

Sacramento Area Sewer District
Sanitary Sewer Overflow (SSO) Response Procedures

Revised 3/29/08 Supercedes 12/12/07

7. SSO Flow Estimation Pictures and Tables

7. 1 SSO Flow Estimation Pictures

Reference Sheet for Estimating Sewer Flow Rate
from Overflowing Sewer Maintenance Holes
All estimates are calculated in gallons per minute (gpm)



All photos were taken during a demonstration using metered water from a hydrant in cooperation with the City of San Diego's Water Department.

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7. 2 SSO Flow Estimation Tables

**TABLE 1
ESTIMATED SSO FLOW OUT OF MH WITH COVER IN PLACE**

24" COVER			36" COVER				
Height of spout above M/H rim H in inches	S S O FLOW Q		Min. Sewer size in which these flows are possible	Height of spout above M/H rim H in inches	S S O FLOW Q		Min. Sewer size in which these flows are possible
	in gpm	in MGD			in gpm	in MGD	
1/4	1	0.001		1/4	1	0.002	
1/2	3	0.004		1/2	4	0.006	
3/4	6	0.008		3/4	8	0.012	
1	9	0.013		1	13	0.019	
1 1/4	12	0.018		1 1/4	18	0.026	
1 1/2	16	0.024		1 1/2	24	0.035	
1 3/4	21	0.030		1 3/4	31	0.044	
2	25	0.037		2	37	0.054	
2 1/4	31	0.045		2 1/4	45	0.065	
2 1/2	38	0.054		2 1/2	55	0.079	
2 3/4	45	0.065		2 3/4	66	0.095	
3	54	0.077		3	78	0.113	
3 1/4	64	0.092		3 1/4	93	0.134	
3 1/2	75	0.107		3 1/2	109	0.157	
3 3/4	87	0.125		3 3/4	127	0.183	
4	100	0.145	4	147	0.211		
4 1/4	115	0.166	4 1/4	169	0.243		
4 1/2	131	0.189	4 1/2	192	0.276		
4 3/4	148	0.214	4 3/4	217	0.312		
5	166	0.240	5	243	0.350		
5 1/4	185	0.266	5 1/4	270	0.389		
5 1/2	204	0.294	5 1/2	299	0.430		
5 3/4	224	0.322	5 3/4	327	0.471		
6	244	0.352	6	357	0.514		
6 1/4	265	0.382	6 1/4	387	0.558		
6 1/2	286	0.412	6 1/2	419	0.603		
6 3/4	308	0.444	6 3/4	451	0.649		
7	331	0.476	7	483	0.696		
7 1/4	354	0.509	7 1/4	517	0.744		
7 1/2	377	0.543	7 1/2	551	0.794		
7 3/4	401	0.578	7 3/4	587	0.845		
8	426	0.613	8	622	0.896		
8 1/4	451	0.649	8 1/4	659	0.949		
8 1/2	476	0.686	8 1/2	697	1.003		
8 3/4	502	0.723	8 3/4	734	1.057		
9	529	0.761	9	773	1.113		

Disclaimer:

This sanitary sewer overflow table was developed by Ed Euyen, Civil Engineer, P.E. No. 33955, California, for County Sanitation District 1. This table is provided as an example. Other Agencies may want to develop their own estimating tables.

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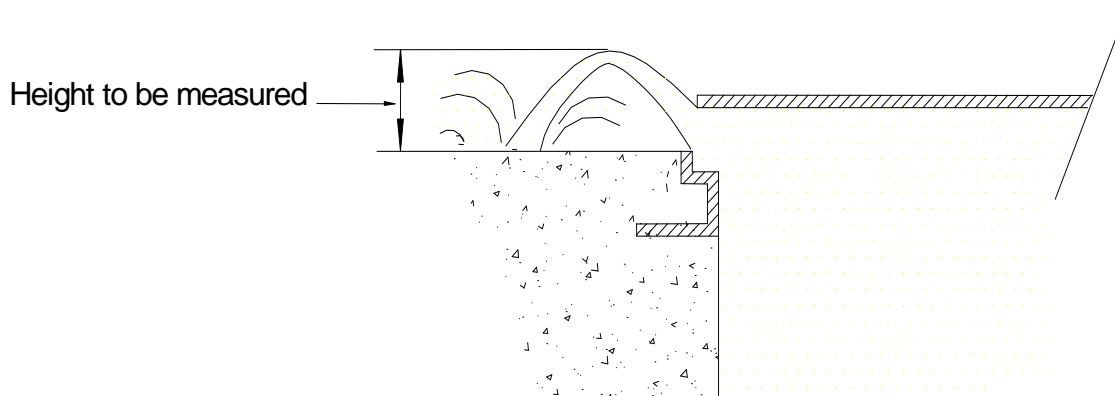
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The formula used to develop Table 1 measures the maximum height of the water coming out of the maintenance hole above the rim. The formula was taken from hydraulics and its application by A.H. Gibson (Constable & Co. Limited).

Example Overflow Estimation:

The maintenance hole cover is unseated and slightly elevated on a 24" casting. The maximum height of the discharge above the rim is 5 ¼ inches. According to Table 1, these conditions would yield an SSO of 185 gallons per minute.

FLOW OUT OF MH WITH COVER IN PLACE



This sanitary sewer overflow drawing was developed by Debbie Myers, Principal Engineering Technician, for Ed Euyen, Civil Engineer, P.E. No. 33955, California, of County Sanitation District 1.

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**TABLE 2
ESTIMATED SSO FLOW OUT OF MH WITH COVER REMOVED**

24" FRAME

Water Height above M/H frame H in inches	S S O FLOW Q		Min. Sewer size in which these flows are possible
	in gpm	in MGD	
1/8	28	0.04	
1/4	62	0.09	
3/8	111	0.16	
1/2	160	0.23	
5/8	215	0.31	6"
3/4	354	0.51	8"
7/8	569	0.82	10"
1	799	1.15	12"
1 1/8	1,035	1.49	
1 1/4	1,340	1.93	15"
1 3/8	1,660	2.39	
1 1/2	1,986	2.86	
1 5/8	2,396	3.45	18"
1 3/4	2,799	4.03	
1 7/8	3,132	4.51	
2	3,444	4.96	21"
2 1/8	3,750	5.4	
2 1/4	3,986	5.74	
2 3/8	4,215	6.07	
2 1/2	4,437	6.39	
2 5/8	4,569	6.58	24"
2 3/4	4,687	6.75	
2 7/8	4,799	6.91	
3	4,910	7.07	

36" FRAME

Water Height above M/H frame H in inches	S S O FLOW Q		Min. Sewer size in which these flows are possible
	in gpm	in MGD	
1/8	49	0.07	
1/4	111	0.16	
3/8	187	0.27	6"
1/2	271	0.39	
5/8	361	0.52	8"
3/4	458	0.66	
7/8	556	0.8	10"
1	660	0.95	12"
1 1/8	1,035	1.49	
1 1/4	1,486	2.14	15"
1 3/8	1,951	2.81	
1 1/2	2,424	3.49	18"
1 5/8	2,903	4.18	
1 3/4	3,382	4.87	
1 7/8	3,917	5.64	21"
2	4,458	6.42	
2 1/8	5,000	7.2	24"
2 1/4	5,556	8	
2 3/8	6,118	8.81	
2 1/2	6,764	9.74	
2 5/8	7,403	10.66	
2 3/4	7,972	11.48	30"
2 7/8	8,521	12.27	
3	9,062	13.05	
3 1/8	9,604	13.83	
3 1/4	10,139	14.6	
3 3/8	10,625	15.3	36"
3 1/2	11,097	15.98	
3 5/8	11,569	16.66	
3 3/4	12,035	17.33	
3 7/8	12,486	17.98	
4	12,861	18.52	
4 1/8	13,076	18.83	
4 1/4	13,285	19.13	
4 3/8	13,486	19.42	

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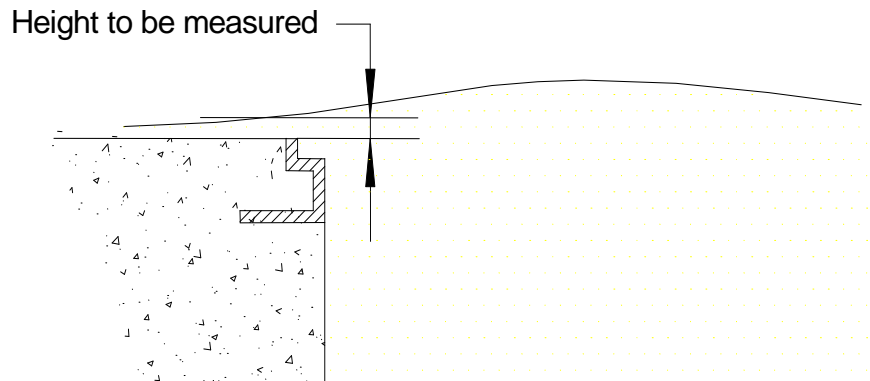
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The formula used to develop Table 2 for estimating SSO's out of maintenance holes without covers is based on discharge over curved weir -- bell mouth spillways for 2" to 12" diameter pipes. The formula was taken from hydraulics and its application by A.H. Gibson (Constable & Co. Limited).

Example Overflow Estimation:

The maintenance hole cover is off and the flow coming out of a 36" frame maintenance hole at one-inch (1") height will be approximately 660 gallons per minute.

FLOW OUT OF MH WITH COVER REMOVED (TABLE 2)



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**TABLE 3
ESTIMATED SSO FLOW OUT OF MH PICK HOLE**

Height of spout above M/H cover H in inches	SSO FLOW Q in gpm	Height of spout above M/H cover H in inches	SSO FLOW Q in gpm
1/8	1.0	5 1/8	6.2
1/4	1.4	5 1/4	6.3
3/8	1.7	5 3/8	6.3
1/2	1.9	5 1/2	6.4
5/8	2.2	5 5/8	6.5
3/4	2.4	5 3/4	6.6
7/8	2.6	5 7/8	6.6
1	2.7	6	6.7
1 1/8	2.9	6 1/8	6.8
1 1/4	3.1	6 1/4	6.8
1 3/8	3.2	6 3/8	6.9
1 1/2	3.4	6 1/2	7.0
1 5/8	3.5	6 5/8	7.0
1 3/4	3.6	6 3/4	7.1
1 7/8	3.7	6 7/8	7.2
2	3.9	7	7.2
2 1/8	4.0	7 1/8	7.3
2 1/4	4.1	7 1/4	7.4
2 3/8	4.2	7 3/8	7.4
2 1/2	4.3	7 1/2	7.5
2 5/8	4.4	7 5/8	7.6
2 3/4	4.5	7 3/4	7.6
2 7/8	4.6	7 7/8	7.7
3	4.7	8	7.7
3 1/8	4.8	8 1/8	7.8
3 1/4	4.9	8 1/4	7.9
3 3/8	5.0	8 3/8	7.9
3 1/2	5.1	8 1/2	8.0
3 5/8	5.2	8 5/8	8.0
3 3/4	5.3	8 3/4	8.1
3 7/8	5.4	8 7/8	8.1
4	5.5	9	8.2
4 1/8	5.6	9 1/8	8.3
4 1/4	5.6	9 1/4	8.3
4 3/8	5.7	9 3/8	8.4
4 1/2	5.8	9 1/2	8.4
4 5/8	5.9	9 5/8	8.5
4 3/4	6.0	9 3/4	8.5
4 7/8	6.0	9 7/8	8.6
5	6.1	10	8.7

Unrestrained
M/H cover will
start to lift

Note: This chart is based on a 7/8-inch diameter pick hole

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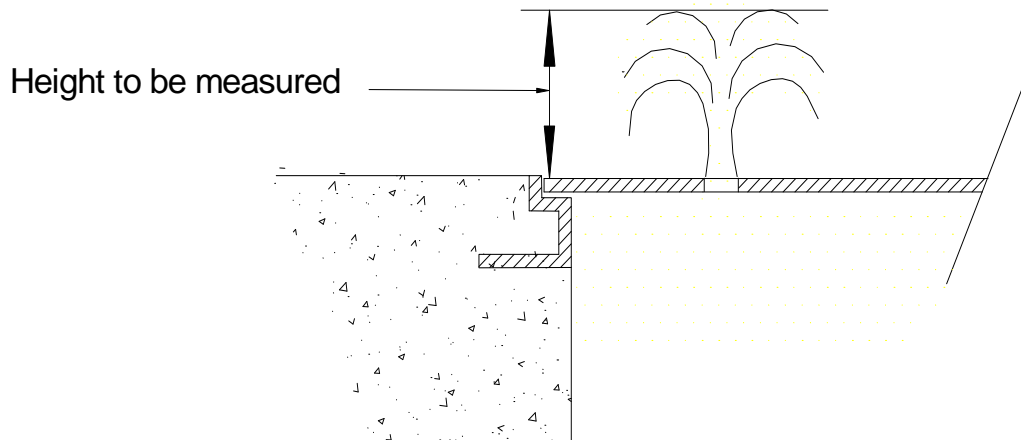
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The formula used to develop Table 3 is $Q=CcVA$, where Q is equal to the quantity of the flow in gallons per minute, Cc is equal to the coefficient of contraction (.63), V is equal to the velocity of the overflow, and A is equal to the area of the pick hole.² If all units are in feet, the quantity will be calculated in cubic feet per second, which when multiplied by 448.8 will give the answer in gallons per minute. (One cubic foot per second is equal to 448.8 gallons per minute, hence this conversion method).

Example Overflow Estimation:

The maintenance hole cover is in place and the height of water coming out of the pick hole seven-eighths of an inch in diameter (7/8") is 3 inches (3"). This will produce an SSO flow of approximately 4.7 gallons per minute.

FLOW OUT OF VENT OR PICK HOLE (TABLE 3)



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² Velocity for the purposes of this formula is calculated by using the formula $h = v^2 / 2G$, where h is equal to the height of the overflow, v is equal to velocity, and G is equal to the acceleration of gravity.