APPENDIX G

EFFLUENT GENERATION DURING OPERATIONS, METRO SHUTDOWNS, AND WINTER SHUTDOWNS

1.0 Objective

The purpose of this calculation is to estimate the dewatering system effluent and potential impacts of precipitation, Metro shutdowns, and winter operations on required storage volume.

2.0 Assumptions

The calculations presented herein assume that the Onondaga Lake dredged sediment would be transported to the Sediment Consolidation Area (SCA) as a slurry. In addition, the slurry would undergo sand-size particle removal and gravity thickening prior to being pumped into the tubes; however, since the solids removal during sand-particle removal would only have a minimal impact on the generated effluent, it will not be considered further in these calculations.

The following assumptions were the basis for the calculations presented herein:

- Slurry flow rate (q) = 4,800 gallons per minute (gpm)
- Working hours (t) = 24 hours/day (conservative assumption for purposes of this analysis)
- Specific gravity of solids (G_s) = 2.54 (average value based on Phase I and III Pre-Design Investigation Data from the top 2-meters of sediment in the In-Lake Waste Deposit [Refs. 1 and 2])
- Unit weight of water: $\gamma_w = 62.4$ pcf
- Solids content by weight of the slurry pumped to the SCA (s) = 10%
- Solids content by weight of the slurry after gravity thickening (s_1) = 20%
- Solids content by weight of the sediment after initial dewatering (first 24 hours) in the geotextile tubes (s_2) = 35%
- Solids content by weight of the sediment after consolidation dewatering in the geotextile tubes (s_3) = 50%
- Active geotextile tube dewatering area = 20 acres during operations and 5 acres during winter shutdown

3.0 Calculations

Given the assumptions presented in Section 2.0, calculations were performed to estimate the effluent generated during operations that would require treatment in the Water Pre-Treatment Plant (WPTP). In addition, the potential impacts of precipitation, Metro shutdowns, and winter shutdowns were taken into consideration.

3.1 Effluent Generated during Operations

The effluent generated during operations would include supernatant, initial filtrate from the geotextile tubes (i.e., filtrate generated within 24 hours of filling), and consolidation filtrate (i.e., filtrate generated after 24 hours). The calculations performed to estimate these volumes are described in the subsections that follow and are summarized in Table 1.

3.1.1 Incoming Slurry

As indicated in Section 2.0, it is assumed that the incoming slurry would be 10% solids by weight. The physical characteristics of the slurry would be as follows:

Daily Slurry Volume (V_T):

$$V_T = q * t = 4{,}800 gpm * \frac{24 hrs}{1 day} * \frac{60 \min}{1 hr}$$

$$V_T = 6{,}912{,}000 \ gallons \text{ or } 926{,}208 \ ft^3$$

Daily Dry Solids Volume (V_s):

$$s = \frac{W_s}{W_T}$$

where $W_T = W_w + W_S$; $W_w = \gamma_w V_w; V_w = V_T - V_s; and \ W_s = G_s \gamma_w V_s$

$solving \ for \ V_s$

$$V_s = \frac{s \gamma_w V_T}{G_s \gamma_w + s \gamma_w - s G_s \gamma_w}$$

$$V_s = 38{,}818 \ ft^3 \text{ or } 290{,}362 \ gallons$$

Daily Dry Solids Weight (W_s):

$$W_s = G_s \gamma_w V_s$$

$$W_s = 6{,}152{,}568 \ lbs$$

Daily Water Volume (V_w) and Weight (W_w):

$$V_w = V_T - V_s$$

$$V_w = 6{,}621{,}638 \ gallons \text{ or } 887{,}390 \ ft^3$$

$$W_w = V_w \gamma_w$$

$$W_w = 55{,}373{,}108 \ lbs$$

Slurry Concentration (C_{sl}):

$$C_{sl} = \frac{W_s}{V_T}$$

$$C_{sl} = 0.89 \ lb/gal \ or \ 6.6 \ lb/ft^3$$

Percent Water in Slurry by Volume (p_w):

$$p_w = \frac{V_w}{V_T} * 100\% = 96\%$$

3.1.2 Gravity Thickening

As indicated in Section 2.0, it is assumed that the slurry entering the gravity thickener would be 10% solids by weight, and the thickened slurry leaving would be 20% solids by weight. The amount of supernatant generated in this process is estimated as follows:

Weight of Water Retained in Thickened Slurry (W_{ret1}):

$$s_1 = \frac{W_s}{W_{ret1} + W_s}$$

$$solving\ \ for\ W_{ret1}$$

$$W_{ret1} = \frac{(1 - s_1)W_s}{s_1}$$

$$W_{ret1} = 24{,}610{,}270\ lbs$$

Daily Supernatant Weight (W_{sup}) and Volume (V_{sup}):

$$W_{\sup} = W_w - W_{ret1}$$

$$\mathrm{W}_{\sup} = 30{,}762{,}838\ lbs$$

$$V_{\sup} = \frac{W_{\sup}}{\gamma_w}$$

$$V_{\sup} = 492{,}994\ ft^3 or 3{,}687{,}597\ gallons$$

Slurry Concentration after Thickening (C_{s2}):

$$C_{s2} = \frac{W_s}{V_T - V_{\sup}}$$

$$C_{s2} = 1.9\ lb/gal\ or 14\ lb/\ ft^3$$

Supernatant as Percent of Daily Water Volume (p_{sup}):

$$p_{\sup} = \frac{V_{\sup}}{V_w} * 100\% = 56\%$$

3.1.3 Initial Geotextile Tube Dewatering

As indicated in Section 2.0, it is assumed that the thickened slurry entering the geotextile tubes would be 20% solids by weight, and the solids content would increase to approximately 35% solids by weight within 24 hours. The amount of filtrate generated in this process is estimated as follows:

Weight of Water Retained in Geotextile Tubes after Initial Dewatering (W_{ret2}):

$$W_{ret2} = \frac{(1-s_2)W_s}{s_2}$$

$$W_{ret2} = 11{,}426{,}197\ lbs$$

Daily Initial Filtrate Weight (W_{if}) and Volume (V_{if}):

$$W_{if} = W_{ret1} - W_{ret2}$$

$$\mathrm{W_{if}} = 13{,}184{,}073\ lbs$$

$$V_{if} = \frac{W_{if}}{\gamma_w}$$

$$V_{if} = 211{,}283\ ft^3\ or\ 1{,}580{,}399\ gallons$$

Slurry Concentration after 24-hour Tube Dewatering (C_{s3}):

$$C_{s3} = \frac{W_s}{V_T - V_{sup} - V_{if}}$$

$$C_{s3} = 3.7\ lb/gal\ or\ 28\ lb/ft^3$$

Supernatant and Filtrate as Percent of Daily Water Volume (p_{sup+if}):

$$p_{sup+if} = \frac{V_{sup} + V_{if}}{V_w} * 100\% = 80\%$$

3.1.4 Consolidation Dewatering

As indicated in Section 2.0, it is assumed that during an initial dewatering period of 24 hours, the solids content of the thickened slurry would increase to approximately 35% solids by weight. It is also assumed that the remainder of dewatering would occur within 60 days (t_c) after initial dewatering is completed. The consolidation water generated during this time period is estimated as follows:

Weight of Water Retained in Geotextile Tubes after Consolidation Dewatering (W_{ret3}):

$$W_{ret3} = \frac{(1-s_3)W_s}{s_3}$$

$$W_{ret3} = 6{,}152{,}568\ lbs$$

Total Consolidation Dewatering Filtrate Weight (W_{cf}) and Volume (V_{cf}):

$$W_{cf} = W_{ret2} - W_{ret3}$$

$$W_{if} = 5{,}273{,}629\ lbs$$

$$V_{cf} = \frac{W_{cf}}{\gamma_w}$$

$$V_{cf} = 84{,}513\ ft^3 or\ 632{,}159\ gallons$$

Average Daily Consolidation Filtrate Volume (V_{dcf}) for 60 days:

$$V_{dcf} = \frac{V_{cf}}{t_c}$$

$$V_{dcf} = 10{,}536\ gallons\ or\ 1{,}409\ ft^3$$

Slurry Concentration after Consolidation Dewatering (C_{s4}):

$$C_{s4} = \frac{W_s}{V_T - V_{sup} - V_{if} - V_{cf}}$$

$$C_{s4} = 6.1\ lb/gal\ or\ 45\ lb/ft^3$$

3.1.5 Total Daily Effluent Volume

The total daily effluent volume is the sum of the supernatant, initial filtrate, and consolidation filtrate (i.e., V_{sup}+V_{if}+V_{cf}). The amount of filtrate due to consolidation would depend on the number of previous production days; therefore, there would be a ramping up period after startup. Based on the assumptions presented here, it would take approximately 60 days for the amount of consolidation filtrate to reach a steady state value. Once steady state is reached the effluent volume is estimated at 5.9 MGD. Table 2 and Figure 1 provides the potential effluent with time based on the calculations presented above and a 148 work day dredge season without any Metro shutdowns.

3.2 Precipitation

Table 3 provides a summary of the maximum precipitation (rainfall) within 24 hours in Syracuse, New York for various return periods (Ref. 3). For purposes of the Metro shutdown calculations presented in Section 3.3, the 100-year storm was used, along with an assumed active geotextile tube dewatering area of 20 acres.

Table 3 also provides the highest monthly average precipitation that has been recorded for Syracuse, New York (i.e., 4.2 inches). This value was used to calculate the highest average daily precipitation, which was used in the winter shutdown evaluation provided in Section 3.4.

3.3 Metro Shutdown Calculation

An example of a Metro shutdown scenario is provided in Table 4 and shown on Figure 2. This example represents a potential design case scenario in which the dredge has operated for approximately one day into a Metro shutdown event that lasts 5 days. In addition, the precipitation that has occurred during that time period corresponds to a 100-year return period event. This evaluation indicates that approximately 12 million gallons of storage would be required for this type of shutdown.

3.4 Winter Shutdown Calculation

A preliminary calculation for winter shutdown is presented in Table 5 and on Figure 3. These calculations show the effluent generated (including precipitation) and the required storage volume with time assuming that full water treatment capabilities will continue for about two weeks after dredging is stopped for the season. In addition, these calculations assume that up to 6 million gallons of storage is available during the winter (i.e., approximately half of the total required based on the calculations in Section 3.3). Given these assumptions, a reduced water treatment rate of approximately 115 gpm is estimated.

4.0 Summary

Using the Section 2.0 assumptions, the preliminary calculations presented above indicate the following:

- Up to 5.9 MGD of effluent could potentially be generated daily during operations.
- Up to 12 million gallons of storage capacity could potentially be required for a 100-year storm event combined with a Metro shutdown lasting 5 days.
- If approximately 6 million gallons of storage capacity is available during the winter shutdown period, the reduced treatment rate would be approximately 115 gpm.

5.0 References

1. Parsons, 2007. *Phase I Pre-Design Investigation Summary Report.*
2. Parsons, 2008. *Phase III Pre-Design Investigation Summary Report.*
3. U.S. Department of Commerce, Weather Bureau, "Technical Paper No. 40 Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years", Washington, D.C., May 1961.

Table 1 Calculation Summary

Incoming Slurry		
Slurry Flow Rate, q	4,800 gpm	
Working Hours, t	24 hr/day	
Daily Slurry Volume, V_T	6,912,000 gallons	926,208 ft^3
Solids Content by Weight of Incoming Slurry, s	10%	
Specific Gravity of Solids, G_s	2.54	
Unit Weight of Water, γ_w	62.4 pcf	
Daily Dry Solids Volume, V_s	290,362 gallons	38,818 ft^3
Daily Dry Solids Weight, W_s	6,152,568 lbs	
Daily Water Volume, V_w	6,621,638 gallons	887,390 ft^3
Daily Water Weight, W_w	55,373,108 lbs	
Slurry Concentration, C_{s1}	0.89 lb/gal	6.6 lb/ft^3
% Water in Slurry (by Volume)	96%	
Gravity Thickener		
Solids Content by Weight of Thickened Slurry, s_1	20%	
Weight of Water Retained in Thickened Slurry, W_{ret1}	24,610,270 lbs	
Daily Supernatant Weight, W_{sup}	30,762,838 lbs	
Daily Supernatant Volume, V_{sup}	3,687,597 gallons	492,994 ft^3
Slurry Concentration After Thickening, C_{s2}	1.9 lb/gal	14 lb/ft^3
Daily Supernatant as a % of Daily Water Volume, p_{sup}	56%	
Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)		
Solids Content by Weight after Initial Dewatering in Tubes, s_2	35%	
Weight of Water Retained in Tubes after Initial Geotextile Tube Dewatering, W_{ret2}	11,426,197 lbs	
Daily Initial Filtrate Weight, W_{if}	13,184,073 lbs	
Daily Initial Filtrate Volume, V_{if}	1,580,399 gallons	211,283 ft^3
Slurry Concentration after 24-hour Tube Dewatering, C_{s3}	3.7 lb/gal	28 lb/ft^3
Filtrate plus Supernatant Volume as a % of Daily Water Volume, p_{sup+if}	80%	
Consolidation Dewatering		
Solids Content by Weight after Consolidation Dewatering	50%	
Weight of Retained Water in Tubes after Consolidation Dewatering, W_{ret3}	6,152,568 lbs	
Total Consolidation Dewatering Filtrate Weight, W_{cf}	5,273,629 lbs	
Total Consolidation Dewatering Filtrate Volume, V_{cf}	632,159 gallons	84,513 ft^3
Consolidation Dewatering Duration, t_c	60 days	
Average Daily Consolidation Dewatering Filtrate Volume, V_{dcf}	10,536 gallons	1,409 ft^3
Slurry Concentration after Consolidation Dewatering, C_{s4}	6.1 lb/gal	45 lb/ft^3
Total Water Volume Removed	5,900,155 gallons	788,791 ft^3

Table 2 Daily Effluent Volume

Day	Supernatant[1]	Initial Dewatering[2]	Consolidation Dewatering[3]	Total
1	3,687,597	1,580,399	0	5,267,995
2	3,687,597	1,580,399	10,536	5,278,531
3	3,687,597	1,580,399	21,072	5,289,067
4	3,687,597	1,580,399	31,608	5,299,603
5	3,687,597	1,580,399	42,144	5,310,139
6	3,687,597	1,580,399	52,680	5,320,675
7	3,687,597	1,580,399	63,216	5,331,211
8	3,687,597	1,580,399	73,752	5,341,747
9	3,687,597	1,580,399	84,288	5,352,283
10	3,687,597	1,580,399	94,824	5,362,819
11	3,687,597	1,580,399	105,360	5,373,355
12	3,687,597	1,580,399	115,896	5,383,891
13	3,687,597	1,580,399	126,432	5,394,427
14	3,687,597	1,580,399	136,968	5,404,963
15	3,687,597	1,580,399	147,504	5,415,499
16	3,687,597	1,580,399	158,040	5,426,035
17	3,687,597	1,580,399	168,576	5,436,571
18	3,687,597	1,580,399	179,112	5,447,107
19	3,687,597	1,580,399	189,648	5,457,643
20	3,687,597	1,580,399	200,184	5,468,179
21	3,687,597	1,580,399	210,720	5,478,715
22	3,687,597	1,580,399	221,256	5,489,251
23	3,687,597	1,580,399	231,792	5,499,787
24	3,687,597	1,580,399	242,328	5,510,323
25	3,687,597	1,580,399	252,864	5,520,859
26	3,687,597	1,580,399	263,400	5,531,395
27	3,687,597	1,580,399	273,936	5,541,931
28	3,687,597	1,580,399	284,472	5,552,467
29	3,687,597	1,580,399	295,008	5,563,003
30	3,687,597	1,580,399	305,544	5,573,539
31	3,687,597	1,580,399	316,080	5,584,075
32	3,687,597	1,580,399	326,616	5,594,611
33	3,687,597	1,580,399	337,152	5,605,147
34	3,687,597	1,580,399	347,688	5,615,683
35	3,687,597	1,580,399	358,224	5,626,219
36	3,687,597	1,580,399	368,760	5,636,755
37	3,687,597	1,580,399	379,296	5,647,291
38	3,687,597	1,580,399	389,832	5,657,827
39	3,687,597	1,580,399	400,368	5,668,363
40	3,687,597	1,580,399	410,904	5,678,899
41	3,687,597	1,580,399	421,440	5,689,435
42	3,687,597	1,580,399	431,976	5,699,971
43	3,687,597	1,580,399	442,512	5,710,507
44	3,687,597	1,580,399	453,048	5,721,043
45	3,687,597	1,580,399	463,584	5,731,579
46	3,687,597	1,580,399	474,120	5,742,115
47	3,687,597	1,580,399	484,656	5,752,651
48	3,687,597	1,580,399	495,192	5,763,187

Table 2 Daily Effluent Volume

Day	Supernatant[1]	Initial Dewatering[2]	Consolidation Dewatering[3]	Total
49	3,687,597	1,580,399	505,728	5,773,723
50	3,687,597	1,580,399	516,264	5,784,259
51	3,687,597	1,580,399	526,800	5,794,795
52	3,687,597	1,580,399	537,336	5,805,331
53	3,687,597	1,580,399	547,871	5,815,867
54	3,687,597	1,580,399	558,407	5,826,403
55	3,687,597	1,580,399	568,943	5,836,939
56	3,687,597	1,580,399	579,479	5,847,475
57	3,687,597	1,580,399	590,015	5,858,011
58	3,687,597	1,580,399	600,551	5,868,547
59	3,687,597	1,580,399	611,087	5,879,083
60	3,687,597	1,580,399	621,623	5,889,619
61	3,687,597	1,580,399	632,159	5,900,155
62	3,687,597	1,580,399	632,159	5,900,155
63	3,687,597	1,580,399	632,159	5,900,155
64	3,687,597	1,580,399	632,159	5,900,155
65	3,687,597	1,580,399	632,159	5,900,155
66	3,687,597	1,580,399	632,159	5,900,155
67	3,687,597	1,580,399	632,159	5,900,155
68	3,687,597	1,580,399	632,159	5,900,155
69	3,687,597	1,580,399	632,159	5,900,155
70	3,687,597	1,580,399	632,159	5,900,155
71	3,687,597	1,580,399	632,159	5,900,155
72	3,687,597	1,580,399	632,159	5,900,155
73	3,687,597	1,580,399	632,159	5,900,155
74	3,687,597	1,580,399	632,159	5,900,155
75	3,687,597	1,580,399	632,159	5,900,155
76	3,687,597	1,580,399	632,159	5,900,155
77	3,687,597	1,580,399	632,159	5,900,155
78	3,687,597	1,580,399	632,159	5,900,155
79	3,687,597	1,580,399	632,159	5,900,155
80	3,687,597	1,580,399	632,159	5,900,155
81	3,687,597	1,580,399	632,159	5,900,155
82	3,687,597	1,580,399	632,159	5,900,155
83	3,687,597	1,580,399	632,159	5,900,155
84	3,687,597	1,580,399	632,159	5,900,155
85	3,687,597	1,580,399	632,159	5,900,155
86	3,687,597	1,580,399	632,159	5,900,155
87	3,687,597	1,580,399	632,159	5,900,155
88	3,687,597	1,580,399	632,159	5,900,155
89	3,687,597	1,580,399	632,159	5,900,155
90	3,687,597	1,580,399	632,159	5,900,155
91	3,687,597	1,580,399	632,159	5,900,155
92	3,687,597	1,580,399	632,159	5,900,155
93	3,687,597	1,580,399	632,159	5,900,155
94	3,687,597	1,580,399	632,159	5,900,155
95	3,687,597	1,580,399	632,159	5,900,155
96	3,687,597	1,580,399	632,159	5,900,155

Table 2 Daily Effluent Volume

Day	Supernatant[1]	Initial Dewatering[2]	Consolidation Dewatering[3]	Total
97	3,687,597	1,580,399	632,159	5,900,155
98	3,687,597	1,580,399	632,159	5,900,155
99	3,687,597	1,580,399	632,159	5,900,155
100	3,687,597	1,580,399	632,159	5,900,155
101	3,687,597	1,580,399	632,159	5,900,155
102	3,687,597	1,580,399	632,159	5,900,155
103	3,687,597	1,580,399	632,159	5,900,155
104	3,687,597	1,580,399	632,159	5,900,155
105	3,687,597	1,580,399	632,159	5,900,155
106	3,687,597	1,580,399	632,159	5,900,155
107	3,687,597	1,580,399	632,159	5,900,155
108	3,687,597	1,580,399	632,159	5,900,155
109	3,687,597	1,580,399	632,159	5,900,155
110	3,687,597	1,580,399	632,159	5,900,155
111	3,687,597	1,580,399	632,159	5,900,155
112	3,687,597	1,580,399	632,159	5,900,155
113	3,687,597	1,580,399	632,159	5,900,155
114	3,687,597	1,580,399	632,159	5,900,155
115	3,687,597	1,580,399	632,159	5,900,155
116	3,687,597	1,580,399	632,159	5,900,155
117	3,687,597	1,580,399	632,159	5,900,155
118	3,687,597	1,580,399	632,159	5,900,155
119	3,687,597	1,580,399	632,159	5,900,155
120	3,687,597	1,580,399	632,159	5,900,155
121	3,687,597	1,580,399	632,159	5,900,155
122	3,687,597	1,580,399	632,159	5,900,155
123	3,687,597	1,580,399	632,159	5,900,155
124	3,687,597	1,580,399	632,159	5,900,155
125	3,687,597	1,580,399	632,159	5,900,155
126	3,687,597	1,580,399	632,159	5,900,155
127	3,687,597	1,580,399	632,159	5,900,155
128	3,687,597	1,580,399	632,159	5,900,155
129	3,687,597	1,580,399	632,159	5,900,155
130	3,687,597	1,580,399	632,159	5,900,155
131	3,687,597	1,580,399	632,159	5,900,155
132	3,687,597	1,580,399	632,159	5,900,155
133	3,687,597	1,580,399	632,159	5,900,155
134	3,687,597	1,580,399	632,159	5,900,155
135	3,687,597	1,580,399	632,159	5,900,155
136	3,687,597	1,580,399	632,159	5,900,155
137	3,687,597	1,580,399	632,159	5,900,155
138	3,687,597	1,580,399	632,159	5,900,155
139	3,687,597	1,580,399	632,159	5,900,155
140	3,687,597	1,580,399	632,159	5,900,155
141	3,687,597	1,580,399	632,159	5,900,155
142	3,687,597	1,580,399	632,159	5,900,155
143	3,687,597	1,580,399	632,159	5,900,155
144	3,687,597	1,580,399	632,159	5,900,155

Table 2 Daily Effluent Volume

Day	Supernatant[1]	Initial Dewatering[2]	Consolidation Dewatering[3]	Total
145	3,687,597	1,580,399	632,159	5,900,155
146	3,687,597	1,580,399	632,159	5,900,155
147	3,687,597	1,580,399	632,159	5,900,155
148	3,687,597	1,580,399	632,159	5,900,155
149	0	1,580,399	632,159	2,212,558
150	0	0	621,623	621,623
151	0	0	611,087	611,087
152	0	0	600,551	600,551
153	0	0	590,015	590,015
154	0	0	579,479	579,479
155	0	0	568,943	568,943
156	0	0	558,407	558,407
157	0	0	547,871	547,871
158	0	0	537,336	537,336
159	0	0	526,800	526,800
160	0	0	516,264	516,264
161	0	0	505,728	505,728
162	0	0	495,192	495,192
163	0	0	484,656	484,656
164	0	0	474,120	474,120
165	0	0	463,584	463,584
166	0	0	453,048	453,048
167	0	0	442,512	442,512
168	0	0	431,976	431,976
169	0	0	421,440	421,440
170	0	0	410,904	410,904
171	0	0	400,368	400,368
172	0	0	389,832	389,832
173	0	0	379,296	379,296
174	0	0	368,760	368,760
175	0	0	358,224	358,224
176	0	0	347,688	347,688
177	0	0	337,152	337,152
178	0	0	326,616	326,616
179	0	0	316,080	316,080
180	0	0	305,544	305,544
181	0	0	295,008	295,008
182	0	0	284,472	284,472
183	0	0	273,936	273,936
184	0	0	263,400	263,400
185	0	0	252,864	252,864
186	0	0	242,328	242,328
187	0	0	231,792	231,792
188	0	0	221,256	221,256
189	0	0	210,720	210,720
190	0	0	200,184	200,184
191	0	0	189,648	189,648
192	0	0	179,112	179,112

Table 2 Daily Effluent Volume

Day	Supernatant[1]	Initial Dewatering[2]	Consolidation Dewatering[3]	Total
193	0	0	168,576	168,576
194	0	0	158,040	158,040
195	0	0	147,504	147,504
196	0	0	136,968	136,968
197	0	0	126,432	126,432
198	0	0	115,896	115,896
199	0	0	105,360	105,360
200	0	0	94,824	94,824
201	0	0	84,288	84,288
202	0	0	73,752	73,752
203	0	0	63,216	63,216
204	0	0	52,680	52,680
205	0	0	42,144	42,144
206	0	0	31,608	31,608
207	0	0	21,072	21,072
208	0	0	10,536	10,536
209	0	0	0	0

Notes:

1. The supernatant value corresponds to the calculations shown in Table 1 and described in Section 3.1.2.
2. The initial filtrate value corresponds to the calculations shown in Table 1 and described in Section 3.1.3.
3. The consolidation filtrate value corresponds to the calculations shown in Table 1 and described in Section 3.1.4. After dredge operations are completed for a season, it is assumed that the amount of filtrate generated decreases by 10,536 gallons per day.
4. This table assumes that dredge operations for the season stop on Day 148.

Table 3 Precipitation

	Rainfall[1] (inches)	Active Area	Volume (cf)	Volume (gallons)
1-Year Storm	2.5	20	181,500	1,357,620
2-Year Storm	3	20	217,800	1,629,144
5-Year Storm	3.5	20	254,100	1,900,668
10-Year Storm	4	20	290,400	2,172,192
25-Year Storm	5	20	363,000	2,715,240
50-Year Storm	5	20	363,000	2,715,240
100-Year Storm	6	20	435,600	3,258,288
During Winter Shutdown				
Highest Monthly Average Precipitation[1]	4.2 inches			
Maximum Average Daily Precipitation	0.14 inches/day			
Average Daily Precipitation Volume over 5 acres	2,541 cf/day		19,007 gallons/day	

Reference:

1. U.S Department of Commerce, Weather Bureau, "Technical Paper No. 40 Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years", Washington, D.C., May 1961.

Table 4 Metro Shutdown Example Calculations

24 Hours of Supernatant[1]	3,687,597	gallons
24 Hours of Initial Filtrate[2]	1,580,399	gallons
Consolidation Filtrate per Day at Steady State[3]	632,159	gallons
Subtotal Without Precipitation	5,900,155	gallons
Precipitation (100-year storm - 6 inches)[4]	3,258,288	gallons
1 Day Shutdown Storage Required	9,158,443	gallons
2 Day Shutdown Storage Required	9,780,066	gallons
3 Day Shutdown Storage Required	10,391,153	gallons
4 Day Shutdown Storage Required	10,991,705	gallons
5 Day Shutdown Storage Required	11,581,720	gallons

Notes:

1. The supernatant value corresponds to the calculations shown in Table 1 and described in Section 3.1.2.
2. The initial filtrate value corresponds to the calculations shown in Table 1 and described in Section 3.1.3.
3. The consolidation filtrate value corresponds to the calculations shown in Table 1 and described in Section 3.1.4. This value assumes that approximately 60 days of dredging have occurred, thus the steady state value has been reached.
4. This precipitation value corresponds to Table 3 and Section 3.2.

Table 5 Winter Shutdown Example Calculations

Winter Treatment Rate:				165,000	gpd
				115	gpm
24 Hours of Initial Filtrate[1]				1,580,399	gallons
Consolidation Filtrate per Day at Steady State[2]				632,159	gallons
			Subtotal Without Precipitation	2,212,558	gallons
Average Daily Precipitation (5 acres)[3]				19,000	gallons
Days after Winter Shutdown	**Initial Filtrate (gallons)**	**Consolidation Filtrate (gallons)**	**Precipitation (gallons)**	**Effluent Generated[4] (gallons)**	**Required Storage Volume[5] (gallons)**
1	1,580,399	632,159	19,000	2,231,558	
2	0	621,623	19,000	640,623	
3	0	611,087	19,000	630,087	
4	0	600,551	19,000	619,551	
5	0	590,015	19,000	609,015	
6	0	579,479	19,000	598,479	
7	0	568,943	19,000	587,943	
8	0	558,407	19,000	577,407	
9	0	547,871	19,000	566,871	
10	0	537,336	19,000	556,336	
11	0	526,800	19,000	545,800	
12	0	516,264	19,000	535,264	
13	0	505,728	19,000	524,728	0
14	0	495,192	19,000	514,192	349,192
15	0	484,656	19,000	503,656	687,847
16	0	474,120	19,000	493,120	1,015,967
17	0	463,584	19,000	482,584	1,333,550
18	0	453,048	19,000	472,048	1,640,598
19	0	442,512	19,000	461,512	1,937,109
20	0	431,976	19,000	450,976	2,223,085
21	0	421,440	19,000	440,440	2,498,525
22	0	410,904	19,000	429,904	2,763,428
23	0	400,368	19,000	419,368	3,017,796
24	0	389,832	19,000	408,832	3,261,628
25	0	379,296	19,000	398,296	3,494,923
26	0	368,760	19,000	387,760	3,717,683
27	0	358,224	19,000	377,224	3,929,907
28	0	347,688	19,000	366,688	4,131,594
29	0	337,152	19,000	356,152	4,322,746
30	0	326,616	19,000	345,616	4,503,362
31	0	316,080	19,000	335,080	4,673,441
32	0	305,544	19,000	324,544	4,832,985
33	0	295,008	19,000	314,008	4,981,993
34	0	284,472	19,000	303,472	5,120,464
35	0	273,936	19,000	292,936	5,248,400
36	0	263,400	19,000	282,400	5,365,800
37	0	252,864	19,000	271,864	5,472,664
38	0	242,328	19,000	261,328	5,568,992
39	0	231,792	19,000	250,792	5,654,783
40	0	221,256	19,000	240,256	5,730,039
41	0	210,720	19,000	229,720	5,794,759
42	0	200,184	19,000	219,184	5,848,943
43	0	189,648	19,000	208,648	5,892,591
44	0	179,112	19,000	198,112	5,925,702
45	0	168,576	19,000	187,576	5,948,278
46	0	158,040	19,000	177,040	5,960,318
47	0	147,504	19,000	166,504	5,961,822
48	0	136,968	19,000	155,968	5,952,790
49	0	126,432	19,000	145,432	5,933,222
50	0	115,896	19,000	134,896	5,903,118
51	0	105,360	19,000	124,360	5,862,478
52	0	94,824	19,000	113,824	5,811,301
53	0	84,288	19,000	103,288	5,749,589
54	0	73,752	19,000	92,752	5,677,341
55	0	63,216	19,000	82,216	5,594,557
56	0	52,680	19,000	71,680	5,501,237
57	0	42,144	19,000	61,144	5,397,381

Days after Winter Shutdown	Initial Filtrate (gallons)	Consolidation Filtrate (gallons)	Precipitation (gallons)	Effluent Generated[4] (gallons)	Required Storage Volume[5] (gallons)
58	0	31,608	19,000	50,608	5,282,989
59	0	21,072	19,000	40,072	5,158,061
60	0	10,536	19,000	29,536	5,022,597
61	0	0	19,000	19,000	4,876,597
62	0	0	19,000	19,000	4,730,597
63	0	0	19,000	19,000	4,584,597
64	0	0	19,000	19,000	4,438,597
65	0	0	19,000	19,000	4,292,597
66	0	0	19,000	19,000	4,146,597
67	0	0	19,000	19,000	4,000,597
68	0	0	19,000	19,000	3,854,597
69	0	0	19,000	19,000	3,708,597
70	0	0	19,000	19,000	3,562,597
71	0	0	19,000	19,000	3,416,597
72	0	0	19,000	19,000	3,270,597
73	0	0	19,000	19,000	3,124,597
74	0	0	19,000	19,000	2,978,597
75	0	0	19,000	19,000	2,832,597
76	0	0	19,000	19,000	2,686,597
77	0	0	19,000	19,000	2,540,597
78	0	0	19,000	19,000	2,394,597
79	0	0	19,000	19,000	2,248,597
80	0	0	19,000	19,000	2,102,597
81	0	0	19,000	19,000	1,956,597
82	0	0	19,000	19,000	1,810,597
83	0	0	19,000	19,000	1,664,597
84	0	0	19,000	19,000	1,518,597
85	0	0	19,000	19,000	1,372,597
86	0	0	19,000	19,000	1,226,597
87	0	0	19,000	19,000	1,080,597
88	0	0	19,000	19,000	934,597
89	0	0	19,000	19,000	788,597
90	0	0	19,000	19,000	642,597
91	0	0	19,000	19,000	496,597
92	0	0	19,000	19,000	350,597
93	0	0	19,000	19,000	204,597
94	0	0	19,000	19,000	58,597
95	0	0	19,000	19,000	0

Notes:

1. The initial filtrate value corresponds to the calculations shown in Table 1 and described in Section 3.1.3.
2. The consolidation filtrate value corresponds to the calculations shown in Table 1 and described in Section 3.1.4. This value assumes that approximately 60 days of dredging have occurred, thus the steady state value has been reached.
3. This precipitation value corresponds to Table 3 and Section 3.2.
4. The generated effluent calculation includes initial and consolidation filtrate plus precipitation for Day 1, and only the remaining consolidation filtrate and precipitation for the remainder of the days.
5. Since it is assumed that the full treatment plant would operate for approximately two weeks after dredging stops, storage is not required until Day 14. Required storage is estimated as the sum of the Effluent Generated on a given day plus the Required Storage Volume from the previous day, less the Winter Treatment Rate.

Figure 1 Estimated Daily Effluent Volume

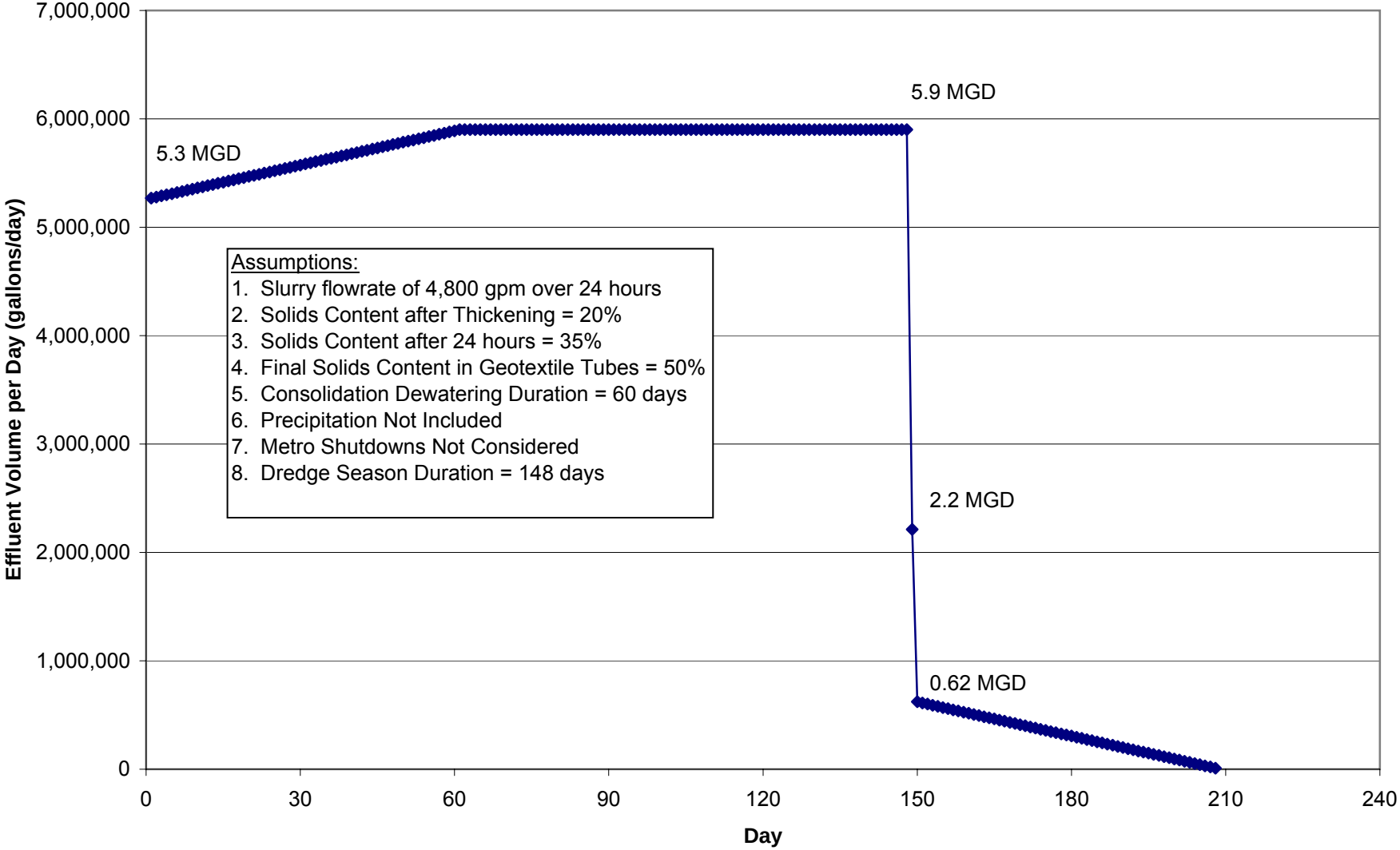


Figure 2 Metro Shutdown

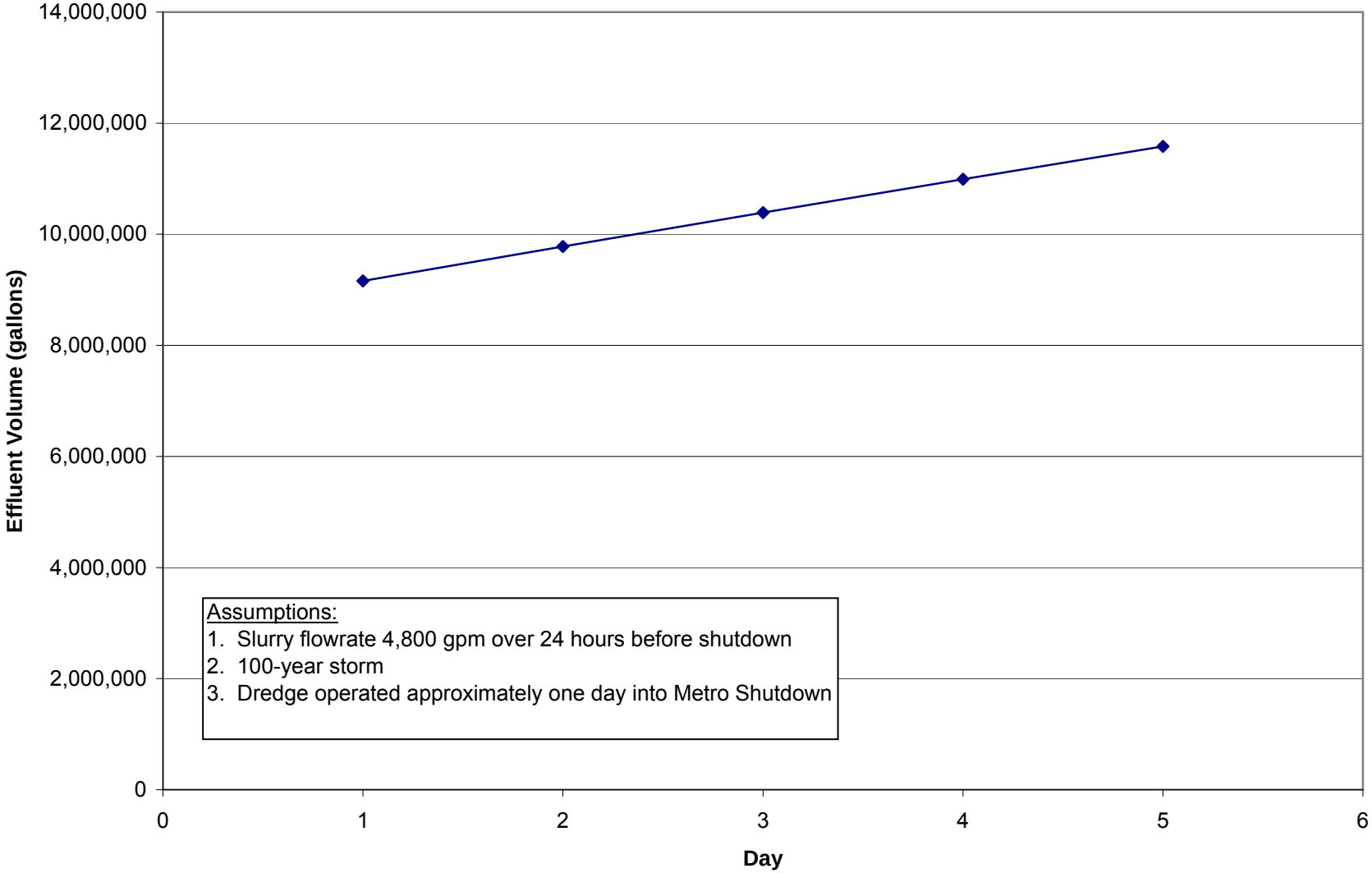
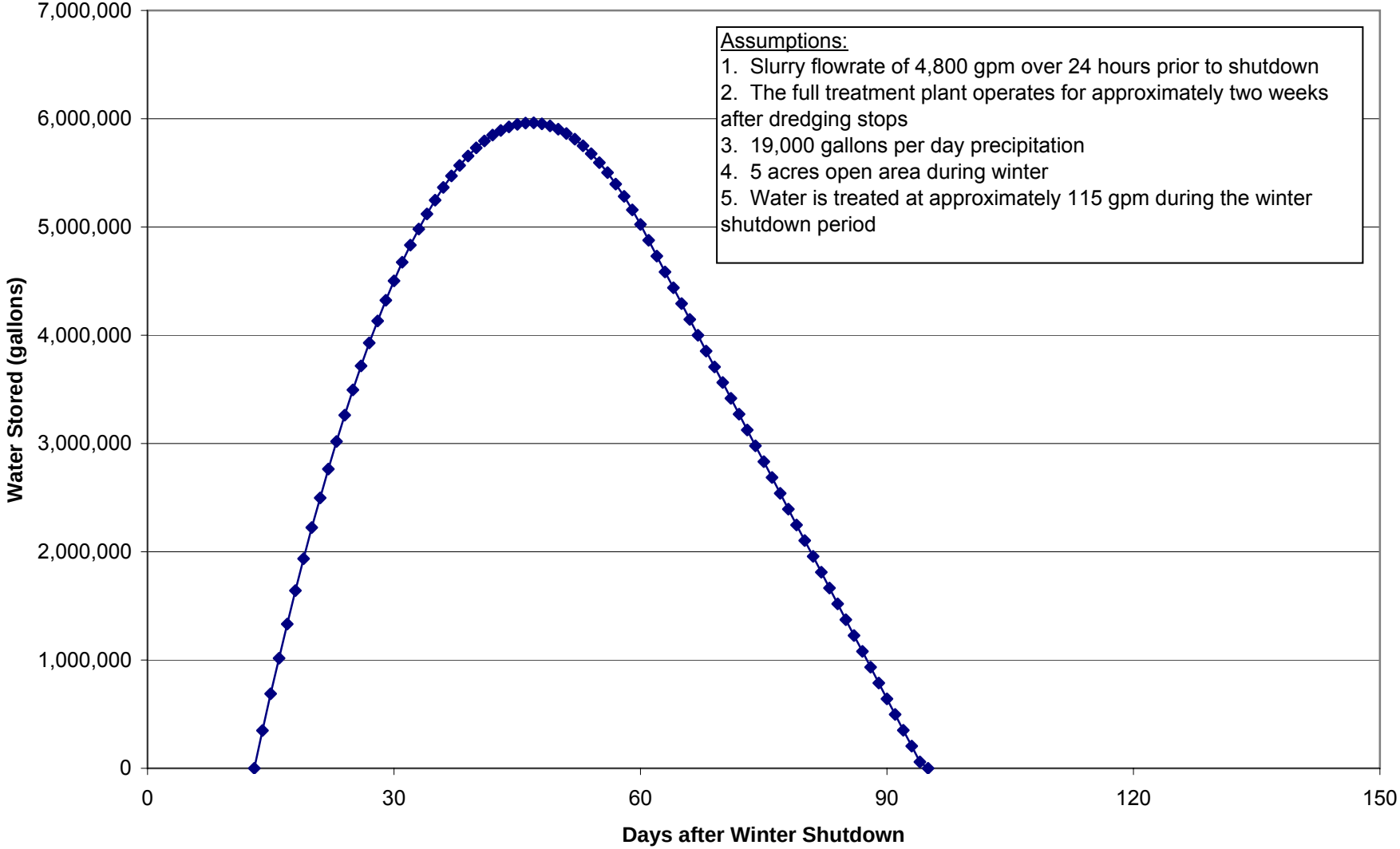


Figure 3 Winter Shutdown



APPENDIX H

WET WEATHER SHUTDOWN STATISTICAL ANALYSIS

Metro Influent Flow Statistical Analysis

Metro Process Evaluation
Honeywell International, Inc.
Syracuse, New York

1.1. General

It has been estimated that a nominal capacity of 10-11 MGD is available at the Onondaga County Metropolitan Wastewater Treatment Plant (Metro), on an average basis, to accept the SCA effluent and comply with the current pre-draft SPDES discharge. Since average daily influent flow to Metro is well below the 126.3 MGD secondary and tertiary treatment capacity, discharging an additional 6.5 MGD on an average basis should be acceptable under average conditions. However, during wet weather events, storm related flow can cause Metro to exceed 126.3 MGD and preclude additional discharge from the SCA. To evaluate the frequency and duration of wet weather events that result in Metro flow exceeding 126.3 MGD, a statistical analysis of the most recent seven years of influent data was performed. This seven-year period was selected as the most reliable and representative dataset, based on conversations with the County. The current computer system, that records influent flow, was installed in 2001 and several industrial customers permanently terminated discharge to Metro either prior to or during this period.

1.2. Statistical Analysis

The statistical analysis focused primarily on the daily data, since decisions on whether to allow discharge to Metro are likely made on a timeframe longer than an hour. Furthermore, the analysis of daily data led to more conservative results with respect to frequency and duration of wet weather events.

Utilizing an estimated average SCA supernatant discharge of 6.5 MGD to Metro, the influent flow threshold considered in this analysis was 118 MGD (126.3 – 6.5 SCA – 1.0 DestiNY). An exceedance event ("event") was defined as a calendar day or series of consecutive calendar days with maximum hourly influent flow greater than or equal to 118 MGD. On such days, the SCA would be unable to discharge to Metro because the resulting combined influent flow would exceed the plant's 126.3 MGD secondary and tertiary treatment capacity. Note that if two events were separated by a single day with maximum hourly influent flow less than 118 MGD, the two events were grouped as a single event.

The objective of the statistical analysis was to answer the following questions, which will allow Honeywell to design in accommodations for the periods when discharge of the SCA effluent is not allowed:

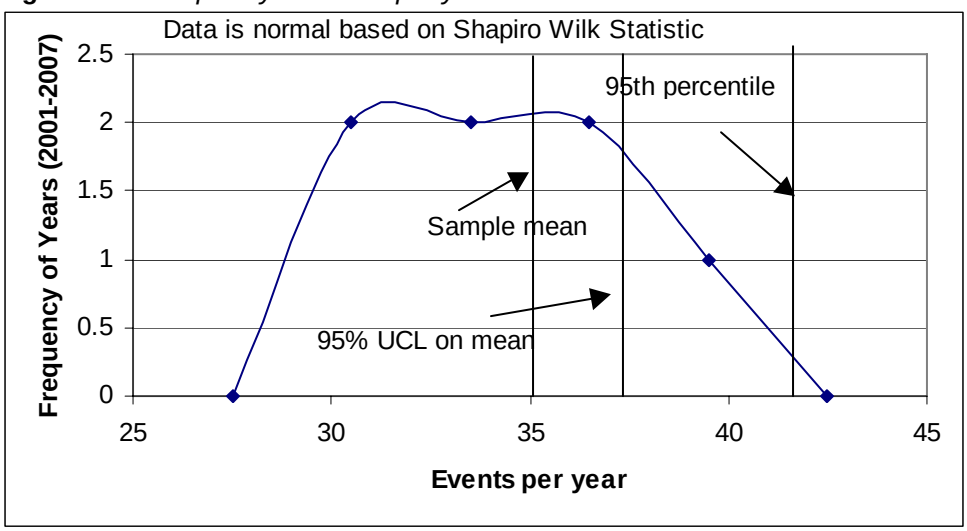
- How many events per year are expected?
- During what months are events expected?
- How long is an event expected to last?
- How often are events expected to occur?

To answer these questions, the flow data was evaluated statistically using USEPA ProUCL software (USEPA, 2007, ProUCL, Version 4.0, National Exposure Research Laboratory, Characterization and Monitoring Branch: Las Vegas, Nevada).

1.3. Expected Number of Events Per Year

Over the period 2001-2007, there were between 32 and 39 events per year, with each event ranging in duration from 1 day to 11 days long. A frequency distribution of events per year is shown in Figure 1-1. The data is normally distributed based on the Shapiro Wilk test statistic (USEPA ProUCL V. 4).

Figure 1-1. *Frequency of events per year over 2001-2007.*



On average, there were approximately 35 events per year. The 95% upper confidence limit (UCL) on that average is approximately 37 events per year, calculated using the Student's-t statistic, appropriate for a normal distribution (USEPA ProUCL V. 4). Furthermore, the 95th percentile of the distribution is approximately 42 events per year (i.e., 95% of all the data fall below 42 events per year). The 95th percentile was calculated using the Z score (standard normal variate) corresponding to the 95th percentile of a normal distribution:

$$95^{th}\ percentile = \mu + (\sigma \bullet Z_{0.95})$$

where:

μ is the 95% UCL on the mean of the data (37.3 events per year)

σ is the standard deviation of the data (2.8 events per year)

$Z_{0.95}$ is the standard normal variate corresponding to the 95th percentile of a normal distribution (1.64)

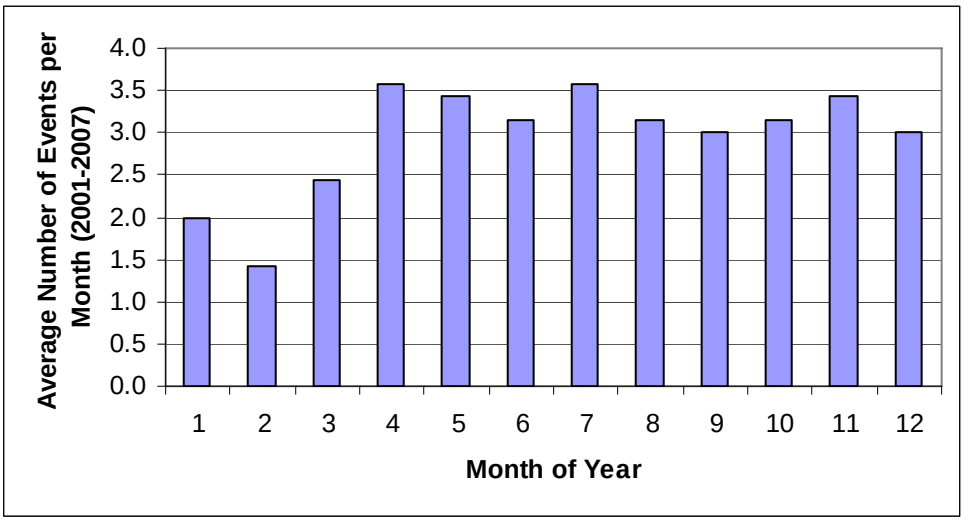
In summary, it can be stated with 95% confidence that:

- On average, approximately 37 events are expected per year
- No more than 42 events are expected per year.

1.4. Months of the Year that Events are Expected

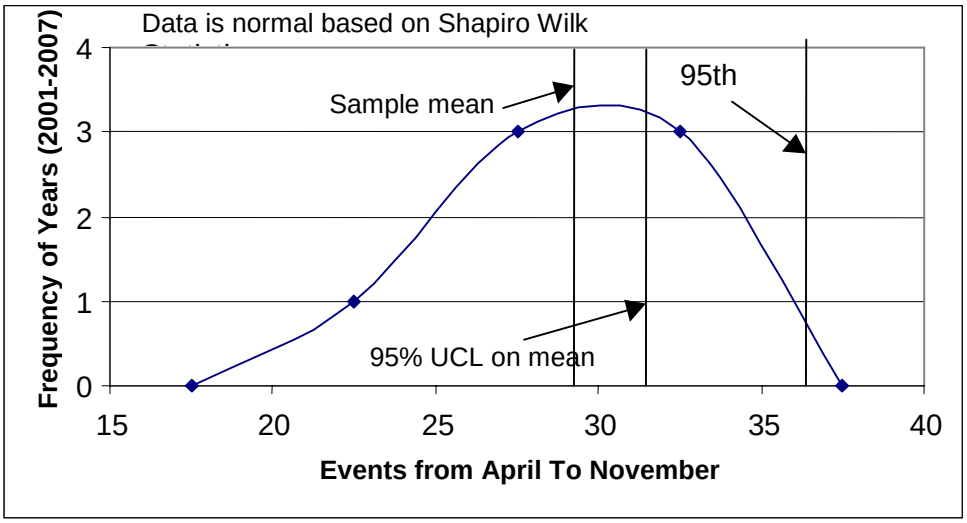
From April to November, there are on average 3 to 4 events per month. The months of November to March incur fewer events on average, ranging between 1 to 3 per month.

Figure 1-2. *Bar chart of average number of events per month over 2001-2007.*



Based on preliminary concepts, dredging at the SCA is expected to be active from April to November over a period of four years (2012-2015). Separate statistical analyses were conducted for the period April to November for comparison with analyses for the entire year. For example, the analysis of frequency of events per year yielded the frequency distribution shown in Figure 1-3 if only the period April to November is considered.

Figure 1-3. *Frequency of events over the period April to November for 2001-2007.*



Using the same approach as in Section 1.3, it can be concluded with 95% confidence that:

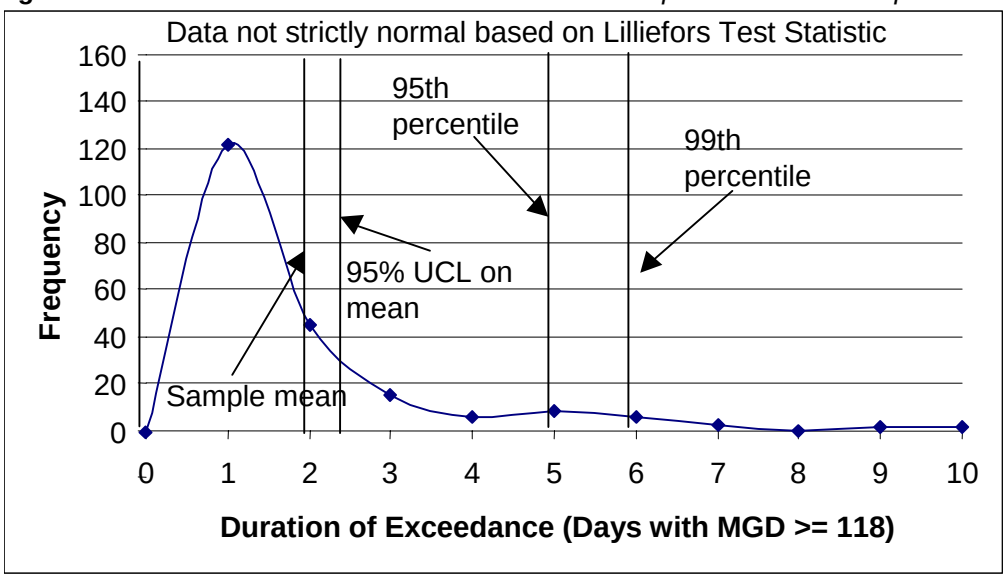
- On average, approximately 32 events are expected for the period April to November.
- No more than about 37 events are expected for the period April to November.

In general, the statistical analyses presented below are based on the April–November period since these months are considered to be representative of the period that the dredge at the SCA is expected to be active.

1.5. Duration of Events

Events for the period April–November over 2001-2007 lasted between 1 and 10 days long. Figure 1-4 presents a frequency distribution of event duration over 2001-2007 for the April-November time period. Note that the data is not strictly normally distributed based on the Lilliefors test statistic (USEPA ProUCL V. 4).

Figure 1-4. *Duration of events over 2001-2007 for the April-November time period.*



On average, an event lasts less than 2 days. When rounded to the nearest whole day, the upper bound (95% UCL) on that average is also about 2 days, calculated using the Chebyshev Theorem, which is recommended for non-parametric data (data with unknown distribution; USEPA ProUCL V. 4). Even though the data does not strictly follow a normal distribution, the 95th percentile of the distribution can be approximated as 5 days and the 99th percentile of the distribution can be approximated as 6 days, when rounding to the nearest whole day. The 95th and 99th percentiles are calculated using the Z scores (standard normal variate) corresponding to the 95th and 99th percentiles of a normal distribution, respectively:

$$\alpha^{th}\, percentile = \mu + (\sigma \bullet Z_{\alpha})$$

where:

μ is the 95% UCL on the mean of the data (2.4 days)

σ is the standard deviation of the data (1.5 days)

Z_{α} is the standard normal variate corresponding to the αth percentile of a normal distribution ($Z_{0.95}$ = 1.64; $Z_{0.99}$ = 2.3).

In summary, it can be stated with 95% confidence that:

- On average, an event lasts approximately 2 days over the April to November period.
- An event will last no more than about 5 days over the April to November period.

Furthermore, we can state with 99% confidence that:

- An event will last no more than about 6 days over the April to November period.

Because the 95th and 99th percentiles of the distribution derived above assume that the data is normally distributed, which is not strictly true, an alternative analysis was performed to derive the upper percentiles of the data. Table 1-1 presents the frequency of event durations from 2001-2007 for the April-November time period.

Table 1-1. *Frequency of event duration over 2001-2007 for April-November time period.*

Event Duration (days)	Frequency	Cumulative Frequency
1	59%	59%
2	22%	81%
3	7%	88%
4	3%	91%
5	4%	95%
6	3%	98%
7	1%	99%
8	0%	99%
9	0%	100%
10	0%	100%

Events are predominantly between 1 and 2 days in duration, accounting for 81% of the 206 events that occurred during the April-November months of 2001-2007.

Furthermore, based on the 2001-2007 data for the April-November time period:

- 95% of events are less than 5 days in duration.
- 99% of events are less than 7 days in duration.

1.6. Frequency of Event Occurrence

In order to evaluate how often events are expected to occur, the inferences made thus far are summarized:

- In Section 1.4, it was found with 95% confidence that no more than approximately 37 events are expected over the period April to November.
- In Section 1.5, it was found with 95% confidence that an event will last less than 5 days over the period April to November; in other words, only 5% of events will last 5 or more days over the period April to November.

- In Section 1.5, it was found with 99% confidence that an event will last less than 7 days over the period April to November; in other words, only 1% of events will last 7 or more days over the period April to November.

If only 5% of events will last 5 or more days and there are no more than approximately 37 events expected over the period April to November, then only 2 events lasting 5 or more days are expected over the period April to November (2 = 5% of 37). In other words, an event lasting 5 or more days is expected 2 times per April-November period.

If only 1% of events will last 7 or more days and there are no more than approximately 37 events expected over the period April to November, then only 0.4 events lasting 7 or more days are expected over the period April to November (0.4 = 1% of 37). In other words, an event lasting 7 or more days is expected every two and a half April-November periods (1/0.4 events per April-November period).

1.7. Water Pretreatment Plant Effluent Holding Capacity

The design of the water pretreatment plant (WPTP) will include provisions for effluent flow retention so that the effluent discharge can be discontinued during periods when Metro is experiencing wet weather, high flow conditions. Effluent holding capacities of 1 day and 2 days were evaluated to estimate the number of events and duration that the SCA would need to shutdown.

Based on the frequency of event duration data presented in Table 1-1, assuming a 1 day effluent holding capacity (6.5 MG), the number of events and duration of shutdown of the SCA for the period April – November are estimated in Table 1-2.

Table 1-2. *SCA shutdown, WPTP effluent holding capacity of 1 day (6.5 MG)*

No. and % events when Metro Influent Flow >= 126 MGD						Assume WTP Effluent Holding Capacity = 1 day No. of events and duration shutdown SCA		
duration (days)	% of events	# of events	duration (days)	% of events	# of events	# of events	duration (days)	Total duration (days)
< 1	59	22	>= 1	41	15	8	0 to 1	0 to 8
< 2	81	30	>= 2	19	7	3	1 to 2	3 to 6
< 3	88	33	>= 3	12	4	1	2 to 3	2 to 3
< 4	91	34	>= 4	9	3	1	3 to 4	3 to 4
< 5	95	35	>= 5	5	2	1	4 to 5	4 to 5
< 6	98	36	>= 6	2	1	1	5 to 6	5 to 6
< 7	99	37	>= 7	1	0	0	6 to 7	0 to 0
Total						**15**	**Events**	**17 to 32 days**

Based on the frequency of event duration data presented in Table 1-1, assuming a 2 day effluent holding capacity (13 MG), the number of events and duration of shutdown of the SCA for the period April – November are estimated in Table 1-3.

Table 1-3. *SCA shutdown, WPTP effluent holding capacity of 2 days (13 MG)*

No. and % events when Metro Influent Flow >= 126 MGD						Assume WTP Effluent Holding Capacity = 2 days No. of events and duration shutdown SCA		
duration (days)	% of events	# of events	duration (days)	% of events	# of events	# of events	duration (days)	Total duration (days)
< 2	81	30	>= 2	19	7	3	0 to 1	0 to 3
< 3	88	33	>= 3	12	4	1	1 to 2	1 to 2
< 4	91	34	>= 4	9	3	1	2 to 3	2 to 3
< 5	95	35	>= 5	5	2	1	3 to 4	3 to 4
< 6	98	36	>= 6	2	1	1	4 to 5	4 to 5
< 7	99	37	>= 7	1	0	0	5 to 6	0 to 0
Total						**7**	**Events**	**10 to 17 days**

1.8. Summary and Conclusions

The statistical analysis focused on wet weather influent flow events, where an event is defined as a calendar day or series of consecutive calendar days with maximum hourly influent flow greater than or equal to 118 MGD (per previous discussion in Section 1.2). Note that if two events were separated by a single day with maximum hourly influent flow less than 118 MGD, the two events were grouped as a single event. The analysis considered daily influent flow data from 2001-2007 for the period April to November, over which the dredging operations at the SCA are anticipated to be active. Overall, the objective of the analysis was to provide Honeywell with design development information for the SCA. A summary of the statistical analyses performed is presented in Table 1-4.

Table 1-4. *Summary of Statistical Analyses.*

	April-November Analysis
Events per year (95% confidence level)	32 avg 37 max
Duration of events (95% confidence level)	2 days avg 5 days max
Duration of events (99% confidence level)	7 days max
Frequency of events	2 per year (>=5 days duration) every two and a half years (>=7 days duration)
SCA shutdown, 1 day WPTP holding capacity	15 events, total duration 17 to 32 days
SCA shutdown, 2 day WPTP holding capacity	7 events, total duration 10 to 17 days

APPENDIX I

GEOTEXTILE TUBE VAPOR COVER MANUFACTURER'S CUT SHEET

Finally, A Technology That Allows Using Of Geotubes® In Cold Weather Applications!

Geo-blanket™

- ⇒ **The Geo-blanket™ is an electric blanket designed for Geotube® dewatering applications**
- ⇒ **The power source only requires 120 volts grounded power supply**
- ⇒ **Geo-blanket™ is waterproof**
- ⇒ **Its has openings for Geoport™ 8" flanges based on stock Geotube® designs**
- ⇒ **Its incorporates the Mirafi® drainage grid, providing an interface for air and water movement between the heater surface of the blanket and Geotube® fabric surface**

Geo-blanket™ can maintain the dewatering process of a Geotube® operating in 0°F abinate temperature!

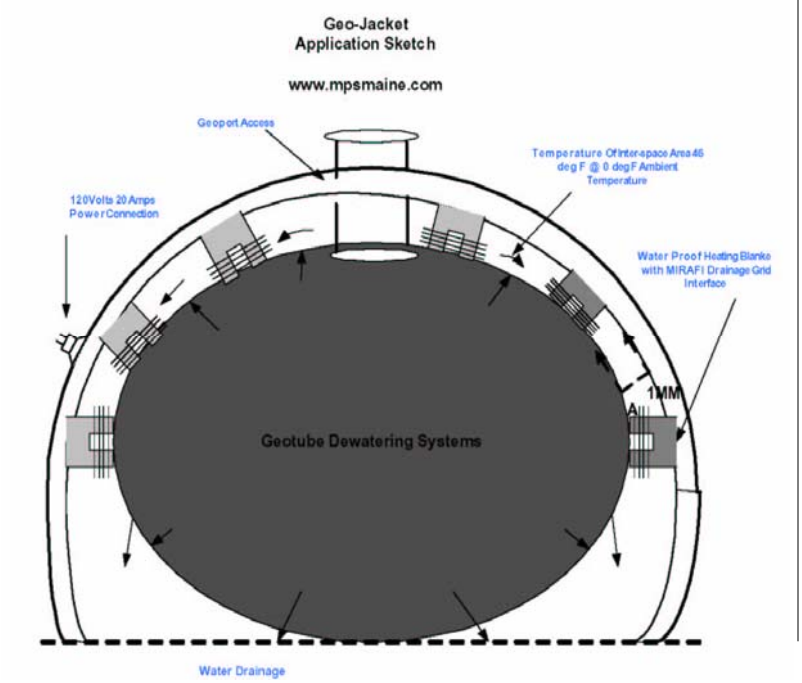
How Do I Order Geo-blanket™?

We offer Geo-blankets™ either for purchase or rentals!

Call or e-mail Jim Meagher: 207-741-2955 * jmmps@maine.rr.com

Or go on Web site http://www.mpsmaine.com under "Tech Support"

<u>End view sketch:</u>
of Geo-blanket™ installed on Geotube®



<u>Photo cross section:</u>
Showing drainage grid interspace between Geotube® and Geo-blanket™