Supplementary Material

This supplementary material presents the input data and the detailed hydraulic design of the three case studies presented.

Benchmark network proposed by Li & Matthew [34].

Table S1. Input data of the Benchmark proposed by Li and Matthew [34].

Manhole ID	Inflow [m³/s]	Elevation [m]
1	0.005	2.5
2	0.006	2.6
3	0.005	2.7
4	0.003	2.8
5	0.007	2.6
6	0.010	2.6
7	0.009	2.3
8	0.010	2.5
9	0.003	2.9
10	0.010	2.85
11	0.017	2.8
12	0.004	2.8
13	0.007	2.2
14	0.008	2.4
15	0.002	2.5
16	0.003	2.6
17	0.006	2.6
18	0.008	2.2
19	0.006	2.4
20	0.011	2.5
21	0.013	2.45
22	0.012	2.4
23	0.011	2.35
24	0.007	2.3
25	0.006	2.1
26	0.002	2.4
27	0.009	2.4
28	0.004	2.25
29	0.006	2.2
30	0.004	2.1
31	0.004	2
32	0.008	2
33	0.006	1.95

34	0.010	2
35	0.010	1.95
36	0.011	1.9
37	0.003	2.05
38	0.003	2.2
39	0.002	2.1
40	0.006	2
41	0.006	2.1
42	0.010	2.1
43	0.003	2
44	0.005	2
45	0.005	2.2
46	0.003	2.1
47	0.007	2.2
48	0.008	2.1
49	0.000	2.1
50	0.000	2.1
51	0.003	2.2
52	0.000	2.2
53	0.000	2.2
54	0.000	2.25
55	0.000	2.7
56	0.013	2.2
57	-	2.2

Table S2. Hydraulic design for the Benchmark proposed by Li and Matthew [34] with cost function of Li and Matthew [34].

Pipe	Upstream Manhole	Downstream Manhole	Type	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m³/s]	Slope [-]
1	1	2	Outer	0.2	1.3	-0.2	0.0040	0.003
2	1	7	Outer	0.2	1.3	0.2	0.0013	0.003
3	4	3	Outer	0.2	1.5	0.7	0.0029	0.003
4	3	2	Inner	0.2	0.7	-0.2	0.0078	0.003
5	2	55	Inner	0.35	-0.2	-1.2	0.0176	0.004
6	55	6	Inner	0.35	-1.2	-2	0.0253	0.003
7	6	11	Inner	0.35	-2	-2.6	0.0354	0.003
8	11	17	Inner	0.38	-2.6	-3	0.0589	0.002
9	17	22	Inner	0.4	-3	-3.4	0.0646	0.002
10	22	29	Inner	0.5	-3.4	-3.7	0.0923	0.001
11	29	34	Inner	0.5	-3.7	-4	0.0983	0.001
12	34	37	Inner	0.5	-4	-4.25	0.1047	0.001
13	37	42	Inner	0.5	-4.25	-4.5	0.1080	0.002
14	5	8	Outer	0.2	1.4	0.6	0.0017	0.003

15	5	55	Outer	0.2	1.4	0.5	0.0052	0.003
16	10	9	Outer	0.2	1.65	0.8	0.0025	0.003
17	10	11	Outer	0.2	1.65	0.5	0.0025	0.003
18	10	16	Outer	0.2	1.65	0.9	0.0025	0.003
19	16	21	Inner	0.2	0.9	0.25	0.0055	0.003
20	10	55	Outer	0.2	1.65	0.7	0.0025	0.003
21	12	11	Outer	0.2	1.5	0.9	0.0045	0.003
22	13	7	Outer	0.2	1	-0.1	0.0017	0.003
23	7	8	Inner	0.25	-0.1	-1	0.0125	0.003
24	8	9	Inner	0.3	-1	-1.7	0.0267	0.003
25	9	15	Inner	0.3	-1.7	-2.4	0.0318	0.003
26	15	20	Inner	0.35	-2.4	-2.9	0.0339	0.003
27	20	27	Inner	0.45	-2.9	-3.3	0.0794	0.002
28	27	32	Inner	0.45	-3.3	-3.6	0.0879	0.002
29	32	40	Inner	0.5	-3.6	-3.8	0.1143	0.001
30	40	41	Inner	0.5	-3.8	-4.2	0.1223	0.002
31	41	42	Inner	0.53	-4.2	-4.7	0.1473	0.002
32	42	43	Inner	0.53	-4.7	-6.3	0.2711	0.006
33	43	49	Inner	1.05	-6.3	-9.8	0.3223	0.013
34	49	54	Inner	1.05	-9.8	-10.05	0.3246	0.001
35	13	18	Outer	0.2	1	0.1	0.0052	0.003
36	14	8	Outer	0.2	1.2	0.3	0.0021	0.003
37	14	19	Outer	0.2	1.2	0.5	0.0062	0.003
38	21	22	Outer	0.25	1.15	0	0.0133	0.003
39	23	35	Outer	0.2	1.15	-0.25	0.0114	0.003
40	24	23	Outer	0.2	1	0.05	0.0029	0.003
41	23	22	Inner	0.2	0.05	-1	0.0029	0.003
42	24	36	Outer	0.2	1	-0.4	0.0045	0.003
43	36	35	Inner	0.25	-0.4	-1.75	0.0161	0.004
44	35	43	Inner	0.35	-1.75	-2.4	0.0468	0.002
45	25	18	Outer	0.2	0.9	-0.2	0.0015	0.003
46	18	19	Inner	0.25	-0.2	-1.7	0.0150	0.004
47	19	20	Inner	0.3	-1.7	-2.6	0.0278	0.003
48	25	30	Outer	0.2	0.9	0	0.0044	0.003
49	30	31	Inner	0.2	0	-0.7	0.0082	0.003
50	26	19	Outer	0.2	1.2	0.2	0.0005	0.003
51	26	31	Outer	0.2	1.2	0.4	0.0015	0.003
52	28	21	Outer	0.2	1.05	0.25	0.0009	0.003
53	21	20	Inner	0.2	0.25	-0.8	0.0064	0.003
54	28	33	Outer	0.2	1.05	0.35	0.0027	0.003
55	33	32	Inner	0.2	0.35	-0.4	0.0027	0.003
56	33	34	Outer	0.2	0.75	-0.3	0.0064	0.003
57	34	35	Outer	0.2	0.8	-0.25	0.0097	0.003
58	38	39	Outer	0.2	1	0.1	0.0022	0.003
59	38	45	Outer	0.2	1	0.3	0.0007	0.003

60	45	51	Inner	0.2	0.3	-0.4	0.0056	0.003
61	51	52	Inner	0.2	-0.4	-1	0.0081	0.003
62	52	47	Inner	0.2	-1	-1.9	0.0082	0.003
63	47	41	Inner	0.25	-1.9	-3	0.0189	0.004
64	54	56	Inner	1.05	-10.05	-10.3	0.3246	0.001
65	56	57	Inner	1.05	-10.3	-10.7	0.3378	0.001
66	39	40	Outer	0.2	0.9	0	0.0023	0.003
67	44	36	Outer	0.2	0.8	-0.3	0.0012	0.003
68	44	43	Outer	0.2	0.8	-0.2	0.0012	0.003
69	44	50	Outer	0.2	0.8	-0.2	0.0023	0.003
70	50	49	Inner	0.2	-0.2	-1	0.0023	0.003
71	46	39	Outer	0.2	0.9	0	0.0007	0.003
72	39	31	Inner	0.2	0	-0.8	0.0029	0.003
73	31	32	Inner	0.35	-0.8	-1.9	0.0161	0.004
74	46	47	Outer	0.2	0.9	0	0.0021	0.003
75	48	42	Outer	0.2	0.9	0	0.0060	0.003
76	48	47	Outer	0.2	0.9	0.2	0.0020	0.003
77	50	56	Outer	0.2	0.9	0	0.0010	0.003
78	53	52	Outer	0.2	1	-0.1	0.0010	0.003
79	53	54	Outer	0.2	1	-0.05	0.0010	0.003

Table S3. Hydraulic design for the Benchmark proposed by Li and Matthew [34] with cost function of Maurer et al. [47].

Pipe	Upstream Manhole	Downstream Manhole	Type	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m³/s]	Slope [-]
1	1	2	Outer	0.2	1.3	-0.2	0.0040	0.003
2	1	7	Outer	0.2	1.3	0.2	0.0013	0.003
3	4	3	Outer	0.2	1.5	0.7	0.0029	0.003
4	3	2	Inner	0.2	0.7	-0.2	0.0078	0.003
5	2	55	Inner	0.25	-0.2	-1.2	0.0176	0.004
6	55	6	Inner	0.3	-1.2	-2	0.0253	0.003
7	6	11	Inner	0.35	-2	-2.6	0.0354	0.003
8	11	17	Inner	0.38	-2.6	-3	0.0589	0.002
9	17	22	Inner	0.4	-3	-3.4	0.0646	0.002
10	22	29	Inner	0.5	-3.4	-3.7	0.0923	0.001
11	29	34	Inner	0.5	-3.7	-4	0.0983	0.001
12	34	37	Inner	0.5	-4	-4.25	0.1047	0.001
13	37	42	Inner	0.5	-4.25	-4.5	0.1080	0.002
14	5	8	Outer	0.2	1.4	0.6	0.0017	0.003
15	5	55	Outer	0.2	1.4	0.5	0.0052	0.003
16	10	9	Outer	0.2	1.65	0.8	0.0025	0.003
17	10	11	Outer	0.2	1.65	0.5	0.0025	0.003

18	10	16	Outer	0.2	1.65	0.9	0.0025	0.003
19	16	21	Inner	0.2	0.9	0.25	0.0055	0.003
20	10	55	Outer	0.2	1.65	0.7	0.0025	0.003
21	12	11	Outer	0.2	1.5	0.9	0.0045	0.003
22	13	7	Outer	0.2	1	-0.1	0.0017	0.003
23	7	8	Inner	0.25	-0.1	-1	0.0125	0.003
24	8	9	Inner	0.3	-1	-1.7	0.0267	0.003
25	9	15	Inner	0.3	-1.7	-2.4	0.0318	0.003
26	15	20	Inner	0.35	-2.4	-2.9	0.0339	0.003
27	20	27	Inner	0.45	-2.9	-3.3	0.0794	0.002
28	27	32	Inner	0.45	-3.3	-3.6	0.0879	0.002
29	32	40	Inner	0.5	-3.6	-3.8	0.1143	0.001
30	40	41	Inner	0.5	-3.8	-4.2	0.1223	0.002
31	41	42	Inner	0.53	-4.2	-4.7	0.1473	0.002
32	42	43	Inner	0.7	-4.7	-5.1	0.2711	0.001
33	43	49	Inner	0.7	-5.1	-5.6	0.3223	0.002
34	49	54	Inner	0.7	-5.6	-6.05	0.3246	0.002
35	54	56	Inner	0.7	-6.05	-6.6	0.3246	0.002
36	56	57	Inner	0.7	-6.6	-7.6	0.3378	0.002
37	13	18	Outer	0.2	1	0.1	0.0052	0.003
38	14	8	Outer	0.2	1.2	0.3	0.0021	0.003
39	14	19	Outer	0.2	1.2	0.5	0.0062	0.003
40	21	22	Outer	0.25	1.15	0	0.0133	0.003
41	23	35	Outer	0.2	1.15	-0.25	0.0114	0.003
42	24	23	Outer	0.2	1	0.05	0.0029	0.003
43	23	22	Inner	0.2	0.05	-1	0.0029	0.003
44	24	36	Outer	0.2	1	-0.4	0.0045	0.003
45	36	35	Inner	0.25	-0.4	-1.75	0.0161	0.004
46	35	43	Inner	0.35	-1.75	-2.4	0.0468	0.002
47	25	18	Outer	0.2	0.9	-0.2	0.0015	0.003
48	18	19	Inner	0.25	-0.2	-1.7	0.0150	0.004
49	19	20	Inner	0.3	-1.7	-2.6	0.0278	0.003
50	25	30	Outer	0.2	0.9	0	0.0044	0.003
51	30	31	Inner	0.2	0	-0.7	0.0082	0.003
52	26	19	Outer	0.2	1.2	0.2	0.0005	0.003
53	26	31	Outer	0.2	1.2	0.4	0.0015	0.003
54	28	21	Outer	0.2	1.05	0.25	0.0009	0.003
55	21	20	Inner	0.2	0.25	-0.8	0.0064	0.003
56	28	33	Outer	0.2	1.05	0.35	0.0027	0.003
57	33	32	Inner	0.2	0.35	-0.4	0.0027	0.003
58	33	34	Outer	0.2	0.75	-0.3	0.0064	0.003
59	34	35	Outer	0.2	0.8	-0.25	0.0097	0.003
60	38	39	Outer	0.2	1	0.1	0.0022	0.003
61	38	45	Outer	0.2	1	0.3	0.0007	0.003
62	45	51	Inner	0.2	0.3	-0.4	0.0056	0.003

63	51	52	Inner	0.2	-0.4	-1	0.0081	0.003
64	52	47	Inner	0.2	-1	-1.9	0.0082	0.003
65	47	41	Inner	0.25	-1.9	-3	0.0189	0.004
66	39	40	Outer	0.2	0.9	0	0.0023	0.003
67	44	36	Outer	0.2	0.8	-0.3	0.0012	0.003
68	44	43	Outer	0.2	0.8	-0.2	0.0012	0.003
69	44	50	Outer	0.2	0.8	-0.2	0.0023	0.003
70	50	49	Inner	0.2	-0.2	-1	0.0023	0.003
71	46	39	Outer	0.2	0.9	0	0.0007	0.003
72	39	31	Inner	0.2	0	-0.8	0.0029	0.003
73	31	32	Inner	0.25	-0.8	-1.9	0.0161	0.004
74	46	47	Outer	0.2	0.9	0	0.0021	0.003
75	48	42	Outer	0.2	0.9	0	0.0060	0.003
76	48	47	Outer	0.2	0.9	0.2	0.0020	0.003
77	50	56	Outer	0.2	0.9	0	0.0010	0.003
78	53	52	Outer	0.2	1	-0.1	0.0010	0.003
79	53	54	Outer	0.2	1	-0.05	0.0010	0.003

Benchmark network proposed by Moeini & Afshar [46].

Table S4. Input data Benchmark proposed by Moeini and Afshar [46].

Manhole ID	Inflow [m³/s]	X coordinate [m]	Y coordinate [m]	Elevation [m]
1	0.00732	0	0	1000
2	0.00732	100	0	1000
3	0.00732	200	0	1000
4	0.00732	300	0	1000
5	0.00732	400	0	1000
6	0.00732	500	0	1000
7	0.00732	600	0	1000
8	0.00732	700	0	1000
9	0.00732	800	0	1000
10	0.00732	0	100	1000
11	0.00732	100	100	1000
12	0.00732	200	100	1000
13	0.00732	300	100	1000
14	0.00732	400	100	1000
15	0.00732	500	100	1000
16	0.00732	600	100	1000
17	0.00732	700	100	1000
18	0.00732	800	100	1000
19	0.00732	0	200	1000
20	0.00732	100	200	1000

21	0.00732	200	200	1000
22	0.00732	300	200	1000
23	0.00732	400	200	1000
24	0.00732	500	200	1000
25	0.00732	600	200	1000
26	0.00732	700	200	1000
27	0.00732	800	200	1000
28	0.00732	0	300	1000
29	0.00732	100	300	1000
30	0.00732	200	300	1000
31	0.00732	300	300	1000
32	0.00732	400	300	1000
33	0.00732	500	300	1000
34	0.00732	600	300	1000
35	0.00732	700	300	1000
36	0.00732	800	300	1000
37	0.00732	0	400	1000
38	0.00732	100	400	1000
39	0.00732	200	400	1000
40	0.00732	300	400	1000
41	0.00732	400	400	1000
42	0.00732	500	400	1000
43	0.00732	600	400	1000
44	0.00732	700	400	1000
45	0.00732	800	400	1000
46	0.00732	0	500	1000
47	0.00732	100	500	1000
48	0.00732	200	500	1000
49	0.00732	300	500	1000
50	0.00732	400	500	1000
51	0.00732	500	500	1000
52	0.00732	600	500	1000
53	0.00732	700	500	1000
54	0.00732	800	500	1000
55	0.00732	0	600	1000
56	0.00732	100	600	1000
57	0.00732	200	600	1000
58	0.00732	300	600	1000
59	0.00732	400	600	1000
60	0.00732	500	600	1000
61	0.00732	600	600	1000
62	0.00732	700	600	1000
63	0.00732	800	600	1000
64	0.00732	0	700	1000
65	0.00732	100	700	1000

66	0.00732	200	700	1000
67	0.00732	300	700	1000
68	0.00732	400	700	1000
69	0.00732	500	700	1000
70	0.00732	600	700	1000
71	0.00732	700	700	1000
72	0.00732	800	700	1000
73	0.00732	0	800	1000
74	0.00732	100	800	1000
75	0.00732	200	800	1000
76	0.00732	300	800	1000
77	0.00732	400	800	1000
78	0.00732	500	800	1000
79	0.00732	600	800	1000
80	0.00732	700	800	1000
81	0.00732	800	800	1000
82	-	900	800	1000

Table S5. Hydraulic design for the Benchmark proposed by Moeini and Afshar [46] with cost function of Li and Matthew [34].

Pipe	Upstream Manhole	Downstream Manhole	Type	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m³/s]	Slope [-]
1	1	2	Outer	0.2	998.8	998.5	0.00549	0.003
2	2	11	Inner	0.2	998.5	998.2	0.01098	0.003
3	1	10	Outer	0.2	998.8	998.5	0.00183	0.003
4	10	11	Inner	0.2	998.5	998.2	0.00183	0.003
5	11	12	Inner	0.25	998.2	997.9	0.01281	0.003
6	12	21	Inner	0.3	997.9	997.6	0.02562	0.003
7	21	22	Inner	0.38	997.6	997.4	0.05124	0.002
8	22	31	Inner	0.38	997.4	997.2	0.0549	0.002
9	31	32	Inner	0.45	997.2	997	0.08235	0.002
10	32	41	Inner	0.5	997	996.8	0.12078	0.002
11	41	50	Inner	0.53	996.8	996.6	0.14457	0.002
12	50	51	Inner	0.6	996.6	996.4	0.19581	0.002
13	51	60	Inner	0.7	996.4	996.2	0.22143	0.002
14	60	61	Inner	0.7	996.2	996	0.26352	0.002
15	61	70	Inner	0.7	996	995.8	0.29646	0.002
16	70	71	Inner	0.7	995.8	995.6	0.34587	0.002
17	71	72	Inner	0.7	995.6	995.2	0.43554	0.004
18	72	81	Inner	0.7	995.2	994.7	0.50691	0.005
19	2	3	Outer	0.2	998.8	998.5	0.00183	0.003
20	3	12	Inner	0.2	998.5	998.2	0.00732	0.003

21	3	4	Outer	0.2	998.8	998.5	0.00183	0.003
22	4	13	Inner	0.2	998.5	998.2	0.00183	0.003
23	13	22	Inner	0.2	998.2	997.9	0.00366	0.003
24	4	5	Outer	0.2	998.8	998.5	0.00732	0.003
25	5	14	Inner	0.2	998.5	998.2	0.00732	0.003
26	14	23	Inner	0.25	998.2	997.8	0.02013	0.004
27	23	32	Inner	0.3	997.8	997.5	0.03294	0.003
28	5	6	Outer	0.2	998.8	998.5	0.00732	0.003
29	6	15	Inner	0.2	998.5	998.2	0.00732	0.003
30	15	24	Inner	0.25	998.2	997.9	0.01464	0.003
31	24	33	Inner	0.25	997.9	997.5	0.02196	0.004
32	33	42	Inner	0.3	997.5	997.1	0.02379	0.004
33	42	51	Inner	0.3	997.1	996.8	0.02562	0.003
34	6	7	Outer	0.2	998.8	998.5	0.00732	0.003
35	7	16	Inner	0.2	998.5	998.2	0.00732	0.003
36	16	25	Inner	0.2	998.2	997.9	0.00915	0.003
37	25	34	Inner	0.2	997.9	997.6	0.01098	0.003
38	34	43	Inner	0.25	997.6	997.2	0.0183	0.004
39	43	52	Inner	0.3	997.2	996.9	0.02562	0.003
40	52	61	Inner	0.3	996.9	996.6	0.03294	0.003
41	7	8	Outer	0.2	998.8	998.5	0.00732	0.003
42	8	17	Inner	0.25	998.5	998.2	0.01281	0.003
43	17	26	Inner	0.3	998.2	997.9	0.02562	0.003
44	26	35	Inner	0.35	997.9	997.6	0.03843	0.003
45	35	44	Inner	0.38	997.6	997.4	0.05124	0.002
46	44	53	Inner	0.4	997.4	997.2	0.06405	0.002
47	53	62	Inner	0.45	997.2	997	0.07686	0.002
48	62	71	Inner	0.45	997	996.8	0.08967	0.002
49	8	9	Outer	0.2	998.8	998.5	0.00183	0.003
50	9	18	Inner	0.2	998.5	998.2	0.00915	0.003
51	18	27	Inner	0.25	998.2	997.8	0.0183	0.004
52	27	36	Inner	0.3	997.8	997.5	0.02745	0.003
53	36	45	Inner	0.35	997.5	997.2	0.0366	0.003
54	45	54	Inner	0.35	997.2	996.9	0.04575	0.003
55	54	63	Inner	0.38	996.9	996.7	0.0549	0.002
56	63	72	Inner	0.4	996.7	996.5	0.06405	0.002
57	10	19	Outer	0.2	998.8	998.5	0.00732	0.003
58	19	20	Inner	0.25	998.5	998.2	0.01281	0.003
59	20	21	Inner	0.3	998.2	997.9	0.02562	0.003
60	11	20	Outer	0.2	998.8	998.5	0.00732	0.003
61	12	13	Outer	0.2	998.8	998.5	0.00183	0.003
62	13	14	Outer	0.2	998.8	998.5	0.00732	0.003
63	14	15	Outer	0.2	998.8	998.5	0.00183	0.003
64	15	16	Outer	0.2	998.8	998.5	0.00183	0.003
65	16	17	Outer	0.2	998.8	998.5	0.00732	0.003

66	17	18	Outer	0.2	998.8	998.5	0.00183	0.003
67	19	28	Outer	0.2	998.8	998.5	0.00183	0.003
68	28	29	Inner	0.2	998.5	998.2	0.00183	0.003
69	29	30	Inner	0.2	998.2	997.9	0.00915	0.003
70	30	31	Inner	0.25	997.9	997.5	0.02196	0.004
71	20	29	Outer	0.2	998.8	998.5	0.00183	0.003
72	21	30	Outer	0.2	998.8	998.5	0.00732	0.003
73	22	23	Outer	0.2	998.8	998.5	0.00732	0.003
74	23	24	Outer	0.2	998.8	998.5	0.00183	0.003
75	24	25	Outer	0.2	998.8	998.5	0.00183	0.003
76	25	26	Outer	0.2	998.8	998.5	0.00732	0.003
77	26	27	Outer	0.2	998.8	998.5	0.00183	0.003
78	28	37	Outer	0.2	998.8	998.5	0.00732	0.003
79	37	38	Inner	0.2	998.5	998.2	0.00732	0.003
80	38	39	Inner	0.2	998.2	997.9	0.00915	0.003
81	39	40	Inner	0.2	997.9	997.6	0.01098	0.003
82	40	41	Inner	0.25	997.6	997.2	0.0183	0.004
83	29	38	Outer	0.2	998.8	998.5	0.00183	0.003
84	30	39	Outer	0.2	998.8	998.5	0.00183	0.003
85	31	40	Outer	0.2	998.8	998.5	0.00183	0.003
86	32	33	Outer	0.2	998.8	998.5	0.00183	0.003
87	33	34	Outer	0.2	998.8	998.5	0.00732	0.003
88	34	35	Outer	0.2	998.8	998.5	0.00732	0.003
89	35	36	Outer	0.2	998.8	998.5	0.00183	0.003
90	37	46	Outer	0.2	998.8	998.5	0.00732	0.003
91	46	47	Inner	0.25	998.5	998.2	0.01281	0.003
92	47	48	Inner	0.3	998.2	997.9	0.02562	0.003
93	48	49	Inner	0.35	997.9	997.6	0.03843	0.003
94	49	50	Inner	0.35	997.6	997.3	0.04575	0.003
95	38	47	Outer	0.2	998.8	998.5	0.00732	0.003
96	39	48	Outer	0.2	998.8	998.5	0.00732	0.003
97	40	49	Outer	0.2	998.8	998.5	0.00183	0.003
98	41	42	Outer	0.2	998.8	998.5	0.00183	0.003
99	42	43	Outer	0.2	998.8	998.5	0.00732	0.003
100	43	44	Outer	0.2	998.8	998.5	0.00732	0.003
101	44	45	Outer	0.2	998.8	998.5	0.00183	0.003
102	46	55	Outer	0.2	998.8	998.5	0.00183	0.003
103	55	56	Inner	0.2	998.5	998.2	0.00732	0.003
104	56	57	Inner	0.25	998.2	997.9	0.01464	0.003
105	57	58	Inner	0.25	997.9	997.5	0.02196	0.004
106	58	59	Inner	0.3	997.5	997.2	0.02928	0.003
107	59	60	Inner	0.35	997.2	996.9	0.0366	0.003
108	47	56	Outer	0.2	998.8	998.5	0.00183	0.003
109	48	57	Outer	0.2	998.8	998.5	0.00183	0.003
110	49	58	Outer	0.2	998.8	998.5	0.00183	0.003

111	50	59	Outer	0.2	998.8	998.5	0.00183	0.003
112	51	52	Outer	0.2	998.8	998.5	0.00732	0.003
113	52	53	Outer	0.2	998.8	998.5	0.00732	0.003
114	53	54	Outer	0.2	998.8	998.5	0.00183	0.003
115	55	64	Outer	0.2	998.8	998.5	0.00183	0.003
116	64	65	Inner	0.2	998.5	998.2	0.00732	0.003
117	65	66	Inner	0.25	998.2	997.9	0.01464	0.003
118	66	67	Inner	0.25	997.9	997.5	0.02196	0.004
119	67	68	Inner	0.3	997.5	997.2	0.02928	0.003
120	68	69	Inner	0.35	997.2	996.9	0.0366	0.003
121	69	70	Inner	0.35	996.9	996.6	0.04392	0.003
122	56	65	Outer	0.2	998.8	998.5	0.00183	0.003
123	57	66	Outer	0.2	998.8	998.5	0.00183	0.003
124	58	67	Outer	0.2	998.8	998.5	0.00183	0.003
125	59	68	Outer	0.2	998.8	998.5	0.00183	0.003
126	60	69	Outer	0.2	998.8	998.5	0.00183	0.003
127	61	62	Outer	0.2	998.8	998.5	0.00732	0.003
128	62	63	Outer	0.2	998.8	998.5	0.00183	0.003
129	64	73	Outer	0.2	998.8	998.5	0.00183	0.003
130	73	74	Inner	0.2	998.5	998.2	0.00915	0.003
131	74	75	Inner	0.25	998.2	997.8	0.0183	0.004
132	75	76	Inner	0.3	997.8	997.5	0.02745	0.003
133	76	77	Inner	0.35	997.5	997.2	0.0366	0.003
134	77	78	Inner	0.35	997.2	996.9	0.04575	0.003
135	78	79	Inner	0.38	996.9	996.7	0.0549	0.002
136	79	80	Inner	0.4	996.7	996.5	0.06405	0.002
137	80	81	Inner	0.7	996.5	996.2	0.07869	0.003
138	65	74	Outer	0.2	998.8	998.5	0.00183	0.003
139	66	75	Outer	0.2	998.8	998.5	0.00183	0.003
140	67	76	Outer	0.2	998.8	998.5	0.00183	0.003
141	68	77	Outer	0.2	998.8	998.5	0.00183	0.003
142	69	78	Outer	0.2	998.8	998.5	0.00183	0.003
143	70	79	Outer	0.2	998.8	998.5	0.00183	0.003
144	71	80	Outer	0.2	998.8	998.5	0.00732	0.003

Table S6. Hydraulic design for the Benchmark proposed by Moeini and Afshar [46] with cost function of Maurer et al. [47].

Pipe	Upstream Manhole	Downstream Manhole	Type	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
1	1	2	Outer	0.2	998.8	998.5	0.00549	0.003
2	2	11	Inner	0.2	998.5	998.2	0.01098	0.003
3	1	10	Outer	0.2	998.8	998.5	0.00183	0.003
4	10	11	Inner	0.2	998.5	998.2	0.00183	0.003

5	11	12	Inner	0.25	998.2	997.9	0.01281	0.003
6	12	21	Inner	0.3	997.9	997.6	0.02562	0.003
7	21	22	Inner	0.38	997.6	997.4	0.05124	0.002
8	22	31	Inner	0.38	997.4	997.2	0.0549	0.002
9	31	32	Inner	0.45	997.2	997	0.08235	0.002
10	32	41	Inner	0.5	997	996.8	0.12078	0.002
11	41	50	Inner	0.53	996.8	996.6	0.14457	0.002
12	50	51	Inner	0.6	996.6	996.4	0.19581	0.002
13	51	60	Inner	0.6	996.4	996.2	0.22143	0.002
14	60	61	Inner	0.6	996.2	995.9	0.26352	0.003
15	61	70	Inner	0.7	995.9	995.7	0.29646	0.002
16	70	71	Inner	0.7	995.7	995.5	0.34587	0.002
17	71	72	Inner	0.7	995.5	995.1	0.43554	0.004
18	72	81	Inner	0.7	995.1	994.6	0.50691	0.005
19	2	3	Outer	0.2	998.8	998.5	0.00183	0.003
20	3	12	Inner	0.2	998.5	998.2	0.00732	0.003
21	3	4	Outer	0.2	998.8	998.5	0.00183	0.003
22	4	13	Inner	0.2	998.5	998.2	0.00183	0.003
23	13	22	Inner	0.2	998.2	997.9	0.00366	0.003
24	4	5	Outer	0.2	998.8	998.5	0.00732	0.003
25	5	14	Inner	0.2	998.5	998.2	0.00732	0.003
26	14	23	Inner	0.25	998.2	997.8	0.02013	0.004
27	23	32	Inner	0.3	997.8	997.5	0.03294	0.003
28	5	6	Outer	0.2	998.8	998.5	0.00732	0.003
29	6	15	Inner	0.2	998.5	998.2	0.00732	0.003
30	15	24	Inner	0.25	998.2	997.9	0.01464	0.003
31	24	33	Inner	0.25	997.9	997.5	0.02196	0.004
32	33	42	Inner	0.3	997.5	997.1	0.02379	0.004
33	42	51	Inner	0.3	997.1	996.8	0.02562	0.003
34	6	7	Outer	0.2	998.8	998.5	0.00732	0.003
35	7	16	Inner	0.2	998.5	998.2	0.00732	0.003
36	16	25	Inner	0.2	998.2	997.9	0.00915	0.003
37	25	34	Inner	0.2	997.9	997.6	0.01098	0.003
38	34	43	Inner	0.25	997.6	997.2	0.0183	0.004
39	43	52	Inner	0.3	997.2	996.9	0.02562	0.003
40	52	61	Inner	0.3	996.9	996.6	0.03294	0.003
41	7	8	Outer	0.2	998.8	998.5	0.00732	0.003
42	8	17	Inner	0.25	998.5	998.2	0.01281	0.003
43	17	26	Inner	0.3	998.2	997.9	0.02562	0.003
44	26	35	Inner	0.35	997.9	997.6	0.03843	0.003
45	35	44	Inner	0.38	997.6	997.4	0.05124	0.002
46	44	53	Inner	0.4	997.4	997.2	0.06405	0.002
47	53	62	Inner	0.45	997.2	997	0.07686	0.002
48	62	71	Inner	0.45	997	996.8	0.08967	0.002

49	8	9	Outer	0.2	998.8	998.5	0.00183	0.003
50	9	18	Inner	0.2	998.5	998.2	0.00915	0.003
51	18	27	Inner	0.25	998.2	997.8	0.0183	0.004
52	27	36	Inner	0.3	997.8	997.5	0.02745	0.003
53	36	45	Inner	0.35	997.5	997.2	0.0366	0.003
54	45	54	Inner	0.35	997.2	996.9	0.04575	0.003
55	54	63	Inner	0.38	996.9	996.7	0.0549	0.002
56	63	72	Inner	0.4	996.7	996.5	0.06405	0.002
57	10	19	Outer	0.2	998.8	998.5	0.00732	0.003
58	19	20	Inner	0.25	998.5	998.2	0.01281	0.003
59	20	21	Inner	0.3	998.2	997.9	0.02562	0.003
60	11	20	Outer	0.2	998.8	998.5	0.00732	0.003
61	12	13	Outer	0.2	998.8	998.5	0.00183	0.003
62	13	14	Outer	0.2	998.8	998.5	0.00732	0.003
63	14	15	Outer	0.2	998.8	998.5	0.00183	0.003
64	15	16	Outer	0.2	998.8	998.5	0.00183	0.003
65	16	17	Outer	0.2	998.8	998.5	0.00732	0.003
66	17	18	Outer	0.2	998.8	998.5	0.00183	0.003
67	19	28	Outer	0.2	998.8	998.5	0.00183	0.003
68	28	29	Inner	0.2	998.5	998.2	0.00183	0.003
69	29	30	Inner	0.2	998.2	997.9	0.00915	0.003
70	30	31	Inner	0.25	997.9	997.5	0.02196	0.004
71	20	29	Outer	0.2	998.8	998.5	0.00183	0.003
72	21	30	Outer	0.2	998.8	998.5	0.00732	0.003
73	22	23	Outer	0.2	998.8	998.5	0.00732	0.003
74	23	24	Outer	0.2	998.8	998.5	0.00183	0.003
75	24	25	Outer	0.2	998.8	998.5	0.00183	0.003
76	25	26	Outer	0.2	998.8	998.5	0.00732	0.003
77	26	27	Outer	0.2	998.8	998.5	0.00183	0.003
78	28	37	Outer	0.2	998.8	998.5	0.00732	0.003
79	37	38	Inner	0.2	998.5	998.2	0.00732	0.003
80	38	39	Inner	0.2	998.2	997.9	0.00915	0.003
81	39	40	Inner	0.2	997.9	997.6	0.01098	0.003
82	40	41	Inner	0.25	997.6	997.2	0.0183	0.004
83	29	38	Outer	0.2	998.8	998.5	0.00183	0.003
84	30	39	Outer	0.2	998.8	998.5	0.00183	0.003
85	31	40	Outer	0.2	998.8	998.5	0.00183	0.003
86	32	33	Outer	0.2	998.8	998.5	0.00183	0.003
87	33	34	Outer	0.2	998.8	998.5	0.00732	0.003
88	34	35	Outer	0.2	998.8	998.5	0.00732	0.003
89	35	36	Outer	0.2	998.8	998.5	0.00183	0.003
90	37	46	Outer	0.2	998.8	998.5	0.00732	0.003
91	46	47	Inner	0.25	998.5	998.2	0.01281	0.003
92	47	48	Inner	0.3	998.2	997.9	0.02562	0.003

93	48	49	Inner	0.35	997.9	997.6	0.03843	0.003
94	49	50	Inner	0.35	997.6	997.3	0.04575	0.003
95	38	47	Outer	0.2	998.8	998.5	0.00732	0.003
96	39	48	Outer	0.2	998.8	998.5	0.00732	0.003
97	40	49	Outer	0.2	998.8	998.5	0.00183	0.003
98	41	42	Outer	0.2	998.8	998.5	0.00183	0.003
99	42	43	Outer	0.2	998.8	998.5	0.00732	0.003
100	43	44	Outer	0.2	998.8	998.5	0.00732	0.003
101	44	45	Outer	0.2	998.8	998.5	0.00183	0.003
102	46	55	Outer	0.2	998.8	998.5	0.00183	0.003
103	55	56	Inner	0.2	998.5	998.2	0.00732	0.003
104	56	57	Inner	0.25	998.2	997.9	0.01464	0.003
105	57	58	Inner	0.25	997.9	997.5	0.02196	0.004
106	58	59	Inner	0.3	997.5	997.2	0.02928	0.003
107	59	60	Inner	0.35	997.2	996.9	0.0366	0.003
108	47	56	Outer	0.2	998.8	998.5	0.00183	0.003
109	48	57	Outer	0.2	998.8	998.5	0.00183	0.003
110	49	58	Outer	0.2	998.8	998.5	0.00183	0.003
111	50	59	Outer	0.2	998.8	998.5	0.00183	0.003
112	51	52	Outer	0.2	998.8	998.5	0.00732	0.003
113	52	53	Outer	0.2	998.8	998.5	0.00732	0.003
114	53	54	Outer	0.2	998.8	998.5	0.00183	0.003
115	55	64	Outer	0.2	998.8	998.5	0.00183	0.003
116	64	65	Inner	0.2	998.5	998.2	0.00732	0.003
117	65	66	Inner	0.25	998.2	997.9	0.01464	0.003
118	66	67	Inner	0.25	997.9	997.5	0.02196	0.004
119	67	68	Inner	0.3	997.5	997.2	0.02928	0.003
120	68	69	Inner	0.35	997.2	996.9	0.0366	0.003
121	69	70	Inner	0.35	996.9	996.6	0.04392	0.003
122	56	65	Outer	0.2	998.8	998.5	0.00183	0.003
123	57	66	Outer	0.2	998.8	998.5	0.00183	0.003
124	58	67	Outer	0.2	998.8	998.5	0.00183	0.003
125	59	68	Outer	0.2	998.8	998.5	0.00183	0.003
126	60	69	Outer	0.2	998.8	998.5	0.00183	0.003
127	61	62	Outer	0.2	998.8	998.5	0.00732	0.003
128	62	63	Outer	0.2	998.8	998.5	0.00183	0.003
129	64	73	Outer	0.2	998.8	998.5	0.00183	0.003
130	73	74	Inner	0.2	998.5	998.2	0.00915	0.003
131	74	75	Inner	0.25	998.2	997.8	0.0183	0.004
132	75	76	Inner	0.3	997.8	997.5	0.02745	0.003
133	76	77	Inner	0.35	997.5	997.2	0.0366	0.003
134	77	78	Inner	0.35	997.2	996.9	0.04575	0.003
135	78	79	Inner	0.38	996.9	996.7	0.0549	0.002
136	79	80	Inner	0.4	996.7	996.5	0.06405	0.002

137	80	81	Inner	0.4	996.5	996.2	0.07869	0.003
138	65	74	Outer	0.2	998.8	998.5	0.00183	0.003
139	66	75	Outer	0.2	998.8	998.5	0.00183	0.003
140	67	76	Outer	0.2	998.8	998.5	0.00183	0.003
141	68	77	Outer	0.2	998.8	998.5	0.00183	0.003
142	69	78	Outer	0.2	998.8	998.5	0.00183	0.003
143	70	79	Outer	0.2	998.8	998.5	0.00183	0.003
144	71	80	Outer	0.2	998.8	998.5	0.00732	0.003

Benchmark network proposed by Duque et al.: Chicó [45].

Table S7. Input data Benchmark proposed by Duque et al: Chicó [45].

Manhole ID	Inflow [m³/s]	X coordinate [m]	Y coordinate [m]	Elevation [m]
1	0.012	2145.39	7352.39	2561.93
2	0.022	1982.51	7441.01	2558.9
3	0.022	1784.49	7532.93	2557.41
4	0.021	1632.28	7617.99	2557.42
5	0.016	1452.89	7704.76	2555.87
6	0.012	1317.86	7779.49	2554.95
7	0.011	2233.12	7204.6	2568.56
8	0.015	2097.16	7271.09	2563.11
9	0.013	1932.99	7372.47	2557.93
10	0.013	1835.94	7416.57	2557.33
11	0.018	1747.32	7462.52	2556.9
12	0.014	1650.5	7499.21	2556.72
13	0.017	1588	7531.5	2556.62
14	0.013	1524.17	7564.57	2555.87
15	0.013	1460.84	7597.47	2555.78
16	0.013	1397.46	7630.55	2555.37
17	0.009	1333.26	7661.29	2554.93
18	0.009	1202.87	7770.98	2553.85
19	0.011	2204.2	7149.6	2570.03
20	0.02	2065.54	7218.98	2564.85
21	0.01	1996.74	7259.19	2559.69
22	0.019	1880.41	7313.67	2558.7
23	0.013	1803.79	7353.82	2557.34
24	0.013	1715.03	7400.08	2557
25	0.009	1144.17	7710.55	2554.38
26	0.012	2157.49	7087.17	2573
27	0.016	2093.6	7119.76	2568.05
28	0.02	2029.41	7153.1	2565.71

29	0.013	1963.14	7187.67	2562.88
30	0.004	1905.84	7224.42	2560.93
31	0.021	1831.54	7256.25	2559.41
32	0.013	1765.15	7289.85	2557.9
33	0.013	1681.29	7333.85	2557.17
34	0.009	1600.04	7388.1	2557.14
35	0.014	1544.46	7448.03	2556.11
36	0.014	1481.47	7481.98	2555.69
37	0.009	1419.46	7517.89	2555.84
38	0.009	1356.12	7550.7	2555.25
39	0.013	1279.69	7558.36	2554.69
40	0.012	1197.64	7600.63	2554.59
41	0.013	1114.68	7643.68	2554.29
42	0.009	1917.32	7098.98	2564.33
43	0.013	1735.7	7224.2	2558.97
44	0.013	1645.68	7265.07	2557.4
45	0.013	1548.16	7315.99	2556.96
46	0.018	1491.4	7345.58	2556.45
47	0.018	1427.55	7377.92	2555.93
48	0.018	1364.27	7411.31	2555.47
49	0.018	1300.92	7444.2	2554.96
50	0.017	1237.38	7477.06	2554.76
51	0.017	1155.71	7519.68	2554.23
52	0.02	1072.14	7561.27	2553.85
53	0.008	1004.44	7596.19	2553.74
54	0.012	2090.9	6933.35	2575.89
55	0.012	2013.31	6965.14	2569.71
56	0.016	1954.28	7002.5	2566.98
57	0.017	1882.86	7032.93	2565.49
58	0.008	1826.73	7064.1	2564.63
59	0.016	1746.82	7099.01	2562.24
60	0.018	1686.22	7129.44	2560.5
61	0.013	1599.01	7175.99	2558.14
62	0.013	1508.1	7223.4	2557.7
63	0.013	1456.74	7260.95	2557.01
64	0.013	1381.43	7289.2	2556.29
65	0.013	1318.17	7322.35	2555.57
66	0.013	1254.73	7355.18	2555.04
67	0.013	1191.38	7388.1	2554.88
68	0.009	1109.34	7429.94	2554.65
69	0.008	962.53	7514.74	2553.56
70	0.009	2056.96	6866.81	2576.09
71	0.017	2002.76	6889.27	2570.15
72	0.013	1920.35	6933.78	2567.7
73	0.018	1832.9	6975.88	2565.94

74	0.009	1728.08	7031.72	2563.69
75	0.016	1649.08	7068.52	2561.04
76	0.017	1559.39	7112.63	2559.04
77	0.017	1471.37	7158.01	2557.99
78	0.008	1393.92	7198.28	2557.27
79	0.013	1305.24	7244.35	2555.82
80	0.009	1230.89	7282.92	2555.43
81	0.017	1155.26	7322.23	2555.31
82	0.016	1076.77	7368.03	2554.96
83	0.02	992.3	7407.29	2554.09
84	0.013	913.3	7446.36	2554.13
85	0.009	826.81	7493.27	2553.36
86	0.017	1958.45	6815.65	2573.03
87	0.026	1785.75	6898.33	2566.15
88	0.017	1604.82	6992.61	2561.96
89	0.009	1530.58	7035.67	2559.86
90	0.017	1434.47	7086.98	2558.71
91	0.025	1268.27	7173.47	2556.42
92	0.016	1116	7247.09	2555.27
93	0.008	1035.11	7288.28	2554.51
94	0.017	955.69	7336.9	2553.91
95	0.017	788.2	7419.13	2553.05
96	0.013	1910.25	6726.98	2575.18
97	0.021	1744.42	6812.62	2569.26
98	0.018	1569.16	6903.75	2564.49
99	0.013	1475.04	6952.68	2560.78
100	0.013	1391.34	6997.48	2560
101	0.008	1302.31	7041.85	2558
102	0.016	1224.8	7082.59	2555.33
103	0.016	1071.64	7162.13	2554.81
104	0.013	981.54	7207.82	2554.23
105	0.013	901.3	7249.35	2552.05
106	0.009	831.25	7286.18	2551.72
107	0.013	741.36	7334.18	2551.63
108	0.017	667.44	7367.24	2551.46
109	-	584.86	7408.61	2551.85

Table S8. Hydraulic design for the Benchmark proposed by Duque et al.: Chicó [45] with cost function of Li and Matthew [34].

Pipe	Upstream Manhole	Downstream Manhole	Type	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m³/s]	Slope [-]
1	2	9	Outer	0.2	2557.7	2556.73	0.0055	0.011

2	3	4	Outer	0.25	2556.11	2555.42	0.022	0.004
3	4	5	Inner	0.25	2555.42	2554.57	0.022	0.004
4	5	6	Inner	0.3	2554.57	2553.55	0.038	0.007
5	6	18	Inner	0.3	2553.55	2552.45	0.05	0.010
6	18	25	Inner	0.38	2552.45	2552.28	0.059	0.002
7	25	41	Inner	0.38	2552.28	2552.09	0.068	0.003
8	41	52	Inner	0.45	2552.09	2551.95	0.084	0.002
9	4	13	Outer	0.2	2556.22	2555.12	0.021	0.011
10	13	35	Outer	0.2	2555.42	2554.91	0.00425	0.005
11	16	38	Outer	0.2	2554.17	2553.85	0.00325	0.004
12	38	49	Inner	0.25	2553.85	2553.46	0.01225	0.003
13	19	7	Outer	0.2	2568.83	2567.36	0.00825	0.024
14	7	8	Inner	0.2	2567.36	2561.91	0.01925	0.036
15	19	20	Outer	0.2	2568.83	2563.65	0.00275	0.033
16	20	8	Outer	0.2	2563.65	2561.91	0.02	0.029
17	8	1	Inner	0.3	2561.91	2560.53	0.05425	0.015
18	1	2	Inner	0.3	2560.53	2557.6	0.06625	0.016
19	2	3	Inner	0.35	2557.6	2556.01	0.08275	0.007
20	3	11	Inner	0.35	2556.01	2555.5	0.08275	0.006
21	22	9	Outer	0.2	2557.5	2556.73	0.019	0.010
22	9	10	Inner	0.3	2556.73	2555.93	0.0375	0.008
23	23	10	Outer	0.2	2556.14	2555.83	0.00325	0.004
24	10	11	Inner	0.35	2555.83	2555.5	0.05375	0.003
25	28	20	Outer	0.2	2564.51	2563.65	0.005	0.011
26	20	21	Inner	0.2	2563.65	2558.49	0.00775	0.065
27	21	22	Inner	0.2	2558.49	2557.5	0.01775	0.008
28	31	22	Outer	0.2	2558.21	2557.5	0.00525	0.009
29	22	23	Inner	0.2	2557.5	2556.14	0.023	0.016
30	23	24	Inner	0.3	2556.14	2555.7	0.03275	0.004
31	34	12	Outer	0.2	2555.94	2555.52	0.00675	0.003
32	34	45	Outer	0.2	2555.94	2555.66	0.00225	0.003
33	45	46	Inner	0.2	2555.66	2555.05	0.0195	0.010
34	46	47	Inner	0.25	2555.05	2554.63	0.02275	0.006
35	37	15	Outer	0.2	2554.64	2554.28	0.00675	0.004
36	37	48	Outer	0.2	2554.64	2554.27	0.00225	0.003
37	40	41	Outer	0.2	2553.39	2553.09	0.003	0.003
38	43	32	Outer	0.2	2557.77	2556.7	0.00325	0.015
39	46	35	Outer	0.25	2555.15	2554.71	0.018	0.004
40	35	36	Inner	0.3	2554.71	2554.39	0.03625	0.004
41	47	36	Outer	0.2	2554.73	2554.29	0.0045	0.004
42	36	14	Inner	0.35	2554.29	2554.07	0.05475	0.002
43	50	39	Outer	0.2	2553.56	2553.19	0.00425	0.004
44	54	26	Outer	0.2	2574.69	2571.8	0.003	0.017
45	26	27	Inner	0.2	2571.8	2566.85	0.015	0.069
46	54	70	Outer	0.2	2574.69	2574.39	0.009	0.004

47	70	71	Inner	0.2	2574.39	2568.95	0.018	0.093
48	56	28	Outer	0.2	2565.78	2564.51	0.004	0.008
49	57	58	Outer	0.2	2564.29	2563.43	0.00425	0.013
50	58	30	Inner	0.2	2563.43	2559.73	0.01025	0.021
51	58	59	Outer	0.2	2563.43	2561.04	0.002	0.027
52	59	31	Inner	0.2	2561.04	2558.21	0.014	0.016
53	59	60	Outer	0.2	2561.04	2559.3	0.004	0.026
54	60	43	Outer	0.2	2559.3	2557.77	0.018	0.014
55	43	44	Inner	0.25	2557.77	2556.1	0.02775	0.017
56	62	63	Outer	0.2	2556.5	2555.81	0.013	0.011
57	63	64	Inner	0.2	2555.81	2554.79	0.02275	0.013
58	64	65	Inner	0.25	2554.79	2554.17	0.0325	0.009
59	65	66	Inner	0.3	2554.17	2553.74	0.04225	0.006
60	66	67	Inner	0.35	2553.74	2553.48	0.052	0.004
61	63	46	Outer	0.2	2555.81	2555.25	0.00325	0.006
62	64	47	Outer	0.2	2555.09	2554.73	0.00325	0.004
63	48	49	Inner	0.35	2553.87	2553.56	0.063	0.004
64	65	48	Outer	0.2	2554.37	2553.97	0.00325	0.004
65	66	49	Outer	0.2	2553.84	2553.46	0.00325	0.004
66	49	50	Inner	0.45	2553.46	2553.26	0.0965	0.003
67	71	55	Outer	0.2	2568.95	2568.51	0.00425	0.006
68	55	27	Inner	0.2	2568.51	2566.85	0.01625	0.010
69	27	28	Inner	0.25	2566.85	2564.41	0.04725	0.034
70	28	29	Inner	0.25	2564.41	2561.58	0.06625	0.038
71	72	56	Outer	0.2	2566.5	2565.78	0.00325	0.009
72	56	57	Inner	0.2	2565.78	2564.29	0.01525	0.019
73	73	57	Outer	0.2	2564.74	2564.29	0.0045	0.006
74	57	42	Inner	0.25	2564.29	2563.03	0.0325	0.017
75	42	29	Inner	0.25	2563.03	2561.58	0.0415	0.015
76	29	30	Inner	0.35	2561.58	2559.53	0.12075	0.030
77	30	31	Inner	0.35	2559.53	2558.01	0.135	0.019
78	31	32	Inner	0.35	2558.01	2556.4	0.16475	0.022
79	32	33	Inner	0.45	2556.4	2555.67	0.181	0.008
80	33	24	Inner	0.53	2555.67	2555.3	0.26	0.005
81	24	11	Inner	0.6	2555.3	2555	0.30575	0.004
82	11	12	Inner	0.7	2555	2554.62	0.46025	0.004
83	12	13	Inner	0.7	2554.62	2554.32	0.481	0.004
84	13	14	Inner	0.7	2554.32	2553.97	0.51475	0.005
85	14	15	Inner	0.7	2553.97	2553.48	0.5825	0.007
86	15	16	Inner	0.8	2553.48	2553.27	0.60225	0.003
87	16	17	Inner	0.8	2553.27	2553.03	0.612	0.003
88	75	60	Outer	0.2	2559.84	2559.3	0.004	0.008
89	60	61	Inner	0.2	2559.3	2556.94	0.008	0.024
90	76	61	Outer	0.2	2557.84	2556.94	0.00425	0.012
91	61	44	Inner	0.25	2556.94	2556.1	0.02525	0.008

92	44	33	Inner	0.35	2556.1	2555.77	0.066	0.004
93	17	39	Inner	0.8	2553.03	2552.59	0.621	0.004
94	39	40	Inner	0.8	2552.59	2552.29	0.63825	0.003
95	40	51	Inner	0.8	2552.29	2551.93	0.64725	0.004
96	51	52	Inner	1	2551.93	2551.65	1.1135	0.003
97	52	53	Inner	1	2551.65	2551.34	1.248	0.004
98	53	69	Inner	1	2551.34	2550.96	1.256	0.004
99	69	84	Inner	1	2550.96	2550.63	1.264	0.004
100	84	85	Inner	1	2550.63	2550.26	1.27375	0.004
101	85	95	Inner	1	2550.26	2549.95	1.28275	0.004
102	95	107	Inner	1	2549.95	2549.53	1.304	0.004
103	107	108	Inner	1	2549.53	2549.06	1.508	0.006
104	77	62	Outer	0.2	2556.79	2556.5	0.00425	0.004
105	62	45	Inner	0.2	2556.5	2555.76	0.00425	0.007
106	47	48	Inner	0.3	2554.63	2554.07	0.0395	0.008
107	81	82	Outer	0.2	2554.11	2553.76	0.00425	0.004
108	82	83	Inner	0.2	2553.76	2552.89	0.01225	0.009
109	81	92	Outer	0.2	2554.11	2553.77	0.01275	0.004
110	92	103	Inner	0.3	2553.77	2553.21	0.04475	0.006
111	103	104	Inner	0.38	2553.21	2552.33	0.12625	0.009
112	104	105	Inner	0.38	2552.33	2550.65	0.15125	0.019
113	82	68	Outer	0.2	2553.76	2553.45	0.004	0.004
114	68	51	Inner	0.2	2553.45	2553.03	0.013	0.004
115	82	93	Outer	0.2	2553.76	2553.31	0.004	0.005
116	93	104	Inner	0.2	2553.31	2552.93	0.012	0.004
117	83	94	Outer	0.2	2552.89	2552.61	0.005	0.004
118	94	105	Inner	0.2	2552.61	2550.85	0.01775	0.017
119	84	83	Outer	0.2	2552.93	2552.59	0.00325	0.004
120	83	52	Inner	0.3	2552.59	2552.05	0.0305	0.003
121	86	71	Outer	0.2	2571.83	2568.95	0.016	0.034
122	71	72	Inner	0.25	2568.95	2566.4	0.04675	0.027
123	72	73	Inner	0.3	2566.4	2564.64	0.0565	0.018
124	87	73	Outer	0.25	2564.85	2564.34	0.026	0.006
125	73	74	Inner	0.35	2564.34	2562.29	0.096	0.017
126	74	75	Inner	0.35	2562.29	2559.64	0.105	0.030
127	75	76	Inner	0.35	2559.64	2557.64	0.148	0.020
128	90	77	Outer	0.2	2557.51	2556.79	0.00425	0.009
129	91	79	Outer	0.2	2555.22	2554.62	0.00625	0.008
130	91	102	Outer	0.2	2555.22	2554.13	0.01875	0.011
131	94	95	Outer	0.2	2552.71	2551.85	0.00425	0.005
132	96	86	Outer	0.2	2573.98	2571.83	0.00325	0.021
133	86	87	Inner	0.2	2571.83	2564.95	0.00425	0.036
134	96	97	Outer	0.2	2573.98	2568.06	0.00975	0.032
135	97	98	Inner	0.2	2568.06	2563.29	0.0255	0.024
136	98	99	Inner	0.2	2563.29	2559.38	0.039	0.037

137	99	89	Inner	0.25	2559.38	2558.26	0.039	0.011
138	89	76	Inner	0.3	2558.26	2557.64	0.048	0.008
139	97	87	Outer	0.2	2568.06	2564.95	0.00525	0.033
140	87	88	Inner	0.2	2564.95	2560.76	0.0095	0.021
141	98	88	Outer	0.2	2563.29	2560.76	0.0045	0.026
142	88	75	Inner	0.25	2560.76	2559.74	0.031	0.012
143	76	77	Inner	0.45	2557.64	2556.49	0.20875	0.012
144	77	78	Inner	0.45	2556.49	2555.57	0.22575	0.011
145	78	79	Inner	0.45	2555.57	2554.32	0.23375	0.013
146	79	80	Inner	0.5	2554.32	2553.73	0.253	0.007
147	80	81	Inner	0.6	2553.73	2553.51	0.262	0.003
148	81	67	Inner	0.6	2553.51	2553.28	0.262	0.003
149	67	50	Inner	0.6	2553.28	2552.86	0.327	0.004
150	50	51	Inner	0.7	2552.86	2552.53	0.43625	0.004
151	99	100	Outer	0.2	2559.58	2558.8	0.013	0.008
152	100	101	Inner	0.2	2558.8	2556.8	0.02275	0.020
153	101	102	Inner	0.2	2556.8	2554.13	0.03075	0.030
154	102	103	Inner	0.35	2554.13	2553.41	0.0655	0.004
155	100	90	Outer	0.2	2558.8	2557.51	0.00325	0.013
156	90	91	Inner	0.2	2557.51	2555.22	0.016	0.012
157	91	92	Inner	0.2	2555.22	2554.07	0.016	0.007
158	105	106	Inner	0.5	2550.65	2550.22	0.182	0.005
159	106	107	Inner	0.5	2550.22	2549.83	0.191	0.004
160	108	109	Inner	0.9	2548.36	2547.35	1.525	0.011

Table S9. Hydraulic design for the Benchmark proposed by Duque et al.: Chicó [45] with cost function of Maurer et al. [47].

Pipe	Upstream Manhole	Downstream Manhole	Type	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
1	2	3	Outer	0.25	2557.6	2556.11	0.022	0.007
2	3	11	Inner	0.3	2556.11	2555.6	0.0385	0.006
3	3	4	Outer	0.2	2556.21	2555.62	0.0055	0.003
4	4	13	Inner	0.25	2555.62	2555.22	0.02125	0.004
5	4	5	Outer	0.2	2556.22	2554.67	0.00525	0.008
6	5	6	Inner	0.25	2554.67	2553.65	0.02125	0.007
7	6	18	Inner	0.25	2553.65	2552.55	0.03325	0.010
8	18	25	Inner	0.35	2552.55	2552.28	0.04225	0.003
9	25	41	Inner	0.35	2552.28	2552.09	0.05125	0.003
10	41	52	Inner	0.38	2552.09	2551.85	0.06725	0.003
11	13	35	Outer	0.2	2555.42	2554.91	0.00425	0.005
12	14	15	Outer	0.2	2554.67	2554.38	0.00325	0.004
13	16	38	Outer	0.2	2554.17	2553.85	0.00325	0.004

14	38	49	Inner	0.25	2553.85	2553.46	0.01225	0.003
15	19	7	Outer	0.2	2568.83	2567.36	0.00275	0.024
16	7	8	Inner	0.2	2567.36	2561.91	0.01375	0.036
17	19	20	Outer	0.2	2568.83	2563.65	0.00825	0.033
18	20	8	Outer	0.2	2563.65	2561.91	0.005	0.029
19	8	1	Inner	0.25	2561.91	2560.63	0.03375	0.014
20	1	2	Inner	0.25	2560.63	2557.6	0.04575	0.016
21	2	9	Inner	0.3	2557.6	2556.53	0.04575	0.013
22	9	10	Inner	0.35	2556.53	2555.93	0.0635	0.006
23	22	9	Outer	0.2	2557.5	2556.73	0.00475	0.010
24	23	10	Outer	0.2	2556.14	2555.83	0.00325	0.004
25	10	11	Inner	0.38	2555.83	2555.5	0.07975	0.003
26	28	20	Outer	0.2	2564.51	2563.65	0.005	0.011
27	20	21	Inner	0.2	2563.65	2558.49	0.02825	0.065
28	21	22	Inner	0.25	2558.49	2557.1	0.03825	0.011
29	22	23	Inner	0.3	2557.1	2556.04	0.05775	0.012
30	31	22	Outer	0.2	2558.21	2557.5	0.00525	0.009
31	23	24	Inner	0.35	2556.04	2555.6	0.0675	0.004
32	34	12	Outer	0.2	2555.94	2555.52	0.00675	0.003
33	34	45	Outer	0.2	2555.94	2555.66	0.00225	0.003
34	45	46	Inner	0.2	2555.66	2555.05	0.0185	0.010
35	46	47	Inner	0.3	2555.05	2554.53	0.03525	0.007
36	37	15	Outer	0.2	2554.64	2554.28	0.00675	0.004
37	15	16	Inner	0.25	2554.28	2553.97	0.023	0.004
38	16	17	Inner	0.3	2553.97	2553.53	0.03275	0.006
39	17	39	Inner	0.35	2553.53	2553.19	0.04175	0.003
40	37	48	Outer	0.2	2554.64	2554.27	0.00225	0.003
41	40	41	Outer	0.2	2553.39	2553.09	0.003	0.003
42	43	32	Outer	0.2	2557.77	2556.7	0.00325	0.015
43	46	35	Outer	0.2	2555.25	2554.81	0.0045	0.004
44	35	36	Inner	0.25	2554.81	2554.39	0.02275	0.006
45	50	39	Outer	0.2	2553.56	2553.19	0.00425	0.004
46	39	40	Inner	0.35	2553.19	2552.89	0.059	0.003
47	40	51	Inner	0.35	2552.89	2552.53	0.068	0.004
48	54	26	Outer	0.2	2574.69	2571.8	0.009	0.017
49	26	27	Inner	0.2	2571.8	2566.85	0.021	0.069
50	54	70	Outer	0.2	2574.69	2574.39	0.003	0.004
51	70	71	Inner	0.2	2574.39	2568.95	0.012	0.093
52	56	28	Outer	0.2	2565.78	2564.51	0.016	0.008
53	57	58	Outer	0.2	2564.29	2563.43	0.00425	0.013
54	58	59	Inner	0.2	2563.43	2561.04	0.01025	0.027
55	59	60	Inner	0.2	2561.04	2559.3	0.02225	0.026
56	58	30	Outer	0.2	2563.43	2559.73	0.002	0.021
57	59	31	Outer	0.2	2561.04	2558.21	0.004	0.016
58	60	43	Outer	0.2	2559.3	2557.77	0.0045	0.014

59	43	44	Inner	0.2	2557.77	2556.2	0.01425	0.016
60	62	45	Outer	0.2	2556.5	2555.76	0.00325	0.007
61	63	46	Outer	0.2	2555.81	2555.25	0.00325	0.006
62	64	47	Outer	0.2	2555.09	2554.73	0.00325	0.004
63	65	48	Outer	0.2	2554.37	2553.97	0.00325	0.004
64	66	49	Outer	0.2	2553.84	2553.46	0.00325	0.004
65	51	52	Inner	1	2552.13	2551.85	1.13025	0.003
66	71	55	Outer	0.2	2568.95	2568.51	0.00425	0.006
67	55	27	Inner	0.2	2568.51	2566.85	0.01625	0.010
68	27	28	Inner	0.25	2566.85	2564.41	0.05325	0.034
69	28	29	Inner	0.3	2564.41	2561.58	0.08425	0.038
70	72	56	Outer	0.2	2566.5	2565.78	0.004	0.009
71	56	57	Inner	0.2	2565.78	2564.29	0.004	0.019
72	73	57	Outer	0.2	2564.74	2564.29	0.0045	0.006
73	57	42	Inner	0.2	2564.29	2563.13	0.02125	0.016
74	42	29	Inner	0.25	2563.13	2561.58	0.03025	0.016
75	29	30	Inner	0.35	2561.58	2559.53	0.1275	0.030
76	30	31	Inner	0.35	2559.53	2558.01	0.1335	0.019
77	31	32	Inner	0.35	2558.01	2556.5	0.15325	0.020
78	32	33	Inner	0.45	2556.5	2555.67	0.1695	0.009
79	75	60	Outer	0.2	2559.84	2559.3	0.004	0.008
80	60	61	Inner	0.25	2559.3	2556.84	0.03975	0.025
81	76	77	Outer	0.2	2557.84	2556.79	0.017	0.011
82	77	62	Outer	0.2	2556.79	2556.5	0.00425	0.004
83	62	63	Inner	0.2	2556.5	2555.81	0.014	0.011
84	63	64	Inner	0.25	2555.81	2554.99	0.02375	0.010
85	64	65	Inner	0.25	2554.99	2554.27	0.0335	0.010
86	65	66	Inner	0.3	2554.27	2553.74	0.04325	0.007
87	66	67	Inner	0.35	2553.74	2553.48	0.053	0.004
88	81	82	Outer	0.2	2554.11	2553.66	0.01275	0.005
89	82	83	Inner	0.2	2553.66	2552.89	0.01275	0.008
90	81	92	Outer	0.2	2554.11	2553.77	0.00425	0.004
91	92	103	Inner	0.3	2553.77	2553.41	0.0265	0.004
92	82	68	Outer	0.2	2553.76	2553.45	0.004	0.004
93	68	51	Inner	0.2	2553.45	2553.03	0.013	0.004
94	82	93	Outer	0.2	2553.76	2553.31	0.012	0.005
95	93	104	Inner	0.25	2553.31	2552.93	0.02	0.004
96	83	84	Outer	0.2	2552.89	2552.53	0.005	0.004
97	84	85	Inner	0.2	2552.53	2551.96	0.01475	0.006
98	85	95	Inner	0.25	2551.96	2551.55	0.02375	0.005
99	95	107	Inner	0.3	2551.55	2550.33	0.045	0.013
100	84	69	Outer	0.2	2552.93	2552.36	0.00325	0.007
101	69	53	Inner	0.2	2552.36	2552.04	0.01125	0.003
102	53	52	Inner	0.25	2552.04	2551.75	0.01925	0.004
103	52	83	Inner	1	2551.75	2551.09	1.23675	0.004

104	83	94	Inner	1	2551.09	2550.81	1.2645	0.004
105	94	105	Inner	1	2550.81	2550.05	1.27725	0.007
106	86	71	Outer	0.2	2571.83	2568.95	0.00425	0.034
107	71	72	Inner	0.2	2568.95	2566.5	0.029	0.026
108	72	73	Inner	0.25	2566.5	2564.64	0.038	0.019
109	87	73	Outer	0.2	2564.95	2564.64	0.0065	0.003
110	73	74	Inner	0.3	2564.64	2562.39	0.058	0.019
111	74	75	Inner	0.3	2562.39	2559.74	0.067	0.030
112	90	77	Outer	0.2	2557.51	2556.79	0.00425	0.009
113	77	78	Inner	0.25	2556.79	2555.97	0.034	0.009
114	78	79	Inner	0.25	2555.97	2554.52	0.042	0.015
115	79	80	Inner	0.35	2554.52	2554.03	0.06125	0.006
116	91	79	Outer	0.2	2555.22	2554.62	0.00625	0.008
117	80	81	Inner	0.38	2554.03	2553.81	0.07025	0.003
118	81	67	Inner	0.38	2553.81	2553.48	0.07025	0.004
119	67	50	Inner	0.5	2553.48	2553.26	0.13625	0.002
120	91	92	Outer	0.2	2555.22	2554.07	0.00625	0.007
121	104	105	Inner	0.35	2552.33	2550.65	0.15075	0.019
122	94	95	Outer	0.2	2552.71	2551.85	0.00425	0.005
123	96	86	Outer	0.2	2573.98	2571.83	0.00325	0.021
124	86	87	Inner	0.2	2571.83	2564.95	0.016	0.036
125	96	97	Outer	0.2	2573.98	2568.06	0.00975	0.032
126	97	87	Inner	0.2	2568.06	2564.95	0.00975	0.033
127	87	88	Inner	0.25	2564.95	2560.66	0.04525	0.021
128	88	75	Inner	0.3	2560.66	2559.54	0.06675	0.013
129	75	76	Inner	0.35	2559.54	2557.64	0.14575	0.019
130	97	98	Outer	0.2	2568.06	2563.29	0.021	0.024
131	98	99	Inner	0.2	2563.29	2559.58	0.0345	0.035
132	99	89	Inner	0.25	2559.58	2558.56	0.0345	0.010
133	89	76	Inner	0.3	2558.56	2557.74	0.0435	0.010
134	98	88	Outer	0.2	2563.29	2560.76	0.0045	0.026
135	76	61	Inner	0.4	2557.64	2556.54	0.18925	0.015
136	61	44	Inner	0.5	2556.54	2555.9	0.242	0.006
137	44	33	Inner	0.6	2555.9	2555.57	0.26925	0.004
138	33	24	Inner	0.7	2555.57	2555.3	0.45175	0.004
139	24	11	Inner	0.8	2555.3	2555.1	0.53225	0.003
140	11	12	Inner	0.8	2555.1	2554.72	0.6685	0.004
141	12	13	Inner	0.8	2554.72	2554.42	0.68925	0.004
142	13	14	Inner	0.8	2554.42	2553.97	0.72325	0.006
143	14	36	Inner	0.9	2553.97	2553.69	0.733	0.003
144	36	47	Inner	0.9	2553.69	2553.33	0.76975	0.003
145	47	48	Inner	0.9	2553.33	2553.07	0.82625	0.004
146	48	49	Inner	0.9	2553.07	2552.76	0.84975	0.004
147	49	50	Inner	0.9	2552.76	2552.46	0.88325	0.004
148	50	51	Inner	1	2552.46	2552.23	1.03225	0.002

149	105	106	Inner	1	2550.05	2549.62	1.441	0.005
150	106	107	Inner	1	2549.62	2549.13	1.45	0.005
151	107	108	Inner	1	2549.13	2548.66	1.508	0.006
152	108	109	Inner	1	2548.66	2548.15	1.525	0.006
153	99	100	Outer	0.2	2559.58	2558.8	0.013	0.008
154	100	101	Inner	0.2	2558.8	2556.8	0.02275	0.020
155	101	102	Inner	0.2	2556.8	2554.13	0.03075	0.030
156	103	104	Inner	0.38	2553.31	2552.53	0.11775	0.008
157	100	90	Outer	0.2	2558.8	2557.51	0.00325	0.013
158	90	91	Inner	0.2	2557.51	2555.22	0.016	0.012
159	91	102	Inner	0.25	2555.22	2554.03	0.0285	0.012
160	102	103	Inner	0.38	2554.03	2553.41	0.07525	0.004

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