D.4 Comparison of Distribution Main System

(1) Type of Distribution Network

There are two kinds of concept developing distribution network. One is loop system and the other one is arborescent system. The concept of loop system is to have multiple routes to supply water to each user. On the other hand, the concept of arborescent system is to have single route to supply water to each user.

Applications of these concepts in the Study Area are shown in Figure D.1, respectively and the result of comparison is summarized in Table D.1.

Alternative-1 (Loop System) is recommended by the following reasons.

- Multiple routes to users are important considering accident and repair work. In arborescent system, accident and repair work causes water failure in the down stream.
- Loop system is hydraulically advantageous since relatively larger pipeline are planned so as to have room to afford for mutual accommodation.
- The difference of construction cost is negligible considering the life time of pipeline, which is approximately 50 years.

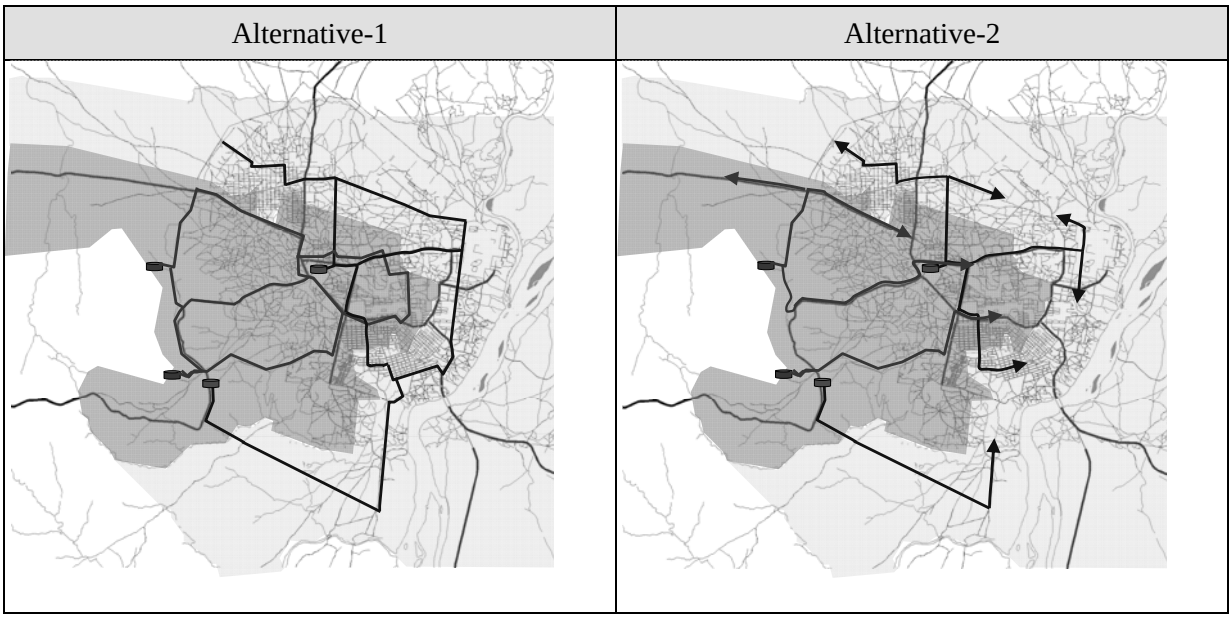
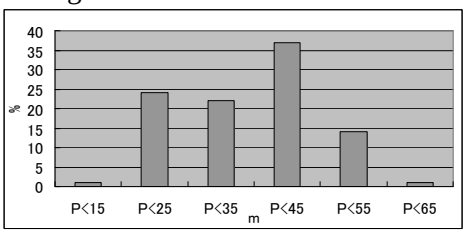
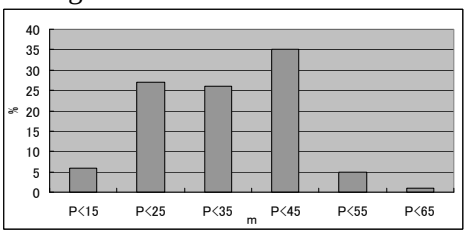
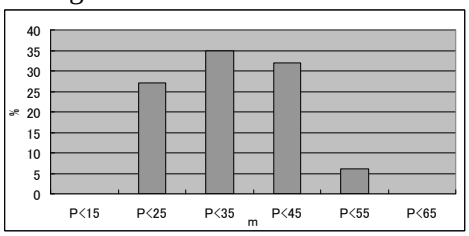
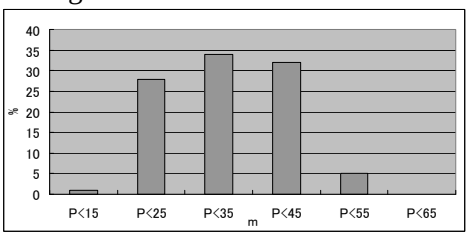


Figure D.1 Alternatives of Distribution Network

Table D.1 Comparison of Alternatives of Distribution Network

<table>
<tr><th>Item</th><th>Alternative-1</th><th>Alternative-2</th></tr>
<tr><td>Concept</td><td>Distribution pipelines are looped having multiple routes to supply water to each of users in principal.</td><td>Distribution pipelines are arborescent having single route to supply water to each of users in principal.</td></tr>
<tr><td>Hydraulic Pressure (High zone in 2025)</td><td>Average Pressure = 34.1 m
 
</td><td>Average Pressure = 30.9 m
 
</td></tr>
<tr><td>Hydraulic Pressure (Low zone in 2025)</td><td>Average Pressure = 31.4 m
 
</td><td>Average Pressure = 30.5 m
 
</td></tr>
<tr><td>Required Diameter and Length of pipelines (Distribution main and sub-main in 2025)</td><td>
<table>
<tr><th>Diameter</th><th>High zone</th><th>Low zone</th></tr>
<tr><td>200mm</td><td>43.1 km</td><td>26.6 km</td></tr>
<tr><td>300mm</td><td>10.2 km</td><td>15.9 km</td></tr>
<tr><td>400mm</td><td>12.6 km</td><td>25.9 km</td></tr>
<tr><td>500mm</td><td>7.3 km</td><td>6.2 km</td></tr>
<tr><td>600mm</td><td>0.9 km</td><td>4.7 km</td></tr>
<tr><td>700mm</td><td>2.0 km</td><td>4.6 km</td></tr>
<tr><td>800mm</td><td>3.5 km</td><td>4.2 km</td></tr>
<tr><td>900mm</td><td>0.4 km</td><td>0.0 km</td></tr>
<tr><td>1000mm</td><td>0.0 km</td><td>0.6 km</td></tr>
<tr><td>Total</td><td>80.0 km</td><td>88.7 km</td></tr>
</table>
</td><td>
<table>
<tr><th>Diameter</th><th>High zone</th><th>Low zone</th></tr>
<tr><td>200mm</td><td>43.1 km</td><td>26.6 km</td></tr>
<tr><td>300mm</td><td>10.2 km</td><td>15.9 km</td></tr>
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<tr><td>500mm</td><td>7.3 km</td><td>7.0 km</td></tr>
<tr><td>600mm</td><td>0.9 km</td><td>3.9 km</td></tr>
<tr><td>700mm</td><td>2.0 km</td><td>4.6 km</td></tr>
<tr><td>800mm</td><td>3.5 km</td><td>4.2 km</td></tr>
<tr><td>900mm</td><td>0.4 km</td><td>0.0 km</td></tr>
<tr><td>1000mm</td><td>0.0 km</td><td>0.6 km</td></tr>
<tr><td>Total</td><td>80.0 km</td><td>88.7 km</td></tr>
</table>
</td></tr>
<tr><td>Construction Cost up to 2025</td><td>
<table>
<tr><th>High zone</th><th>Low zone</th><th>Total</th></tr>
<tr><td>100 %</td><td>100 %</td><td>100 %</td></tr>
</table>
</td><td>
<table>
<tr><th>High zone</th><th>Low zone</th><th>Total</th></tr>
<tr><td>91.8 %</td><td>95.0 %</td><td>93.6 %</td></tr>
</table>
</td></tr>
</table>

D.5 Hydraulic Analysis of Distribution Main System

D.5.1 Model of Distribution Network

Models of distribution network in both 2015 and 2025 are shown in Figure D.2 and Figure D.3, respectively. Red pipelines show network in the high zone, blue pipelines show network in low zone and green pipelines show network in Gumbo area.

A model of distribution network in 2015 was developed to cover targeted area of house connection and public tap in 2015. A part of Kator area is supplied by utilizing the existing Kator elevated tank. Five tanker track stations were planned to distribute to the directions shown in Figure D.2. Tanker track stations were planned on the main streets and the closest distribution mains to the consuming areas.

Model of distribution network in 2025 was developed to cover target area of conceptual master plan. A part of high zone, of which elevation is above 520 m at foothill of the mountain, are supplied from the elevated tank, which is planned to be constructed in the same location of the West South High Service Reservoir.

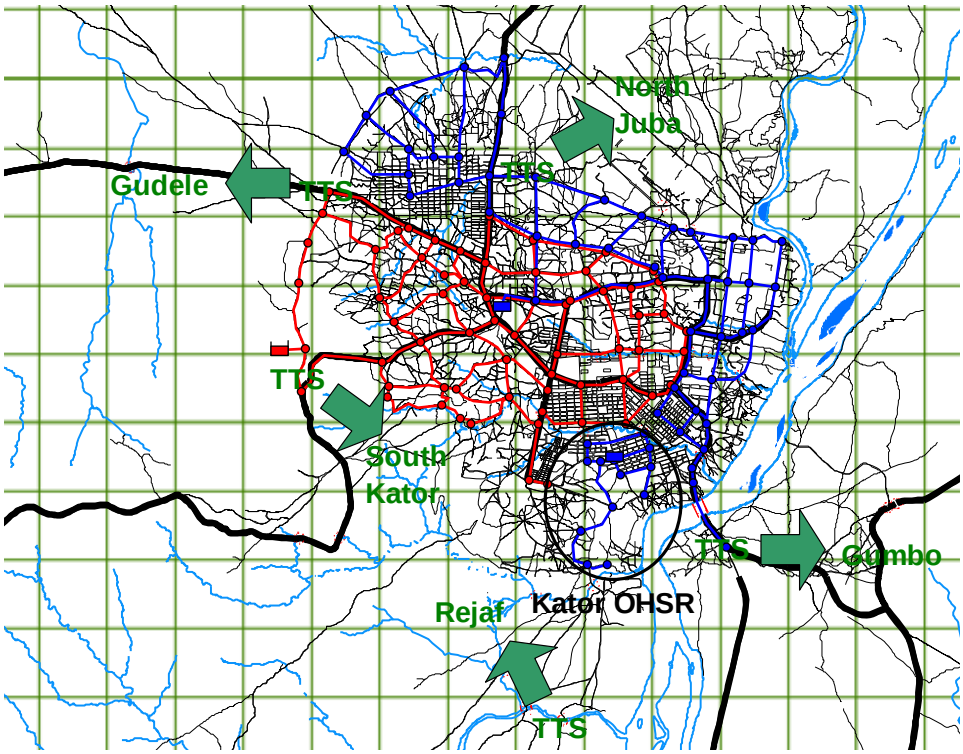


Figure D.2 Model of Distribution Network in 2015

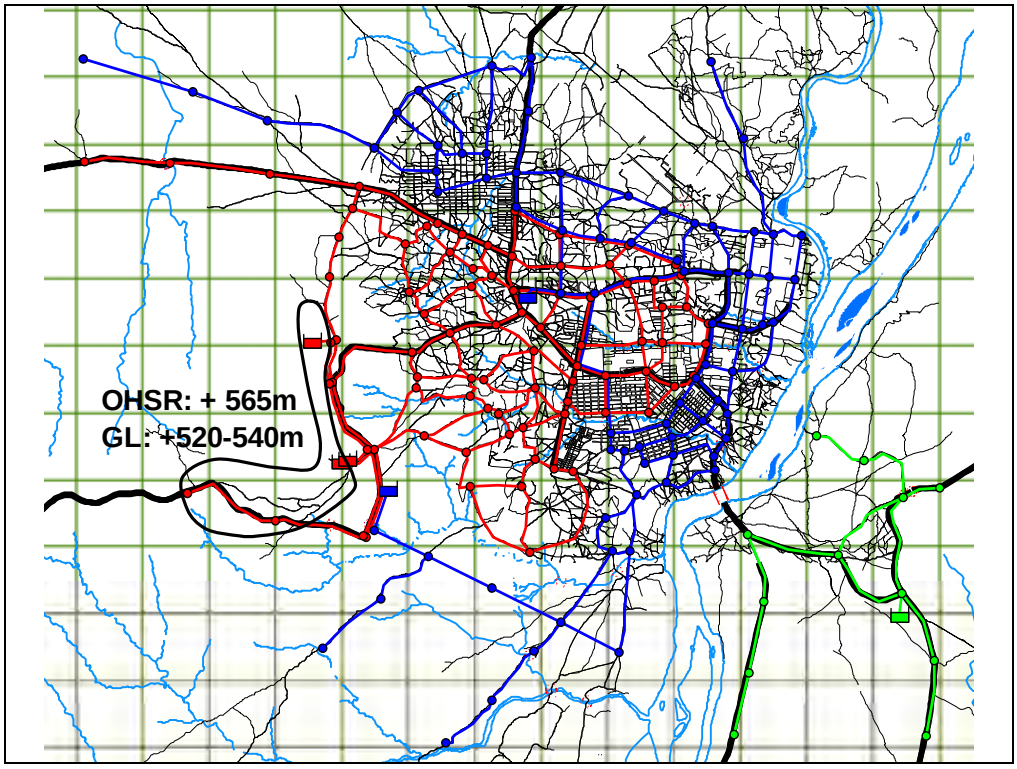
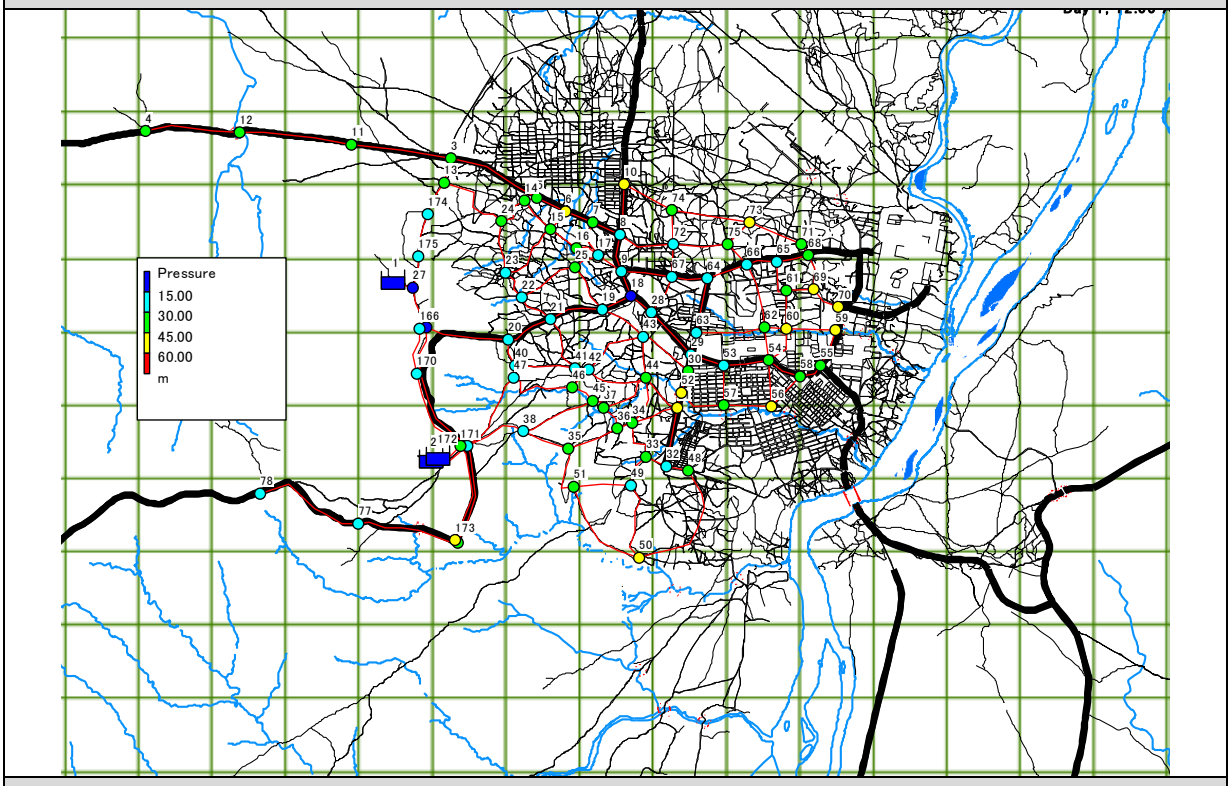


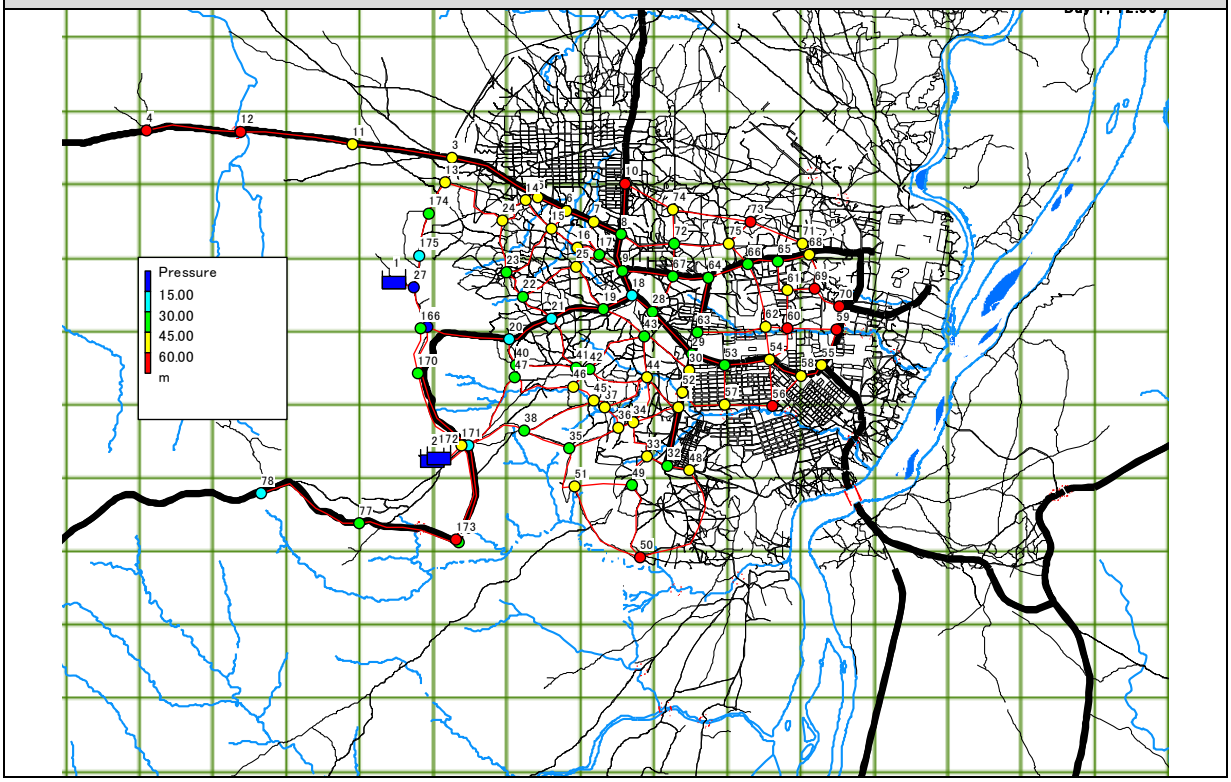
Figure D.3 Model of Distribution Network in 2025

D.5.2 Results of Network Analysis for High Zone

Hydraulic Pressure in 2025



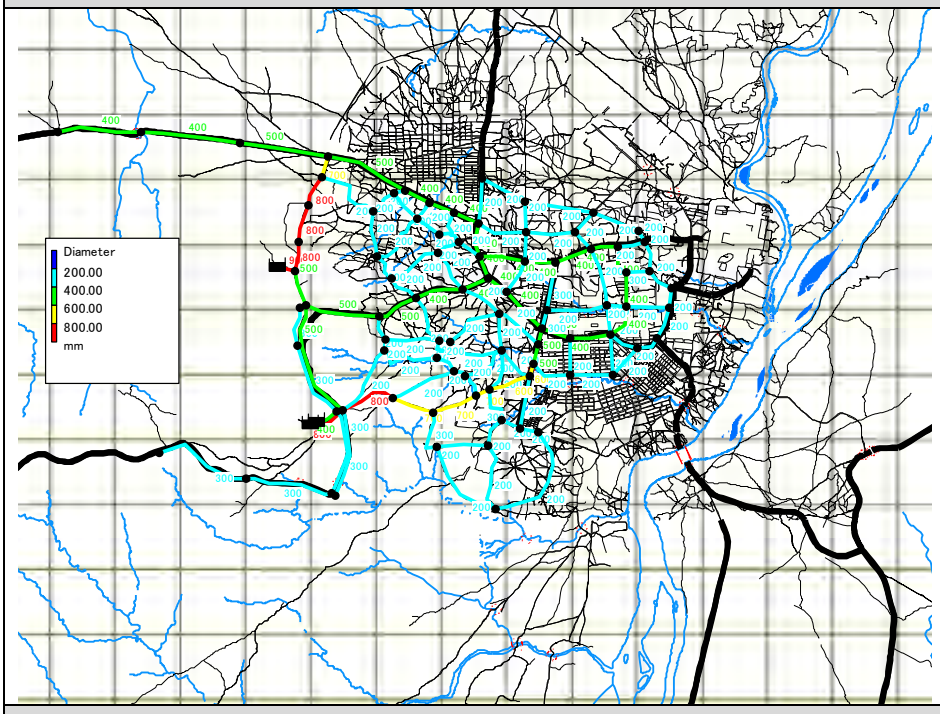
Static Pressure in 2025



Network Table of High Zone

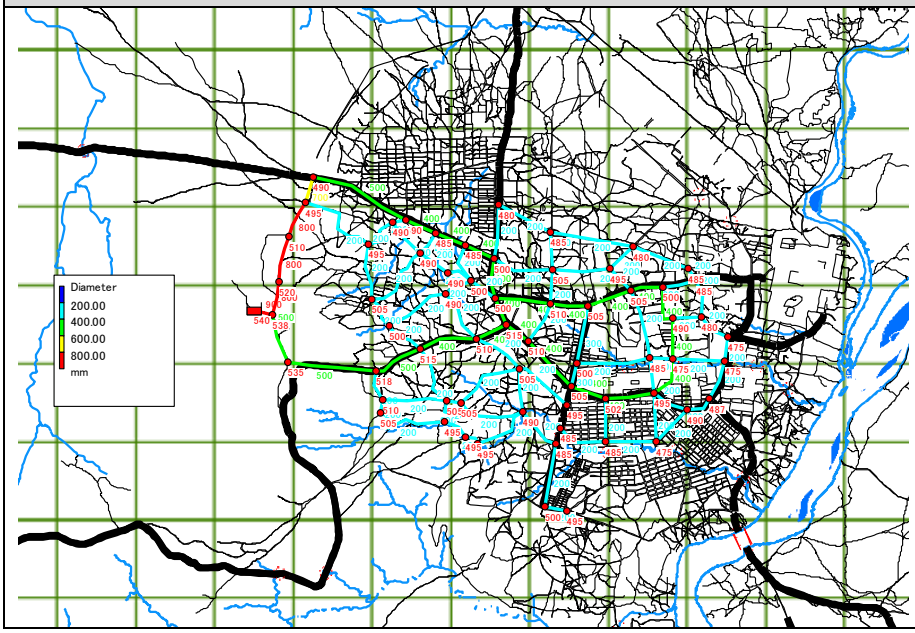
Node ID	Peak Demand CMD	Hydraulic Pressure m	Static Pressure m	Node ID	Peak Demand CMD	Hydraulic Pressure m	Static Pressure m
3	8,445	44.6	54.0	44	1,277	39.7	54.0
4	6,648	41.0	64.0	45	1,746	34.6	49.0
5	2,928	41.7	54.0	46	1,760	33.6	49.0
6	1,057	45.4	59.0	47	3,851	23.3	39.0
7	526	44.5	59.0	48	1,036	33.3	49.0
8	742	28.9	44.0	49	2,273	29.0	44.0
9	742	28.7	44.0	50	2,273	48.3	64.0
10	1,424	45.7	64.0	51	2,273	36.5	49.0
11	6,527	45.0	59.0	52	887	45.3	59.0
12	6,587	42.7	64.0	53	1,057	25.7	42.0
13	5,211	40.6	49.0	54	1,068	31.5	49.0
14	1,002	40.8	54.0	55	1,170	37.7	57.0
15	1,057	40.0	54.0	56	1,128	51.1	69.0
16	614	39.3	54.0	57	1,043	42.5	59.0
17	614	29.2	44.0	58	1,170	35.4	54.0
18	1,503	14.0	29.0	59	1,336	49.7	69.0
19	1,503	19.7	34.0	60	1,110	51.1	69.0
20	1,221	15.5	26.0	61	1,420	36.0	54.0
21	1,221	17.1	29.0	62	1,194	41.3	59.0
22	1,195	29.9	44.0	63	1,347	27.9	44.0
23	1,126	24.9	39.0	64	1,347	22.2	39.0
24	1,030	35.8	49.0	65	1,014	26.1	44.0
25	905	39.3	54.0	66	1,191	21.3	39.0
26	0	2.8	9.0	67	1,202	17.7	34.0
27	4,820	1.2	6.0	68	1,014	40.4	59.0
28	1,140	18.9	34.0	69	1,420	45.5	64.0
29	1,140	23.9	39.0	70	1,533	49.6	69.0
30	887	34.5	49.0	71	721	40.3	59.0
31	2,074	45.6	59.0	72	1,046	21.4	39.0
32	2,074	28.8	44.0	73	1,044	45.3	64.0
33	2,273	34.8	49.0	74	1,889	40.3	59.0
34	2,273	37.1	49.0	75	1,296	30.6	49.0
35	2,273	34.2	44.0	76	5,198	31.5	42.0
36	2,273	37.5	49.0	77	2,031	22.8	34.0
37	1,746	34.7	49.0	78	2,031	16.8	29.0
38	2,273	26.4	34.0	166	2,605	21.5	31.0
39	0	18.2	24.0	170	2,182	25.1	34.0
40	3,851	18.4	34.0	171	1,136	43.7	49.0
41	1,233	23.7	39.0	173	0	58.7	67.0
42	1,219	23.7	39.0	174	5,211	26.5	34.0
43	1,529	24.2	39.0	175	5,211	17.9	24.0

Distribution Network in 2025



Diameter	Length
200 mm	43.1 km
300 mm	10.2 km
400 mm	12.6 km
500 mm	7.3 km
600 mm	0.9 km
700 mm	2.0 km
800 mm	3.5 km
900 mm	0.4 km
1000 mm	0.0 km
Total	80.0 km

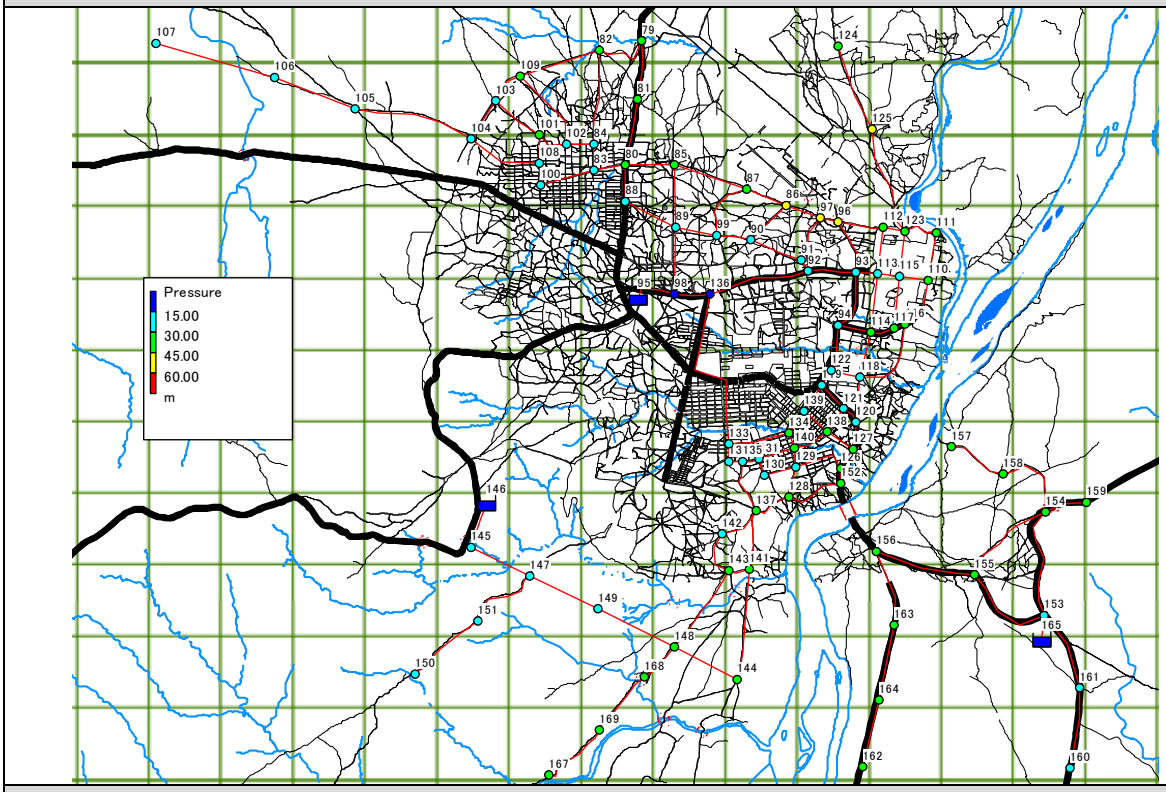
Distribution Network in 2015



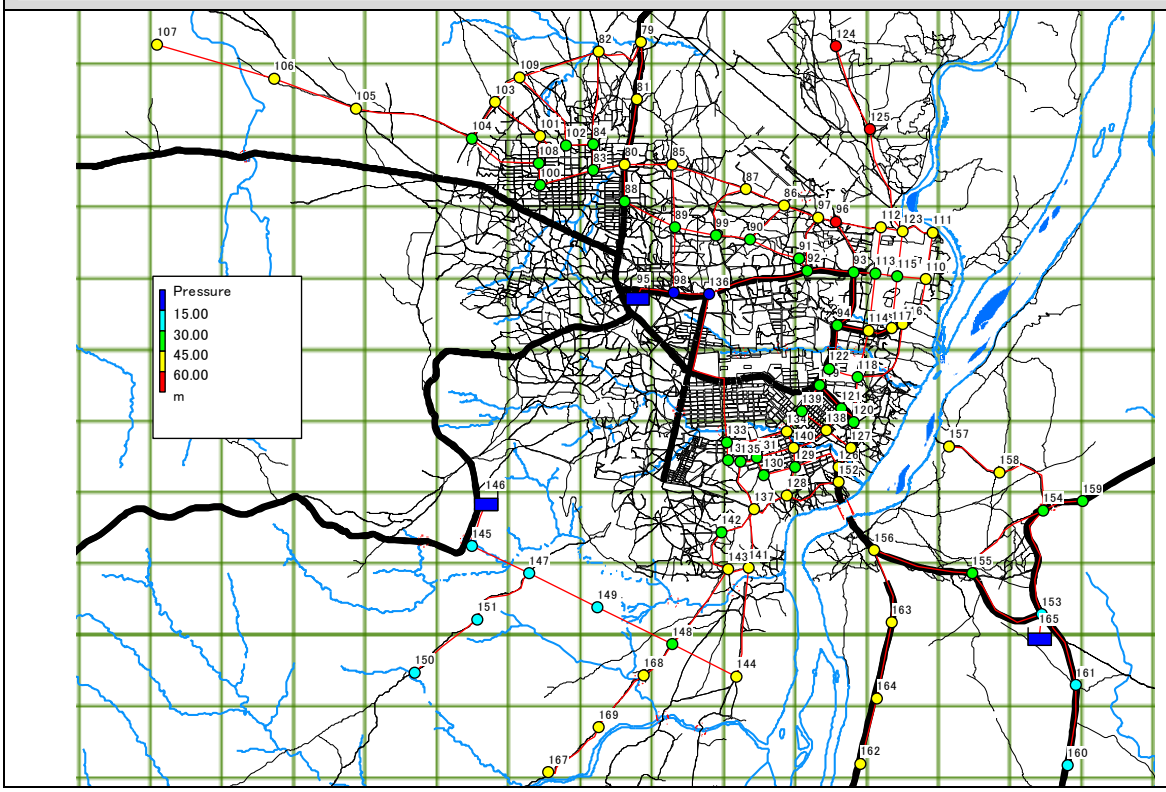
Diameter	Length
200 mm	36.0 km
300 mm	1.4 km
400 mm	9.3 km
500 mm	4.1 km
600 mm	0.0 km
700 mm	0.3 km
800 mm	2.1 km
900 mm	0.4 km
1000 mm	0.0 km
Total	53.7 km

D.5.3 Results of Network Analysis for Low Zone

Hydraulic Pressure in 2025



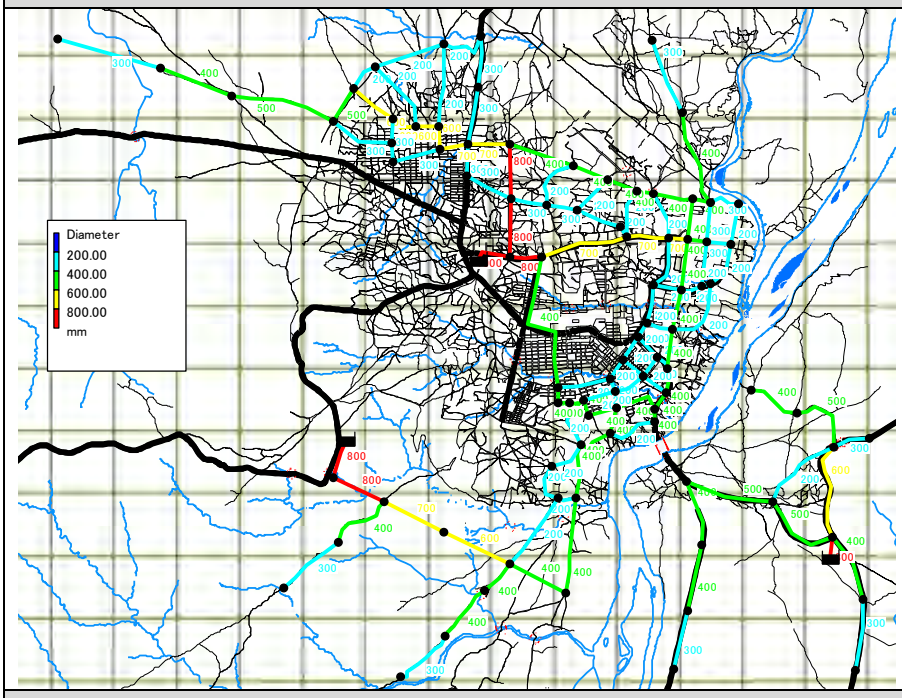
Static Pressure in 2025



Network Table of Low Zone

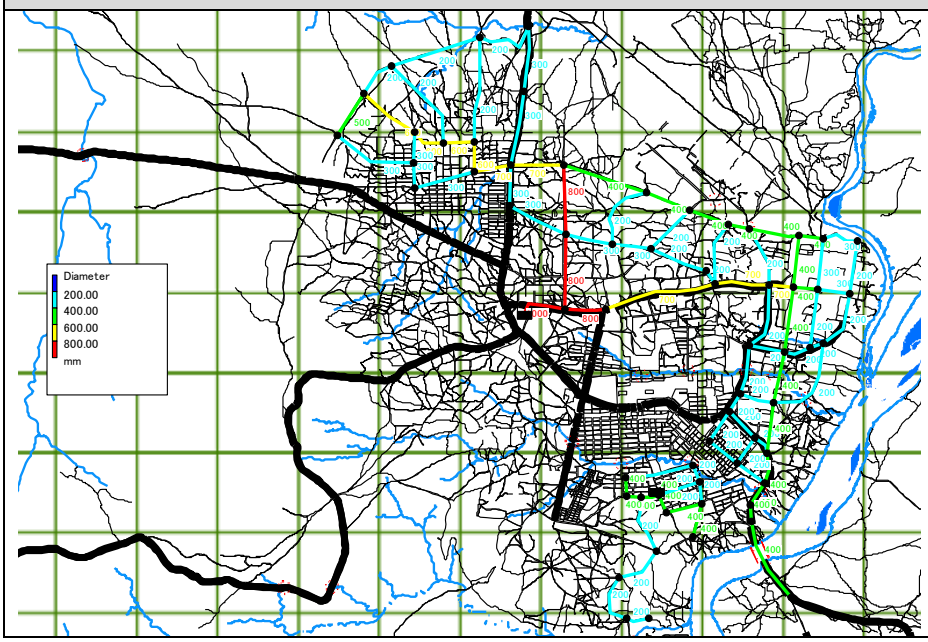
Node ID	Peak Demand CMD	Hydraulic Pressure m	Static Pressure m	Node ID	Peak Demand CMD	Hydraulic Pressure m	Static Pressure m
79	2,072	40.8	59.0	124	2,704	44.0	64.0
80	2,072	35.4	49.0	125	5,856	45.2	64.0
81	2,072	37.0	54.0	126	1,215	42.0	59.0
82	2,155	39.4	59.0	127	1,161	40.1	57.0
83	2,213	29.2	44.0	128	964	31.9	49.0
84	2,213	27.8	44.0	129	964	27.0	44.0
85	5,931	37.4	49.0	130	1,043	22.2	39.0
86	2,150	45.5	59.0	131	1,043	22.3	39.0
87	2,150	41.0	54.0	132	803	28.0	44.0
88	1,643	26.4	39.0	133	803	23.5	39.0
89	2,003	24.5	34.0	134	1,074	32.0	49.0
90	1,699	27.0	39.0	135	1,043	22.6	39.0
91	1,381	22.3	34.0	136	0	6.8	14.0
92	1,703	23.0	34.0	137	1,992	36.9	54.0
93	1,703	21.6	34.0	138	1,020	32.0	49.0
94	826	28.9	44.0	139	750	16.9	34.0
96	1,831	47.0	61.0	140	964	32.0	49.0
97	1,831	45.1	59.0	141	3,887	42.0	59.0
98	0	2.9	9.0	142	2,701	25.2	44.0
99	1,595	27.4	39.0	143	2,701	36.1	54.0
100	2,155	15.9	34.0	144	3,887	37.2	52.0
101	2,155	30.7	49.0	145	0	19.0	24.0
102	2,692	26.7	44.0	147	4,247	17.6	24.0
103	2,973	26.4	46.0	148	3,887	32.4	44.0
104	2,973	20.8	42.0	149	4,247	20.8	29.0
105	7,071	19.8	46.0	150	3,026	19.5	29.0
106	7,071	17.5	48.0	151	4,247	15.9	24.0
107	4,274	15.4	50.0	152	1,215	42.0	59.0
108	2,155	25.3	44.0	153	7,986	24.2	29.0
109	2,973	33.9	54.0	154	3,566	36.1	44.0
110	2,641	33.8	49.0	155	3,566	32.7	41.0
111	6,286	37.1	54.0	156	3,566	38.1	49.0
112	2,262	39.6	54.0	157	8,034	36.9	49.0
113	1,493	26.2	39.0	158	8,034	38.5	49.0
114	826	34.1	49.0	159	3,566	35.1	44.0
115	1,493	30.0	44.0	160	3,566	16.5	25.0
116	1,168	43.5	59.0	161	3,566	17.5	24.0
117	826	38.8	54.0	162	3,566	31.4	49.0
118	1,065	28.0	44.0	163	3,566	34.6	49.0
119	655	15.1	32.0	164	3,566	33.0	49.0
120	892	27.3	44.0	167	4,247	30.5	49.0
121	655	27.1	44.0	168	3,887	39.9	54.0
122	828	17.6	34.0	169	4,247	37.9	54.0
123	2,262	43.5	59.0				

Distribution Network in 2025



Diameter	Length
200 mm	26.6 km
300 mm	15.9 km
400 mm	25.9 km
500 mm	6.2 km
600 mm	4.7 km
700 mm	4.6 km
800 mm	4.2 km
900 mm	0.0 km
1000 mm	0.6 km
Total	88.7 km

Distribution Network in 2015



Diameter	Length
200 mm	22.2 km
300 mm	8.2 km
400 mm	10.2 km
500 mm	0.6 km
600 mm	2.0 km
700 mm	3.5 km
800 mm	2.3 km
900 mm	0.0 km
1000 mm	0.6 km
Total	49.6 km