WASTEWATER SYSTEM NARRATIVE

FOR THE

BOARDWALK RESIDENCES AT MARINA BAY

QUINCY, MA

Prepared by:
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Howard/Stein-Hudson Associates, Inc.
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Project-Generated Sanitary Sewer Flow

Table 1 Projected Sanitary Sewer Flows

Use	Quantity	Unit Flow Rate	Estimated Maximum Daily Flow (gpd)
Residential Units (Phase 1)	295 beds	110 gpd/bedroom	32,450 gpd
Residential Units (Phase 2)	235 beds	110 gpd/bedroom	25,850 gpd
Restaurants (Phase 1)	667 seats	35 gpd/seat	23,345 gpd
Restaurant (Phase 2)	167 seats	35 gpd/seat	5,845 gpd
Retail (Phase 1)	4,140 sf	50 gpd/1,000 sf	207 gpd
Retail (Phase 2)	900 sf	50 gpd/1,000 sf	45 gpd
Total			**87,742 gpd**

Proposed Maximum Daily Flow = 87,742 gpd = 61 gpm
Proposed Peak Hour Flow = 152 gpm

Sanitary Sewer Connection

The sanitary sewer services for the Phase One (North) and Phase Two (South) buildings tie into the existing 12-inch sewer in Lot 48 (aka Victory Road). This 12-inch sewer flows easterly in Lot 48 and then continues southerly in Victory Road to a pump station located in the rotary where Victory Road meets Seaport Drive. The flow full capacity of this 12-inch pipe network is 964 gpm. The projected maximum daily sewer flow for the Project is about 6.3% of this line's capacity with the peak flow being about 15.8%.

Both buildings have below-grade parking. The parking lot drainage will be routed to an oil and sand separator prior to discharging to the sanitary sewer. Proposed restaurants will have a dedicated kitchen waste line that will flow to a grease trap prior to continuing onto the sanitary sewer system. It is anticipated at this time that oil and sand separators and grease traps will be located within the building footprints.

Pump Station

The pump station design (See Appendix) is based on the projected sewer flows provided in Table 1 and the existing flows to the pump station. A monitoring system has been installed in the pump station and indicates an existing maximum daily flow of 45 gpm and a peak hour flow of 70 gpm. We have added a 15% safety factor to these flows giving an existing maximum daily flow of 52 gpm and peak hour flow of 80 gpm. Therefore the total maximum daily flow to the pump station after development is estimated at 113 gpm with a peak hour flow of 232 gpm.

The pump station appears to have adequate capacity to handle the additional flows introduced by the proposed development. The design calls for increasing the effective capacity of the wet well to limit the number of cycles per days required by the pumps. The proponent will continue to monitor the flow to the pump station to determine if there are seasonal variations to the flows to the pump station and if adjustments to the design are required.

The pump station has a 6-inch force main exiting it. This force main continues in Victory Road for approximately 1,100 feet to a manhole located about 200 feet east of Marina Drive. The sanitary sewer system continues easterly in Victory Road as a 12-inch gravity line. The flow full capacity of this line is 1,102 gpm. It is anticipated that the pump station will generally pump at 325 gpm$\pm$ or 29% of the flow full capacity of the existing 12-inch sewer. This 12-inch sewer ties into an existing 30-inch sewer in East Squantum Street which has a flow full capacity of 5,822 gpm.

Sewer Inspection

After Hours Drain Service was retained by the proponent to inspect the condition of the 12-inch sewer line in Lot 48. The system was inspected with Howard/Stein-Hudson Associates, Inc. (HSH) on May 8, 2013. The inspection included opening three sewer manholes for inspection (EX SMH 1-1, 1-2 and 1-3 as shown on Drawing Number 3.02, Off-Site Utilities) and providing a video inspection between EX SMH 1-1 and 1-2. The inspections revealed that the 12-inch PVC was in good condition. However, the video inspection was only completed for about 1/3 of the pipe run (approximately 130 feet of 360 feet) due to the camera being impeded by grease and debris that has built up over the years. It is recommended that the sewer be cleaned and another video inspection be performed prior to construction.

APPENDIX

DISCHARGE HEAD
(Piping Losses)

Hazen-Williams Equation for Pipes Flowing Full: S=hf/L=(4.73/C^1.85)(Q^1.85/D^4.87) {D in ft, Q in cfs}

A	B	C	D	E	F	G
Q (gpm)	**C**	**L (ft)**	**D (in)**	**A (ft^2)**	**V (ft/s)**	**hf (ft)**
325	100	1102	6	0.20	3.69	16.74
327.5	100	1102	6	0.20	3.72	16.98
330	100	1102	6	0.20	3.75	17.22
332.5	100	1102	6	0.20	3.78	17.46
335	100	1102	6	0.20	3.80	17.70
337.5	100	1102	6	0.20	3.83	17.95
340	100	1102	6	0.20	3.86	18.20
342.5	100	1102	6	0.20	3.89	18.45
345	100	1102	6	0.20	3.92	18.70
347.5	100	1102	6	0.20	3.95	18.95
350	100	1102	6	0.20	3.97	19.20
352.5	100	1102	6	0.20	4.00	19.45
355	100	1102	6	0.20	4.03	19.71
357.5	100	1102	6	0.20	4.06	19.97
360	100	1102	6	0.20	4.09	20.23
362.5	100	1102	6	0.20	4.12	20.49
365	100	1102	6	0.20	4.14	20.75

User Input	*A*	Discharge
User Input	*B*	Hazen-Williams Coefficient of Roughness (see table)
User Input	*C*	Force Main Length
User Input	*D*	Force Main Diameter
Calculated	*E*	Force Main Cross-Section Area [3.14*(((D9/12)^2)/4)]
Calculated	*F*	Force Main Velocity from Continuity Equation (Q=VA) [A9/(E9*7.48*60)]
Calculated	*G*	Friction Head (Hazen-Williams Equation solved for hf) [(4.73/(B9^1.85))*((((1/(7.48*60))*A9)^1.85)/((D9/12)^4.87))*(C9)]

SUCTION LIFT
(Piping Losses){Use for Suction Lift Stations}

Hazen-Williams Equation for Pipes Flowing Full: S=hf/L=(4.73/C^1.85)(Q^1.85/D^4.87) {D in ft, Q in cfs}

A	B	C	D	E	F	G
Q (gpm)	**C**	**Lift Station? (0/1)**	**D (in)**	**A (ft²)**	**V (ft/s)**	**hf (ft)**
325	100	1	4	0.09	8.30	0.1094
327.5	100	1	4	0.09	8.37	0.111
330	100	1	4	0.09	8.43	0.1126
332.5	100	1	4	0.09	8.49	0.1141
335	100	1	4	0.09	8.56	0.1157
337.5	100	1	4	0.09	8.62	0.1173
340	100	1	4	0.09	8.69	0.119
342.5	100	1	4	0.09	8.75	0.1206
345	100	1	4	0.09	8.81	0.1222
347.5	100	1	4	0.09	8.88	0.1239
350	100	1	4	0.09	8.94	0.1255
352.5	100	1	4	0.09	9.00	0.1272
355	100	1	4	0.09	9.07	0.1288
357.5	100	1	4	0.09	9.13	0.1305
360	100	1	4	0.09	9.20	0.1322
362.5	100	1	4	0.09	9.26	0.1339
365	100	1	4	0.09	9.32	0.1356

User Input	*A*	Discharge
User Input	*B*	Hazen-Williams Coefficient of Roughness (see table)
User Input	*C*	Suction Lift Station 0=No 1=Yes
User Input	*D*	Suction Lift Diameter
Calculated	*E*	Suction Lift Cross-Section Area [3.14*(((D9/12)^2)/4)]
Calculated	*F*	Suction Lift Velocity from Continuity Equation (Q=VA) [A9/(E9*7.48*60)]
Calculated	*G*	Friction Head (Hazen-Williams Equation solved for hf) [(4.73/(B9^1.85))*((((1/(7.48*60))*A9)^1.85)/((D9/12)^4.87))*(C9)]

Discharge Head
(Minor Losses)

							K=	K=	K=	K=	K=	K=	K=	
							0.24	0.57	0.15	1.9	1.14	0.38	1	
A	B	C	D	E	F	G				H				I
Q (gpm)	**C**	**L (ft)**	**D (in)**	**A (ft²)**	**V (ft/s)**	**V^2/2g (ft)**	**22.5° Bend 2 (ft)**	**Elbow-90 (ft)**	**Gate Valve-Open 1 (ft)**	**Check Valve-swing 1 (ft)**	**Tee-Branch Flow 1 (ft)**	**Tee-Run Flow (ft)**	**Pipe Exit 1 (ft)**	**Minor Loss Total (ft)**
325	100	1102	6	0.20	3.69	0.21	0.10	0.00	0.03	0.40	0.24	0.00	0.21	0.99
327.5	100	1102	6	0.20	3.72	0.21	0.10	0.00	0.03	0.41	0.24	0.00	0.21	1.00
330	100	1102	6	0.20	3.75	0.22	0.10	0.00	0.03	0.41	0.25	0.00	0.22	1.02
332.5	100	1102	6	0.20	3.78	0.22	0.11	0.00	0.03	0.42	0.25	0.00	0.22	1.03
335	100	1102	6	0.20	3.80	0.22	0.11	0.00	0.03	0.43	0.26	0.00	0.22	1.05
337.5	100	1102	6	0.20	3.83	0.23	0.11	0.00	0.03	0.43	0.26	0.00	0.23	1.06
340	100	1102	6	0.20	3.86	0.23	0.11	0.00	0.03	0.44	0.26	0.00	0.23	1.08
342.5	100	1102	6	0.20	3.89	0.23	0.11	0.00	0.04	0.45	0.27	0.00	0.23	1.10
345	100	1102	6	0.20	3.92	0.24	0.11	0.00	0.04	0.45	0.27	0.00	0.24	1.11
347.5	100	1102	6	0.20	3.95	0.24	0.12	0.00	0.04	0.46	0.28	0.00	0.24	1.13
350	100	1102	6	0.20	3.97	0.25	0.12	0.00	0.04	0.47	0.28	0.00	0.25	1.15
352.5	100	1102	6	0.20	4.00	0.25	0.12	0.00	0.04	0.47	0.28	0.00	0.25	1.16
355	100	1102	6	0.20	4.03	0.25	0.12	0.00	0.04	0.48	0.29	0.00	0.25	1.18
357.5	100	1102	6	0.20	4.06	0.26	0.12	0.00	0.04	0.49	0.29	0.00	0.26	1.19
360	100	1102	6	0.20	4.09	0.26	0.12	0.00	0.04	0.49	0.30	0.00	0.26	1.21
362.5	100	1102	6	0.20	4.12	0.26	0.13	0.00	0.04	0.50	0.30	0.00	0.26	1.23
365	100	1102	6	0.20	4.14	0.27	0.13	0.00	0.04	0.51	0.30	0.00	0.27	1.25

User Input	*A*	Discharge
User Input	*B*	Hazen-Williams Coefficient of Roughness (see table)
User Input	*C*	Force Main Length
User Input	*D*	Force Main Diameter
Calculated	*E*	Force Main Cross-Section Area [3.14*(((D8/12)^2)/4)]
Calculated	*F*	Force Main Velocity from Continuity Equation (Q=VA) [A8/(E8*7.48*60)]
Calculated	*G*	Velocity Head (V^2/2g) [(F9^2)/(2*32.2)]
Calculated	*H*	Minor Losses due to Fittings (HL=KV^2/2g) [H7*0.45*G9]
Calculated	*I*	Total Minor Losses due to Fittings [SUM(H9:N9)]

Pump Station Fittings
1 check valve per pump
1 gate valve per pump
1 tee branch

Pipe Run Fittings
2 22-1/2 bends
1 pipe exit

Suction Lift
(Minor Losses){Use for Suction Lift Stations}

K=	K=	K=
0.78	0.54	0.15

A	B	C	D	E	F	G	H			I
Q (gpm)	**C**	**Lift Station? (0/1)**	**D (in)**	**A (ft²)**	**V (ft/s)**	**V^2/2g (ft)**	**Inlet (4") (ft)**	**Elbow (ft)**	**Gate Valve (ft)**	**Minor Loss Total (ft)**
325	100	1	4	0.09	8.30	1.07	0.83	0.58	0.16	1.57
327.5	100	1	4	0.09	8.37	1.09	0.85	0.59	0.16	1.60
330	100	1	4	0.09	8.43	1.10	0.86	0.60	0.17	1.62
332.5	100	1	4	0.09	8.49	1.12	0.87	0.60	0.17	1.65
335	100	1	4	0.09	8.56	1.14	0.89	0.61	0.17	1.67
337.5	100	1	4	0.09	8.62	1.15	0.90	0.62	0.17	1.70
340	100	1	4	0.09	8.69	1.17	0.91	0.63	0.18	1.72
342.5	100	1	4	0.09	8.75	1.19	0.93	0.64	0.18	1.75
345	100	1	4	0.09	8.81	1.21	0.94	0.65	0.18	1.77
347.5	100	1	4	0.09	8.88	1.22	0.95	0.66	0.18	1.80
350	100	1	4	0.09	8.94	1.24	0.97	0.67	0.19	1.82
352.5	100	1	4	0.09	9.00	1.26	0.98	0.68	0.19	1.85
355	100	1	4	0.09	9.07	1.28	1.00	0.69	0.19	1.88
357.5	100	1	4	0.09	9.13	1.30	1.01	0.70	0.19	1.90
360	100	1	4	0.09	9.20	1.31	1.02	0.71	0.20	1.93
362.5	100	1	4	0.09	9.26	1.33	1.04	0.72	0.20	1.96
365	100	1	4	0.09	9.32	1.35	1.05	0.73	0.20	1.98

User Input	*A*	Discharge
User Input	*B*	Hazen-Williams Coefficient of Roughness (see table)
User Input	*C*	Suction Lift Station 0=No 1=Yes
User Input	*D*	Suction Lift Diameter
Calculated	*E*	Suction Lift Cross-Section Area [3.14*(((D8/12)^2)/4)]
Calculated	*F*	Suction Lift Velocity from Continuity Equation (Q=VA) [A8/(E8*7.48*60)]
Calculated	*G*	Velocity Head (V^2/2g) [(F9^2)/(2*32.2)]
Calculated	*H*	Minor Losses due to Fittings (HL=KV^2/2g) [H7*0.78*G9]
Calculated	*I*	Total Minor Losses due to Fittings [SUM(H9:I9)]

Net Positive Suction Head
{Use for Suciton Lift Stations}

Pump Lift Height =	2.65

A	B	C
Q (gpm)	**Total Suction Losses (ft)**	**NPSH (Available) (ft)**
325	1.68	34.82
327.5	1.71	34.79
330	1.73	34.76
332.5	1.76	34.73
335	1.79	34.70
337.5	1.81	34.67
340	1.84	34.64
342.5	1.87	34.61
345	1.90	34.58
347.5	1.92	34.55
350	1.95	34.51
352.5	1.98	34.48
355	2.01	34.45
357.5	2.03	34.42
360	2.06	34.39
362.5	2.09	34.36
365	2.12	34.32

NPSH(A) = hs - hfs - hms - (V^2)/2g + Patm/s.w.w - Pvap/s.w.w
Eqn (8-17) M&E page 299 Collection & Pumping of Wastewater

User Input	*A*	Discharge	
Calculated	*B*	Total Suction Losses (Summation of Suction Minor and Piping Losses)	
Calculated	*C*	NPSH(A)	Available Net Positive Suction Head (ft)
		Patm	Atmospheric Pressure (lb/sf)
		Pvapor	Absolute Vapor Pressure of Water (lb/sf)
		s.w.w.	Specific Weight of Water (lb/sf)
		hs	Pump Lift Height (ft)
		hfs	Suction Lift Piping Losses (ft)
		hms	Suction Lift Minor Losses (ft)

Static Lift

	Elevation (ft)
Pump Off Elevation	-3.80
Assumed high point	8.55
Static Lift	12.35

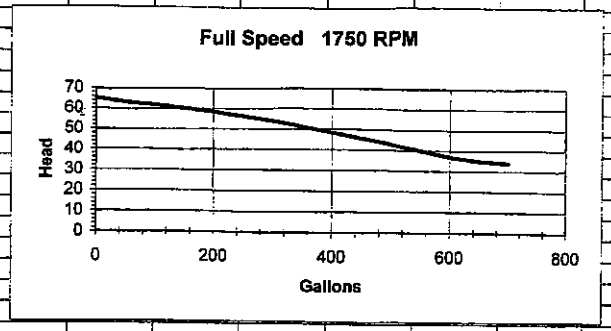
Pump Curve Data Points

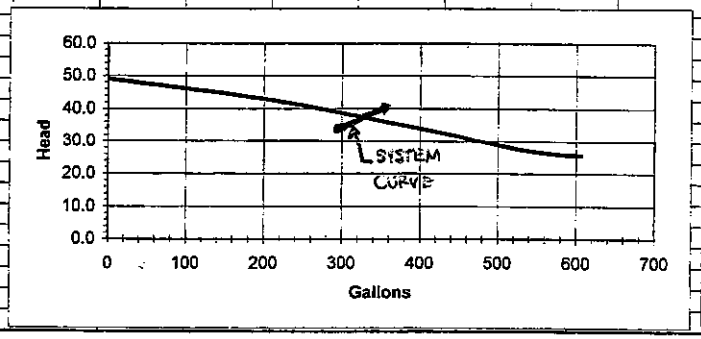
Safety Factor=
1.2

A	B	C
Q (gpm)	**TDH (ft)**	**NPSH (ft)**
325	38.11	34.82
327.5	38.45	34.79
330	38.79	34.76
332.5	39.13	34.73
335	39.47	34.70
337.5	39.81	34.67
340	40.16	34.64
342.5	40.51	34.61
345	40.86	34.58
347.5	41.22	34.55
350	41.57	34.51
352.5	41.93	34.48
355	42.29	34.45
357.5	42.66	34.42
360	43.02	34.39
362.5	43.39	34.36
365	43.76	34.32

JOB NAME:	Marina Bay, Quincy								
ESSCO		MODEL	CURVE #	SOLID	SUCTION	DISCH			
		4x4x9	10023CW	3	4"	4"			
FROM PUMP CURVE					DESIGN POINT				
RPM	1750	1750	1750	1750	1750	1750	1750	1750	1750
FLOW	0	100	200	300	400	500	600	650	700
HEAD	65.3	62	58.5	54	48.5	43	37	35	34
HP	0.00	6.52	9.23	11.36	12.56	13.57	14.37	14.36	14.66
EFFICIENCY	12.0%	24.0%	32.0%	36.0%	39.0%	40.0%	39.0%	40.0%	41.0%
SPEED CHANGE									
NEW RPM	1517	1517	1517	1517	1517	1517	1517	1517	1517
FLOW	0	87	173	260	347	433	520	563	607
HEAD	49.1	46.6	44.0	40.6	36.4	32.3	27.8	26.3	25.5
HP	0.00	4.25	6.01	7.40	8.18	8.84	9.36	9.36	9.55

52 Hertz





III. WETWELL DESIGN

A. VOLUME OF WETWELL

V = t q / 4

t = Minimum Cycle Time (min)
q = Peak Flow (gpm)
V = Volume (gal.)

t =	15
q =	232
V =	**870**

B. WETWELL & PUMP ELEVATIONS

-0.80	**Invert In**
-1.30	**Lag Pump On**
-1.80	**Lead Pump On**
-3.80	**Pumps Off And Alternate**
--	**Low Water Alarm**
-6.63	**Bottom Of Chamber**

C. EFFECTIVE CAPACITY OF WET WELL

X - Area (sf) =	**50.00**
Effective Capacity (gal) =	**748**

IV WETWELL DETENTION TIMES

A. TIME TO EMPTY WETWELL (PUMP RUN START TO STOP)

T1 = Effective Capacity / (Qpump - Qin)

Effective Capacity (gal) = 748

Pumping Rate (gpm) = 325

1. No Inflow :	**T1 (min) =**	**2.30**
2. Maximum Daily Inflow :	**T1 (min) =**	**3.53**
3. Peak Inflow :	**T1 (min) =**	**8.04**
4. 1/2 Of Pump Rate :	**T1 (min) =**	**4.60**

B. TIME TO FILL WETWELL (PUMP OFF)

T2 = Effective Capacity - Qin

1. No Inflow :	**T2 (min) =**	***N/A***
2. Maximum Daily Inflow :	**T2 (min) =**	**6.62**
3. Peak Inflow :	**T2 (min) =**	**3.22**
4. 1/2 Of Pump Rate :	**T2 (min) =**	**4.60**

C. CYCLE TIME (PUMP START TO START)

Tt = T1 + T2

1. No Inflow :	**Tt (min) =**	***N/A***
2. Maximum Daily Inflow :	**Tt (min) =**	**10.15**
3. Peak Inflow :	**Tt (min) =**	**11.27**
4. 1/2 Of Pump Rate :	**Tt (min) =**	**9.21**

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JOB 11140: Boardwalk Residences at Martha Bay
SHEET NO. 1 OF 1
CALCULATED BY RL DATE 11/19/12
CHECKED BY DATE
SCALE

GRAVITY PIPE CAPACITY

1. To Pump Station

- Limiting line is a 12" pipe w/ slope of 0.0026 ft/ft

$$\text{Capacity of } 12'' = \frac{1.486}{n}(A)(R)^{2/3}(S)^{1/2} = \frac{1.486}{0.011}(0.785)(0.250)^{2/3}(0.0026)^{1/2}$$

Capacity = 2.15 cfs = 964 gpm

964 gpm > 239 gpm

2. To Municipal Sewer in E. Squantum

- Limiting line is 12" @ 0.0034 ft/ft

$$\text{Capacity} = \frac{1.486}{0.011}(0.785)(0.250)^{2/3}(0.0034)^{1/2}$$

Capacity = 2.46 cfs = 1,102 gpm

1,102 gpm > 239 gpm

3. Capacity of 24" sewer across E. Squantum St.

$$Q_{24} = \frac{1.486}{0.013}(3.142)(0.5)^{2/3}(0.006)^{1/2}$$

Q_{24} = 17.5 cfs = 7,865 gpm

4. Capacity of 30" sewer in E. Squantum St

$$Q_{30} = \frac{1.486}{0.013}(4.909)(0.625)^{2/3}(0.001)^{1/2}$$

Q_{30} = 12.97 cfs = 5,822 gpm