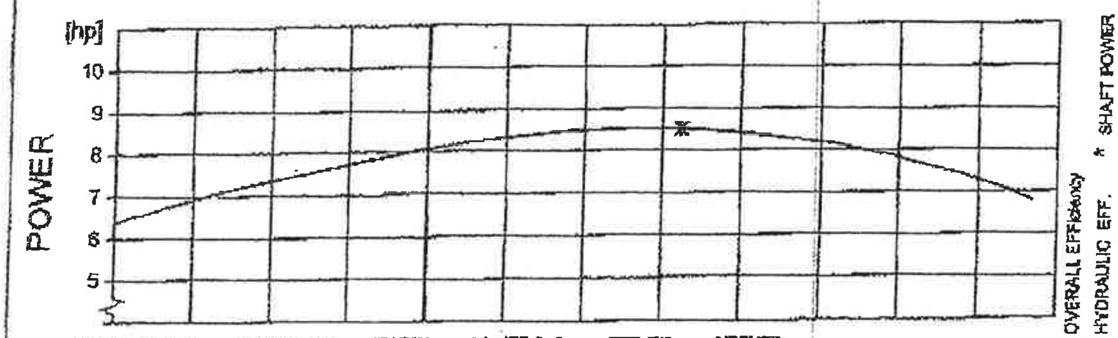
PRODUCT	CP3127.180
TYPE	MT
DATE	2002-02-04
PROJECT	
CURVE NO	63-432-00-3730
ISSUE	3

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.89	0.87	0.81
MOTOR EFFICIENCY	83.5 %	85.0 %	84.5 %
GEAR EFFICIENCY	—	—	—

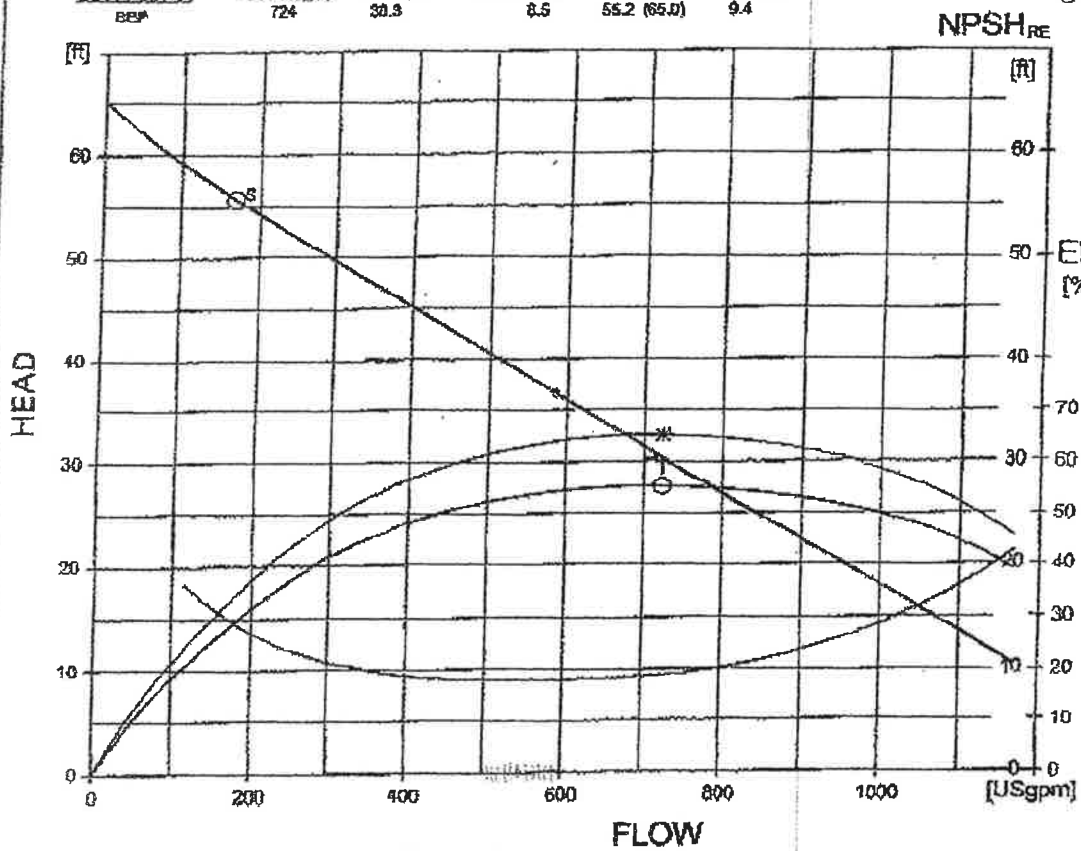
MOTOR SHAFT POWER	10 hp
STARTING CURRENT	64 A
RATED CURRENT	13 A
RATED SPEED	1735 rpm
TOT.MOM.OF INERTIA	—
NO. OF BLADES	1
INLET/OUTLET	-/150 mm
IMP. THROUGHLET	87 mm
IMPELLER DIAMETER	229 mm
MOTORTYPE	21-12-4AL
STATOR	12YSER
REV	10
FREQ.	60 Hz
PHASES	3
VOLTAGE	460 V
POLES	4
GEARTYPE	—
RATIO	—

COMMENTS

DISCH. CONN. DIAM 150 MM



DUTY POINTs :	FLOW[USgpm]	HEAD[ft]	POWER [hp]	EFF. [%]	NPSH[ft]
BEP	724	30.3	8.5	55.2 (65.0)	9.4



S: RISK OF SEDIMENTATION AT VELOCITY BELOW 0.6 m/s
(Point (S) show risk in a 150 mm pipe)

CURVES SHOW PERFORMANCE WITH CLEAR COLD WATER

CURVE

12/29/2005 07:23

3

FLYGT	PERFORMANCE CURVE			PRODUCT CP3201.180	TYPE HT
				CURVE NO 63-452-00-5350	ISSUE 3
DATE 2002-02-04	PROJECT			IMPELLER DIAMETER 330 mm	

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.89	0.86	0.80
MOTOR EFFICIENCY	87.5 %	87.5 %	86.0 %
GEAR EFFICIENCY	—	—	—

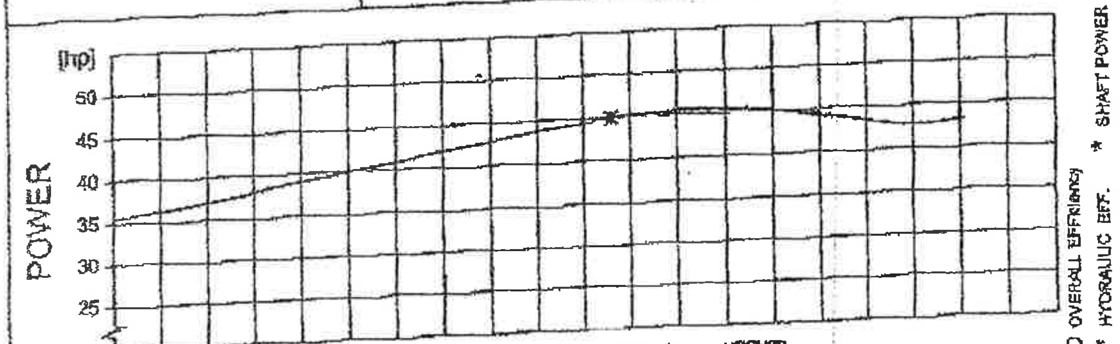
COMMENTS

INLET/OUTLET -/150 mm

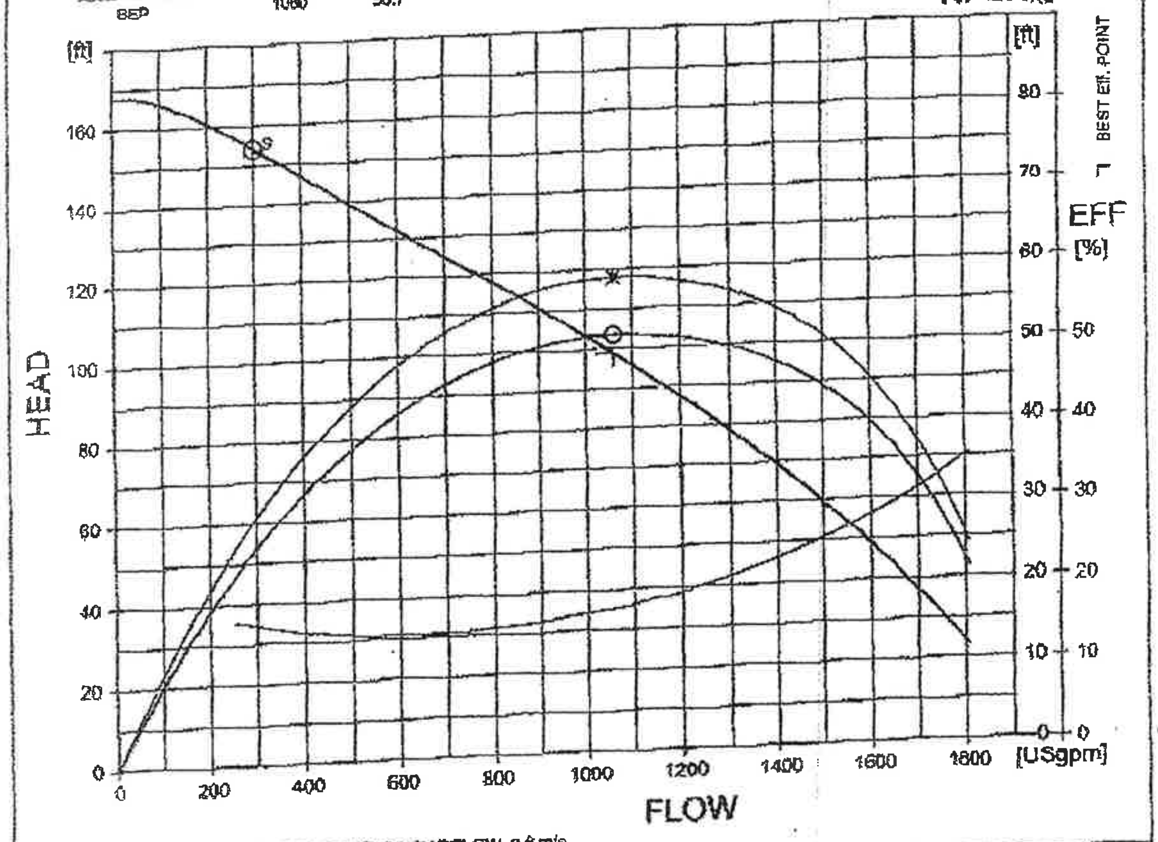
IMP. THROUGHLET 77 mm

MOTOR SHAFT POWER	47	hp
STARTING CURRENT	375	A
RATED CURRENT	57	A
RATED SPEED	1755	rpm
TOT.MOM.OF INERTIA	0.58	kgm2
NO. OF BLADES	1	

MOTORTYPE		STATOR	REV
27-26-4AA		37YSER	10
FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	460 V	4
GEARTYPE		RATIO	
—		—	



DUTY POINTS:	FLOW[USgpm]	HEAD[ft]	POWER [hp]	EFF. [%]	NPSH[ft]
BEP	1060	98.7	45.0	51.6 (58.9)	17.7



S: RISK OF SEDIMENTATION AT VELOCITY BELOW 0.6 m/s
(Point (S) show risk in a 200 mm pipe)

FLYGT | CURVE

CURVES SHOW PERFORMANCE WITH CLEAR COLD WATER

CAPACITY OF GRAVITY LINES CONTRIBUTING TO PUMP STATION #2

Manning's Equation (Solved for Velocity)

Variables

Q = Quantity (cfs)
V = Velocity (ft/s)
A = Area ft^2
K = Conversion Factor for English Units
n = Manning's Coefficient (From Table)
P = Wetted Perimeter (ft)
S = Slope (EGL ft/ft)

Equations

$$Q = VA \qquad V = \frac{k}{n}\left(\frac{A}{P}\right)^{2/3} S^{1/2}$$

Line 1

Q = 0.8227cfs
V = 2.3567 ft/s
A = 0.3491 ft^2
K = 1.49
n = 0.011
P = 2.0945 ft
S = 0.0033 ft/ft

Line 3

Q = 0.8227cfs
V = 2.3567 ft/s
A = 0.3491 ft^2
K = 1.49
n = 0.011
P = 2.0945 ft
S = 0.0033 ft/ft

Line 7

Q = 0.3819cfs
V = 1.9453 ft/s
A = 0.1963 ft^2
K = 1.49
n = 0.011
P = 1.5708 ft
S = 0.0033 ft/ft

Table of Manning's Coefficients

Material	Manning n	Material	Manning n
Natural Streams		*Excavated Earth Channels*	
Clean and Straight	0.030	Clean	0.022
Major Rivers	0.035	Gravelly	0.025
Sluggish with Deep Pools	0.040	Weedy	0.030
		Stony, Cobbles	0.035
Metals		*Floodplains*	
Brass	0.011	Pasture, Farmland	0.035
Cast Iron	0.013	Light Brush	0.050
Smooth Steel	0.012	Heavy Brush	0.075
Corrugated Metal	0.022	Trees	0.15
Non-Metals			
Glass	0.010	Finished Concrete	0.012
Clay Tile	0.014	Unfinished Concrete	0.014
Brickwork	0.015	Gravel	0.029
Asphalt	0.016	Earth	0.025
Masonry	0.025	Planed Wood	0.012
		Un-planed Wood	0.013
Corrugated Polyethylene (PE) with smooth inner walls [a,b]			0.009-0.015
Corrugated Polyethylene (PE) with corrugated inner walls [c]			0.018-0.025
Polyvinyl Chloride (PVC) with smooth inner walls [d,e]			0.009-0.011

References

Footnotes refer to Manning n table above. .

[a] Barfuss, Steven and J. Paul Tullis. Friction factor test on high density polyethylene pipe. Hydraulics Report No. 208. Utah Water Research Laboratory, Utah State University. Logan, Utah. 1988.

[c] Barfuss, Steven and J. Paul Tullis. Friction factor test on high density polyethylene pipe. Hydraulics Report No. 208. Utah Water Research Laboratory, Utah State University. Logan, Utah. 1994.

[e] Bishop, R.R. and R.W. Jeppson. Hydraulic characteristics of PVC sewer pipe in sanitary sewers. Utah State University. Logan, Utah. September 1975.

[d] Neale, L.C. and R.E. Price. Flow characteristics of PVC sewer pipe. Journal of the Sanitary Engineering Division, Div. Proc 90SA3, ASCE. pp. 109-129. 1964.

[b] Tullis, J. Paul, R.K. Watkins, and S. L. Barfuss. Innovative new drainage pipe. Proceedings of the International Conference on Pipeline Design and Installation, ASCE. March 25-27, 1990.

Existing Flows to PS#2

Existing flows below are derived using the pump performance rate and number of hours operated during both dry weather and wet weather (10-year storm) conditions.

Existing Dry Weather Flow to Pump Station #2

(1.1898 ft3/s)(3.32 hours) = 14,222 ft3/day

Capacity – 3.32hr/24hr = 13.8% capacity

Existing Wet Weather Flow to Pump Station #2

(1.1898 ft3/s)(15.5 hours) = 66,390 ft3/day

Capacity – 15.5hr/24hr = 64.6% capacity

Existing Flows to Line 1

Line 1 – Dry Weather is 19.3% of Total Pumped

Daily flow = 0.193 x 14,222 ft3/day x 1 day = 2,747 ft3

Average Flow = 2,747 ft3 / 86,400 sec = 0.0318 ft3/s

Peak Flow = 2.8 x 0.0318 ft3/s = 0.089 ft3/s

Total Capacity = 0.8227 ft3/s

Pipe @ 10.8% capacity

Line 1 – Wet Weather is apx. 46% of total flow pumped (per previous analysis of sewer system)

Daily flow = 0.4671 x 66,390 ft3/day x 1 day = 31,010 ft3

Average Flow = 31,010 ft3 / 86,400 sec = 0.3589 ft3/s

Peak Flow = 1.5 x 0.3589 ft3/s = 0.5384 ft3/s

Total Capacity = 0.8227 ft3/s

Pipe @ 65.4% capacity

Conclusion

The existing sewer system including gravity mains, pump station, and force mains have the capacity to support the proposed project. See below for a summary of the proposed impacts to the existing system on a flow rate and percentage of capacity basis.

Line #1

New Flow is 50 residential units @ 210 gpd each = 1,404 ft3/day

Average Flow = 0.0163 ft3/sec

Peak Flow = 2.8 x 0.0163 = 0.0455 ft3/sec

Additional 5.5% of capacity due to development

After development the pipe will be at:

18.0% of capacity during dry weather

70.9% of capacity during 10-year storm event

Line #3, #7, and #8 will not be affected by this project.

Pump Station #2

New Flow is 50 residential units @ 210 gpd each = 1,404 ft3/day

1,404 ft3 / 1.1898 ft3/s = 1,180 sec

1,180 sec / 86,400 sec = 1.36%

New flow is 1.36% of pump station capacity

Pump Station will be:

@ 15.16% of capacity during dry weather flows

@ 66.0% of capacity during 10-year storm events

Pump Station #3

New Flow is 50 residential units @ 210 gpd each = 1,404 ft3/day

1,404 ft3 / 1.401 ft3/s = 1,002 sec

1,002 sec / 86,400 sec = 1.16%

New flow is 1.16% of pump station capacity

Pump Station will be:

@ 16.74% of capacity during dry weather flows

@ 58.29% of capacity during 10-year storm events