Attached Table 2-1a Water Quality Data of RBC and RWSR

Date	Water	Canal Water			Clarified Water			Date	Water	Canal Water			Clarified Water		
	Temperature	Turbidity	pH	E.C	Turbidity	pH	E.C		Temperature	Turbidity	pH	E.C	Turbidity	pH	E.C
	℃	NTU	-	μs/cm	NTU	-	μs/cm		℃	NTU	-	μs/cm	NTU	-	μs/cm
12.02.14	15.3	42.1	7.4	258				12.04.02	29.6	103	7.7	349	4.8	8.0	305
12.02.15	15.3	45.6	7.6	246				12.04.18	28.3	460	8.2	258	17.8	8.7	280
12.02.16	15.7	22.2	7.2	246				12.04.24	28.4	126	8.5	282	10.2	9.0	260
12.02.17	15.7	57.0	7.2	248				**average**		**230**	**8.1**	296	**10.9**	**8.6**	282
12.02.18	15.8	34.0	7.3	231				12.05.07	33.6	149	8.0	212	28.5	8.5	234
12.02.20	20.1	52.0	7.1	227	1.5	7.3	215	12.05.12	35.0	128	7.8	199.2	1.8	7.5	213
12.02.21	20.6	7.1	7.5	244				**average**		**139**	**7.9**	206	**15.1**	**8.0**	224
12.02.22	20.6	11.9	6.5	254				12.06.05	37.4	138	6.7	184	3.6	8.0	183.7
12.02.23	20.5	31.5	7.5	248				12.06.12	36.4	202	7.6	184.6	6.3	7.6	174.6
12.02.24	20.5	36.2	7.6	250				12.06.26	38.3	18.2	8.4	154	5.5	8.6	151
12.02.25	20.6	36.2	7.6	247				**average**		**119**	**7.5**	174	**5.1**	**8.1**	**169.8**
12.02.27	21.0	35.8	7.6	240	1.4	7.7	247								
average	18.5	**34.3**	**7.3**	245	**1.4**			12.07.24	34.6	**136**	8.3	156	**16.1**	8.7	158
12.03.02	20.6	51.0	7.6	258											
12.03.05	20.8	48.5	7.4	274	1.9	7.2	230	12.08.01	35.3	158	7.9	176	16.6	7.75	161
12.03.06	20.6	25.5	7.3	271				12.08.07	34.1	**799**	8.0	164	24.1	8.6	157
12.03.07	20.5	12.4	7.7	271				12.08.15	33.6	232	7.6	189	16.0	8.0	167
12.03.09	21.5	103	7.7	264				**average**		**396**	**7.8**	176	**18.9**	8.1	162
12.03.10	20.5	357	7.6	258											
12.03.12	23.6	10.7	8.2	251	4.4	8.1	246								
12.03.21	22.5	92.0	8.2	295											
average	21.3	**87.5**	**7.7**	268	**3.1**										

Attached Table 2-1b

Turbidity Change between RBC and RWSR Water

Year	Season	Monthly*1 Precipitation	Canal Water Sample No.	Range	Average	Raw Water Tank Sample No.	Range	Average
2012		mm		NTU	NTU		NTU	NTU
January	transit	53.2	-	-	-	-	-	-
February	dry	17.7	12	7.1 ~ 57	34.3	2	1.4 ~ 1.5	1.4
March	dry	25.0	8	10.7 ~357	87.5	2	1.9 ~ 4.4	3.1
April	transit	58.2	3	103 ~460	230	3	4.7 ~17.8	10.9
May	dry	15.4	2	128 ~139	139	2	1.8 ~28.5	15.1
June	dry	24.6	3	18.2 ~138	119	3	3.6 ~ 6.3	5.1
July	wet	109.6	1	136	-	1	16.1	-
August	wet	89.5	3	158 ~799	396	3	16 ~24.1	18.9
September	transit	34.1	-	-	-	-	-	-
October	dry	5.9	-	-	-	-	-	-
November	dry	3.6	-	-	-	-	-	-
December	dry	9.1	-	-	-	-	-	-
Annual			32	7.1 ~799	163	16	1.4 ~28.5	10.1
2013								
June	dry	-	1	273	-	-	-	-
2014								
February	dry	17.7	1	17.1	-	-	-	-
March	dry	25.0	4	3.2 ~ 5.6	3.9	-	-	-
April	transit	58.2	5	3.4 ~ 4.7	3.9	-	-	-
Average			10	3.2 ~17.6	6.3	-	-	-
2016								
November*2	dry	-	1	28	-	1	8.5	-

note *1: CLIMATICAL DATA - from M/P by World Bank (1953~1991)

*2: by JICA Mission Team

Attached Table 2-1c

Effect of RWSR

Range	sample no.	Raw water	Clarifird W.	Reduction Rate
< 50	1	36	1.4	96%
	2	49	1.9	96%
	3	11	4.4	59%
	4	18	5.5	70%
	average	28	3.3	88%
50 - 100	1	52	1.5	97%
100 - 150	1	103	4.8	95%
	2	126	10.2	92%
	3	149	28.5	**81%**
	4	128	1.8	99%
	5	138	3.6	97%
	6	136	16.1	88%
	average	130	11	92%
150 - 200		158	16.6	90%
200 - 250		232	16.0	**93%**
250 - 300		-	-	-
300 - 400		-	-	-
400 - 500		460	17.8	**96%**
>500		799	24.1	**97%**

Attached Table 2-2a Raw Water Quality – Water Temperature

New Jhal Khanuana WTP
Year: 2017/18

Month	7	8	9	10	11	12	1	2	3	4	5	6
1	26.1	27.2	27.3	-	-	17.1	13.2	-	-	-	25.7	26.4
2	26.1	26.9	-	26.4	-	17.1	13.3	-	-	-	26.4	27.5
3	27.0	26.9	27.5	26.8	22.3	17.1	13.2	-	-	-	25.8	26.5
4	27.3	27.3	28.0	26.7	21.2	16.7	12.4	-	-	25.5	26.3	27.9
5	26.5	27.2	27.1	25.8	-	15.9	12.5	-	-	25.2	25.7	29.0
6	27.6	-	27.7	26.8	-	15.8	12.2	-	-	28.3	26.4	27.7
7	26.0	29.1	27.2	26.9	-	15.1	11.2	14.4	-	28.2	24.4	28.6
8	27.5	29.2	27.8	-	-	17.5	13.0	14.3	18.9	26.2	24.4	30.2
9	28.5	29.4	-	26.3	-	16.1	13.7	14.1	20.7	25.5	28.2	28.1
10	28.5	29.4	-	26.8	21.4	15.4	12.5	14.2	21.1	26.2	26.6	27.2
11	-	29.0	-	26.6	19.9	15.5	14.5	-	22.3	25.1	26.1	27.3
12	-	29.2	-	26.6	-	16.4	13.0	13.4	22.2	25.2	27.4	27.3
13	26.9	-	-	25.8	19.6	15.1	12.7	13.8	22.5	25.7	25.2	26.9
14	27.4	-	27.0	25.5	20.1	14.9	14.9	14.3	22.9	24.6	25.6	27.1
15	27.6	28.2	-	-	19.0	14.2	14.2	15.2	22.5	27.6	26.1	27.9
16	28.1	27.8	26.8	24.8	18.5	13.8	14.9	15.4	22.1	25.6	25.1	26.2
17	28.1	28.2	-	26.2	18.9	13.5	15.1	15.5	22.0	25.3	26.2	26.7
18	-	29.1	27.0	26.5	18.3	13.7	-	-	-	25.3	26.5	27.1
19	27.7	30.4	27.9	25.4	-	14.5	-	17.2	22.2	25.5	26.0	26.8
20	27.9	-	27.9	25.4	18.5	14.2	-	17.8	22.1	-	27.2	28.9
21	28.0	30.3	27.3	25.1	18.0	-	-	17.7	20.3	-	25.6	26.9
22	27.0	29.2	27.7	-	18.1	-	-	18.3	20.0	-	26.0	29.2
23	27.6	29.4	27.7	-	17.9	-	-	18.5	21.2	-	27.3	28.3
24	26.5	29.1	-	-	18.1	14.0	-	17.9	21.0	-	26.9	32.5
25	27.5	28.9	27.7	-	18.9	14.2	-	19.1	20.2	-	27.4	29.0
26	28.1	28.2	27.5	-	-	-	-	18.5	-	25.1	25.7	28.5
27	27.9	-	30.0	-	18.1	-	-	18.9	-	27.2	26.2	28.4
28	28.3	28.2	26.8	-	17.5	14.7	-	20.4	-	27.6	27.3	28.1
29	26.8	27.9	-	-	17.3	14.2	-		-	27.9	26.8	25.8
30	28.3	27.7	28.0	-	17.2	13.2	-		-	26.2	26.7	-
31	27.7	27.1		-		12.7	-		-		27.4	
No. of Sample	28	26	20	18	20	26	17	20	17	21	31	29
Minimum	26.0	27.1	26.8	24.8	17.2	12.7	11.2	13.4	18.9	24.6	24.4	25.8
Average	27.4	28.5	27.6	26.1	18.9	15.1	13.3	16.4	21.4	26.1	26.3	27.9
Maximum	28.5	30.4	28.0	26.9	22.3	17.5	15.1	20.4	22.9	28.3	28.2	30.2

Water Quality Water Temperature (℃) NEW JHAL KHANUANA WTP, 2017/18

	7	8	9	10	11	12	1	2	3	4	5	6	Ave.
Wet Season													
Maximun	28.5	30.4	28.0							28.3	28.2	30.2	28.9
Average	27.4	28.5	27.6							26.1	26.3	27.9	27.3
Minimum	26.0	27.1	26.8							24.6	24.4	25.8	25.8
Dry Season													
Maximun				26.9	22.3	17.5	15.1	20.4	22.9				20.9
Average				26.1	18.9	15.1	13.3	16.4	21.4				18.5
Minimum				24.8	17.2	12.7	11.2	13.4	18.9				16.4
Annal Average													
Maximun													24.9
Average													22.9
Minimum													21.1

Attached Table 2-2b Raw Water Quality - pH

New Jhal Khanuana WTP
Year: 2018/19

Month	7	8	9	10	11	12	1	2	3	4	5	6
1	8.6	8.6	8.7	-	-	8.1	8.2	-	-	-	7.8	8.1
2	8.5	8.6	-	7.7	-	8.1	8.0	-	-	-	8.0	8.1
3	8.5	8.6	8.7	7.7	7.9	8.1	8.1	-	-	-	8.0	8.1
4	8.5	8.6	8.7	7.7	7.9	8.1	8.1	-	-	8.1	8.0	8.1
5	8.6	8.6	8.7	7.8	-	8.1	8.1	-	-	8.1	8.0	8.1
6	8.6	-	8.6	7.8	-	8.1	8.1	-	-	8.1	8.0	8.1
7	8.6	8.6	8.7	7.7	-	8.1	8.0	8.4	-	8.1	8.1	8.1
8	8.5	8.6	8.7	-	-	8.1	8.1	8.4	8.3	8.1	8.1	8.1
9	8.5	8.6	-	7.8	-	8.1	8.1	8.4	8.1	8.1	8.0	8.0
10	8.5	8.6	-	7.8	8.0	8.1	8.1	8.4	8.1	8.1	8.0	8.1
11	-	8.6	-	7.8	7.9	8.1	8.1	-	8.1	8.1	8.0	8.2
12	-	8.6	-	7.8	-	8.1	8.1	8.4	8.1	8.0	8.0	8.2
13	8.6	-	-	7.8	7.9	8.1	8.1	8.4	8.1	8.1	8.0	8.2
14	8.6	-	8.7	7.8	7.8	8.1	8.3	8.2	8.1	8.1	8.1	8.2
15	8.6	8.6	-	-	7.8	8.1	8.3	8.2	8.1	8.0	8.1	8.2
16	8.5	8.6	8.7	7.8	7.9	8.1	8.4	8.2	8.1	8.0	8.1	8.1
17	8.5	8.6	-	7.8	7.9	8.1	8.5	8.3	8.2	8.0	8.0	8.2
18	-	8.6	7.9	7.8	7.8	8.0	-	-	-	8.0	8.1	8.2
19	8.6	8.6	7.7	7.9	-	8.1	-	8.3	8.1	8.0	8.9	8.2
20	8.6	-	7.8	7.8	7.9	8.1	-	8.3	8.1	0.0	8.1	8.2
21	8.6	8.7	7.7	7.8	7.9	-	-	8.3	8.1	0.0	8.1	8.2
22	8.5	8.6	7.7	-	8.0	-	-	8.2	8.1	-	8.1	8.1
23	8.6	8.7	7.7	-	8.0	-	-	8.2	8.1	-	8.1	8.4
24	8.5	8.7	-	-	8.1	8.2	-	8.2	8.1	-	8.1	8.2
25	8.6	8.7	7.7	-	8.7	8.2	-	8.2	8.6	-	8.1	8.2
26	8.5	8.6	7.7	-	-	-	-	8.3	-	8.0	8.1	8.1
27	8.5	-	7.6	-	8.1	-	-	8.3	-	8.0	8.1	8.2
28	8.6	8.6	7.6	-	8.0	8.3	-	8.4	-	8.0	8.1	8.2
29	8.6	8.6	-	-	8.0	8.3	-		-	8.1	8.1	8.2
30	8.6	8.7	7.8	-	8.0	8.1	-		-	8.0	8.1	-
31	8.5	8.7		-		8.2	-		-	0.0	8.1	
No. of Sample	29	31	30	22	28	31	16	7	28			
Minimum	8.5	8.6	7.6	-	7.97	8.2	8.1	8.2	-			
Average	8.3	7.2	5.4	6.4	5.7	6.8	8.7	23.7	4.9			
Maximum	8.6	8.6	-	-	8.7	8.1	8.4	8.2	8.2			

Water Quality - pH NEW JHAL KHANUANA WTP, 2017/18

	7	8	9	10	11	12	1	2	3	4	5	6	Ave.
Wet Season													
Maximun	8.5	8.6	7.6							8.1	8.1	8.2	8.2
Average	8.3	7.2	5.4							8.0	8.1	8.1	7.5
Minimum	8.5	8.6	7.6							8.0	7.8	8.0	8.1
Dry Season													
Maximun				7.9	8.7	8.3	8.5	8.4	8.6				8.4
Average				7.8	8.0	8.1	8.2	8.3	8.1				8.1
Minimum				7.7	7.8	8.0	8.0	8.2	8.1				8.0
Annal Average													
Maximun													8.3
Average													7.8
Minimum													8.0

Attached Table 2-2c Raw Water Quality - Turbidity

New Jhal Khanuana WTP
Year: 2017/18

Month	7	8	9	10	11	12	1	2	3	4	5	6
1	381	792	272	-	-	34	30	-	-	-	182	114
2	306	702	-	91	-	32	91	-	-	-	202	127
3	839	850	250	101	48	35	32.5	-	-	-	162	137
4	719	972	304	94	34	32	40	-	-	144	160	180
5	495	1310	431	81	60.52	29	36	-	-	142	149	259
6	499	-	423	81	-	32	43	-	-	125	151	155
7	542	1365	249	77	-	30	74	20	-	116	240	128
8	522	510	230	-	-	28	70	33.1	26	113	236	191
9	298	476	-	76	-	32	69.1	36.35	85	117	150	285
10	320	610	-	78	77	30	70	35.1	85	139	112	275
11	-	726	-	73	-	30.2	65.1	-	77	159	141	506
12	-	580	-	74	-	30	42.8	34	67	144	130	593
13	320	-	-	74	67	28	43	28.4	63	156.3	145	655
14	423	-	207	109	77	30	27.77	28.69	72	115	131	465
15	520	542	-	-	65	30	10	29	72	101	82	428
16	740	576	149	65	63	67	7.77	125	68	127	32	300
17	328	660	-	72	52.67	140	2.7	68	67	185.1	173	288
18	-	517	123	65	60.2	115	-	-	-	211	164	346
19	820	360	128	65	-	111	-	38.9	94	150	171	360
20	970	-	106	45	42	61	-	39	105	-	165	388
21	1033	297	108	45	40	-	-	34	130	-	141	296
22	1436	351	113	-	34	-	-	33	124	-	127	264
23	876	322	115	-	39	-	-	32.41	108	-	125	220
24	792	360	-	-	38	22	-	34	123	-	122	92
25	488	267	110	-	39	28	-	35	124	-	119	245
26	552	324	106	-	-	-	-	24	-	-	115	227
27	545	-	107	-	33	-	-	22	-	160	125	201
28	600	388	107	-	31	40	-	7.9	-	231	110	138
29	478	458	-	-	34	24	-		-	227	130	145
30	508	309	102	-	35	32	-		-	202	113	-
31	528	221		-		30	-		-		110	
No. of Sample	28	26	20	18	20	26	14	19	17	20	31	29
Minimum	298	221	102	45	31	22	28	20	26	101	32	92
Average	603	571	187	76	48	44	52	39	88	153	142	276
Maximum	1436	1365	431	109	77	140	91	125	130	231	240	655

Water Quality - Turbidity (NTU) NEW JHAL KHANUANA WTP, 2017/18

	7	8	9	10	11	12	1	2	3	4	5	6	Ave.
Wet Season													
Maximun	1,436	1,365	431							231	240	655	726
Average	603	571	187							153	142	276	322
Minimum	298	221	102							101	32	92	141
Dry Season													
Maximun				109	77	140	91	125	130				112
Average				76	48	44	52	39	88				58
Minimum				45	31	22	28	20	26				29
Annal Average													
Maximun													419
Average													190
Minimum													85

Attached Table 2-3a

Water Quality Test Result by JICA Consultant In M/P

Sr. No.	Parameter		Unit	Chenab River		RBC	
				23 Sep'16	16 Nov'16	23 Sep'16	16 Nov'16
1	Temperature		℃	31.9	21.0	27	18.8
2	Turbidity		NTU	8	15	57	36
3	Colour		TCU	11	0.7	5.5	0.8
4	pH		-	8.6	8.09	8.2	8.83
5	EC		µS/cm	296	330	193	197
6	Hardness		mg/l	82	130	88	104
7	Total Alkalinity		mg/l	110	133	70	120
8	Chloride	CL	mg/l	60	40	70	30
9	Total Dissolved Solids	TDS	mg/l	222	227	140	141
10	Dissolved oxgen	DO	mg/l	3.75	5.08	5.64	5.04
11	Nitrite-N	NO_2	mg/l	0.11	0.04	0.19	0.05
12	Nitrate-N	NO_3	mg/l	3.3	4.7	5.5	4.9
13	Ammonia	NH3	mg/l	<0.01	<0.01	<0.01	<0.01
14	Chemical Oxygen Demand	CODcr	mg/l	38	71	32	22
15	Sulphate	SO_4^{2-}	mg/l	28	33	22	32
16	Fluoride	F	mg/l	3.0 (1.13)	0.30 (0.01)	4.8 (0.95)	0.11(<0.01)
17	Manganese	Mn	mg/l	<0.01	0.01	<0.01	<0.01
18	Iron	Fe	mg/l	0.32	0.18	1.83	0.36
19	Calcium	Ca	mg/l	31	36	21	30
20	Sodium	Na	mg/l	48	9.2	55	13.8
21	Magnesium	Mg	mg/l	<0.01	10	<0.01	7
22	Aluminium	Al	mg/l	<0.020	<0.020	<0.020	<0.020
23	Antimony	Sb	mg/l	0.186	0.115	0.139	0.298
24	Barium	Ba	mg/l	< 0.70	< 0.70	< 0.70	< 0.70
25	Cadmium	Cd	mg/l	< 0.002	< 0.002	< 0.002	< 0.002
26	Chromium	Cr	mg/l	0.40	<0.01	0.30	<0.01
27	Copper	Cu	mg/l	< 0.002	< 0.002	< 0.002	< 0.002
28	Lead	Pb	mg/l	<0.01	<0.01	<0.01	<0.01
29	Mercury	Hg	mg/l	<0.001	<0.001	<0.001	<0.001
30	Nickel	Ni	mg/l	<0.020	<0.020	<0.020	<0.020
31	Selenium	Se	mg/l	0.37	< 0.04	0.35	< 0.04
32	Zinc	Zn	mg/l	< 0.05	< 0.05	< 0.05	< 0.05
33	Cyanoid	CN^-	mg/l	< 0.002	< 0.002	< 0.002	< 0.002
34	Total Arsenic	As	mg/l	0.004	0.006	0.002	0.002
	Soluble Arsenic	As	mg/l	0.004	0.005	0.002	0.002
35	Bacteria		MPN/100mg	24	3.4×10^2	120	4.1×10^2
36	E. Coli		MPN/100mg	5.1×10^2	2.0×10^2	5.1×10^2	2.5×10^2

Data Source: The Project for Water Supply, Seweage and Drainage Master Plan of Faisalabad

Attached Table 2-3b

Past Water Quality Test Results in M/P

Sr. No.	Parameter	Unit	Chenab R*1	JBC*2	RBC*3
			2009	2016	2013 ~ 16
1	Temperature	℃	15.5 ~ 18.0	-	20 ~ 31
2	pH	-	7.9 ~ 8.1	8.3 ~ 8.8	7.7 ~ 8.6
3	DO	mg/l	8.0 ~ 8.4	4	-
4	BOD	mg/l	4.0 ~ 6.0	-	-
5	COD	mg/l	11.6 ~ 24.8	15	-
6	Total Dissolved Solid (TDS)	mg/l	280 ~ 780	140 ~ 176	100 ~ 160
7	Total Suspended Solid (TSS)	mg/l	20 ~ 360	20.5	15 ~ 85
8	Chloride (CL)	mg/l	10 ~ 60	10.6	-
9	Sulphate (SO_4)	mg/l	44 ~ 76	11 ~ 67	-
10	Sulfide (S)	mg/l	< LOD	-	-
11	Fluoride (F)	mg/l	0.10 ~ 0.46	ND	-
12	Cyanide (CN)	mg/l	0.20 ~ 0.33	< 0.05	< 0.05
13	Manganese (Mn)	mg/l	0.02	0.11	-
14	Copper (Cu)	mg/l	0.04 ~ 0.06	0.08	-
15	Cadmium (Cd)	mg/l	0.005~0.081	< 0.003	-
16	Chromium (Cr)	mg/l	< LOD	< 0.005	-
17	Zinc (Zn)	mg/l	0.01 ~ 0.02	< 0.04	-
18	Iron (Fe)	mg/l	0.81 ~ 0.88	-	-
19	Nickel (N)	mg/l	0.02	< 0.005	-
20	Oil & Grease	mg/l	< LOD	-	-
21	Sodium	mg/l	12 ~ 37	7	-
22	Calcium (Ca)	mg/l	20 ~ 27	-	24 ~ 50
23	Potassium (K)	mg/l	2.7 ~ 5.4	-	-
24	Amnonium (NH_3)	mg/l	-	0.1 ~ 0.5	-

Note *1 : Water source of JBC and RBC, LDD: Limit of detection,
Date source: Environmental Monitoring of River Chenab,2009, EPA Laboratory, Punjab

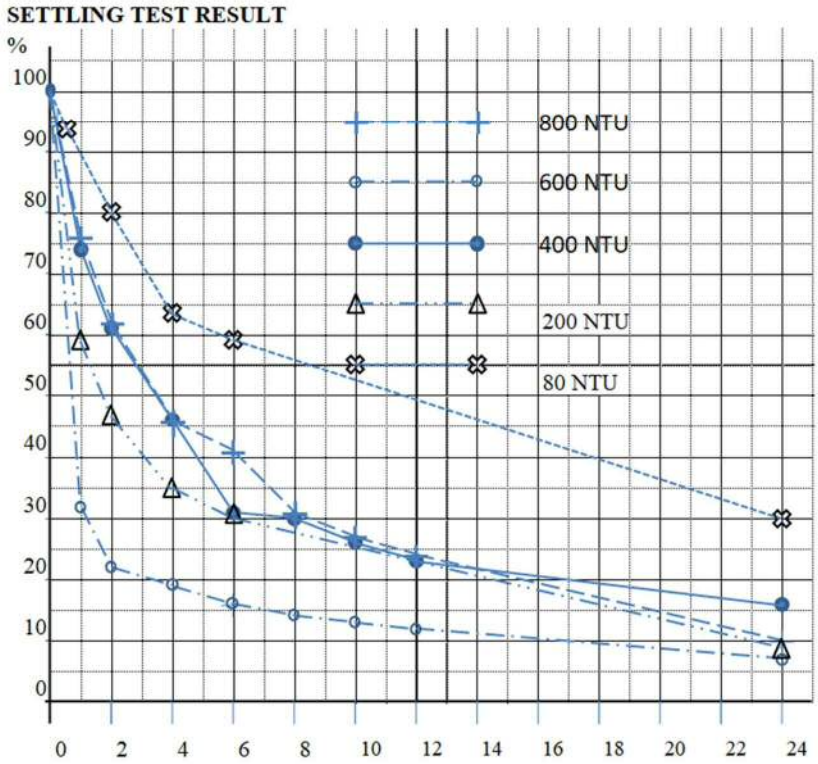
*2 : Jang Branch Canal, ND: Not detected,
Data source: Feasibility Study for Extension of Water Resources for Fisalabad City, Phase II

*3 : Rakh Branch Canal, WASA-F Central Laboratory, 2013 ~ 16

Attached Table 2-4 Results of Settling Test

Sample #	1		2		3		4		5		6	
Initial Turbidity	960		790		620		400		190		80	
Settling Hour	NTU	%	NTU	%	NTU	%	NTU	%	NTU	%	NTU	%
1	-		594	75%	200	32%	295	74%	111	58%	75	94%
2	-		491	62%	137	22%	242	61%	90	47%	64	80%
3	888	93%	429	54%	127	20%	192	48%	78	41%	56	70%
4	828	86%	365	46%	116	19%	185	46%	66	35%	50	63%
5	757	79%	-	-	-	-	-	-	64	34%	50	63%
6	708	74%	320	41%	97	16%	125	31%	58	31%	47	59%
8	744	78%	244	31%	85	14%	120	30%	-	-	-	-
10	370	39%	216	27%	78	13%	102	26%	-	-	-	-
12	685	71%	185	23%	71	11%	93	23%	-	-	-	-
24	416	43%	76	10%	41	7%	63	16%	16	8%	24	30%

note: RBC water was sampled for settling test and 1 litter cylinder was used for the test taking sample of clarified water from 10 cm below water surface.



Attached Table 2-5 Clarified Water Turbidity in RWSR

New Jhal Khanuana WTP Data Year: 2017/18

	Month	7	8	9	10	11	12	1	2	3	4	5	6
Season		Wet	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Wet	Wet	Wet
	1	381	792	272	-	-	34	30	-	-	-	182	114
	2	306	702	-	91	-	32	91	-	-	-	202	127
	3	839	850	250	101	48	35	33	-	-	-	162	137
	4	719	972	304	94	34	32	40	-	-	144	160	180
	5	495	1310	431	81	61	29	36	-	-	142	149	259
	6	499	-	423	81	-	32	43	-	-	125	151	155
	7	542	1365	249	77	-	30	74	20	-	116	240	128
	8	522	510	230	-	-	28	70	33	26	113	236	191
	9	298	476	-	76	-	32	69	36	85	117	150	285
	10	320	610	-	78	77	30	70	35	85	139	112	275
	11	-	726	-	73	-	30	65	-	77	159	141	506
	12	-	580	-	74	-	30	43	34	67	144	130	593
	13	320	-	-	74	67	28	43	28	63	156	145	655
	14	423	-	207	109	77	30	28	29	72	115	131	465
	15	520	542	-	-	65	30	10	29	72	101	82	428
	16	740	576	149	65	63	67	8	125	68	127	32	300
	17	328	660	-	72	53	140	3	68	67	185	173	288
	18	-	517	123	65	60	115	-	-	-	211	164	346
	19	820	360	128	65	-	111	-	39	94	150	171	360
	20	970	-	106	45	42	61	-	39	105	-	165	388
	21	1033	297	108	45	40	-	-	34	130	-	141	296
	22	1436	351	113	-	34	-	-	33	124	-	127	264
	23	876	322	115	-	39	-	-	32	108	-	125	220
	24	792	360	-	-	38	22	-	34	123	-	122	92
	25	488	267	110	-	39	28	-	35	124	-	119	245
	26	552	324	106	-	-	-	-	24	-	-	115	227
	27	545	-	107	-	33	-	-	22	-	160	125	201
	28	600	388	107	-	31	40	-	8	-	231	110	138
	29	478	458	-	-	34	24	-		-	227	130	145
	30	508	309	102	-	35	32	-		-	202	113	-
	31	528	221		-		30	-		-		110	
No. of Sample		28	26	20	18	20	26	14	19	17	20	31	29
Minimum		298	221	102	45	31	22	28	20	26	101	32	92
Average		603	571	187	76	49	44	53	38	88	153	142	276
Maximum		1436	1365	431	109	77	140	91	125	130	231	240	655

not: figures with red color are excluded for average turbidity calculation

	7	8	9	10	11	12	1	2	3	4	5	6

Average Turbidity

Month	7	8	9	10	11	12	1	2	3	4	5	6	Annual
Canal Water													
Wet Season	603	571	187	-	-	-	-	-	-	153	142	276	322
Dry Season	-	-	-	76	49	44	53	38	88	-	-	-	58
Annual	-	-	-	-	-	-	-	-	-	-	-	-	190
Raw Water Storage Reservoir													Annual
Wet Season	121	114	56							46	43	69	75
Dry Season				27	19	17	21	15	31				22
Annual													**48**

2.2 Chemical Dosage

(1) Water Treatment Capacity

			Present Plan (2028)	Future Plan (2038)
Production Capacity	(Day Maximum)		17,900	45,500 m^3/d
	(Day Average)		15,600	39,600 m^3/d
Treatment Capacity	(Loss in Treatment Process)	5%		
	(Day Maximum)		18,800	47,900 m^3/d
	(Day Average)		16,400	41,700 m^3/d

(2) Raw Water Quality

Chemical dosage is planed based on water quality of Clarified water in RASR. Estimated water quality is presented in table bwlow.

		Raw Water Storage Reservoir		
Quality Parameters	unit	Max.	Ave,	Min.
Water Temperature	℃	30	23	11
pH	-	8.7	8.2	7.6
Turbidity	NTU	200	48	10
Alkalinity	mg/l	120	90	70
Ammonium	mg/l	0.05	0.03	0.01
Iron	mg/l	0.8	0.5	0.3
Mangan	mg/l	0.05	0.02	0.01

(3) Chemicals

Aluminum Sulfate	Coagulant
Polymer	Coagulant Aid
Liquid Chlorine	Oxidization/Disinfection
Sodium Hypochlorite	Oxidization/Disinfection (Emergency)

(4) Chemical Dosage

1) Aluminium Sulfate (Solid ALUM)

a. Dosage Rate

Maximum	38 mg/l
Average	23 mg/l

b. Dosage Point: Flash Mixing Tank

c. Solution Tank

			Present Plan	Future Plan
Solid Alum	Treatment Capacity (Day Max.)		18,800 m^3/d	47,900 m^3/d
	Weight		710 kg/d	1,820 kg/d
Solution Rate			10 %	10 %
Solution Tank	Volume		7.1 m^3	18.2 m^3
	Number of tanks		3 nos.	3 nos.
	Dimension	Width	1.8 m	1.8 m
		Length	1.8 m	1.8 m
		Water depth	2.2 m	2.2 m
		Effective volume	21.4 m^3	21.4 m^3
		Free board	0.55 m	0.55 m
	Solution time		1 tanks/d	3 tanks/d

d. ALUM Storage

Days for Storage		30 d	30 d
Storage Volume	Average Treatment Capacity	16,400 m^3/d	41,700 m^3/d
	Weight	11,300 kg/d	28,800 kg/d
Method of Storage	Pallet containers for Alum bags (25kg/bag x 12 bags) are stored in storage yard (width 4.2 x length 3.0m) A storage yard houses 18 pallets (3/width x 2/length x 3 stages) or 5,400 kg Fork lift is used for loading and unloading of pallets		
	Required storage yards is counted as	3 lots.	6 lots.
Area for Storage		37.8 m^2	57.6 m^2

e. Dosage Equipment — Refer to Mechanical and Electric Equipment

2) Polymer

a. Dosage Rate	Maximum	1 mg/l	1 mg.l
	Average	0.5 mg/l	0.5 mg/l
b. Dosage Point	Select 2 placed for effective dosage pints	Flocculation Tank	
c. Dosage Equipment	Refer to Mechanical and Electric Equipment		

3) Chlorine

In the present design, Sodium Hypochlorite is used for chlorination. However, liquid chlorine is expected to be applied in the future for increased consumption of chlorine, Therefore, Chemical Building houses chlorination equipment at the space for future Alum storage. Sodium hypochlorite could be utilized as the emergency chlorination for disinfection when chlorine shift to liquid one in the future.

a. Chlorine Requirement and Dosage

Chlorine dosage rates required for contents of 1 mg/l of Ammonium, Iron and Manganese are

	Ammonium	Iron	Manganese	Total
	10	0.7	1.3	
Contents in Raw Water (mg/l)				
Maximum	0.05	0.8	0.05	
Average	0.03	0.5	0.03	
Chlorine Requirement (mg/l)				
Maximum	0.5	0.56	0.07	1.1 mg/l
Average	0.3	0.35	0.03	0.7 mg/l

Chlorine Requirement for disinfection — 1 mg/l

			Present Plan	Future Plan
Chlorine Dosage				
	Pre-Chlorination	Maximum	21 kg/d	53 kg/d
		Average	11 kg/d	29 kg/d
	Post-Chlorination	Maximum	18 kd/d	46 kg/d
		Average	16 kg/d	40 kg/d
	Total	Maximum	39 kd/d	99 kg/d
		Average	27 kg/d	69 kg/d

b. Dosage Point — Pre-Chlorination: Receiving Tank; Post-Chlorination: Filter Outlet

c. Sodium Hypochlorite

Form of Chemical and Effective Content — Form of Chemical: Powder; Effective Chlorine Content: 12 %

			Present Plan	Future Plan*
Dosage	Pre-Chlorine	Maximum	175 kg/d	-
		Average	150 kg/d	-
		Total	325 kg/d	-
	Post-Chlorine	Maximum	150 kg/d	383 kg/d
		Average	133 kg/d	333 kg/d
		Total	283 kg/d	716 kg/d

Note*: assuming liquid chlorine will be used in the future, and Sodium hypochlorite will be used for disinfection in emergency case.

Solution Tank	Chlorine Content		3%	
	Volume		1.3 m3	1.5 m2
	Number of Tank	Working	1 tank	1 tank
		Stand-by	1 tank	1 tank
		Total	2 tanks	2 tanks
	Dimensions	Diameter	1 m	1.2 m
		Water Depth	1.8 m	1.8 m
		Effective volume	1.4 m^3	2.0 m^3
		Free Board	0.3 m	0.3 m

Tank volume is determined as 2.0 m3 per tank including ample safety factor and taking into account future use of present tank for future.

	Solution times	1 tank/d	1 tank/d

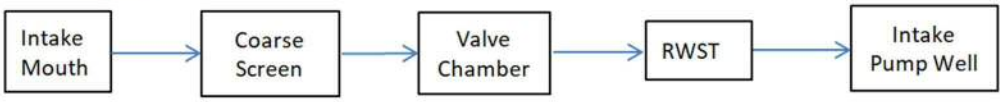
Dosage Equipment — Refer to Mechanical and Electric Equipment

3 Hydraulic Profile of Intake and Treatment Plant

3. Hydraulic Profile of Intake and Treatment Plant

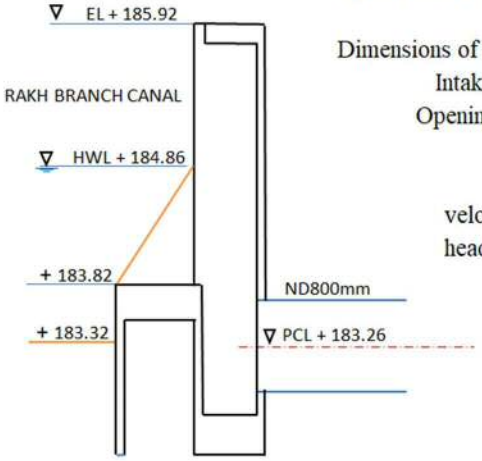
3. 1 Hydraulic Analysis of Intake and Raw Water Transmission

(1) Flow Diagram



(2) Hydraulic Analysis

1) Intake Mouth



Water Level of RBC			WL +	184.86
Dimensions of Intake Mouth				
Intake flow	47,900 m3/s	0.554 m^3/s		
Opening area	width (2 x 0.6m)	1.2 m		
	water depth	1.04 m		
	area	1.248 m^2		
velocity		0.444 m^2/s		
head loss				
hi = (1+fe) x v^2/2g =		0.015	WL +	184.84
fe:	0.5			

2) Raw Water Transmission Main (RWTR)

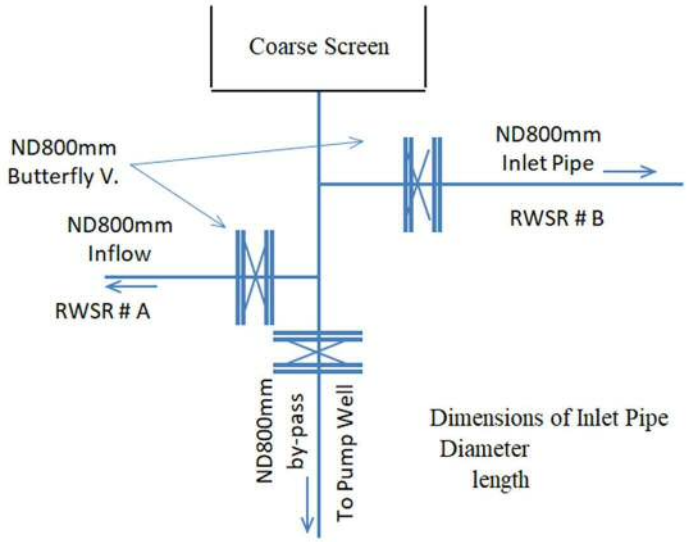
Dimensions of RWTM

Diameter					800 mm	
Length					26.6 m	
Velocity					1.103 m/s	
H. Gradient	(C = 130)				1.30 ‰	
Head Loss Friction loss					0.035 m	
Loss of fittings	Inflow:	0.5	Outflow:	1.0	0.093 m	
Total Loss				h =	0.128 m	WL + 184.72

3) Coarse Screen 1 unit

hscr = C x v^2/2g =			0.001 m	
C = c x (s/b)^4/3 x sinΘ			0.23	
c: Shape co-efficient (flat bar)			2.42	
s: Thickness of flat bar			9 mm	
b: Spacing of flat bar			60 mm	
Θ: Installation angle of flat bar			70 度	
w: opening area			1.80 m	
h: water depth			2.30 m	
v: approach velocity			0.134 m/s	
α: opening ration due to clogging			50 %	
hs = Head loss of coarse screen is set at 2 cm			0.020 m	WL + 184.70

4) Inflow Loss to RWSR (to RWSR B)



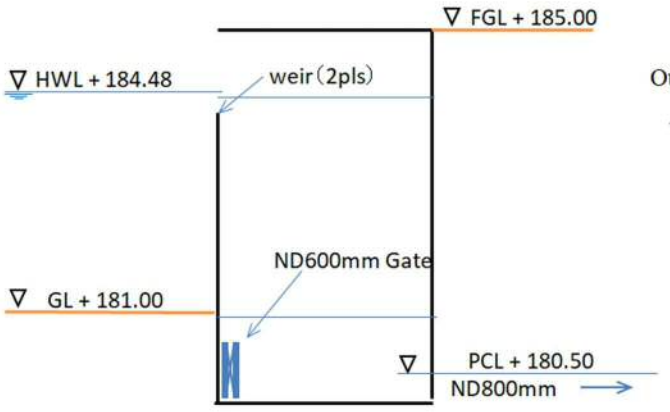
Dimensions of Inlet Pipe

Diameter	800 mm
length	28.6 m

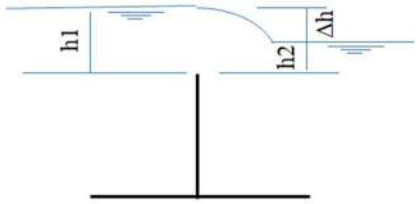
Flow rate			0.554 m^3/s		
Velocity			1.103 m/s		
H. Gradient	(C = 130)		1.30 ‰		
Friction loss			0.037 m		
Other losses (fittings, valve, etc.)			0.170 m		
inlet		0.50			
Valve (butterfly)		0.24			
Refraction		0.99			
Outlet		1.0			
Loss of Tranfer Pipe(ND900)			0.010 m		
Total head loss			hin = 0.217 m	WL +	184.48

5) Outflow Loss from RWSR

Loss of Weir



Outflow Weir



Loss of Submerged Weir - Velmonte Formula

$h2 = \{1 - (Q/Qo)^{2.6}\}^{\wedge 1.5} \times h1 =$ 0.421 m

Weir length	1.0 m			
Overflow rate	Q : flow rate by submerged weir flow	0.277 m^3/s・weir		
	Qo: flow rate under overflow height h1	0.651 m^3/s		
Overflow height	h1: overflow height at upstream	0.500 m		
	h2: overflow height at downstream	0.421 m		
	Δh: loss of submerged weir flow	0.079 m	WL +	184.40

Out flow from RWST

Dimensions of outlet pipe

Diameter					800 mm	
Length					27.6 m	
Flow rate					0.554 m^3/s	
Velocity					1.103 m/s	
H. Gradient	(C=130)				1.30 ‰	
Friction loss					0.036 m	
Other losses (fittings, valves,etc.)					0.093 m	
	Inlet	0.5	Outlet	1.0		
Total Head Loss					0.129 m	WL + 184.27

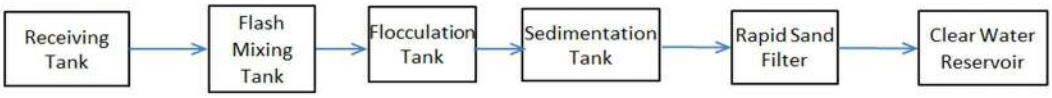
6) Raw Water Transmission Pump Station

Receiving Chamber

Flow rate	per one stream				0.277 m^3/s	
Fine screen	assumed				0.040 m	
Gate (600/600x 2pls)	hg = 1/C^2*V^2/2g				0.168 m	
	C:	0.6	V:	0.770 m/s		
Total head loss					0.208 m	
Water level of Pump Well						WL + 184.06

3.2 Hydraulic Analysis of Water Treatment Plant

(1) Flow Diagram



(2) Hydraulic Analysis

Transmission Pump Head				10.000 m	
Transmission flow				0.554 m^3/s	
Water level of pump well				WL +	184.06
Head loss in pump room				1.700 m	
Head loss of Raw Water Transmission Main				0.320 m	
Head lodd of flow control valve	v =	2.823 m/s		3.100 m	
	fv =	7.63			
Total Head Loss				5.120 m	
Static Head				4.880 m	
Water Level of Receoving Tank				WL +	188.94

Head Loss of Raw Water Transmission Main（Raw Water Pump Sta.～Receiving Tank）

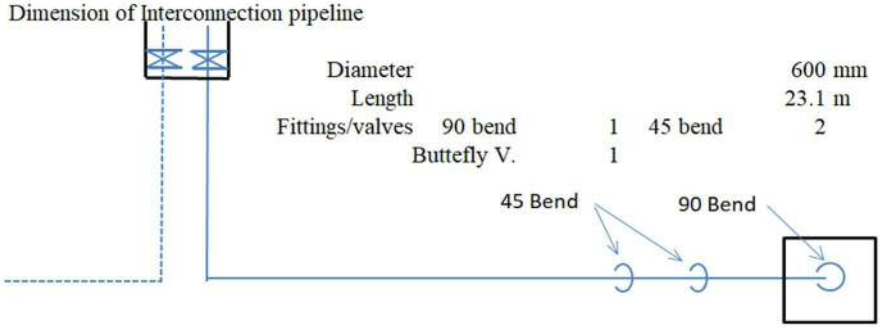
Dimensions of Transmission Main					
Diameter				700 mm	
Length				46 m	
Fittings/valves	90 bend:	2	45bend: 2		
	Butterfuly V.:	1			
Head Loss Flow rate					
Velocity			v =	1.440 m/s	
H. Gradient		C = 130	i =	2.50 ‰	
Friction loss			hf =	0.115 m	
Other losses		Σf = 0.70	hm =	0.074 m	
Butterfly V.		fv = 0.24	hv =	0.025 m	
Outlet		fo = 1.0	ho =	0.106 m	
			Hrwm =	0.320 m	

1) Receicing Tank

Receiving Water Level				WL +	188.94
Treatment Capacity				0.554 m3/s	
Number of units				2	
Flow per unit				0.277 m^3/s	
Head Loss Inlet gate	Size:			600 x 600 mm	
	Velocity:			0.769 m/s	
	Loss of gate: co-efficient	C = 0.6		0.084 m	
	Water level of Receiving Tank			WL +	188.86
Rectifying wall	Diameter:			100 mm	
	Number:			150 nos.	
	Area:			1.178 m2	
	Velocity:			0.235 m^3/s	
	Head loss: co-efficient	C = 0.6		0.008 m	WL - 188.85
Overflow weir	Weir level:		EL +	188.73	
	Weir width:			3.0 m	
	Head loss: Overflow height:	C = 1.84	hw =	0.123 m	
	Freefall depth:		hd =	0.225 m	
	Head loss:			0.348 m	WL - 188.50

Receiving Tank～Flash Mixing Tank

Dimension of Interconnection pipeline

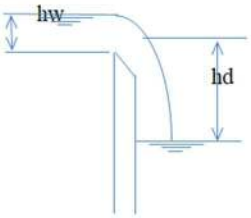


	Diameter					600 mm
	Length					23.1 m
	Fittings/valves	90 bend	1	45 bend		2
		Buttefly V.	1			

Head Loss	Flow rate					0.277 m^3/s
	Velocity					0.980 m/s
	H. gradient（C=130）					1.47 ‰
	Friction loss					0.034 m
	Other losses	inflow:	0.5	Butterfly v.:	0.24	0.120 m
		90bend:	0.24	45bend	0.11	
		outflow:	1.0			
	Total loss					0.153 m

2) Flash Mixing Tank

Water level of Flash mixing tank	WL +	188.35 m
Rapid mixing method	Mixing by Waterfall	
Freefall depth	0.6 m	



Number of tank			2 tanks
Treatment flow			0.277 m^3/s
Overflow height	(C = 1.84)	hw =	0.136 m
Weir width		B =	3.0 m
Freefall depth		hd =	0.464 m
Head loss (refer to Attachment 3-1)			0.600 m
Water level at effluent		WL +	187.75 m

3) Flocculation Tank

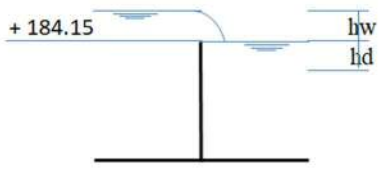
Slow Mixing Method				Up-and-Down flow	
Number of tanks				4 tanks	
Treatment flow				0.139 m3/s	
Head loss	Loss in Inlet channel			neglect	
	Inlet gate	Size		450 x 450 mm	
		Velocity		0.684 m/s	
		Head loss co-efficient	C = 0.6	hg = 0.066 m	
	Water level of Flocculation tank	(1st mixing channel)		WL +	187.68 m
	Loss of slow mixing			0.356 m	
	(refer to Attachment 3-2 Mixing Intensity and GT-value of slow mixing)				
	Water level of Flocculation tank	(4th mixing channel)		WL +	187.32 m
	Rectifying wall	Velocity		0.2 m/s	
		Head loss co-efficient	C = 0.6	0.003 m	
	Water level of Sedimentation Tank			WL +	187.32 m

4) Sedimentation Tank (Inclining Tube)

Number of tanks				4 tanks
Treatment flow				0.139 m3/s
Head loss	(refer to Attachment 3-3 Head loss of clarified water extraction)			
	Clarified water extraction pipe		hs =	0.306 m
	Clarified water channel		he =	0.110 m
	Total head loss		h =	0.415 m

5) Rapid Sand Filter

Filtration Method				Equal split constant rate filtration	
Treatment flow	(3% of loss in process is assume)			46,900 m3/d	
				0.543 m3/s	
				0.068 m3/s/池	
Number of Filter				8 filters	
	Water level of Filter Inflow Channel			WL +	186.91
Head loss	Inlet gate	Size		300 x 300 mm	
		Velocity		0.754 m/s	
		Head loss co-efficient	C = 0.6	0.081 m	
	Inflow weir	Weir width		0.9 m	
		Overflow height	C=1.84 hw =	0.119 m	
		Freefall depth	hd =	0.097	
	Inlet pipe	Diameter		300 mm	
		Length		1.8 m	
		Velocity	v =	0.960 m/s	
		H. gradient	i =	3.18 ‰	
		Friction loss		0.076 m	
	Total head loss			0.373 m	
	Water level of Filter			WL +	186.53
	Loss of filtration	(refer to Attachment 3-4 Head loss of Filter)			
		Clean sand layer, gravel layer and underdra		0.325 m	
		Clogging loss		1.275 m	
	Loss of filtered water pipes			0.667 m	
	Water level of Filyer outlet (before weir)			WL +	184.27
	Effluent Weir Level			EL +	184.15

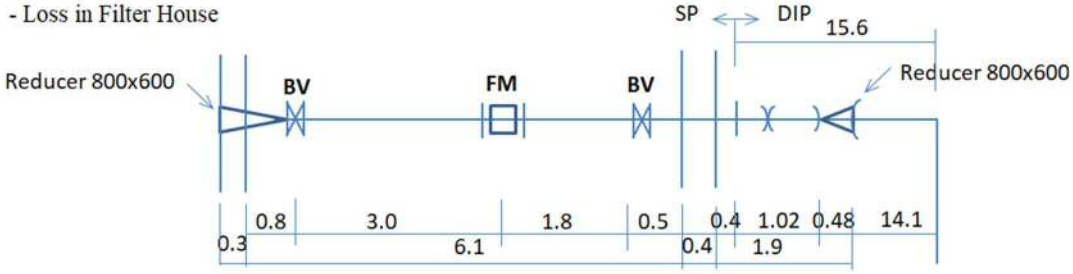


hw =	$(Q / (C \times B))^{2/3}$ =			0.116 m
	where, C :	coefficient	1.86	
	Q :	filtered water flow	0.543 m3/s	
	B :	weir length	7.4 m	
hd =	0			

Water level of Filyer outlet (after weir)	WL +	184.15

6) Interconnectin Pipeline (Filter ~ Clear Water Reservoir)

- Loss in Filter House

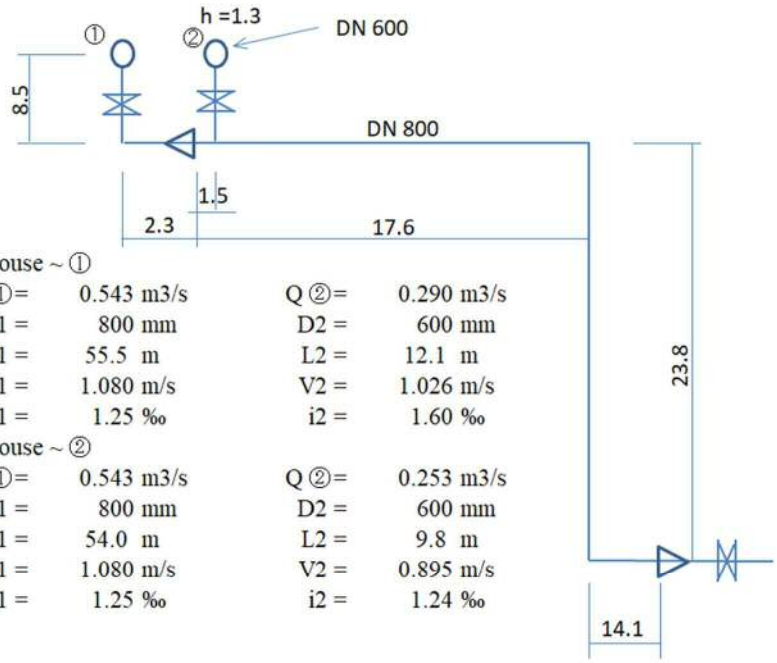


Q = 0.543 m3/s ND = 800 L = 0
v = 1.081 m/s i = 1.25 ‰
ND = 600 L = 8.70 m
v = 1.921 m/s i = 5.09 ‰

Overflow height of weir	
Weir Lengtl	7.4
hw	0.117

hf = 1.25 x 0 x 1/1000 + 5.09 x 8.7 x 1/1000 = 0.044
hm = 0.5 x 1.081^2/2g + 2 x 0.24 x 1 921^2/2g = 0.120
where, DN800 fi: 0.5
DN600 fv: 0.24
H1 = hf + hm = 0.164 m

- Flter House to CWR



Filter house ~ ①

Q ①=	0.543 m3/s	Q ②=	0.290 m3/s
D1 =	800 mm	D2 =	600 mm
L1 =	55.5 m	L2 =	12.1 m
V1 =	1.080 m/s	V2 =	1.026 m/s
i1 =	1.25 ‰	i2 =	1.60 ‰

Filter house ~ ②

Q ①=	0.543 m3/s	Q ②=	0.253 m3/s
D1 =	800 mm	D2 =	600 mm
L1 =	54.0 m	L2 =	9.8 m
V1 =	1.080 m/s	V2 =	0.895 m/s
i1 =	1.25 ‰	i2 =	1.24 ‰

- Filter House to ①

Loss of DN800:

hf = 1.25 x 55.5 x 1/1000 = 0.070 m
hm = 0.63 x 1.081^2/2g = 0.037 m
h800 = 0.107 m
where, fge: 0.10 fb90: 0.24
fγ: 0.05 Σf: 0.63

Loss of DN600: Q = 0.2900 m3/s

v = 1.026 m/s i = 1.60 ‰

hf = 1.41 x 13.4 x 1/1000 = 0.019 m

hm = 1.48 x 0.961^2/2g = 0.080 m

h600 = 0.099 m

where, fgc: 0.00 fb90: 0.24

fo: 1.00 Σf: 1.48

Total Loss ① 0.206 m

Total Loss to CWR 0.370 m

- Filter House to ②

Loss of DN800:

hf = 1.25 x 54 x 1/1000 = 0.068 m

hm = 1.78 x 1.081^2/2g = 0.106 m

h800 = 0.174 m

where, fge: 0.10 fb90: 0.24

fβ: 1.20 Σf: 1.78

Loss of DN600: Q = 0.2528 m3/s

v = 0.895 m/s i = 1.24 ‰

hf = 1.41*9.8*1/1000 = 0.012 m

hm = 1.24 x 0.961^2/2g = 0.067 m

h600 = 0.079 m

where, fb90: 0.24 fo: 1.0

Σf: 1.24

Total Loss ② 0.253 m

Total Loss to CWR H2 = 0.417 m

Contraction (fge)

			12	
	100	480	0.207912	0.208333
Θ =		20	0.4	
		30	0.7	

fge: Θ = 24 deg. fge = 0.52

D1 = 600 D2 = 800

f = 0.52 x (1-(600/800)^2)^2 = 0.100

Diversion loss: $f\beta$: $0.95 \times (1-q_\beta)^2 + q_\beta \times (1.3\mathrm{Cot}(\Theta/2) - 0.3 + (0.4-0.1\varphi)/\varphi^2) \times (1-0.9\sqrt{\rho}/\varphi) + 0.4 q_\beta \times (1-q_\beta)(1-1/\varphi)\mathrm{Cot}(\Theta/2)$

when, Θ is 90°and ρis zer0

$f\beta$: $0.95 \times (1-q\beta)^2 + q\beta \times (1.3\mathrm{Cot} - 0.3 + (0.4-0.1\varphi)/\varphi 2) + 0.4 \times q\beta \times (1- q\beta) \times (1-1/\varphi)$

$f\gamma$: $0.58q_\beta^2 - 0.26q_\beta + 0.03$

where, qβ= 0.5 Θ = 90 deg.

φ= 0.56

fβ: = 1.20

fγ = 0.05

Contraction (fgc) fgc = 0

7) Clear Water Reservoir (Loss of interconnecting pipeline Filter ~ Clear water reservoir)

H = h1 + h2 = **0.370** m

Water Level of Clear Water Reservoir WL + 183.78

Summary of Hydraulic Analysis - Intake & Water Treatment process

	Facilities		Head Loss		Key Elevation	Flow (m^3/s)		Water level
1	**Intake & Raw water Transmission**							
	Water Level of RBC						+	184.86
1.1	**Intake Mouth**		0.015			0.554		
	Transmission Main		0.128					
	(Intake Mouth~Coarse screen)							
1.2	**Coarse Screen**		0.020			0.554	+	184.72
	Inlet Pipe (Coarse Screen~RWSR)		0.217					
1.3	**RWSR**					0.554	+	184.48
	Outflow Chamber		0.079					
	Outlet Pipe (RWSR~RW. Pump Sta.)		0.129					
1.4	**Raw Water Pump Station**					0.554		
	Inlet Chamber		0.208					
	Pump Well						+	184.06
	RW Pump Sta. ~ Receiving Tank Pump Transmission							
	Raw Water Pump Head	10 m						
	Loss of Piping around pump		1.700					
	Raw Water Transmission		0.320					
	Loss of Flow control valve		3.100					
2	**Water Treatment Facilities**							
2.1	**Receiving Tank**		loss in treatment process		5%	0.554		
	Receiving water level of Receiving Tank						+	188.94
	Inlet loww		0.084					
	Water Level of Receiving tank						+	188.86
	Loss of Rectifying wall		0.008					
	Weir	hw	0.123	+	188.73			
		hd	0.225					
		h	0.348					
	Interconnecting Pipeline		0.153					
	(Receiving tank ~ Flash Mixing tank)							
2.2	**Flash Mixing Tank**					0.554		
	Water Level of Flash Mixing Tank						+	188.35
	Weir	hw	0.136	+	188.21			
		hd	0.464					
2.3	**Flocculation Tank**					0.554		
	Inlet gate	hg	0.066					
	Water Level of Flocculation Tank						+	187.68
	Baffle Plate	hor1	0.356					
	Rectifying Wall	hor2	0.003					
2.4	**Sedimentation Tank**					0.554		
	Water Level of Sedimentation Tank						+	187.32
	Clarified water extraction			+	187.22			
	Collecting pipe	hcor+d+hd	0.306					
	Clarified water channel	ho-hc	0.110					
		hf	0.415					
2.5	**Filter**		loss in treatment process		3%	0.543		
	Water Level of Inflow Channel of Filter						+	186.91
	Inlet gate	hg	0.081					
	Inlet weir			+	186.70			
	Head loss of Filter inlet	hi	0.292					
	Water Level of Filter						+	186.54
	Loss of Filtration	h	1.600	including sand cloggong loss				
	Loss of Filtered water pipes	hp	0.667					
	Filter effluent weir	hw	0.116	+	184.15			
		hd	0.000					
	Water level of Filter effluent chamber						+	184.15
2.6	**Clear water Reservoir**					0.543		
	Interconnecting Pipeline		0.370					
	(Filter ~ Clear Water Reservoir)							
	Water Level of	HWL					+	183.78
	Clear Water Reservoir	LWL	(effective water depth :4.5m)				+	179.28

Attachment 3-1 Mixing Intensity of Flash Mixing Tank

$G = (1/\mu*(\rho*g*q*hf / V))^{0.5}$ = 497 sec^{-1}

where,

μ :	viscosity (15 ℃)		0.00098	kg/m/s
ρ :	specific gravity of water		1,000	kg/m3
g :	gravity acceleration m/sec		9.8	m/sec^2
q :	flow rate		0.277	m3/sec
h :	free fall depth below weir crest		0.532	m
hf :	head loss	(1/2*hw + hd)	0.600	m
V :	volume	($^{W}0.8*^{L}3.0*^{D}2.8$)	6.72	m3
hw :	overflow depth		0.136	m
hd :	free fall		0.464	m

Attachment 3-2 Mixing Intensity and GT-Value of Slow Mixing

Descripions	unit	umber of Row				
		No.1	No.2	No.3	No.4	Total
No. of Baffle Walls	nos.	5	5	5	5	20
No. of Baffle Plates	nos.	3	4	5	6	18
Slit size of baffle plate	mm	$^{w}300 \times {}^{h}80 \times {}^{n}4$				
Area of slit per baffle	m2	0.29	0.38	0.48	0.58	-
Velocity at slit	m/sec	0.481	0.361	0.289	0.241	-
Head loss of slit	m	0.164	0.092	0.059	0.041	0.356
Volume of channel	m3	68.9	66.0	64.3	63.3	263
Width	m	1.85	1.85	1.85	1.85	-
Length	m	9.70	9.70	9.70	9.70	-
Water depth	m	3.84	3.68	3.58	3.53	3.66
Detention time	sec	497	476	464	456	1,893
Mixing intensity	sec^{-1}	57.4	44.0	35.7	30.0	43.4
Energy dissipation	G	28,500	20,900	16,500	13,700	79,600

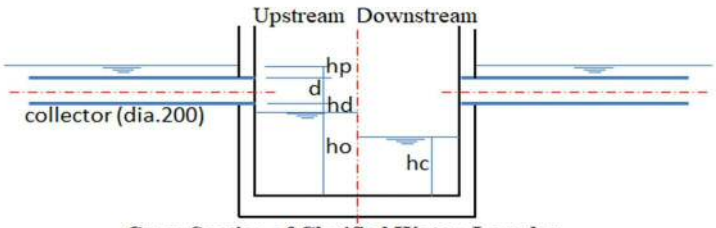
note: Mixing intensity is calculated by the following formula:

$G = (1/\mu*(\rho*g*q*hf / V))^{0.5}$ sec^{-1}

where,

μ :	viscosity (15 ℃)	0.00098	kg/m/s
ρ :	specific gravity of water	1,000	kg/m3
g :	gravity acceleration m/sec	9.8	m/sec^2
q :	flow rate	0.1386	m3/sec
hf :	head loss (hor = n x 1/C^2 x v^2/2g)		m
	C: orifice coefficient as 0.6		
V :	volume	variable	m3

Attachment 3-3 Head Loss of Clarified Water Extraction



Cross Section of Clarified Water Launder

hp:	loss of inflow to collector (orifice loss)			0.039 m
d:	size of collector			0.216 m
hd:	free fall height			0.051 m
ho:	upflow water depth of launder			0.260 m
hc:	critical water depth at effluent			0.150 m
h:	Head loss of clarified water intake			0.415 m
	(hp + d + hd + ho - hc)			

Loss of Collector

Flow per tank				0.139 m3/s
Collector size				200 mm
number				8 nos.
Velocity of collector				0.55 m/s
Number of slit holes	(ctc 420mm)			10 nos/collector
				80 nos/tank
Size of slit hole				65 mm
Area of slit holes				0.265 m2
Velocity				0.522 m/s
loss			hor:	0.039 m
pipe dia.			OD:	0.216 m
Freefall deth			hd:	0.051 m
Total loss	(hor + OD + hd)			0.306 m

Loss of Launder

Critical water depth	hc =(α x q^2 / (9.8 x B^2))^1/3 =			0.150 m
	where,	α = 1.1	B =	0.8
Upstream water depth	ho = 1.732 x hc =			0.260 m
Loss of Launder				0.110 m
Loss of Clarified Water Collection				0.415 m

Attachment 3-4 Head Loss of Filter

1. Loss Filter Sand

Treatment Capacity			46,900	m^3/d
Number of Filter			8	nos.
Filtration Rate of Filter	Filtration per Filter		5,900	m^3/d
	Filter Bed Area		42.3	m2
	Filtration Rate		139.0	m/d

Loss of Sand Layer

$hs = 0.178 * Cd/g * v^2/p^4 * h =$ 0.323 m

where,	Cd :	Drag coefficient		
	g :	Acceleration of gravity	980	cm/s^2
	v :	Filtration rate (cm/s) 139.0 m/d =	0.161	cm/s
	p :	Void ration of sand layer	0.4	
	A :	Surface area of sand particle		
	V :	Volume of sand particle		
	h :	Thickness of sand layer	100	cm

$A/V = 6/\sigma d = 6/(0.81*0.09) =$ 82.3

where,	σ:	Spericity of sand particle	0.81	
	d :	Effective size of filter sand	0.09	cm

$Cd = 24/Re + 3/\sqrt{Re} + 0.34$ 17.6

where,	Re :	Reynol's number (= v*d/n)	1.609	
	n :	Kinematic viscoursity	0.009	(at 25℃)

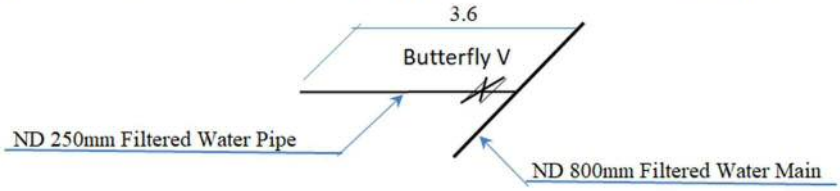
$= 58.4\ Cd * v^2$

2. Loss of Supporting Gravel 0.001 m

3. Loss of Underdrain 0.001 m

4. Loss of Filtered Water Pipes

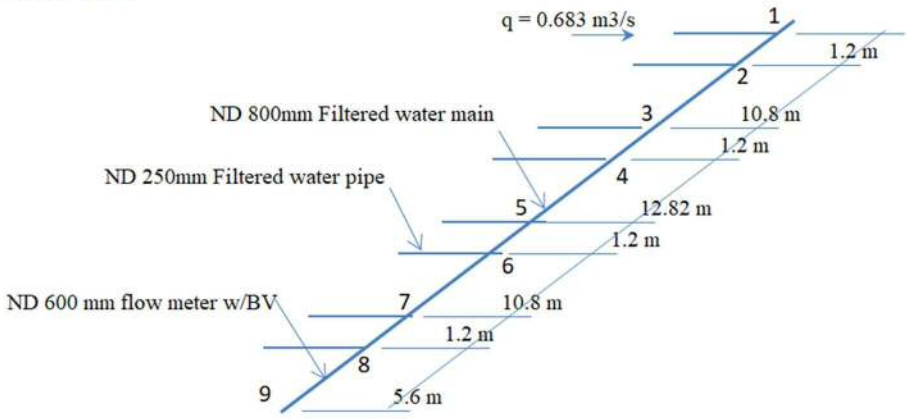
Fileted water pipe q: Flow of Filtered Water Pipe 0.0683 m^3/d



$hp1 = (fi + fv + fo + f*l/d) * v^2/2g =$ 0.217 m

where,	fi :	inlet coefficient	0.5	
	fv :	valve coefficient	0.3	
	fo :	outlet coefficient	1.00	
	f*l/d-1 :	friction coefficient (400	0.40	((124.5*0.012^2/0.25^1/3) * (3.5/0.2))
	v :	velocity	1.392	(0.0683/(0.785*(0.25^2))

Filtered water main



	friction loss			minor loss					total loss
section	f*l/d	q	v	hf	hβ	hα	hv & hge	ho	Σh
1 ~ 2	0.03	0.0683	0.136	0.000	0.068	-	-	-	0.07
2 ~ 3	0.26	0.1366	0.272	0.001	0.072	0.003	-	-	0.08
3 ~ 4	0.03	0.2049	0.408	0.000	0.078	0.004	-	-	0.08
4 ~ 5	0.31	0.2731	0.544	0.005	0.086	0.006	-	-	0.10
5 ~ 6	0.03	0.3414	0.680	0.001	0.096	0.007	-	-	0.10
6 ~ 7	0.26	0.4097	0.816	0.009	0.107	0.009	-	-	0.12
7 ~ 8	0.03	0.4780	0.951	0.001	0.120	0.010	-	-	0.13
8 ~ 9	0.20	0.5463	1.087	0.012	0.135	0.011	0.013		0.17
8 ~ 9	-	0.5463	1.087	-	-	-	-	0.060	0.06

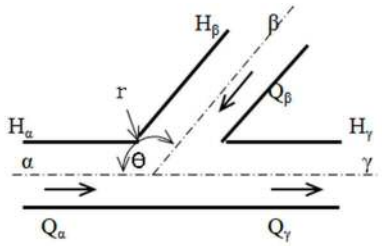
where, 2*fb : 22 bend 0.22

fo : outlet 1.0

Summary: Loss of Filtered Water Pipe and Main

filter	filtered water pipe		filtered water main		loss of outlet section		total
	hp1	hp2	hf	hm	2 x hb	ho	loss
1	0.217	0.068	0.029	0.049	-	-	0.363
2	0.217	0.072	0.029	0.049	-	-	0.367
3	0.217	0.078	0.028	0.047	-	-	0.370
4	0.217	0.086	0.028	0.042	-	-	0.374
5	0.217	0.096	0.023	0.037	-	-	0.373
6	0.217	0.107	0.022	0.030	-	-	0.376
7	0.217	0.120	0.013	0.021	-	-	0.372
8	0.217	0.135	0.012	0.011	-	-	0.376
9					0.013	0.060	**0.449**

Loss of Confluence



$H_\beta - H\gamma = f_\beta \times V_\gamma^2/2g$

$f_\beta = -q_\beta^2 \times \{1.2x(1/\varphi - 1) + 0.8(1-1/\varphi^2)\} - (1-q_\beta) \times \{0.92 + q_\beta(2.92-\varphi)\}$

$H_\alpha - H\gamma = f_\alpha \times V_\gamma^2/2g$

$f\alpha = -q_\beta^2 \times \{2.59-1.62) - 0.62\varphi\} - q_\beta(1.94-\varphi) + 0.03$

where,

H_α: Pressure of main pipe before confluence

H_β: Pressure of branch pipe

H_γ: Pressure of main pipe after confluence

q_β: $-Q_\beta/Q\gamma$

θ: Angle of branch to main pipe (90 deg)

φ: Section area of Main/Section area of Branch

ρ: r/D (0)

r: Radius of pipe connection between main and branch pipes (0)

Loss of Confluence Main pipe: 800 mm Branch pipe: 250 mm

Loss of Branch Pipe: $H_\beta - H\gamma = f_\beta \times V_\gamma^2/2g$

node	Qα	Qβ	Qγ	qβ	φ	fβ	vγ	hβ
1	0	0.0683	0.0683	1.00	0.0976563	-72	0.136	-0.068
2	0.0683	0.0683	0.1366	0.50	0.0976563	-19.2	0.272	-0.072
3	0.1366	0.0683	0.2049	0.33	0.0976563	-9.2	0.408	-0.078
4	0.2049	0.0683	0.2731	0.25	0.0976563	-5.7	0.544	-0.086
5	0.2731	0.0683	0.3414	0.20	0.0976563	-4.07	0.680	-0.096
6	0.3414	0.0683	0.4097	0.17	0.0976563	-3.16	0.816	-0.107
7	0.4097	0.0683	0.4780	0.14	0.0976563	-2.60	0.951	-0.120
8	0.4780	0.0683	0.5463	0.13	0.0976563	-2.24	1.087	-0.135

Loss of Main Pipe: $H_\alpha - H\gamma$ $f_\alpha \times V_\gamma^2/2g$

node	Qα	Qβ	Qγ	qβ	φ	fγ	vγ	hα
1	0	0.0683	0.0683	1.00	0.0976563	-	-	-
2	0.0683	0.0683	0.1366	0.50	0.0976563	-0.66	0.272	-0.003
3	0.1366	0.0683	0.2049	0.33	0.0976563	-0.48	0.408	-0.004
4	0.2049	0.0683	0.2731	0.25	0.0976563	-0.37	0.544	-0.006
5	0.2731	0.0683	0.3414	0.20	0.0976563	-0.30	0.680	-0.007
6	0.3414	0.0683	0.4097	0.17	0.0976563	-0.25	0.816	-0.009
7	0.4097	0.0683	0.4780	0.14	0.0976563	-0.21	0.951	-0.010
8	0.4780	0.0683	0.5463	0.13	0.0976563	-0.19	1.087	-0.011

4. Distribution Center

4. Distribution Center

4.1 Dimensions of Distribution Center I (Abudulah Pur)

(1)	Water Demand	Day Maximum Demand				8,060 m^3/s
		Peak Hourly Demand	Co-efficient		1.5	504 m^3/h
(2)	Distribution Center					
	Site	Area				816 m^2
		Shape	Width			17 m
			Length			48 m
	Facilities	Ground Reservoir	Detention time			4 h
			Volume			1343 m^3
			Number of reservoirs			2 nos.
			Dimension:	Width		7.5 m
				Length		15.5 m
				Effective water depth		6.0 m
				Volume		698 m^3
			Inlet pipe	Diameter		250 mm
				Level controller (float valve)		250 mm
			Overflow	Diameter		200 mm
			Drain pipe	Diameter		150 mm
		Pump / Electric room	Width			7.5 m
			Length			7.5 m
			Height	Pump room (below beam sofit)		8.0 m
				Electric room (below beam sofit)		3.0 m
		Overhead Reservoir	Detention time			1.5 h
			Volume			504 m^3
			Structure			RC
			Dimension:	Diameter		10.8 m
				Effective water depth		5.5 m
				Volume		504 m^3
			LWL	from Ground level		25 m
			Inlet pipe	Diameter		350 mm
			Outlet pipe	Diameter		350 mm
		Yard piping	Inlet pipe	Diameter		350 mm
				Flow mete	Type	Electro magnetic
					Diameter	250 mm
				Flow	Type	Butterfly valve
				control V.	Diameter	250 mm
			Distribution	Diameter		350 mm
			Main	Flow mete	Type	Electro magnetic
					Diameter	300 mm

4.2 Dimensions of Distribution Center DZ II (Madina Town No.2)

(1)	Water Demand	Day Maximum Demand				15,460 m^3/s
		Peak Hourly Demand		Co-efficient	1.5	966 m^3/h
(2)	Distribution Center					Madina Town 1
	Site	Area				2,560 m^2
		Shape	Width			40 m
			Length			64 m
	Facilities	Ground Reservoir	Detention time			4 h
			Volume			2,577 m^3
			Number of reservoirs			2 池
			Dimension	Width		13.1 m
				Length		21.1 m
				Effective water depth		4.8 m
				Volume		1,327 m^3
			Inlet pipe	Diameter		300 mm
				Level controller (float valve)		300 mm
			Overflow	Diameter		200 mm
			Drain pipe	Diameter		150 mm
		Pump / Electric room	Width			5.6 m
			Length			17.2 m
			Height	Pump room (below beam sofit)		6.20 m
				Electric room (below beam sofit)		3.0 m
		Overhead Reservoir	Detention time			1.5 h
			Volume			933 m^3
			Structure			RC
			Dimension	Diameter		14.7 m
				Effective water depth		5.5 m
				Volume		933 m^3
			LWL	from Ground level		25 m
			Inlet pipe	Diameter		450 mm
			Outlet pip	Diameter		450 mm
		Yard piping	Inlet pipe	Diameter		400 mm
				Flow mete	Type	Electro magnetic
					Diameter	350 mm
				Flow control V.	Type	Butterfly valve
					Diameter	350 mm
			Distribution Main	Diameter		450 mm
				Flow mete	Type	Electro magnetic
					Diameter	350 mm

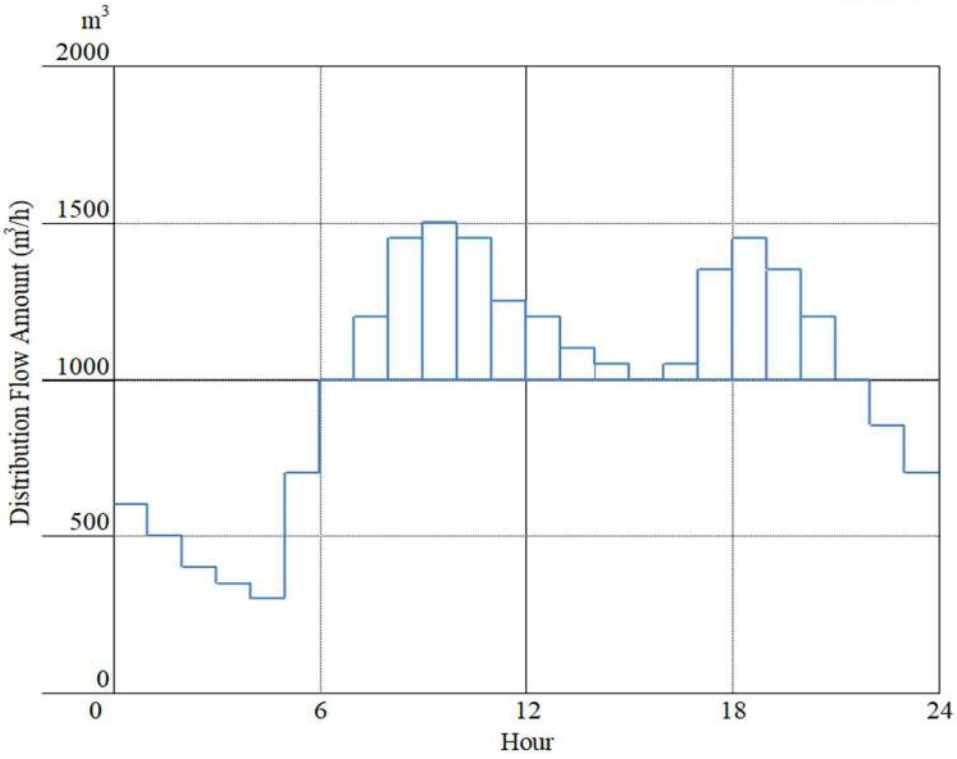
Attachment 4-1 Capacity of Ground Reservoir (Detention Time)

Conditions of Analysis

Peak hourlu Factor	1.5
Physical Loss of Distribution System	20%
Minimum Night Flow (Consumption)	10%

Ditention Time of Ground Reservoir 15%

3.6 hours



Day Max. Distribution Flow 2400 m^3

Hour	Rate per Ave. flow %	Hourly Flow m^3	Hour	Rate per Ave. flow %	Hourly Flow m^3	Hour	Rate per Ave. flow %	Hourly Flow m^3
0 ~ 1	60	60	8 ~ 9	145	145	16 ~ 17	105	105
1 ~ 2	50	50	9 ~ 10	150	150	17 ~ 18	135	135
2 ~ 3	40	40	10 ~ 11	145	145	18 ~ 19	145	145
3 ~ 4	35	35	11 ~ 12	125	125	19 ~ 20	135	135
4 ~ 5	30	30	12 ~ 13	120	120	20 ~ 21	120	120
5 ~ 6	70	70	13 ~ 14	110	110	21 ~ 22	100	100
6 ~ 7	100	100	14 ~ 15	105	105	22 ~ 23	85	85
7 ~ 8	120	120	15 ~ 16	100	100	23 ~ 24	70	70

Volume of Reservoir (7 ~ 22 時) 360 m^3

Detention Time 1960 - 16 x 100 = 3.6 hours

Rate to Day Max. Distribution Capacity: 15%

Detention time of ground reservoir is determined at 4 hours of May Max. Distribution Capacity

5. Treated Water Transmission and Distribution System

5. Treated Water Transmission and Distribution System

5.1 Brief Description of Treated Water Transmission and Distribution System

(1) Service Area

Service area under the Priority Project of Master Plan includes three distribution zones (DZs) located at city center. Under the present plan, two DZs (DZ I: Abdullahpur and DZ II: Madina Town) are selected out of three DZs.

The distribution center (DC) is selected at the existing Overhead Reservoir site in each DZ which will be demolished before construction of new facilities including a ground reservoir (GR) and a Overhead Reservoir (OHR).

Production capacity of new water treatment plant in Old JK WTP is determined at 45,500 m^3/d or 10 mgd taking future requirement into account. 50% or 5 mgd of finished water in WTP is transmitted by pumps to the above two DZs, where received water in GR is pumped up to OHR for gravity distribution to respective DZs. Flow meters are provided for control of inflow into GR and for monitoring of distribution flow from OHR.

Each DZ is hydraulically independent service area from others and it is further divided into multiple district meter areas (DMAs). At the inflow point of DMA, district meter is provided to monitor distribution flow. Pressure gauge is also provided there for monitor of pressure conditions of DMA. The flow monitoring facilitate to grasp the tendency of demand and status of physical loss to compare consumption in respective DMA for loss abatement actions required. The electro-magnetic flow meter is planned taking the necessity of accurate flow measuring into account.

The size of DMA is set at approximately 2000 service connection. The size of DMAs (number of service connections and water demand estimated in Master Plan is presented in the table below.

Number of Service Connections and Water Demand Forecast in DZ and DMA

Zone	DMA	2023		2028		2033		2038	
		Connection	Demand	Connection	Demand	Connection	Demand	Connection	Demand
		unit	m^3/d	unit	m^3/d	unit	m^3/d	unit	m^3/d
DZ I	I-1	970	2,460	1,300	3,100	1,670	3,710	2,010	4,190
(DC22)	I-2	890	2,270	1,200	2,860	1,540	3,430	1,850	3,860
	subtotal	1,860	4,730	2,500	5,960	3,210	7,140	3,860	8,050
	II-1	1,200	3,050	1,590	3,770	2,010	4,460	2,350	4,910
DZ II	II-2	700	1,770	920	2,180	1,170	2,590	1,370	2,820
(DC21)	II-3	740	1,860	980	2,360	1,240	2,770	1,450	3,050
	II-4	1,140	2,910	1,510	3,590	1,910	4,230	2,230	4,680
	subtotal	3,780	9,590	5,000	11,900	6,330	14,050	7,400	15,460
	III-1	820	2,080	1,090	2,610	1,380	3,070	1,610	3,360
	III-2	970	2,470	1,280	3,030	1,620	3,630	1,900	3,960
DZ III	III-3	790	2,000	1,040	2,460	1,320	2,940	1,540	3,230
(DC18)	III-4	790	2,000	1,040	2,500	1,320	2,910	1,550	3,230
	III-5	1,170	2,960	1,550	3,680	1,960	4,360	2,290	4,770
	III-6	1,060	2,730	1,400	3,360	1,780	3,960	2,080	4,320
	subtotal	5,600	14,240	7,400	17,640	9,380	20,870	10,970	22,870
	Total	11,240	28,560	14,900	35,500	18,920	42,060	22,230	46,380

Note *1: Present Plan includes DZ 1and DZ 2.

*2: Figures of service connections and water demand (day maximum) is based on the Master Plan study.

*3: number of service connection is for domestic users estimated using household size of 7.15, 7.10 and 7.0 in year 2023, 2028 and 2038 respectively

(2) Design Criteria

1) Definition and Function of Treated Water Transmission and Distribution Mains

The system is composed of treated water transmission main and distribution main which is further divided into three categories of primary, secondary and tertiary mains.

The definitions and functions of above categories of pipelines are as follows:

Transmission main: The transmission main is pipeline only to transmit finished water from WTP to above mentioned three distribution centers. Therefore, no tapping water from the transmission main is allowed.

Distribution main: Distribution mains have a functions by respective pipe size rang.

Primary Main: Size of distribution primary main is ND 300~500mm, which covers entire service area of distribution zone (DZ).

Secondary Main: Size of distribution secondary main is ND 150~250 mm, which covers entire district meter area (DMA).

Tretiary Main: Size of distribution tertiary main is ND 75~100mm, from which tapping to consumer is allowed.

2) Hydraulic Design Criteria

a. Design Flow

The flow of transmission main is based on the day maximum demand, on the other hand the distribution flow is based on the peak hourly demand.

Peak hourly or peak flow is defined for categories of distribution mains as follows:

Primary main: 1.5 times of day maximum demand

Secondary main: 1.7 times of day maximum demand

Tertiary main: Simultaneous tapping rate of connections as 80%, where unit flow per connection is set at 18 l/min.

b. Head Loss Analysis

Head loss of pipelines is calculated based on Hazen-William formula, where the following loss co-efficient factor (C-value) is used.

Transmission Main:	130
Distribution Mains:	120

c. Minimum Pressure of Distribution System

The pressure of distribution system is determined so as to supply directly up to three stories buildings and houses in consideration that three stories houses and apartments are prevailing in Faisalabad-MC. The minimum pressure of each category of distribution main is presented as follows:

Tapping at Tertiary main:	12 m	
Secondary main:	14 m	(head loss of tertiary main as approx. 2m)
Primary main:	18 m	(head loss of secondary network as 4~5m)

3) Transmission and Distribution Pipelines

For design bases of transmission and distribution pipelines, the following criteria are applied:

a. Pipe Materials

The type of pipe materials is determined taking characteristic of pipe materials, cost and importance of pipelines as follows:

Transmission main: DCIP/HDPE size of pipelines is ranging from 350mm to 600mm in diameters. considering importance to maintain transmission flow and characteristics of pipe materials (strength and durability), HDPE is selected for size of pipeline ranging 250mm to 500mm and DCIP for 600mm pipeline.

Distribution main: HDPE considering advantage of low friction loss, high efficiency of pipe installation works and less cost comparing with DCIP for smaller size of pipeline, HDPE is selected. Size of pipe line will be in the range of 80 to 500mm.

b. Types of Valve

Following types of valve are preferable to be used by size of pipelines.

Size of pipeline	Type of valve
ND 80 ~ 250 mm (Tertiary and Secondary mains)	Gate valve (non-rising stem)
ND 300mm or larger (Primary and Transmission mains)	Butterfly valve (short body)

c. Earth Cover

The earth cover by size and category of pipeline is determined as follows:

Transmission main (350mm ~ 600mm)	1.2 m
Distribution primary main (300 ~ 500mm)	1.2 m
Distribution secondary main (150 ~ 250mm)	0.9 m
Distribution tertiary main (75 ~ 100mm)	0.6 m

d. Ground Reservoir and Overhead Reservoir

The structure, detension time and effective depth of reservoir is as follows:

	Ground Reservoir (GR)	Overhead Reservoir (OHR)
Structure:	RC	RC
Detention time:	4 h	1.5 h
Effective Water depth:	4 ~ 6 m	max. 6 m

note 1: Detention time of reservoir of 4 hours is determined based on the peak hourly factor of 1.5 of day max. demand

2: Detention time of OHR as 1.5 hours is determined based on capacity of lift pump from GR as peak hourly demand with power suply failure of one hour.

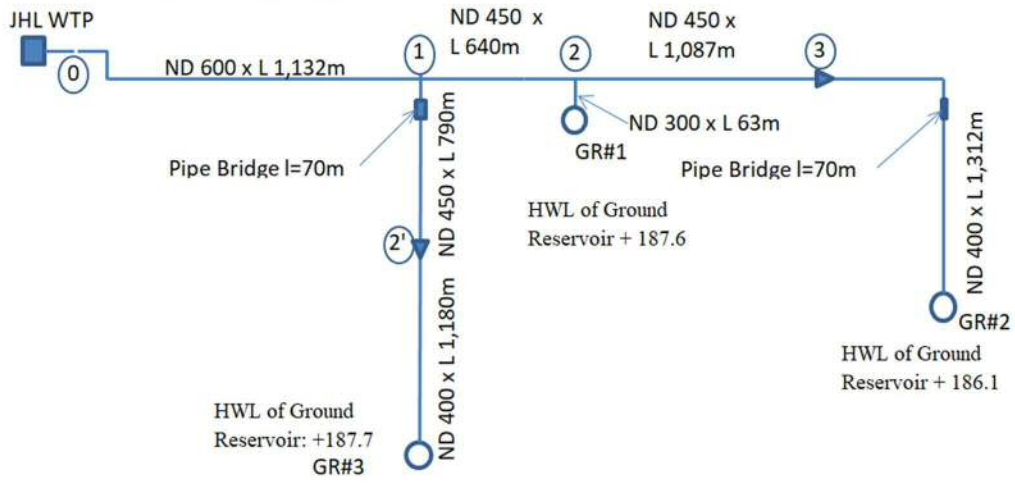
5.2 Design of Transmission Mains

Hydraulic analysis is made based on the following conditions for treated water transmission main

Parameter	DZ	DZ I Abudullah Pur	DZ II Madina Town No.2	DZ III (for Future) Peoples Colony No.2
JK WTP:	Water level of CW Reservoir		HWL +	183.78
			LWL +	179.28
	Designed Delivery Head		Pump head +	35 m
			Loss in WTP	2.3 m
			Delivery head +	211.98 m
Distribution Center				
Levels	Ground Level (FGL)	186.10 m	184.60 m	186.20 m
	Water Level of GR			
	HWL +	187.60 m	186.10 m	187.70 m
	LWL +	181.60 m	181.30 m	182.20 m
	Water Level of OHR			
	HWL +	216.60 m	215.10 m	216.70 m
	LWL +	211.10 m	209.60 m	211.20 m
Demand for Year 2028				
Distribution Capacity (Day max.)		5,960 m^3/d	11,900 m^3/d	17,640 m^3/d
		0.069 m^3/s	0.138 m^3/s	0.204 m^3/s
Peak Flow (hourly max.)		373 m^3/hr	744 m^3/h	1,103 m^3/h
(for primary network)		0.104 m^3/d	0.207 m^3/s	0.306 m^3/s
Demand for Year 2038				
Distribution Capacity (Day max.)		8,050 m^3/d	15,460 m^3/d	22,870 m^3/d
		0.093 m^3/s	0.179 m^3/s	0.265 m^3/s
Peak Flow (hourly max.)		503 m^3/hr	966 m^3/h	1,429 m^3/h
(for primary network)		0.140 m^3/s	0.268 m^3/s	0.397 m^3/s

(1) Hydraulic Analysis and Sizing of Transmission Main

Configulation of Transmission Main



Diameter of each section of transmission main is calculated as shown in the following table, where friction loss co-efficient (C-value) of 130 is used included minor losses of fittings and valves.

1) Hydraulic Analysis for Day Max. Demand in 2028 - No supply to DC3

DZ/DC:	1	2	3
Water Demand (m3/d)	5,960	11,900	17,640
(m3/s)	0.069	0.138	0.204

Section	GL *3	WL *1	ND	L	q	v	‰	hf	Dinamic H *2	Res. Head
		m	mm	m	m3/s	m/s		m	m	m
0	185.00	179.28							212.58	27.6
1	184.77		600	985	0.207	0.73	0.85	0.84	211.74	27.0
2	185.99		450	640	0.207	1.30	3.46	2.22	209.52	23.5
GR1	185.92	187.60	350	63	0.069	0.72	1.55	0.10	209.43	**21.8**
3	186.04		450	1,087	0.138	0.87	1.63	1.78	207.75	21.7
GR2	184.24	186.10	400	1,312	0.138	1.10	2.90	3.81	203.94	**17.8**
2'	185.0		450	790						
GR3	184.8	187.70	450	1,180						

note 1: Design water level of Distribution Reservoir is set at 1.5 m higher than FGL
GL is Formation Ground Level (FGL)

2: Pump head is designed as 35m, Piping loss around pumps is set at 1.5m, pipeline loss in WTP is set at 0.2m
Head Loss in WTP:

q =	0.207 m3/s	D =	600 mm	L =	147 m
i =	0.85 ‰	hf =	0.13 m	rounded:	0.2 m

Loss of flow control valve at transmission pump station is set at 3 m.

Loss of flow control valve (ND600)	q =	0.207 m3/s	hv = fv x v^2/2g =	3.00	
	v =	0.731 m/s	fv =	110	

3: Excess head at Distribution Center is adjusted by control valve set at inlet of Distribution Reservoir of each Distribtion Center

4: Butterfly type of float valve is used at the inlet of Distribution Reservoir to prevent overflow, where head loss of 5 m is provided at inlet of Distribution Center as excess head

2) Hydraulic Analysis at Design Maximum Flow in 2028 - Include Supply to DC3

DZ/DC:	1	2	3
Water Demand (m3/d)	5,960	11,900	17,640
(m3/s)	0.069	0.138	0.204

Section	GL*3	WL*1	ND	L	q	v	‰	hf	Dinamic H*2	Res. Head
		m	mm	m	m3/s	m/s		m	m	m
0	185.00	179.28							212.18	27.2
1	184.77		600	985	0.411	1.45	3.04	3.00	209.18	24.4
2	185.99		450	640	0.207	1.30	3.46	2.22	206.97	21.0
GR1	185.92	187.60	350	63	0.069	0.72	1.55	0.10	206.87	**19.3**
3	186.04		450	1,087	0.138	0.87	1.63	1.78	205.19	19.2
GR2	184.24	184.60	400	1,312	0.138	1.10	2.90	3.81	201.39	**16.8**
2'	185.0		450	1400	0.204	1.28	3.39	4.74	204.45	19.4
GR3	184.8	186.10	400	570	0.204	1.63	6.01	3.42	201.02	**14.9**

note 1: Design water level of Clear Water Reservoir of WTP is taken as mid water level (+183.78-4.5/2)
Design water level of Ground Reservoir is set at 1.5 m higher than FGL
GL is Formation Ground Level (FGL)

2: Pump head is designed as 35m, Piping loss around pumps is set at 1.5m, pipeline loss in WTP is set at 0.5m.
Loss of flow control valve at transmission pump station is set at 3m.
Head Loss in WTP:

q =	0.411 m3/s	D =	600 mm	L =	147 m
i =	3.04 q	hf =	0.45 m	rounded:	0.5 m

Loss of flow control valve at transmission pump station is set at 10m.

Loss of flow control valve (ND600)	q =	0.411 m3/s	hv = fv x v^2/2g =	10.0
and Cabitation Factor	v =	1.454 m/s	fv =	93

3: Excess head at Distribution Center is adjusted by control valve set at inlet of Distribution Reservoir of each Distribtion Center

4: Butterfly type of float valve is used at the inlet of Distribution Reservoir to prevent overflow, where

3) Hydraulic Analysis of Transmission Main in 2038

DZ/DC:	1	2	3	Total
Water Demand (m3/d)	8,050	15,460	22,870	46,380
(m3/s)	0.093	0.179	0.265	0.537

Diameter of each section of transmission main is calculated as shown in the following table, where friction loss co-efficient (C-value) of 130 is used included minor losses of fittings and valves.

Hydraulic Analysis at Design Maximum Flow in 2038

Section	GL*3	WL*1	ND	L	q	v	‰	hf	Dinamic H*2	Res. Head
		m	mm	m	m3/s	m/s		m	m	m
0	185.00	179.28							211.98	27.0
1	184.77		600	985	0.537	1.90	4.99	4.91	207.07	22.3
2	185.99		450	640	0.272	1.71	5.76	3.69	203.38	17.4
GR1	186.10	187.60	350	63	0.093	0.97	2.70	0.17	203.21	**15.6**
3	186.04		450	1,087	0.179	1.13	2.65	2.88	200.50	14.5
GR2	184.60	186.10	400	1,320	0.179	1.42	4.71	6.21	194.29	**8.2**
2'	185.0		450	790	0.265	1.67	5.47	4.32	202.74	17.7
GR3	184.8	187.70	450	1,180	0.265	1.67	5.47	6.46	196.29	**8.6**

note 1: Design water level of Ground Reservoir is set at 1.5 m higher than FGL
GL is Formation Ground Level (FGL)

2: Pump head is designed as 35m, Piping loss around pumps is set at 1.5m, pipeline loss in WTP is set at 0.8m
Head Loss in WTP:

q =	0.537 m3/s	D =	600 mm	L =	147 m
i =	4.99 ‰	hf =	0.73 m	rounded:	0.8 m

3: Excess head at Distribution Center is adjusted by control valve set at inlet of Distribution Reservoir of each Distribtion Center

4: Butterfly type of float valve is used at the inlet of Distribution Reservoir to prevent overflow, where head loss of 5 m is provided at inlet of Distribution Center as excess head

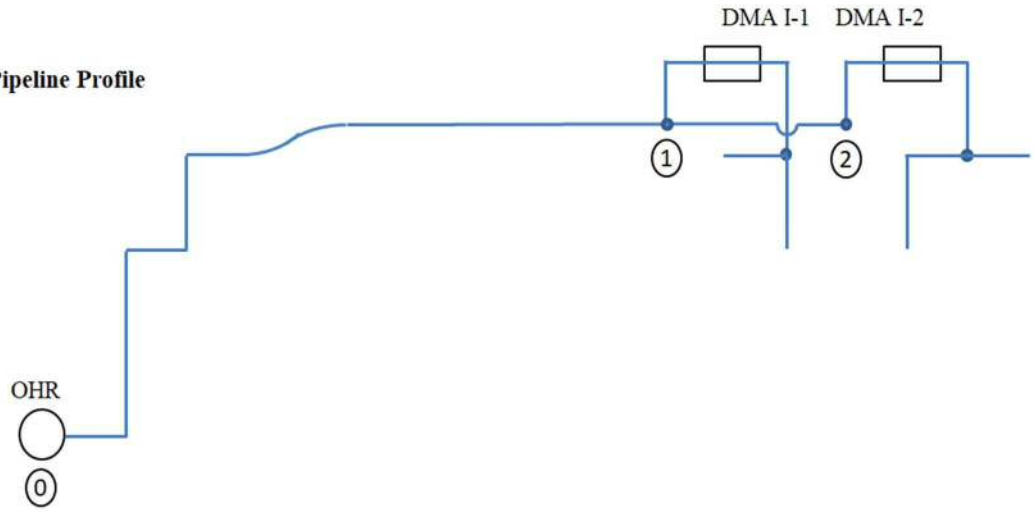
5.3 Distribution Main System

(1) Hydraulic / Network Analysis and Sizing of Distribution Primary Main (2038)

1) Hydraulic Analysis (DZ I Abddulahpur)

		Future Plan (2038)		
Design Flow	unit	Zone I	Zone I-1	Zone I-2
Day Max. Distribution Flow	m^3/d	8,050	4,190	3,860
Peak Hourly Flow	m^3/h	503	262	241
	m^3/s	139.75	72.74	67.01

a. **Pipeline Profile**



b. Hydraulic Analysis

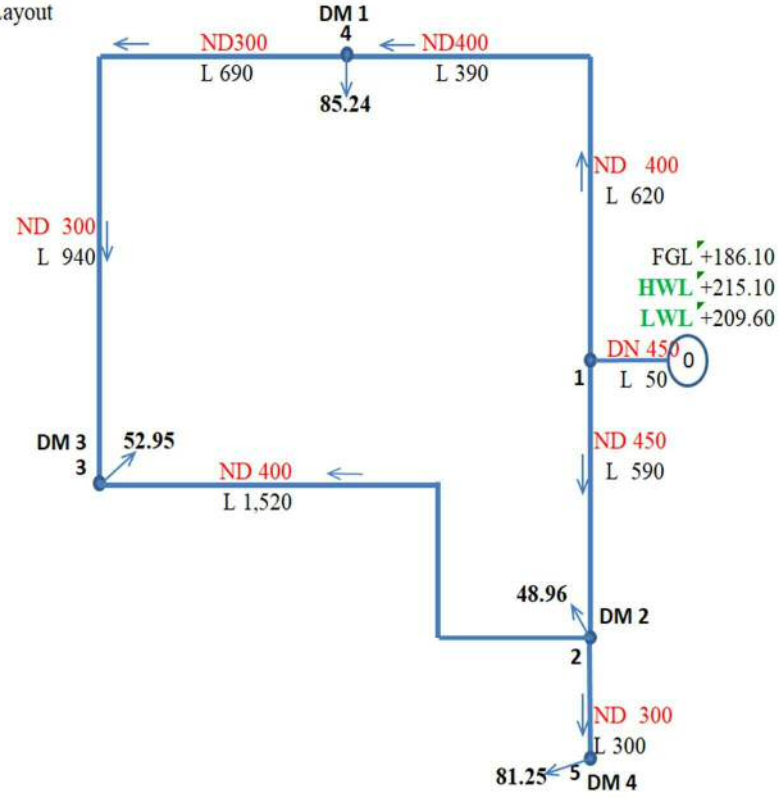
Section	Flow (l/s)	ND (mm)	L (m)	i ‰	hf (m)	GL	WL* (m)	Eff. Head (m)
⓪						186.1	210.60	24.5
	140.0	350	630	6.64	4.18			
①						186.3	206.42	20.1
	67.0	300	100	3.60	0.36			
②						185.1	206.06	21.0

Note * LWL of OHR + 211.10
loss in Distribution Center as 0.5m is assumed.

2) Network Analysis DZ II (Madina Town No.2)

Design Flow	unit	Zone II	DMA II-1	DMA II-2	DMA II-3	DMA II-4
Day maximum Demand	m^3/d	15,460	4,910	2,820	3,050	4,680
Peak Hourly Demand	m^3/hr	966	307	176	191	293
	l/s	268.40	85.24	48.96	52.95	81.25

a. Network Layout



b. Network Analysis

Node Data

Node No.	Type	Discharge	WL*1	GL	Eff. Head	Note
		l/sec	m	m	m	
0		-268.40	**209.60**	186.1	23.50	
1		0.00	209.28	183.9	25.38	
2		48.96	207.66	183.7	24.01	DM 2
3		52.95	207.16	184.6	22.58	DM 3
4		85.24	207.46	185.8	21.62	DM 1
5		81.25	206.13	183.4	22.70	DM 4
note *: LWL of OHR			+	209.60		

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H. gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	450	50	120	0.32	268.40	1.69	6.51
1	2	450	590	120	1.62	169.54	1.07	2.78
2	3	400	1520	120	0.50	39.33	0.31	0.33
3	4	300	1630	120	-0.30	-13.62	-0.19	-0.19
4	5	400	1010	120	-1.82	-98.86	-0.79	-1.82
4	2	300	300	120	1.52	-81.25	-1.15	-5.14

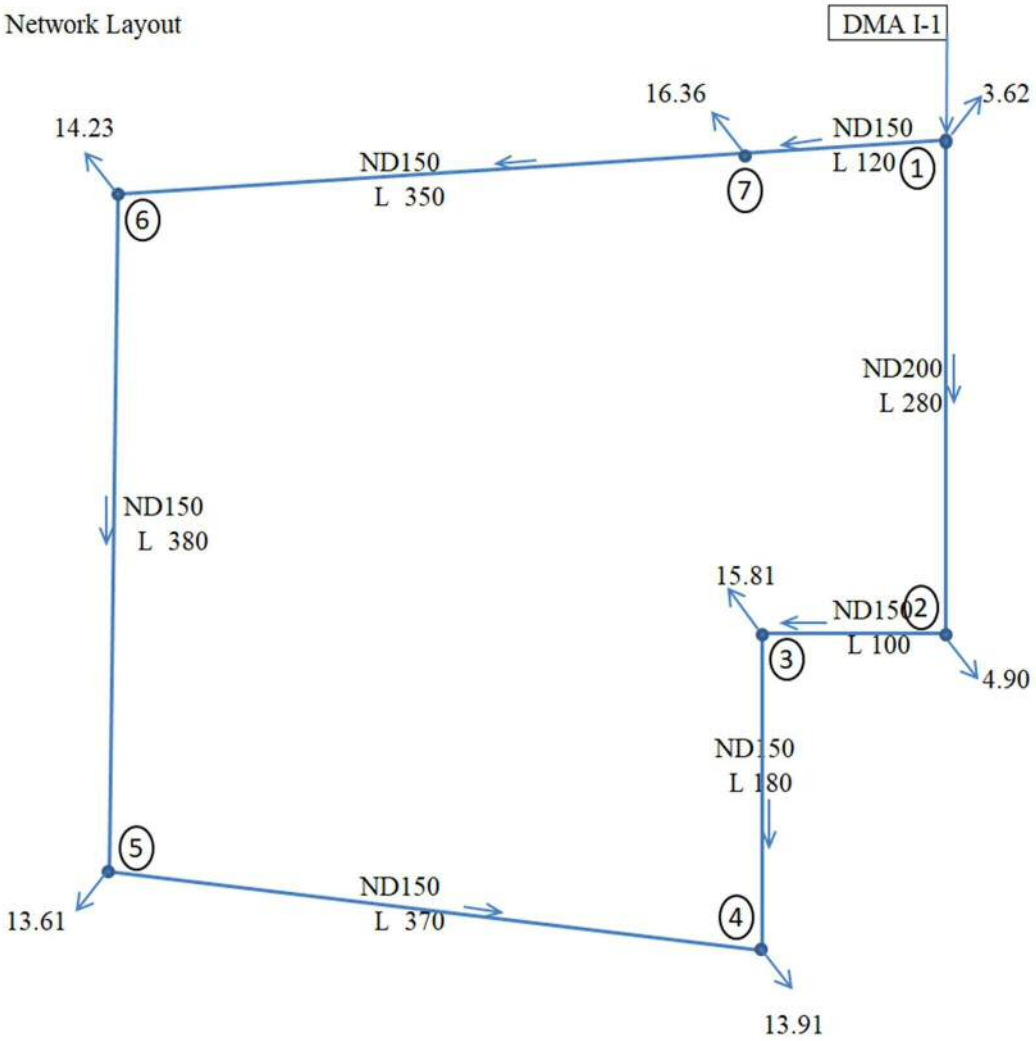
(2) Network Analysis and Sizing of Distribution Secondary Main

1) Network Analysis (Abddulahpur: DMA I - 1)

Day Maximum Demand : 4,190 m3/d Peak Hourly Demand: 296.8 m3/h
82.44 l/s
(Peak Hourly Factor: 1.7)

Node. No.:	1	2	3	4	5	6	7	Σq
Discharge (l/s):	3.62	4.90	15.81	13.91	13.61	14.23	16.36	82.44
Ground level:	185.3	185.1	185.10	186.2	185.90	185.80	185.30	
Section:	①～②	②～③	③～④	④～⑤	⑤～⑥	⑥～⑦	⑦～①	
Diameter (mm):	200	150	150	150	150	150	150	
Length (m):	280	100	180	370	380	350	120	1,780

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge	WL	GL	Eff. Head
	l/sec	m	m	m
0	-82.44	206.42	185.30	21.12
1	3.62	205.43	185.30	20.13
2	4.90	203.35	185.10	18.25
3	15.81	201.07	185.10	15.97
4	13.91	200.09	186.20	13.89
5	13.61	200.09	185.90	14.19
6	14.23	202.21	185.80	16.41
7	16.36	204.00	185.30	18.70

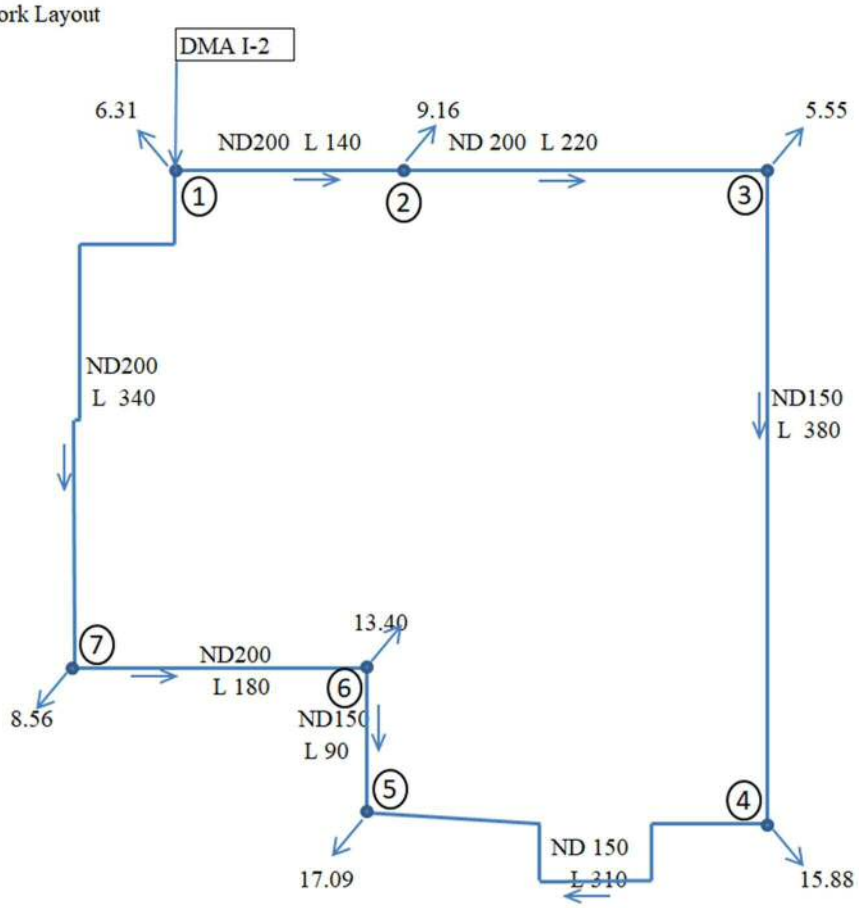
Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	78	120	0.99	82.44	1.68	12.84
1	2	200	280	120	2.09	34.40	1.10	7.55
2	3	150	100	120	2.27	29.50	1.67	23.08
3	4	150	180	120	0.99	13.69	0.78	5.58
4	5	150	370	120	-0.00	-0.22	-0.01	0.00
5	6	150	380	120	-2.12	-13.83	-0.78	5.68
6	7	200	350	120	-1.79	-28.06	-0.89	5.18
7	1	200	120	120	-1.43	-44.42	-1.41	12.12

2) Network Analysis (Abddulahpur: DMA I - 2)

Day Maximum Demand :			3,860 m3/d		Peak Hourly Demand:		273.4 m3/h	
							75.95 l/s	
					(Peak Hourly Factor:		1.7)	
Node. No.:	1	2	3	4	5	6	7	Σq
Discharge (l/s):	6.31	9.16	5.55	15.88	17.09	13.40	8.56	75.95
Ground level:	185.1	185.2	185.4	185.9	186.1	185.5	185.1	
Section:	①~②	②~③	③~④	④~⑤	⑤~⑥	⑥~⑦	⑦~①	
Diameter (mm):	200	200	150	150	150	200	200	
Length (m):	140	220	380	310	90	180	340	1,660

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge	WL	GL	Eff. Head
	l/sec	m	m	m
0	-75.95	206.06	185.30	20.76
1	6.31	205.06	185.10	19.96
2	9.16	204.17	185.20	18.97
3	5.55	203.43	185.40	18.03
4	15.88	200.35	185.90	14.45
5	17.09	200.34	186.10	14.24
6	13.40	201.00	185.50	15.50
7	8.56	202.01	185.10	16.91

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	90	120	1.00	75.95	1.55	11.03
1	2	200	140	120	0.89	31.60	1.01	6.46
2	3	200	220	120	0.74	22.44	0.71	3.43
3	4	150	380	120	3.08	16.89	0.96	8.22
4	5	150	310	120	0.01	1.01	0.06	0.04
5	6	150	90	120	-0.67	-16.08	-0.91	7.51
6	7	200	180	120	-1.01	-29.48	-0.94	5.68
7	1	200	340	120	-3.05	-38.04	-1.21	9.10

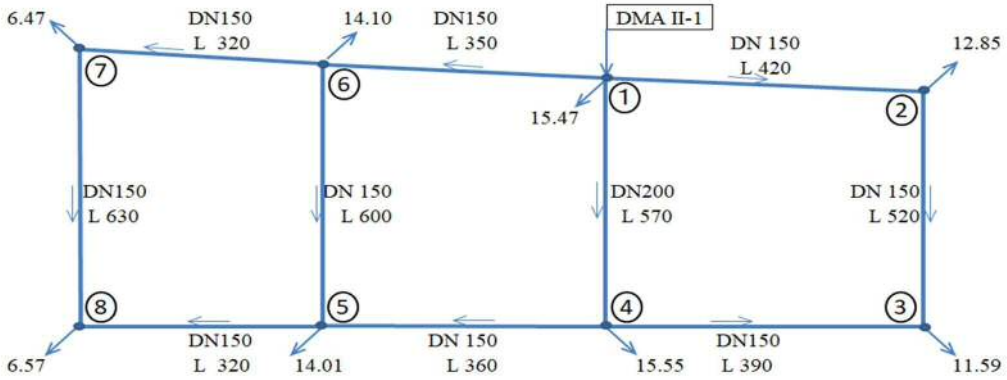
3) Network Analysis (Madina Town: DMA II - 1)

Day Maximum Demand : 4,910 m3/d Peak Hourly Demand: 347.8 m3/h
96.61 l/s
(Peak Hourly Factor: 1.7)

Node. No.:	1		2	3	4	5
Discharge (l/s):	15.47		12.85	11.59	15.55	14.01
Ground level:	185.6		186.8	184.6	184.6	184.9
Section:	①~②	①~④	②~③	③~④	④~⑤	⑤~⑥
Diameter (mm):	150	200	150	150	150	150
Length (m):	420	570	520	390	360	600

Node. No.:	6		7	8	Σq
Discharge (l/s):	14.10		6.47	6.57	96.61
Ground level:	185.1		184.7	184.8	
Section:	⑥~①	⑥~⑦	⑦~⑧	⑧~⑤	
Diameter (mm):	150	150	150	150	
Length (m):	350	320	630	320	

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge	WL	GL	Eff. Head
	l/sec	m	m	m
0	-96.61	207.46	185.8	21.66
1	15.47	206.44	185.6	20.84
2	12.85	202.18	186.8	15.38
3	11.59	201.51	184.6	16.91
4	15.55	201.89	184.6	17.29
5	14.01	199.60	184.9	14.70
6	14.10	199.99	185.1	14.89
7	6.47	199.36	184.7	14.66
8	6.57	199.31	184.8	14.51
	96.61			

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	60	120	1.02	96.61	1.97	17.21
1	2	150	420	120	4.26	19.08	1.08	10.31
2	3	150	520	120	0.67	6.23	0.35	1.30
3	4	150	390	120	-0.38	-5.36	-0.30	0.98
4	5	150	360	120	2.29	14.82	0.84	6.46
5	6	150	600	120	-0.39	-4.35	-0.25	0.67
6	1	150	350	120	-6.45	-26.33	-1.49	18.70
1	4	200	570	120	4.55	35.73	1.14	8.10
6	7	150	320	120	0.63	7.88	0.45	2.01
7	8	150	630	120	0.05	1.41	0.08	0.08
8	5	150	320	120	-0.29	-5.16	-0.29	0.92

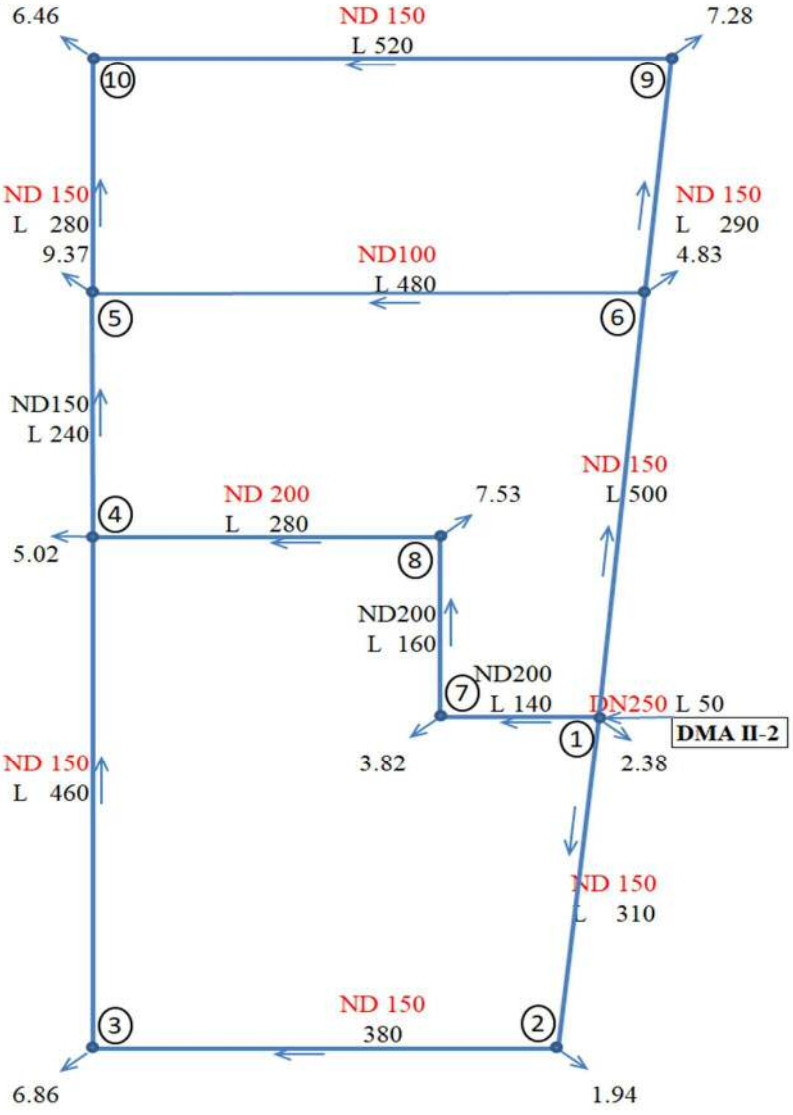
4) Network Analysis (Madina Town: DMA II - 2)

Day Maximum Demand : 2,820 m3/d Peak Hourly Demand: 200 m3/h
55.49 l/s
(Peak Hourly Factor: 1.7)

Node. No.:	1	2		3	4	5	
Discharge (l/s):	2.38	1.94		6.86	5.02	9.37	
Ground level:	183.5	183.4		183.9	183.8	185.0	
Section:	①～②	①～⑦	②～③	③～④	④～⑤	⑤～⑧	
Diameter (mm):	150	200	150	150	150	100	
Length (m):	310	140	380	460	240	480	

Node. No.:	6		7	8	9	10	
Discharge (l/s):	4.83		3.82	7.53	7.28	6.46	Σq
Ground level:	184.1		184.0	184.3	184.6	184.4	55.49
Section:	⑧～①	⑥～⑨	⑦～⑧	⑧～④	⑨～⑩	⑩～⑤	
Diameter (mm):	150	150	200	200	150	150	
Length (m):	500	290	160	280	520	280	

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge	WL	GL	Eff. Head
	l/sec	m	m	m
0	-55.49	207.66	183.7	23.96
1	2.38	207.15	183.5	23.65
2	1.94	206.12	184.0	22.12
3	6.86	205.26	183.9	21.36
4	5.02	205.21	183.8	21.41
5	9.37	203.90	185.0	18.90
6	4.83	204.19	184.1	20.09
7	3.82	206.42	184.0	22.42
8	7.53	205.78	184.3	21.48
9	7.28	203.60	184.6	19.00
10	6.46	203.59	184.4	19.19
	55.49			

Pipeline Data

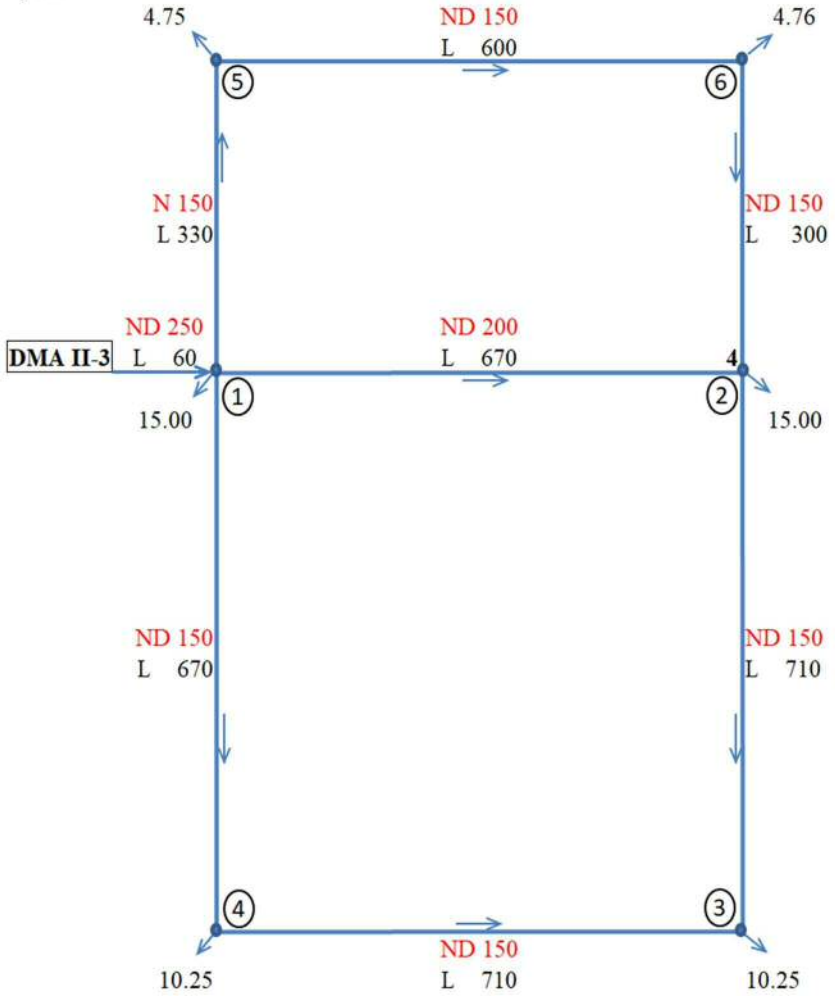
Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	84	120	0.51	55.49	1.13	6.17
1	2	150	310	120	1.03	10.44	0.59	3.37
2	3	150	380	120	0.86	8.50	0.48	2.31
3	4	150	460	120	0.05	1.64	0.09	0.11
4	5	150	240	120	1.31	13.67	0.77	5.56
5	6	100	480	120	-0.29	-1.44	-0.18	0.62
6	1	150	500	120	-2.96	-14.27	-0.81	6.02
1	7	200	140	120	0.73	28.41	0.91	5.30
7	8	200	160	120	0.64	24.59	0.78	4.06
8	4	200	280	120	0.57	17.06	0.54	2.06
6	9	150	290	120	0.59	8.00	0.45	2.06
9	10	150	520	120	0.01	0.72	0.04	0.02
10	5	150	280	120	-0.31	-5.74	-0.33	1.12

5) Network Analysis (Madina Town: DMA II - 3)

Day Maximum Demand : 3,050 m3/d Peak Hourly Demand: 216 m3/h
60.01 l/s
(Peak Hourly Factor: 1.7)

Node. No.:	1	2	3	4	5	6		Σq
Discharge (l/s):	15.00	15.00	10.25	10.25	4.75	4.76		60.01
Ground level:	184.5	183.8	184.0	184.7	184.7	184.6		
Section:	①～②		①～⑤	②～③	③～④	④～①	⑤～⑥	⑥～②
Diameter (mm):	200		150	150	150	150	150	150
Length (m):	670		330	710	710	670	600	300

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge l/sec	WL m	GL m	Eff. Head m
0	-60.01	207.16	184.6	22.56
1	15.00	206.18	184.5	21.68
2	15.00	204.14	183.8	20.34
3	10.25	202.78	184.0	18.78
4	10.25	202.95	184.7	18.25
5	4.75	204.96	184.7	20.26
6	4.76	204.17	184.6	19.57

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	140	120	0.99	60.01	1.22	7.13
1	2	200	670	120	2.03	21.20	0.68	3.08
2	3	150	710	120	1.36	7.75	0.44	1.94
3	4	150	710	120	-0.17	-2.50	-0.14	0.24
4	1	150	670	120	-3.22	-12.75	-0.72	4.89
1	5	150	330	120	1.22	11.06	0.63	3.76
5	6	150	600	120	0.79	6.31	0.36	1.33
6	2	150	300	120	0.03	1.55	0.09	0.10

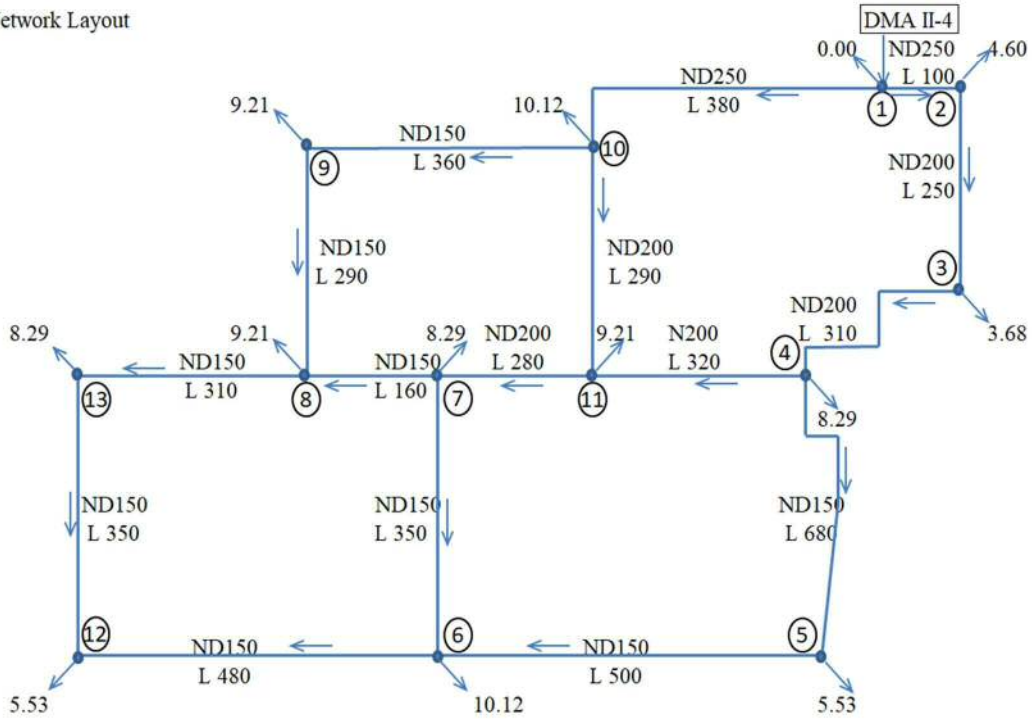
6) Network Analysis (Madina Town: DMA II - 4)

Day Maximum Demand : Day Max. 4,680 m3/d Peak Hour: 332 m3/h
92.08 l/s
(Peak Hourly Factor: 1.7)

Node. No.:	1	2	3	4	5	6		7	
Discharge (l/s):	0.00	4.60	3.68	8.29	5.53	10.12		8.29	
Ground level:	183.5	183.40	183.8	183.9	184.1	184.6		184.2	
Section:	①～②	②～③	③～④	④～⑤	⑤～⑥	⑥～⑦	⑥～⑫	⑦～⑧	⑦～⑪
Diameter (mm):	250	200	150	150	150	150	150	150	200
Length (m):	100	250	310	680	500	350	480	160	280

Node. No.:	8	9	10		11	12	13		Σq
Discharge (l/s):	9.21	9.21	10.12		9.21	5.53	8.29		92.08
Ground level:	184.4	184.3	183.8		183.8	194.6	185.0		
Section:	⑧～⑨	⑨～⑩	⑩～⑪	⑩～①	⑪～④	⑫～⑬	⑬～⑧		
Diameter (mm):	150	150	200	250	200	150	150		
Length (m):	290	360	290	380	320	350	310		

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge	WL	GL	Eff. Head
	l/sec	m	m	m
0	-92.08	206.13	183.4	22.73
1	0.00	205.15	183.5	21.65
2	4.60	204.87	183.4	21.47
3	3.68	203.22	183.8	19.42
4	8.29	201.59	183.9	17.69
5	5.53	199.29	184.1	15.19
6	10.12	198.86	184.6	14.26
7	8.29	199.88	184.2	15.68
8	9.21	199.34	184.4	14.94
9	9.21	199.90	184.3	15.60
10	10.12	202.85	183.8	19.05
11	9.21	201.36	183.8	17.56
12	5.53	198.51	184.6	13.91
13	8.29	198.52	185.0	13.52

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	63	120	0.98	92.08	1.88	15.75
1	2	250	100	120	0.28	36.79	0.75	2.89
2	3	200	250	120	1.65	32.19	1.03	6.68
3	4	200	310	120	1.63	28.51	0.91	5.34
4	5	150	680	120	2.30	10.55	0.60	3.44
5	6	150	500	120	0.43	5.02	0.28	0.87
6	7	150	350	120	-1.02	-9.73	-0.55	2.96
7	8	150	160	120	0.55	10.60	0.60	3.47
8	9	150	290	120	-0.56	-7.81	-0.44	1.97
9	10	150	360	120	-2.96	-17.02	-0.96	8.34
10	11	200	290	120	1.49	28.15	0.90	5.21
10	1	250	380	120	-2.30	-55.29	-1.13	6.13
11	7	200	280	120	1.48	28.61	0.91	5.37
11	4	200	320	120	-0.23	-9.67	-0.31	0.72
6	12	150	480	120	0.35	4.63	0.26	0.75
12	13	150	350	120	-0.01	-0.91	-0.05	0.04
13	8	150	310	120	-0.81	-9.20	-0.52	2.67

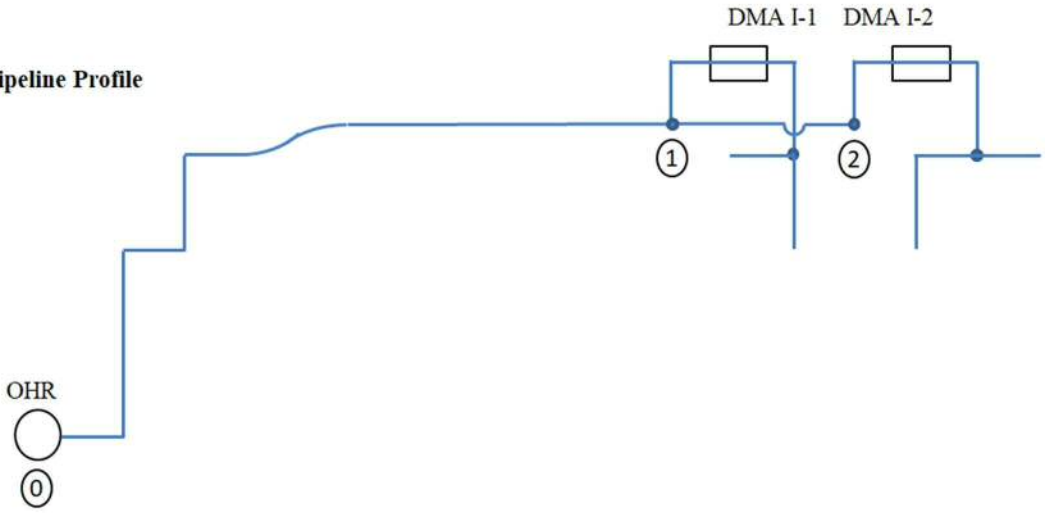
Reference: Distribution System for Requirement in Year 2028

(1) Hydraulic / Network Analysis and Sizing of Distribution Primary Main

1) Hydraulic Analysis (DZ I Abddulahpur)

		Present Plan (2028)		
Design Flow	unit	Zone I	Zone I-1	Zone I-2
Day Max. Distribution Flow	m^3/d	5,960	3,100	2,860
Peak Hourly Flow	m^3/h	373	194	179
	m^3/s	103.47	53.82	49.65

a. **Pipeline Profile**



b. Hydraulic Analysis

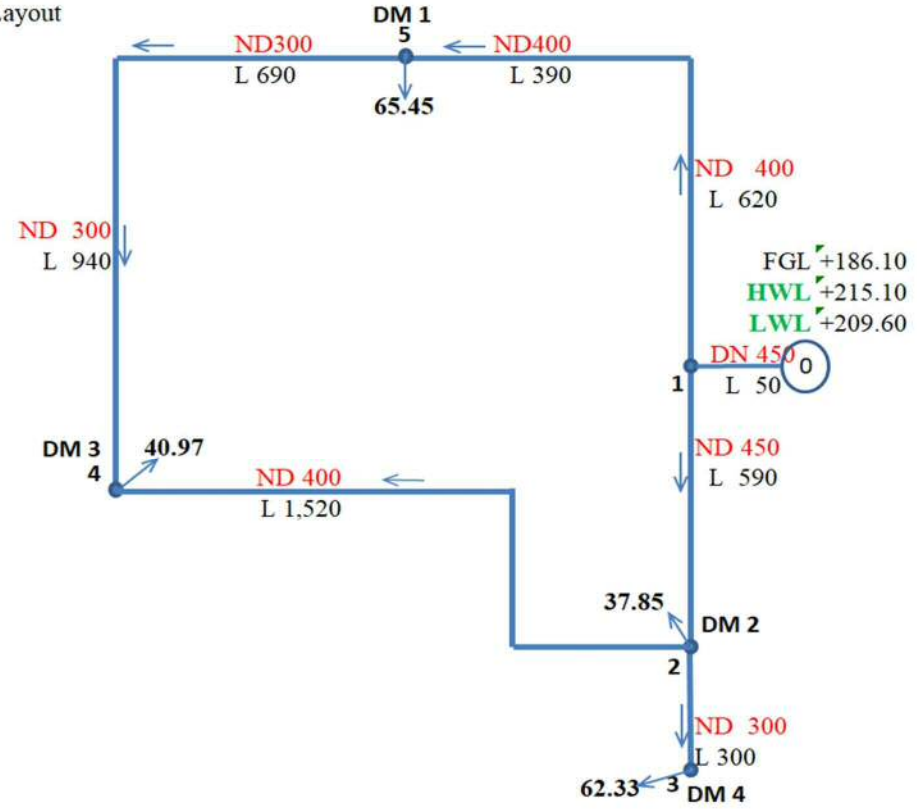
Section	Flow (l/s)	ND (mm)	L (m)	i ‰	hf (m)	GL	WL* (m)	Eff. Head (m)
⓪						186.1	210.60	24.5
	103.5	350	630	3.80	2.39			
①						186.3	208.21	21.9
	49.7	300	100	2.07	0.21			
②						185.1	208.00	22.9

Note * LWL of OHR + 211.10
loss in Distribution Center as 0.5m is assumed.

2) Network Analysis (DZ II Madina Town No.2)

Design Flow	unit	Zone II	DMA II-1	DMA II-2	DMA II-3	DMA II-4
Day maximum Demand	m^3/d	11,900	3,770	2,180	2,360	3,590
Peak Hourly Demand	m^3/hr	744	236	136	148	224
	l/s	206.60	65.45	37.85	40.97	62.33

a. Network Layout



b. Network Analysis

Node Data

Node No.	Type	Discharge	WL*1	GL	Eff. Head	Note
		l/sec	m	m	m	
0		-206.60	**209.60**	186.1	23.50	
1		0.00	209.40	183.9	25.50	
2		37.85	208.40	183.7	24.75	DM 2
3		62.33	207.47	183.4	24.04	DM 4
4		40.97	208.09	184.6	23.51	DM 3
5		65.45	208.29	185.8	22.45	DM 1
note *: LWL of OHR			+	209.60		

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H. gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	450	50	120	0.20	206.60	1.30	4.01
1	2	450	590	120	1.00	130.55	0.82	1.72
2	3	300	300	120	0.93	62.33	0.88	3.15
4	5	300	1630	120	-0.19	-10.60	-0.15	-0.12
4	2	400	1520	120	-0.31	-30.37	-0.24	-0.21
5	1	400	1010	120	-1.12	-76.05	-0.61	-1.12

(2) Network Analysis and Sizing of Distribution Secondary Main

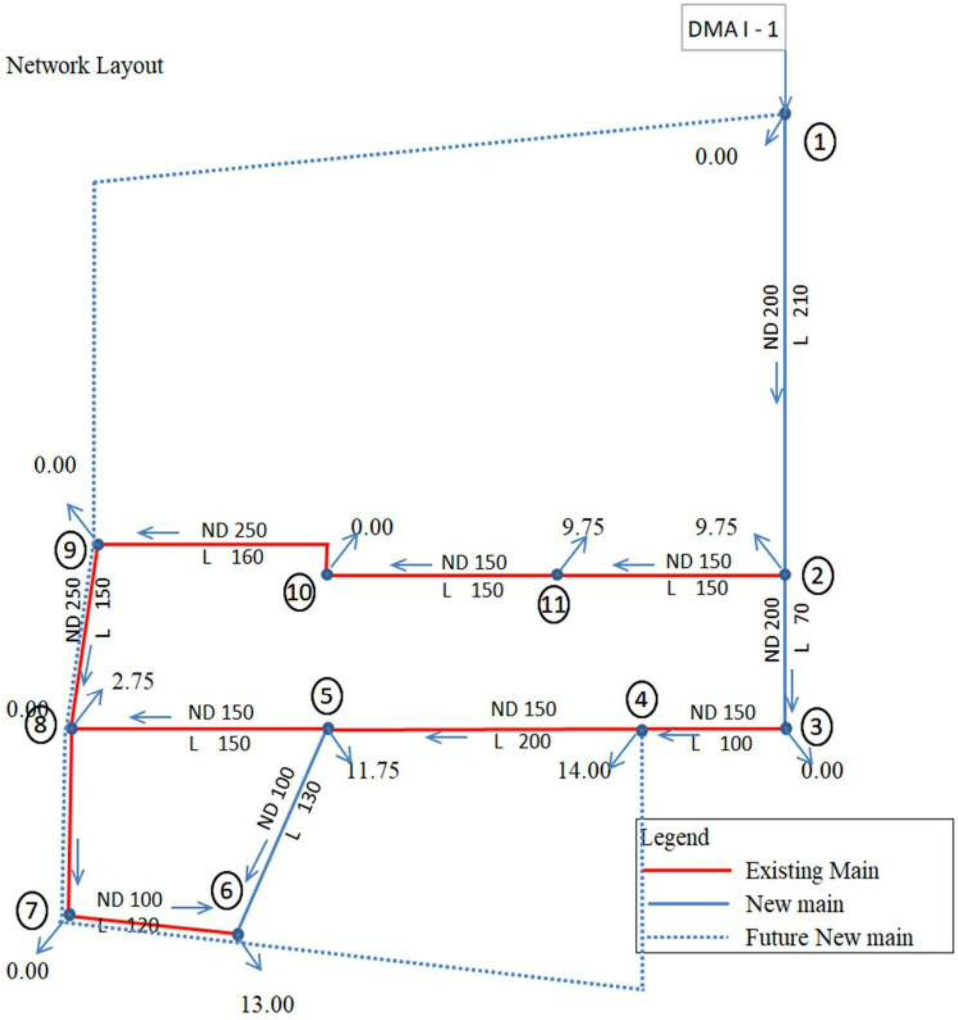
1) Network Analysis (Abddulahpur DMA I-1)

Day Maximum Demand 3,100 m3/d Peak Hourly Demand 219.6 m3/h
61.00 l/s
(Peak Hourly Factor: 1.7)

Node No.:	1	2	3	4	5		6	7
Discharge (l/s):	0.00	9.75	0.00	14.00	11.75		13.00	0.00
Ground Level:	185.3	185.5	185.50	185.6	185.7		185.8	185.9
Section:	①~②	②~③	③~④	④~⑤	⑤~⑧	⑤~⑧	⑧~⑦	⑦~⑧
Diameter (mm):	200	200	150	150	150	100	100	100
Length (m):	210	70	100	200	150	130	120	120

Node No.:	8	9	10	11	Σq
Discharge (l/s):	2.75	0.00	0.00	9.75	61.00
Ground Level:	185.8	185.8	185.7	185.6	
Section:	⑧~⑨	⑨~⑩	⑩~⑪	⑪~②	
Diameter (mm):	250	250	150	150	
Length (m):	150	160	150	150	

a. Network Layout



b. Network Analysis

Node Data

Node No.	Flow	WL	GL	Eff. Head
	l/sec	m	m	m
0	-61.00	208.21	185.30	22.91
1	0.00	207.64	185.30	22.34
2	9.75	203.13	185.50	17.63
3	0.00	202.78	185.50	17.28
4	14.00	200.78	185.60	15.18
5	11.75	199.70	185.70	14.00
6	13.00	198.05	185.80	12.25
7	0.00	198.96	185.90	13.06
8	2.75	199.86	185.80	14.06
9	0.00	199.93	185.80	14.13
10	0.00	200.01	185.70	14.31
11	9.75	200.86	185.60	15.26

Pipeline Data

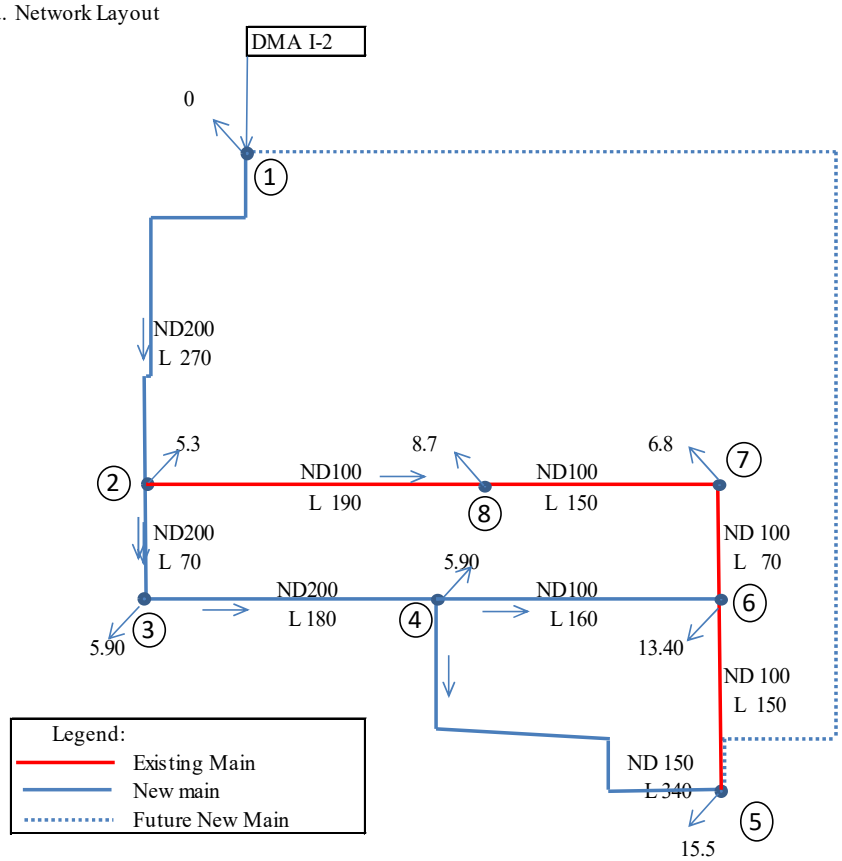
Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	78	120	0.57	61.00	1.24	7.35
1	2	200	210	120	4.52	61.00	1.94	21.80
2	3	200	70	120	0.35	27.56	0.88	5.01
3	4	150	100	120	2.00	27.56	1.56	20.34
4	5	150	200	120	1.08	13.56	0.77	5.48
5	8	150	150	120	-0.16	-5.60	-0.32	1.07
5	6	100	130	120	1.65	7.41	0.94	12.90
6	7	100	120	120	-0.90	-5.59	-0.71	7.66
7	8	100	120	120	-0.90	-5.59	-0.71	7.66
8	9	250	150	120	-0.07	-13.94	-0.28	0.48
9	10	250	160	120	-0.08	-13.94	-0.28	0.48
10	11	150	150	120	-0.85	-13.94	-0.79	5.77
11	2	150	150	120	-2.27	-23.69	-1.34	15.38

2) Network Analysis (Abddulahpur: DMA I - 2)

	Day Maximum Demand :		2,860 m3/d		Peak Hourly Demand:		202.6 m3/h 56.3 l/s	
					(Peak Hourly Factor:		1.7)	
Node. No.:	1	2	3	4	5	6		7
Discharge (l/s):	0.00	5.30	5.90	5.90	15.50	8.10		6.90
Ground level:	185.1	185.2	185.4	185.9	186.1	185.5		185.5
Section:	①～②	②～③	③～④	④～⑤	⑤～⑥	⑥～⑦	⑥～④	⑦～⑧
Diameter (mm):	200	200	200	150	100	100	100	100
Length (m):	270	70	180	340	150	70	160	150

Node. No.:	8	Σq
Discharge (l/s):	8.70	56.30
Ground level:	185.4	
Section:	⑧～②	
Diameter (mm):	100	
Length (m):	190	1,390

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge	WL	GL	Eff. Head
	l/sec	m	m	m
0	-56.30	208.00	185.10	22.90
1	0.00	207.51	185.10	22.41
2	5.30	202.51	185.20	17.31
3	5.90	201.83	185.40	16.43
4	5.90	200.54	185.90	14.64
5	15.50	197.43	186.10	11.33
6	8.10	197.17	185.50	11.67
7	6.90	196.86	185.50	11.36
8	8.70	197.15	185.40	11.75

Pipeline Data

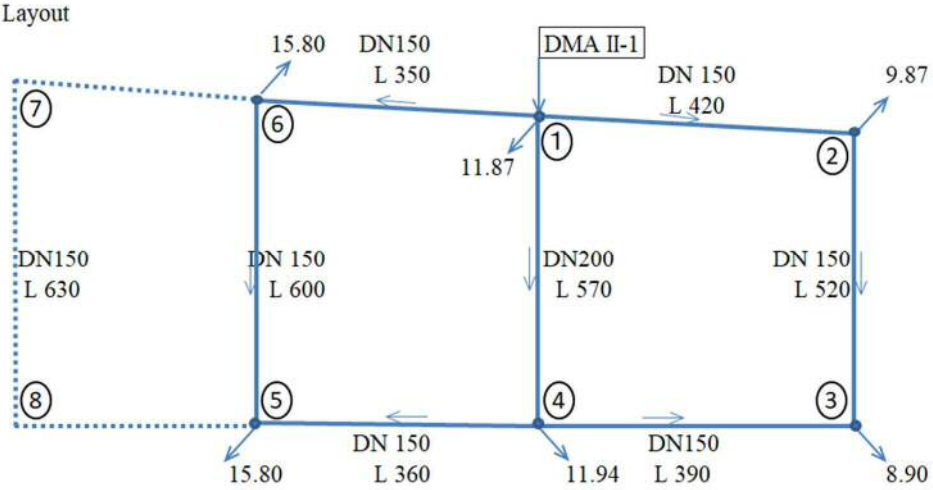
Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	78	120	0.49	56.30	1.15	6.34
1	2	200	270	120	5.01	56.30	1.79	18.79
2	3	200	70	120	0.68	39.60	1.26	9.80
3	4	200	180	120	1.29	33.70	1.07	7.27
4	5	150	340	120	3.11	18.05	1.02	9.30
5	6	100	150	120	0.26	2.55	0.32	1.79
6	7	100	70	120	0.31	4.20	0.53	4.51
6	4	100	160	120	-3.37	-9.75	-1.24	21.44
7	8	100	150	120	-0.29	-2.70	-0.34	2.00
8	2	100	190	120	-5.36	-11.40	-1.45	28.65

3) Network Analysis (Madina Town: DMA II - 1)

Day Maximum Demand : 3,770 m3/d Peak Hourly Demand: 267.0 m3/h
74.18 l/s
(Peak Hourly Factor: 1.7)

Node No.:	1	2	3	4	5	6	Σq
Demand (l/s):	11.87	9.87	8.90	11.94	15.80	15.80	74.18
GL:	185.6	186.8	184.6	184.6	184.9	185.1	
Section:	①～②	①～④	②～③	③～④	④～⑤	⑤～⑥	⑥～①
ND:	150	200	150	150	150	150	150
L:	420	570	520	390	360	600	350

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge	WL	GL	Eff. Head
	l/sec	m	m	m
0	-74.18	208.29	185.8	22.49
1	11.87	207.67	185.6	22.07
2	9.87	205.04	186.8	18.24
3	8.90	204.62	184.6	20.02
4	11.94	204.85	184.6	20.25
5	15.80	203.40	184.9	18.50
6	15.80	203.78	185.1	18.68

Pipeline Data

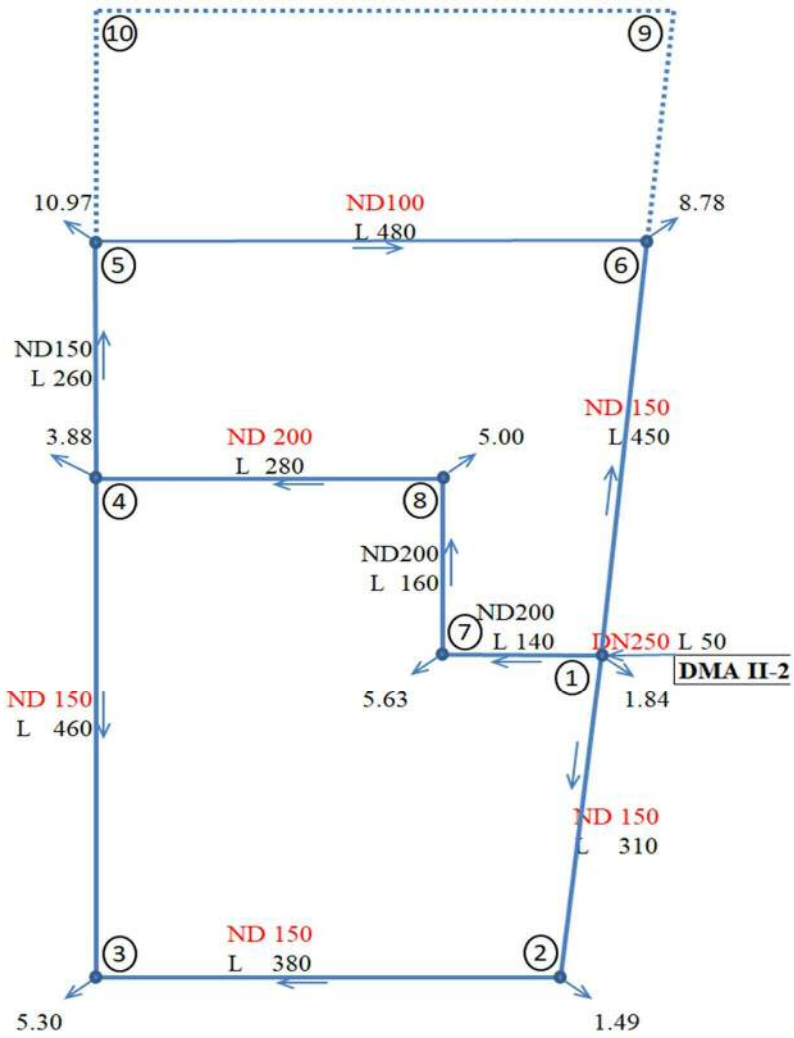
Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	60	120	0.63	74.18	1.51	10.56
1	2	150	420	120	2.63	14.70	0.83	6.36
2	3	150	520	120	0.41	4.83	0.27	0.81
3	4	150	390	120	-0.23	-4.07	-0.23	0.59
4	5	150	360	120	1.45	11.56	0.66	4.08
5	6	150	600	120	-0.38	-4.24	-0.24	0.64
6	1	150	350	120	-3.89	-20.04	-1.13	11.28
1	4	200	570	120	2.82	27.57	0.88	5.02

4) Network Analysis (Madina Town: DMA II - 2)

Demand : Day Max. 2,180 m3/d Peak Hour: 154 m3/h
42.89 l/s
(Peak hourly Factor: 1.7)

Node No.:	1	2		3	4	5	
Demand (l/s):	1.84	1.49		5.30	3.88	10.97	
GL:	183.5	183.4		183.9	183.8	185.0	
Section:	①～②	①～⑦	②～③	③～④	④～⑤	⑤～⑧	
ND:	150	200	150	150	150	100	
L:	310	140	380	460	240	480	
Node No.:	6		7	8	9	10	
Demand (l/s):	8.78		5.63	5.00	0.00	0.00	Σq
GL:	184.1		184.0	184.3	184.6	184.4	42.89
Section:	⑧～①	⑧～⑨	⑦～⑧	⑧～④			
ND:	150	150	200	200			
L:	500	290	160	280			

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge l/sec	WL m	GL m	Eff. Head m
0	-42.89	208.40	183.7	24.70
1	1.84	208.08	183.5	24.58
2	1.49	207.47	184.0	23.47
3	5.30	206.96	183.9	23.06
4	3.88	206.94	183.8	23.14
5	10.97	206.25	185.0	21.25
6	8.78	206.51	184.1	22.41
7	5.63	207.59	184.0	23.59
8	5.00	207.25	184.3	22.95

Pipeline Data

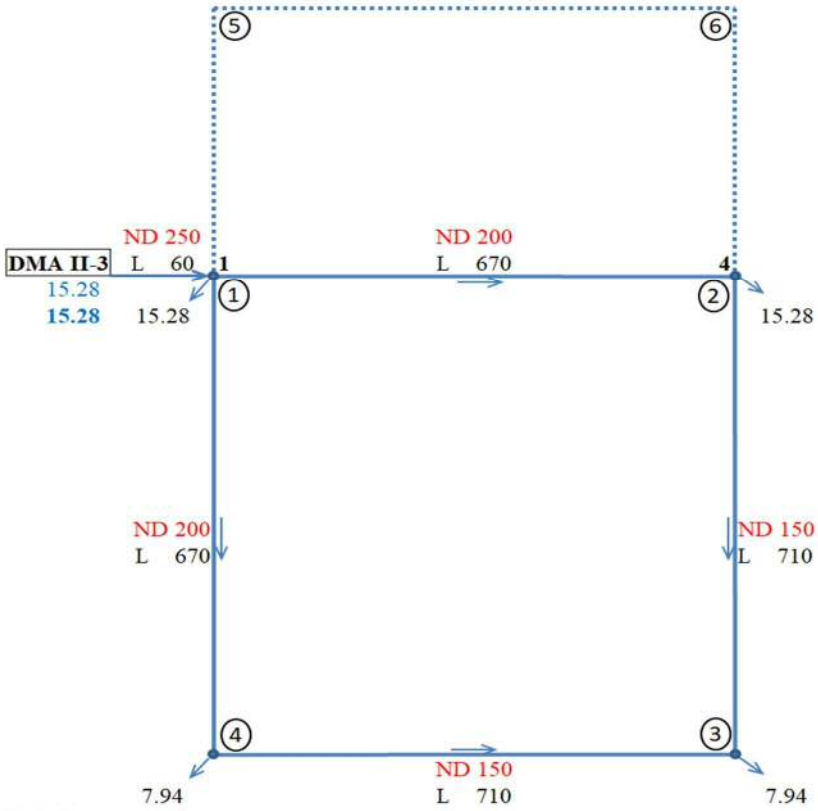
Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	84	120	0.32	42.89	0.87	3.83
1	2	150	310	120	0.61	7.89	0.45	2.01
2	3	150	380	120	0.51	6.40	0.36	1.37
3	4	150	460	120	0.02	1.10	0.06	0.05
4	5	150	240	120	0.69	9.62	0.55	2.90
5	6	100	480	120	-0.26	-1.35	-0.17	0.55
6	1	150	500	120	-1.57	-10.13	-0.57	3.20
1	7	200	140	120	0.50	22.03	0.70	3.31
7	8	200	160	120	0.34	17.40	0.55	2.14
8	4	200	280	120	0.32	12.40	0.40	1.14

5) Network Analysis (Madina Town: DMA II - 3)

Day Maximum Demand : 2,360 m3/d Peak Hourly Demand: 167 m3/h
46.44 l/s
(Peak Hourly Factor: 1.7)

Node No.:	1		2	3	4	5	6	Σq
Demand (l/s):	15.28		15.28	7.94	7.94	0.00	0.00	46.44
GL:	184.5		183.8	184.0	184.7	184.7	184.6	
Section:	①～②	①～⑤	②～③	③～④	④～①	⑤～⑥	⑥～②	
ND:	200	150	150	150	150	150	150	
L:	670	330	710	710	670	600	300	

a. Network Layout



b. Network Analysis

Node Data

Node No.	Discharge l/sec	WL m	GL m	Eff. Head m
0	-46.44	208.09	184.6	23.49
1	15.28	207.48	184.5	22.98
2	15.28	205.58	183.8	21.78
3	7.94	204.94	184.0	20.94
4	7.94	205.14	184.7	20.44

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H.Gradient
Up-stream	Dn-stream	m	m	Co-efficient	m	l/sec	m/sec	‰
0	1	250	140	120	0.61	46.44	0.95	4.44
1	2	200	670	120	1.90	20.44	0.65	2.88
2	3	150	710	120	0.64	5.16	0.29	0.92
3	4	150	710	120	-0.20	-2.78	-0.16	0.29
4	1	150	670	120	-2.34	-10.72	-0.61	3.55

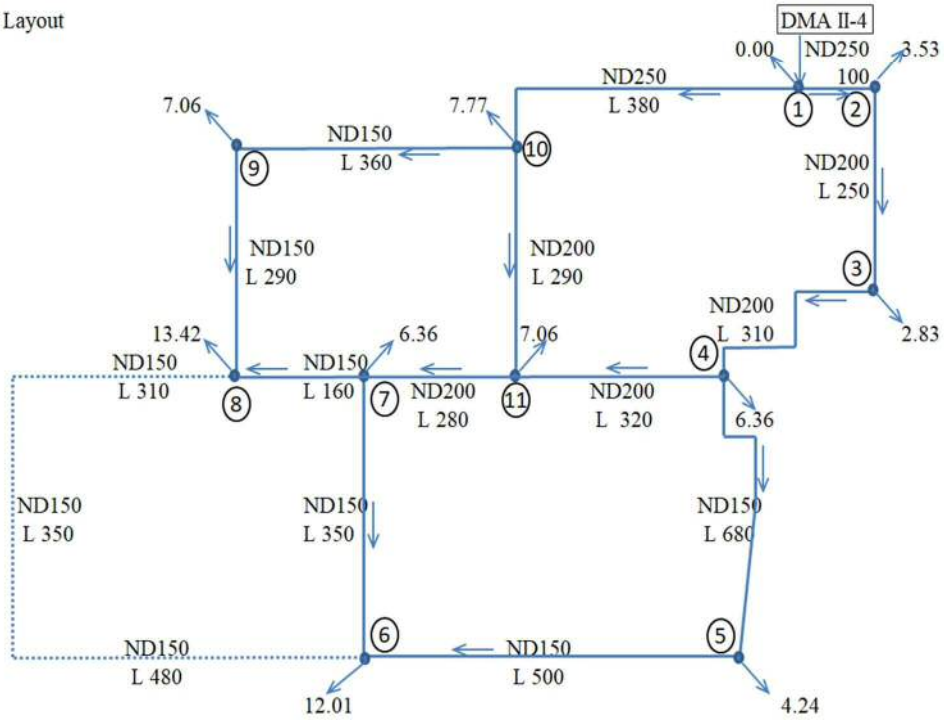
6) Network Analysis (Madina Town: DMA II - 4)

Day Maximum Demand : 3,590 m3/d Peak Hourly Demand: 254 m3/h
70.64 l/s
(Peak Hourly Factor: 1.7)

Node No.:	1	2	3	4	5	6		7	
Demand (l/s):	0.00	3.53	2.83	6.36	4.24	12.01		6.36	
GL:	183.5	183.40	183.8	183.9	184.1	184.6		184.2	
Section:	①～②	②～③	③～④	④～⑤	⑤～⑥	⑥～⑦	⑥～⑫	⑦～⑧	⑦～⑪
ND:	250	200	150	150	150	150	150	150	200
L:	100	250	310	680	500	350	480	160	280

Node No.:	8	9	10		11	12	13		Σq
Demand (l/s):	13.42	7.06	7.77		7.06	0	0		70.64
GL:	184.4	184.3	183.8		183.8	194.6	185.0		
Section:	⑧～⑨	⑨～⑩	⑩～⑪	⑩～①	⑪～④	⑫～⑬	⑬～⑧		
ND (mm):	150	150	200	250	200	150	150		
L (m):	290	360	290	380	320	350	310		

a. Network Layout



b. Network Analysis

Node Data

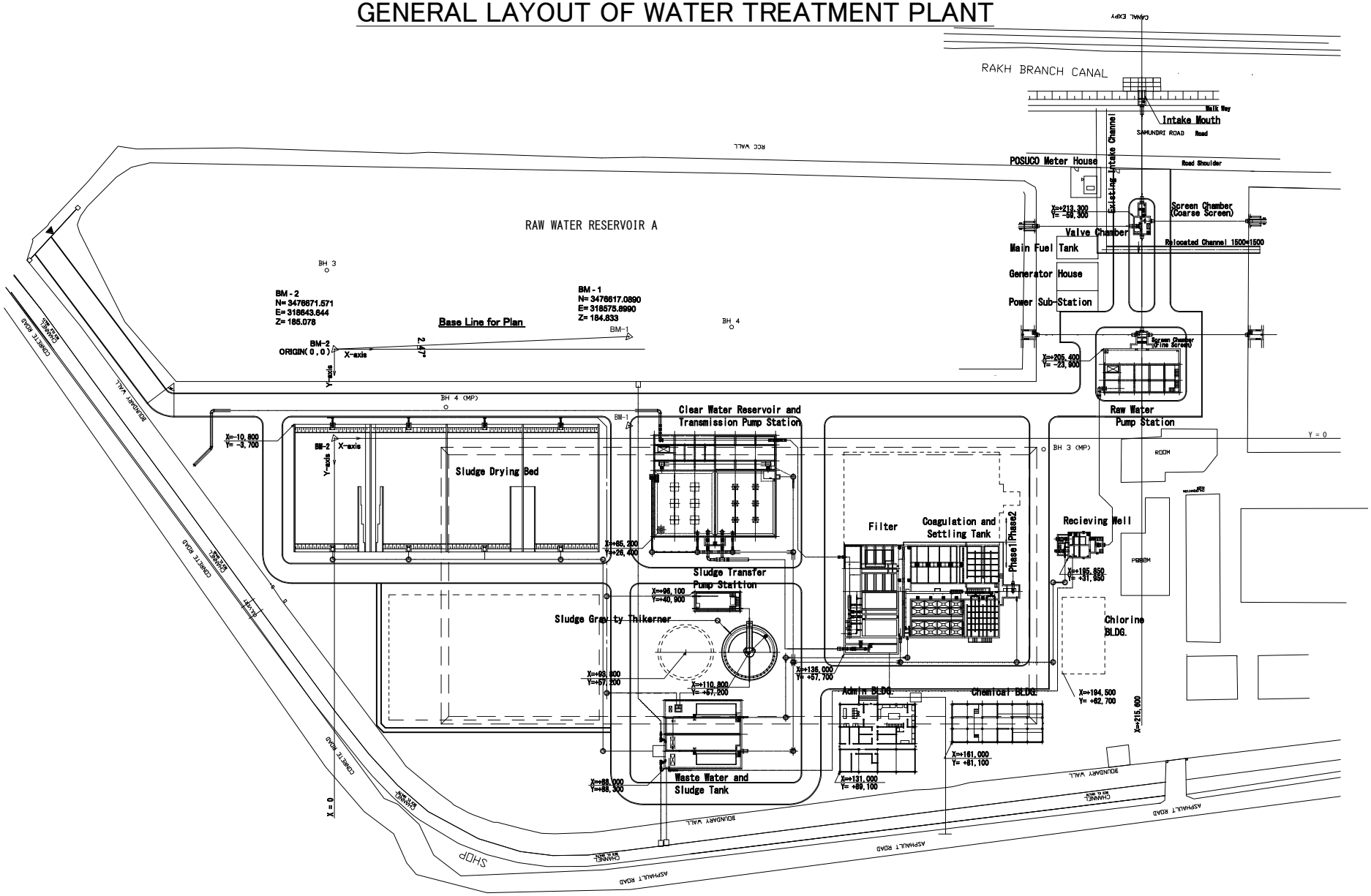
Node No.	Discharge l/sec	WL m	GL m	Eff. Head m
0	-70.64	207.47	183.4	24.07
1	0.00	206.87	183.5	23.37
2	3.53	206.70	183.4	23.30
3	2.83	205.68	183.8	21.88
4	6.36	204.67	183.9	20.77
5	4.24	203.19	184.1	19.09
6	12.01	202.90	184.6	18.30
	28.97			

Node No.	Discharge l/sec	WL m	GL m	Eff. Head m
7	6.36	203.60	184.2	19.40
8	13.42	203.52	184.4	19.12
9	7.06	203.81	184.3	19.51
10	7.77	205.47	183.8	21.67
11	7.06	204.53	183.8	20.73
	41.67		70.64	

Pipeline Data

Node Number Up-stream	Dn-stream	Dia. m	Length m	Friction Co-efficient	Head Loss m	Flow l/sec	Velocity m/sec	H.Gradient ‰
0	1	250	63	120	0.60	70.64	1.44	9.65
1	2	250	100	120	0.18	28.37	0.58	1.78
2	3	200	250	120	1.02	24.84	0.79	4.14
3	4	200	310	120	1.01	22.01	0.70	3.31
4	5	150	680	120	1.48	8.31	0.47	2.21
5	6	150	500	120	0.29	4.07	0.23	0.59
6	7	150	350	120	-0.70	-7.94	-0.45	2.04
7	8	150	160	120	0.08	7.98	0.45	2.05
8	9	150	290	120	-0.29	-5.44	-0.31	1.01
9	10	150	360	120	-1.67	-12.50	-0.71	4.71
10	11	200	290	120	0.94	22.00	0.70	3.30
11	7	200	280	120	0.93	22.29	0.71	3.38
11	4	200	320	120	-0.14	-7.35	-0.23	0.43
10	1	250	380	120	-1.40	-42.27	-0.86	3.73

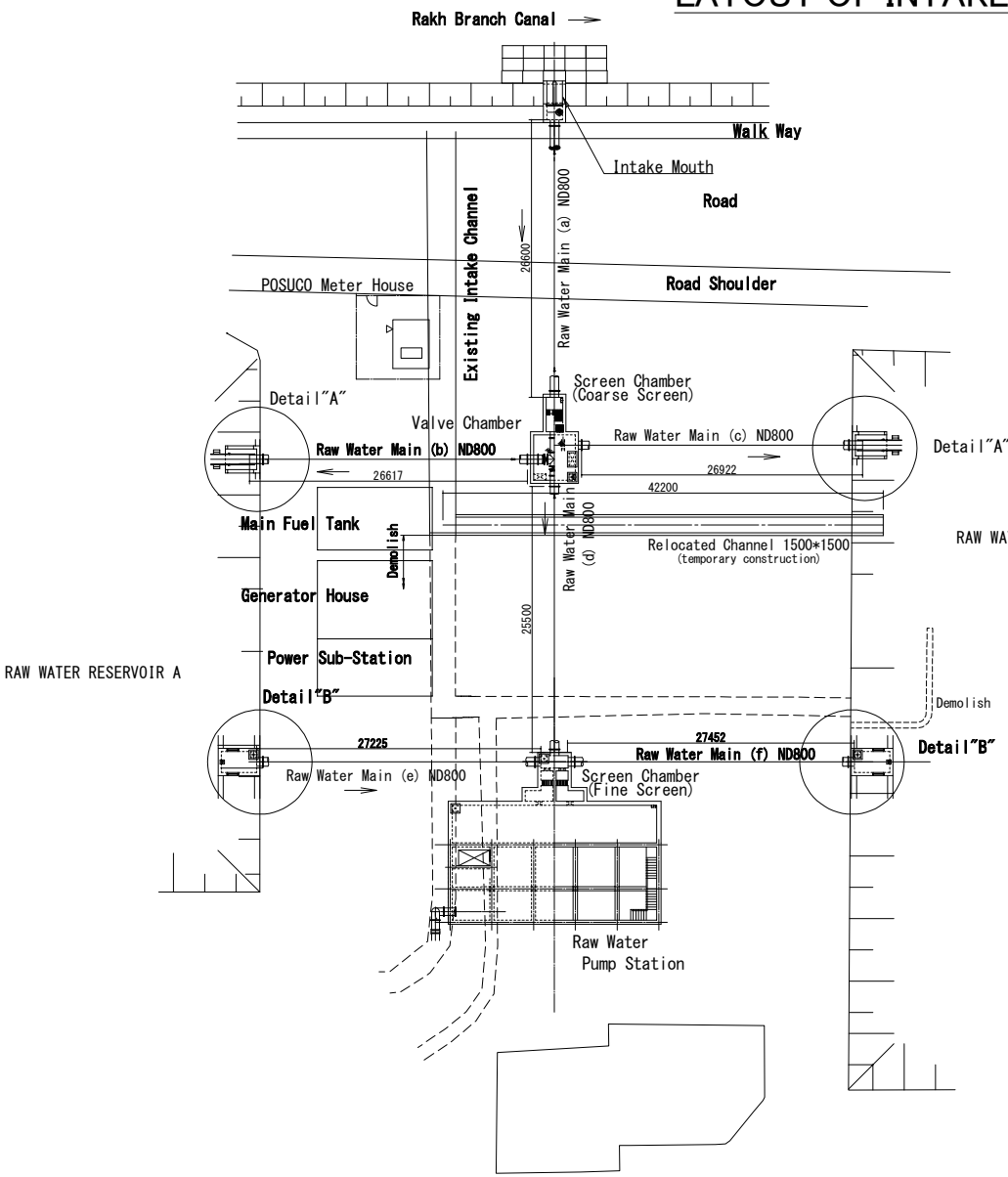
GENERAL LAYOUT OF WATER TREATMENT PLANT

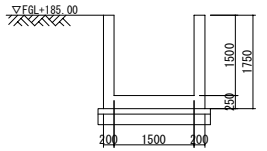


	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GENERAL LAYOUT OF WATER TREATMENT PLANT	1/1,000	WTP-C-01

WTP-01

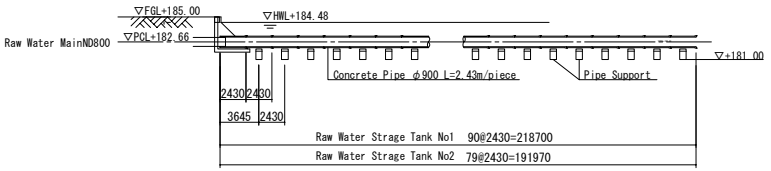
LAYOUT OF INTAKE FACILITIES





Relocatede Channel

S=1/100



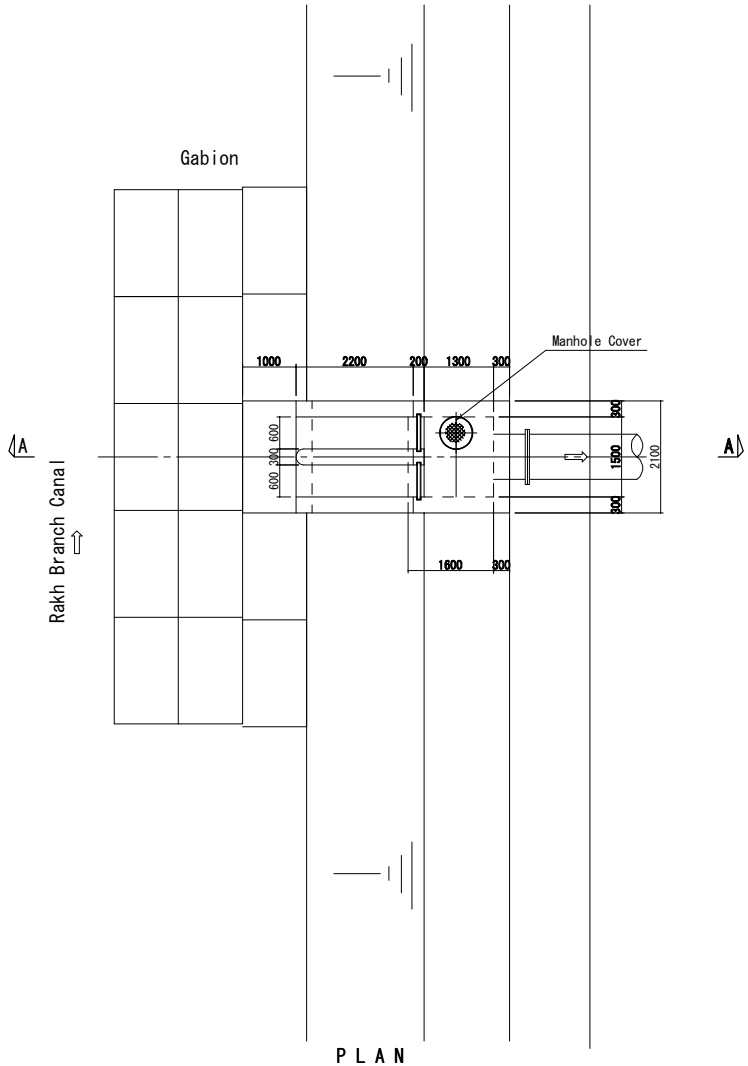
Concrete Pipe Profile

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	LAYOUT OF INTAKE FACILITIES	1/500	WTP-C-02

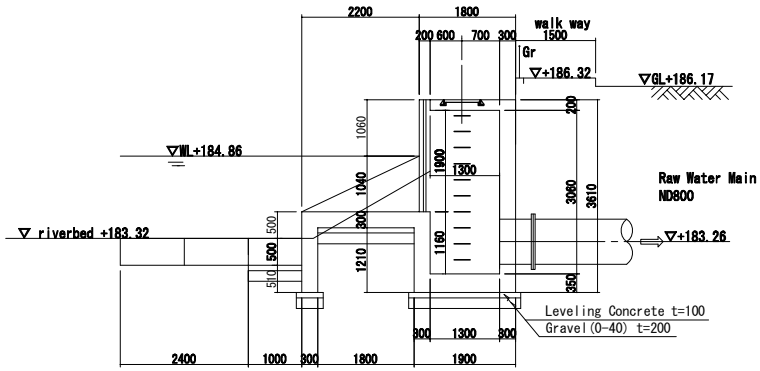
App 7(5)-2

WTP-02

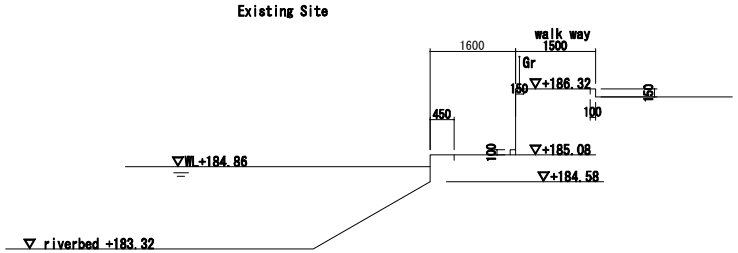
INTAKE MOUTH



P L A N



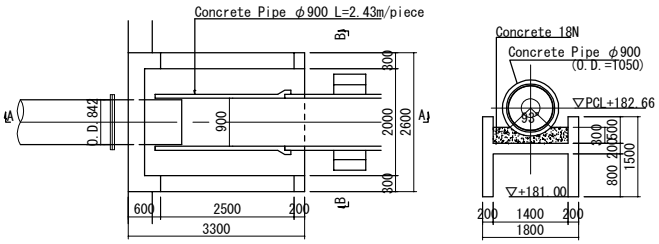
A - A SECTION



	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	INTAKE MOUTH	1/100	WTP-C-03

CONNECTION FACILITIES OF STORAGE TANK

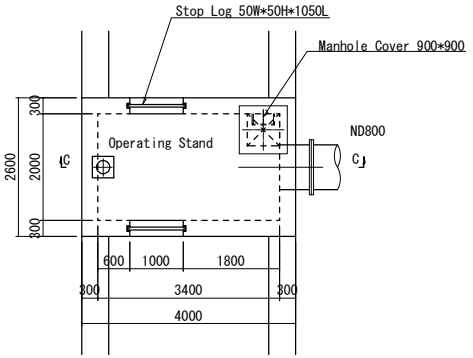
Detail"A"
S=1/100



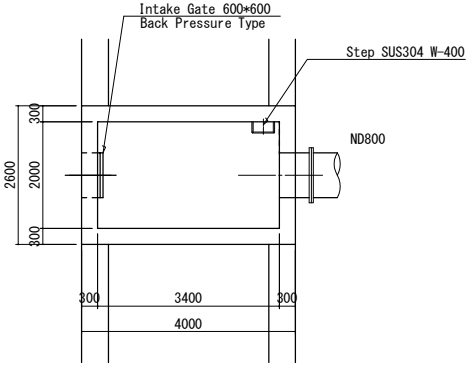
Plan

B-B Section

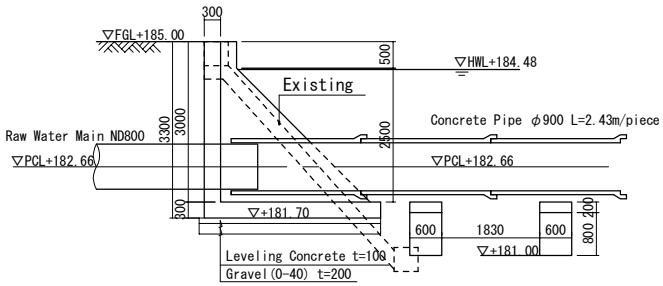
Detail"B"
S=1/100



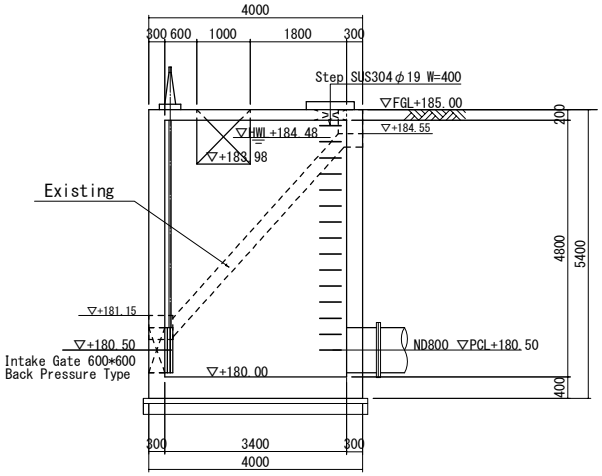
PLAN



Plane Section



A-A Section

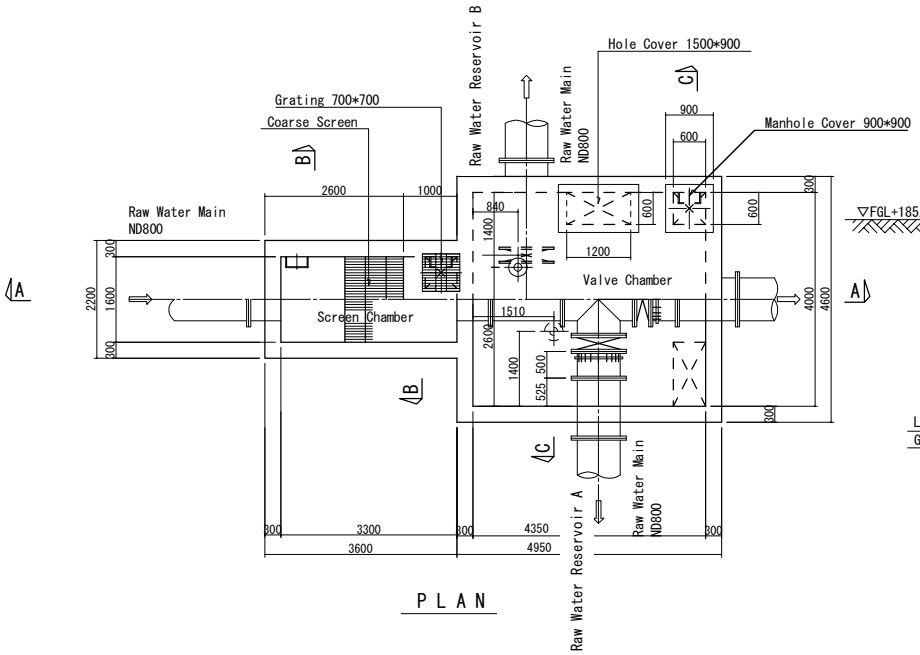


C-C Section

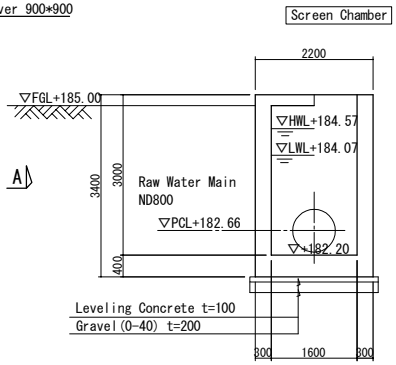
	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: CONNECTION FACILITIES OF STORAGE TANK	SCALE: 1/100	DRAWING NO: WTP-C-04

App 7(5)-4

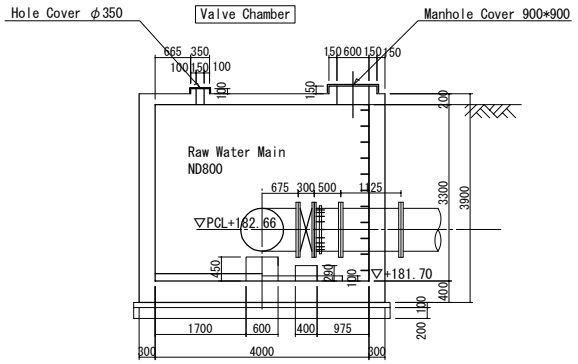
SCREEN AND RAW WATER DISTRIBUTION VALVE CHAMBER



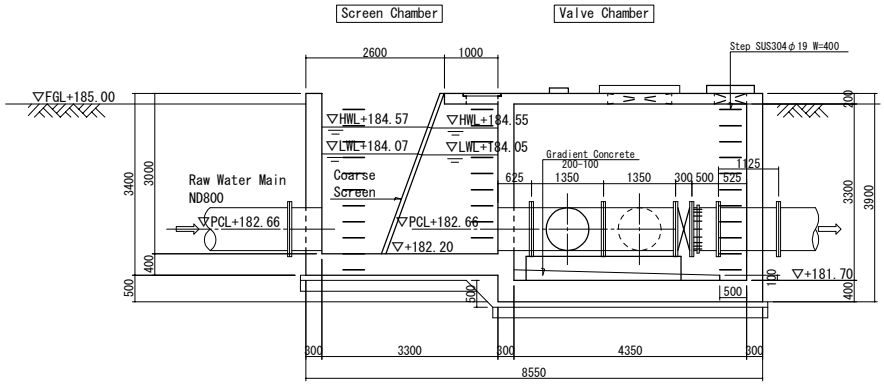
P L A N



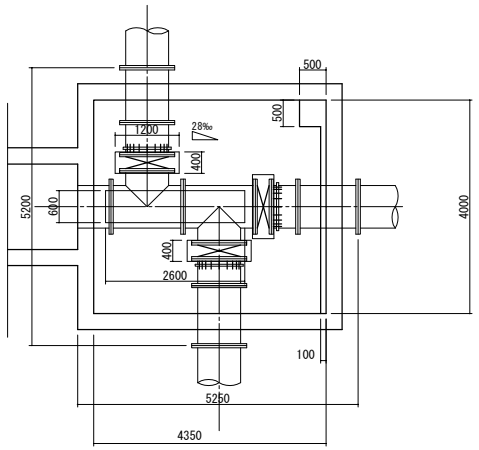
B - B SECTION



C - C SECTION



A - A SECTION



PIPE SUPPORT

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	SCREEN AND RAW WATER DISTRIBUTION VALVE CHAMBER	1/100	WTP-C-05

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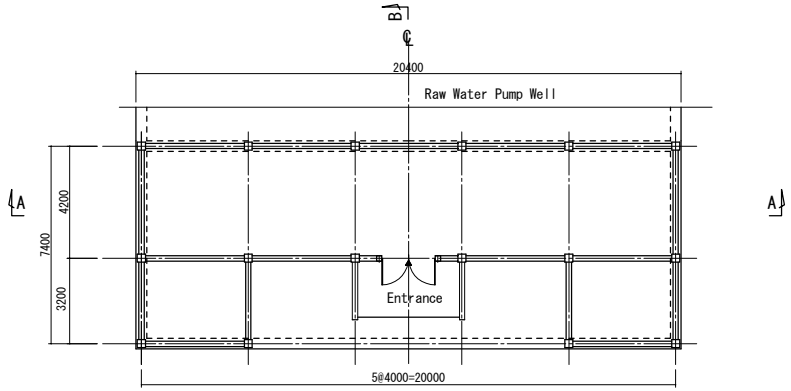
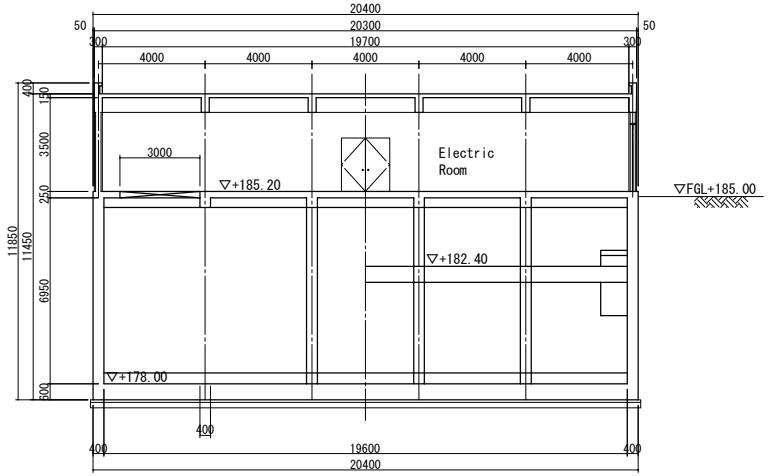
WTP-05

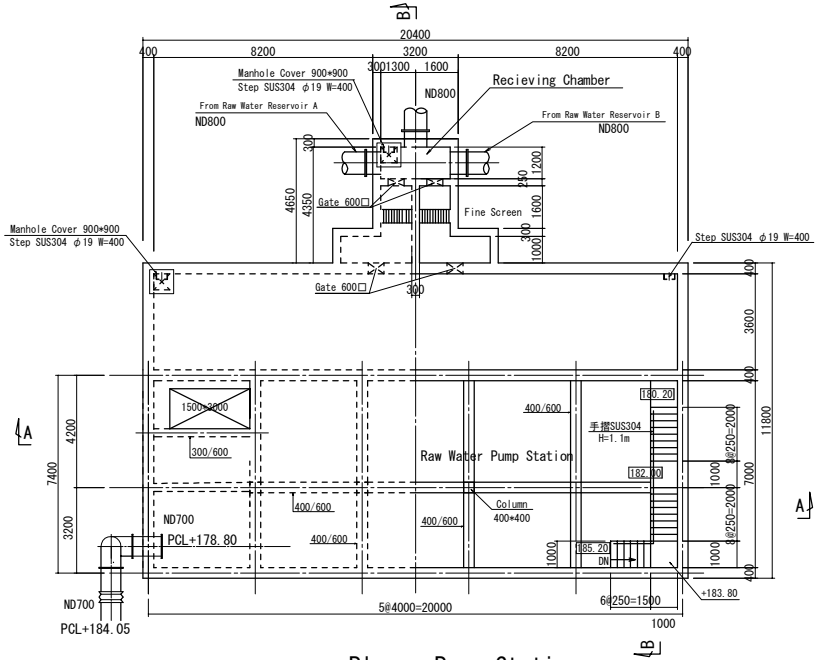
RAW WATER PUMP STATION



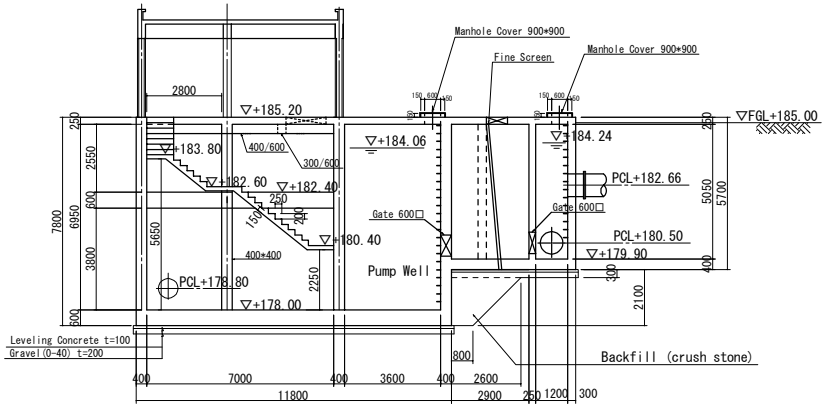
Plan - Electric Room



A-A SECTION



Plan - Pump Station



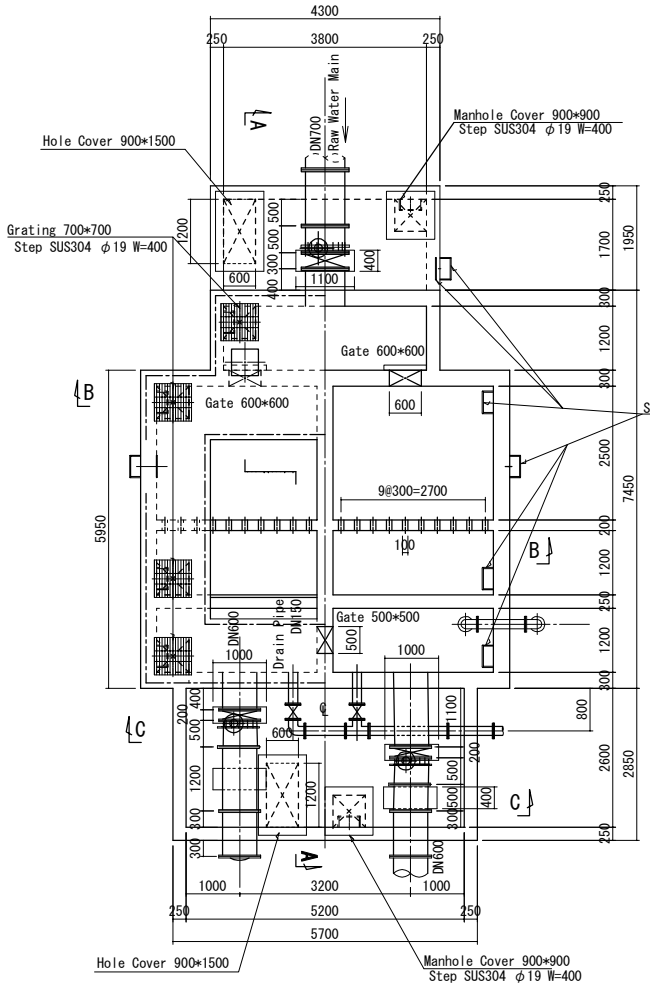
B-B SECTION

	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: RAW WATER PUMP STATION	SCALE: 1/200	DRAWING NO: WTP-C-06

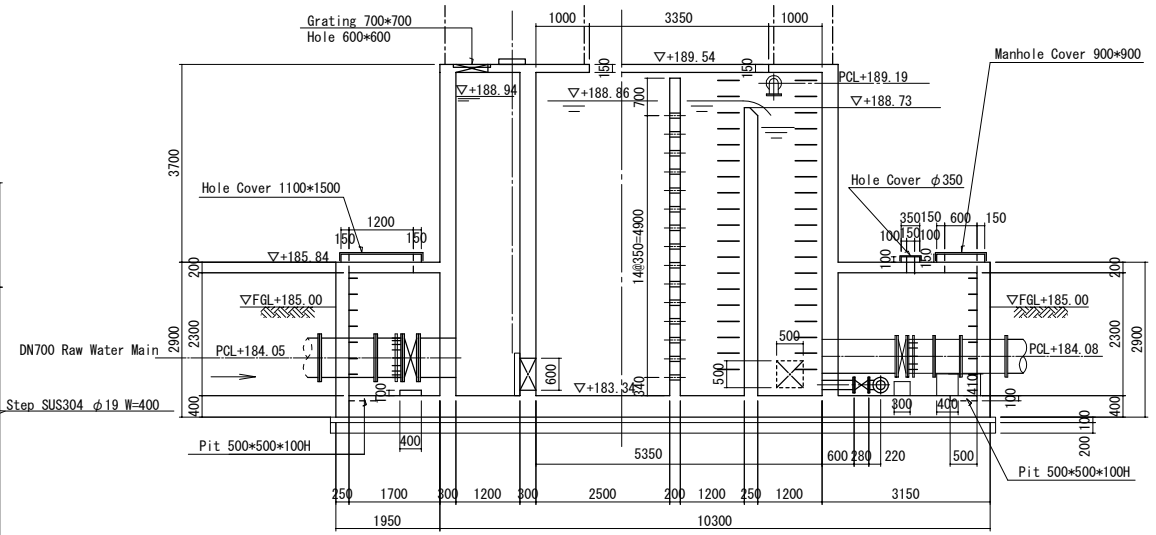
App 7(5)-6

WTP-06

RECEIVING AND DISTRIBUTION TANK



P L A N



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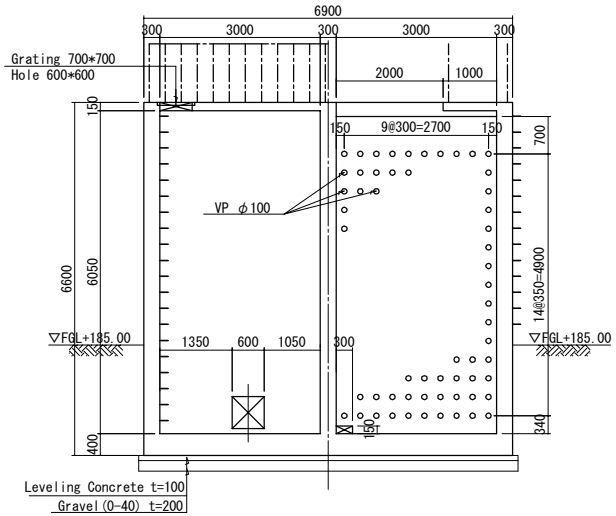
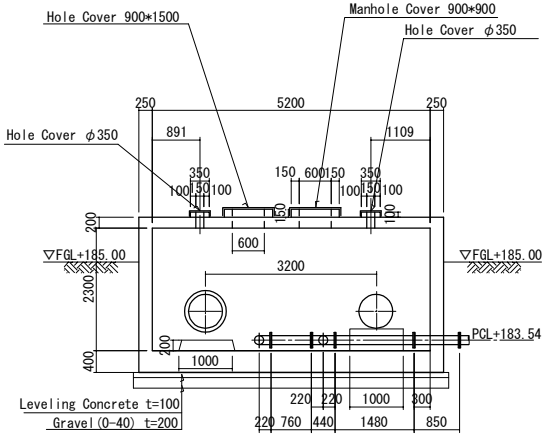


B-B SECTION



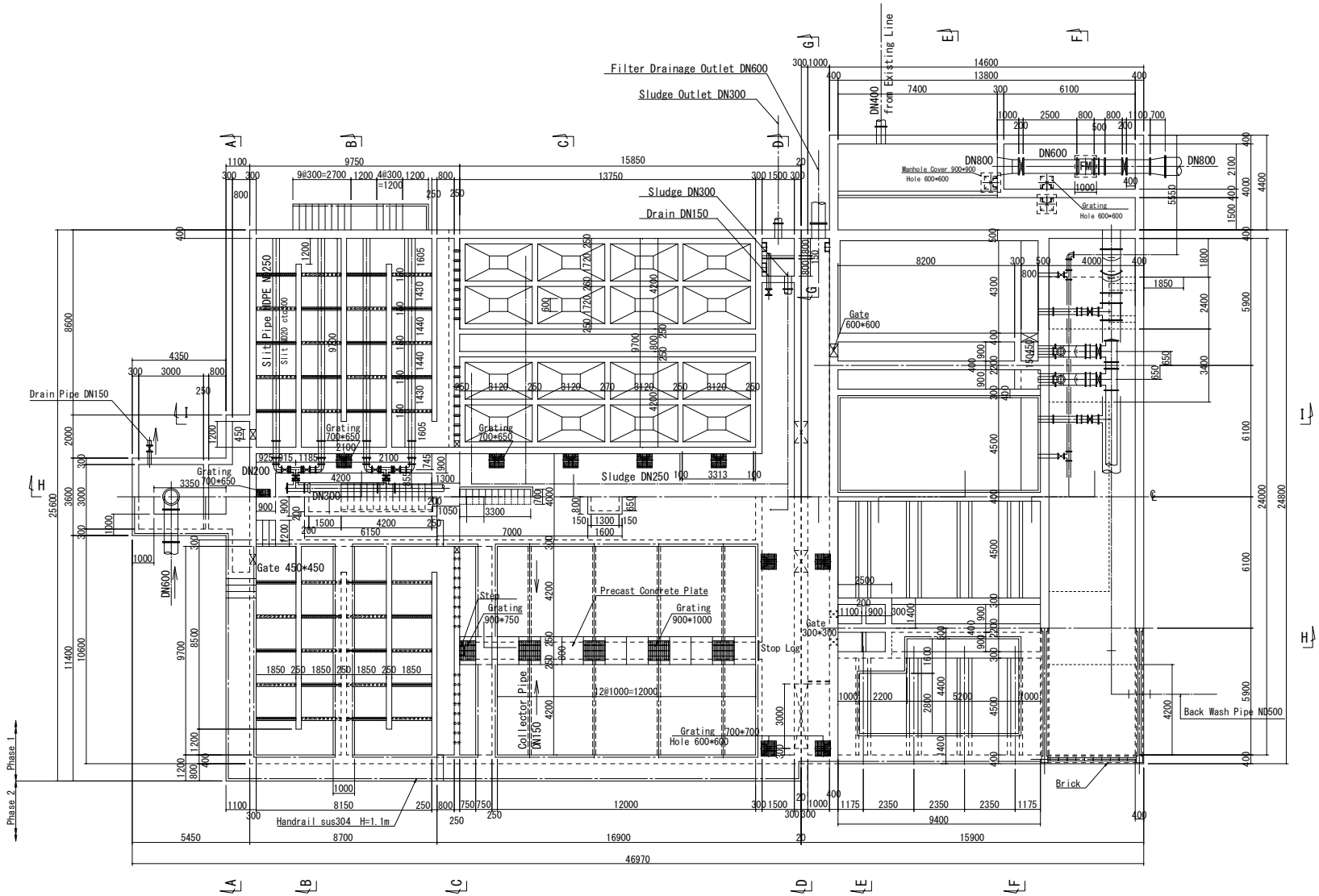
C-C SECTION

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	RECEIVING AND DISTRIBUTION TANK	1/100	WTP-C-07

App 7(5)-7

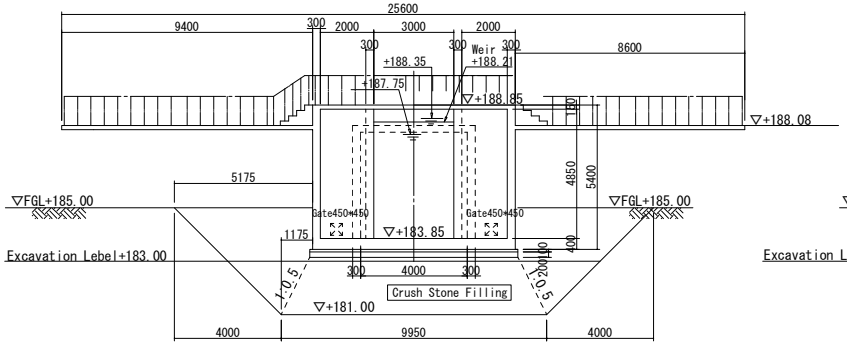
WTP-07

COAGULATION, SETTLING TANK AND RAPID SAND FILTER (1)

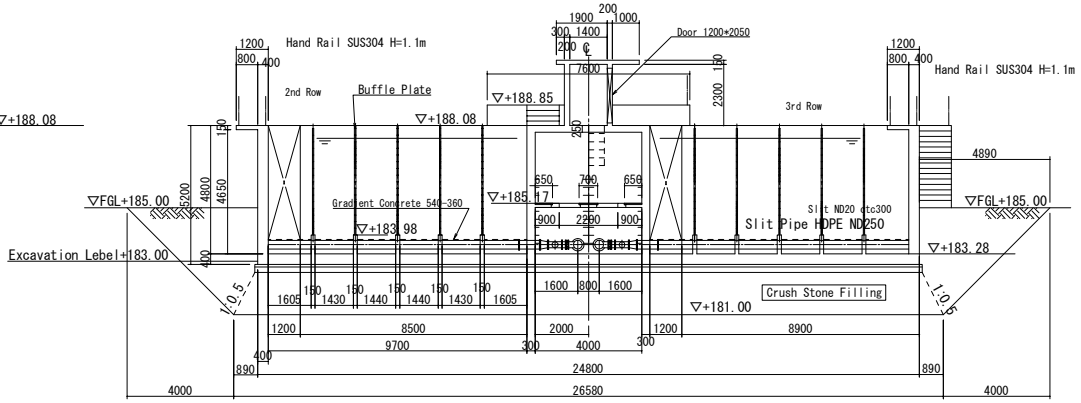


	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	COAGULATION, SETTLING TANK AND RAPID SAND FILTER (1)	1/200	WTP-C-08

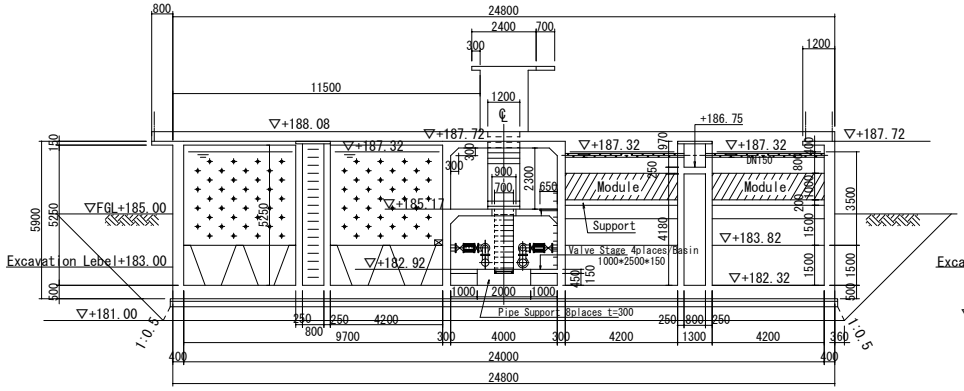
COAGULATION, SETTLING TANK AND RAPID SAND FILTER (2)



A-A SECTION



B-B SECTION



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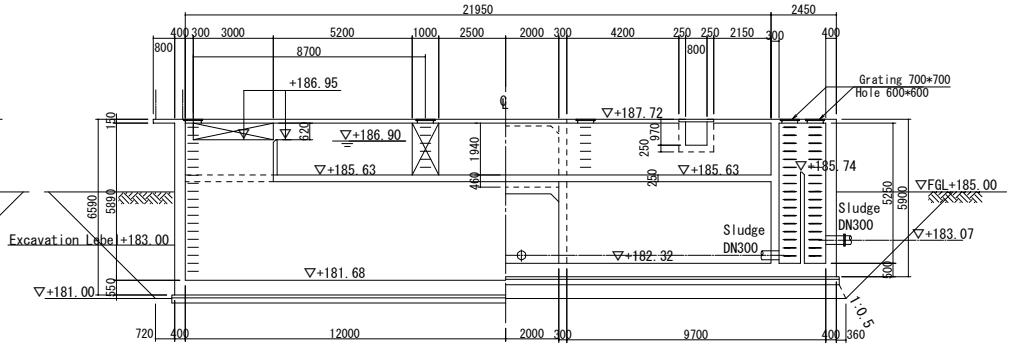

D-D SECTION

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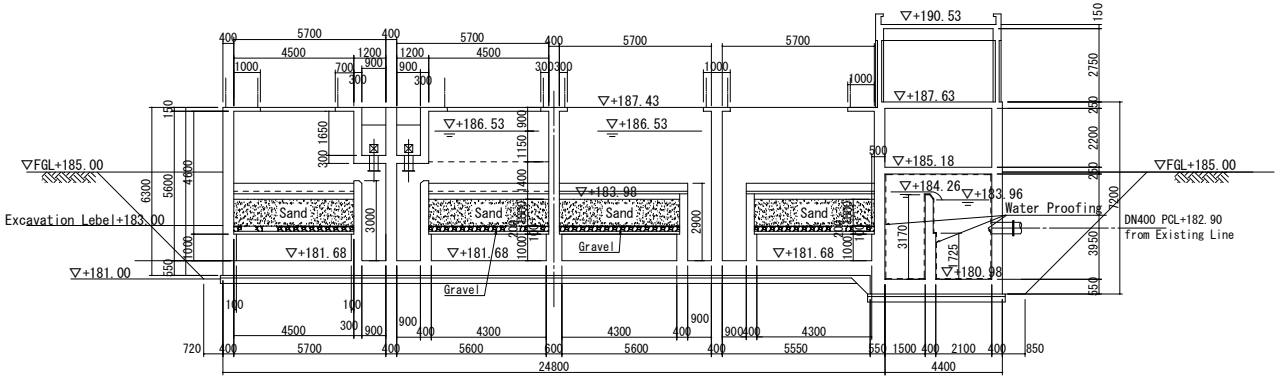
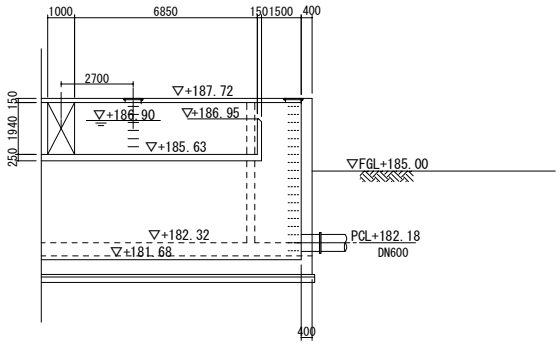
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	COAGULATION, SETTLING TANK AND RAPID SAND FILTER (2)	1/200	WTP-C-09

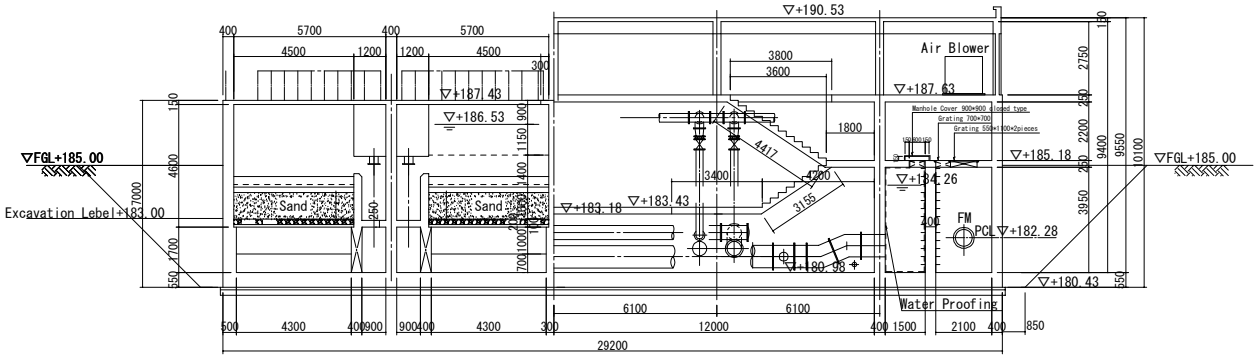
COAGULATION, SETTLING TANK AND RAPID SAND FILTER (3)



E-E SECTION



G-G SECTION



F-F SECTION

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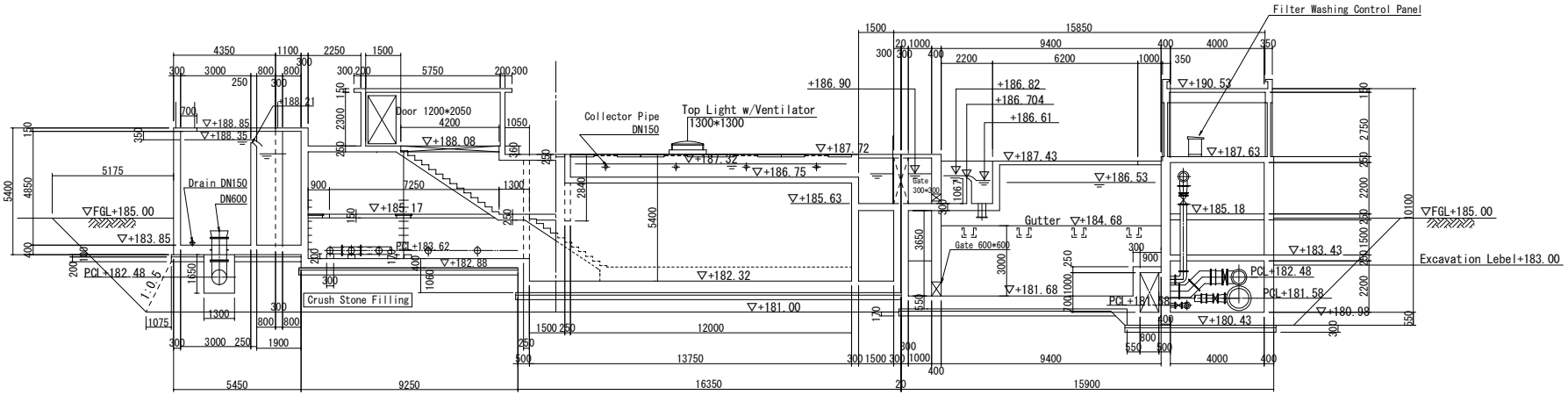
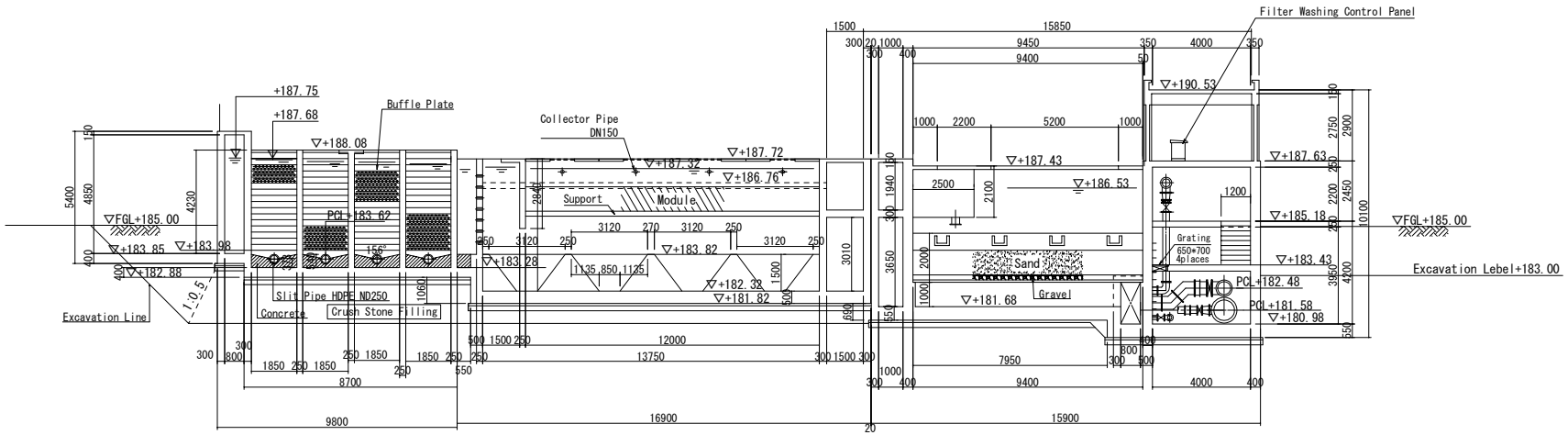
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	COAGULATION, SETTLING TANK AND RAPID SAND FILTER (3)	1/200	WTP-C-10

COAGULATION, SETTLING TANK AND RAPID SAND FILTER (4)



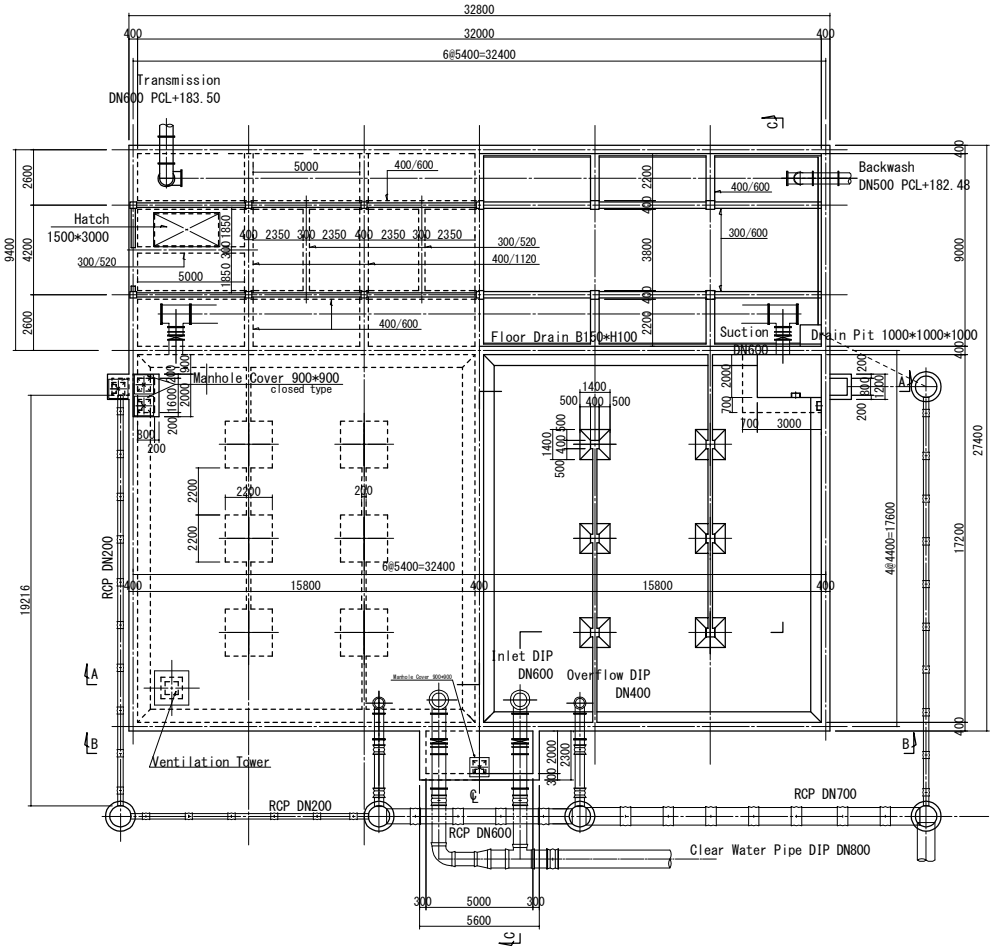
H-H SECTION



I-I SECTION

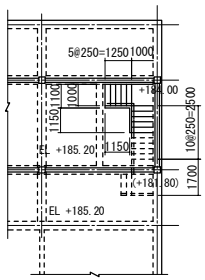
	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	COAGULATION, SETTLING TANK AND RAPID SAND FILTER (4)	1/200	WTP-C-11

CLEAR WATER RESERVOIR AND TRANSMISSION PUMP STATION (1)

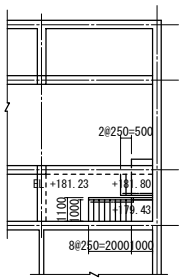


P L A N

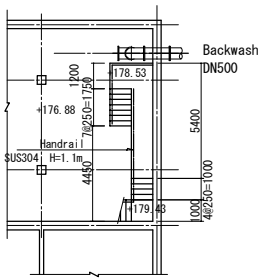
STAIRS



Section +185.20



Section +181.23



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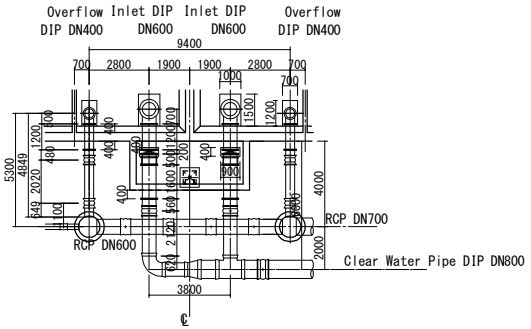
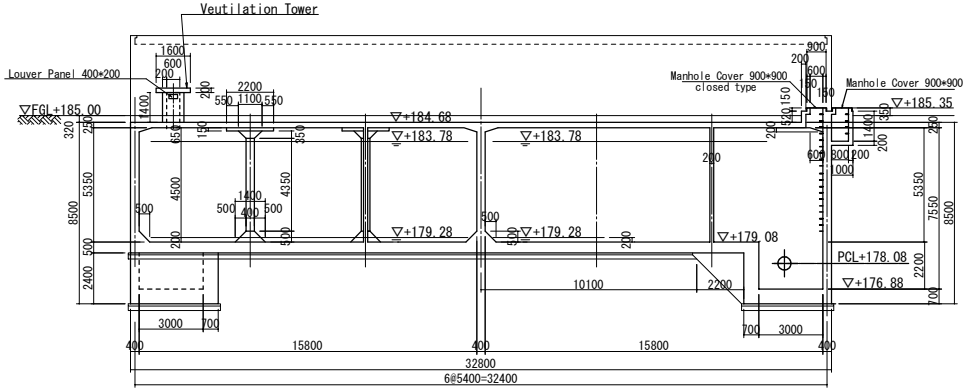


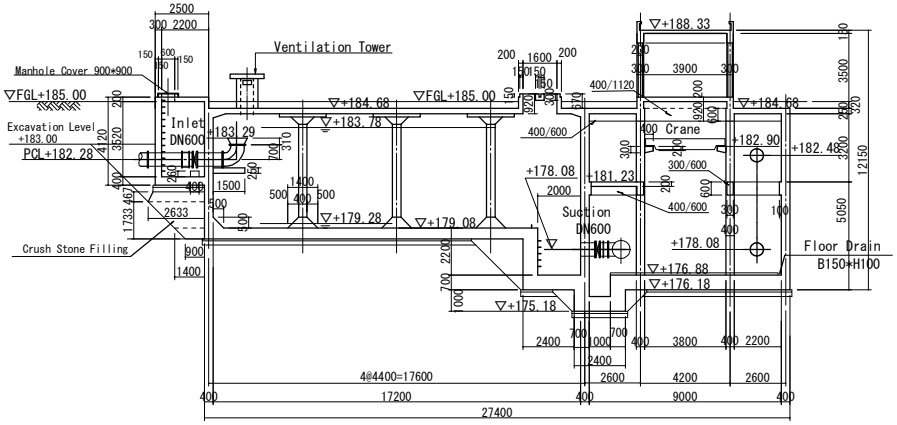
Pipe Arrangement

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	CLEAR WATER RESERVOIR AND TRANSMISSION PUMP STATION (1)	1/250	WTP-C-12

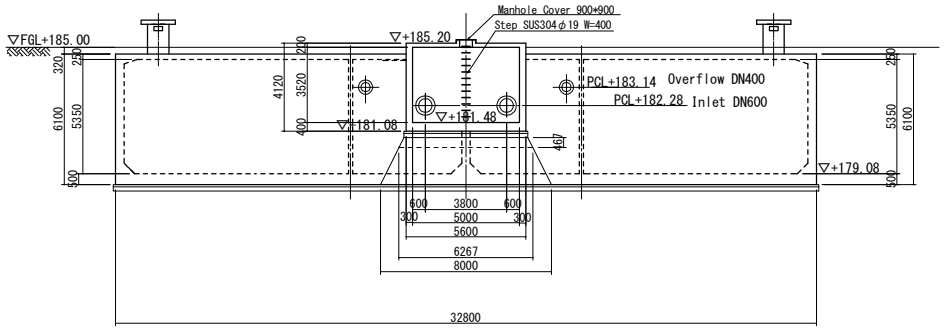
CLEAR WATER RESERVOIR AND TRANSMISSION PUMP STATION (2)



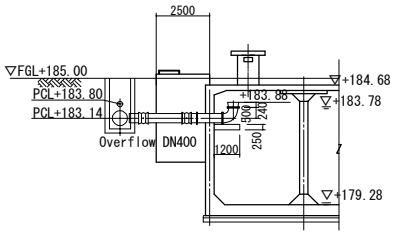
A-A SECTION



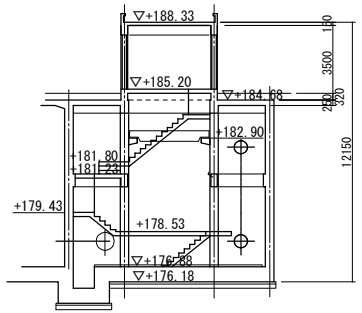
C-C SECTION



B-B SECTION



Overflow Pipe

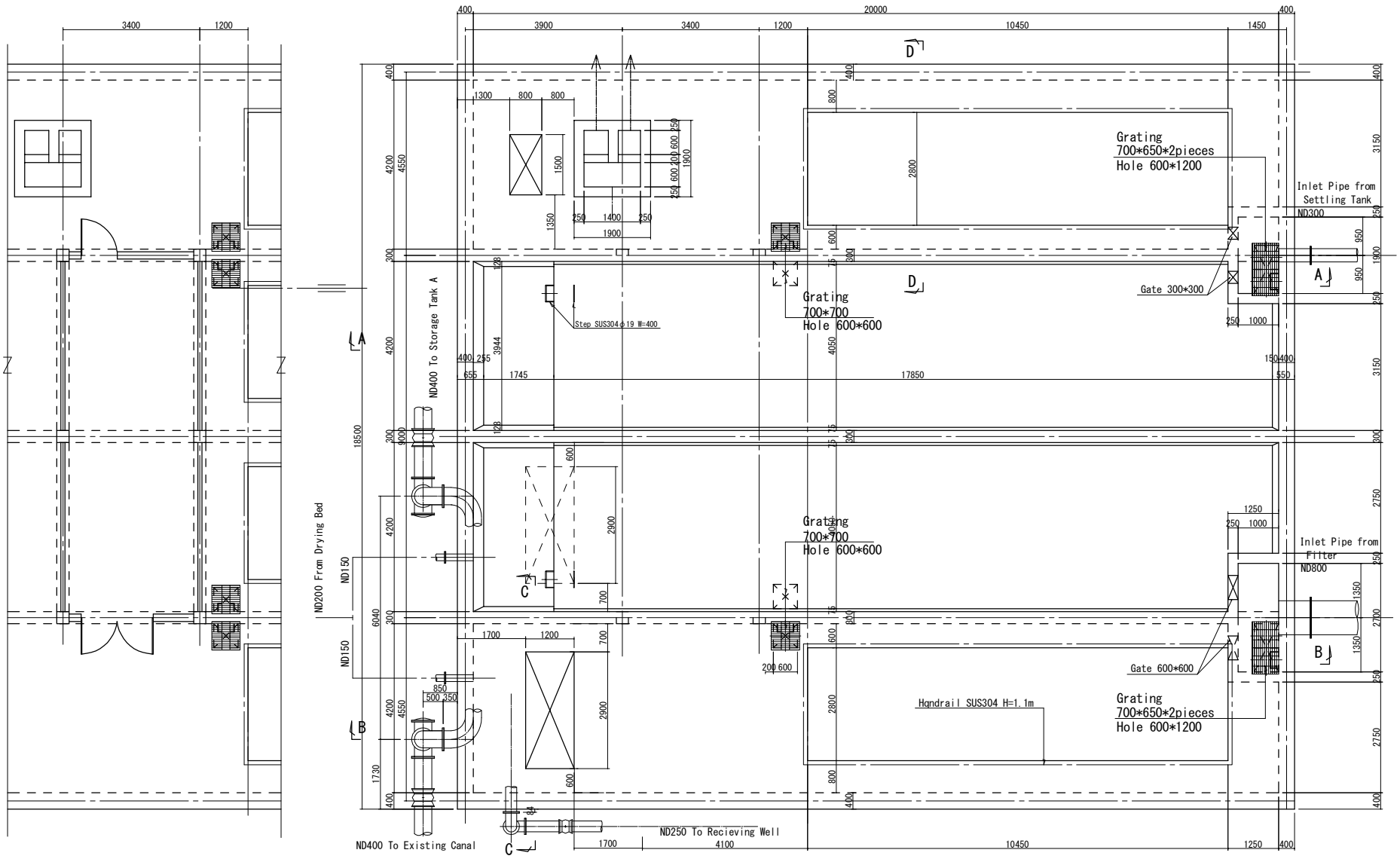


Stairs - Section

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	CLEAR WATER RESERVOIR AND TRANSMISSION PUMP STATION (2)	1/250	WTP-C-13

WASTE WATER TANK (1)

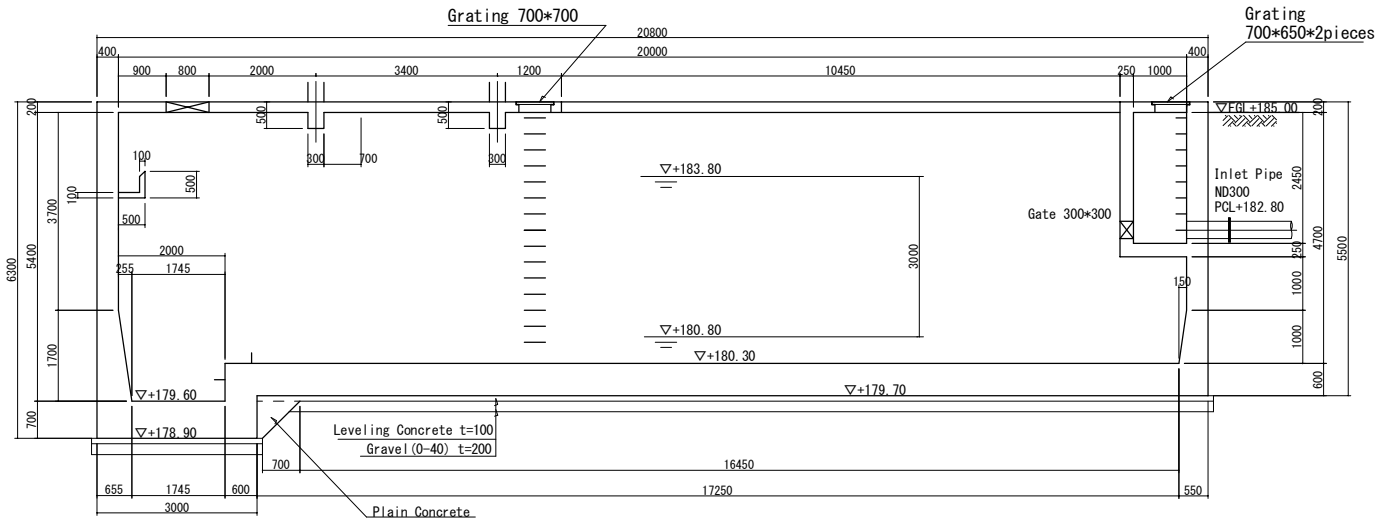
P L A N



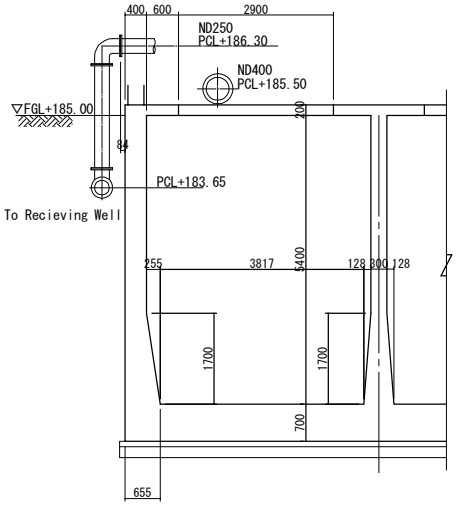
	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: WASTE WATER TANK (1)	SCALE: 1/100	DRAWING NO: WTP-C-14

App 7(5)-14

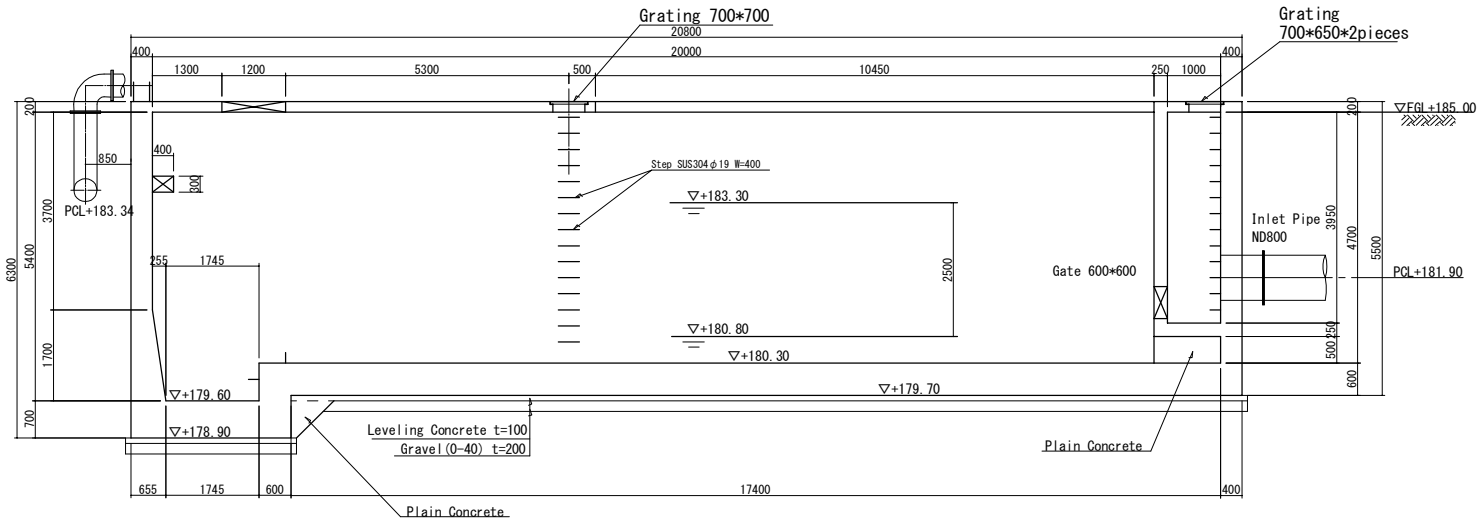
WASTE WATER TANK (2)



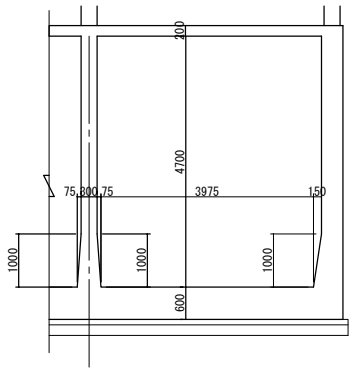
A - A SECTION



C - C SECTION



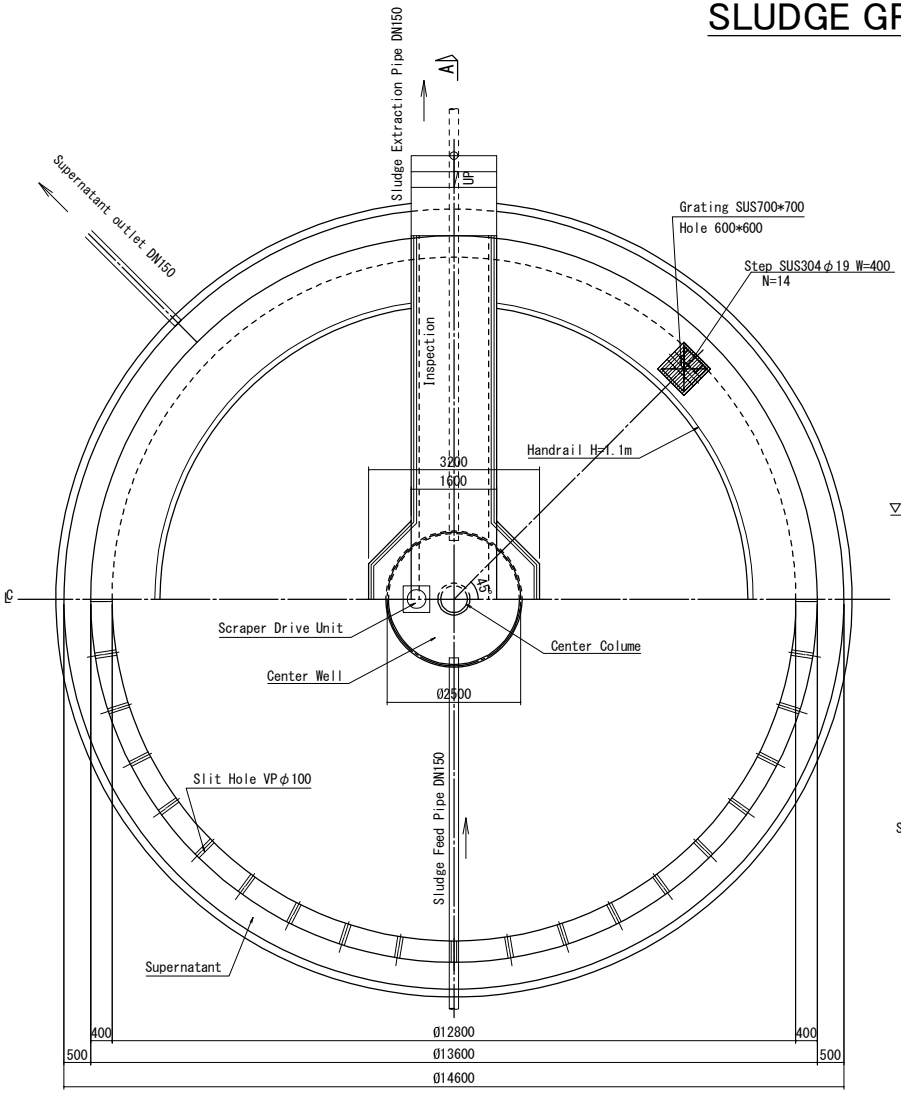
B - B SECTION



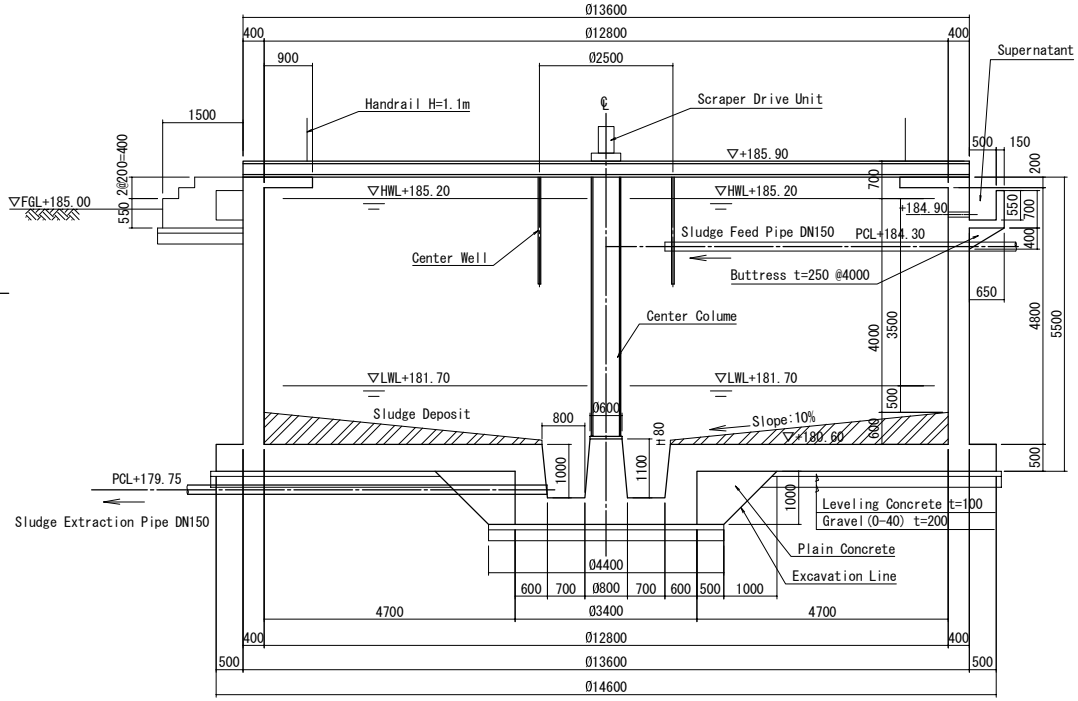
D - D SECTION

	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: WASTE WATER TANK (2)	SCALE: 1/100	DRAWING NO: WTP-C-15

SLUDGE GRAVITY THICKENER



PLAN

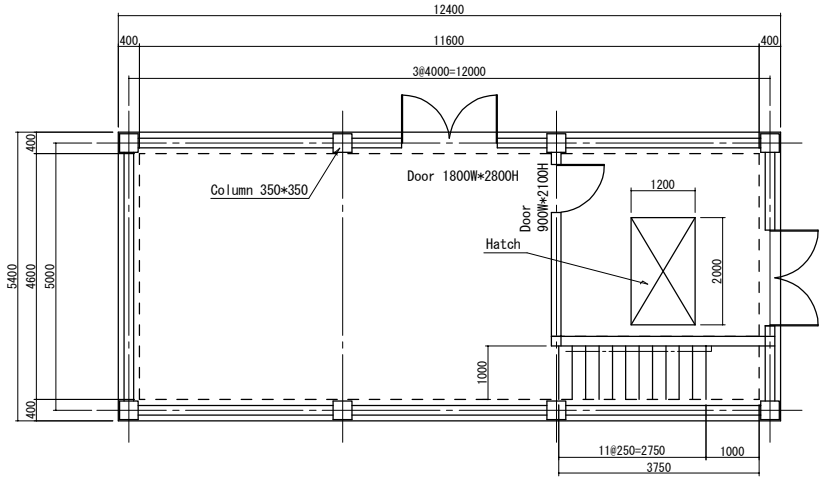


SECTION A-A

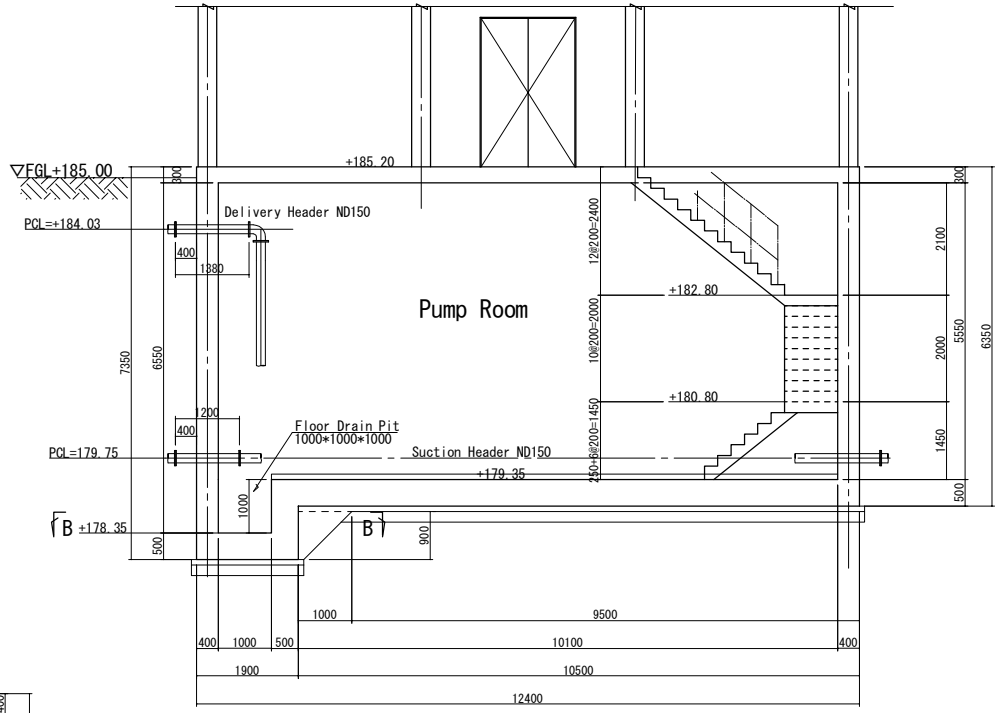
	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: SLUDGE GRAVITY THICKENER	SCALE: 1/100	DRAWING NO: WTP-C-16

App 7(5)-16

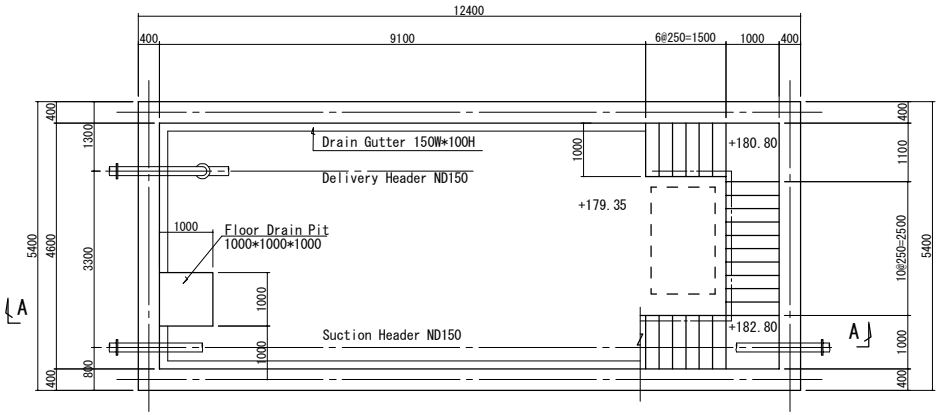
SLUDGE TRANSFER PUMP STATION



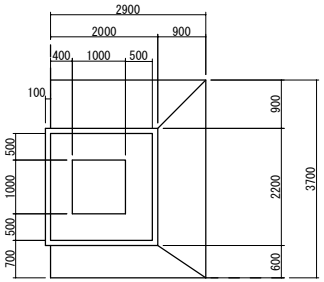
P L A N



SECTION A-A



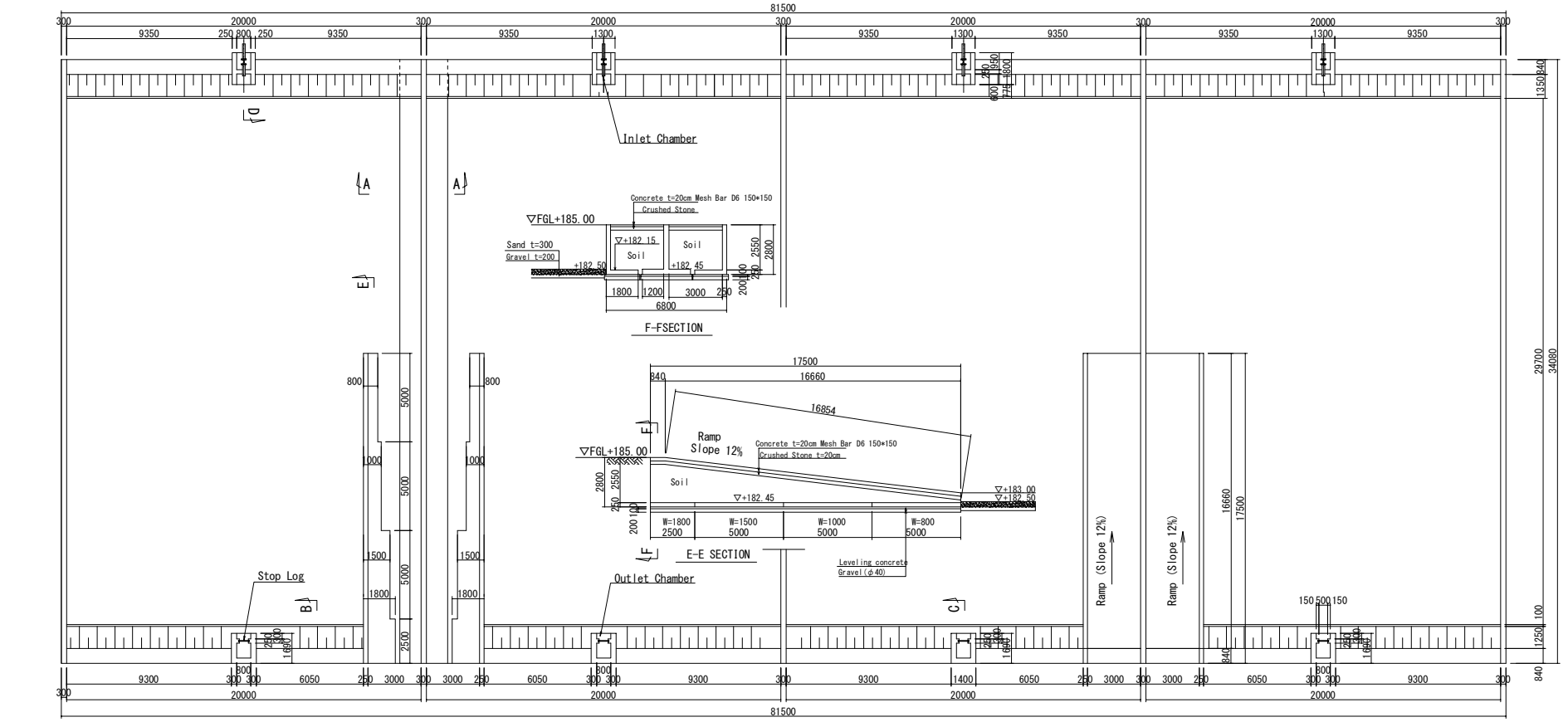
P L A N - Pump Room

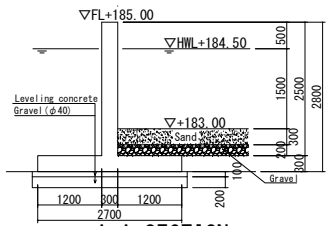


SECTION B-B

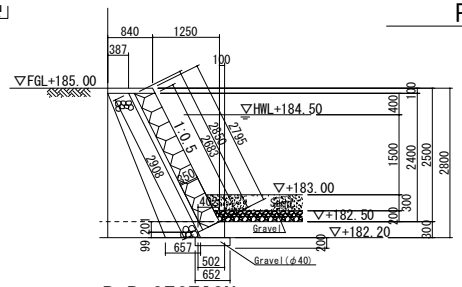
	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: SLUDGE TRANSFER PUMP STATION	SCALE: 1/100	DRAWING NO: WTP-C-17

SLUDGE DRYING BED

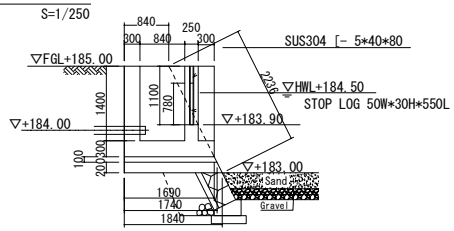




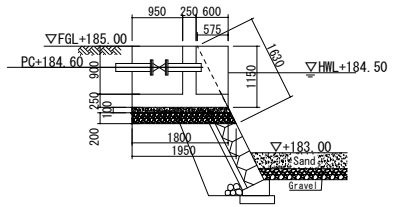
A-A SECTION
S=1/100



B-B SECTION
S=1/100



C-C SECTION
S=1/100

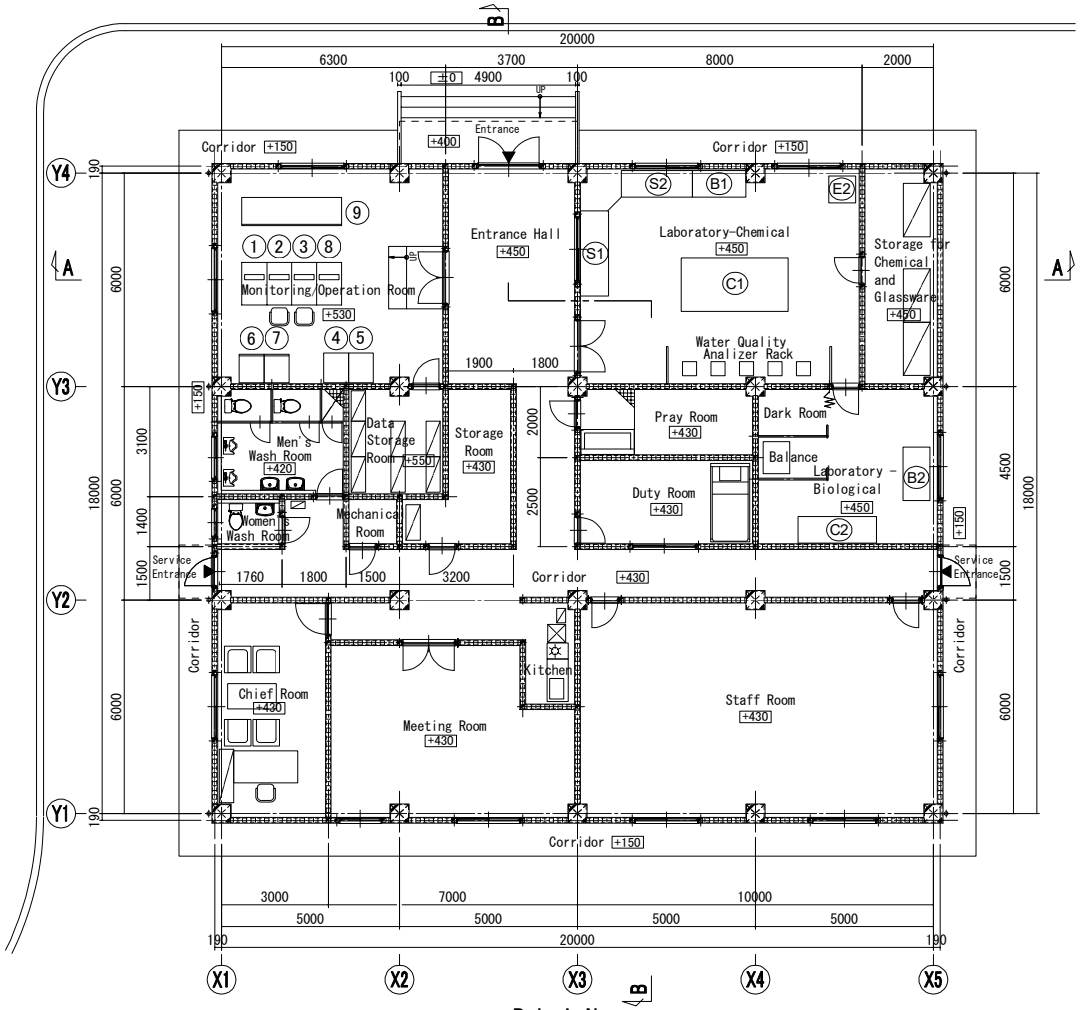


D-D SECTION
S=1/100

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	SLUDGE DRYING BED	1/250	WTP-C-18

ADMINISTRATION BUILDING(1)

Layout Plan S=1/150



PLAN

Monitoring/Operation Room

	ID No.	NAME
①	AB-ES	ENGINEERING STATION
②	AB-OS-1	OPERATOR STATION
③	AB-OS-2	OPERATOR STATION
④	AB-PR-1	A4 COLOR LASER PRINTER
⑤	AB-PR-2	A3 MONOCHROME LASER PRINTER
⑥	AB-PDB	POWER DISTRIBUTION PANEL
⑦	AB-TM	TELEMETER PANEL
⑧	AB-CS	CAMERA SERVER
⑨	AB-GMP	GRAPHIC MONITORING PANEL

Laboratory - Chemical/Biological

Furniture			Equipment/Testing
Chemical Test	C1	Center Table	Water quality testing
	S1	Side Table	pH meter,
			Turbidity meter,
			Conductivity,
			Stirrer
			Spectrophotometer
	S2	Side Table	Jar Tester
	B1	Sink Basin	
	E2	Refrigerator	
Biological Test	C2	Center Table	Water quality testing
	B2	Sink Basin	

+000 GL+

Reinforced Concrete Pillar (500mm x 500mm)

Brick Wall and Mortar Finish(total thickness 160mm)

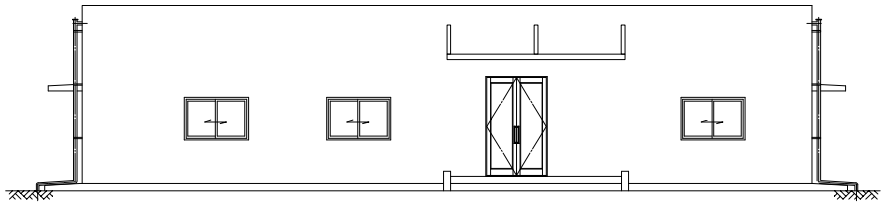
Partition Wall(Print Plywood)

Roof Drain

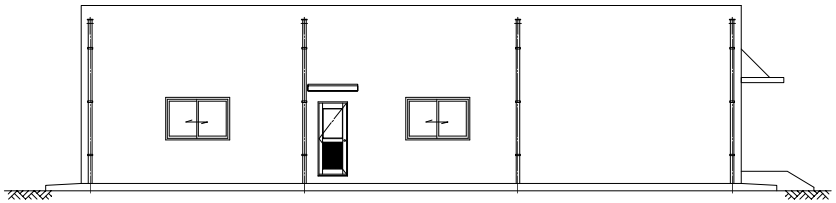
	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	Administration Building(1) - Layout Plan	1/150	WTP-A-01

ADMINISTRATION BUILDING(2)

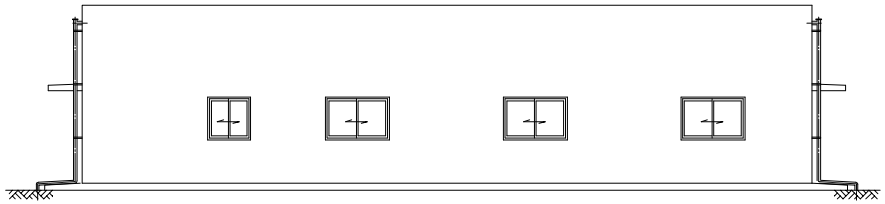
Side View S=1/150



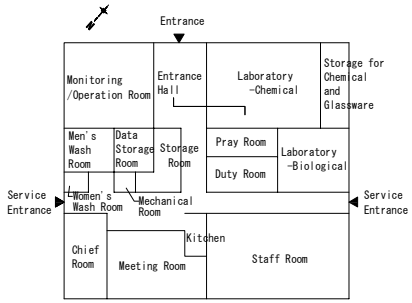
FRONT VIEW
(Entrance Facade)



SIDE VIEW
(Eastwest)



BACK VIEW

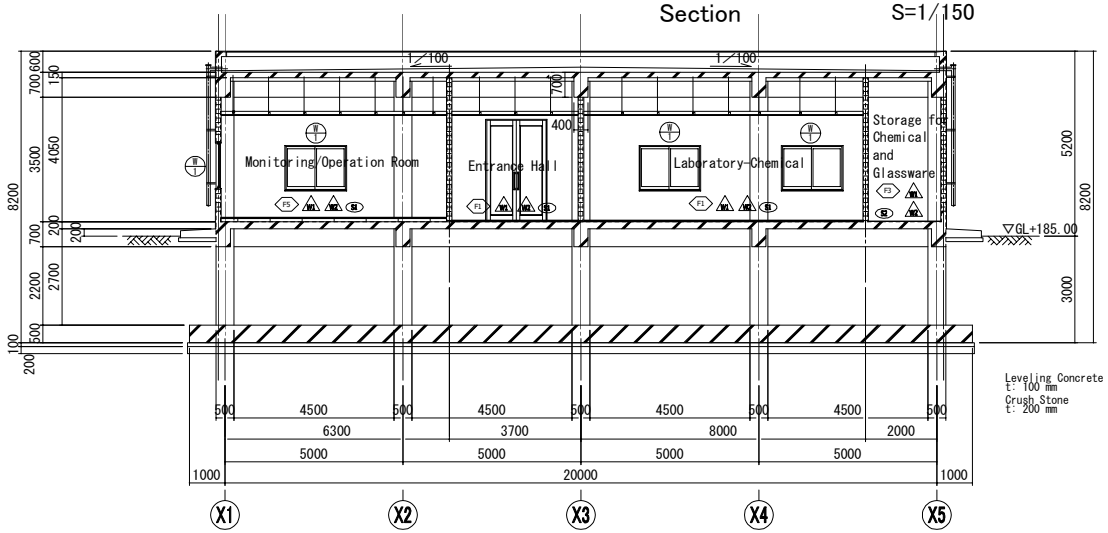


Key Plan

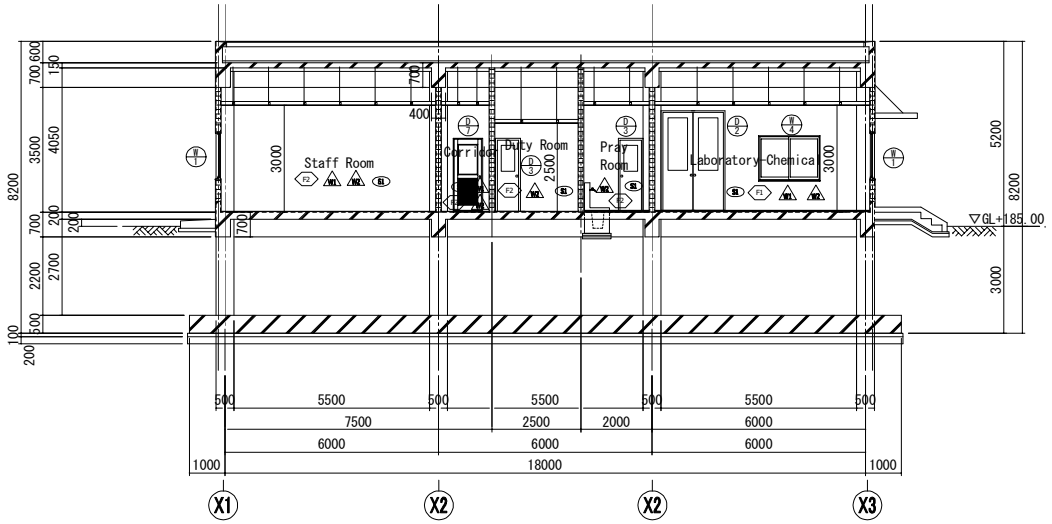
	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	Administration Building(2) -Side View	1/150	WTP-A-02

ADMINISTRATION BUILDING(3)

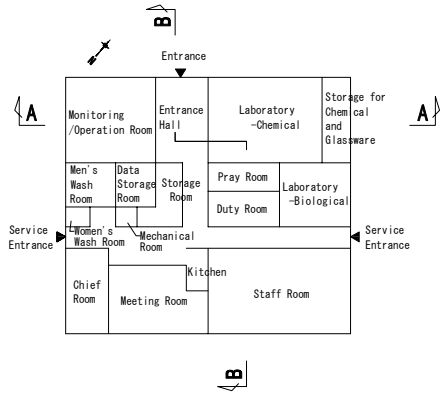
Section S=1/150



A-A SECTION



B-B SECTION



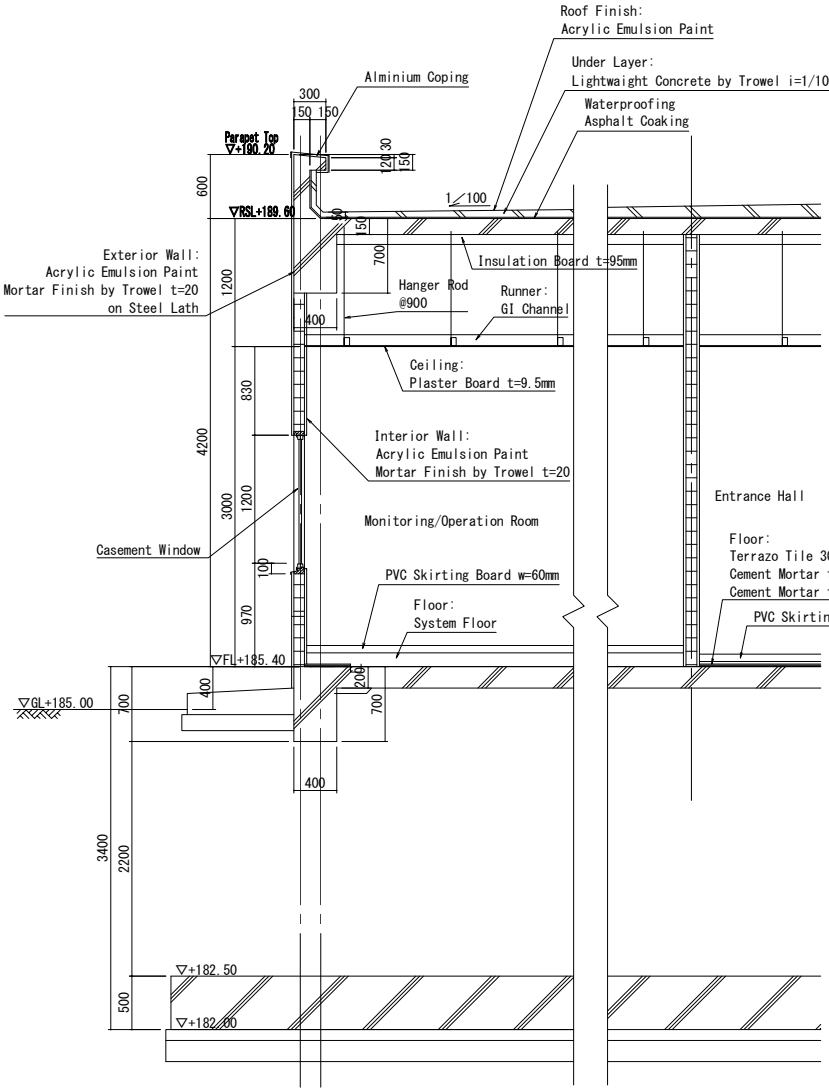
Key Plan

	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: Administration Building(3) - Section	SCALE: 1/150	DRAWING NO: WTP-A-03

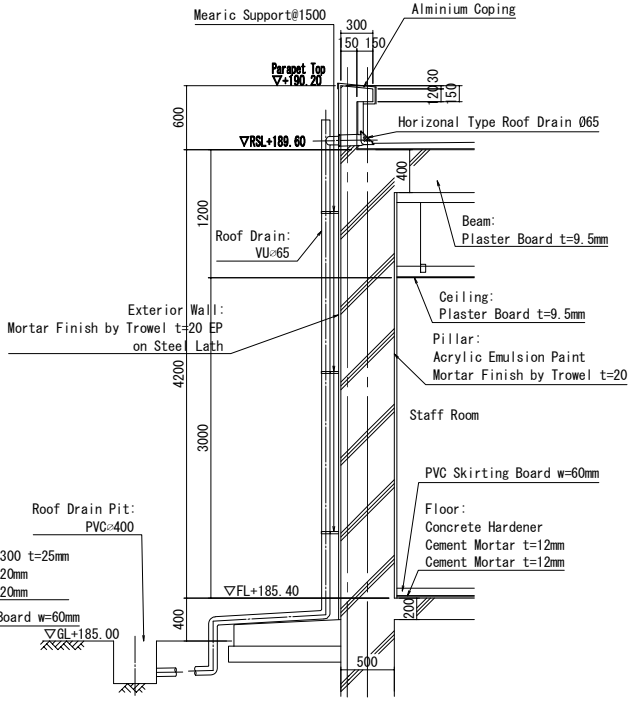
App 7(5)-21

ADMINISTRATION BUILDING(4)

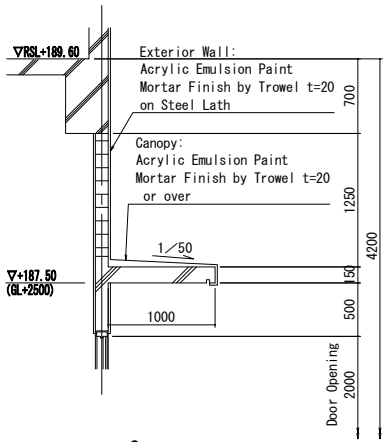
Sectional Details S=1/50



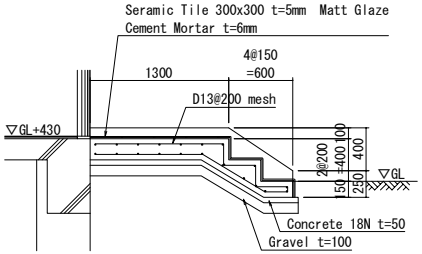
SECTIONAL DETAIL A



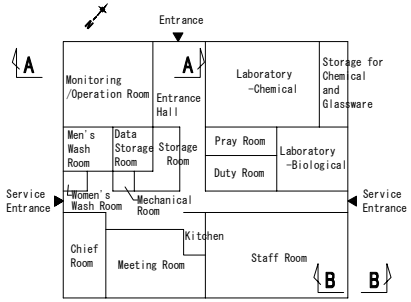
SECTIONAL DETAIL B
(Roof Drain)



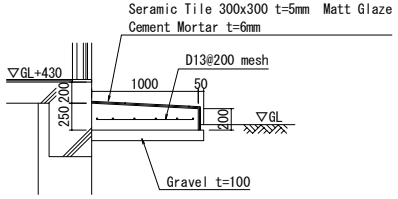
Canopy
Service Entrance



Step
Entrance



Key Plan

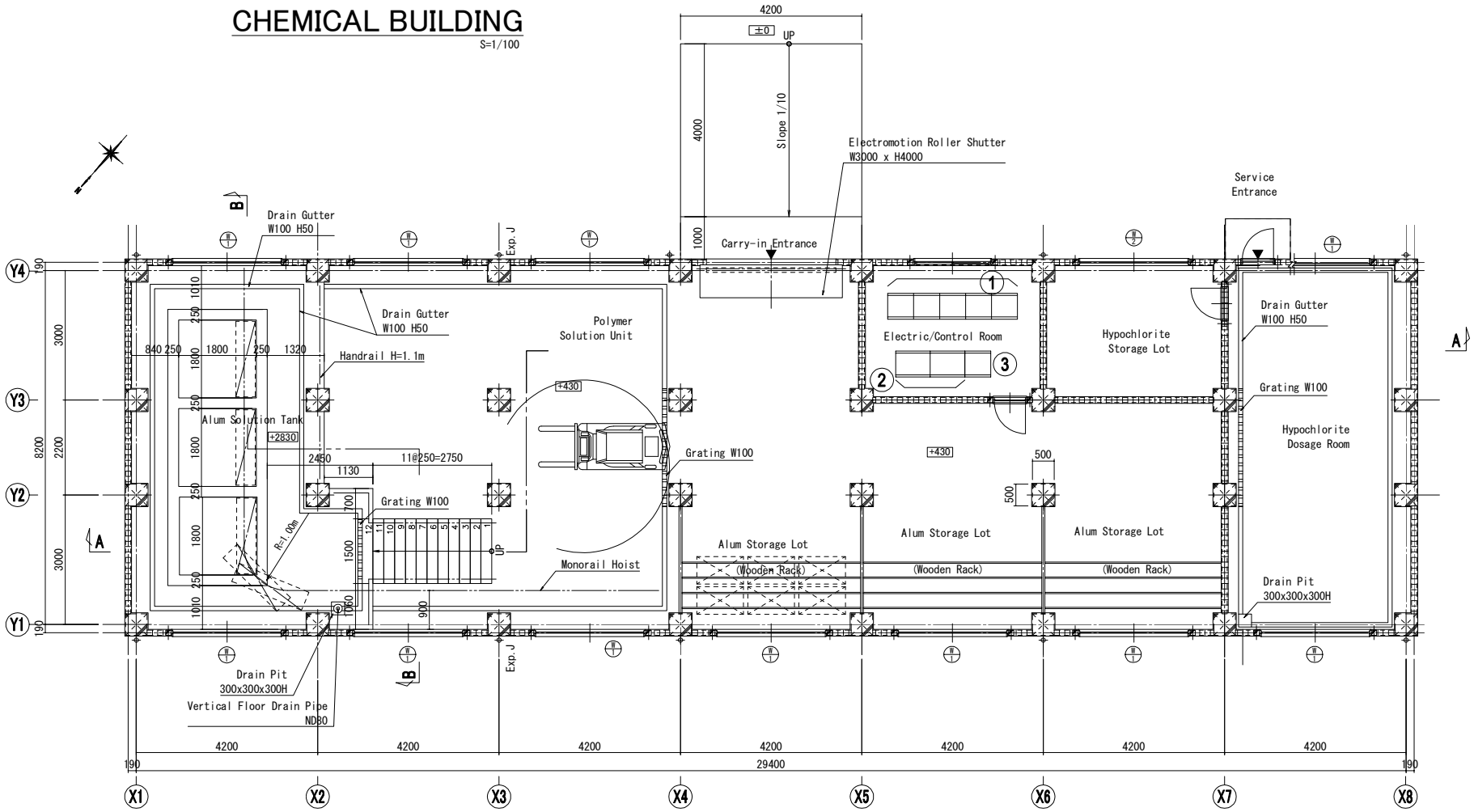


Corridor

	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: Administration Building(4) -Sectional Details	SCALE: 1/50	DRAWING NO: WTP-A-04

CHEMICAL BUILDING

S=1/100



P L A N

	ID No.	NAME
①	CHB-MCC	MCC FOR CHEMICAL BUILDING
②	CHB-RY	AUX. RELAY PANEL FOR CHEMICAL BUILDING
③	CHB-IP	INSTRUMENTATION PANEL

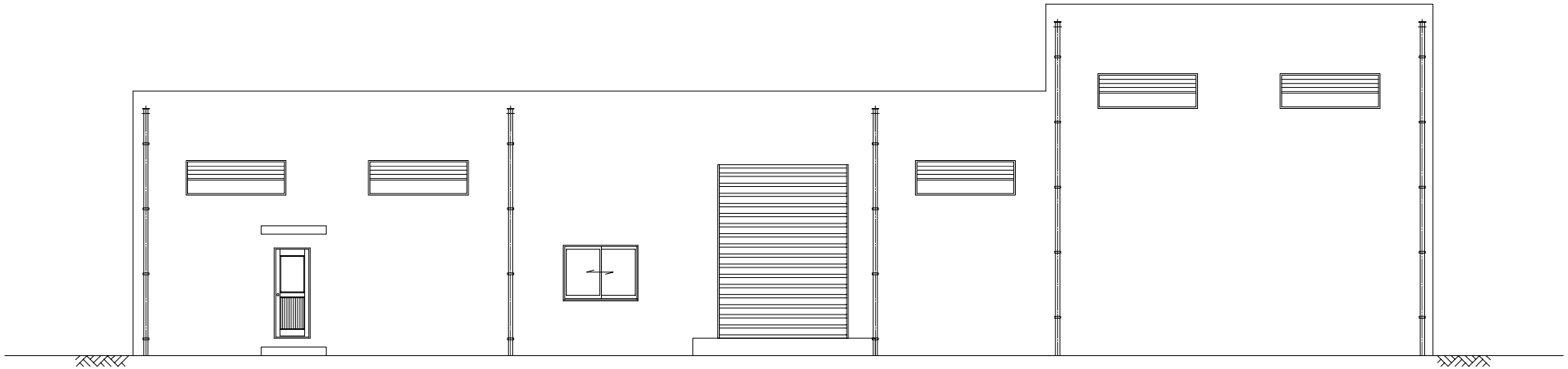
+000 GL+

Reinforced Concrete Pillar (500mm x 500mm)

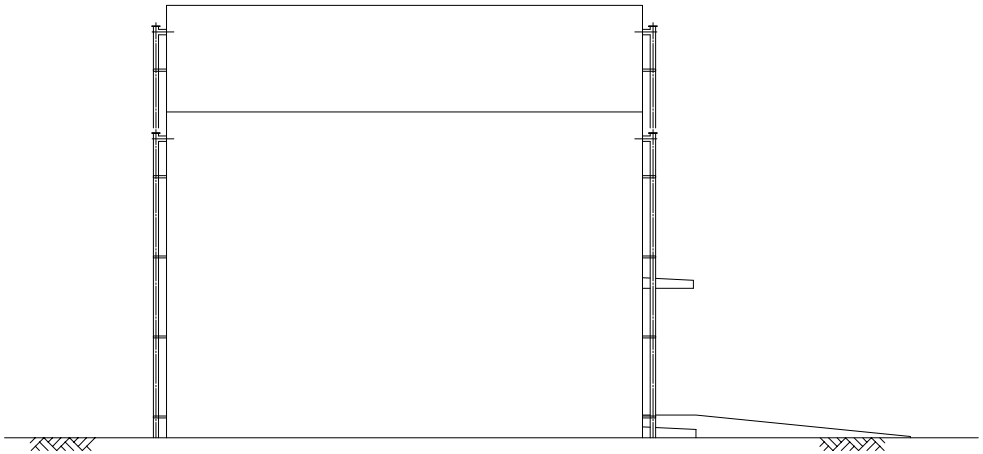
Brick Wall(thickness 160mm)

Roof Drain PVC ND80

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	Chemical Building - Layout Plan	1/100	WTP-A-10

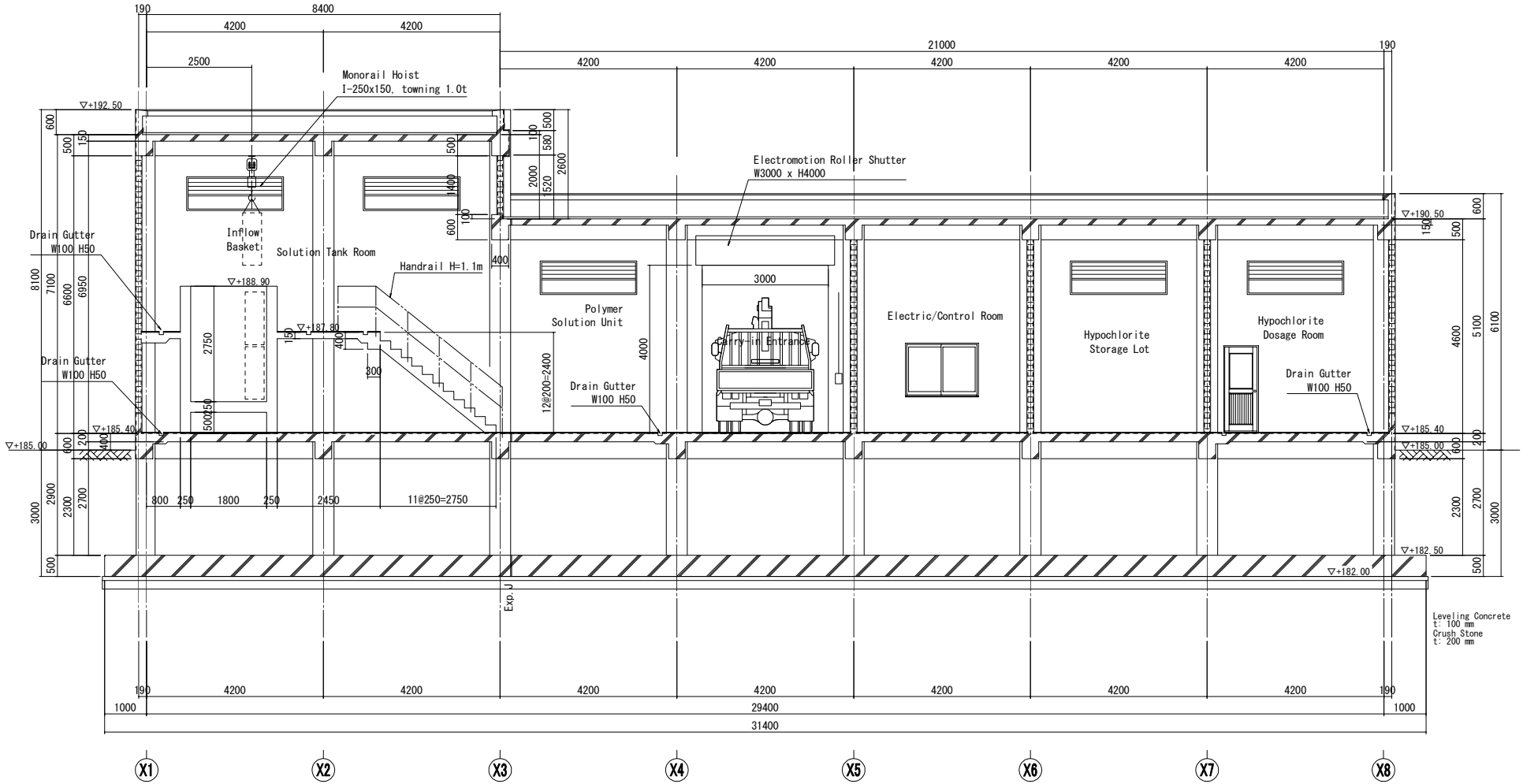


FRONT VIEW



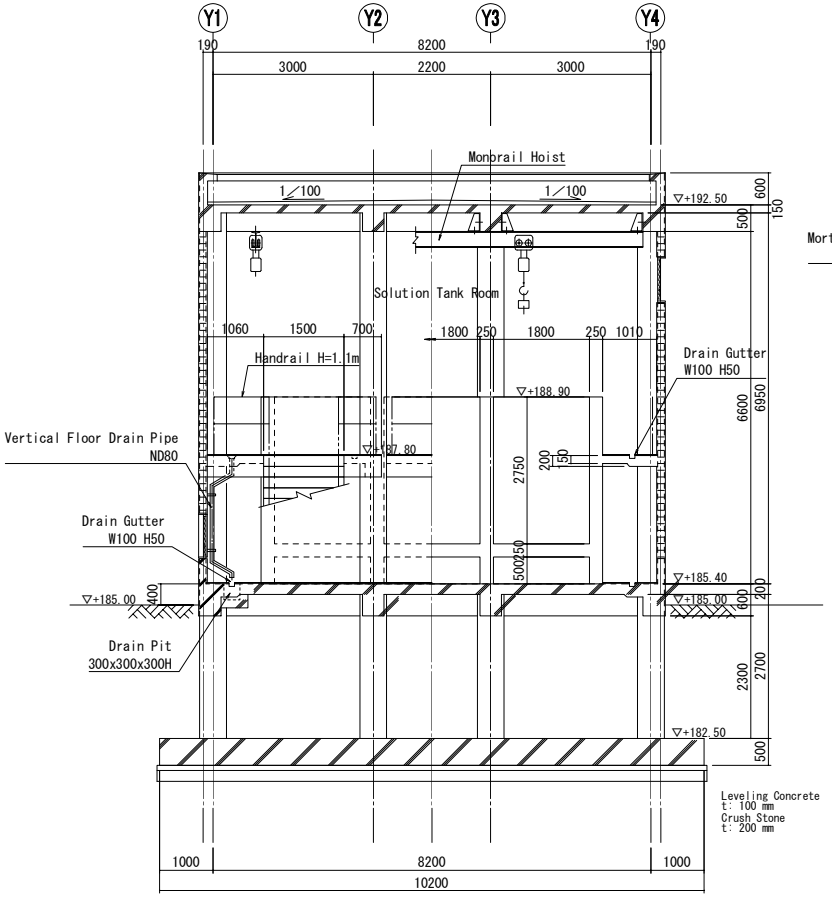
SIDE VIEW

	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: Chemical Building – Side View	SCALE: 1/100	DRAWING NO: WTP-A-11

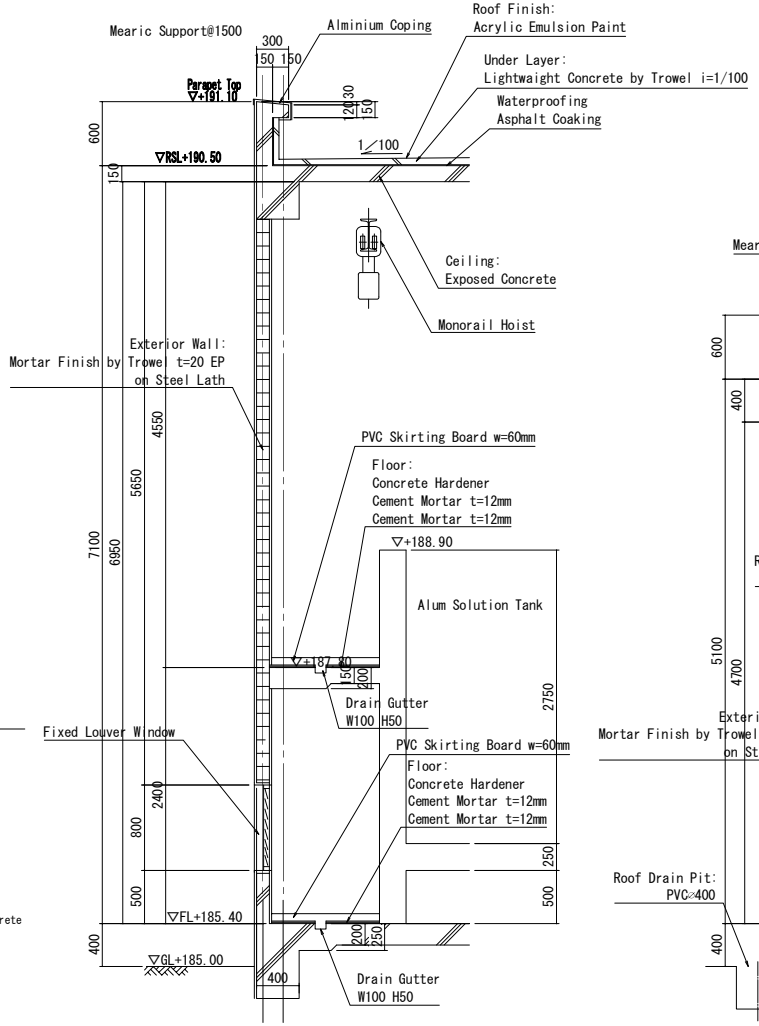


SECTION A-A

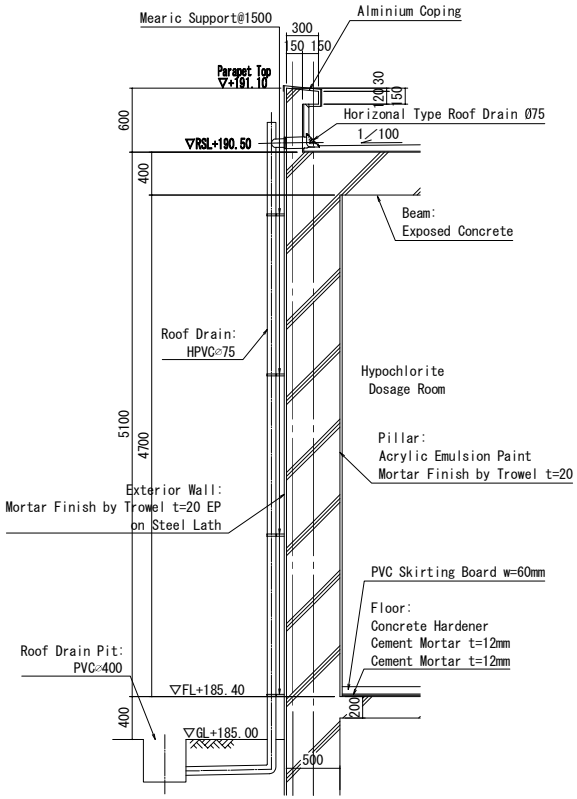
	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	Chemical Building – Section(1)	1/100	WTP-A-12



SECTION B-B



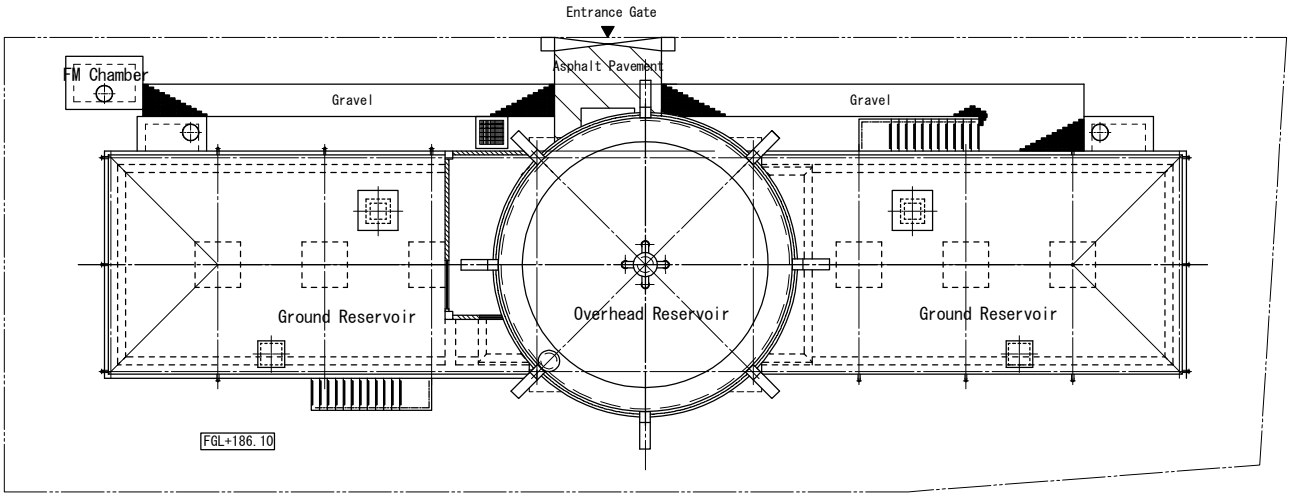
SECTIONAL DETAIL
(Solution Tank Room)



SECTIONAL DETAIL
(Roof Drain)

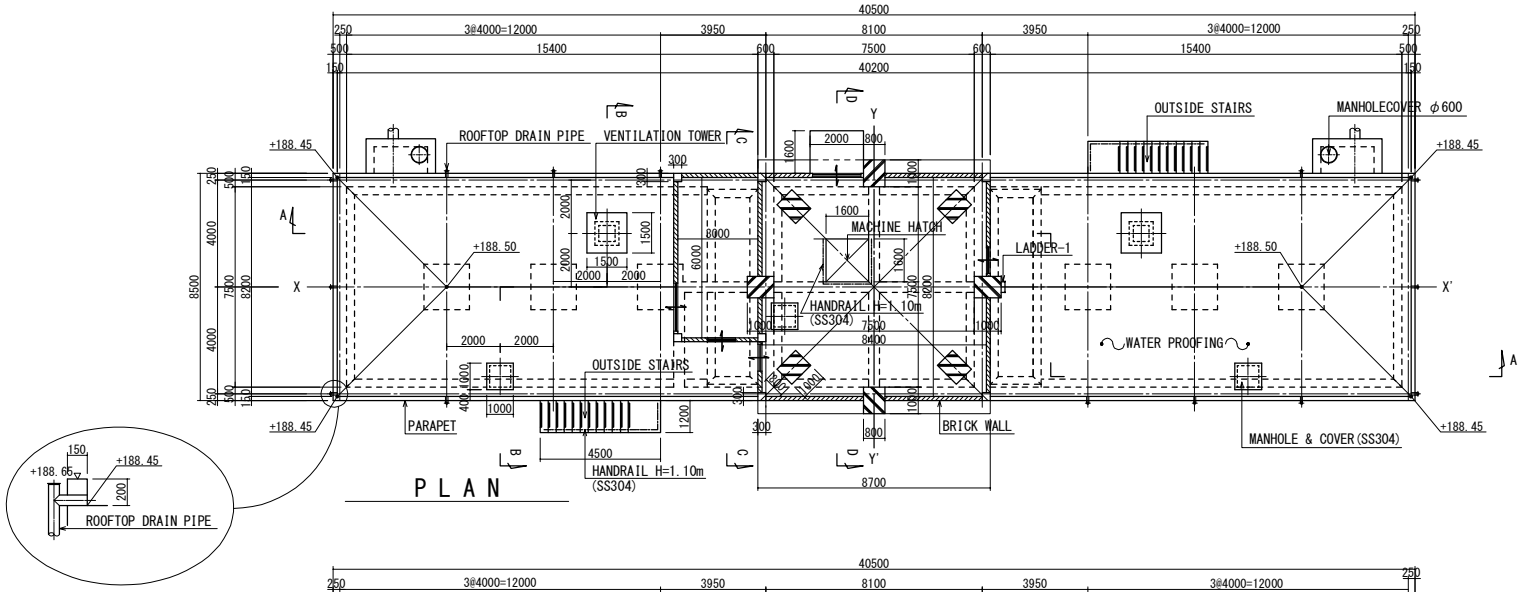
	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	Chemical Building - Section(2), Sectional Detail	1/100,1/50	WTP-A-13

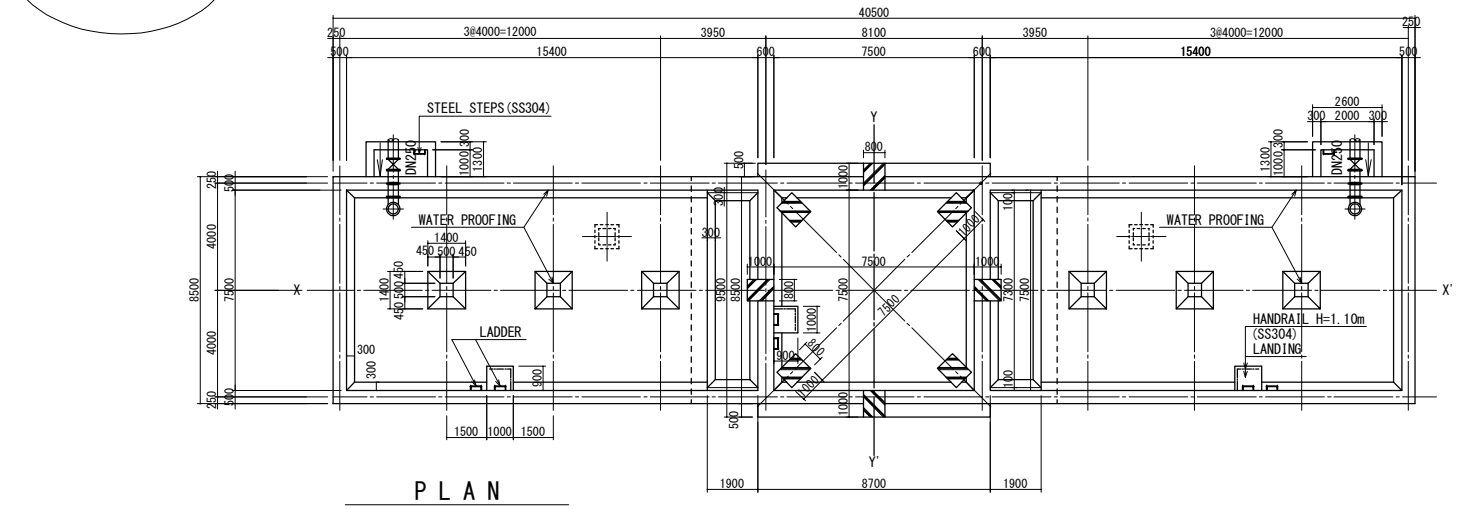
GENERAL LAYOUT



	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: GENERAL LAYOUT	SCALE: 1/200	DRAWING NO: DC#1-C-01

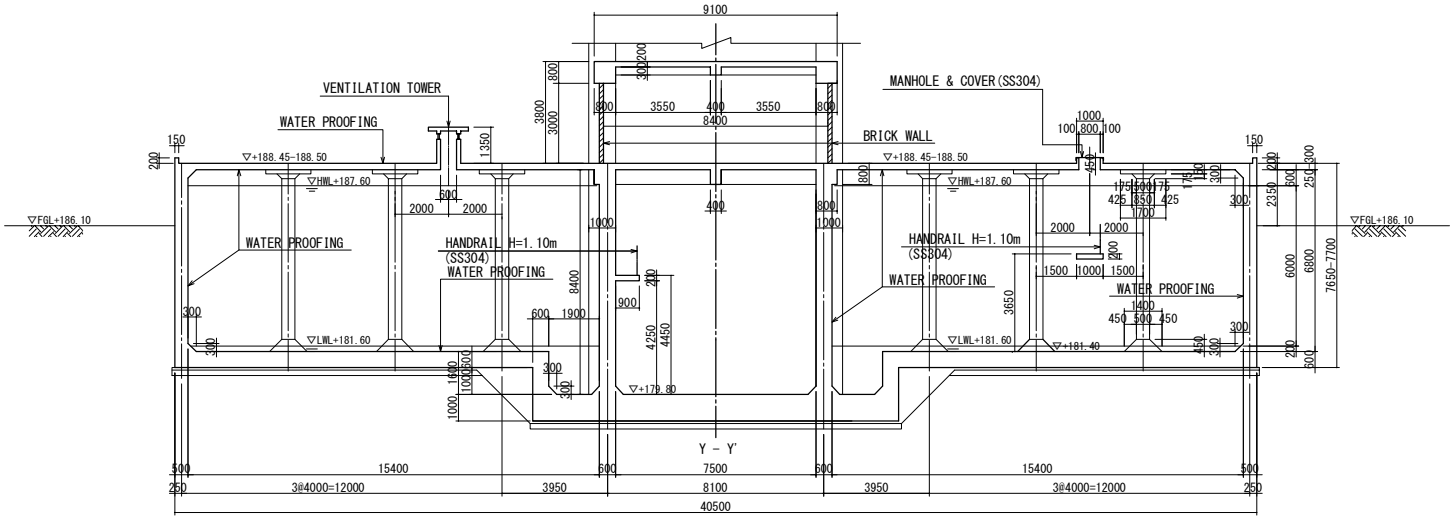
GROUND RESERVOIR (1)



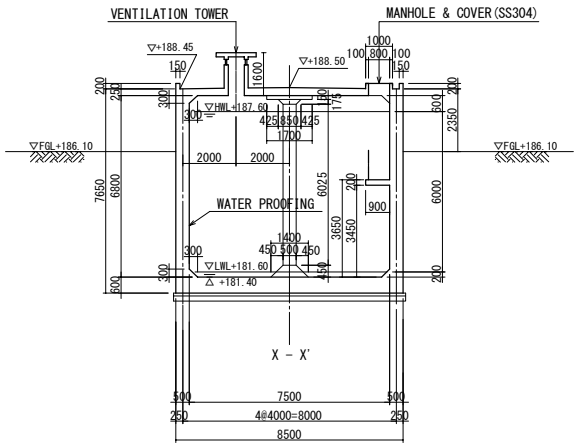


	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GROUND RESERVOIR (1)	1/200	DC#1-C-02

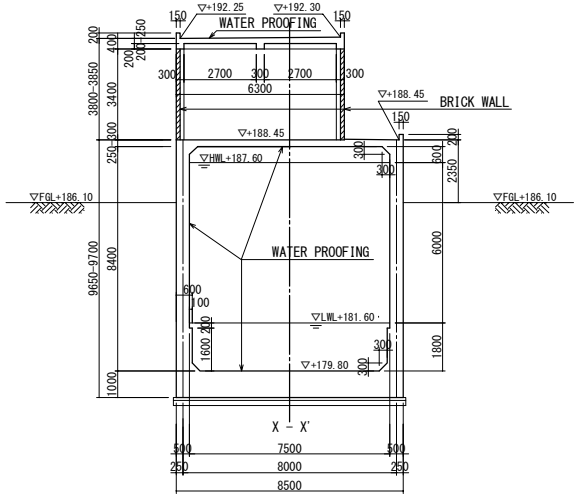
GROUND RESERVOIR (2)



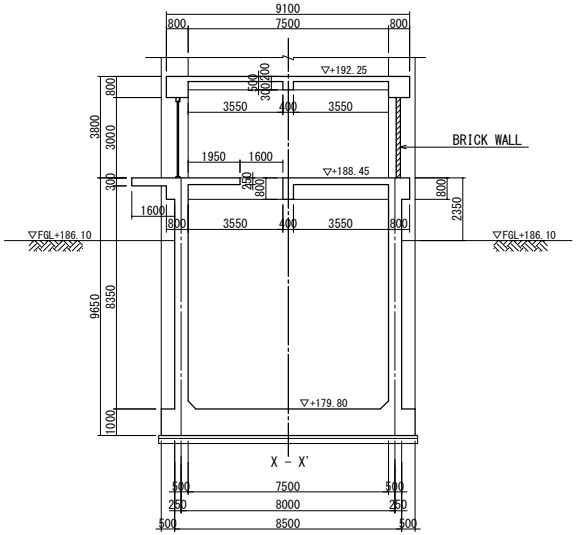
A - A SECTION



B - B SECTION



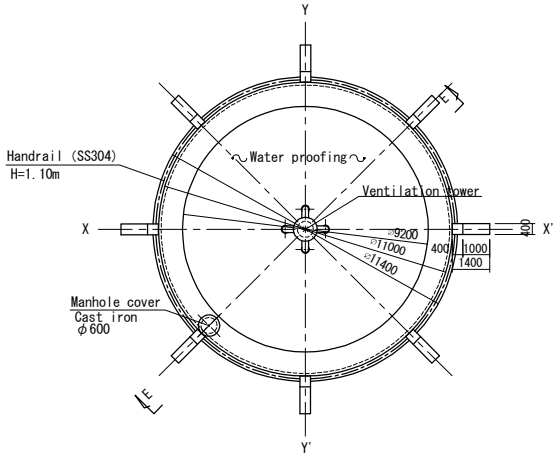
C - C SECTION



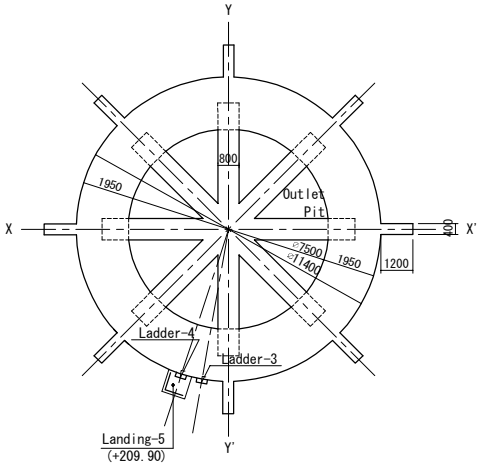
D - D SECTION

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GROUND RESERVOIR (2)	1/200	DC#1-C-03

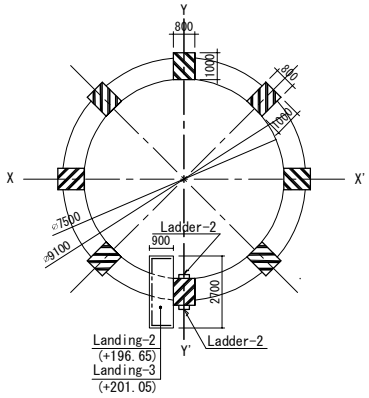
OVERHEAD RESERVOIR (1)



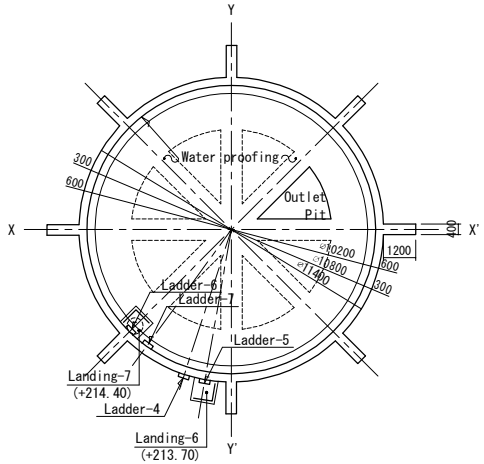
P L A N



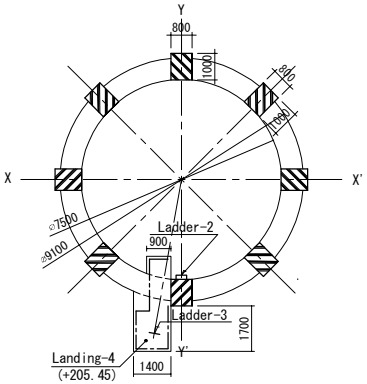
B - B SECTION



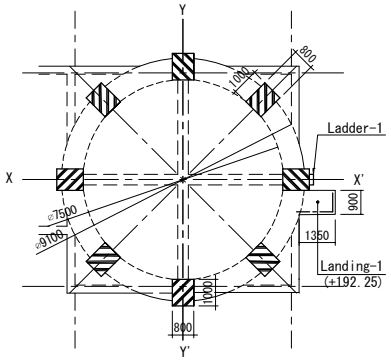
C - C SECTION
(C-2, C-3)



A - A SECTION



C - C SECTION
(C-1)



D - D SECTION

	PROJECT TITLE: THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	DRAWING TITLE: OVERHEAD RESERVOIR (1)	SCALE: 1/200	DRAWING NO: DC#1-C-05

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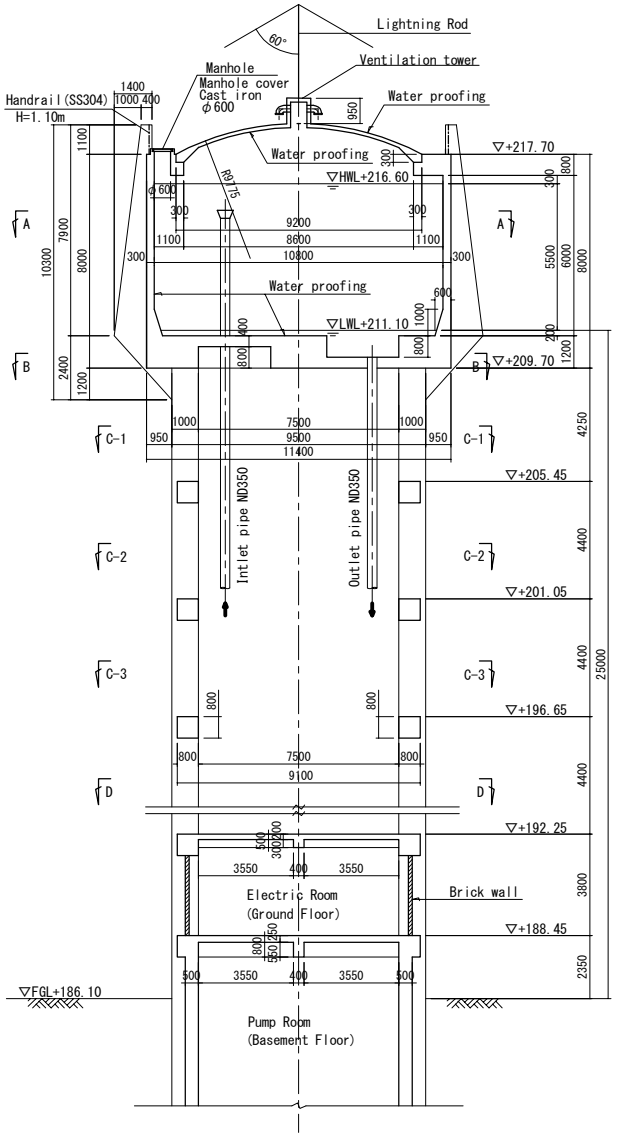
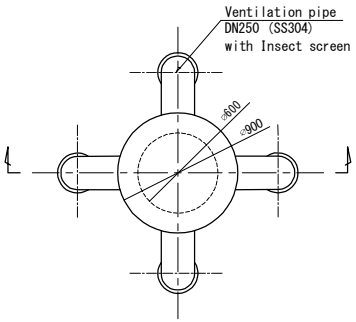
DC#1-04

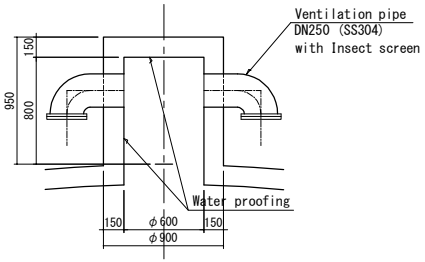
OVERHEAD RESERVOIR (2)



E - E SECTION
S=1/200



PLAN

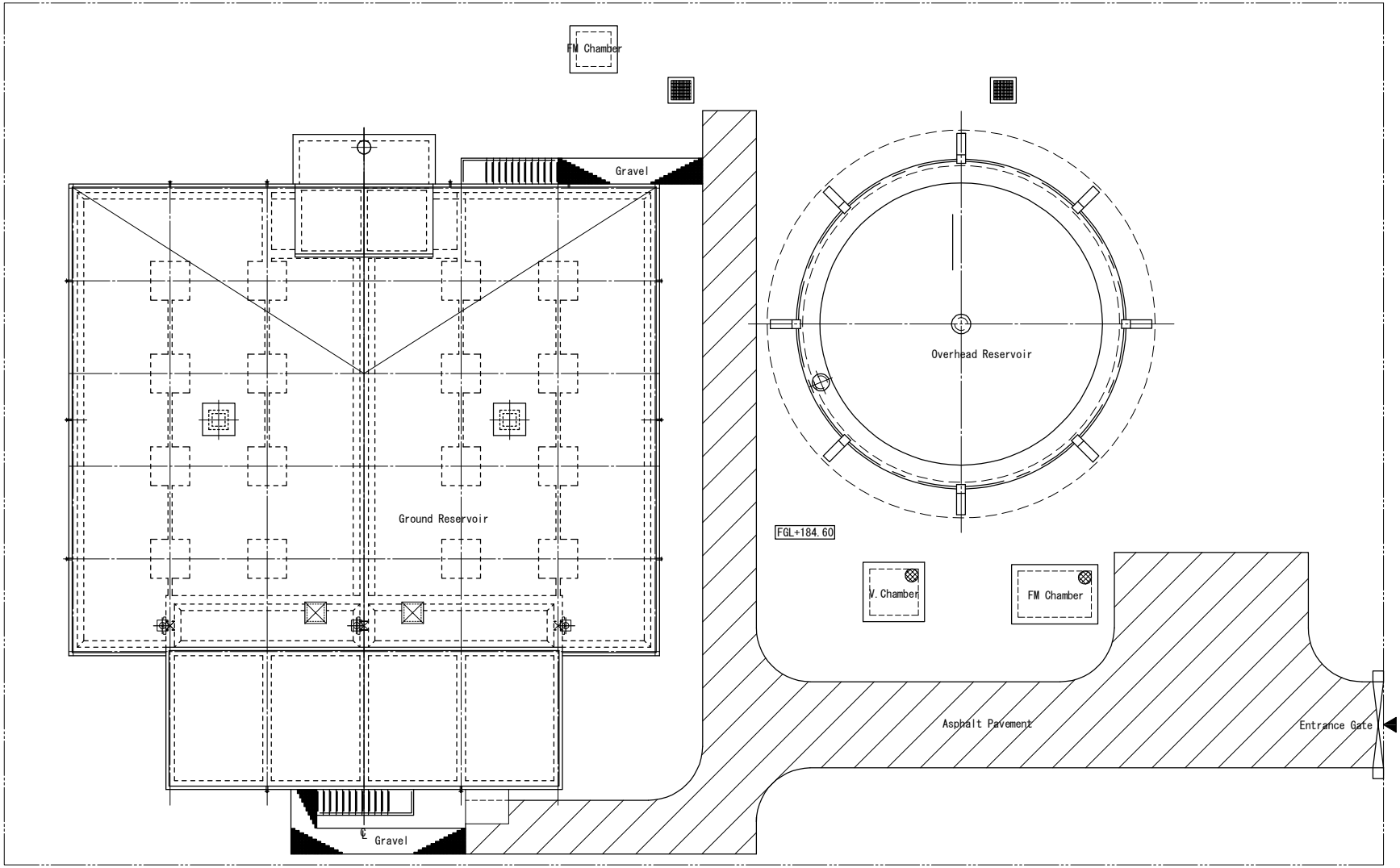


SECTION

Ventilation tower
S=1/50

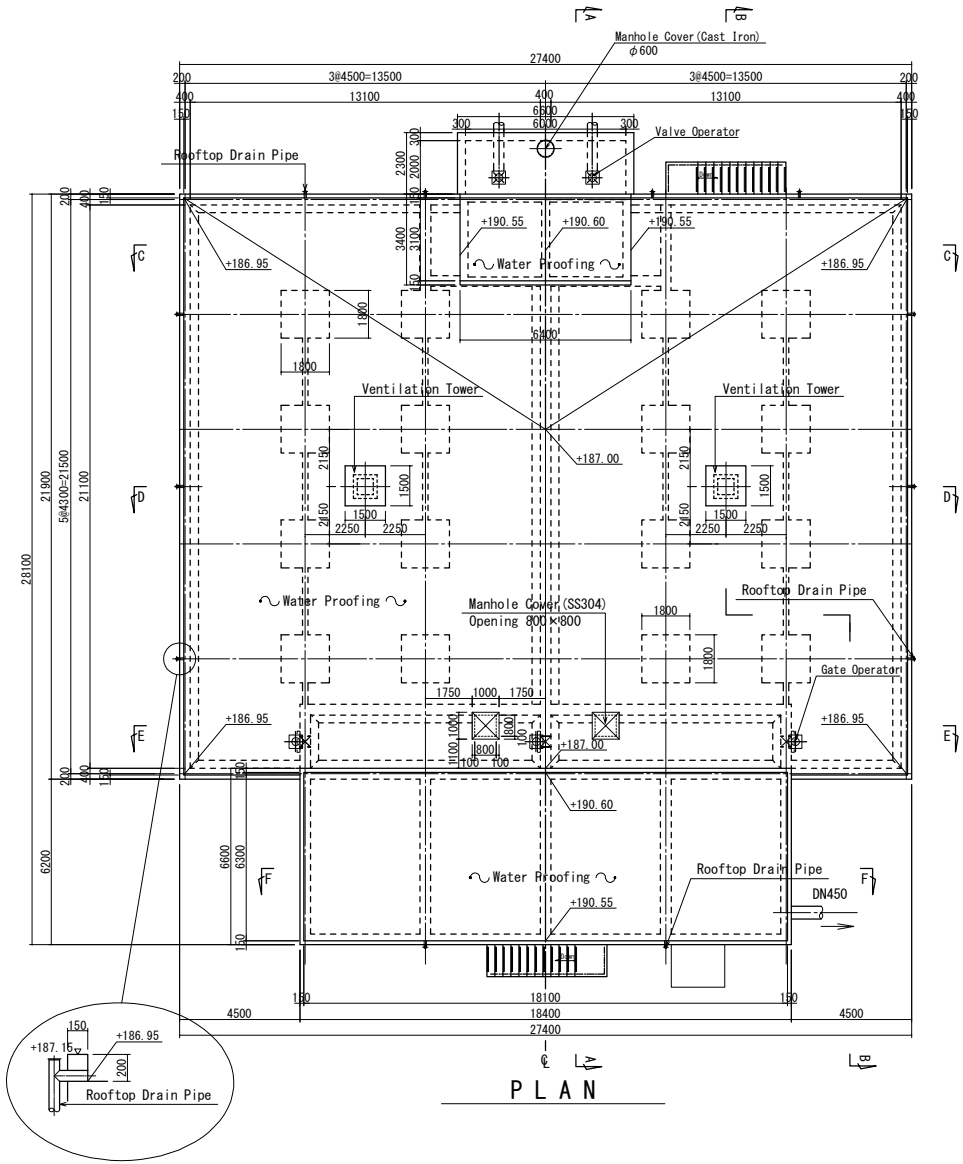
	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	OVERHEAD RESERVOIR (2)	1/200	DC#1-C-06

GENERAL LAYOUT

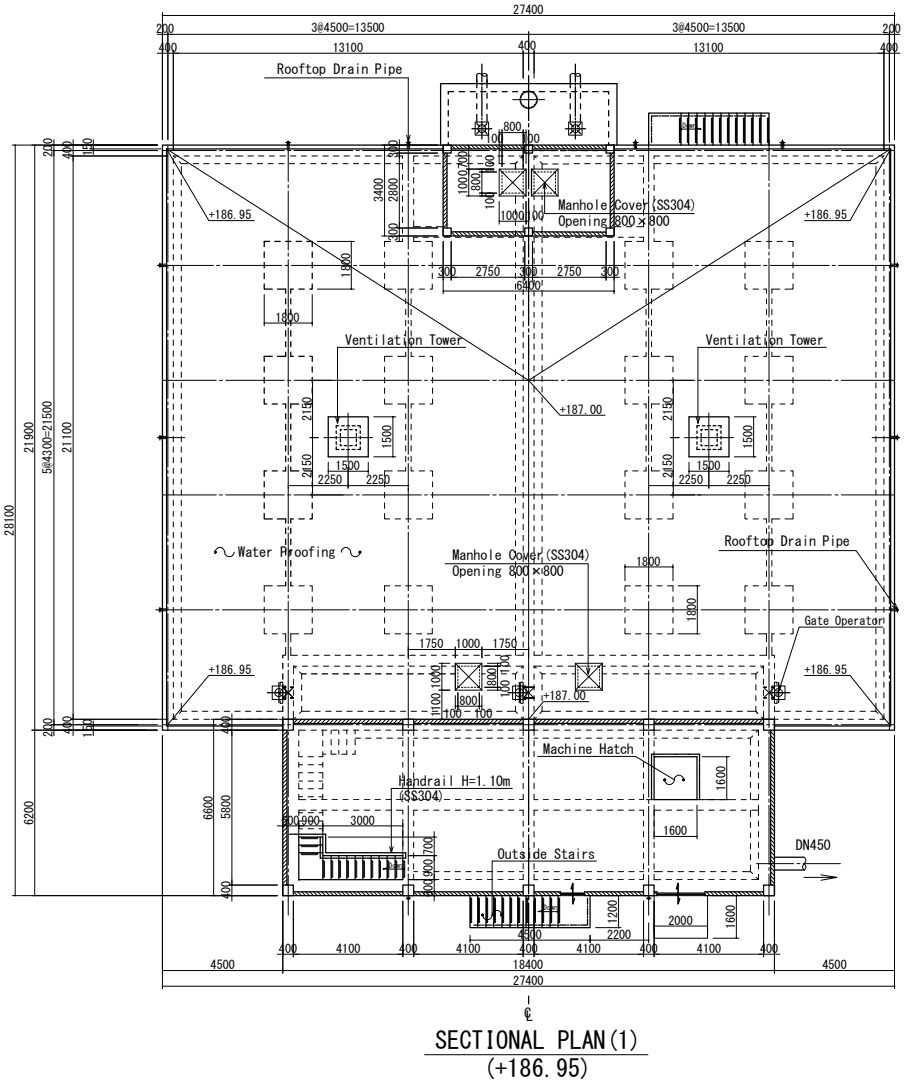


	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GENERAL LAYOUT	1/200	DC#2-C-01

GROUND RESERVOIR (1)



PLAN



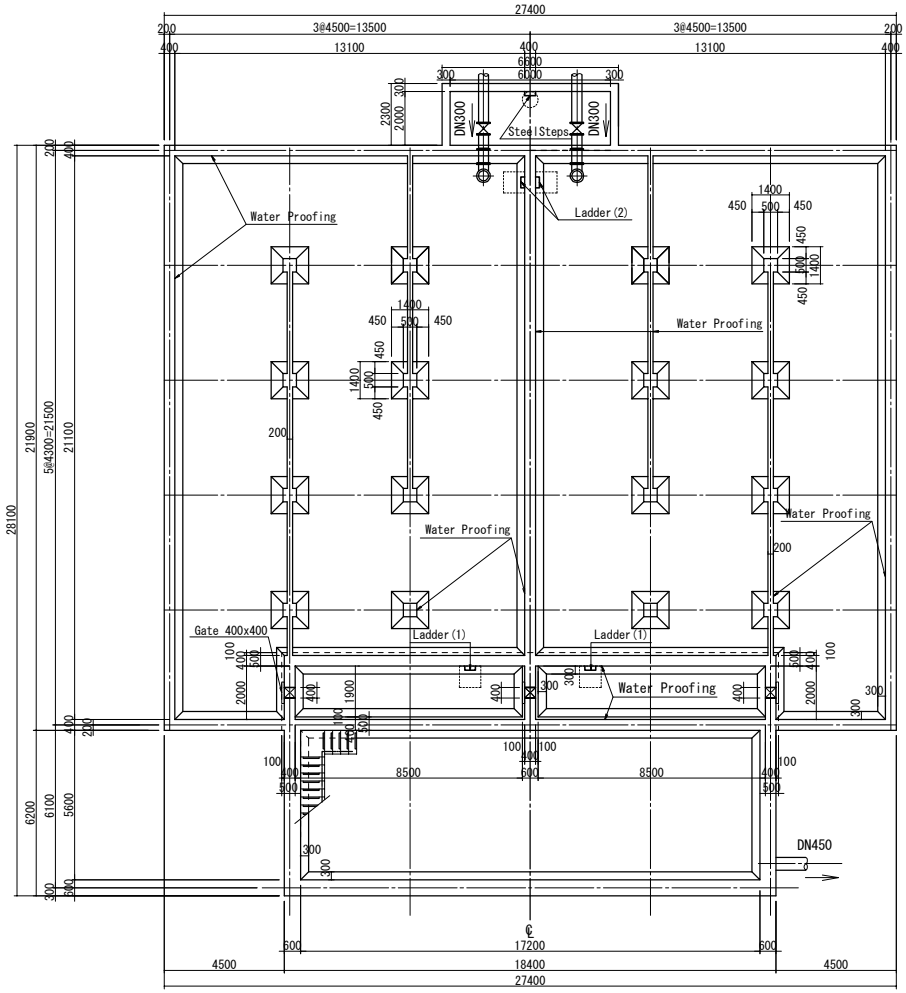
SECTIONAL PLAN (1)
(+186.95)

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GROUND RESERVOIR (1)	1/200	DC#2-C-02

App 7(5)-33

DC#2-02

GROUND RESERVOIR (2)



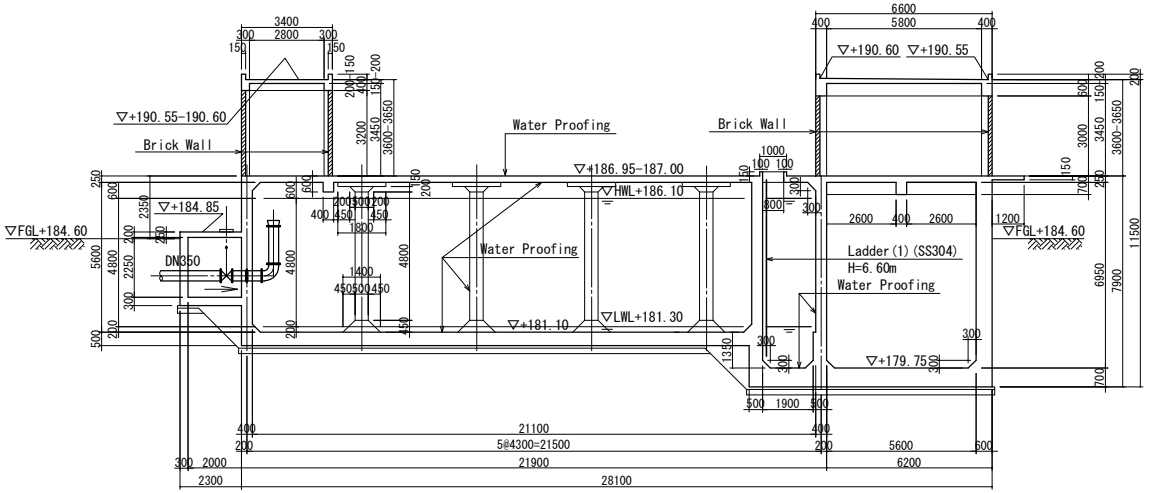
SECTIONAL PLAN (2)

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GROUND RESERVOIR (2)	1/200	DC#2-C-02

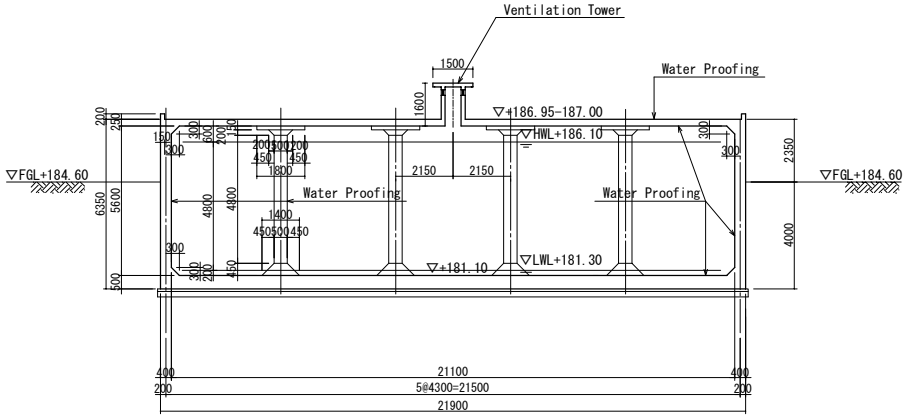
App 7(5)-34

DC#2-03

GROUND RESERVOIR (3)



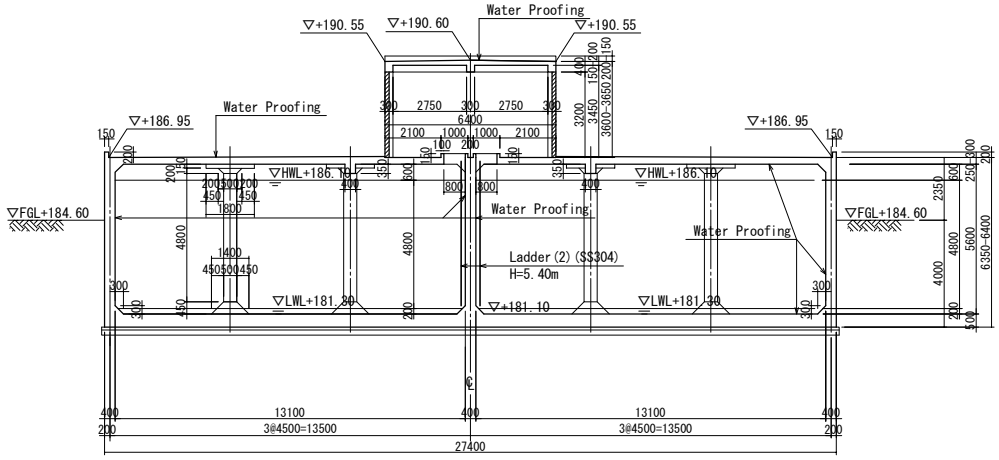
A - A SECTION



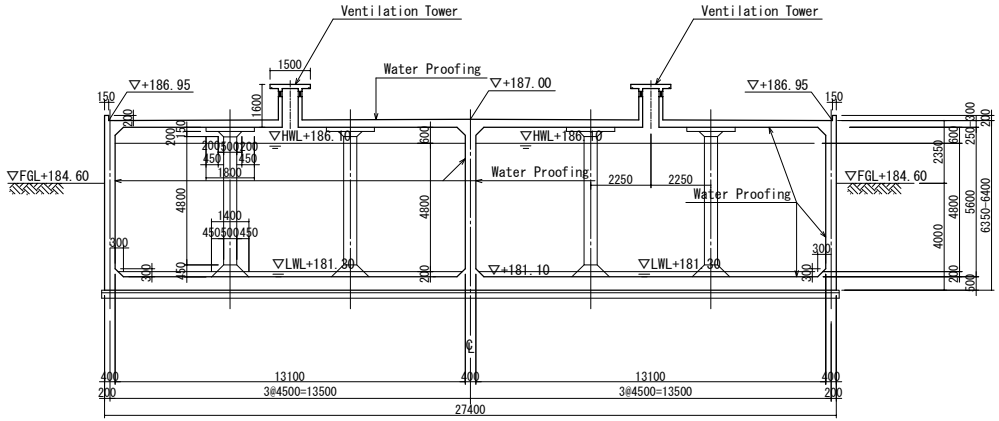
B - B SECTION

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GROUND RESERVOIR (3)	1/200	DC#2-C-04

GROUND RESERVOIR (4)



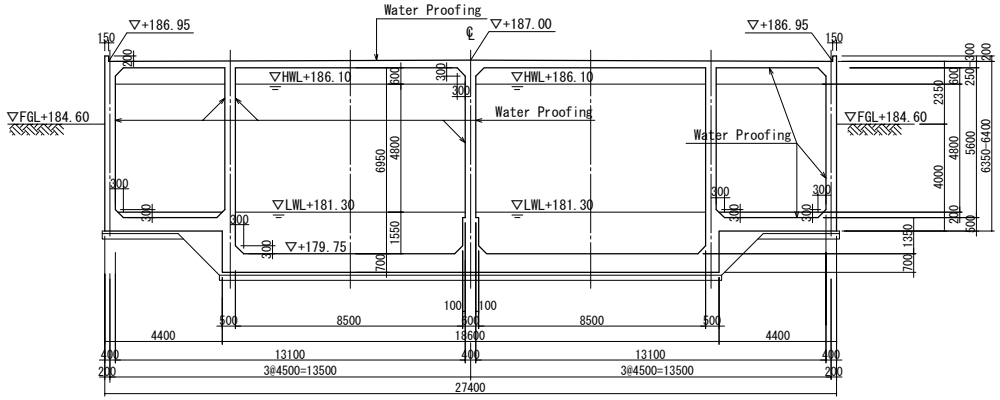
C - C SECTION



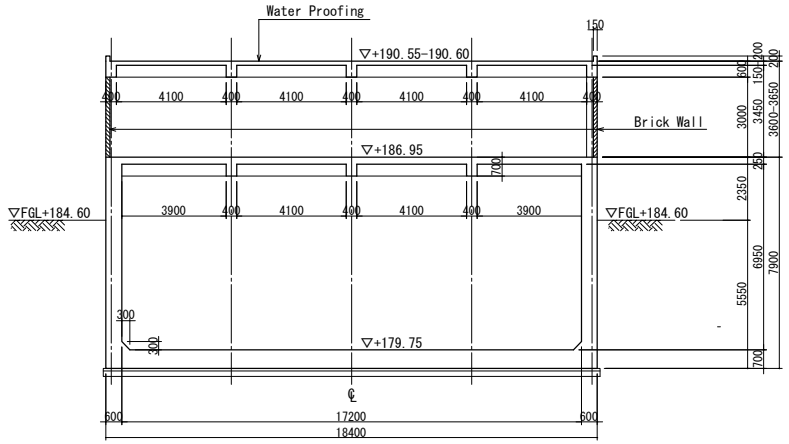
D - D SECTION

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GROUND RESERVOIR (4)	1/200	DC#2-C-05

GROUND RESERVOIR (5)



E - E SECTION



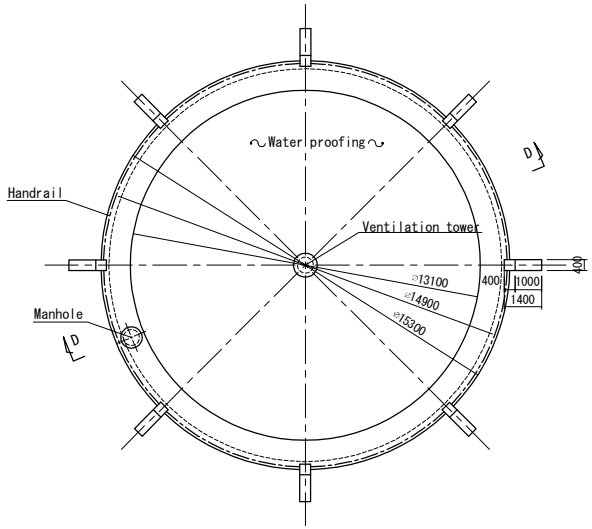
F - F SECTION

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	GROUND RESERVOIR (5)	1/200	DC#2-C-06

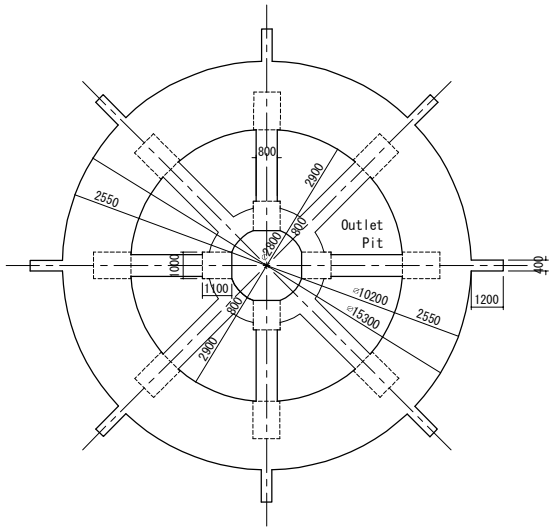
App 7(5)-37

DC#2-06

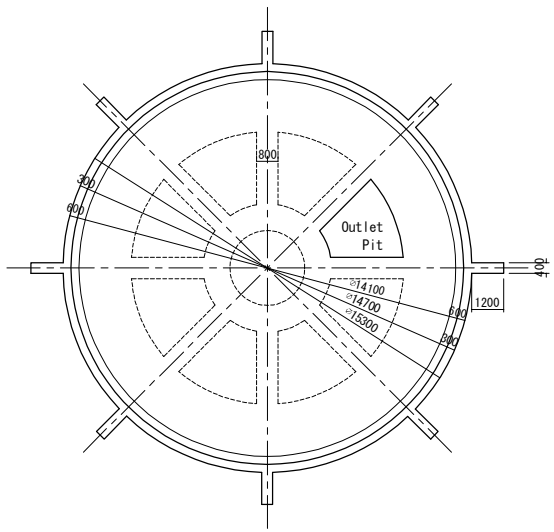
OVERHEAD RESERVOIR (1)



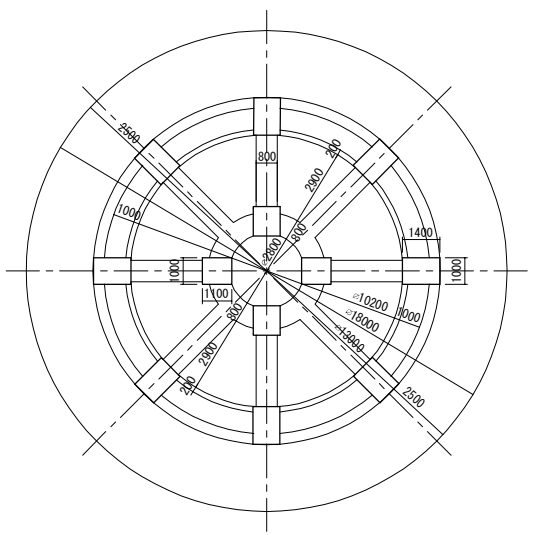
P L A N



B - B SECTION



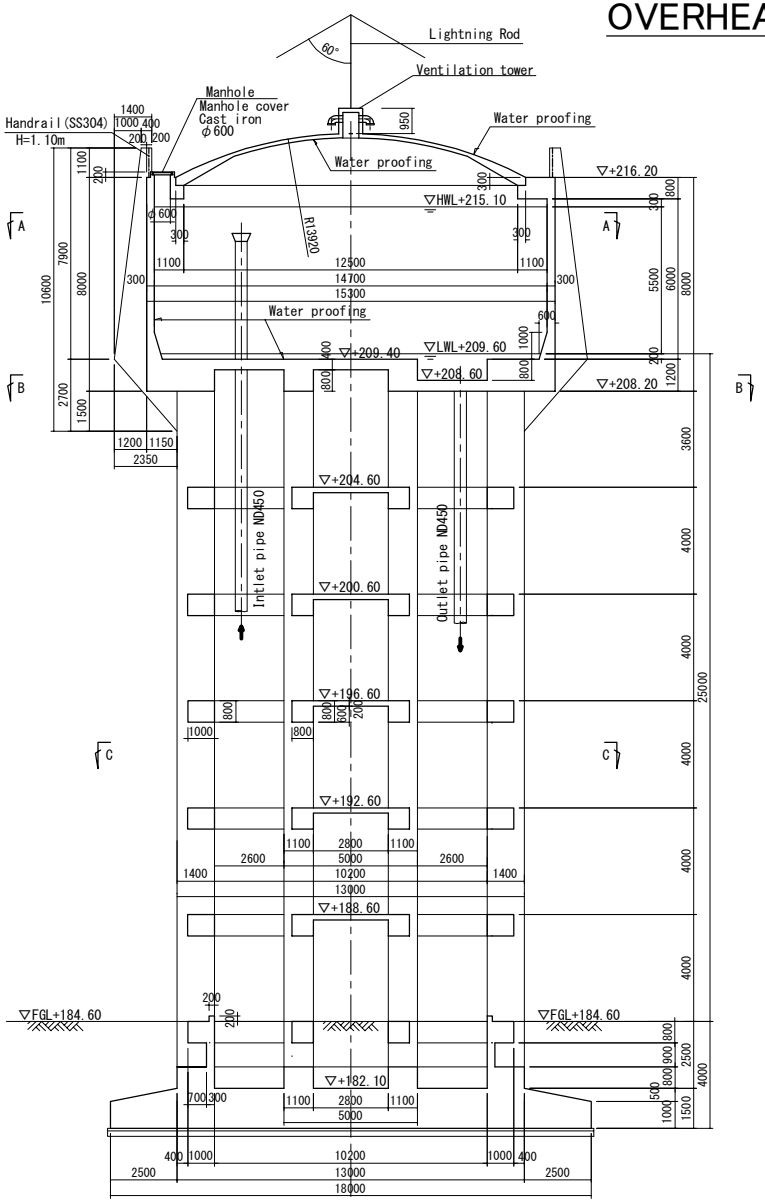
A - A SECTION



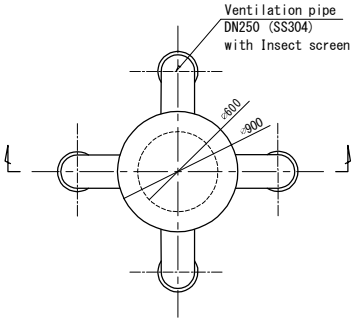
C - C SECTION

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	OVERHEAD RESERVOIR (1)	1/200	DC#2-C-09

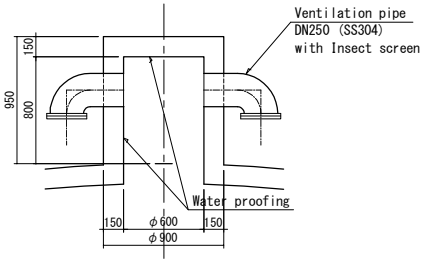
OVERHEAD RESERVOIR (2)



D - D SECTION
S=1/200



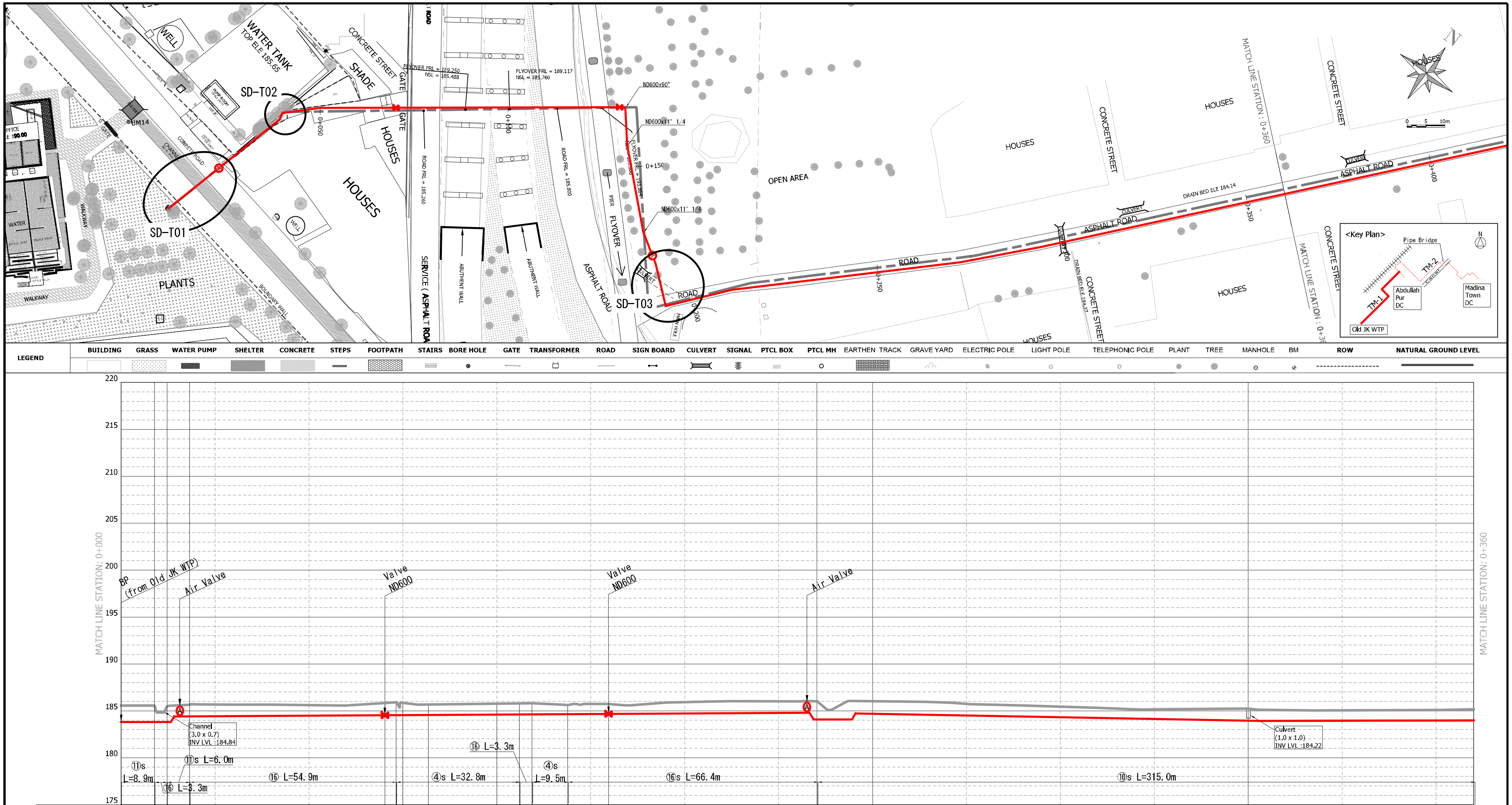
PLAN



SECTION

Ventilation tower
S=1/50

	PROJECT TITLE:	DRAWING TITLE:	SCALE:	DRAWING NO:
	THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD	OVERHEAD RESERVOIR (2)	1/200	DC#2-C-10



Water Level	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00	000.00
Ground Elevations	185.55	185.66	185.66	185.66	185.91	185.67	185.76	185.61	185.73	185.93	186.02	185.99	186.01	185.74	185.43	185.15	185.23	185.05	185.07	185.16
Pipe Center Level	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000	000.000
Pipeline (Diameter)	TM-1 DIP ND600 L=985m																			
Cumulative Distance	0	12	25	50	73	75	100	119	125	150	175	185	200	225	250	275	300	325	350	360
Chainage	0+000	+12	+25	+50	+73	+75	0+100	+119	+25	+50	+75	+85	0+200	+25	+50	+75	0+300	+25	+50	0+360

PROJECT TITLE:
THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF WATER TREATMENT PLANT AND WATER DISTRIBUTION SYSTEM IN FAISALABAD

DRAWING TITLE:
PLAN AND PROFILE OF TRANSMISSION MAIN (1)

SCALE: 1/1000,1/400

DRAWING NO: TM-001

TM-01