SUPPLEMENTARY MATERIAL

The Git repository https://bitbucket.org/nduquevillarreal/snd_java-xpress.git contains the updated version of the code. This supplementary material presents the input data and the detailed results for the design of all case studies presented.

Benchmark proposed by Li and Matthew [34] .

Table S.1. Input data Benchmark proposed by Li and Matthew [34] . The exact x and y coordinates are not defined, however the length of the pipes is known.

Manhole ID	Q_i [$\mathrm{m^3/s}$]	z [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

Manhole ID	Q_i [m^3/s]	z [m]
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	0	2.2

Table S.2. Hydraulic design for the Benchmark proposed by Li and Matthew [34].

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
1	4	3	outer	0.2	1.30	-0.17	0.0040	0.003

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
2	1	2	outer	0.2	1.30	0.22	0.0013	0.003
3	2	55	inner	0.25	-0.17	-1.13	0.0176	0.0038
4	1	7	outer	0.2	0.87	-0.03	0.0078	0.003
5	19	18	inner	0.2	1.59	0.87	0.0029	0.003
6	5	8	inner	0.2	0.60	-0.18	0.0069	0.003
7	6	11	inner	0.3	-1.97	-2.59	0.0302	0.0027
8	7	8	inner	0.25	-0.05	-0.92	0.0125	0.003
9	8	9	inner	0.35	-0.92	-1.45	0.0360	0.0024
10	9	15	inner	0.38	-1.45	-1.94	0.0458	0.002
11	10	11	outer	0.2	1.65	0.51	0.0025	0.003
12	10	55	outer	0.2	1.65	0.72	0.0025	0.003
13	3	2	inner	0.2	0.65	-0.18	0.0072	0.003
14	11	17	inner	0.38	-2.59	-2.96	0.0538	0.0019
15	12	11	outer	0.2	1.59	1.02	0.0045	0.003
16	13	7	outer	0.2	1.00	-0.05	0.0017	0.003
17	13	18	outer	0.2	1.00	0.10	0.0052	0.003
18	14	8	outer	0.2	1.20	0.39	0.0062	0.003
19	14	19	outer	0.2	1.20	0.51	0.0021	0.003
20	15	20	inner	0.38	-1.94	-2.30	0.0479	0.002
21	16	10	outer	0.2	1.40	0.65	0.0022	0.003
22	19	20	inner	0.2	1.40	0.80	0.0007	0.003
23	17	22	inner	0.4	-2.96	-3.31	0.0594	0.003
24	18	25	inner	0.25	0.10	-0.98	0.0115	0.003
25	10	9	outer	0.2	1.00	-0.05	0.0021	0.003
26	26	19	inner	0.25	-0.91	-1.81	0.0131	0.003
27	20	27	inner	0.45	-2.30	-2.69	0.0756	0.0015
28	21	20	outer	0.2	1.25	0.29	0.0033	0.003
29	21	28	inner	0.25	0.09	-0.69	0.0136	0.003
30	22	23	inner	0.45	-3.31	-3.80	0.0726	0.0015
31	16	21	outer	0.2	1.20	0.09	0.0029	0.003
32	23	35	inner	0.45	-3.80	-4.43	0.0812	0.0014
33	22	21	outer	0.2	1.15	0.28	0.0029	0.003
34	33	32	inner	0.2	0.28	-1.04	0.0102	0.003
35	25	30	inner	0.25	-0.98	-2.06	0.0173	0.0039
36	49	50	inner	0.2	0.02	-0.91	0.0029	0.003
37	27	32	inner	0.5	-2.69	-2.95	0.0841	0.0014
38	28	33	inner	0.25	-0.69	-1.58	0.0172	0.0039
39	29	34	outer	0.2	1.00	0.37	0.0045	0.003

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
40	29	22	outer	0.2	1.00	0.31	0.0015	0.003
41	30	31	inner	0.25	-2.06	-2.85	0.0211	0.0034
42	31	32	inner	0.3	-2.85	-3.65	0.0229	0.0032
43	31	39	outer	0.2	0.80	0.02	0.0009	0.003
44	31	26	outer	0.2	0.80	0.05	0.0009	0.003
45	32	40	inner	0.53	-3.65	-3.86	0.1366	0.0015
46	37	34	inner	0.3	-1.58	-2.33	0.0220	0.0033
47	33	34	outer	0.2	0.75	-0.30	0.0016	0.003
48	48	42	inner	0.2	-0.30	-0.84	0.0104	0.003
49	34	35	outer	0.2	0.80	-0.16	0.0024	0.003
50	35	43	inner	0.5	-4.43	-4.84	0.1193	0.0014
51	36	35	inner	0.3	-1.18	-2.09	0.0261	0.0029
52	44	36	inner	0.25	-0.84	-1.29	0.0137	0.003
53	38	45	inner	0.2	0.09	-0.60	0.0034	0.003
54	39	40	inner	0.2	0.05	-0.76	0.0033	0.003
55	39	38	outer	0.2	0.90	0.09	0.0006	0.003
56	40	41	inner	0.6	-3.86	-4.22	0.1457	0.0014
57	41	42	inner	0.6	-4.22	-4.65	0.1503	0.0013
58	43	44	outer	0.2	0.90	0.00	0.0015	0.003
59	42	43	inner	0.6	-4.65	-5.01	0.1757	0.0012
60	43	49	inner	0.7	-5.01	-5.42	0.2975	0.0015
61	23	24	inner	0.2	0.80	-0.13	0.0008	0.003
62	24	36	inner	0.2	-0.13	-1.18	0.0054	0.003
63	45	51	inner	0.2	-0.60	-1.29	0.0083	0.003
64	48	42	outer	0.2	0.90	0.06	0.0007	0.003
65	48	47	outer	0.2	0.90	0.06	0.0021	0.003
66	47	52	inner	0.25	0.00	-1.09	0.0163	0.004
67	46	47	outer	0.2	0.90	0.00	0.0020	0.003
68	41	47	outer	0.2	0.90	0.21	0.0060	0.003
69	49	54	inner	0.7	-5.42	-5.76	0.3008	0.0015
70	46	39	outer	0.2	0.90	-0.03	0.0050	0.003
71	50	44	inner	0.2	0.10	-0.68	0.0033	0.003
72	51	52	inner	0.2	-1.29	-1.83	0.0109	0.003
73	52	53	inner	0.3	-1.83	-2.84	0.0272	0.0029
74	53	54	inner	0.3	-2.84	-3.85	0.0272	0.0029
75	54	56	inner	0.7	-5.76	-6.25	0.3279	0.0018
76	55	6	inner	0.25	-1.13	-1.97	0.0202	0.0035
77	55	5	outer	0.2	1.50	0.60	0.0050	0.003

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
78	56	50	outer	0.2	1.00	0.10	0.0033	0.003
79	56	57	inner	0.7	-6.25	-7.18	0.3378	0.0019

Benchmark proposed by Moeini and Afshar [31].

Table S.3. Input data Benchmark proposed by Moeini and Afshar [31] .

Manhole ID	Q_i [m^3/s]	x [m]	y [m]	z [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

Manhole ID	Q_i [m^3/s]	x [m]	y [m]	z [m]
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

Manhole ID	Q_i [m$^3/s$]	x [m]	y [m]	z [m]
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	-0.59292	900	800	1000

Table S.4. Hydraulic design for the Benchmark proposed by Moeini and Afshar [31].

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
1	2	1	outer	0.8	994.9	994.6	0.5901	0.003
2	3	2	outer	0.8	995.2	994.9	0.5832	0.003
3	3	4	inner	0.2	998.8	998.4	0.0012	0.004
4	4	5	outer	0.2	998.4	998.0	0.0012	0.004
5	5	6	inner	0.2	998.8	998.4	0.0012	0.004
6	7	6	outer	0.2	998.4	998.0	0.0081	0.004
7	8	7	inner	0.2	998.8	998.4	0.0012	0.004
8	9	8	inner	0.2	998.8	998.4	0.0017	0.004
9	1	10	inner	0.2	998.8	998.4	0.0006	0.004
10	11	2	inner	0.2	998.8	998.4	0.0023	0.004
11	12	3	outer	0.8	995.5	995.2	0.5797	0.003
12	4	13	inner	0.2	998.8	998.4	0.0046	0.004
13	5	14	outer	0.2	998.0	997.6	0.0046	0.004
14	6	15	outer	0.25	998.0	997.6	0.0139	0.004
15	16	7	inner	0.2	998.8	998.4	0.0023	0.004
16	8	17	outer	0.2	998.4	998.0	0.0052	0.004
17	9	18	inner	0.2	998.8	998.4	0.0006	0.004
18	10	11	outer	0.2	998.4	998.0	0.0064	0.004
19	11	12	outer	0.25	998.0	997.5	0.0156	0.005
20	13	12	outer	0.25	998.4	998.0	0.0139	0.004
21	14	13	inner	0.2	998.8	998.4	0.0023	0.004
22	15	14	outer	0.45	997.1	996.9	0.0774	0.002
23	16	15	outer	0.38	997.3	997.1	0.0520	0.002
24	17	16	outer	0.35	997.6	997.3	0.0428	0.003
25	18	17	outer	0.2	998.4	998.0	0.0098	0.004
26	19	10	inner	0.2	998.8	998.4	0.0012	0.004
27	20	11	inner	0.2	998.8	998.4	0.0023	0.004
28	21	12	outer	0.8	995.8	995.5	0.5410	0.003
29	13	22	inner	0.2	998.8	998.4	0.0023	0.004
30	14	23	outer	0.45	996.9	996.7	0.0890	0.002
31	24	15	inner	0.2	998.8	998.4	0.0023	0.004
32	25	16	inner	0.2	998.8	998.4	0.0023	0.004
33	26	17	outer	0.25	998.0	997.6	0.0185	0.004
34	27	18	inner	0.2	998.8	998.4	0.0046	0.004
35	19	20	inner	0.2	998.8	998.4	0.0023	0.004
36	20	21	outer	0.3	997.6	997.3	0.0312	0.003
37	22	21	outer	0.8	996.0	995.8	0.4670	0.002
38	23	22	outer	0.5	996.7	996.5	0.1214	0.002
39	24	23	outer	0.25	998.0	997.6	0.0208	0.004
40	25	24	outer	0.2	998.4	998.0	0.0116	0.004
41	26	25	inner	0.2	998.8	998.4	0.0023	0.004
42	27	26	outer	0.2	998.4	998.0	0.0012	0.004
43	19	28	inner	0.2	998.8	998.4	0.0012	0.004
44	29	20	outer	0.25	998.0	997.6	0.0220	0.004
45	30	21	outer	0.35	997.6	997.3	0.0335	0.003

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
46	31	22	outer	0.8	996.1	996.0	0.3341	0.001
47	32	23	inner	0.2	998.8	998.4	0.0023	0.004
48	33	24	inner	0.2	998.8	998.4	0.0023	0.004
49	34	25	inner	0.2	998.8	998.4	0.0023	0.004
50	35	26	outer	0.2	998.4	998.0	0.0104	0.004
51	36	27	inner	0.2	998.8	998.4	0.0012	0.004
52	28	29	outer	0.2	998.4	998.0	0.0081	0.004
53	30	29	inner	0.2	998.8	998.4	0.0023	0.004
54	31	30	inner	0.2	998.8	998.4	0.0023	0.004
55	32	31	outer	0.3	997.5	997.2	0.0254	0.003
56	33	32	outer	0.25	998.0	997.5	0.0162	0.005
57	34	33	outer	0.2	998.4	998.0	0.0116	0.004
58	35	34	inner	0.2	998.8	998.4	0.0023	0.004
59	36	35	inner	0.2	998.8	998.4	0.0012	0.004
60	37	28	inner	0.2	998.8	998.4	0.0023	0.004
61	38	29	inner	0.2	998.8	998.4	0.0023	0.004
62	39	30	outer	0.3	998.0	997.6	0.0243	0.004
63	40	31	outer	0.8	996.2	996.1	0.3017	0.001
64	41	32	inner	0.2	998.8	998.4	0.0023	0.004
65	33	42	inner	0.2	998.8	998.4	0.0023	0.004
66	43	34	inner	0.2	998.8	998.4	0.0023	0.004
67	44	35	inner	0.2	998.8	998.4	0.0023	0.004
68	36	45	inner	0.2	998.8	998.4	0.0023	0.004
69	37	38	inner	0.2	998.8	998.4	0.0012	0.004
70	38	39	outer	0.2	998.4	998.0	0.0104	0.004
71	40	39	inner	0.2	998.8	998.4	0.0023	0.004
72	41	40	outer	0.7	996.4	996.2	0.1884	0.002
73	42	41	outer	0.25	998.4	997.9	0.0162	0.005
74	43	42	inner	0.2	998.8	998.4	0.0023	0.004
75	44	43	inner	0.2	998.8	998.4	0.0058	0.004
76	45	44	inner	0.2	998.8	998.4	0.0012	0.004
77	37	46	inner	0.2	998.8	998.4	0.0012	0.004
78	47	38	inner	0.2	998.8	998.4	0.0023	0.004
79	48	39	inner	0.2	998.8	998.4	0.0023	0.004
80	49	40	outer	0.7	996.5	996.3	0.1063	0.002
81	50	41	outer	0.53	996.6	996.4	0.1653	0.002
82	51	42	inner	0.2	998.8	998.4	0.0023	0.004
83	43	52	outer	0.2	998.4	998.0	0.0104	0.004
84	44	53	outer	0.2	998.4	998.0	0.0023	0.004
85	45	54	outer	0.2	998.4	998.0	0.0058	0.004
86	46	47	outer	0.2	998.4	998.0	0.0046	0.004
87	47	48	outer	0.38	996.9	996.7	0.0485	0.002
88	48	49	outer	0.45	996.7	996.5	0.0832	0.002
89	50	49	inner	0.2	998.8	998.4	0.0023	0.004
90	51	50	outer	0.53	996.8	996.6	0.1607	0.002
91	52	51	outer	0.38	997.3	997.1	0.0474	0.002
92	53	52	outer	0.3	997.6	997.3	0.0254	0.003
93	54	53	outer	0.2	998.0	997.6	0.0116	0.004

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
94	46	55	inner	0.2	998.8	998.4	0.0012	0.004
95	56	47	outer	0.35	997.2	996.9	0.0370	0.003
96	57	48	outer	0.3	998.0	997.7	0.0277	0.003
97	58	49	outer	0.2	998.4	998.0	0.0116	0.004
98	50	59	inner	0.2	998.8	998.4	0.0023	0.004
99	60	51	outer	0.5	997.0	996.8	0.1063	0.002
100	61	52	inner	0.2	998.8	998.4	0.0023	0.004
101	62	53	inner	0.2	998.8	998.4	0.0023	0.004
102	63	54	outer	0.2	998.4	998.0	0.0012	0.004
103	55	56	outer	0.25	998.0	997.6	0.0133	0.004
104	56	57	inner	0.2	998.8	998.4	0.0023	0.004
105	58	57	inner	0.2	998.8	998.4	0.0023	0.004
106	59	58	inner	0.2	998.8	998.4	0.0023	0.004
107	59	60	outer	0.2	998.4	998.0	0.0116	0.004
108	61	60	outer	0.25	998.0	997.6	0.0231	0.004
109	62	61	outer	0.25	998.4	998.0	0.0139	0.004
110	63	62	inner	0.2	998.8	998.4	0.0046	0.004
111	64	55	outer	0.2	998.4	998.0	0.0075	0.004
112	65	56	outer	0.25	997.6	997.2	0.0168	0.004
113	66	57	outer	0.25	998.4	998.0	0.0139	0.004
114	67	58	inner	0.2	998.8	998.4	0.0023	0.004
115	68	59	inner	0.2	998.8	998.4	0.0023	0.004
116	69	60	outer	0.38	997.2	997.0	0.0624	0.002
117	70	61	inner	0.2	998.8	998.4	0.0023	0.004
118	71	62	inner	0.2	998.8	998.4	0.0023	0.004
119	72	63	inner	0.2	998.8	998.4	0.0012	0.004
120	65	64	inner	0.2	998.8	998.4	0.0023	0.004
121	66	65	inner	0.2	998.8	998.4	0.0023	0.004
122	67	66	inner	0.2	998.8	998.4	0.0023	0.004
123	67	68	outer	0.2	998.0	997.6	0.0092	0.004
124	68	69	outer	0.25	997.6	997.2	0.0208	0.004
125	70	69	outer	0.3	997.5	997.2	0.0312	0.003
126	71	70	outer	0.25	998.0	997.5	0.0162	0.005
127	72	71	outer	0.2	998.4	998.0	0.0052	0.004
128	73	64	inner	0.2	998.8	998.4	0.0006	0.004
129	74	65	outer	0.2	998.0	997.6	0.0075	0.004
130	75	66	inner	0.2	998.8	998.4	0.0046	0.004
131	76	67	outer	0.2	998.4	998.0	0.0046	0.004
132	77	68	outer	0.2	998.4	998.0	0.0046	0.004
133	78	69	inner	0.2	998.8	998.4	0.0012	0.004
134	79	70	outer	0.2	998.0	997.6	0.0081	0.004
135	80	71	inner	0.2	998.8	998.4	0.0040	0.004
136	81	72	inner	0.2	998.8	998.4	0.0017	0.004
137	73	74	inner	0.2	998.8	998.4	0.0017	0.004
138	75	74	outer	0.2	998.4	998.0	0.0012	0.004
139	76	75	inner	0.2	998.8	998.4	0.0012	0.004
140	77	76	inner	0.2	998.8	998.4	0.0012	0.004
141	78	77	inner	0.2	998.8	998.4	0.0012	0.004

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
142	78	79	inner	0.2	998.8	998.4	0.0023	0.004
143	80	79	outer	0.2	998.4	998.0	0.0012	0.004
144	81	80	inner	0.2	998.8	998.4	0.0006	0.004

Real sewer network: Chicó

Table S.5. Input data for the manholes of Chicó's sewer network (109 maholes).

Manhole ID	Q_i [m^3/s]	x [m]	y [m]	z [m]
1	0.012	2145.39	7352.39	2561.93
2	0.022	1982.51	7441.01	2558.90
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	7204.60	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	2556.90
12	0.014	1650.50	7499.21	2556.72
13	0.017	1588.00	7531.50	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

Manhole ID	Q_i $[\mathrm{m}^3/s]$	x [m]	y [m]	z [m]
17	0.009	1333.26	7661.29	2554.93
18	0.009	1202.87	7770.98	2553.85
19	0.011	2204.20	7149.60	2570.03
20	0.020	2065.54	7218.98	2564.85
21	0.010	1996.74	7259.19	2559.69
22	0.019	1880.41	7313.67	2558.70
23	0.013	1803.79	7353.82	2557.34
24	0.013	1715.03	7400.08	2557.00
25	0.009	1144.17	7710.55	2554.38
26	0.012	2157.49	7087.17	2573.00
27	0.016	2093.60	7119.76	2568.05
28	0.020	2029.41	7153.10	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	2557.90
33	0.013	1681.29	7333.85	2557.16
34	0.009	1600.04	7388.10	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	7550.70	2555.25

Manhole ID	Q_i [m^3/s]	x [m]	y [m]	z [m]
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	1735.70	7224.20	2558.97
44	0.013	1645.68	7265.07	2557.40
45	0.013	1548.16	7315.99	2556.96
46	0.018	1491.40	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	7444.20	2554.96
50	0.017	1237.38	7477.06	2554.76
51	0.017	1155.71	7519.68	2554.23
52	0.020	1072.14	7561.27	2553.85
53	0.008	1004.44	7596.19	2553.74
54	0.012	2090.90	6933.35	2575.89
55	0.012	2013.31	6965.14	2569.71
56	0.016	1954.28	7002.50	2566.98
57	0.017	1882.86	7032.93	2565.49
58	0.008	1826.73	7074.10	2564.63
59	0.016	1746.82	7099.01	2562.24
60	0.018	1686.22	7129.44	2560.50

Manhole ID	Q_i $[\mathrm{m}^3/s]$	x [m]	y [m]	z [m]
61	0.013	1599.01	7175.99	2558.14
62	0.013	1508.10	7223.40	2557.70
63	0.013	1456.74	7260.95	2557.01
64	0.013	1381.43	7289.20	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	7388.10	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	2567.70
73	0.018	1832.90	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

Manhole ID	Q_i [m^3/s]	x [m]	y [m]	z [m]
83	0.020	992.30	7407.29	2554.09
84	0.013	913.30	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	1116.00	7247.09	2555.27
93	0.008	1035.11	7288.28	2554.51
94	0.017	955.69	7336.90	2553.91
95	0.017	788.20	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	2560.00
101	0.008	1302.31	7041.85	2558.00
102	0.016	1224.80	7082.59	2555.33
103	0.016	1071.64	7162.13	2554.81
104	0.013	981.54	7207.82	2554.23

Manhole ID	Q_i [m^3/s]	x [m]	y [m]	z [m]
105	0.013	901.30	7249.35	2552.05
106	0.009	831.25	7286.18	2551.71
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

* Outfall

Table S.6. Hydraulic design for the Benchmark Chicó.

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
1	1	2	outer	0.20	2560.53	2557.50	0.0031	0.0164
2	1	8	outer	0.20	2560.53	2560.21	0.0093	0.0034
3	2	9	inner	0.38	2554.60	2554.43	0.0566	0.0020
4	3	2	inner	0.30	2555.21	2554.60	0.0313	0.0028
5	4	3	outer	0.20	2556.02	2555.41	0.0052	0.0035
6	4	13	inner	0.45	2553.82	2553.42	0.0196	0.0041
7	5	4	outer	0.20	2554.47	2553.82	0.0039	0.0033
8	5	6	outer	0.20	2554.47	2553.55	0.0117	0.0060
9	6	18	inner	0.25	2553.55	2552.35	0.0237	0.0104
10	7	8	inner	0.20	2567.16	2561.71	0.0138	0.0360
11	8	20	inner	0.30	2560.21	2559.95	0.0383	0.0043
12	9	10	outer	0.20	2556.53	2555.93	0.0033	0.0057
13	9	22	inner	0.40	2554.43	2554.30	0.0666	0.0017
14	10	11	inner	0.25	2555.63	2555.20	0.0200	0.0043
15	11	3	outer	0.20	2555.50	2555.21	0.0044	0.0036
16	11	12	inner	1.05	2541.00	2540.82	0.5744	0.0018
17	12	13	inner	1.05	2540.82	2540.72	0.5957	0.0015
18	13	35	inner	1.05	2540.72	2540.31	0.6355	0.0043
19	14	13	outer	0.20	2554.47	2554.22	0.0032	0.0035
20	14	36	inner	0.35	2553.07	2552.79	0.0392	0.0030
21	15	14	inner	0.30	2553.28	2553.07	0.0296	0.0030
22	16	15	outer	0.20	2553.97	2553.68	0.0031	0.0040
23	16	17	outer	0.20	2553.97	2553.53	0.0031	0.0062
24	16	38	outer	0.20	2553.97	2553.65	0.0031	0.0035
25	17	39	inner	0.25	2553.53	2552.99	0.0157	0.0047
26	18	25	inner	0.30	2552.35	2552.08	0.0331	0.0032
27	19	7	outer	0.20	2568.63	2567.16	0.0028	0.0237
28	19	20	outer	0.20	2568.63	2563.45	0.0084	0.0334
29	20	21	inner	0.35	2559.95	2558.00	0.1766	0.0245
30	21	22	inner	0.45	2558.00	2557.00	0.1866	0.0078
31	22	23	inner	1.05	2542.80	2541.44	0.5215	0.0157
32	23	10	outer	0.20	2555.94	2555.63	0.0033	0.0044
33	23	24	inner	1.05	2541.44	2541.10	0.5313	0.0034
34	24	33	outer	0.20	2555.60	2555.37	0.0033	0.0031
35	24	11	inner	1.05	2541.10	2541.00	0.5411	0.0014
36	25	41	inner	0.35	2552.08	2551.89	0.0417	0.0026

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
37	26	54	inner	0.25	2566.40	2565.69	0.0158	0.0042
38	27	26	outer	0.20	2566.65	2566.40	0.0041	0.0035
39	27	28	inner	0.20	2566.65	2564.31	0.0285	0.0323
40	28	29	outer	0.20	2564.31	2561.48	0.0051	0.0379
41	28	20	inner	0.35	2564.01	2563.25	0.1101	0.0101
42	29	30	inner	0.20	2561.48	2559.53	0.0247	0.0286
43	30	31	inner	0.25	2559.53	2557.91	0.0422	0.0201
44	31	22	inner	1.05	2543.51	2542.80	0.2497	0.0094
45	32	33	outer	0.20	2556.50	2555.77	0.0032	0.0078
46	32	31	inner	0.35	2556.50	2556.31	0.0488	0.0027
47	33	44	inner	0.25	2555.37	2555.00	0.0193	0.0047
48	34	12	outer	0.20	2555.74	2555.32	0.0070	0.0035
49	34	45	outer	0.20	2555.74	2555.46	0.0023	0.0032
50	35	46	outer	0.20	2554.71	2554.35	0.0034	0.0031
51	35	36	inner	1.05	2540.31	2540.19	0.6457	0.0017
52	36	47	inner	1.05	2540.19	2540.03	0.6985	0.0014
53	37	15	inner	0.25	2553.64	2553.28	0.0139	0.0040
54	38	49	inner	0.25	2553.65	2553.26	0.0124	0.0033
55	39	50	outer	0.20	2553.29	2552.96	0.0033	0.0036
56	39	40	inner	0.30	2552.99	2552.69	0.0257	0.0033
57	40	41	outer	0.20	2553.19	2552.89	0.0031	0.0032
58	40	51	inner	0.35	2552.69	2552.43	0.0349	0.0028
59	41	52	inner	0.35	2551.89	2551.65	0.0573	0.0026
60	42	29	outer	0.20	2562.93	2561.48	0.0065	0.0146
61	42	57	outer	0.20	2562.93	2562.69	0.0022	0.0032
62	43	32	outer	0.20	2557.57	2556.50	0.0134	0.0148
63	43	60	inner	0.35	2554.67	2554.30	0.0034	0.0034
64	44	61	outer	0.20	2556.00	2555.64	0.0033	0.0036
65	44	43	inner	0.35	2555.00	2554.67	0.0291	0.0034
66	45	46	inner	0.20	2555.46	2555.05	0.0119	0.0063
67	45	62	outer	0.20	2555.56	2555.21	0.0032	0.0035
68	46	47	inner	0.35	2554.35	2554.13	0.0362	0.0032
69	47	48	inner	1.05	2540.03	2539.57	0.7562	0.0064
70	48	37	outer	0.20	2554.07	2553.64	0.0046	0.0036
71	48	49	inner	1.05	2539.57	2539.06	0.8195	0.0072
72	49	50	inner	1.05	2539.06	2538.86	0.8536	0.0029
73	50	67	outer	0.20	2553.36	2552.98	0.0022	0.0037

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
74	50	51	inner	1.05	2538.86	2538.73	0.8636	0.0013
75	51	52	inner	1.05	2538.73	2538.55	0.9174	0.0020
76	52	83	inner	1.05	2538.55	2538.19	1.0013	0.0021
77	53	52	outer	0.20	2552.34	2552.05	0.0063	0.0038
78	53	69	outer	0.20	2552.34	2552.07	0.0021	0.0030
79	54	70	inner	0.30	2565.69	2565.39	0.0275	0.0041
80	55	27	inner	0.20	2568.31	2566.65	0.0163	0.0095
81	56	57	outer	0.20	2565.58	2564.09	0.0040	0.0191
82	56	28	inner	0.35	2564.68	2564.01	0.0663	0.0040
83	57	58	inner	0.25	2562.69	2562.04	0.0356	0.0102
84	58	30	outer	0.20	2563.24	2559.53	0.0010	0.0207
85	58	59	inner	0.25	2562.04	2560.74	0.0386	0.0149
86	59	31	inner	1.05	2546.34	2543.51	0.1378	0.0159
87	60	59	inner	1.05	2554.30	2546.34	0.0831	0.1174
88	61	60	inner	0.25	2555.64	2555.30	0.0208	0.0034
89	62	63	inner	0.25	2555.21	2554.91	0.0205	0.0046
90	63	46	outer	0.20	2555.61	2555.05	0.0032	0.0061
91	63	64	inner	0.30	2554.91	2554.69	0.0300	0.0028
92	64	47	outer	0.20	2554.89	2554.53	0.0033	0.0036
93	64	65	inner	0.30	2554.69	2554.07	0.0398	0.0087
94	65	66	outer	0.20	2554.17	2553.64	0.0033	0.0075
95	65	48	inner	0.35	2554.07	2553.87	0.0496	0.0020
96	66	49	outer	0.20	2553.64	2553.26	0.0033	0.0037
97	66	67	inner	0.25	2553.64	2553.38	0.0131	0.0035
98	67	81	inner	0.30	2552.98	2552.71	0.0283	0.0037
99	68	51	outer	0.20	2553.25	2552.83	0.0022	0.0042
100	68	82	outer	0.20	2553.25	2552.96	0.0066	0.0042
101	69	84	inner	0.20	2552.07	2551.73	0.0105	0.0039
102	70	71	inner	0.30	2565.39	2565.15	0.0362	0.0040
103	71	55	outer	0.20	2568.75	2568.31	0.0043	0.0058
104	71	86	outer	0.20	2568.75	2568.43	0.0043	0.0038
105	71	72	inner	0.35	2565.15	2564.90	0.0447	0.0027
106	72	73	outer	0.20	2566.30	2564.54	0.0032	0.0181
107	72	56	inner	0.35	2564.90	2564.68	0.0543	0.0029
108	73	57	outer	0.20	2564.54	2564.09	0.0121	0.0059
109	73	74	inner	0.20	2564.54	2562.29	0.0045	0.0189
110	73	87	outer	0.20	2564.54	2564.25	0.0045	0.0032

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
111	74	75	inner	0.20	2562.29	2559.64	0.0136	0.0304
112	75	88	outer	0.20	2559.64	2559.36	0.0041	0.0032
113	75	60	inner	0.35	2557.04	2556.80	0.0412	0.0033
114	76	61	inner	0.20	2556.24	2555.94	0.0044	0.0039
115	76	75	outer	0.20	2557.64	2557.04	0.0153	0.0060
116	77	62	outer	0.20	2556.59	2556.31	0.0042	0.0038
117	77	76	outer	0.20	2556.59	2556.24	0.0042	0.0035
118	77	78	outer	0.20	2556.59	2555.87	0.0042	0.0082
119	77	90	outer	0.20	2556.59	2556.31	0.0042	0.0035
120	78	79	inner	0.20	2555.87	2554.42	0.0125	0.0145
121	79	91	outer	0.20	2554.42	2554.12	0.0033	0.0038
122	79	80	inner	0.25	2554.42	2553.93	0.0223	0.0059
123	80	81	inner	0.30	2553.93	2553.61	0.0309	0.0038
124	81	82	inner	0.45	2552.71	2552.56	0.0802	0.0016
125	82	83	inner	0.45	2552.56	2552.29	0.1094	0.0029
126	83	94	inner	1.05	2538.19	2538.01	1.1506	0.0023
127	84	85	outer	0.20	2552.73	2551.96	0.0031	0.0079
128	84	83	inner	0.25	2551.73	2551.39	0.0199	0.0039
129	85	95	inner	0.20	2551.96	2551.65	0.0118	0.0037
130	86	87	inner	0.25	2566.83	2564.55	0.0396	0.0119
131	87	88	inner	0.30	2564.25	2560.46	0.0804	0.0186
132	88	98	inner	0.40	2559.36	2558.89	0.1017	0.0049
133	89	76	outer	0.20	2558.46	2557.64	0.0022	0.0100
134	89	99	outer	0.20	2558.46	2558.08	0.0065	0.0038
135	90	91	inner	0.20	2556.31	2555.02	0.0043	0.0069
136	90	100	outer	0.25	2557.21	2556.80	0.0170	0.0042
137	91	92	outer	0.20	2555.02	2553.87	0.0061	0.0068
138	91	102	inner	0.30	2554.12	2553.73	0.0259	0.0039
139	92	81	outer	0.20	2553.87	2553.61	0.0040	0.0031
140	92	103	inner	0.25	2553.87	2553.32	0.0182	0.0058
141	93	82	outer	0.20	2553.11	2552.76	0.0062	0.0039
142	93	104	outer	0.20	2553.11	2552.82	0.0021	0.0030
143	94	95	inner	1.05	2538.01	2537.15	1.4558	0.0046
144	95	107	inner	1.05	2537.15	2536.73	1.4844	0.0043
145	96	86	inner	0.25	2567.29	2566.83	0.0180	0.0045
146	97	87	outer	0.20	2567.86	2564.75	0.0106	0.0327
147	97	96	outer	0.20	2567.86	2567.29	0.0053	0.0031

Pipe	Upstream Manhole	Downstream Manhole	Type [inner/outer]	Diameter [m]	Upstream Elevation [m]	Downstream Elevation [m]	Flow [m^3/s]	Slope [-]
148	97	98	outer	0.20	2567.86	2563.09	0.0053	0.0242
149	98	99	inner	0.40	2558.89	2558.18	0.1247	0.0067
150	99	100	inner	0.40	2558.08	2557.20	0.1488	0.0093
151	100	101	inner	0.40	2556.80	2555.50	0.1788	0.0130
152	101	102	inner	0.40	2555.50	2553.73	0.1871	0.0203
153	102	103	inner	0.50	2553.73	2552.82	0.2290	0.0053
154	103	104	inner	0.50	2552.82	2552.12	0.2635	0.0069
155	104	105	inner	0.45	2551.82	2550.35	0.2784	0.0163
156	105	106	outer	0.20	2550.65	2550.32	0.0032	0.0042
157	105	94	inner	0.60	2550.35	2550.01	0.2880	0.0033
158	106	107	inner	0.20	2550.32	2549.93	0.0120	0.0038
159	107	108	inner	1.05	2536.73	2536.36	1.5096	0.0045
160	108	109	inner	1.05	2536.36	2535.95	1.5180	0.0045

Figure S.1 presents the distribution of the coefficient of determination R^2 of the linear approximation of the cost function for each pipe in Chicó case study after 25 iterations. The average R^2 across all the individual linear regressions is 0.84, with a standard deviation of 0.23. The distribution shows that for half of the pipes there is a good linear approximation of the costs with R^2 greater than 0.94. On the one hand, pipes with $R^2 = 1$ represent those pipes that got the exact same design along the iterations. On the other hand, pipes with R^2 close to 0 indicate a poor linear fit between the construction cost and flow rate.

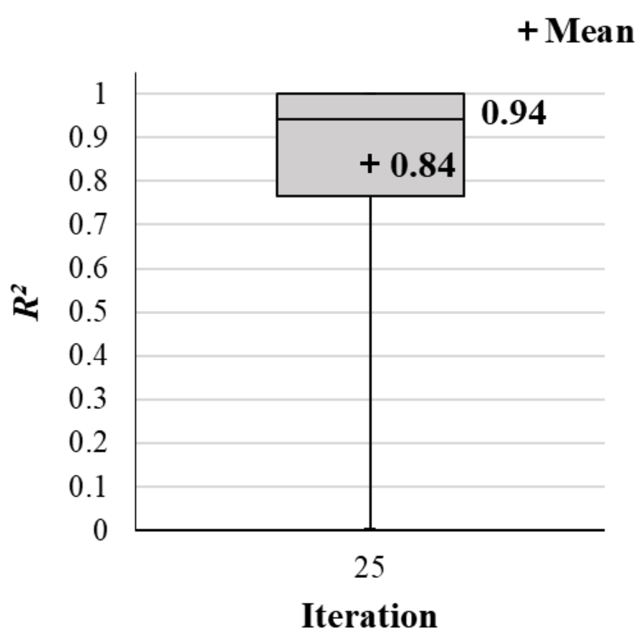

Figure S.1. Coefficient of determination R^2 of the linear approximation of the cost function for each pipe in Chicó case study after 25 iterations.

Figure S.2 analyzes all the network as a whole, by calculating the fitness of a single linear regression that combines observations from all the pipes. We calculate a global coefficient of determination R^2 of the whole network for each iteration. The regression model gets a weak fit with the initial iterations, which is then improved with the iterative procedure. We can attribute the weakness of the fitness in the regression model to the linear nature of the approximation of the cost function in terms of the flow rate in the pipes. This can be improved in future work by using non-linear functions to represent the cost in terms of the flow rate in the pipes.

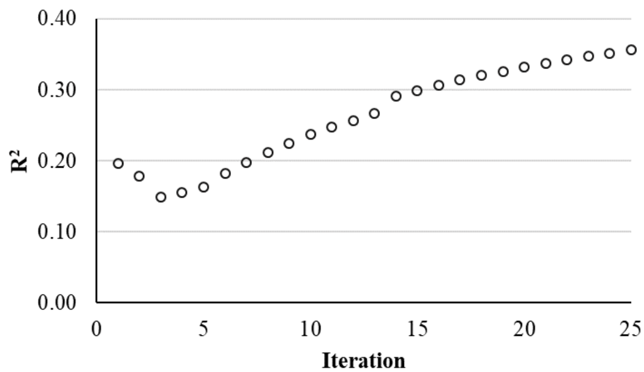

Figure S.2. Global fitness of the linear approximation of the cost in terms of the flow rate.

REFERENCES

The following are the references for the Benchmarks used as case studies.

31. Moeini, R. and Afshar, M. H. Extension of the Hybrid Ant Colony Optimization Algorithm for Layout and Size Optimization of Sewer Networks. Journal of Environmental Informatics, **2019** doi: 10.3808/jei.201700369.

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