City of Coos Bay

COOS COUNTY, OREGON

WASTEWATER COLLECTION SYSTEM MASTER PLAN

Volume A

APPENDICES

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January 2006

REGISTERED PROFESSIONAL ENGINEER
56560PE

OREGON
JULY 9, 2001
JAMES G. PALLO

EXPIRATION DATE: 12/31/06

H B H
Consulting Engineers

Appendix A

Pipe Inventory and Flow Calculation Worksheet

Coos Bay Collection System
Pipe Inventory (IN FEET)

Basin-->	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	OTHER	Totals
3" Pressure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	385	285	0	0	0	0	0	670
4" Pressure	0	0	0	0	0	0	134	1,381	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	380	0	1,895
6" pressure	176	157	0	104	170	0	565	0	772	171	146	284	0	0	1,970	0	60	0	0	0	0	0	400	0	0	0	0	0	96	99	0	1,140	1,175	136	0	11,000	18,620
8" Pressure	0	0	0	0	0	0	0	0	50	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,670	0	0	2,770
10" Pressure	0	0	0	0	0	0	0	0	0	0	0	185	3,400	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,664	0	0	6,301
12" Pressure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,117	582	0	0	0	0	0	0	0	0	0	0	3,699
14" Pressure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,817	1,400	0	2,218	0	0	0	0	0	0	0	0	0	0	0	5,435
15" Pressure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,417	0	0	0	0	0	0	0	0	0	0	0	1,417
18" Pressure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,456	0	0	0	0	0	0	0	0	0	0	0	1,456
24" Pressure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	335	1,056	1,986	0	0	0	0	0	0	0	0	0	0	0	0	0	3,377
4"	0	0	0	353	57	0	0	0	0	0	0	0	0	0	117	0	0	0	0	0	0	267	0	0	0	0	0	0	0	458	0	0	0	843	0	2,095
6"	0	251	420	197	780	2,424	218	750	165	0	146	423	2,296	1,712	2,678	488	121	1,511	2,564	547	1,953	5,511	849	2,069	0	1,759	403	403	562	0	1,139	865	206	17		33,428
8"	13,143	16,001	3,007	10,748	18,520	20,787	16,531	5,544	9,607	1,063	3,177	2,147	7,004	7,218	12,104	8,643	4,188	13,919	9,518	1,980	7,406	21,819	5,405	19,450	4,711	4,330	4,693	11,825	6,857	0	6,629	2,644	20,726	12,429	0	313,772
10"	2,163	1,497	0	1,770	1,123	832	2,176	0	0	0	225	392	6,019	2,217	1,003	0	0	1,785	537	0	0	2,943	365	2,538	9	322	166	1,778	1,380	0	0	0	435	0		31,675
12"	0	0	0	0	2,129	0	0	0	0	0	0	325	344	2,034	59	727	0	3,102	659	0	287	706	0	3,399		168	1,852	0	0	0	0	1,174	61	0		17,025
14"	0	0	0	1,507	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	495	945	1,394	0	2,058	593	0	0	0	0	0	0	0	0	0	0	6,992
15"	0	0	0	0	0	0	46	0	0	0	0	0	0	0	0	0	0	297	0	0	0	37	0	3,451	0	0	0	0	0	0	0	0	0	0	0	3,831
16"	0	0	0	32	2,511	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	2,578
18"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,515	0	126	0	610	0	0	0	0	0	0	0	0	0	0	0	0	0	2,250
24"	0	0	0	0	1,796	0	0	0	0	0	0	0	0	0	0	0	0	0	0	367			0	0	0	0	0	0	0	0	0	0	0	0		2,163
27"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	245	0	745	0	0	0	0	0	0	0	0	0	0	0	0	0	990
30"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,777	0	0	0	0	0	0	0	0	0	0	0	0	0	3,777
Total Pipe	15,482	17,906	3,427	14,711	27,086	24,043	19,670	7,675	10,594	1,234	3,744	3,756	19,062	13,233	17,931	9,858	4,368	22,129	13,278	4,095	13,464	41,195	7,054	41,173	5,894	6,579	7,114	14,102	9,283	743	8,907	5,858	26,898	13,670	11,000	**466,216** feet
Manholes	70	64	29	47	93	71	79	19	55	6	16	12	43	62	76	50	24	89	64	13	45	180	31	113	16	24	27	51	27	1	27	25	84	67		**1,700**

88.30 miles

Flow and Inflow Tables

Basin-->	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH		
Estimated number of laterals (assume 4")	140	360	117	201	395	240	615	60	195	20	42	30	152	122	253	130	48	312	216	16	117	357	107	520	80	90	125	305	80	8	116	40	305	145	6059.00	
Estimated average lateral length	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70		
Estimated total lateral length	9800	25200	8190	14070	27650	16800	43050	4200	13650	1400	2940	2100	10640	8540	17710	9100	3360	21840	15120	1120	8190	24990	7490	36400	5600	6300	8750	21350	5600	560	8120	2800	21350	10150	424130.00	80.33 miles
inch-dia*mile for all gravity pipe	31.43	46.46	11.24	34.88	72.68	48.55	62.16	12.43	25.08	2.67	7.63	6.81	33.46	28.17	36.92	22.20	9.03	50.63	31.30	9.13	22.80	96.78	15.63	87.19	12.97	14.32	18.72	37.92	17.88	0.77	17.49	9.78	48.77	27.18	688.57	Plant 1 Service Area Total
Service Area Plant No.	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**322.50**	**Plant 2 Service Area Tota**
% of Total inch*mile piping per basin	9.75	14.40	3.48	10.82	22.53	15.06	19.27	3.86	3.64	0.83	1.11	0.99	4.86	4.09	5.36	3.22	1.31	7.35	4.55	1.33	3.31	14.06	2.27	12.66	1.88	2.08	2.72	5.51	2.60	0.11	2.54	1.42	7.08	3.95		
Total flow from basin- PDF 2003 (MGD)	0.31	0.45	0.11	0.34	0.71	0.47	0.61	0.12	0.34	0.03	0.10	0.09	0.46	0.38	0.50	0.30	0.12	0.69	0.43	0.12	0.31	1.32	0.21	1.19	0.18	0.20	0.26	0.52	0.24	0.01	0.24	0.13	0.67	0.37	12.55	
Total flow from basin- PWWF (hour) 2003 (MGD)	0.48	0.71	0.17	0.53	1.10	0.74	0.94	0.19	0.51	0.04	0.16	0.14	0.69	0.58	0.76	0.45	0.18	1.04	0.64	0.19	0.47	1.98	0.32	1.79	0.27	0.29	0.38	0.78	0.37	0.02	0.36	0.20	1.00	0.56	19.00	
Total flow from basin- Average Dry 2003 (MGD)	0.06	0.09	0.02	0.06	0.13	0.09	0.11	0.02	0.05	0.00	0.02	0.01	0.07	0.06	0.08	0.05	0.02	0.11	0.07	0.02	0.05	0.21	0.03	0.19	0.03	0.03	0.04	0.08	0.04	0.00	0.04	0.02	0.11	0.06	2.10	
Total flow from basin- PDF 2027 (MGD)	0.38	0.55	0.13	0.42	0.87	0.58	0.74	0.15	0.46	0.03	0.14	0.12	0.61	0.51	0.67	0.40	0.16	0.92	0.57	0.17	0.41	1.76	0.28	1.58	0.24	0.26	0.34	0.69	0.32	0.01	0.32	0.18	0.89	0.49	16.35	
Total flow from basin- PWWF (hour) 2027 (MGD)	0.59	0.87	0.21	0.65	1.36	0.91	1.16	0.23	0.68	0.05	0.21	0.19	0.91	0.77	1.01	0.61	0.25	1.38	0.85	0.25	0.62	2.64	0.43	2.38	0.35	0.39	0.51	1.04	0.49	0.02	0.48	0.27	1.33	0.74	24.82	
Total flow from basin- Average Dry 2027 (MGD)	0.07	0.10	0.02	0.08	0.16	0.11	0.13	0.03	0.06	0.01	0.02	0.02	0.08	0.07	0.09	0.05	0.02	0.12	0.07	0.02	0.05	0.22	0.04	0.20	0.03	0.03	0.04	0.09	0.04	0.00	0.04	0.02	0.11	0.06	2.30	

Inch-Mile Approach

Area Dist. Method 1

Area in Each Basin (acre)	112	126	17	114	220	202	271	314	358	22	54	53	119	106	112	74	95	146	92	27	68	231	58	336	48	83	148	115	53	3	74	41	186	135	4213.00	Total acres
Service Area Plant No.	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**		
% of Total area in Service Area	8.01	9.01	1.22	8.15	15.74	14.45	19.38	22.46	12.72	1.57	1.92	1.88	4.23	3.77	3.98	2.63	3.37	5.19	3.27	0.96	2.42	8.21	2.06	11.94	1.71	2.95	5.26	4.09	1.88	0.11	2.63	1.46	6.61	4.80	2815.00	Plant 1 Service Area Total
Total flow from basin- PDF 2003 (MGD)	0.25	0.28	0.04	0.26	0.50	0.46	0.61	0.71	1.20	0.05	0.06	0.06	0.13	0.12	0.13	0.08	0.11	0.16	0.10	0.03	0.08	0.26	0.06	0.38	0.05	0.09	0.17	0.13	0.06	0.00	0.08	0.05	0.21	0.15	1398.00	Plant 2 Service Area Total
Total flow from basin- PWWF (hour) 2003 (MGD)	0.39	0.44	0.06	0.40	0.77	0.71	0.95	1.10	1.79	0.08	0.27	0.27	0.60	0.53	0.56	0.37	0.48	0.73	0.46	0.14	0.34	1.16	0.29	1.68	0.24	0.42	0.74	0.58	0.27	0.02	0.37	0.21	0.93	0.68		
Total flow from basin- Average Dry 2003 (MGD)	0.05	0.05	0.01	0.05	0.09	0.09	0.12	0.13	0.19	0.01	0.03	0.03	0.06	0.06	0.06	0.04	0.05	0.08	0.05	0.01	0.04	0.12	0.03	0.18	0.03	0.04	0.08	0.06	0.03	0.00	0.04	0.02	0.10	0.07		
Total flow from basin- PDF 2027 (MGD)	0.38	0.55	0.13	0.42	0.87	0.58	0.74	0.15	0.46	0.03	0.14	0.12	0.61	0.51	0.67	0.40	0.16	0.92	0.57	0.17	0.41	1.76	0.28	1.58	0.24	0.26	0.34	0.69	0.32	0.01	0.32	0.18	0.89	0.49		
Total flow from basin- PWWF (hour) 2027 (MGD)	0.48	0.54	0.07	0.49	0.95	0.87	1.17	1.35	2.39	0.09	0.36	0.35	0.79	0.71	0.75	0.49	0.63	0.98	0.61	0.18	0.45	1.54	0.39	2.24	0.32	0.55	0.99	0.77	0.35	0.02	0.49	0.27	1.24	0.90		
Total flow from basin- Average Dry 2027 (MGD)	0.06	0.06	0.01	0.06	0.11	0.10	0.14	0.16	0.20	0.01	0.03	0.03	0.07	0.06	0.06	0.04	0.05	0.08	0.05	0.02	0.04	0.13	0.03	0.19	0.03	0.05	0.08	0.07	0.03	0.00	0.04	0.02	0.11	0.08		

Area Dist. Method 2

Area in Each Basin (acre)	112	126	17	114	220	202	271	314	358	22	54	53	119	106	112	74	95	146	92	27	68	231	58	336	48	83	148	115	53	3	74	41	186	135	4213.00	Total acres
Service Area Plant No.	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**		
% of Developed Area	70.00%	85.00%	85.00%	90.00%	75.00%	85.00%	85.00%	35.00%	45.00%	65.00%	65.00%	50.00%	85.00%	80.00%	75.00%	75.00%	60.00%	75.00%	60.00%	85.00%	85.00%	88.00%	90.00%	70.00%	90.00%	95.00%	90.00%	70.00%	90.00%	70.00%	80.00%	80.00%	80.00%	85.00%	85.00%	85.00%
% Future Developed Area	75.00%	90.00%	88.00%	95.00%	95.00%	95.00%	88.00%	40.00%	85.00%	70.00%	85.00%	65.00%	95.00%	85.00%	78.00%	80.00%	80.00%	80.00%	65.00%	85.00%	88.00%	90.00%	70.00%	90.00%	95.00%	90.00%	70.00%	90.00%	70.00%	80.00%	80.00%	80.00%	85.00%	85.00%		
Estimated devloped area - Exist	78.40	107.10	14.45	102.60	165.00	171.70	230.35	109.90	161.10	14.30	35.10	26.50	101.15	84.80	84.00	55.50	57.00	109.50	55.20	22.95	57.80	203.28	31.90	268.80	40.80	45.65	51.80	92.00	31.80	2.40	44.40	28.70	139.50	94.50	1926.13	Plant 1 developed
Estimated Developed area - future	84.00	113.40	14.96	108.30	209.00	191.90	238.48	125.60	304.30	15.40	45.90	34.45	113.05	90.10	87.36	59.20	76.00	116.80	59.80	22.95	59.84	207.90	40.60	302.40	45.60	74.70	103.60	103.50	37.10	2.40	59.20	32.80	158.10	114.75	2352.40	Plant 1 Developec
% of Total developed area in Service Area - Existing	7.50%	10.25%	1.38%	9.82%	15.79%	16.43%	22.04%	10.52%	8.36%	1.37%	1.82%	1.38%	5.25%	4.40%	4.36%	2.88%	2.96%	5.68%	2.87%	1.19%	3.00%	10.55%	1.66%	13.96%	2.12%	2.37%	2.69%	4.78%	1.65%	0.12%	2.31%	1.49%	7.24%	4.91%	1045.00	Plant 2 developed
% of Total developed area in Service Area - Future	6.56%	8.86%	1.17%	8.46%	16.33%	15.00%	18.64%	9.81%	12.94%	1.20%	1.95%	1.46%	4.81%	3.83%	3.71%	2.52%	3.23%	4.97%	2.54%	0.98%	2.54%	8.84%	1.73%	12.85%	1.94%	3.18%	4.40%	4.40%	1.58%	0.10%	2.52%	1.39%	6.72%	4.88%	1279.74	Plant 2 Developec
Total flow from basin- PDF 2003 (MGD)	0.24	0.32	0.04	0.31	0.50	0.52	0.69	0.33	0.79	0.04	0.17	0.13	0.49	0.41	0.41	0.27	0.28	0.53	0.27	0.11	0.28	0.99	0.16	1.31	0.20	0.22	0.25	0.45	0.16	0.01	0.22	0.14	0.68	0.46		
Total flow from basin- PWWF (hour) 2003 (MGD)	0.37	0.50	0.07	0.48	0.77	0.81	1.08	0.52	1.18	0.07	0.26	0.19	0.74	0.62	0.61	0.41	0.42	0.80	0.40	0.17	0.42	1.49	0.23	1.97	0.30	0.33	0.38	0.67	0.23	0.02	0.33	0.21	1.02	0.69		
Total flow from basin- Average Dry 2003 (MGD)	0.04	0.06	0.01	0.06	0.09	0.10	0.13	0.06	0.13	0.01	0.03	0.02	0.08	0.07	0.07	0.04	0.04	0.09	0.04	0.02	0.05	0.16	0.02	0.21	0.03	0.04	0.04	0.07	0.02	0.00	0.03	0.02	0.11	0.07		
Total flow from basin- PDF 2027 (MGD)	0.25	0.34	0.05	0.33	0.63	0.58	0.72	0.38	1.62	0.05	0.24	0.18	0.60	0.48	0.46	0.31	0.40	0.62	0.32	0.12	0.32	1.10	0.22	1.61	0.24	0.40	0.55	0.55	0.20	0.01	0.31	0.17	0.84	0.61		
Total flow from basin- PWWF (hour) 2027 (MGD)	0.40	0.53	0.07	0.51	0.98	0.90	1.12	0.59	2.43	0.07	0.37	0.28	0.90	0.72	0.70	0.47	0.61	0.93	0.48	0.18	0.48	1.66	0.32	2.42	0.36	0.60	0.83	0.83	0.30	0.02	0.47	0.26	1.26	0.92		
Total flow from basin- Average Dry 2027 (MGD)	0.05	0.06	0.01	0.06	0.11	0.10	0.13	0.07	0.21	0.01	0.03	0.02	0.08	0.06	0.06	0.04	0.05	0.08	0.04	0.02	0.04	0.14	0.03	0.21	0.03	0.05	0.07	0.07	0.03	0.00	0.04	0.02	0.11	0.08		

Basis For Planning Existing PWWF	0.5	0.55	0.1	0.53	0.95	0.8	1	0.4	0.75	0.07	0.25	0.2	0.75	0.6	0.62	0.4	0.4	0.9	0.45	0.16	0.4	1.6	0.5	1.8	0.25	0.35	0.5	0.65	0.25	0.02	0.35	0.25	1	0.7		
Basis For Planning Future PWWF	0.6	0.6	0.15	0.57	1.25	0.95	1.2	0.6	1.8	0.1	0.35	0.3	1	0.72	0.72	0.5	0.6	1.1	0.5	0.18	0.47	1.8	0.6	2.33	0.3	0.58	0.9	0.85	0.3	0.02	0.45	0.28	1.25	0.9		
Existing gpd/Ac (developed area)	6378	5135	6920	5166	5758	4659	4341	3640	4655	4895	7123	7547	7415	7075	7381	7207	7018	8219	8152	6972	6920	7871	15674	6696	6127	7667	9653	7065	7862	8333	7883	8711	7168	7407		
Future gpd/Ac (developed area)	7143	5291	10027	5263	5981	4950	5032	4777	5915	6494	7625	8708	8846	7991	8242	8446	7895	9418	8361	7843	7854	8658	14778	7705	6579	7764	8687	8213	8086	8333	7601	8537	7906	7843		

Appendix B

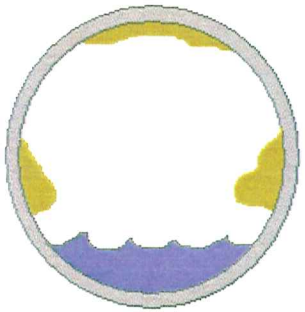
Manhole Inventory

Manholes by Basin				
Basin No.	Total Manholes		double checked	
A	70		70	
B	64		64	
C	18		18	
D	57		57	
E	71		69	
F	71		71	
G	59		79	
H	39		19	
I	52		55	
J	0		6	
K	20		20	
L	12		12	
M	43		43	
N	62		62	
O	76		76	
P	50		50	
Q	24		24	
R	89		89	
S	64		64	
T	13		13	
U	45		45	
V	180		180	
W	28		31	
X	114		113	
Y	14		16	
Z	24		24	
AA	27		27	
BB	51		51	
CC	27		27	
DD	2		1	
EE	27		27	
FF	24		25	
GG	84		84	
HH	27		67	
II	6		0	
TOTAL	1634		1679	

Appendix C

Fats, Oils & Grease (FOG) Sample Information

HOW GREASE CAUSES A BLOCKAGE



The start of a blocked pipe begins when grease collects on the top and sides of the pipe interior.

The build-up increases over time when grease and other debris are washed down the drain.

Excessive accumulation will restrict the flow of wastewater and can result in a sanitary sewer overflow.

HOW A GREASE INTERCEPTOR WORKS

A grease interceptor is a passive control device that is designed to help reduce fats, oils, greases, and solids from entering the sanitary sewer collection and treatment system. Grease interceptors hold the fats, oils, greases, and solids until they can be removed and disposed of by recycling, rendering, or land application.

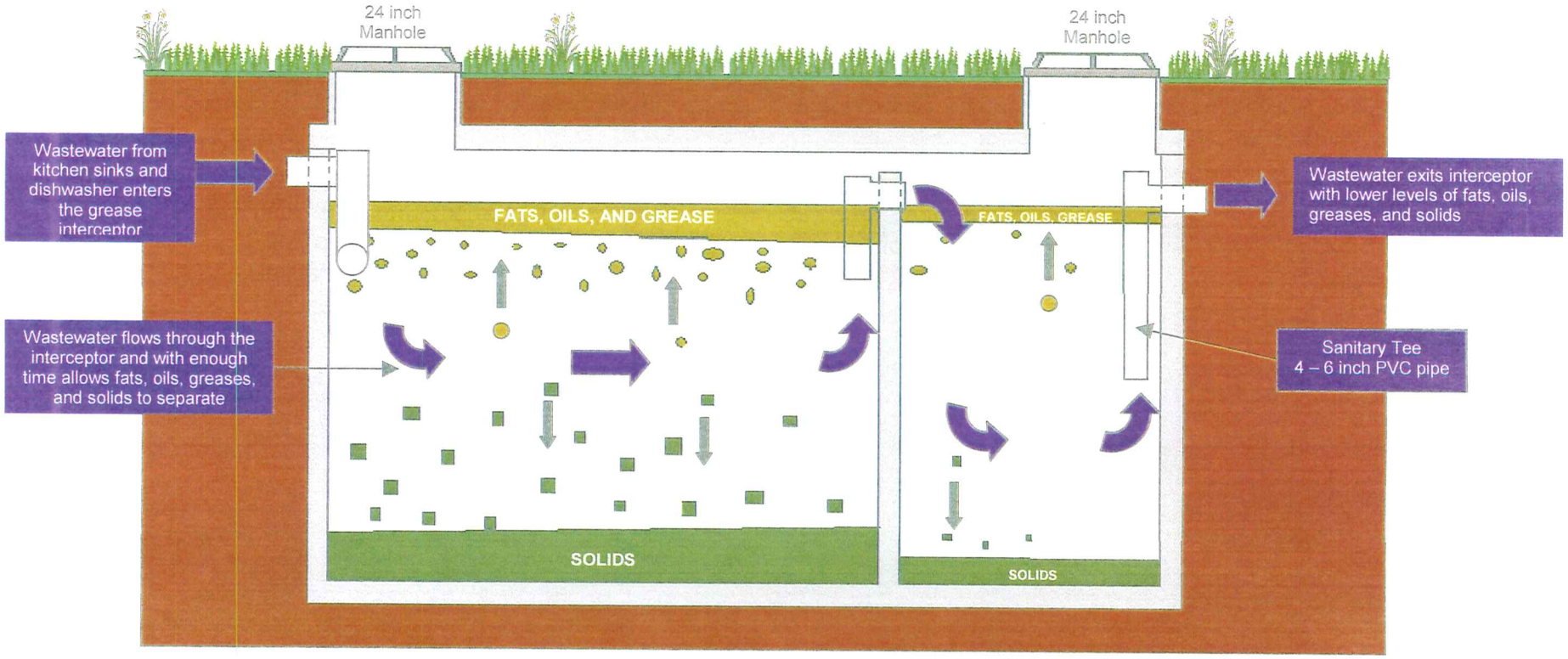


Illustration by:
Donald Smith
Town of Cary

- Grease interceptors allow wastewater flows to slow down
- With sufficient time fats, oils, greases, and solids separate from wastewater
- Fats, oils, and greases are less dense than water and float
- Solids are denser than water and sink
- Grease interceptors are designed in a variety of sizes, shapes, and constructed of various materials

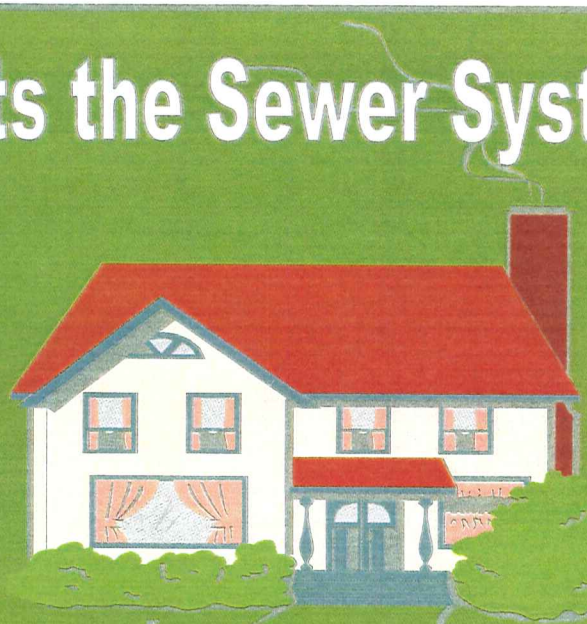
How A Sewer Blockage Affects the Sewer System

Sewer Blockage Formation

The start of a blocked pipe begins when grease and solids collect on the top and sides of the pipe interior.

The build-up increases over time when grease and other debris are washed down the drain.

Excessive accumulation will restrict the flow of wastewater and can result in a sanitary sewer overflow.



#2 Wastewater will back up in manholes, sewer cleanouts, and even home plumbing

#3 Sanitary Sewer Overflows occur and expose untreated wastewater to humans, animals, and the environment

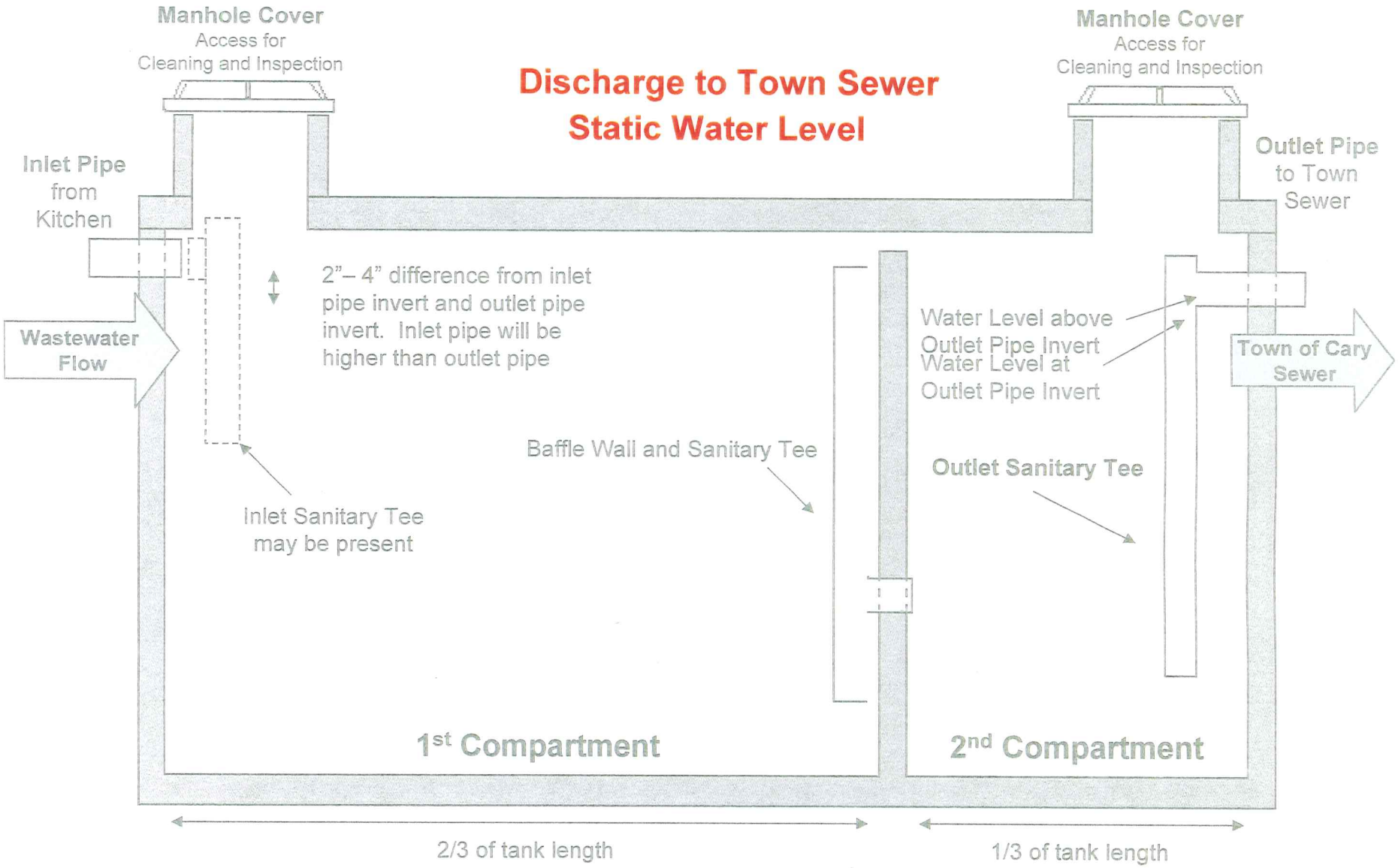
Manhole

Sewer Cleanout

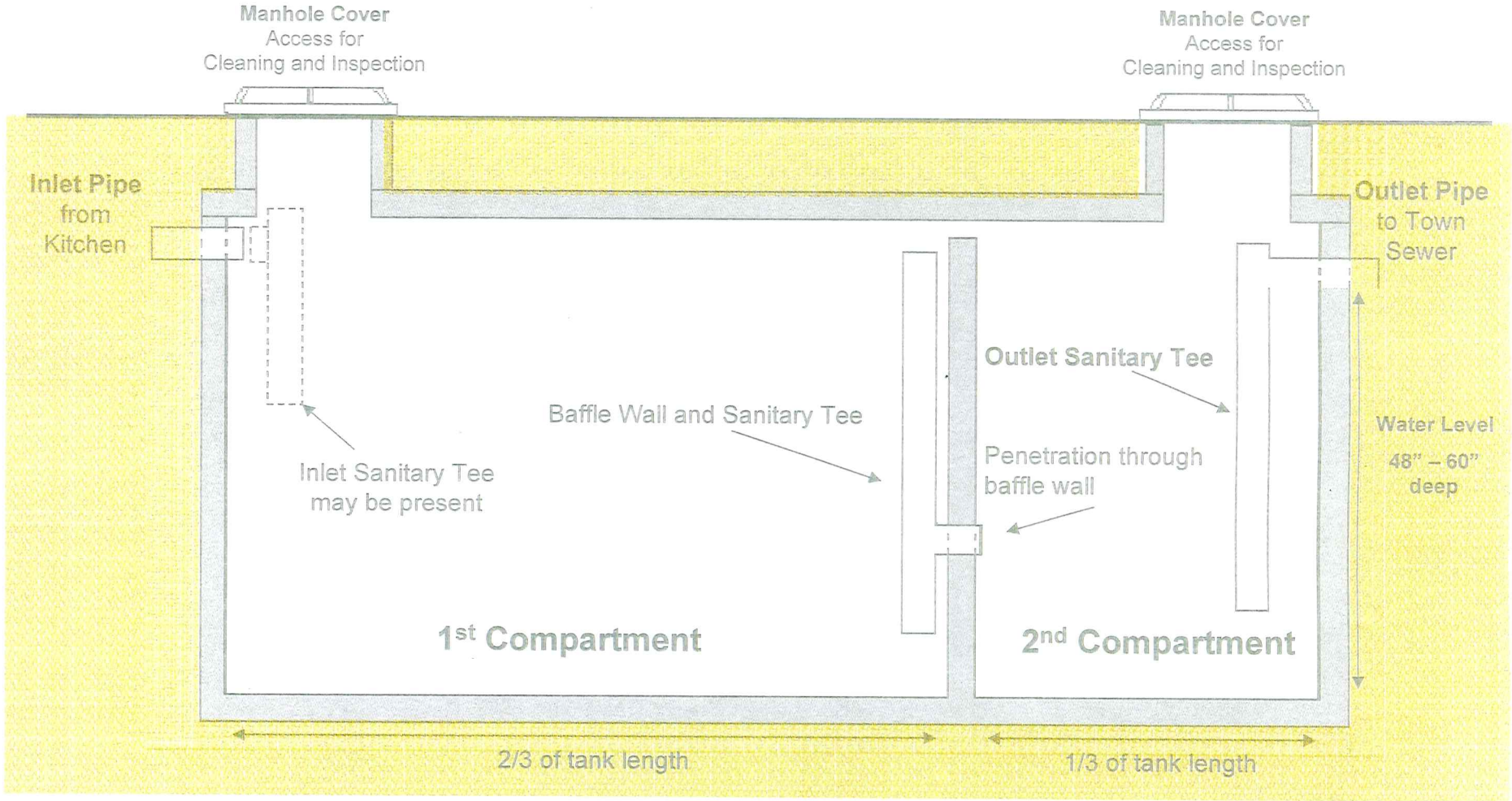
Storm Drain

#1 Grease and Solids accumulate and block the flow of wastewater

Grease Trap Fluid Levels



Typical Grease Trap/Interceptor Design



TOWN of CARY
Section 36-183.
FATS, OILS, AND GREASES CONTROL ORDINANCE

Adopted by Town Council: December 10, 1998
Effective Date: January 1, 1999

A. Scope and Purpose

To aid in the prevention of sanitary sewer blockages and obstructions from contribution and accumulation of fats, oils, and greases into such sewer system from industrial or commercial establishments, particularly food preparation and serving facilities.

B. Definitions

Cooking Establishments. Those establishments primarily engaged in activities of preparing, serving, or otherwise making available for consumption foodstuffs and that use one or more of the following preparation activities: cooking by frying (all methods), baking (all methods), grilling, sautéing, rotisserie cooking, broiling (all methods), boiling, blanching, roasting, toasting, or poaching. Also included are infrared heating, searing, barbecuing, and any other food preparation activity that produces a hot, non-drinkable food product in or on a receptacle that requires washing.

Fats, Oils, and Greases. Organic polar compounds derived from animal and/or plant sources that contain multiple carbon chain triglyceride molecules. These substances are detectable and measurable using analytical test procedures established in 40 CFR 136, as may be amended from time to time. All are sometimes referred to herein as "Grease" or "Greases".

Grease Trap or Interceptor. A device for separating and retaining waterborne Greases and Grease complexes prior to the wastewater exiting the trap and entering the sanitary sewer collection and treatment system. These devices also serve to collect settlable solids, generated by and from food preparation activities, prior to the water exiting the trap and entering the sanitary sewer collection and treatment system. Grease Traps and Interceptors are sometimes referred to herein as "Grease Interceptors".

Minimum Design Capability. The design features of a Grease Interceptor and its ability or volume required to effectively intercept and retain Greases from grease-laden wastewaters discharged to the public sanitary sewer.

Non-Cooking Establishments. Those establishments primarily engaged in the preparation of precooked foodstuffs that do not include any form of cooking. These include cold dairy and frozen foodstuffs preparation and serving establishments.

User. Any person, including those located outside the jurisdictional limits of the Town, who contributes, causes or permits the contribution or discharge of wastewater into the POTW, including persons who contribute such wastewater from mobile sources, such as those who discharge hauled wastewater.

C. Grease Interceptor Maintenance, Record Keeping, and Grease Removal

1. Grease Interceptors shall be installed by Users as required by the Director or his designee. Grease Interceptors shall be installed at the User's expense, when such User operates a Cooking Establishment. Grease Interceptors may also be required in non-cooking or cold dairy and frozen foodstuffs establishments and other industrial or commercial establishments when they are deemed necessary by the Director for the proper handling of liquid wastes containing Grease. No User shall allow wastewater discharge concentration from subject Grease Interceptor to exceed 325 milligrams per liter, as identified by method EPA Method 1664 or 275 milligrams per liter, as identified by EPA method 413. All Grease Interceptors shall be of a type, design, and capacity approved by the Director or his designee and shall be readily and easily accessible for User cleaning and Town inspection. All such Grease Interceptors shall be serviced and emptied of accumulated waste content as required in order to maintain Minimum Design Capability or effective volume of the Grease Interceptor, but not less often than every thirty (30) days. Users who are required to pass water through a Grease Interceptor shall:

a. Provide for a minimum hydraulic retention time of twenty-four (24) minutes at actual peak flow or 12 minutes at the calculated theoretical peak flow rate as predicted by the Uniform Plumbing Code fixture criteria, between the influent and effluent baffles with twenty (20) percent of the total volume of the Grease Interceptor being allowed for sludge to settle and accumulate, identified hereafter as a "sludge pocket".

b. Remove any accumulated Grease cap and sludge pocket as required, but at intervals of not longer than thirty (30) days at the Users expense. Grease Interceptors shall be kept free of inorganic solid materials such as grit, rocks, gravel, sand, eating utensils, cigarettes, shells, towels, rags, etc., which could settle into this pocket and thereby reduce the effective volume of the Grease Interceptor.

c. Accept the following conditions: If any skimmed or pumped wastes or other materials removed from Grease Interceptor are treated in any fashion onsite and reintroduced back into the Grease Interceptor as an activity of and after said onsite treatment, the User shall be responsible for the attainment of established Grease numerical limit consistent with and contained in (C)(1) on all discharges of wastewater from said Grease Interceptor into the Town of Cary sanitary sewer collection and treatment system.

d. Operate the Grease Interceptor in a manner so as to maintain said device such that attainment of the grease limit is consistently achieved. "Consistent" shall mean any wastewater sample taken from said Grease Interceptor shall be subject to terms of numerical limit attainment described in (C)(1). If an establishment desires, because of documented space constraints, an alternate to an out--of--building Grease Interceptor, the request for an alternative location shall contain the following information:

1. Location of Town sewer main and easement in relation to available exterior space outside building

2. Existing plumbing at or in a site that uses common plumbing for all services at that site.

e. Understand and agree that: The use of biological additives as a Grease degradation agent is conditionally permissible, upon prior written approval by the Director. Any establishment using this method of Grease abatement shall maintain the trap or interceptor in such a manner that attainment of the Grease wastewater discharge limit, as measured from the trap's outlet, is consistently achieved.

f. Understand and agree that: The use of automatic Grease removal systems is conditionally permissible, upon prior written approval by the Director, the Lead Plumbing Inspector of the Town of Cary, and the Wake County Department of Health. Any establishment using this equipment shall operate the system in such a manner that attainment of the Grease wastewater discharge limit, as measured from the unit's outlet, is consistently achieved.

g. Understand and agree that: The Director reserves the right to make determinations of Grease Interceptor adequacy and need, based on review of all relevant information regarding Grease Interceptor performance, facility site and building plan review and to require repairs to, or modification or replacement of such traps.

2. The User shall maintain a written record of trap maintenance for three (3) years. All such records will be available for inspection by the Town at all times.

3. No non-grease-laden sources are allowed to be connected to sewer lines intended for Grease Interceptor service.

4. Except as provided herein, for a period of one year following adoption of this Ordinance, although installation of Grease Interceptors will be required to be installed, no enforcement actions will be taken under this Ordinance for failure to achieve limits on Grease discharges from Grease Interceptors. If, during this one year period an obstruction of a Town sewer main(s) occurs that causes a sewer overflow to the extent that an impact on the environment is realized and that said overflow or failure of the sanitary sewer collection system to convey sewage can be attributed in part or in whole to an accumulation of Grease in the Town's sewer main(s), the Town of Cary will take appropriate enforcement actions, as stipulated in the Town's Industrial Pretreatment Enforcement Plan and Sewer Use Ordinance, against the generator or contributor of such Grease.

5. Access manholes, with a minimum diameter of 24 inches, shall be provided over each chamber and sanitary tee. The access manholes shall extend at least to finished grade and be designed and maintained to prevent water inflow or infiltration. The manholes shall also have readily removable covers to facilitate inspection, Grease removal, and wastewater sampling activities.

Search

Entire Site
Clean Streams Only

- Residents
- Businesses
  - Fats, Oils and Grease
  - Non-point source pollution
  - Join the Team
- Educators
- News & Information

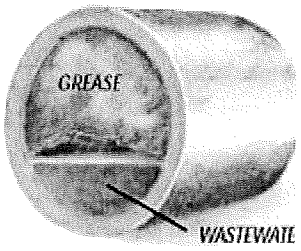
Home > Local Government > City > Public Works > Protecting the Environment > Indianapolis Clean Stream Team > How You Can Help > Businesses > Fats, Oils and Grease

Fats, Oils and Grease

Fats, oils and grease are an unhealthy and expensive problem in our city sewers. Do yo part to comply with the law and keep our sewers flowing.
This page contains important information for:

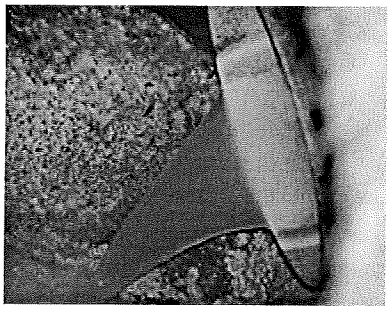
- Restaurant owners
- Bar owners
- Hospitals
- School cafeterias
- Other food preparation establishments

Why are Fats, Oils and Grease a problem in our sewers?



- When Fats, Oils and Grease (FOG) are disposed of improperly they can cause sewer backups. Backups expose the city to costly environmental penalties, and cause health hazards on your property.
- FOG washed down sinks and floor drains builds up over time and eventually creates clogs.
- FOG leads to increased costs for maintaining sewers and wastewater treatment plants and cleaning grease clogs out of private and public property.
- Fats, Oils and Grease are found in food scraps, meat fats, lard, oil, margarine, butter, baking goods, sauces, and dairy products.
- FOG from food preparation establishments is a major source of these wastes in cit sewers.

Why should FOG matter to you?



- Sewer backups and clogs attract insects and vermin and create health hazards.
- Sewer backups can result in property damage and health code violations.
- Clogged sewers can cause sewer overflows, which release untreated sewage into our neighborhoods, rivers and streams.
- FOG is a valuable resource. When recycled rather than dumped down the drain, FOG can be sold to rendering companies for use in soaps, fertilizers, and animal feeds.

Improper FOG disposal is costly at a time when we can least afford it .

- Increased sewer backups and overflows lead to extra maintenance and repairs by the city.
- Increased costs for the city means increased costs for ratepayers.
- Average annual FOG-related preventive maintenance and treatment costs for the City of Indianapolis: $631,000.

What is required?

Chapter 671 of the Indianapolis City Code states:

No person shall discharge or cause to be discharged to any city sewer wastewater or pollutants that cause, threaten to cause or are capable of causing... obstruction to the flow in city sewers. - Sec. 671-4(c)(3)

No person shall discharge or cause to be discharged to any city sewer... solid or viscous substances and/or other pollutants that may cause obstruction to the flow in a sewer ... such as, but not limited to, grease. - Sec. 671-4(d)(6)

Restaurants and other establishments are required to install a grease interceptor (commonly known as grease traps) in the waste line leading from plumbing fixtures or equipment where grease may be introduced to the sewer system. (Sec. 671-4(g)) Grease interceptors must be properly sized, installed and maintained. In reality, many are not maintained on a regular basis.

Click here for MCHD Best Management Practices for FOG.

Click here to read the city code.

Click here to view the city's enforcement policy.

For more information on managing fat, oil and grease discharges, contact the Office of Environmental Services at 327-2234. For more information on the proper installation and sizing of grease interceptors, contact the Department of Metropolitan Development at 327-5544 or 327-5552.

Last Updated: 9/2/2005 | Print This Page | Email to Frie

Dispose of fats, oils and grease where they belong.

Don't cause sewer clogs.

You can help protect the environment, improve health, and save money in the process just by taking responsibility for the proper disposal of food waste generated by your business.

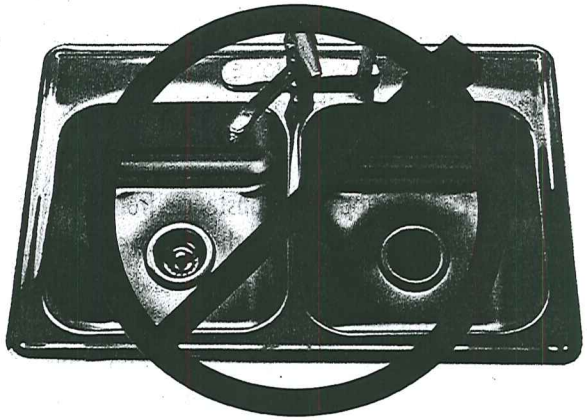
Prevent fats, oils, and grease from getting in the sewer lines. It's more than just a good habit. It's also good business.

Approved by
CALIFORNIA Restaurant ASSOCIATION SINCE 1906

IRVINE RANCH WATER DISTRICT

Irvine Ranch Water District
15600 Sand Canyon Avenue, Irvine, CA 92618
(949) 453-5300 www.irwd.com

The drain is not a dump.



The problem with fats, oils and grease

Fats, oils and grease (FOG) come from meat, lard, cooking oil, butter and shortening. You can find them in fryers, pots and pans, food scraps, and spoiled food, and on floors and cooking surfaces. The trouble starts when FOG gets into the sewer through sinks and floor drains.

Sewer lines can become blocked, which can cause untreated wastewater to overflow into your facility and into storm drains leading to the ocean. Sewage spills can spread disease, pollute streets and beaches, require expensive cleanup, and even close your business.

Food service establishments have been found to be major sources of fats, oils and grease that enter the sewer system. The state now requires that your city and local sewer agency enforce limitations on the amount of FOG and other debris that goes in the sewers.

The best way to stop these substances from building up in sewer lines is to prevent them from entering your drains, by using "Kitchen Best Management Practices." The most common Kitchen Best Management Practices are listed here, but be sure to consult with your city or local sewer agency for any additional practices you may be required to follow. Your city or local agency may also conduct inspections to confirm that you are following these practices.

Use Best Practices In The Kitchen

Training – all new employees should be trained in Kitchen Best Management Practices, including the proper methods of fats, oils and grease disposal. Provide frequent refresher training as well.

Signage – display the appropriate signs or posters prominently in the workplace.

Drain screens – install screens on all kitchen drains. Openings should be no more than 3/16 inch. Screens should be removable for frequent cleaning.

Collect & recycle – pour all cooking grease (yellow grease) and liquid oil from pots, pans and fryers into a covered grease container for recycling. Use a permitted waste collection service or authorized recycling center. Keep all written records of their pick ups; inspectors may ask to see them.

Don't overfill – avoid spills by emptying FOG containers before they get full.

Transport carefully – use a covered container to move grease without spilling.

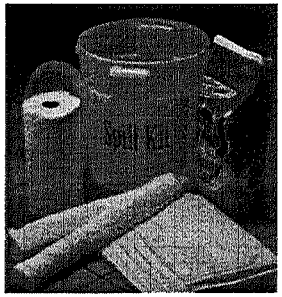
Clean before washing– scrape or dry-wipe excess food and solidified grease from pots, pans, fryers, utensils, screens and mats, then dispose of it in the trash.

Don't dump hot water – cooking or cleaning water over 140° F should NOT be put down a drain that's connected to a grease trap or interceptor.

Clean hoods – dispose of waste from hoods and filters by emptying it into a drain connected to a grease interceptor if you have one, or have the hoods professionally maintained.

Soak up drips & spills – place absorbent materials such as paper towels or absorbent pads under fryers or other areas where grease may drip or spill.

Use "spill kits" – make your own "spill kits" with absorbent materials such as absorbent pads or kitty litter. Keep them well marked and accessible for cleaning spills. Designate a key employee on each shift to monitor cleanup and restock the kits.



Managing FATS, OIL and GREASE "It's Easier than YOU Think!"

THE WRONG WAY
La Forma Incorrecta

1

Do not pour cooking residue directly into the drain.

No vierta residuos de cocinar directamente en el desague.

2

Do not dispose of food waste into the garbage disposal.

No ponga desperdicios de comida en el triturador de comida.

3

Do not pour waste oil directly into the drain.

No ponga desperdicio de aceite directamente en el desague.

4

Do not wash floor mats where water will run off directly into the storm drain.

No lave tapetes de piso en un lugar donde el agua corra hacia el desague.

THE RIGHT WAY
La Forma Correcta

1

Wipe pots, pans, and work areas prior to washing.

Limpie con una toallita las ollas, cazuelas, y areas de trabajo antes de lavarlos.

2

Dispose of food waste directly into the trash.

Deseche los desperdicios de comida en el bote de basura.

3

Collect waste oil and store for recycling.

Junte el desperdicio de aceite y guardelo para que sea reciclado.

4

Clean mats inside over a utility sink.

Limpie los tapetes de piso detro de un lavabo o fregador.

CALIFORNIA Restaurant ASSOCIATION SINCE 1906

California Restaurant Association and Irvine Ranch Water District
For more information, (para mas informacion llame a) (949) 453-5300 or visit www.irwd.com

IRVINE RANCH WATER DISTRICT

Commercial Fats, Oils & Grease (FOG) Program

Problems caused by wastes (fats, oils & grease) from restaurants and other grease-producing establishments have served as the basis for ordinances and regulations governing the discharge of grease materials to the sanitary sewer system. This type of waste has forced the requirement of the installation of preliminary treatment facilities, commonly known as grease traps or interceptors.

Determine if you need to install a grease trap or interceptor with the following FAQs. A brochure is available for download in English (PDF, 360KB) and Spanish (PDF, 331KB).

What is a grease trap? How does it work?

A grease trap is a small reservoir built into the wastewater piping a short distance from the grease producing area. Baffles in the reservoir retain the wastewater long enough for the grease to congeal and rise to the surface. The grease can then be removed and disposed of properly as mentioned below.

Do I have a grease trap?

If you are not sure, please contact the Clean Water Services at (503) 681-3600 or the Washington County Public Health Department at (503) 846-8722 for assistance.

Do I need a grease trap?

If you use oil and grease OR you cook greasy food in your establishment and they are washed into the sanitary sewer system, you should have a grease trap or interceptor.

What if I don't install a grease trap?

If you are a restaurant owner and use oil or grease in your food preparation, you will eventually have a maintenance problem with a plugged building sewer line. This blockage can create a sewer backup situation and ultimately a health problem in your restaurant. Someone will have to pay for removing the blockage. If the problem is in your building sewer line, then you will have direct responsibility for paying to remove the blockage or restriction. Contact your local jurisdiction. Their staff will visit your site and assist you in establishing proper grease trap maintenance intervals. If the blockage or restriction is in the public sewer main and it can be proven that you are the cause of the blockage, you are in violation of the Clean Water Act. Enforcement action can be taken and you may also have to pay for the public sewer to be maintained.

What if I don't choose to help?

The rules of the Health Department, Clean Water Services and the Oregon State Plumbing code will assist you in making the correct decision. Oregon State Plumbing Code states that a grease interceptor may be required by the administrative authority. Clean Water Services is the administrative authority in this case, and the District prohibits the discharge of materials that can solidify and create blockage problems in the sewer system or the treatment plants. The Health Department makes periodic inspections to see that no health problems exist due to improperly maintained grease traps. These rules will be enforced if a problem exists.

What is the criteria for grease trap inspections?

All restaurants suspected of causing problems to the collection system or treatment facilities will be inspected. The grease trap shall be inspected using the following criteria: If the trap is in Fair condition, you will be advised that you may need to keep an eye on the maintenance schedule. You may need to increase the cleaning frequency. If a trap is found to be in Poor condition, you will be issued a compliance order to have it cleaned immediately. You will be required to contact the issuing authority within 30 days to have them verify that the grease interceptor has been properly cleaned. It is extremely difficult to formulate exact criteria for sizing grease interceptors because of the many

variables that exist. Where one restaurant may burn grease it has collected, another may use a grill and collect its grease for disposal. No two are operated in a like manner. It is important that the method of operation employed be evaluated prior to determining the size of the grease trap. If you have questions, contact your city sewer maintenance, the Washington County Public Health Department at (503) 846-8722 or Clean Water Services at (503) 846-8931.

How can I be sure I am in compliance with the rules?

Contact your local City Public Works Department, Clean Water Services or the County Health Department. They will inspect your facility and provide technical assistance if necessary.

When and how do I clean a grease trap?

The following procedure is recommended:

All grease traps should be cleaned at least twice each week. Some establishments will find it necessary to clean their traps more often than twice per week. If you are having to clean it too often then maybe you should think about installing a larger trap.

- Bail out any water in the trap to facilitate cleaning.
- Dip the accumulated grease out of the trap. Be sure to scrape the sides and the lid.
- Deposit the grease in a watertight container and have a rendering/tallow company pick it up.

DO NOT...

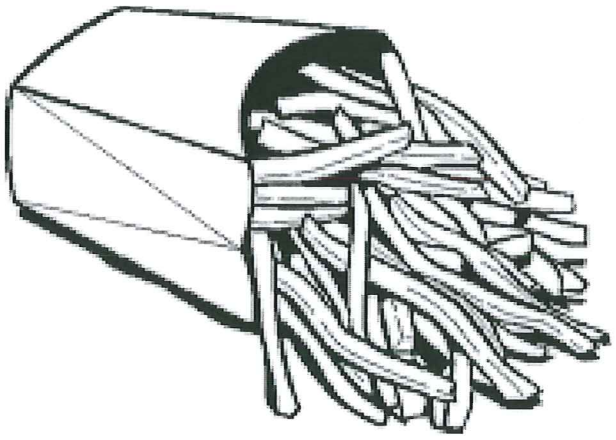
- Flush out the trap with hot water.
- Rely on drain cleaners, enzymes or bacterial agents. They merely soften the grease and transfer the problem down stream.

Remember...

If you have a grease trap, maintain it properly. Work out a specific cleaning schedule right for you and your establishment. All grease traps need to have the separated grease cleaned out periodically and no one likes to do it. It is a dirty job. Running extremely hot water down the sewer drain only moves the problem down stream. It does not go away. Catch the grease at the source to protect public health and the environment!

Preventing Water
Pollution

PROPER HANDLING OF FATS, OILS AND GREASE



WATER POLLUTION PREVENTION TIPS FOR THE FOOD SERVICE INDUSTRY

Prepared by
Oregon Department of
Environmental Quality

Oregon Association of
Clean Water Agencies

and your local sewerage agency

Why Is Water Pollution Prevention Important?

It's in everyone's best interest to reduce the amount of chemicals, hazardous substances and food wastes that flow into the sewer system. It's good for the earth, it's good for our pocketbooks and it's good for our communities.

Oregon's waterways are fragile environmental systems that need our care and protection. Over the last 50 years, local governments and businesses have made tremendous investments in sewage treatment to keep pollution out of lakes, streams and rivers. But just because the facilities are in place doesn't mean we can ignore our responsibilities toward our waterways. It's critical that in homes and businesses we pay attention to the impact of our actions on water quality.

Sanitary Sewers. The fundamental reason we have to be careful about what goes into sanitary sewers is that ***even the best sewage treatment facility has limitations.*** Oregon's sewage treatment systems are designed primarily to handle sanitary or domestic sewage. Bacteria provide "treatment" by breaking down organic matter in the water. We need to remember that:

- Treatment facilities can't treat many chemicals, so the substances may pass untouched into the environment. This may threaten fish, wildlife and vegetation, as well as people using polluted water sources for drinking and recreation.
- Some chemicals can destroy the bacteria in the treatment process – leaving the facility useless. This not only endangers the environment – it means tremendous expense to community ratepayers.

Why Is Water Pollution Prevention Important?

- If the facility receives too much of one type of waste at a time, it will not be able to process the organic matter. Again, this creates environmental hazards, and the community may need to invest in greater treatment capacity.
- Some chemicals in the sewage treatment system put system employees at risk. Exposure to chemicals can cause health problems, and some substances may cause explosions and fires.

How the Food Service Industry can Affect Sanitary Sewer Systems. Every commercial cooking operation produces waste products of fats, oils and grease (FOG). On a small scale, we all know what can happen when heated grease congeals in kitchen pipes – the pipes plug up, blocking passage of liquid and creating unsanitary back-ups into the kitchen.

On a larger scale, the same thing can happen to sewer systems. Most blockages in wastewater collection systems can be traced to FOG. The result can have damaging effects throughout the system, creating sewage spills, manhole overflows or back-ups into homes and businesses. Too much grease and oil also can create the need for increased maintenance of sanitary lines, increasing costs to all customers.

Restaurant personnel often use chemicals during clean-up that can impact the sewage treatment system – and ultimately lakes, streams or rivers. It's always best to reduce chemical use, and make sure those chemicals you do use are friendly to the environment.

Storm Sewers. In most Oregon communities, storm drains flow directly into waterways without passing through a treatment plant. Anything in the storm drain – from leaves to motor oil – can contribute to water pollution.

How the Food Service Industry Can Affect the Storm Water Collection System

Whenever grease or oil receptacles are stored outside, there is a chance of spills or overflows that will be collected by storm drains. Food product contamination in rivers and streams can interfere with the water's nutrient balance and affect the health of vegetation and wildlife.

Cleaning chemicals washed into storm drains can also impact water quality, as can debris from outdoor eating areas. Leaves, grass and motor oil from parking lots can also be washed into the storm drains and have a negative impact on rivers and streams. Grease and oil escaping through the exhaust system will be collected in rain water and carried into the sewers and waterways.

How Can Pollution Prevention Help Businesses' Bottom Line? Many businesses find that taking steps to prevent pollution – including keeping FOG materials out of the sewer system – saves money.

- Keeping FOG out of your drains will reduce the likelihood of grease-related plumbing problems.
- An establishment causing a FOG spill to the storm sewer may be eligible for fines.
- Fats, oils and grease can often be recycled, reducing garbage costs.
- Some agencies will bill a business for excess sewer line maintenance if the agency can trace the source of the problem to that establishment.
- Ultimately, we all pay if we need to build more treatment system capacity. We all save by keeping materials out of the sewer system.

How to Keep FOG out of the Sewer System

1. **Post "No Grease" signs above sinks and in front of dishwashers.** Frequent reminders can help educate employees about the importance of keeping FOG out of sinks and drains.
2. **Dry wipe pots, pans and dishes.** Get as much oil and grease as possible off the cookware before it hits the water. Send it into the trash for disposal in the solid waste system.
3. **Recycle waste cooking oil and other food wastes.** Call your local sewerage agency for businesses in your area that collect and recycle cooking oil.
4. **Use lower water temperatures.** Water over 140 degrees will dissolve grease, sending it down the drain in wastewater. Inevitably, this grease will congeal – either in your pipes or in the public sewer system.
5. **Use a three-sink dishwashing system.** Design a series of sinks for washing, rinsing and sanitizing with a 50-10 ppm. bleach solution. This system allows you to use water temperatures below 140 degrees, lowering your water heating cost, and better controlling the amount of FOG and food wastes that are washed down the drain.
6. **Install and properly maintain grease traps and interceptors.** State and local laws require restaurants to install and maintain grease traps, interceptors or both, depending on the size and type of the food service. Contact your local health department or your local sewerage agency to find out local requirements and to make sure you are in compliance with all regulations.

   Some rules for maintenance are:

   ✓ **Clean undersink grease traps weekly**. If grease traps are more than 50 percent full after one week, increase how frequently you clean the trap. You also may want to consider ways to reduce the amount of FOG reaching the sink drain.

How to Keep FOG out of the Sewer System

- ✓ **Have interceptors cleaned at least twice a year**. It may be necessary to have interceptors cleaned more often. If more frequent cleanings are needed, consider installing a better trap or an interceptor with larger capacity or using other techniques to keep FOG out of the drains.
- ✓ **Make sure maintenance is done correctly**. At least one employee in each facility should be knowledgeable about cleaning procedures for traps and interceptors. That employee should observe maintenance contractors, haulers and recyclers to make sure all procedures are carried out fully and effectively.

7. **Cover any grease and oil storage containers kept outdoors.** Open containers can collect rainwater and overflow, sending grease and oil into the stormwater system and ultimately polluting local waterways.
8. **Keep grease dumpsters and storage containers an adequate distance from storm drains.** The farther away you keep these units from a catch basin, the more time there will be for someone to clean up a spill or leak before it reaches the sewer system.
9. **Use absorbent pads inside storm drains to catch FOG that may leak into the catch basins.** If grease dumpsters or containers are within 20 feet of the catch basin, or if you detect signs of FOG near the basin, line the basin with an absorbent cloth or pad. Do not use materials like kitty litter to absorb grease or oil. This can be washed into the sewer system. Use absorbent pads or clothes to clean up any spills or leaks.

How to Keep FOG out of the Sewer System

10. **Keep kitchen exhaust filters clean.** Grease and oil escaping through the exhaust system can accumulate on the roof, ultimately getting washed into the storm sewers. Establish a routine schedule and a record-keeping system for cleaning exhaust filters. Make sure that wastewater from washing is routed into the interceptor, where oil and grease can be collected before it reaches the sewer system.

11. **Be cautious about outside cleaning**. Do not conduct outside cleaning activities where wastes can flow into storm drains.

12. **Don't throw wastewater down storm drains.** Train employees and contractors to dispose of wastewater appropriately. Water used for mopping, for carpet cleaning and for washing hood filters should be disposed of through the sanitary sewer system – never in storm drains. To protect the municipal treatment system, limit cleaning chemicals and use the least hazardous products available.

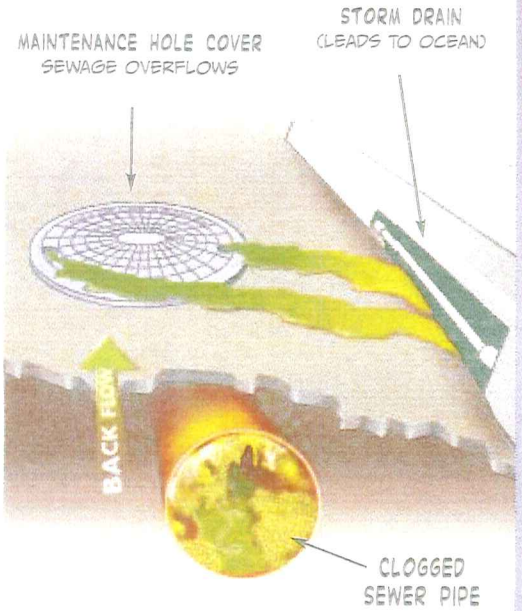
For More Information . . .

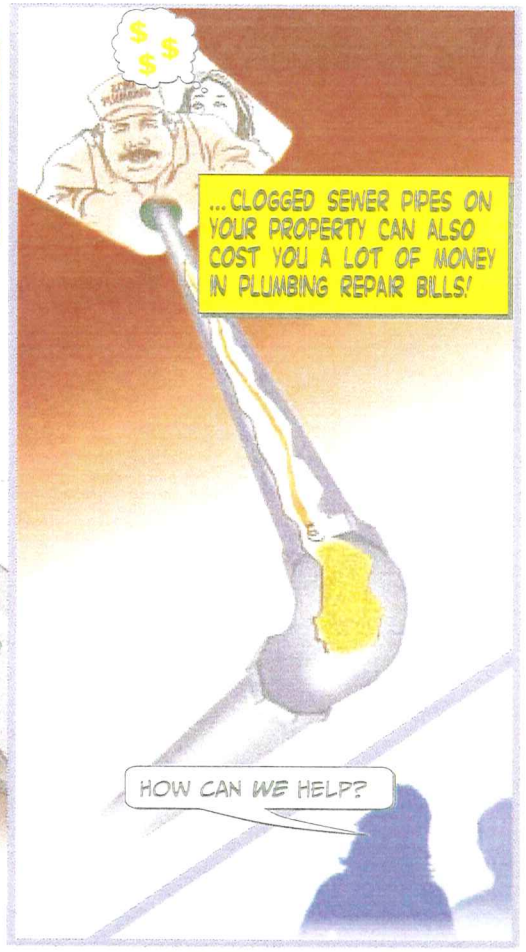
See "Fats, Oil and Grease Best Management Practices Manual" - available on the Internet at *www.oracwa.org.*

For more information contact your local sewerage agency at...

GREASE CAN BUILD UP IN SEWERS, RESTRICTING THE FLOW OF THE WASTEWATER THAT COMES FROM OUR HOMES.

THIS BLOCKAGE FORCES THE WASTEWATER UP ONTO OUR STREETS—WHERE IT THEN ENTERS THE STORM DRAIN SYSTEM. AND...





REMEMBER...

- USE BASKETS OR STRAINERS IN SINK DRAINS TO CATCH FOOD SCRAPS AND OTHER SOLIDS...
- SCRAPE GREASE AND FOOD SCRAPS FROM PLATES, POTS AND PANS, UTENSILS AND GRILLS...
- FREEZE ANIMAL FATS IN A CAN AND PUT ALL FOOD WASTE AND DISCARDS IN A TRASH CONTAINER—*DON'T* POUR THEM DOWN THE SINK, GARBAGE DISPOSAL OR TOILET...
- GARBAGE DISPOSALS USE LARGE VOLUMES OF WATER AND ELECTRICITY—REDUCING OR ELIMINATING THEIR USE WILL LOWER YOUR SEWER, WATER AND POWER BILLS...
- BE CAUTIOUS OF CHEMICALS OR ADDITIVES THAT CLAIM TO DISSOLVE GREASE—THESE MAY NOT BE EFFECTIVE

KEEP FATS, OIL AND GREASE OUT OF THE SEWERS—AND HELP KEEP OUR ENVIRONMENT CLEAN!

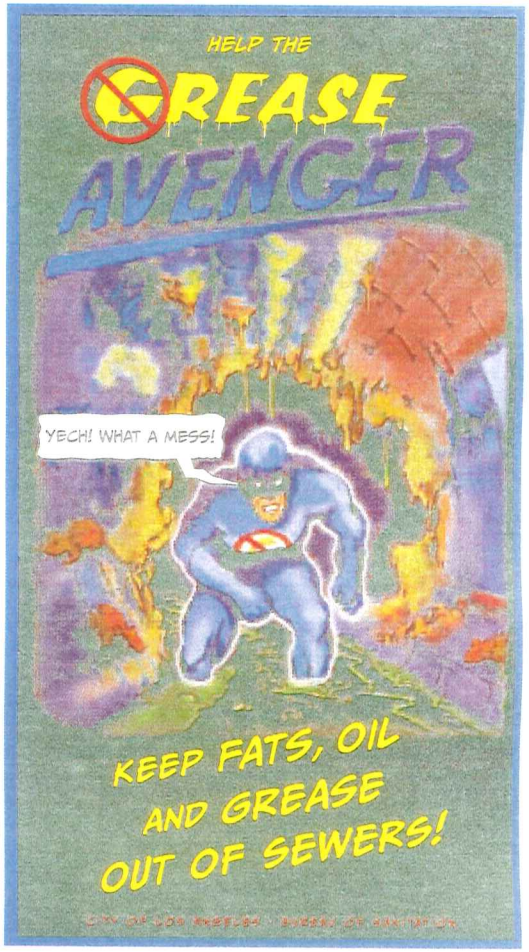
REPORT PROBLEMS WITH THE CITY'S SEWER SYSTEM TO THE WASTEWATER COLLECTION SYSTEMS DIVISION:

(213) 485-7575

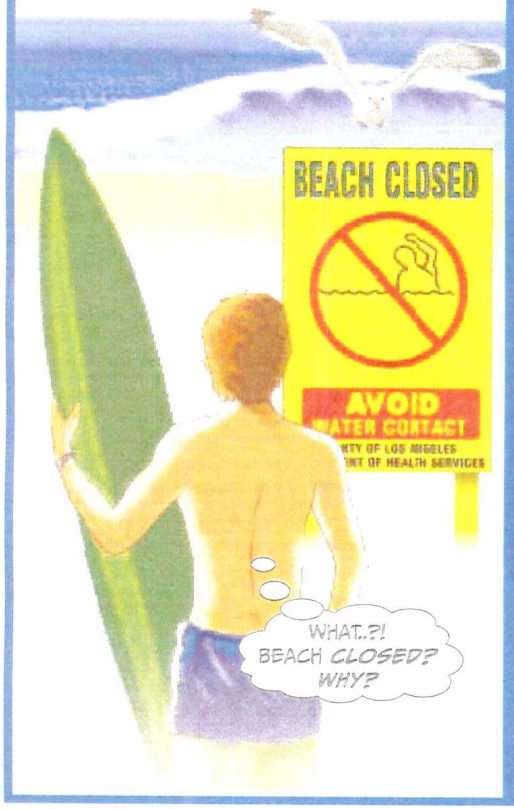
WEB SITE:
WWW.LACITY.ORG/SAN

PRODUCED BY:
CITY OF LOS ANGELES
DEPT. OF PUBLIC WORKS
BUREAU OF SANITATION

ARTWORK:
OSCAR AMARO



ONE MORNING AT THE BEACH...



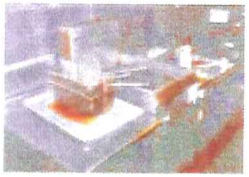
YEAH, DUDE! I HEARD THERE WAS A SEWAGE SPILL!

A WHAT? HOW DOES THAT HAPPEN?

SUDDENLY, OUT OF THE SKY APPEARS...

SEE THAT? EVERY DAY, MILLIONS OF PEOPLE THROUGHOUT THE CITY POUR FATS, OIL AND COOKING GREASE DOWN KITCHEN SINKS. THIS CREATES A LOT OF PROBLEMS, SUCH AS...

Fats, Oils and Grease CLOG THE SEWERS!



Sewage backups and overflows are typically the result of grease buildup which can cause property damage, environmental problems and other health hazards.

Fats, oils and grease get into the sewers mainly from commercial food preparation establishments that do not have adequate grease control measures in place such as grease interceptors.

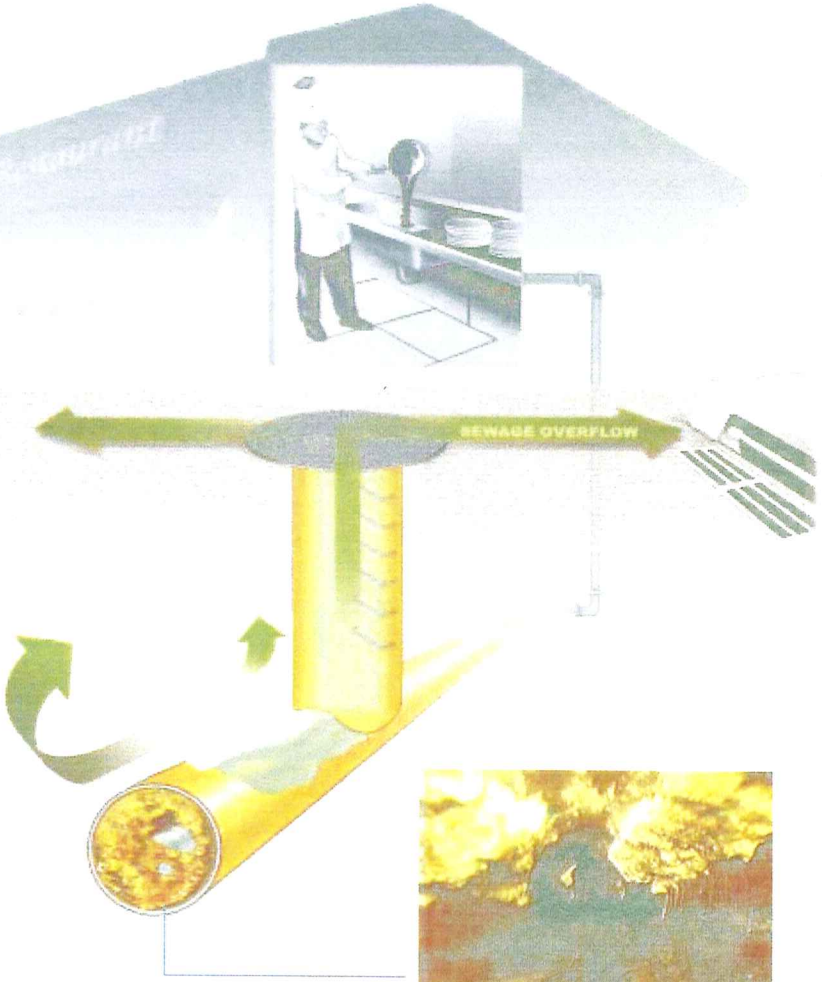
Most grease is the byproduct of cooking and is usually found in such things as:

- Food scraps
- Meat fats
- Lard
- Cooking oil
- Butter and margarine
- Baking goods
- Sauces
- Dairy products

All too often, fats, oils and grease are washed into the plumbing system, (usually through kitchen sinks and floor drains found in food preparation areas) and stick to the insides of sewer pipes both on your property and in the streets.

Over time, fats, oils and grease builds up and eventually **blocks the entire pipe** causing sewage backups and overflows.

From Sinks...



...to Sewers

Actual photo taken by remote controlled camera showing grease buildup in sewer pipe interior.

COSTS:

To Your Business:

As your sewer pipes back up, sewage and food particles that accumulate can attract insects and other vermin and may create potential health hazards.

Property damage can result from sewage backups leading to expensive cleanup and plumbing repairs that may have to be paid for by you.

Health code violations or closures can greatly impact your business operations.

To the Environment:

Clogged sewers can lead to overflows.

As sewage overflows onto streets, it enters the storm drain system...

...where the sewage is then carried to our local beaches, creating a health risk for swimmers, marine life—and causing beach closures.

To the City:

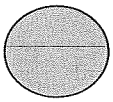
Increased sewer blockages and overflows lead to excessive and costly maintenance and can result in severe fines from the regulatory agencies.

This can increase your sewer fees.

Appendix D

Gravity Piping Capacity Worksheets

MANNING EQUATION FOR PIPE FLOW



→	Depth of flow?	7.99 *inches*
→	Pipe diameter?	8 *inches*

phi=	6.142 *radians*	351.90 *degrees*
Wetted Perimeter=	24.567 *inches*	2.047 *feet*
Area=	50.262 *in^2*	0.349 *feet^2*
Hyd. Radius=	2.046 *inches*	0.170 *feet*

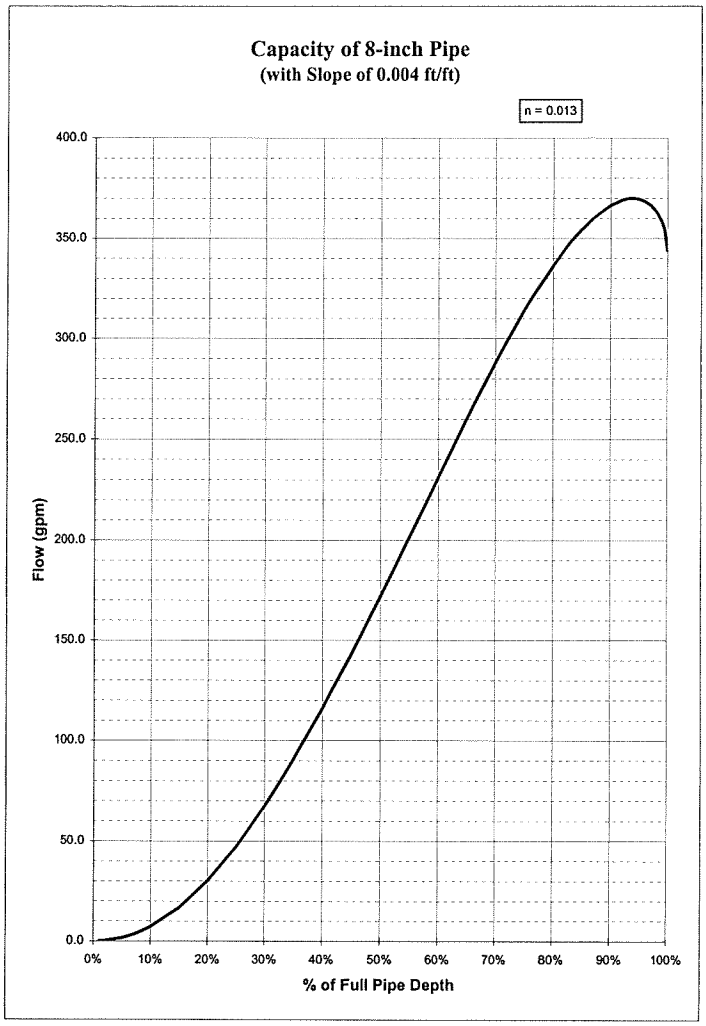
→	Slope ?	0.004
→	n ?	0.013

Velocity=	2.229 *fps*	
Flow=	0.778 *cfs*	349.168 *gpm*

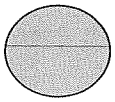
Table Below Assumes Constant Value for "n"

% full	depth (in)	phi (rad)	P (in)	A (in^2)	Rh (in)	Q (cfs)	Q (gpm)	Q (mgd)
1%	0.08	0.401	1.603	0.085	0.053	0.000	0.1	0.0001
2%	0.16	0.568	2.270	0.240	0.106	0.001	0.2	0.0003
5%	0.40	0.902	3.608	0.940	0.260	0.004	1.7	0.0024
7%	0.56	1.071	4.284	1.547	0.361	0.008	3.4	0.0049
8%	0.64	1.147	4.588	1.884	0.411	0.010	4.5	0.0065
10%	0.80	1.287	5.148	2.616	0.508	0.016	7.2	0.0103
15%	1.20	1.591	6.363	4.728	0.743	0.037	16.7	0.0241
20%	1.60	1.855	7.418	7.157	0.965	0.067	30.1	0.0434
25%	2.00	2.094	8.378	9.827	1.173	0.105	47.1	0.0678
30%	2.40	2.319	9.274	12.683	1.368	0.150	67.4	0.0970
35%	2.80	2.532	10.129	15.679	1.548	0.201	90.4	0.1302
40%	3.20	2.739	10.956	18.776	1.714	0.258	115.9	0.1669
45%	3.60	2.941	11.765	21.938	1.865	0.319	143.3	0.2063
50%	4.00	3.142	12.566	25.133	2.000	0.383	172.0	0.2476
55%	4.40	3.342	13.368	28.327	2.119	0.449	201.5	0.2901
60%	4.80	3.544	14.177	31.490	2.221	0.515	231.1	0.3328
65%	5.20	3.751	15.004	34.587	2.305	0.580	260.2	0.3746
70%	5.60	3.965	15.859	37.583	2.370	0.642	288.0	0.4147
75%	6.00	4.189	16.755	40.439	2.413	0.699	313.6	0.4516
80%	6.40	4.429	17.714	43.109	2.434	0.749	336.2	0.4841
83%	6.64	4.583	18.333	44.599	2.433	0.775	347.7	0.5008
85%	6.80	4.692	18.770	45.538	2.426	0.790	354.4	0.5104
87%	6.96	4.808	19.231	46.426	2.414	0.802	360.1	0.5186
90%	7.20	4.996	19.985	47.649	2.384	0.817	366.6	0.5279
92%	7.36	5.136	20.545	48.382	2.355	0.822	369.2	0.5316
93%	7.44	5.212	20.849	48.719	2.337	0.824	369.8	0.5325
94%	**7.52**	**5.293**	**21.173**	**49.034**	**2.316**	**0.824**	**370.0**	**0.5328**
95%	7.60	5.381	21.525	49.326	2.292	0.823	369.6	0.5322
96%	7.68	5.478	21.911	49.591	2.263	0.821	368.5	0.5306
97%	7.76	5.587	22.347	49.826	2.230	0.817	366.6	0.5279
98%	7.84	5.716	22.862	50.026	2.188	0.810	363.5	0.5234
99%	7.92	5.883	23.530	50.180	2.133	0.798	358.4	0.5161
99.5%	7.96	6.000	24.000	50.235	2.093	0.789	354.3	0.5102
100%	8.00	6.283	25.133	50.265	2.000	0.766	344.0	0.4953

Channel Surface	*n*
Smooth Steel Surface	0.012
Corrugated Metal	0.024
Smooth Concrete	0.011
Concrete Culvert (with connection)	0.013
Glazed Brick	0.013
Earth Excavation, clean	0.022
Natural Stream Bed, clean, straight	0.03
Smooth Rock Cuts	0.035
Channels Not Maintained	0.05-0.1
Clean, coated cast iron	0.012-0.013
dirty, tuberculated cast iron	0.015-0.035



MANNING EQUATION FOR PIPE FLOW



→ Depth of flow?	9.99 *inches*	
→ Pipe diameter?	10 *inches*	
phi=	6.157 *radians*	352.75 *degrees*
Wetted Perimeter=	30.783 *inches*	2.565 *feet*
Area=	78.536 *in^2*	0.545 *feet^2*
Hyd. Radius=	2.551 *inches*	0.213 *feet*
→ Slope ?	0.0028	
→ n ?	0.013	
Velocity=	2.160 *fps*	
Flow=	1.178 *cfs*	528.837 *gpm*

Table Below Assumes Constant Value for "n"

% full	depth (in)	phi (rad)	P (in)	A (in^2)	Rh (in)	Q (cfs)	Q (gpm)	Q (mgd)
1%	0.10	0.401	2.003	0.133	0.066	0.000	0.1	0.0001
2%	0.20	0.568	2.838	0.375	0.132	0.001	0.4	0.0005
5%	0.50	0.902	4.510	1.468	0.326	0.006	2.5	0.0036
7%	0.70	1.071	5.355	2.417	0.451	0.011	5.1	0.0074
8%	0.80	1.147	5.735	2.944	0.513	0.015	6.8	0.0098
10%	1.00	1.287	6.435	4.088	0.635	0.024	10.9	0.0157
15%	1.50	1.591	7.954	7.387	0.929	0.057	25.4	0.0365
20%	2.00	1.855	9.273	11.182	1.206	0.102	45.7	0.0658
25%	2.50	2.094	10.472	15.355	1.466	0.159	71.5	0.1029
30%	3.00	2.319	11.593	19.817	1.709	0.228	102.2	0.1471
35%	3.50	2.532	12.661	24.498	1.935	0.306	137.2	0.1976
40%	4.00	2.739	13.694	29.337	2.142	0.392	175.8	0.2532
45%	4.50	2.941	14.706	34.278	2.331	0.484	217.3	0.3130
50%	5.00	3.142	15.708	39.270	2.500	0.581	260.9	0.3757
55%	5.50	3.342	16.710	44.262	2.649	0.681	305.6	0.4401
60%	6.00	3.544	17.722	49.203	2.776	0.781	350.5	0.5048
65%	6.50	3.751	18.755	54.042	2.881	0.879	394.7	0.5683
70%	7.00	3.965	19.823	58.723	2.962	0.973	436.8	0.6290
75%	7.50	4.189	20.944	63.185	3.017	1.060	475.8	0.6851
80%	8.00	4.429	22.143	67.357	3.042	1.136	510.0	0.7344
83%	8.30	4.583	22.916	69.686	3.041	1.175	527.5	0.7596
85%	8.50	4.692	23.462	71.152	3.033	1.198	537.6	0.7742
87%	8.70	4.808	24.039	72.540	3.018	1.217	546.3	0.7867
90%	9.00	4.996	24.981	74.452	2.980	1.239	556.1	0.8008
92%	9.20	5.136	25.681	75.596	2.944	1.248	560.0	0.8064
93%	9.30	5.212	26.061	76.123	2.921	1.250	561.0	0.8078
94%	**9.40**	**5.293**	**26.467**	**76.616**	**2.895**	**1.250**	**561.2**	**0.8082**
95%	9.50	5.381	26.906	77.072	2.865	1.249	560.6	0.8073
96%	9.60	5.478	27.389	77.486	2.829	1.245	559.0	0.8050
97%	9.70	5.587	27.934	77.853	2.787	1.239	556.1	0.8007
98%	9.80	5.716	28.578	78.165	2.735	1.228	551.3	0.7939
99%	9.90	5.883	29.413	78.407	2.666	1.211	543.7	0.7829
99.5%	9.95	6.000	30.001	78.493	2.616	1.198	537.5	0.7740
100%	10.00	6.283	31.416	78.540	2.500	1.162	521.8	0.7513

Channel Surface	*n*
Smooth Steel Surface	0.012
Corrugated Metal	0.024
Smooth Concrete	0.011
Concrete Culvert (with connection)	0.013
Glazed Brick	0.013
Earth Excavation, clean	0.022
Natural Stream Bed, clean, straight	0.03
Smooth Rock Cuts	0.035
Channels Not Maintained	0.05-0.1
Clean, coated cast iron	0.012-0.013
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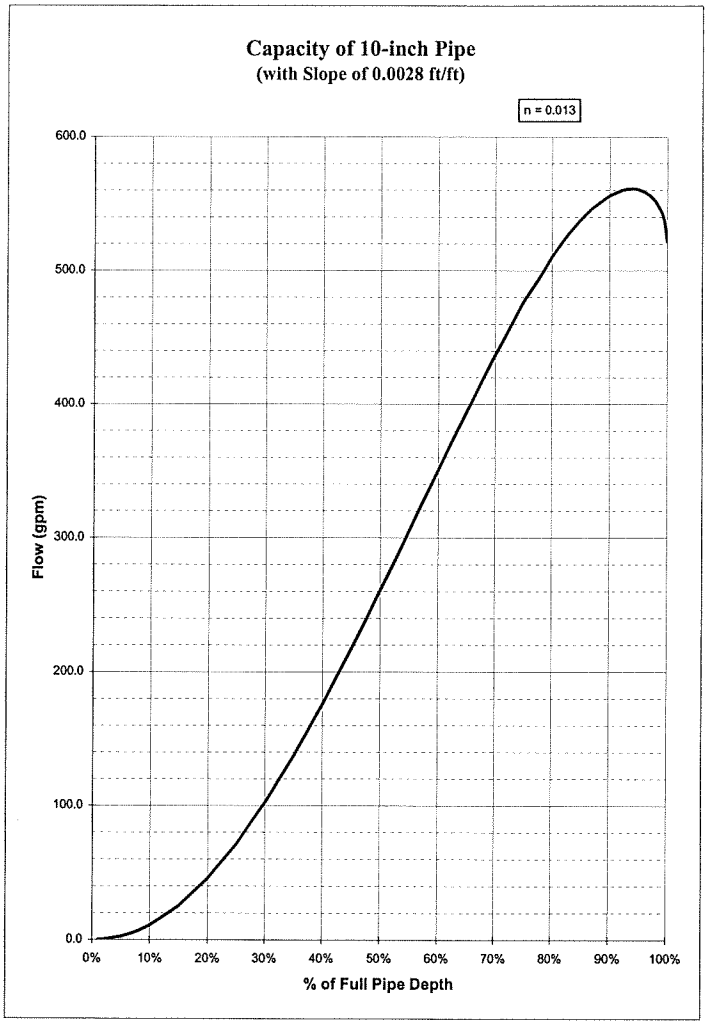
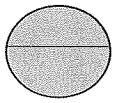


MANNING EQUATION FOR PIPE FLOW



→ Depth of flow?	11.99 *inches*	
→ Pipe diameter?	12 *inches*	

phi=	6.168 *radians*	353.38 *degrees*
Wetted Perimeter=	37.006 *inches*	3.084 *feet*
Area=	113.093 *in^2*	0.785 *feet^2*
Hyd. Radius=	3.056 *inches*	0.255 *feet*

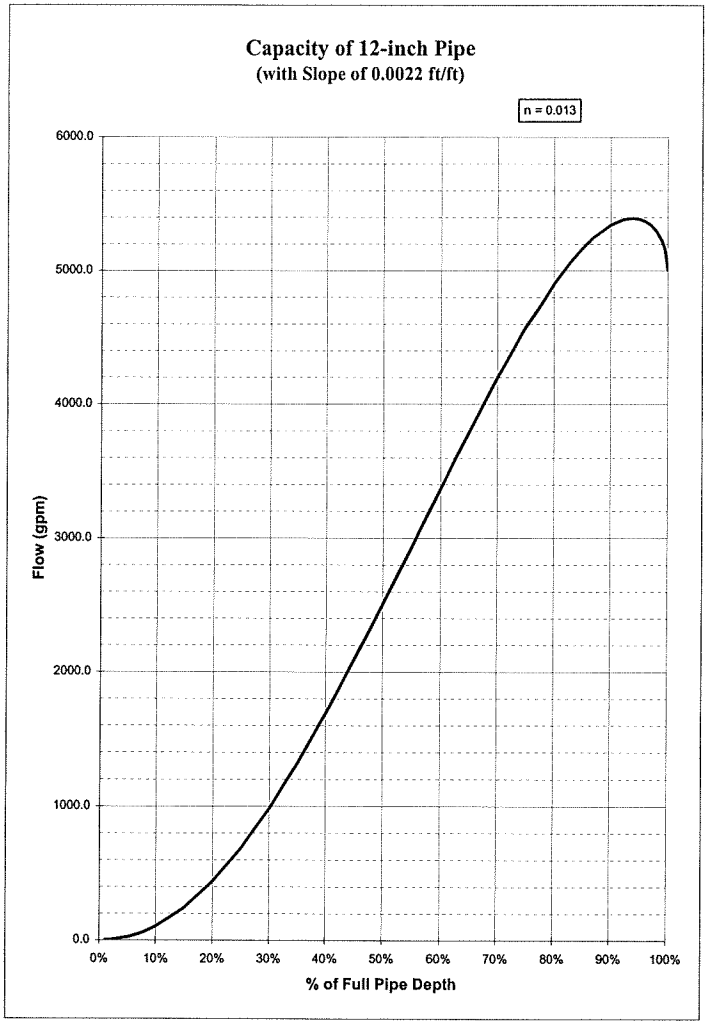
→ Slope ?	0.0028	
→ n ?	0.0022	

Velocity=	14.399 *fps*	
Flow=	11.308 *cfs*	5075.557 *gpm*

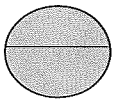
Table Below Assumes Constant Value for "n"

% full	depth (in)	phi (rad)	P (in)	A (in^2)	Rh (in)	Q (cfs)	Q (gpm)	Q (mgd)
1%	0.12	0.401	2.404	0.191	0.080	0.002	0.8	0.0011
2%	0.24	0.568	3.406	0.540	0.159	0.008	3.4	0.0049
5%	0.60	0.902	5.412	2.114	0.391	0.054	24.1	0.0347
7%	0.84	1.071	6.426	3.480	0.542	0.110	49.3	0.0710
8%	0.96	1.147	6.882	4.239	0.616	0.146	65.4	0.0942
10%	1.20	1.287	7.722	5.886	0.762	0.233	104.7	0.1507
15%	1.80	1.591	9.545	10.638	1.115	0.543	243.7	0.3509
20%	2.40	1.855	11.128	16.103	1.447	0.978	439.0	0.6322
25%	3.00	2.094	12.566	22.111	1.760	1.530	686.8	0.9889
30%	3.60	2.319	13.911	28.536	2.051	2.187	981.8	1.4138
35%	4.20	2.532	15.193	35.277	2.322	2.937	1318.3	1.8983
40%	4.80	2.739	16.433	42.245	2.571	3.764	1689.5	2.4329
45%	5.40	2.941	17.648	49.361	2.797	4.653	2088.3	3.0071
50%	6.00	3.142	18.850	56.549	3.000	5.585	2506.8	3.6097
55%	6.60	3.342	20.052	63.737	3.179	6.542	2936.5	4.2285
60%	7.20	3.544	21.266	70.852	3.332	7.505	3368.3	4.8503
65%	7.80	3.751	22.506	77.820	3.458	8.449	3792.3	5.4609
70%	8.40	3.965	23.788	84.561	3.555	9.352	4197.5	6.0444
75%	9.00	4.189	25.133	90.987	3.620	10.186	4571.7	6.5833
80%	9.60	4.429	26.572	96.995	3.650	10.918	4900.5	7.0568
83%	9.96	4.583	27.499	100.348	3.649	11.293	5068.9	7.2991
85%	10.20	4.692	28.154	102.459	3.639	11.510	5166.1	7.4392
87%	10.44	4.808	28.846	104.457	3.621	11.696	5249.4	7.5592
90%	10.80	4.996	29.977	107.211	3.576	11.905	5343.4	7.6945
92%	11.04	5.136	30.817	108.859	3.532	11.989	5380.9	7.7485
93%	11.16	5.212	31.273	109.617	3.505	12.010	5390.5	7.7623
94%	**11.28**	**5.293**	**31.760**	**110.327**	**3.474**	**12.016**	**5392.9**	**7.7658**
95%	11.40	5.381	32.287	110.983	3.437	12.002	5387.1	7.7574
96%	11.52	5.478	32.867	111.580	3.395	11.967	5371.3	7.7347
97%	11.64	5.587	33.521	112.109	3.344	11.905	5343.1	7.6941
98%	11.76	5.716	34.294	112.558	3.282	11.803	5297.7	7.6288
99%	11.88	5.883	35.295	112.906	3.199	11.639	5223.9	7.5224
99.5%	11.94	6.000	36.001	113.030	3.140	11.507	5164.8	7.4373
100%	12.00	6.283	37.699	113.097	3.000	11.170	5013.5	7.2195

Channel Surface	*n*
Smooth Steel Surface	0.012
Corrugated Metal	0.024
Smooth Concrete	0.011
Concrete Culvert (with connection)	0.013
Glazed Brick	0.013
Earth Excavation, clean	0.022
Natural Stream Bed, clean, straight	0.03
Smooth Rock Cuts	0.035
Channels Not Maintained	0.05-0.1
Clean, coated cast iron	0.012-0.013
dirty, tuberculated cast iron	0.015-0.035



MANNING EQUATION FOR PIPE FLOW



→ Depth of flow?	13.99 *inches*	
→ Pipe diameter?	14 *inches*	
phi=	6.176 *radians*	353.87 *degrees*
Wetted Perimeter=	43.234 *inches*	3.603 *feet*
Area=	153.933 *in^2*	1.069 *feet^2*
Hyd. Radius=	3.560 *inches*	0.297 *feet*
→ Slope ?	0.002	
→ n ?	0.013	
Velocity=	2.280 *fps*	
Flow=	2.438 *cfs*	1094.027 *gpm*

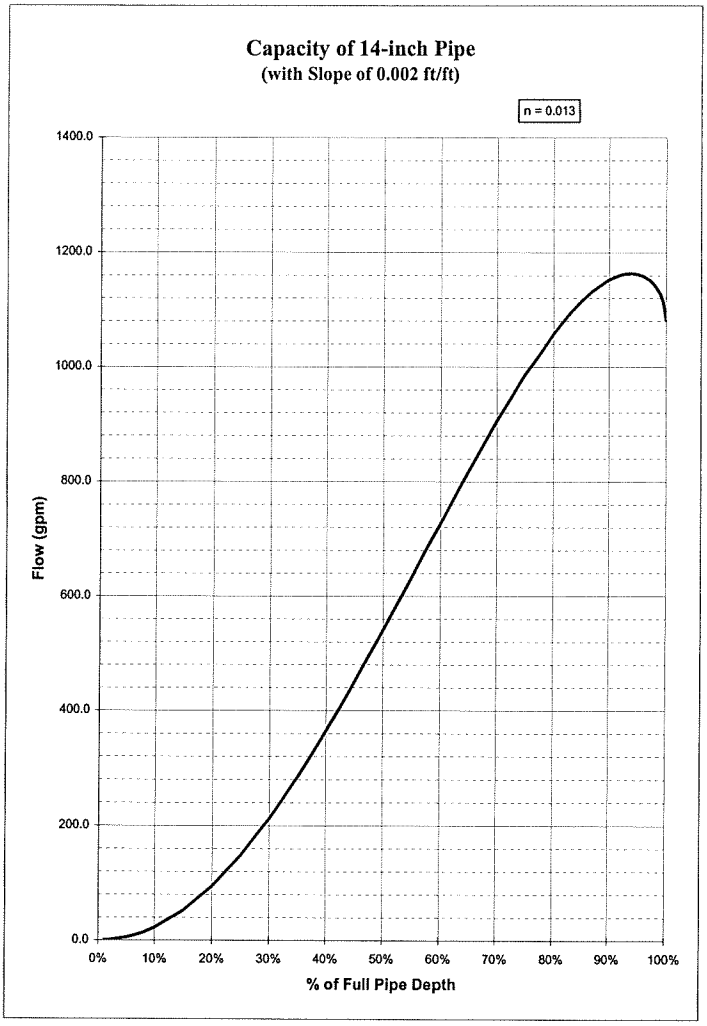
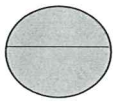


Table Below Assumes Constant Value for "n"

% full	depth (in)	phi (rad)	P (in)	A (in^2)	Rh (in)	Q (cfs)	Q (gpm)	Q (mgd)
1%	0.14	0.401	2.805	0.261	0.093	0.000	0.2	0.0002
2%	0.28	0.568	3.973	0.735	0.185	0.002	0.7	0.0010
5%	0.70	0.902	6.314	2.878	0.456	0.012	5.2	0.0075
7%	0.98	1.071	7.497	4.737	0.632	0.024	10.6	0.0153
8%	1.12	1.147	8.029	5.769	0.719	0.031	14.1	0.0203
10%	1.40	1.287	9.009	8.012	0.889	0.050	22.6	0.0325
15%	2.10	1.591	11.136	14.479	1.300	0.117	52.6	0.0757
20%	2.80	1.855	12.982	21.917	1.688	0.211	94.7	0.1364
25%	3.50	2.094	14.661	30.095	2.053	0.330	148.2	0.2134
30%	4.20	2.319	16.230	38.841	2.393	0.472	211.8	0.3050
35%	4.90	2.532	17.725	48.016	2.709	0.634	284.4	0.4095
40%	5.60	2.739	19.172	57.500	2.999	0.812	364.5	0.5249
45%	6.30	2.941	20.589	67.185	3.263	1.004	450.5	0.6488
50%	7.00	3.142	21.991	76.969	3.500	1.205	540.8	0.7788
55%	7.70	3.342	23.393	86.753	3.708	1.412	633.5	0.9123
60%	8.40	3.544	24.810	96.438	3.887	1.619	726.7	1.0464
65%	9.10	3.751	26.257	105.922	4.034	1.823	818.2	1.1782
70%	9.80	3.965	27.752	115.097	4.147	2.018	905.6	1.3040
75%	10.50	4.189	29.322	123.843	4.224	2.198	986.3	1.4203
80%	11.20	4.429	31.000	132.021	4.259	2.356	1057.3	1.5225
83%	11.62	4.583	32.083	136.585	4.257	2.437	1093.6	1.5748
85%	11.90	4.692	32.847	139.459	4.246	2.483	1114.6	1.6050
87%	12.18	4.808	33.654	142.178	4.225	2.523	1132.5	1.6309
90%	12.60	4.996	34.973	145.926	4.173	2.568	1152.8	1.6600
92%	12.88	5.136	35.953	148.169	4.121	2.586	1160.9	1.6717
93%	13.02	5.212	36.485	149.201	4.089	2.591	1163.0	1.6747
94%	**13.16**	**5.293**	**37.053**	**150.167**	**4.053**	**2.592**	**1163.5**	**1.6754**
95%	13.30	5.381	37.668	151.060	4.010	2.589	1162.2	1.6736
96%	13.44	5.478	38.344	151.873	3.961	2.582	1158.8	1.6687
97%	13.58	5.587	39.108	152.592	3.902	2.568	1152.8	1.6600
98%	13.72	5.716	40.009	153.203	3.829	2.547	1143.0	1.6459
99%	13.86	5.883	41.178	153.677	3.732	2.511	1127.0	1.6229
99.5%	13.93	6.000	42.001	153.846	3.663	2.483	1114.3	1.6046
100%	14.00	6.283	43.982	153.938	3.500	2.410	1081.6	1.5576

Channel Surface	*n*
Smooth Steel Surface	0.012
Corrugated Metal	0.024
Smooth Concrete	0.011
Concrete Culvert (with connection)	0.013
Glazed Brick	0.013
Earth Excavation, clean	0.022
Natural Stream Bed, clean, straight	0.03
Smooth Rock Cuts	0.035
Channels Not Maintained	0.05-0.1
Clean, coated cast iron	0.012-0.013
dirty, tuberculated cast iron	0.015-0.035

MANNING EQUATION FOR PIPE FLOW



→ Depth of flow?	14.99 *inches*	
→ Pipe diameter?	15 *inches*	
phi=	6.180 *radians*	354.08 *degrees*
Wetted Perimeter=	46.349 *inches*	3.862 *feet*
Area=	176.709 *in^2*	1.227 *feet^2*
Hyd. Radius=	3.813 *inches*	0.318 *feet*
→ Slope ?	0.002	
→ n ?	0.013	
Velocity=	2.387 *fps*	
Flow=	2.929 *cfs*	1314.505 *gpm*

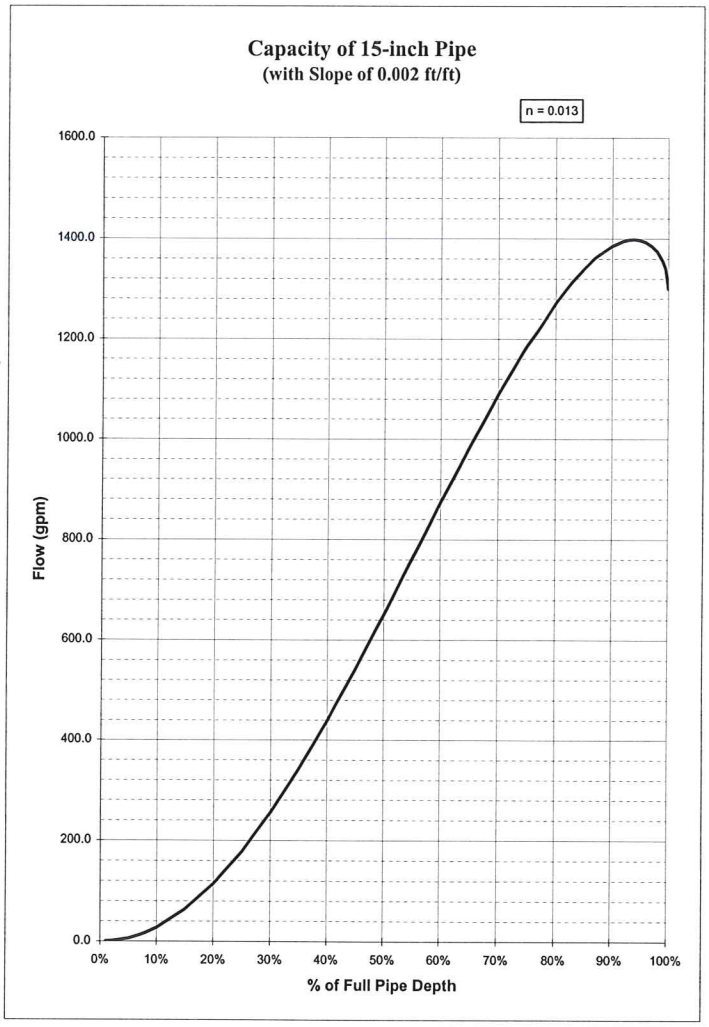
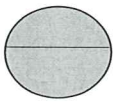


Table Below Assumes Constant Value for "n"

% full	depth (in)	phi (rad)	P (in)	A (in^2)	Rh (in)	Q (cfs)	Q (gpm)	Q (mgd)
1%	0.15	0.401	3.005	0.299	0.100	0.000	0.2	0.0003
2%	0.30	0.568	4.257	0.843	0.198	0.002	0.9	0.0013
5%	0.75	0.902	6.765	3.303	0.488	0.014	6.2	0.0090
7%	1.05	1.071	8.033	5.438	0.677	0.028	12.8	0.0184
8%	1.20	1.147	8.603	6.623	0.770	0.038	17.0	0.0244
10%	1.50	1.287	9.653	9.197	0.953	0.060	27.1	0.0391
15%	2.25	1.591	11.931	16.622	1.393	0.141	63.2	0.0910
20%	3.00	1.855	13.909	25.160	1.809	0.254	113.9	0.1639
25%	3.75	2.094	15.708	34.548	2.199	0.397	178.1	0.2565
30%	4.50	2.319	17.389	44.588	2.564	0.567	254.6	0.3666
35%	5.25	2.532	18.992	55.121	2.902	0.762	341.9	0.4923
40%	6.00	2.739	20.542	66.008	3.213	0.976	438.1	0.6309
45%	6.75	2.941	22.059	77.126	3.496	1.207	541.5	0.7798
50%	7.50	3.142	23.562	88.357	3.750	1.448	650.1	0.9361
55%	8.25	3.342	25.064	99.589	3.973	1.697	761.5	1.0966
60%	9.00	3.544	26.582	110.706	4.165	1.946	873.5	1.2578
65%	9.75	3.751	28.132	121.594	4.322	2.191	983.4	1.4161
70%	10.50	3.965	29.735	132.127	4.444	2.425	1088.5	1.5675
75%	11.25	4.189	31.416	142.167	4.525	2.641	1185.6	1.7072
80%	12.00	4.429	33.214	151.554	4.563	2.831	1270.8	1.8300
83%	12.45	4.583	34.374	156.794	4.561	2.929	1314.5	1.8928
85%	12.75	4.692	35.193	160.093	4.549	2.985	1339.7	1.9292
87%	13.05	4.808	36.058	163.215	4.526	3.033	1361.3	1.9603
90%	13.50	4.996	37.471	167.518	4.471	3.087	1385.7	1.9954
92%	13.80	5.136	38.521	170.092	4.416	3.109	1395.4	2.0094
93%	13.95	5.212	39.091	171.277	4.381	3.114	1397.9	2.0129
94%	**14.10**	**5.293**	**39.700**	**172.386**	**4.342**	**3.116**	**1398.5**	**2.0139**
95%	14.25	5.381	40.358	173.411	4.297	3.113	1397.0	2.0117
96%	14.40	5.478	41.083	174.344	4.244	3.103	1392.9	2.0058
97%	14.55	5.587	41.901	175.170	4.181	3.087	1385.6	1.9953
98%	14.70	5.716	42.867	175.871	4.103	3.061	1373.8	1.9783
99%	14.85	5.883	44.119	176.415	3.999	3.018	1354.7	1.9507
99.5%	14.93	6.000	45.001	176.609	3.925	2.984	1339.4	1.9287
100%	15.00	6.283	47.124	176.715	3.750	2.897	1300.1	1.8722

Channel Surface	*n*
Smooth Steel Surface	0.012
Corrugated Metal	0.024
Smooth Concrete	0.011
Concrete Culvert (with connection)	0.013
Glazed Brick	0.013
Earth Excavation, clean	0.022
Natural Stream Bed, clean, straight	0.03
Smooth Rock Cuts	0.035
Channels Not Maintained	0.05-0.1
Clean, coated cast iron	0.012-0.013
dirty, tuberculated cast iron	0.015-0.035

MANNING EQUATION FOR PIPE FLOW



→ Depth of flow?	17.99 *inches*	
→ Pipe diameter?	18 *inches*	
phi=	6.189 *radians*	354.60 *degrees*
Wetted Perimeter=	55.700 *inches*	4.642 *feet*
Area=	254.463 *in^2*	1.767 *feet^2*
Hyd. Radius=	4.568 *inches*	0.381 *feet*
→ Slope ?	0.002	
→ n ?	0.013	
Velocity=	2.692 *fps*	
Flow=	4.758 *cfs*	2135.482 *gpm*

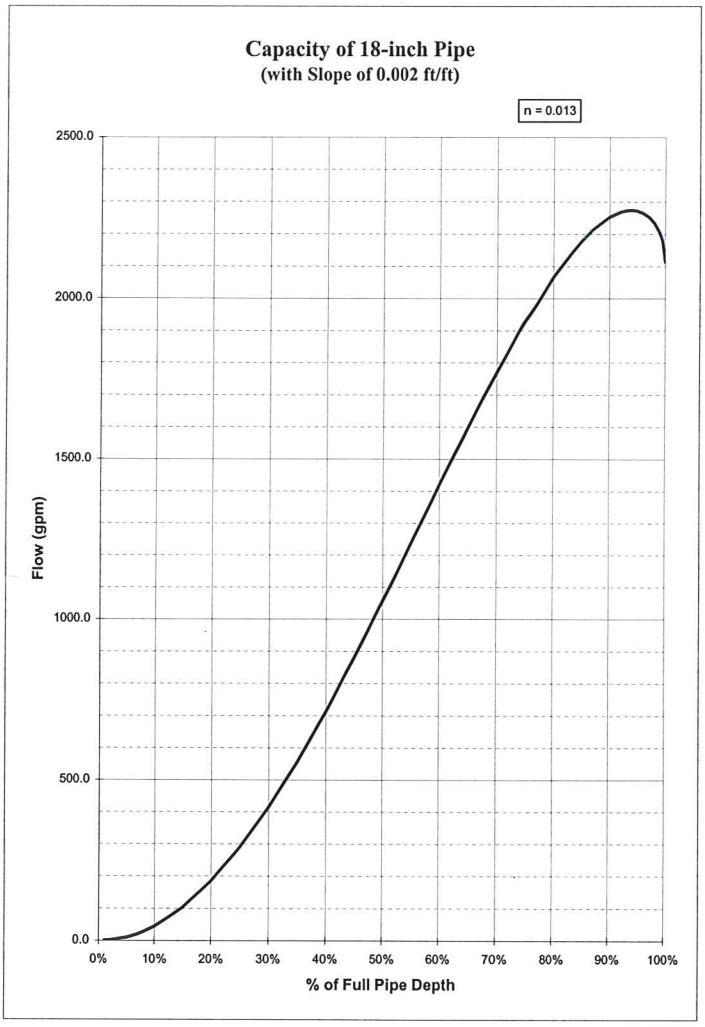
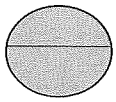


Table Below Assumes Constant Value for "n"

% full	depth (in)	phi (rad)	P (in)	A (in^2)	Rh (in)	Q (cfs)	Q (gpm)	Q (mgd)
1%	0.18	0.401	3.606	0.431	0.119	0.001	0.3	0.0005
2%	0.36	0.568	5.108	1.215	0.238	0.003	1.4	0.0020
5%	0.90	0.902	8.118	4.757	0.586	0.023	10.2	0.0146
7%	1.26	1.071	9.639	7.831	0.812	0.046	20.8	0.0299
8%	1.44	1.147	10.323	9.537	0.924	0.061	27.6	0.0397
10%	1.80	1.287	11.583	13.244	1.143	0.098	44.1	0.0636
15%	2.70	1.591	14.317	23.935	1.672	0.229	102.8	0.1480
20%	3.60	1.855	16.691	36.231	2.171	0.412	185.1	0.2666
25%	4.50	2.094	18.850	49.749	2.639	0.645	289.6	0.4170
30%	5.40	2.319	20.867	64.207	3.077	0.922	414.0	0.5962
35%	6.30	2.532	22.790	79.374	3.483	1.239	555.9	0.8005
40%	7.20	2.739	24.650	95.052	3.856	1.587	712.4	1.0259
45%	8.10	2.941	26.471	111.062	4.196	1.962	880.6	1.2681
50%	9.00	3.142	28.274	127.235	4.500	2.355	1057.1	1.5222
55%	9.90	3.342	30.077	143.407	4.768	2.759	1238.3	1.7831
60%	10.80	3.544	31.899	159.417	4.998	3.165	1420.4	2.0453
65%	11.70	3.751	33.759	175.095	5.187	3.563	1599.2	2.3028
70%	12.60	3.965	35.682	190.262	5.332	3.944	1770.0	2.5489
75%	13.50	4.189	37.699	204.720	5.430	4.295	1927.8	2.7761
80%	14.40	4.429	39.857	218.238	5.475	4.604	2066.5	2.9758
83%	14.94	4.583	41.249	225.783	5.474	4.762	2137.5	3.0780
85%	15.30	4.692	42.231	230.534	5.459	4.854	2178.5	3.1370
87%	15.66	4.808	43.270	235.029	5.432	4.932	2213.6	3.1876
90%	16.20	4.996	44.966	241.225	5.365	5.020	2253.2	3.2447
92%	16.56	5.136	46.225	244.932	5.299	5.055	2269.1	3.2674
93%	16.74	5.212	46.909	246.638	5.258	5.065	2273.1	3.2733
94%	**16.92**	**5.293**	**47.640**	**248.235**	**5.211**	**5.067**	**2274.1**	**3.2748**
95%	17.10	5.381	48.430	249.712	5.156	5.061	2271.7	3.2712
96%	17.28	5.478	49.300	251.055	5.092	5.047	2265.0	3.2617
97%	17.46	5.587	50.282	252.245	5.017	5.020	2253.1	3.2445
98%	17.64	5.716	51.440	253.254	4.923	4.977	2234.0	3.2170
99%	17.82	5.883	52.943	254.038	4.798	4.908	2202.9	3.1721
99.5%	17.91	6.000	54.001	254.316	4.709	4.852	2177.9	3.1362
100%	18.00	6.283	56.549	254.469	4.500	4.710	2114.1	3.0444

Channel Surface	*n*
Smooth Steel Surface	0.012
Corrugated Metal	0.024
Smooth Concrete	0.011
Concrete Culvert (with connection)	0.013
Glazed Brick	0.013
Earth Excavation, clean	0.022
Natural Stream Bed, clean, straight	0.03
Smooth Rock Cuts	0.035
Channels Not Maintained	0.05-0.1
Clean, coated cast iron	0.012-0.013
dirty, tuberculated cast iron	0.015-0.035

MANNING EQUATION FOR PIPE FLOW



→ Depth of flow?	23.99 *inches*	
→ Pipe diameter?	24 *inches*	
phi=	6.202 *radians*	355.32 *degrees*
Wetted Perimeter=	74.418 *inches*	6.202 *feet*
Area=	452.383 *in^2*	3.142 *feet^2*
Hyd. Radius=	6.079 *inches*	0.507 *feet*
→ Slope ?	0.002	
→ n ?	0.013	
Velocity=	3.257 *fps*	
Flow=	10.233 *cfs*	4592.837 *gpm*

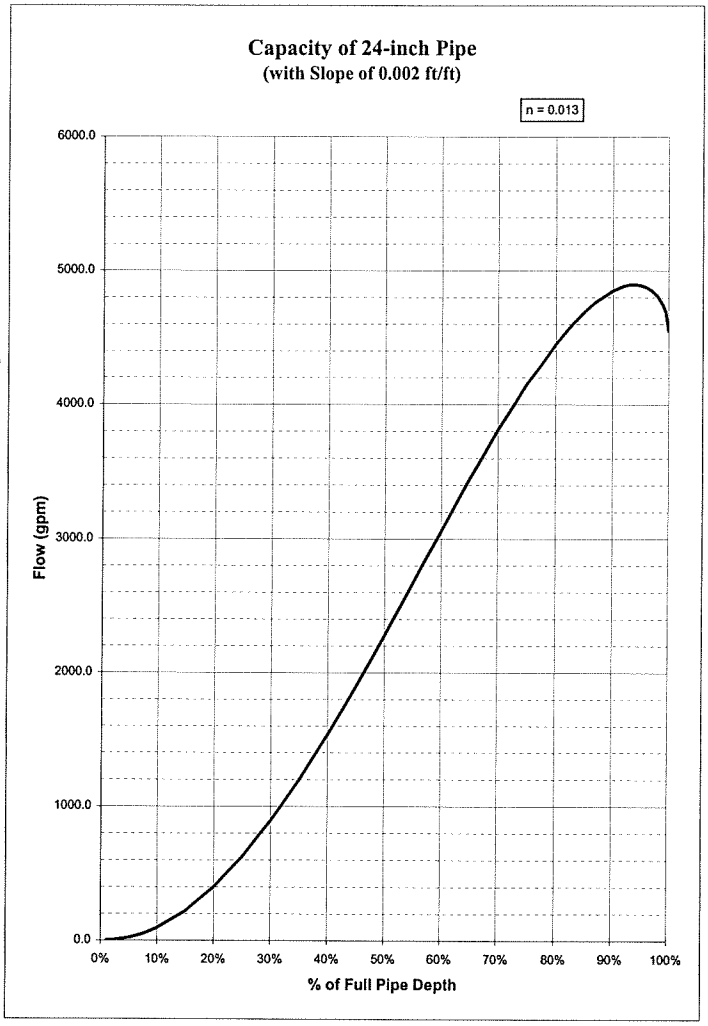
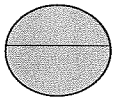


Table Below Assumes Constant Value for "n"

% full	depth (in)	phi (rad)	P (in)	A (in^2)	Rh (in)	Q (cfs)	Q (gpm)	Q (mgd)
1%	0.24	0.401	4.808	0.766	0.159	0.002	0.7	0.0010
2%	0.48	0.568	6.811	2.159	0.317	0.007	3.1	0.0044
5%	1.20	0.902	10.825	8.457	0.781	0.049	21.9	0.0315
7%	1.68	1.071	12.853	13.921	1.083	0.100	44.8	0.0644
8%	1.92	1.147	13.764	16.955	1.232	0.132	59.4	0.0855
10%	2.40	1.287	15.444	23.544	1.524	0.212	95.1	0.1369
15%	3.60	1.591	19.090	42.552	2.229	0.493	221.3	0.3187
20%	4.80	1.855	22.255	64.411	2.894	0.888	398.7	0.5742
25%	6.00	2.094	25.133	88.443	3.519	1.390	623.7	0.8981
30%	7.20	2.319	27.823	114.145	4.103	1.987	891.6	1.2840
35%	8.40	2.532	30.386	141.109	4.644	2.667	1197.2	1.7239
40%	9.60	2.739	32.867	168.981	5.141	3.418	1534.3	2.2094
45%	10.80	2.941	35.295	197.443	5.594	4.225	1896.5	2.7309
50%	12.00	3.142	37.699	226.195	6.000	5.072	2276.5	3.2782
55%	13.20	3.342	40.103	254.947	6.357	5.942	2666.8	3.8402
60%	14.40	3.544	42.532	283.408	6.663	6.815	3058.9	4.4049
65%	15.60	3.751	45.012	311.281	6.916	7.673	3444.0	4.9593
70%	16.80	3.965	47.576	338.244	7.110	8.493	3812.0	5.4893
75%	18.00	4.189	50.265	363.947	7.240	9.250	4151.8	5.9787
80%	19.20	4.429	53.143	387.979	7.301	9.916	4450.5	6.4087
83%	19.92	4.583	54.999	401.393	7.298	10.256	4603.3	6.6288
85%	20.40	4.692	56.309	409.838	7.278	10.453	4691.7	6.7560
87%	20.88	4.808	57.693	417.830	7.242	10.622	4767.3	6.8650
90%	21.60	4.996	59.954	428.845	7.153	10.812	4852.6	6.9878
92%	22.08	5.136	61.634	435.435	7.065	10.888	4886.7	7.0369
93%	22.32	5.212	62.546	438.468	7.010	10.907	4895.4	7.0494
94%	**22.56**	**5.293**	**63.520**	**441.307**	**6.948**	**10.912**	**4897.6**	**7.0526**
95%	22.80	5.381	64.574	443.933	6.875	10.900	4892.3	7.0450
96%	23.04	5.478	65.733	446.320	6.790	10.868	4878.0	7.0244
97%	23.28	5.587	67.042	448.435	6.689	10.811	4852.4	6.9875
98%	23.52	5.716	68.587	450.230	6.564	10.719	4811.2	6.9281
99%	23.76	5.883	70.590	451.624	6.398	10.570	4744.1	6.8315
99.5%	23.88	6.000	72.001	452.118	6.279	10.450	4690.5	6.7543
100%	24.00	6.283	75.398	452.389	6.000	10.144	4553.1	6.5564

Channel Surface	*n*
Smooth Steel Surface	0.012
Corrugated Metal	0.024
Smooth Concrete	0.011
Concrete Culvert (with connection)	0.013
Glazed Brick	0.013
Earth Excavation, clean	0.022
Natural Stream Bed, clean, straight	0.03
Smooth Rock Cuts	0.035
Channels Not Maintained	0.05-0.1
Clean, coated cast iron	0.012-0.013
dirty, tuberculated cast iron	0.015-0.035

MANNING EQUATION FOR PIPE FLOW



→ Depth of flow?	29.99 *inches*	
→ Pipe diameter?	30 *inches*	
phi=	6.210 *radians*	355.82 *degrees*
Wetted Perimeter=	93.152 *inches*	7.763 *feet*
Area=	706.851 *in^2*	4.909 *feet^2*
Hyd. Radius=	7.588 *inches*	0.632 *feet*
→ Slope ?	0.002	
→ n ?	0.013	
Velocity=	3.776 *fps*	
Flow=	18.536 *cfs*	8319.715 *gpm*

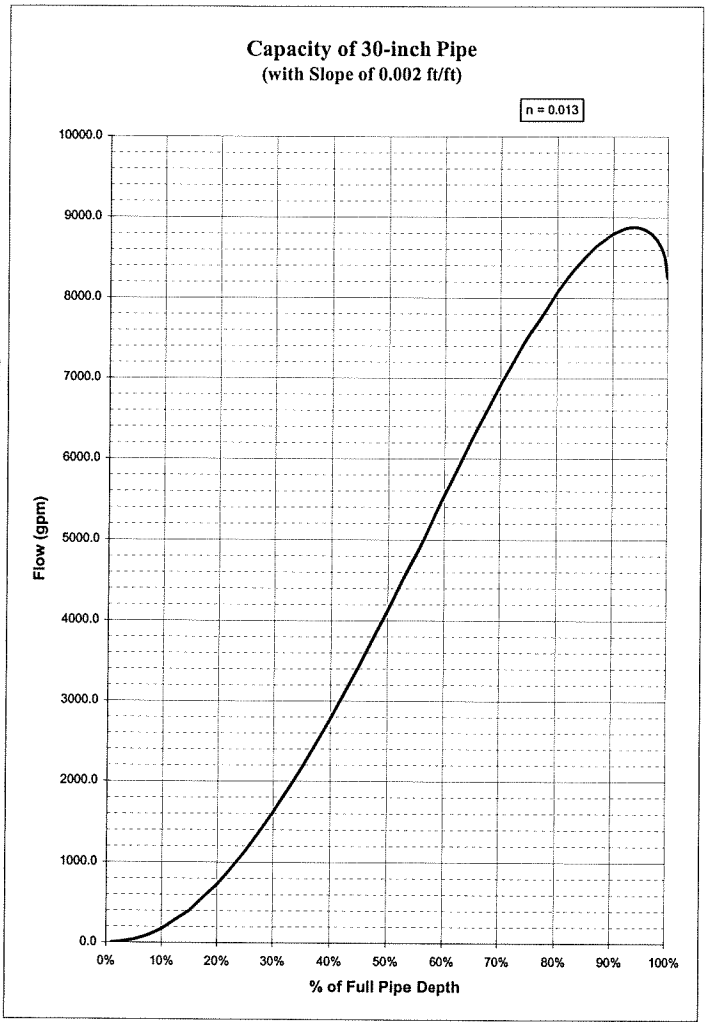


Table Below Assumes Constant Value for "n"

% full	depth (in)	phi (rad)	P (in)	A (in^2)	Rh (in)	Q (cfs)	Q (gpm)	Q (mgd)
1%	0.30	0.401	6.010	1.196	0.199	0.003	1.2	0.0018
2%	0.60	0.568	8.514	3.374	0.396	0.012	5.5	0.0080
5%	1.50	0.902	13.531	13.213	0.977	0.088	39.6	0.0571
7%	2.10	1.071	16.066	21.752	1.354	0.181	81.1	0.1168
8%	2.40	1.147	17.205	26.492	1.540	0.240	107.7	0.1550
10%	3.00	1.287	19.305	36.788	1.906	0.384	172.4	0.2482
15%	4.50	1.591	23.862	66.487	2.786	0.894	401.3	0.5778
20%	6.00	1.855	27.819	100.641	3.618	1.611	722.9	1.0410
25%	7.50	2.094	31.416	138.192	4.399	2.519	1130.8	1.6284
30%	9.00	2.319	34.778	178.352	5.128	3.602	1616.6	2.3280
35%	10.50	2.532	37.983	220.482	5.805	4.836	2170.6	3.1257
40%	12.00	2.739	41.083	264.033	6.427	6.198	2781.9	4.0060
45%	13.50	2.941	44.119	308.504	6.993	7.661	3438.6	4.9515
50%	15.00	3.142	47.124	353.429	7.500	9.196	4127.6	5.9438
55%	16.50	3.342	50.129	398.354	7.947	10.773	4835.2	6.9627
60%	18.00	3.544	53.165	442.826	8.329	12.357	5546.2	7.9866
65%	19.50	3.751	56.265	486.376	8.644	13.912	6244.3	8.9919
70%	21.00	3.965	59.469	528.507	8.887	15.399	6911.6	9.9527
75%	22.50	4.189	62.832	568.667	9.051	16.772	7527.8	10.8400
80%	24.00	4.429	66.429	606.217	9.126	17.978	8069.2	11.6197
83%	24.90	4.583	68.748	627.176	9.123	18.596	8346.4	12.0188
85%	25.50	4.692	70.386	640.371	9.098	18.953	8506.6	12.2494
87%	26.10	4.808	72.116	652.859	9.053	19.258	8643.8	12.4470
90%	27.00	4.996	74.943	670.071	8.941	19.603	8798.4	12.6697
92%	27.60	5.136	77.042	680.367	8.831	19.741	8860.2	12.7587
93%	27.90	5.212	78.182	685.107	8.763	19.776	8876.0	12.7814
94%	**28.20**	**5.293**	**79.400**	**689.543**	**8.684**	**19.785**	**8880.0**	**12.7872**
95%	28.50	5.381	80.717	693.645	8.594	19.763	8870.4	12.7734
96%	28.80	5.478	82.166	697.374	8.487	19.706	8844.5	12.7360
97%	29.10	5.587	83.803	700.679	8.361	19.602	8798.0	12.6691
98%	29.40	5.716	85.734	703.485	8.205	19.436	8723.3	12.5615
99%	29.70	5.883	88.238	705.662	7.997	19.165	8601.7	12.3864
99.5%	29.85	6.000	90.002	706.435	7.849	18.948	8504.4	12.2464
100%	30.00	6.283	94.248	706.858	7.500	18.393	8255.3	11.8876

Channel Surface	*n*
Smooth Steel Surface	0.012
Corrugated Metal	0.024
Smooth Concrete	0.011
Concrete Culvert (with connection)	0.013
Glazed Brick	0.013
Earth Excavation, clean	0.022
Natural Stream Bed, clean, straight	0.03
Smooth Rock Cuts	0.035
Channels Not Maintained	0.05-0.1
Clean, coated cast iron	0.012-0.013
dirty, tuberculated cast iron	0.015-0.035