Appendix-9　Examination on Water Distribution Pipe Network

EXAMINATION ON WATER DISTRIBUTION PIPE NETWORK

1. Purpose

While implementation of this Project is expected to ensure sufficient water supply relative to demand in the target districts, it is likely that some areas will not receive enough water even after the completion of this Project unless the existing water distribution network is rehabilitated. While insufficient water supply is the main cause of the current water shortage, its impact varies depending on the location. The further the location from the water distribution point, the wider the area of frequent water outage spreads from the central dense residential district and the western outskirts to the northern residential district. The impact is especially severe during the peak months of water demand in April and May, during which total water outage occurs, forcing the residents to survive by buying water from private water carriers (donkey water vendors). This has become a major social problem (Figure-A).

The top priority objective of this Project is to relieve these areas from water outage. Thus, we decided to determine whether or not the Project would take its intended effect without rehabilitating the existing water distribution network by building a piping model based on the GIS database of the existing distribution pipes to perform piping calculation.

2. Parameter of Calculation

① Build a piping model by connecting the existing water distribution facilities (water pipe network, Mahata WTP, and northern well group) to the new South WTP and the distribution main.

② Set the water supply volume (maximum volume per day) at 6,828m^3/day for the northern well group, 11,050m^3/day for Mahata WTP, and 15,400m^3/day for the new South WTP.

③ For the study case, use the maximum flow per hour (of the peak months of April and May). For Mahata WTP and the new South WTP, multiply the peak flow by the time factor of 1.5 to enter the maximum water flow per hour of these facilities.

④ Give water use volume to each node of the calculation model, and enter the flow rate load on each node (obtained by multiplying the water service population in 2016 by the maximum water use per capita per day derived from the average water use per capita per day (90liters/c/d) and adding the leakage rate of 28%).

⑤ The result of calculation is judged by whether or not each node has an effective water pressure of 15m or greater. If it does, water outage is deemed to be resolved.

3. Result of Calculation

1) No additional pipes scenario (Figure-B)

The nodes in the central dense residential district and the western outskirts attained effective water pressure of 15m or greater, indicating that this scenario would greatly improve the water supply conditions and eliminate water outage in these areas. However, effective water pressure on the nodes in some parts of the western outskirts and those in the northern residential district was less than 15m or negative (zero flow), which means that the water supply conditions in these locations would not improve.

2) Additional pipes scenario (Figure-C)

We added water distribution pipes one at a time until the effective pressure on all nodes reached the required level. As a result, all nodes in the entire target area of this Project attained effective water pressure of 15m or greater, indicating that this scenario would eliminate the water outage problem from the target area.

4. Conclusion

The water outage area cannot be completely eliminated without the additional water distribution pipes. Therefore, addition of water pipes is deemed necessary for this Project to take its intended effect.

Attached Documents: Calculation sheets of water distribution pipe network

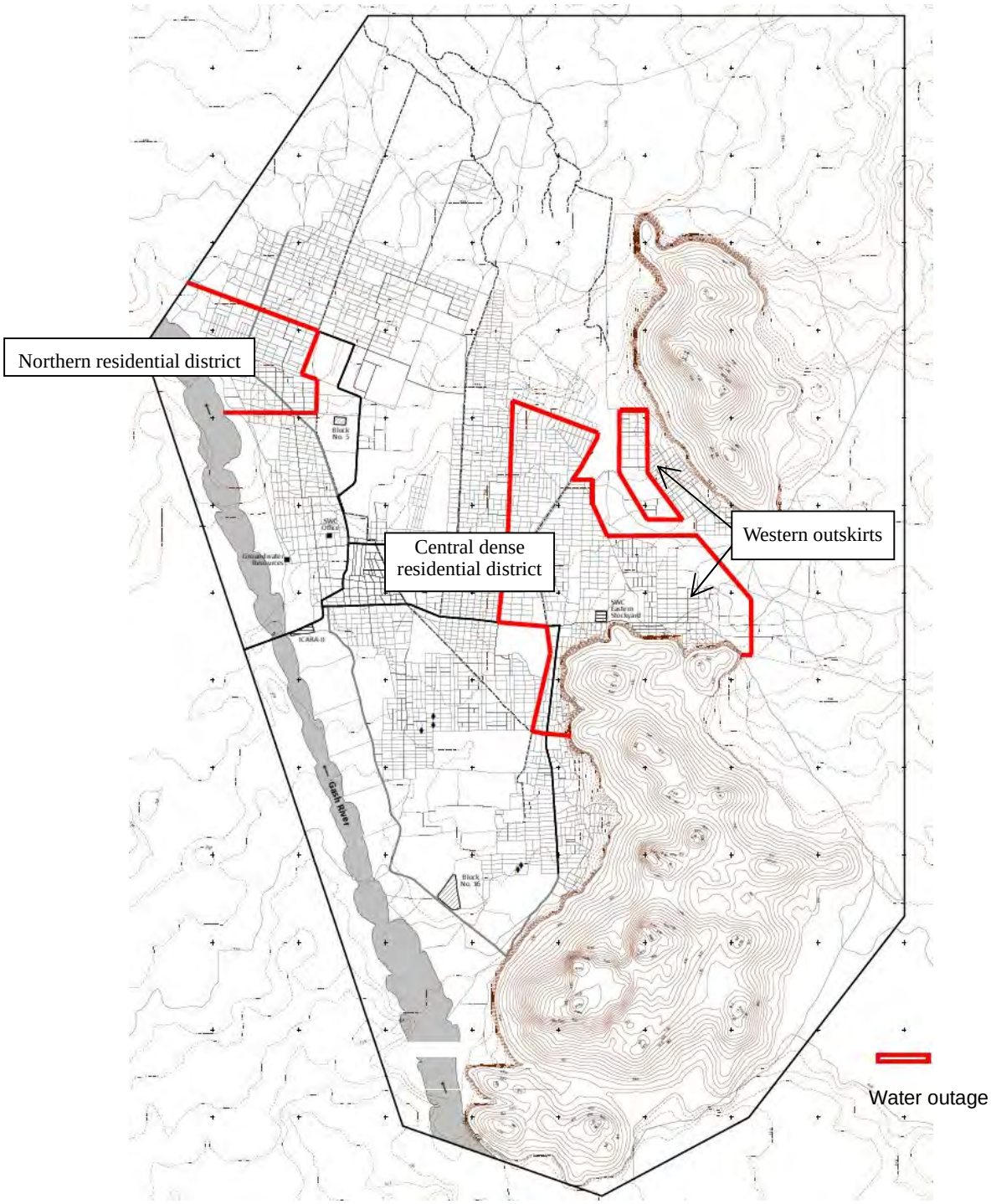


Figure-A: Present Conditions of Water Distribution (water outage area)

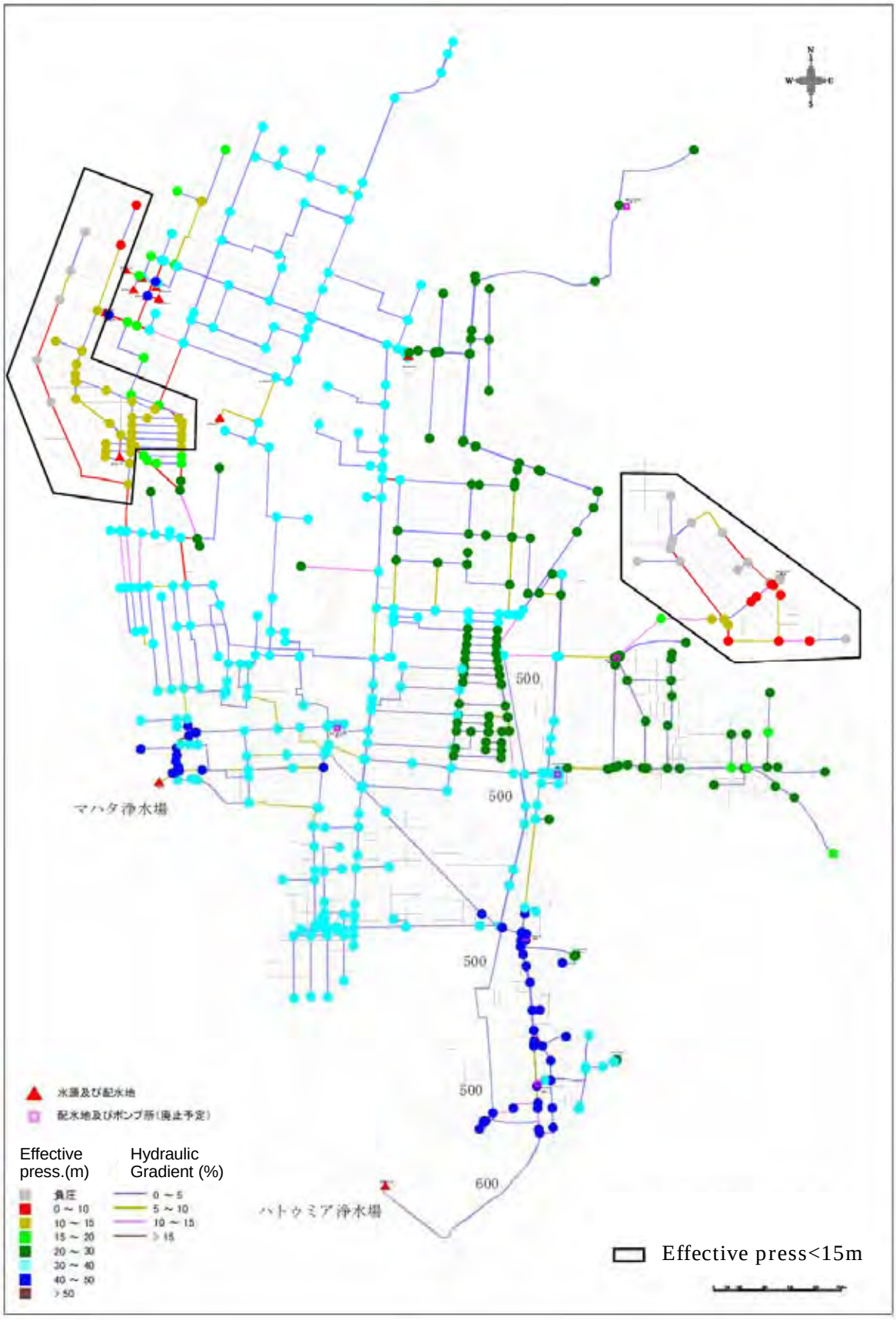


Figure-B: No Additional Pipes Scenario

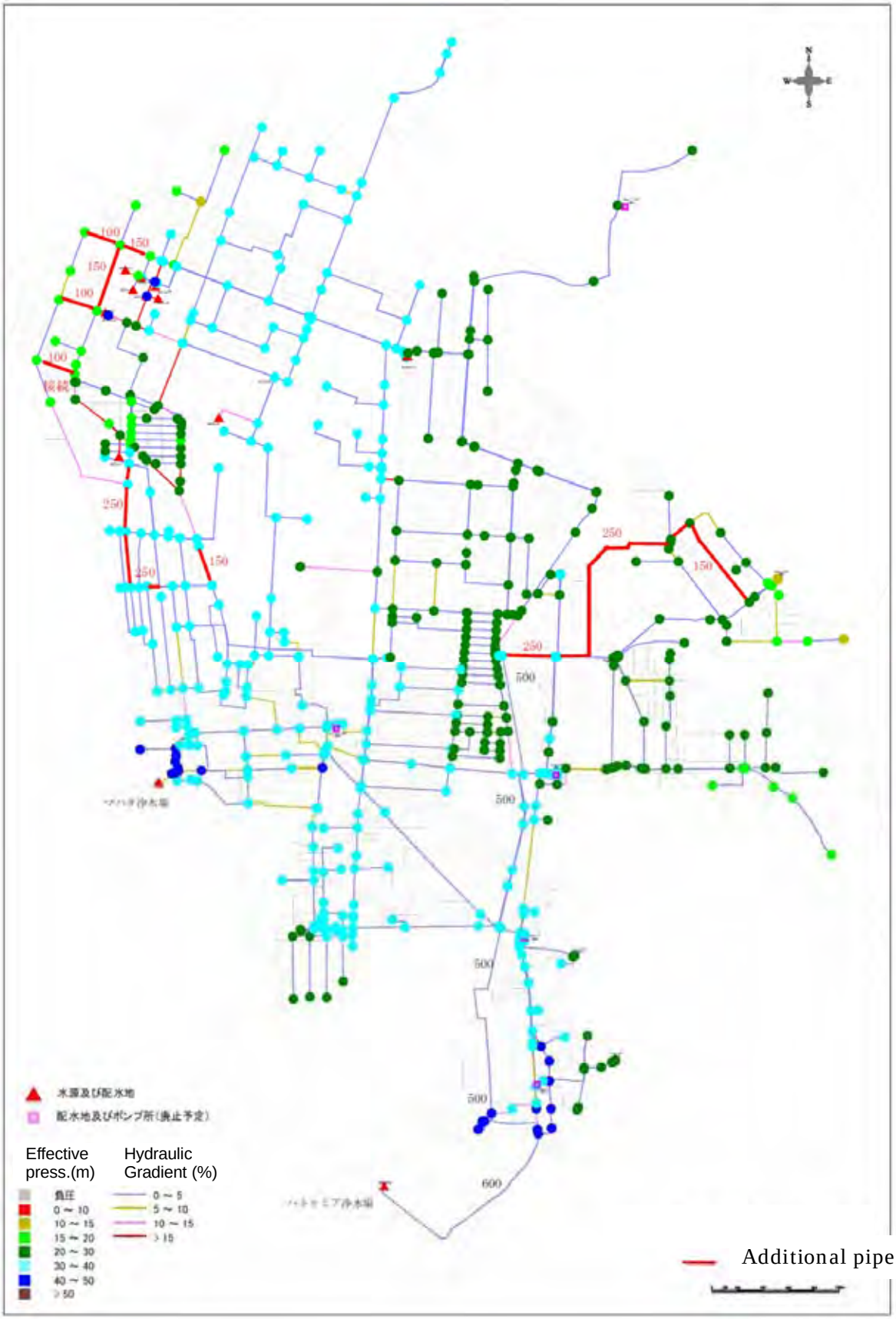


Figure-C: Additional Pipes Scenario

Attached Documents: Calculation of Water Distribution Pipe Network

1. Setting the Calculation Parameter

Piping calculation is performed based on the following parameter values:

- Planned maximum water supply volume per day: 34,124m^3/day
- Time factor: 1.5

(1) Water Distribution Conditions

Conditions of water distribution, which are set based on the following formula, are listed in the table below.

DWL(m) at each initial point = LWL(m) + Pump discharge pressure (m)

Table-1: Initial DWLs of Northern Wells

Well No.	GL *1	Depth (m)	LWL *2 (m)	Head (m)	Initial DWL (m)	Measurement (m^3/hour)	Capacity (m^3) *3
19	492	27	468	57	525	18	648
20	491	31	463	41	504	21	756
34	490	33	460	72	532	36	1296
35	490	33	460	72	532	23	828
36	490	27	466	41	507	2	72
37	491	33	461	72	533	35	1260
38	491	30	464	72	536	33	1188

*1: Obtained from contour lines.
*2: Depth + 3 m
*3: Measurement x 24 hours x 1.5 (time factor)

Table-2: Initial DWL of Each Water Treatment Plant

WTP	LWL (m)	Head (m)	Initial DWL (m)	Zone
Waw Nour (1)	488.8	28.0	516.8	North
Waw Nour (2)	488.8	28.0	516.8	North
Mahata WTP	494.7	50.0	544.7	Central
Khatmia WTP	497.9	55.0	552.9	South

Pump stations and reservoirs other than the above are considered disused.

(2) Nodes

1) Ground Levels

Elevation of each node was obtained from the contour lines generated by the Geographic Information System (GIS). (2)**節点**

2) Flow Rate of Each Node

It is calculated using the following formula:

Max. demand per hour at each node = Max. demand per hour of the zone ÷ No. of nodes

Note: Demands of the water treatment plants (including pump stations) that are presently operating or scheduled to be shut down, as well as the demands of the northern wells, are set at 0.

Table-3: Maximum Demand per Hour by Zone (Leakage and losses: 28%)

Parameters	LPCD		m^3/day	Percentage
Total demand	90		18,427	100%
Domestic demand	75		15,355	83%
Non-domestic @20% of to	15		3,072	17%
Non-domestic to three areas				20%
Leakage and losses				28%
Daily maximum (1/0.75)				133%

時間係数	1.5

Ah_ID	Ah_Name	Area (m^2)	Pop 2010	Pop 2016	Water demand (L/day)			Leakage and loss	Total (m^3/day)	Daily max demand (m^3/day)	North Zone	Central Zone	South Zone	アイテムID	時間最大	エリア統合(節点なし)
					DOM	Non-DOM	Sub-total									
1	Alnourab B 31	130,068	2326	2,702	202,650	32,424	235,074	91,418	326	435	North			34	653	34
2	Alefraj	658,986	3880	4,507	338,025	54,084	392,109	152,487	545	726	North			6	1,089	6
3	Waw Nour	498,831	4786	5,560	417,000	66,720	483,720	188,113	672	896	North			7	1,344	7
4	Engaz N 6,9,10,11&12	3,436,481	10536	12,240	918,000	146,880	1,064,880	414,120	1,479	1,972	North			5	2,958	5
5	Altadamon B 5 & 8	727,364	6568	7,630	572,250	91,560	663,810	258,148	922	1,229	North			9	1,844	9
6	Dar Alsalam B 16	263,853	1895	2,202	165,150	26,424	191,574	74,501	266	355	North			8	532	8
7	Gandehar	23,484	304	353	26,475	4,236	30,711	11,943	43	57	North			3	85	10
8	Alwehda	392,351	3798	4,412	330,900	52,944	383,844	149,273	533	711	North			10	1,066	10
9	Beryeyia	434,119	5849	6,795	509,625	81,540	591,165	229,898	821	1,095		Central		11	1,642	11
10	Alhalanga North	462,934	6416	7,454	559,050	89,448	648,498	252,194	901	1,201		Central		13	1,801	13
11	Albarnou & Albargou	410,958	4996	5,804	435,300	69,648	504,948	196,369	701	935		Central		12	1,403	12
12	Alrashedein	316,846	1402	1,629	122,175	19,548	141,723	55,115	197	262			South	4	394	50
13+36	Alshaheid Kaila N +	271,996	1297	1,507	113,025	18,084	131,109	50,987	182	243		Central		15	364	15
14	Alhalanga South	414,070	4201	4,881	366,075	58,572	424,647	165,141	590	786		Central		14	1,180	14
15	Almorabat B25&Alrrei	212,900	2922	3,394	254,550	40,728	295,278	114,830	410	547	North			33	820	33
16	Alnourab B 30	276,786	1625	1,887	141,525	22,644	164,169	63,844	228	304	North			36	456	36
17	Almorabat B 17	249,393	2805	3,258	244,350	39,096	283,446	110,229	394	525		Central		32	787	32
18	Almorabat B 18	274,211	2887	3,353	251,475	40,236	291,711	113,443	405	540		Central		31	810	31
19	Alkhatmeia Algadeda	430,766	4201	4,881	366,075	58,572	424,647	165,141	590	786		Central		35	1,180	35
20	Alshabeia B 23	165,964	1741	2,023	151,725	24,276	176,001	68,445	244	326			South	42	489	42
21	Alshabeia B 21	422,488	3570	4,148	311,100	49,776	360,876	140,341	501	668		Central		41	1,002	41
22	Mukram Alderwa	861,272	5803	6,741	505,575	80,892	586,467	228,071	815	1,086			South	50	1,629	50
23	Mukram Algadema	71,318	783	910	68,250	10,920	79,170	30,788	110	147			South	52	220	52
24	Mukram B 2A	233,217	1432	1,663	124,725	19,956	144,681	56,265	201	268			South	51	402	51
25	Mukram Faresey	171,228	1461	1,697	127,275	20,364	147,639	57,415	205	273			South	48	410	48
26	Mukram Almdares	227,945	1286	1,493	111,975	17,916	129,891	50,513	180	241			South	49	361	49
27	Engaz Sharg B 38	200,706	1584	1,840	138,000	22,080	160,080	62,253	222	296			South	44	445	43
28	Kadogley	248,713	1870	2,172	162,900	26,064	188,964	73,486	262	350			South	43	525	43
29	Althoura	467,316	2647	3,075	230,625	36,900	267,525	104,038	372	495		Central		29	743	29
30	Alshabeia B 22	383,824	2717	3,157	236,775	37,884	274,659	106,812	381	509			South	40	763	40
31	Altora South	270,912	3173	3,686	276,450	44,232	320,682	124,710	445	594		Central		26	891	26
32	Almorabat B 16	208,698	2787	3,238	242,850	38,856	281,706	109,552	391	522		Central		30	783	30
33	Altora North	209,277	2267	2,634	197,550	31,608	229,158	89,117	318	424		Central		28	637	28
34	Alshahed Hran A	367,962	2343	2,722	204,150	32,664	236,814	92,094	329	439		Central		53	658	53
35	Alshahed Hran B	248,278	1508	1,751	131,325	21,012	152,337	59,242	212	282		Central		55	423	55
37	Almerganeia N	672,788	1659	1,928	144,600	23,136	167,736	65,231	233	311		Central		20	466	20
38	Aljasor	182,654	467	543	40,725	6,516	47,241	18,372	66	87		Central		19	131	19
39	Alshaheid Kaila S	546,019	2939	3,415	256,125	40,980	297,105	115,541	413	550		Central		18	825	18
40	Altora Wasat	320,048	4599	5,342	400,650	64,104	464,754	180,738	645	861		Central		27	1,291	27
41	Almerganeia S	427,929	3903	4,535	340,125	54,420	394,545	153,434	548	731		Central		22	1,096	22
42+45	Alsoreba +	407,372	4266	4,956	371,700	59,472	431,172	167,678	599	798			South	24	1,198	24
43	Alshahed Taj Alser	368,201	3658	4,250	318,750	51,000	369,750	143,792	514	685			South	23	1,027	23
44	Alameria	1,110,266	8882	10,318	773,850	123,816	897,666	349,092	1,247	1,662			South	25	2,494	25
46	Alkhatmia B 1&40	327,502	4745	5,512	413,400	66,144	479,544	186,489	666	888			South	38	1,332	38
47	Engaz Sharg B 2 & 3	625,104	1636	1,901	142,575	22,812	165,387	64,317	230	306			South	46	459	46
48	Engaz Sharg B 39	347,259	3787	4,399	329,925	52,788	382,713	148,833	532	709			South	45	1,063	45
49	Alkhatmia B 2	510,175	3500	4,066	304,950	48,792	353,742	137,566	491	655			South	16	983	16
50	Alkhatmia B 3 & 4	878,178	7018	8,153	611,475	97,836	709,311	275,843	985	1,314			South	17	1,970	17
51	Alkhatmia B 7 & 8	683,083	6106	7,094	532,050	85,128	617,178	240,014	857	1,143			South	2	1,714	2
52	Awetala B 8 & 11	112,627	2811	3,265	244,875	39,180	284,055	110,466	395	526			South	1	789	17
53	Military Camp	188,252	2097	2,376	178,200	28,512	206,712	80,388	287	383		Central		54	574	54
54	Dar Alsalam	612,623	2727	3,168	237,600	38,016	275,616	107,184	383	510			South	37	766	37
UN1	Helat Musa	214,378		2,119	158,925	25,428	184,353	71,693	256	341			South	47	512	49
UN2	Industrial Area S	246,982			0	336,289	336,289	130,779	467	623			South	39	934	39
UN3	Kassala Market	204,254			0	278,111	278,111	108,154	386	515		Central		21	773	21
	Total	**23,631,208**	**174,466**	**204,739**	**15,355,425**	**3,071,268**	**18,426,693**	**7,165,936**	**25,593**	**34,124**	**7,232**	**12,973**	**13,919**		**51,186**	

(3) Pipes

1) Pipe Length

Length was measured using the Geographic Information System (GIS).

2. Piping Calculation

(1) Calculation Method

Piping calculation is performed based on the following method, formula, etc:

① Node energy method

② Flow formula: Hazen-Williams equation

③ Flow velocity coefficient: C=110

(2) Case Simulations

The following two case scenarios are examined:

Case 1: Install the New Pipeline (tentative name) from Kahatmia WTP in South Zone.

Case 2: Perform work to improve water pressure in Case 1.

3. Result of Piping Calculation

(1) Case 1

Figure-2 shows the distribution of water pressure in case the New Pipeline (tentative name) from Khatmia WTP is installed in South Zone.

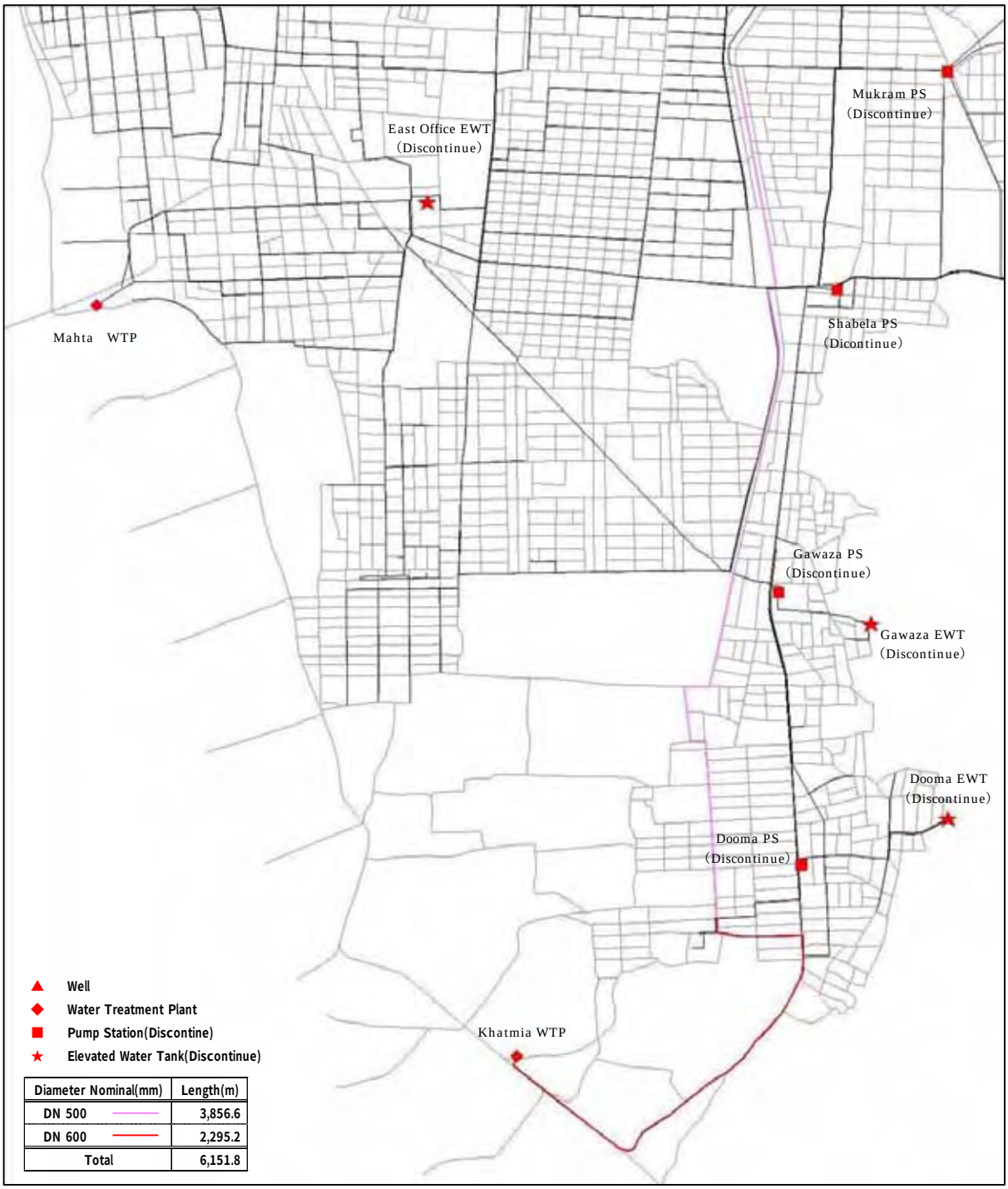


Figure-1: Installation Route of New Pipeline

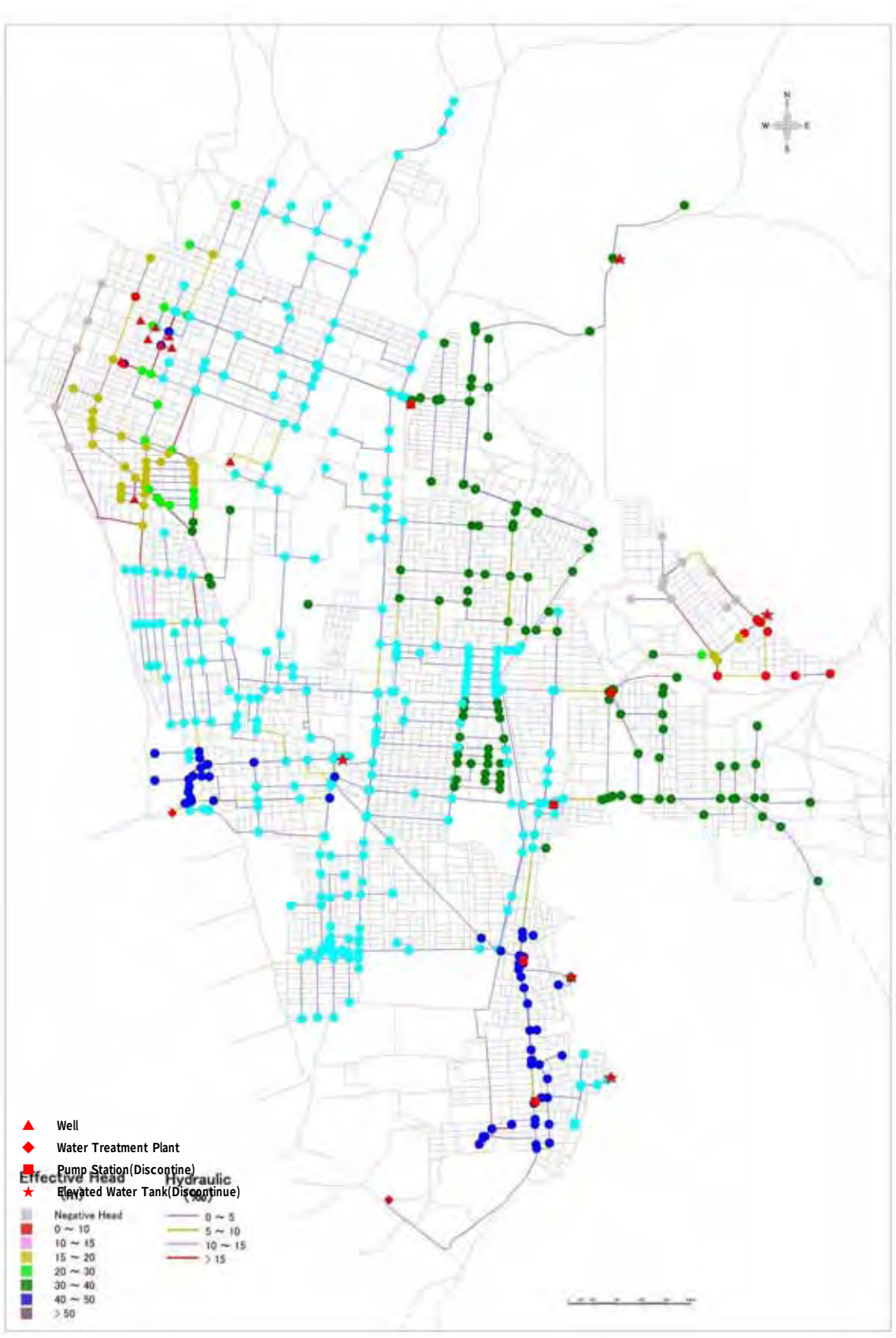


Figure-2: Water Pressure Distribution Diagram

(2) Case 2

Figure-4 shows the distribution of water pressure in case, after installing the New Pipeline (tentative name) in South Zone, additional work as illustrated in Figure-3 is performed to increase water pressure.

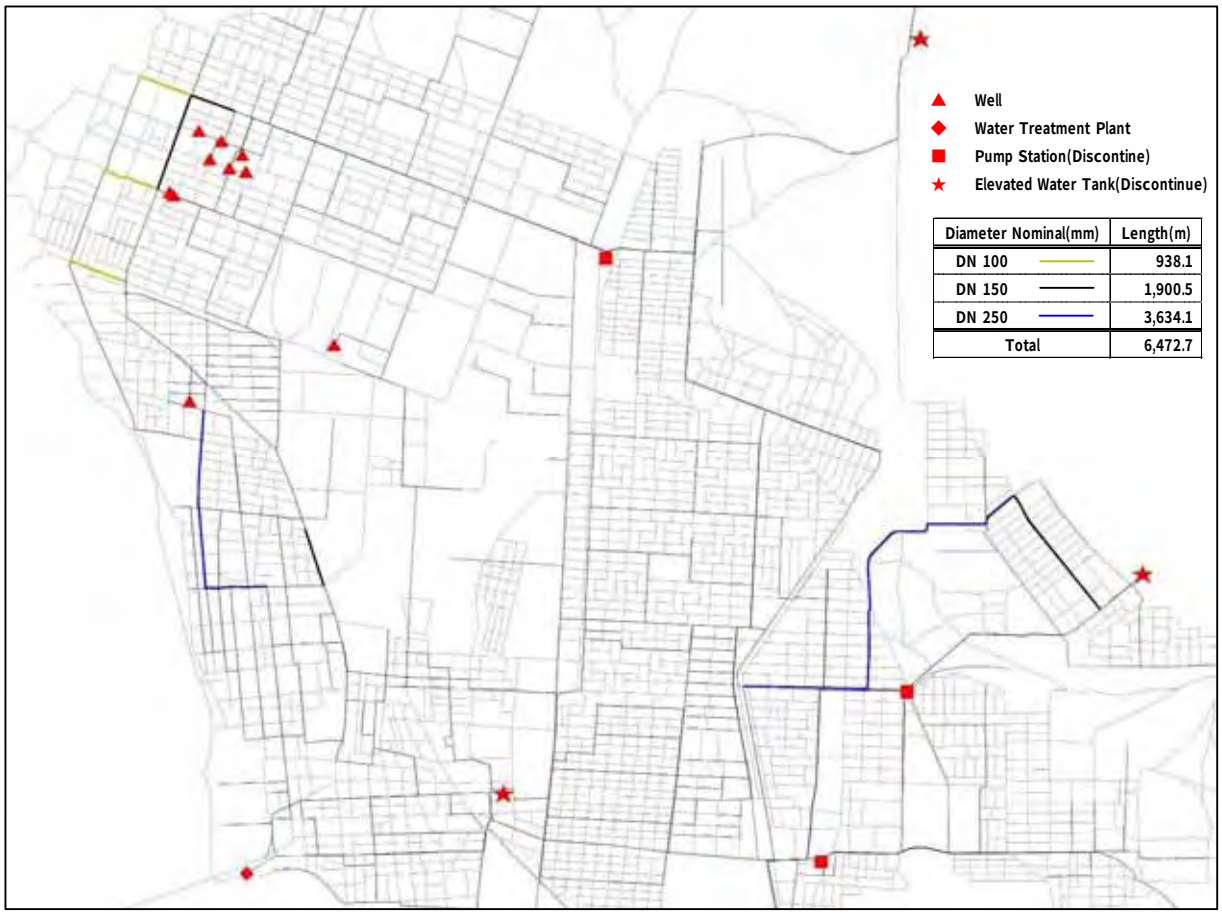


Figure-3: Work for Increasing Water Pressure

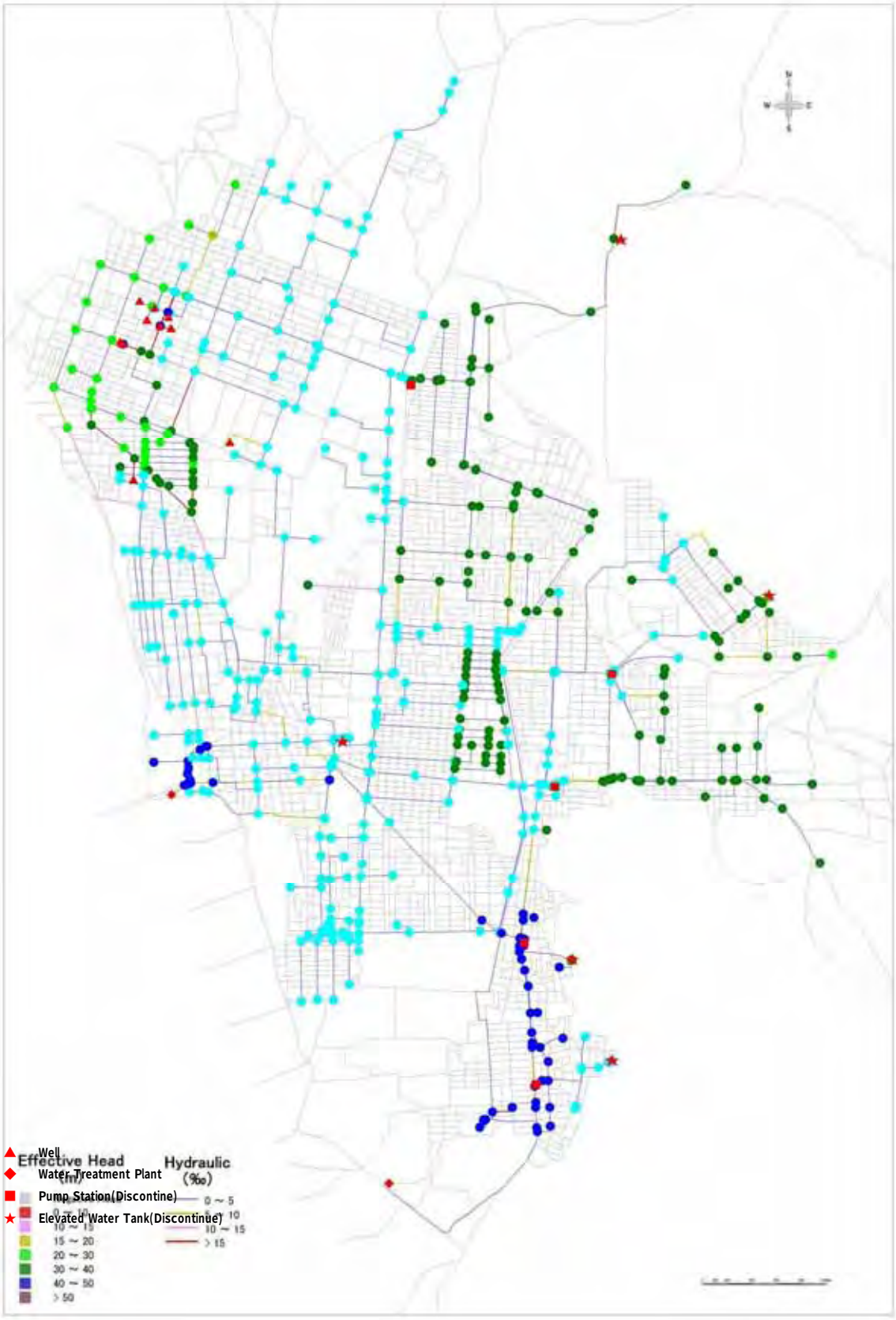
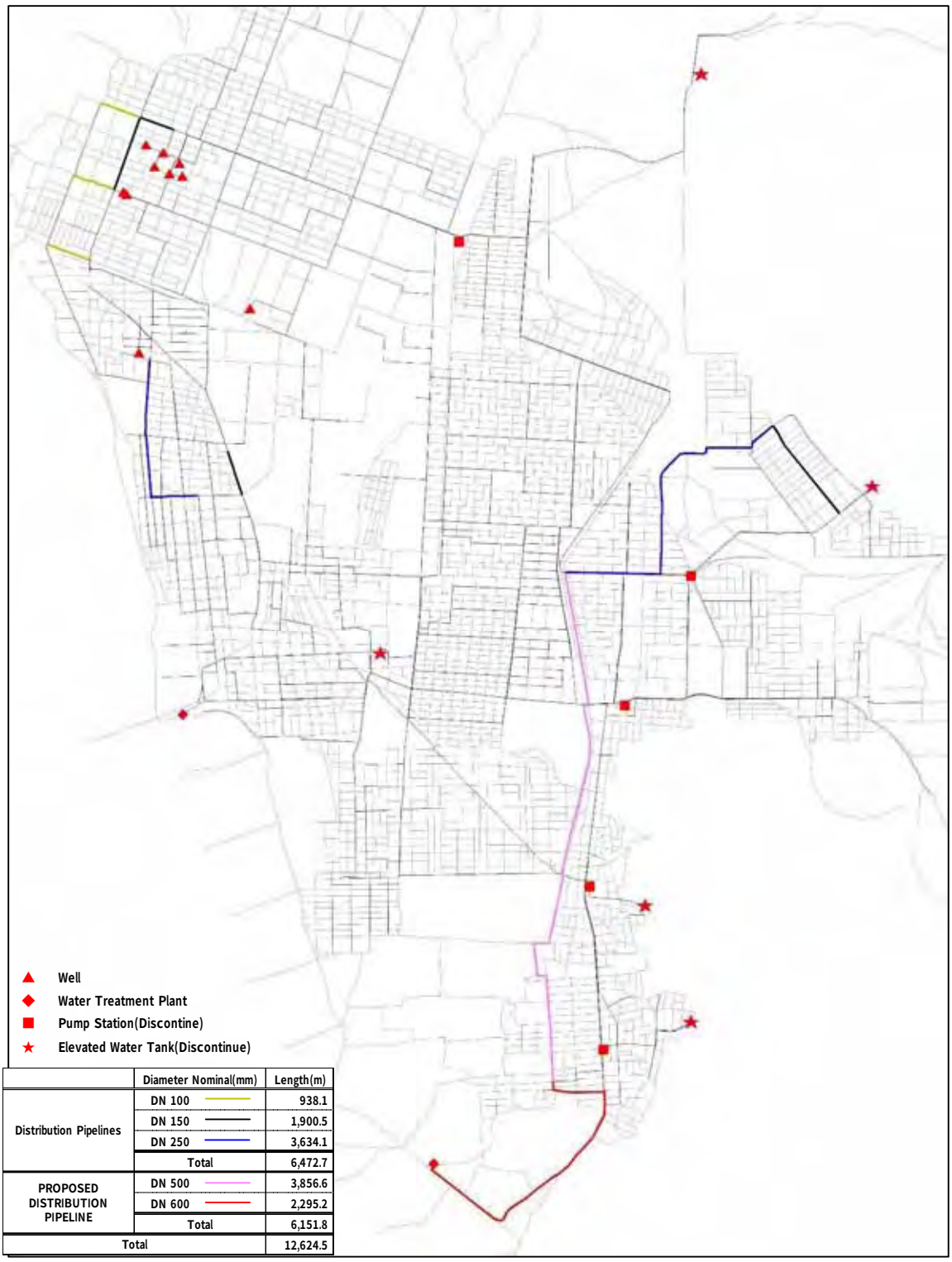


Figure-5: Installation Sites Diagram

2) Piping Model Diagram

The figure below shows a piping model diagram of this Project. The piping model diagram map is shown in Figure-6.



	Diameter Nominal(mm)	Length(m)
Distribution Pipelines	DN 100	938.1
	DN 150	1,900.5
	DN 250	3,634.1
	Total	6,472.7
PROPOSED DISTRIBUTION PIPELINE	DN 500	3,856.6
	DN 600	2,295.2
	Total	6,151.8
Total		12,624.5

Figure-5: Installation Sites Diagram

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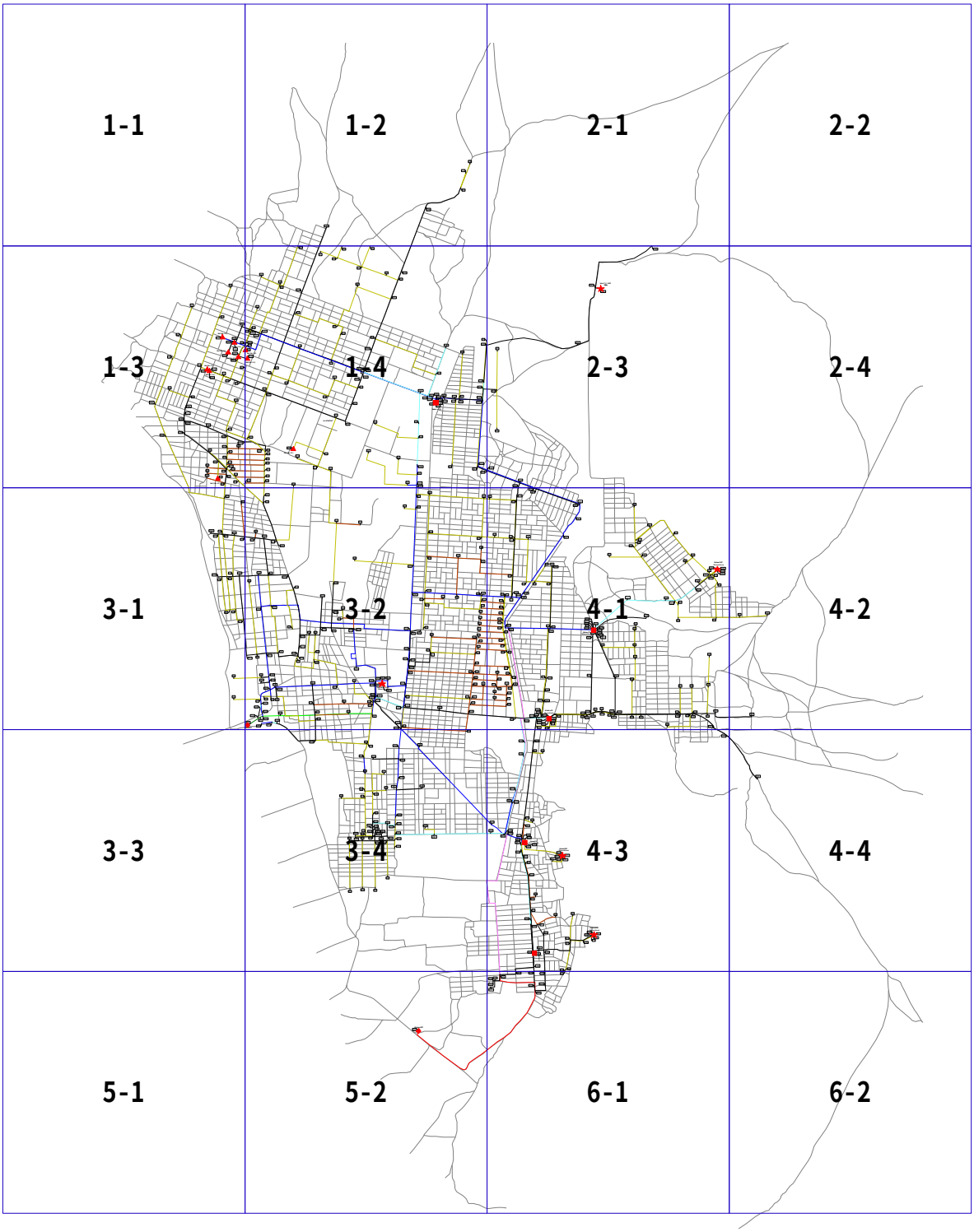

Figure-6: Piping Model Diagram Map

MODEL FOR DISTRIBUSION NETWORK ANALYSIS

Diameter Nominal (mm)

- DN 80
- DN 100
- DN 150
- DN 200
- DN 250
- DN 300
- DN 400
- DN 500
- DN 600

- Well
- Water Treatment Plant
- Pump Station(Discontinue)
- Elevated Water Tank(Discontinue)

MODEL FOR DISTRIBUSION NETWORK ANALYSIS

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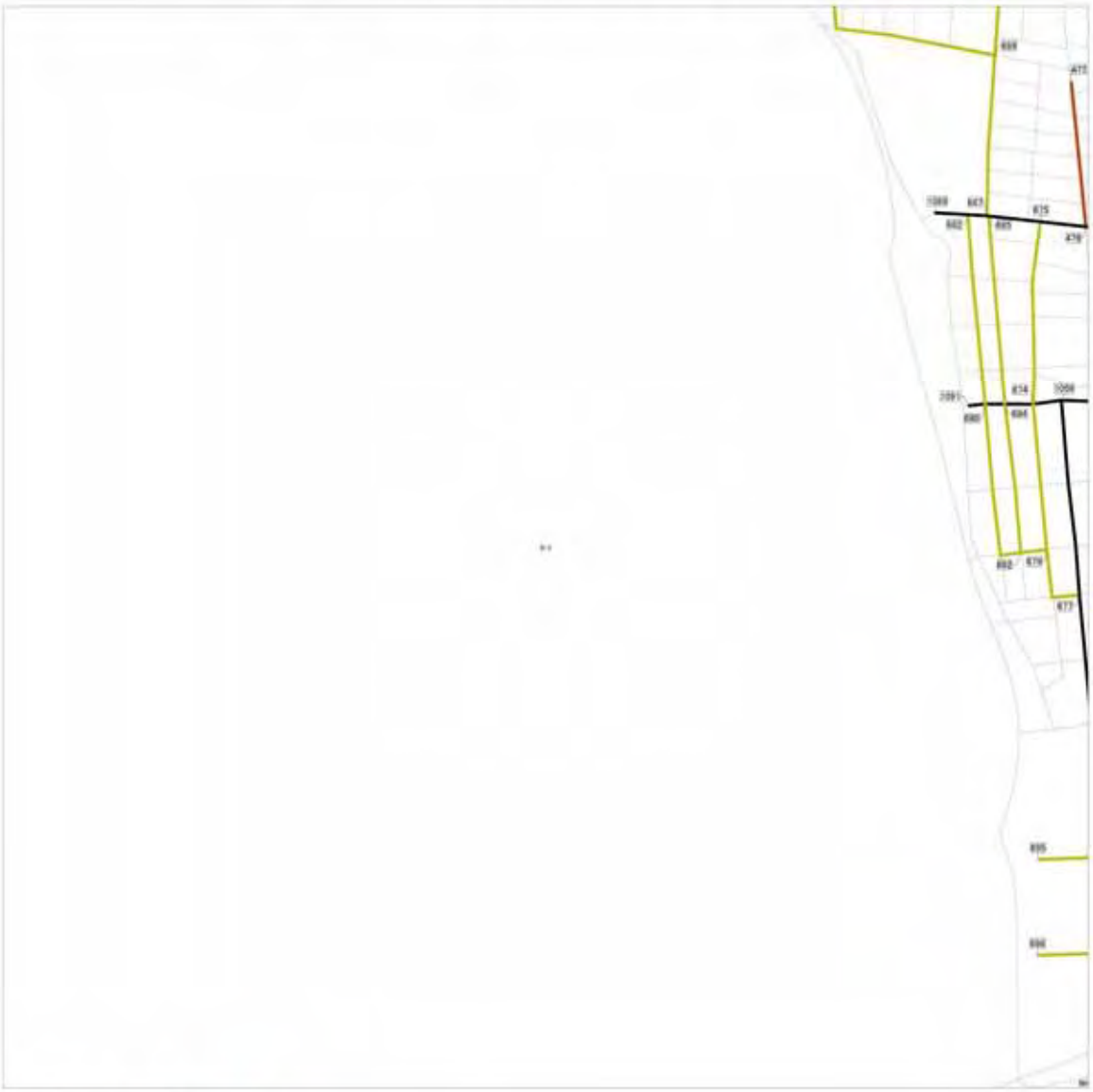

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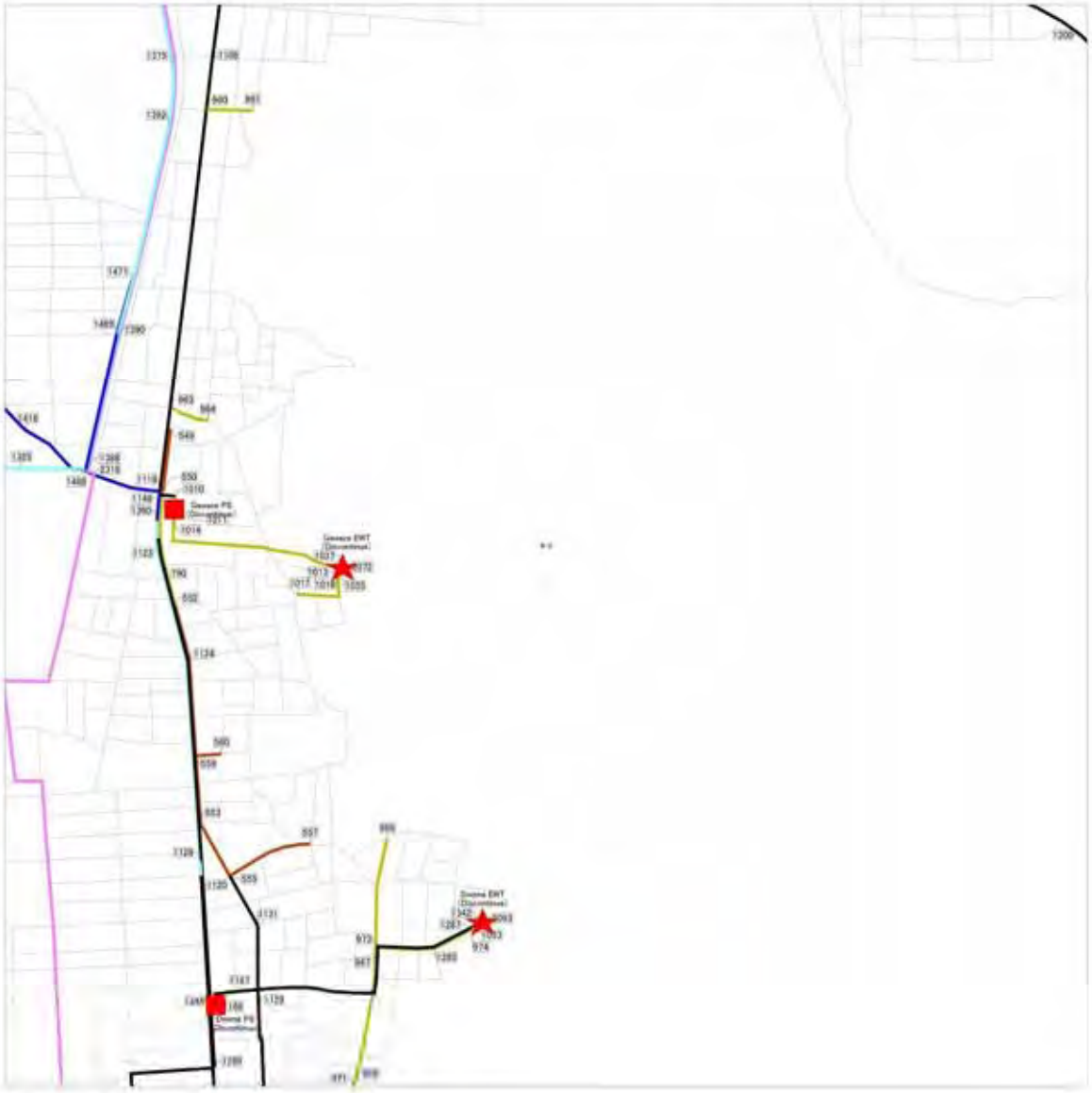

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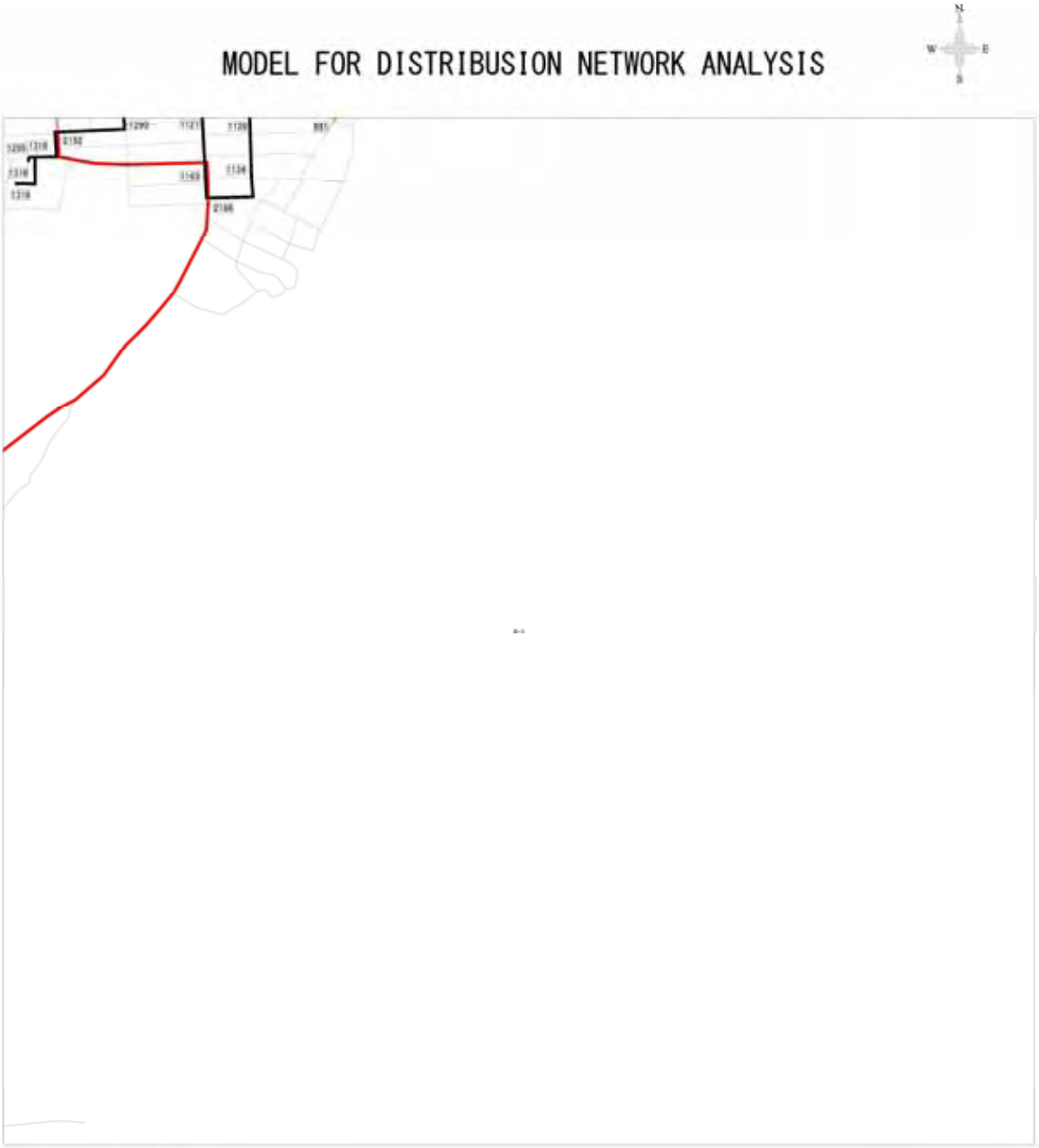

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- DN 500
- DN 600

- Well
- Water Treatment Plant
- Pump Station(Discontinue)
- Elevated Water Tank(Discontinue)

3) Hydraulic Calculation

Hydraulic calculation of this Project (Case 2) is shown in the following pages.

References

1. Installation Sites

(1) Whole Diagram of Installation Sites

Pipes to be newly installed or connected to the existing pipes in order to increase water pressure are shown in Figure-7.

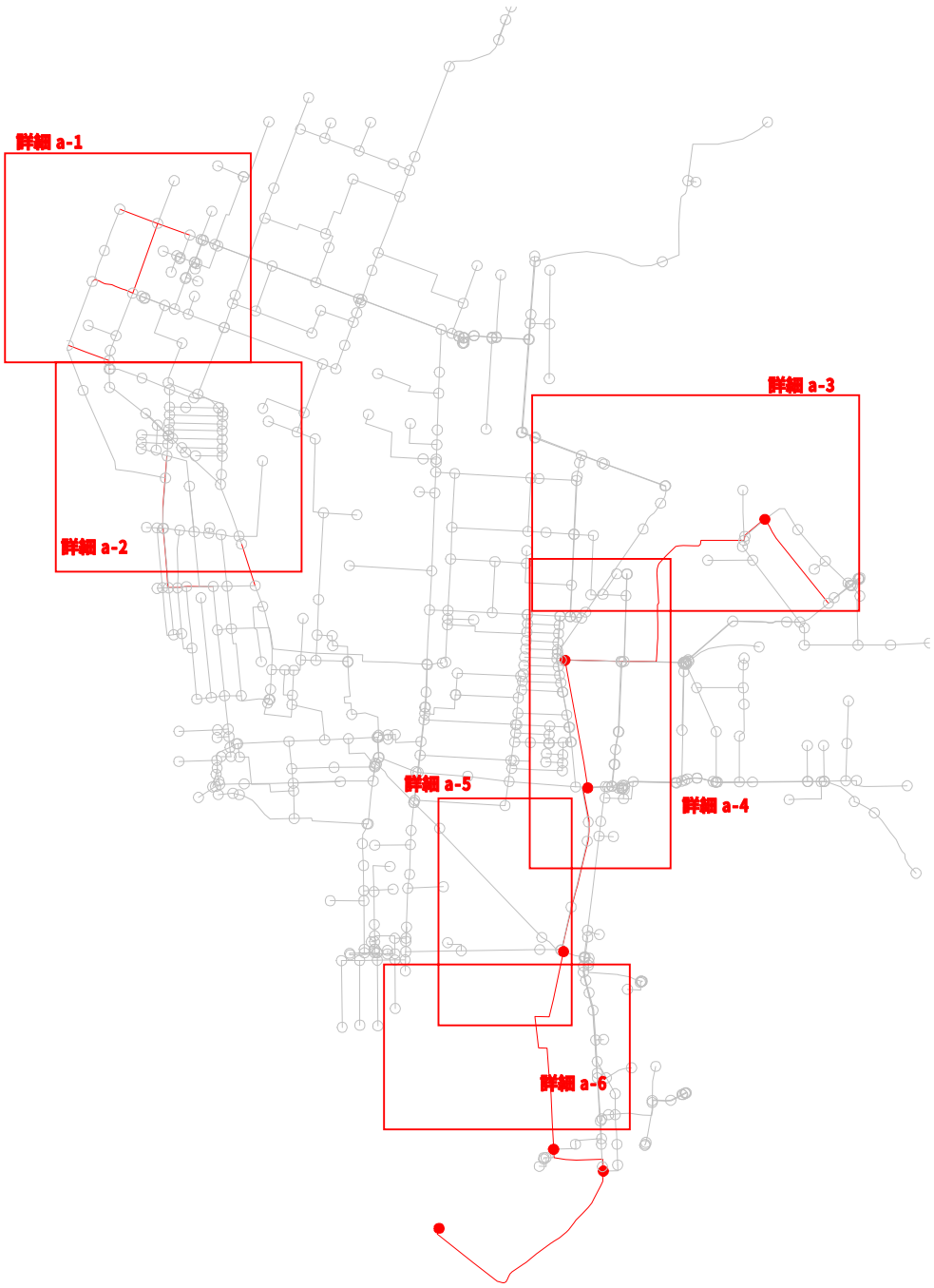

Figure-7: Whole Diagram of Installation Sites

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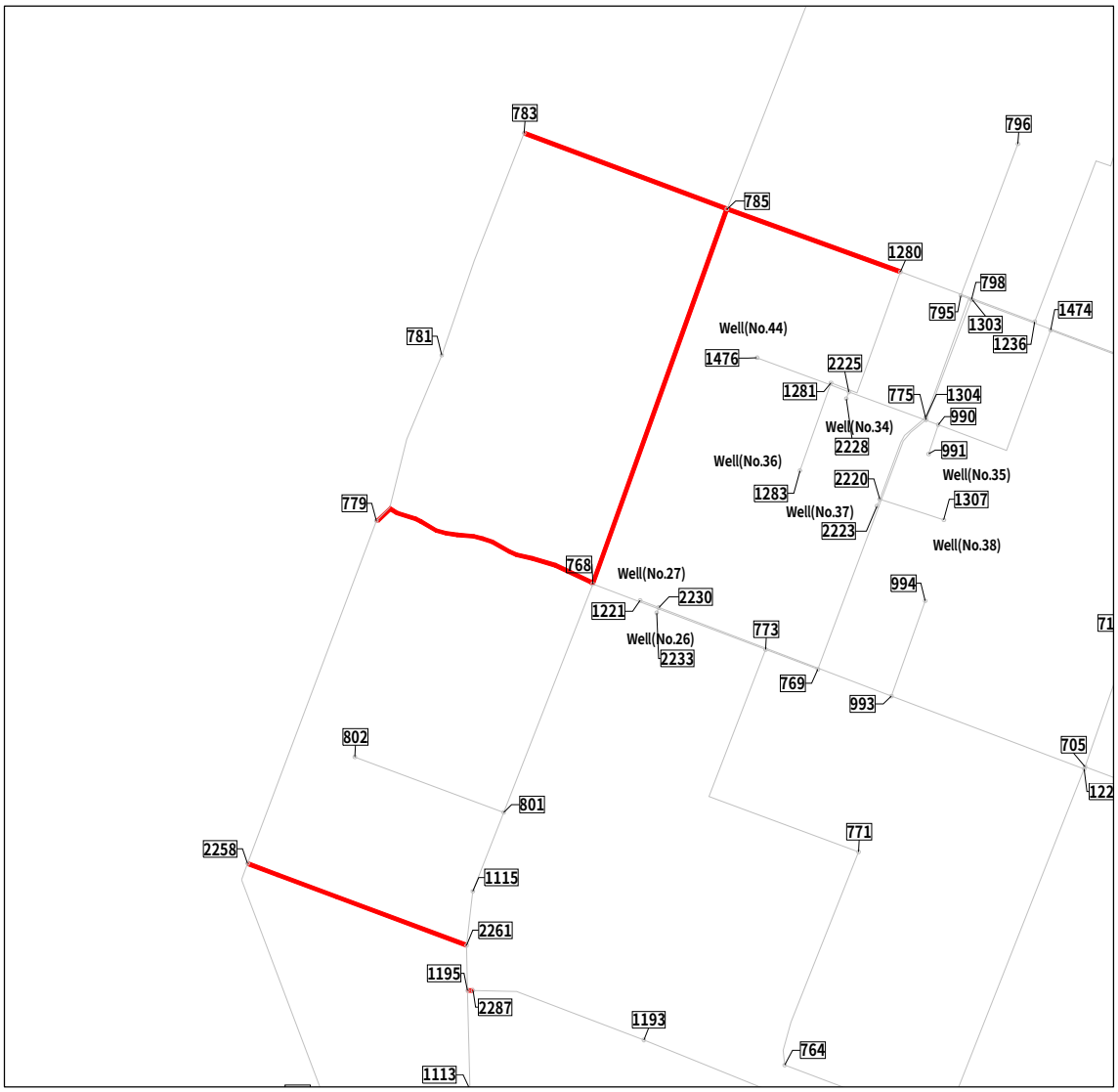
(2) Detailed Diagram of Installation Sites

1) Detail, a-1

(New) Node 783→Node 785 Diameter：φ100, Length：295.6m
(New) Node 785→Node 1280Diameter：φ150, Length：252.1m
(Expand) Node785→Node 768 Diameter：φ150, Length: 544.1m (expanded from φ100)
(New) Node 768→Node 779 Diameter：φ100, Length：323.4m
(New) Node 2258→Node 2261 Diameter：φ100, Length：319.1m
(New) Node 1195→Node 2287 Diameter：φ150, Length：7.3m



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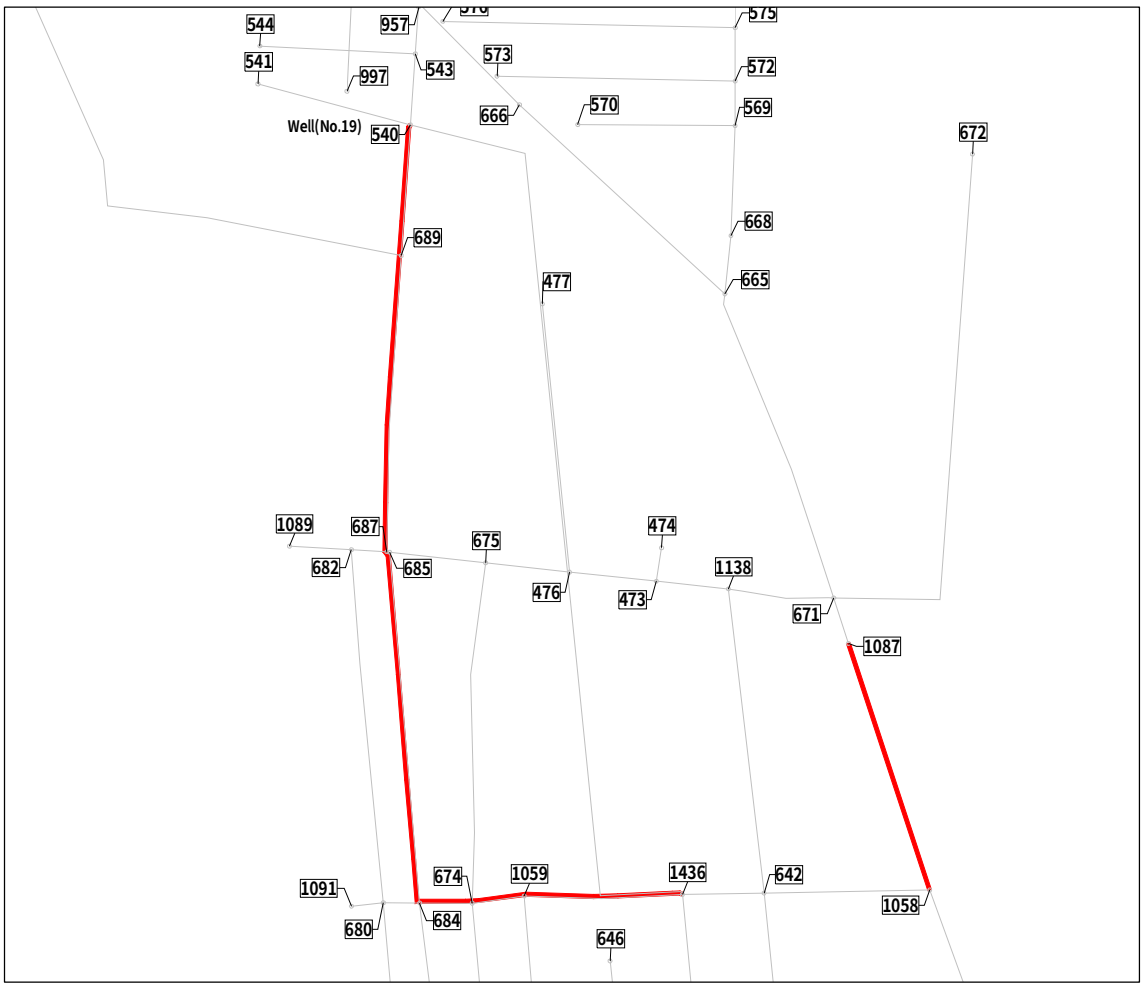
2) Detail, a-2

(New) Node 540→Node 1436Diameter：φ250, Length：1302.3m
(New) Node 1058→Node 1087 Diameter：φ150, Length：323.3m



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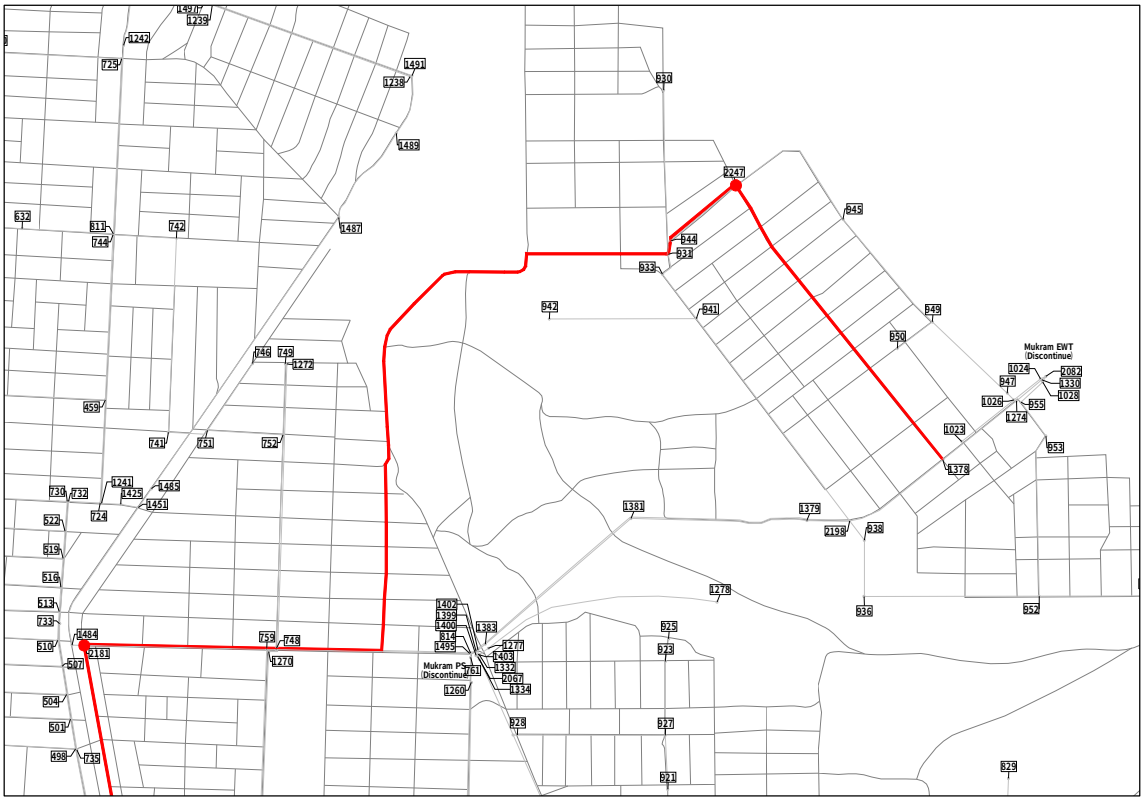
3) Detail, a-3

(New) Node 1378→Node 2247　　Diameter：φ150, Length：773.8m
(New) Node 944→Node 2247Diameter：φ250, Length：196.0m
(New) Node 931→Node 944　Diameter：φ250, Length：30.8m
(New) Node 931→Node 2181Diameter：φ250, Length：2,105.0m
(New Node) Node 2247



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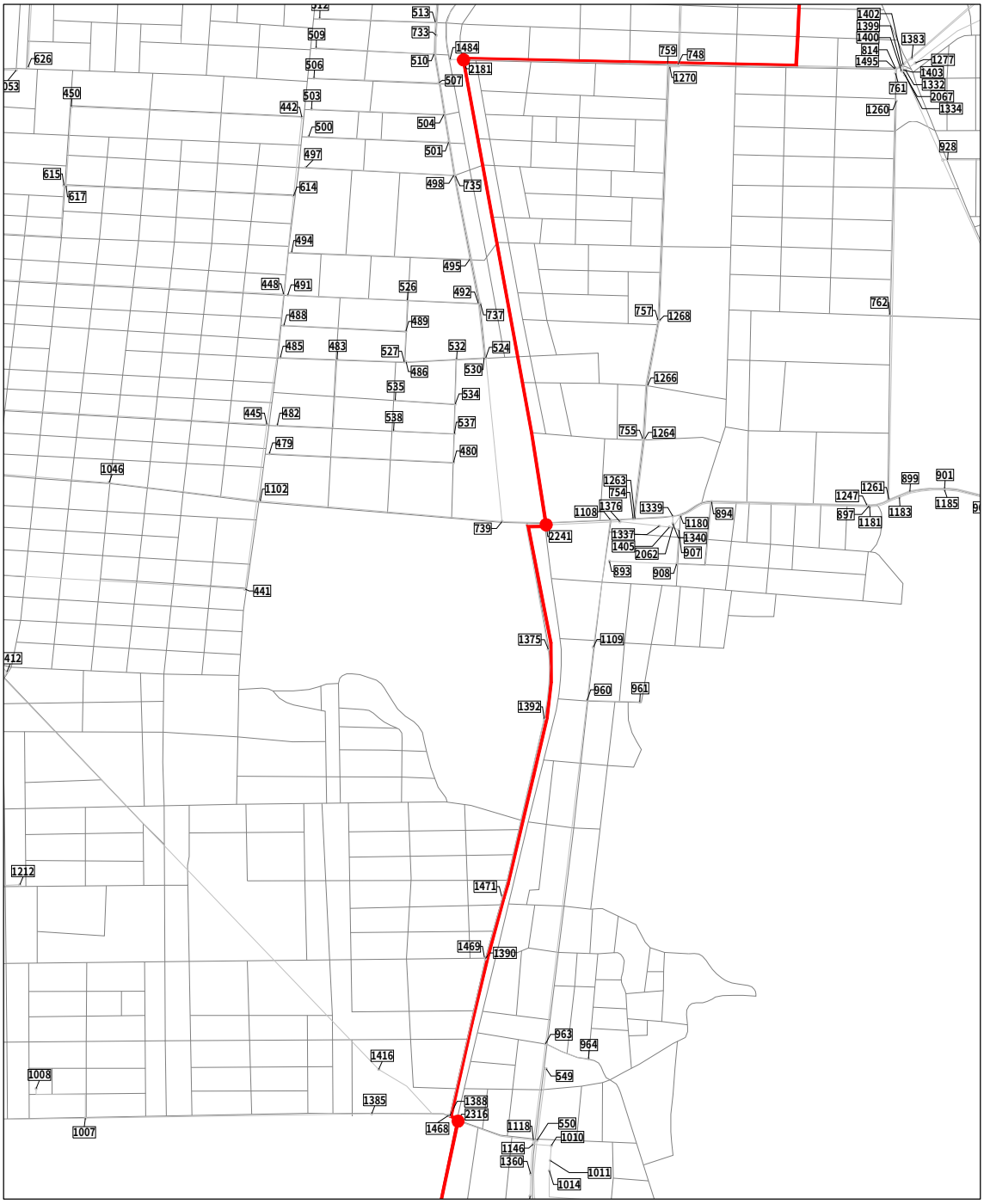
4) Detail, a-4

(New) Node 2181→Node2241　　Diameter：φ500, Length：951.1m
(New) Node 2241→Node2316　　Diameter：φ500, Length：1,273.7m
(New node) Node 2316
(New node) Node 2181
(New node) Node 2241



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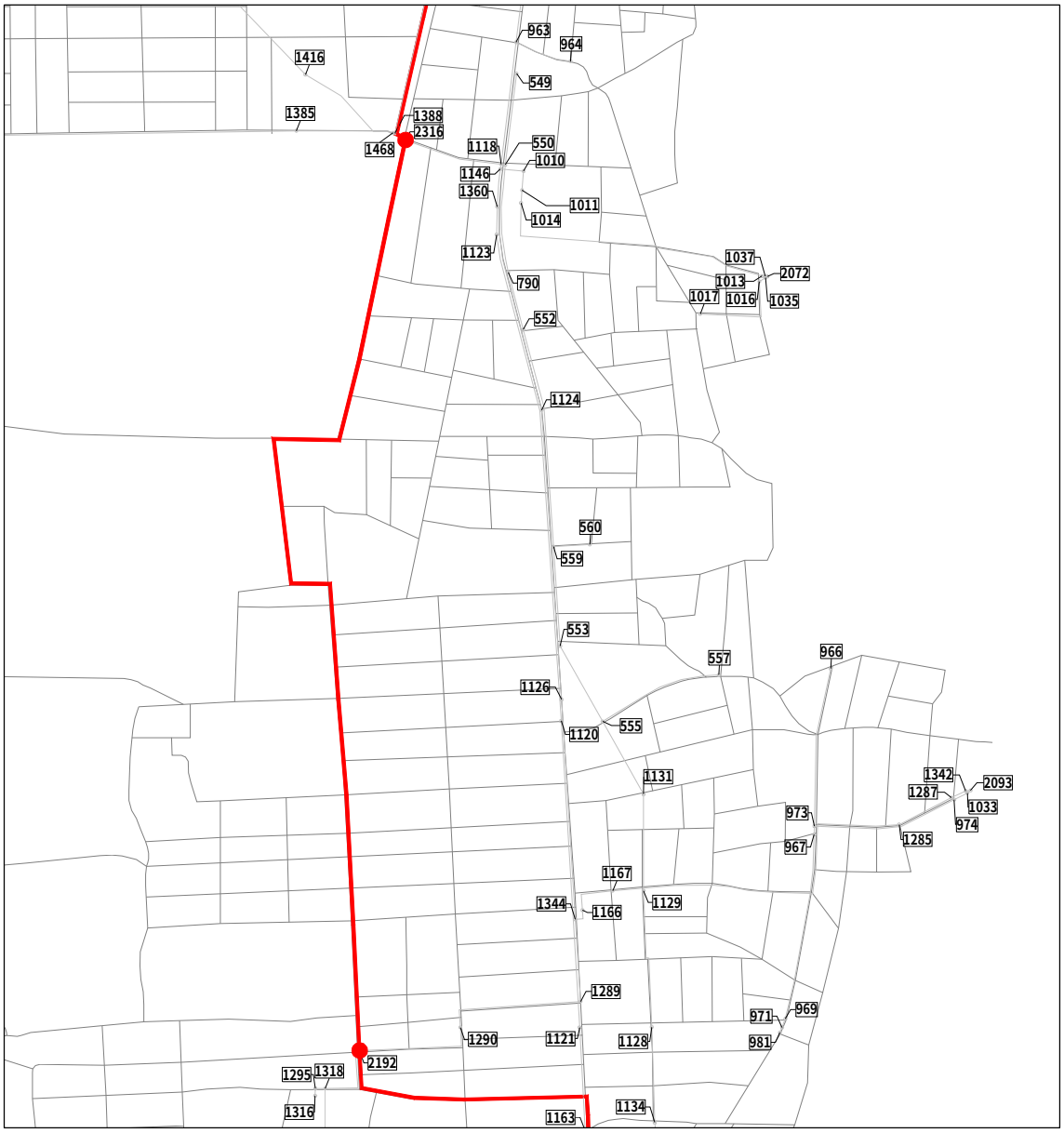
5) Detail, a-5

(New) Node 2192→Node2316　　Diameter：φ500, Length：1,631.8m
(New node) Node 2192



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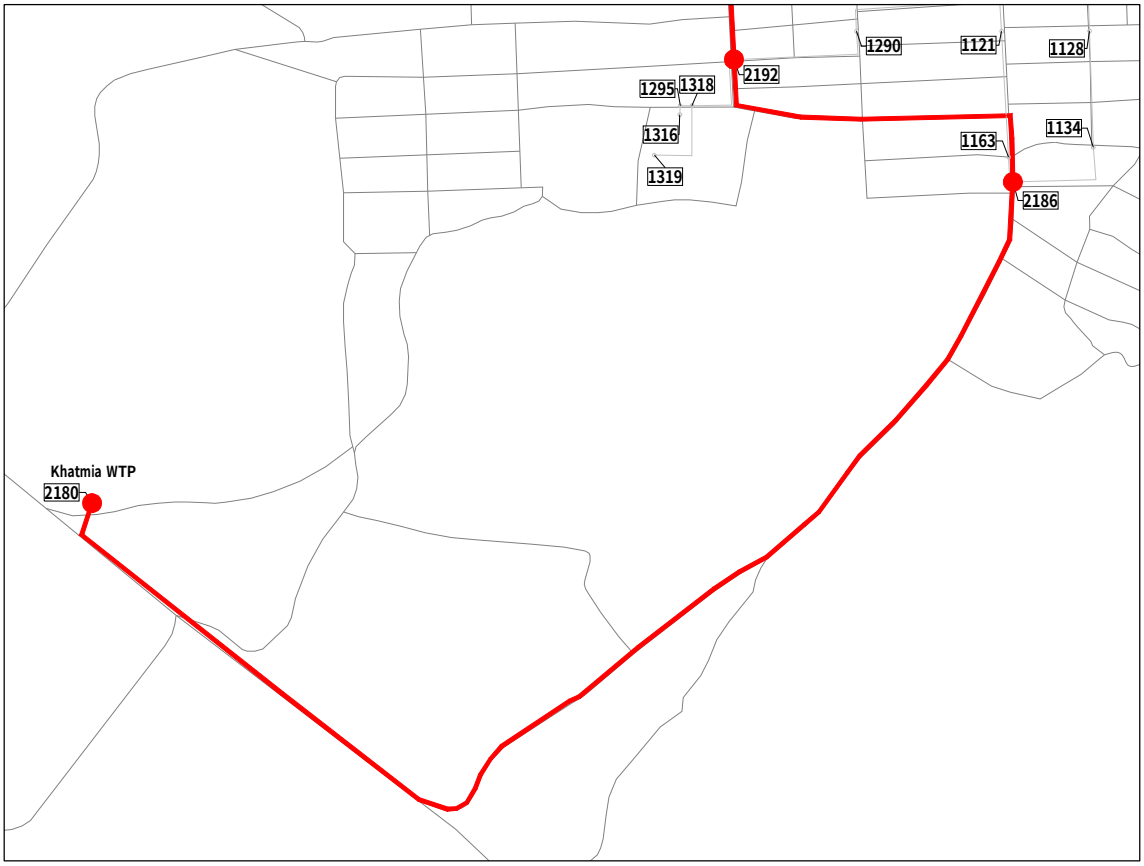
6) Detail, a-6

(New) Node 2186→Node2192　　Diameter：φ600, Length：506.5m
(New) Node 2180→Node2186　　Diameter：φ600, Length：1,788.7m
(New node) Node2180
(New node）Node2186



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Appendix-10　Environmental and Social Consideration

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY

MAY 2011

KASSALA STATE WATER CORPORATION

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

1 Environmental Impact Assessment

1-1 Outline of Project Components of having Environmental and Social Impacts

The purpose of this project is rehabilitation of the existing water service facilities in the eastern and western part of Kassala city and extension in the eastern part. Outlines of project components are shown in Table 2.1.

Table 2.1 Outlines of Project Components

(Rehabilitation facilities)

Name of WTP	Contents of Facilities	Qty.
Mahta WTP (Eastern part of Kassala city)	1. Receiving well Capacity: 48.0 m^3/ 2 basins Dimensions: Width 2.0 m, length 3.0 m, effective water depth 4.0 m	2
	2. Distribution reservoir Capacity: 3,686.0 m^3/ 2 basins Dimensions: Width 16.0 m, length 32.0 m, effective water depth 3.6 m	2
	3. Distribution pump building Dimensions: Width 9.5 m, length: 30.0 m Basement 1; above ground 1 storey	1
	4. Plant connection pipes raw water mains, treated water pipes, discharge pipes, service pipes	1 set
	5. Distribution pump equipment Type: Single suction horizontal centrifugal pump Capacity: 2.88 m^3/minute Head: 50.0 m Motor output: 45.0 kW	5 pumps (Of which 1 is spare)
	6. Chlorine dosing equipment Dosing rate: 0.5 - 2.0mg /L	1 set
	7. Electric measuring equipment Switch panel: 1 Incoming panel: 1 Pump panel: 5 Instrumentation panel: 1	8
	8. Emergency generator equipment Type: Diesel engine Output: 500 kVA	1 set
Galbe WTP (Western part of Kassala city)	1. Receiving well Capacity: 26.3 m^3/ 2 basins Dimensions: Width 1.5 m, length 2.5 m, effective water depth 3.5 m	2
	2. Distribution reservoir Capacity: 1,728 m^3/ 2 basins Dimensions: Width 12.0 m, length 24.0 m, effective water depth 3.0 m	2
	4. Plant connection pipes raw water mains, treated water pipes, discharge pipes, service pipes	1 set

(Extended facilities: South WTP)

Category	Facility	Scale	Qty.	Remarks
1. Water intake facility	Existing wells	7,537 m^3/ day	10	
	Test well	Well diameter $10^3/_4$inch, 720 m^3/day (average)	4	Excavation complete at BD
	New well	Same as above	7	Excavation at DD
	Existing well facility (rehabilitated)	-Renewal of submersible motor pumps	10	
		-Electric equipment (incoming panel, control panel)	10 sets	
		-Building	10 locations	
	New well facilities	-Submersible motor pumps (3.7-5.5 kW)	11	Tentative value
		-Electric equipment (incoming panel, control panel)	11 sets	
		-Diesel generator (12.5-17kVA)	11	Tentative value
		-Building	11 locations	
2. Raw water main facility	Raw water mains (new well)	DN150,DN250,DN300,uPVC pipes	4.96 km	Tentative distance
	Raw water mains (existing well)	DN100,DN200,DN300,uPVC pipe	7.150 km	
		Total	12.110km	
3. Treated water and distribution facilities	Receiving well	Reinforced concrete construction Dimensions: Width 2.0 m, length 3.0 m, effective water depth 4.0 m Capacity: 48.0 m^3/ 2 basins Retention time: 4.5 minutes	2	With shed
	Distribution reservoir	Reinforced concrete construction Dimensions: Width 24.0 m, length 32.0 m, effective water depth 3.4 m Capacity: 5,200 m^3/ 2 basins Retention time: 8.1 hours	2	
	Distribution pump building	Reinforced concrete construction Dimensions: Width 9.5 m, length: 30.0 m Basement 1; above ground 1 storey	1	
	Plant connection pipes	raw water mains, treated water pipes, discharge pipes, service pipes	1 set	
	Maintenance within premises	Roads in premises, drainage in premises	1 set	
	Distribution pump equipment	Type: Single suction horizontal centrifugal pump Capacity: 4.01 m^3/minute Head: 55.0 m	5 pumps (Of which 1 is spare)	

Category	Facility	Scale	Qty.	Remarks
		Motor output: 75 kW		
	Chlorine dosing equipment	Disinfectant: Liquid chlorine Maximum dosing rate: 2 mg/L Maximum feed rate ：1.28 kg/hour Vacuum type chlorinator: 2 units Dosing pump: 2	1 set	
	Electric measuring equipment	Power specifications: 3-phase, 4-wire, 415 V, 50 Hz Switch panel: 1 Incoming panel: 1 Pump panel: 5 Instrumentation panel: 11 Water level gauge, flow meter	1 set	
	Emergency generator equipment	Type: Diesel engine Output: 500 kVA	1 set	
	Distribution reservoir	Reinforced concrete construction Dimensions: Width 24.0 m, length 32.0 m, effective water depth 3.4 m Capacity: 5,200 m^3/ 2 basins Retention time: 8.1 hours	2	
	South distribution pipeline (distribution main)	DN500 mm DN600 mm, ductile cast iron pipe	6.3 km	

The scope of the Project for environmental and social consideration is adverse impacts assumed by activity of the plan, construction and operation stages in the above-mentioned main facilities planning. However, since new land acquisition and permission do not occur as shown in Table 2.2, the examination of plan stage is excluded.

Table 2.2 Construction Sites of Water Supply Facilities

Facilities	Land owner / Administrator	Land acquisition / permission
Mahta WTP	SWC	Inside of the existing water treatment plant
Galbe WTP	SWC	Inside of the existing water treatment plant
South WTP	SWC	Land acquisition of project site is secured.
Production wells	Ministry of Agriculture	Permission of land use is acquired.

1-2 Basic Environment and Social Situation

(1) Natural Environment

1) Outline of the Study Area

Kassala city which is the provincial capital of Kassala state is located in about 400 km of east sides of Khartoum. The boundary of the State of Kassala touches Eritrea in the east side, the State of Red Sea in the north side, the State of Khartoum in the west side and the State of Al Gedaref in the south side. The Gash River is flowing through the central part of Kassala city toward north from

south, and this river is a wadi where water flows only during rainy season. The survey area is the eastern part area in Kassala city surrounded by the Gash River, the Mukram Mountain, and the Kassala Mountain. This area is flat geographical feature quietly inclined toward a Gash river from the Mukram Mountain.

2) Climate (temperature, precipitation, and wind direction & speed)

< Air Temperature>

Kassala city belongs to the dry desert climatic zone. From December to March, it is winter season, and temperature is comparatively low. The maximum temperature of the summer season (from April to June) exceeds 40 oC. It is reported 43.2 oC (April) as for the maximum value of the monthly mean maximum temperature, and 15.2 oC (January) as the minimum value of monthly mean minimum temperature.

< Precipitation>

The average annual precipitation for ten years (1999 - 2009) is 234 mm. However, fluctuation of annual precipitation is large, and the precipitation in 2007 (425mm/year) has reached about 4 times as compared with the precipitation in 2009 (102mm/year). The rainy season is in June to September, and about 90% of annual precipitation is concentrating it on this period.

< Wind direction & speed>

The prevailing wind of Kassala city is south wind in the period from May to October and north wind in the period from November to April. Wind velocity does not change a lot throughout the year, and monthly average wind velocity is 5 knot (sea mile/hr.). However, there is also a weather situation which a strong wind blows for a short time.

3) Nature Preserve

Neither nature preserve nor forest preserve is in the eastern area of Kassala city.

4) Ecology

In the eastern area of Kassala city, the animals and plants of rare species and endangered species do not exist.

(2) Environmental Pollutions and Contaminations

1) Air Pollution

The factory and place of business which generates air pollution are not in the survey area. The national highway (between Khartoum and Port Sudan) which is a source of the air pollution by vehicles is located in the position of 7-8 km from Kassala city, and direct influence cannot be considered. However, the sandstorm of the dry season and scattering of the particulates from surface of dry road during rainy season are considered to be the air pollution about which it should be most anxious.

2) Water Pollution and Contamination (Surface water and groundwater)

<Surface water>

Gash River is a wadi where water flows only during the rainy seasons. Moreover, this river is a raised bed river with the grit from the upper stream, and even if generated by wastewater in the Kassala city, it does not flow in directly from the area of the Kassala city.

Drainage canal: The drainage canals of the survey area are dried during the dry season, and there are no flows of water including wastewater. Although rain water is collected at the time of rain, it is thought that rain water is eliminated by infiltration into land and evaporation except cataracts of rain. Almost all the households of the survey area have a leaching pit, and black and grey wastewater from the household are not discharged into the drainage canals.

<Groundwater>

Almost all wastewater from households (black and grey wastewater) in the survey area is disposed of by infiltration facilities such as leaching pit. In the future, the possibility of pollution and contamination of groundwater by these wastewater disposal facilities can be considered. There is no sign of contamination and contamination in the present SWC production wells.

3) Noise and Vibration

Although the noise and vibration from vehicles, factories, and electric generators are expected, it is not reported as noise and vibration problem.

(3) Social Environment

1) Population

According to the census (2008), it is reported that population in the whole Kassala city was 298,529 persons and, population in the survey area is 165,915 persons, respectively. Future population (2016) of the Central Bureau of Statistics is predicted to be 202,620 persons in the whole city and 364,581 persons in the survey area. (Central Bureau of Statistics, Ministry of the Cabinet, the Republic of Sudan)

Although the population growth rate increased quickly till 1973 - 1993, it has become slow from 1993 till 2008. Domestic riots and the war in the neighboring country, etc. can be considered as this cause. The predicted value of 2.53% as population annual growth rate by 2016 is reported by the Central Bureau of Statistics.

Table 2.3 Population of Kassala City

	Locality	No. of Household	Population	伸び率
Census 1973	Kassala City	16,609	99,653	-
	East Elgash	9,135	54,809	-
	West Elgash	7,474	44,844	-
Census 1983	Kassala City	22,841	140,493	3.49%
	East Elgash	12,562	77,271	-
	West Elgash	10,279	63,222	-

Census 1993	Kassala City	37,911	234,622	5.26%
	East Elgash	20,851	129,042	-
	West Elgash	17,060	105,580	-
Census 2008	Kassala City	53,706	298,529	1.67%
	East Elgash	29,848	165,915	-
	West Elgash	23,858	132,614	-
Predicted population (2016)	Kassala City	-	364,581	2.53%
	East Elgash	-	202,620	-
	West Elgash	-	161,961	-

Source: Central Bureau of Statistics, Ministry of the Cabinet, the Republic of Sudan (Kassala office)

2) Ethnic Group and Religion

Five races are mentioned as main races of the State of Kassala, and the race of Beja group, Beni Amer, Rashaida, and Shukrriyya are living. There is most Beja group in these races, and it is a race which has moved from a northern part zone. Not less than 90% of the population of the State of Kassala is Islam, and the partial residents from the southern Sudan are Christianities.

3) Medical Service and Public Health

The index of the number of hospitals and beds per population of 100,000 in the State of Kassala is less than the national average. However, about 45% of the number of beds is concentrating in Kassala city, and Kassala city is in a good medical-facilities situation.

The morbidity rate of the main infection and diseases in Kassara State is shown in Table 2.4. From this Table, as compared with a national average value, morbidity rate values of nutritional disorder and anemia have a little high tendency. Moreover, the morbidity rate of Bilharzias is twice the national average.

The morbidity rates of the diarrhea, dysentery and typhoid which are typical water-borne infection disease are also less than the national average values.

Table 2.4 Morbidity Rate of Main Infection Diseases (2008)

Diseases	Kassala State			National Average		
	Out-Patient	In-patient	Prevalence per 1,000 Population (out-patient)	Out-patient	In-patient	Prevalence per 1,000 Population (out-patient)
Diarhorea	21,970	1,951	12.3	543,200	29,681	18
Malaria	108,122	7,773	60.4	3,024,664	111,987	98
Nutritional Deficiencies	13,230	708	7.4	32,293	8,909	1
Dysentery	10,002	231	5.6	2,229,259	3,629	7
Anemia	13,230	1,143	7.4	95,782	13,264	3
Pneumonia	46,604	5,833	26.1	918,608	78,440	30
Typhoid	550	97	0.3	89,473	4,984	3
Viral Hepatitis	16	69	0.0	12,951	4,270	0.4
Bilharzias	3,514	0	2.0	13,684	183	0.4
Leishmaniaisis	6	1	0.0	4,124	2,985	0.1
T.B	699	287	0.4	17,590	5,314	1

Source: Ministry of Health (Kassala State Office)

5) Water Service

The household which has received water supply service of the survey area is presumed to be about 74% of the whole. About 25% of remaining households are purchased from water vender. However, water venders have received water supply from the water tap of SWC, and is considered that all the households use water supply of SWC mostly as a result.

The average water amount of consumption of the household which has purchased water from water vender is 23 lcd. On the other hand, the average water amount of consumption of the household which has received water supply is 49 lcd. The former is below half as compared with the latter. On the other hand, average amount-disbursed 63 SDG/month of the household which has purchased water was presumed, and it has reached the twice of the former.

6) Wastewater

Kassala does not have a sewer system, and wastewater from the household is disposed by the treatment facilities (leaching pit) of each household.

Therefore, although the storm drainage system network (include a natural drainage canal) is developed, the wastewater from households is not discharged into the drainage canal.

Moreover, although the increase in the amount of wastewater is expected by expansion of water supply service, it is thought that it can fully respond by the treatment facilities currently installed at households.

7) Solid waste

Garbage collection service of Kassala city is carried out once per week in principle. The collected solid waste is carried and disposed in the disposal site in the northeast region of the Mukram Mountain.

8) Economic Activities

It is said that the composition of the industry of Kassala city is 70% of commerce, 20% of agriculture, and other 10%, and Kassala city is the center of the trade activity of the Kassala state.

The agriculture of Kassala city is performed in farmland of the Gash River side and main agricultural products are fruit and fresh vegetables. 90% of agricultural products are shipped to cities, such as capital Khartoum and Port Sudan. Although called the state which poverty followed most, Kassala city is an area which industry is promoting most in the State of Kassala.

9) Traffic and Road

Kassala city is located in the middle point of the national highway which connects between Khartoum and Port Sudan, moreover, an airport is developed and access by an airplane is also a possible area.

The main road networks in Kassala city are paved. However, many roads have not been paved and the stagnant water of the rainy season is worsening the convenience of traffic.

10) Cultural Heritage

In Kassala city, cultural heritages, historical buildings, remains, and etc. are not registered.

1-3 Environmental and Social Consideration System and Government Organization of the Partner Country

(1) Environmental Legislation Policy, Legal and Administrative Framework

By the Interim Constitution proclaimed in 2005, the Sudan is advancing decentralization strongly. Similarly, decentralization is advanced also about environment, and it is specified that evaluation and approval of project are carried out by the authority of the state government. However, when an environmental impact influences ranging over two or more country and states, it is under jurisdiction on national level. The basic items concerning the environment in the Sudan is described below.

1) Environmental Protection Act (2001)

Environment and Natural Resources Supreme Council Act, (1991) was revised and Environmental Protection Act was enacted newly in 2001. The foundation of the laws and regulations concerning the environmental preservation and proper exploitation of natural resources in Sudan made this law establish. The contents which Environment Protection Law should mention specially are summarized below.

- This law has prescribed establishment of the Environment and natural resources Supreme Council with the authority of national level and the State's Council in each state clearly. (5th article and 14th article)
- As basic policy of environmental social consideration, any project is obliged to submit Environmental Feasibility Study (EFS). Environmental approval of project is examined based on evaluation of the EFS. (17th article (1))
- Including the items of the adverse impacts expected by the project, measures to avoid or to mitigate of adverse impacts, and alternatives of the proposed project as contents of EFS is specified. (17th article (2))
- Penal regulations are specified to the offender of Environment Protection Law. (20th article)

At present, neither revision of the Environment Protection Law nor decision of the environmental social consideration guideline is performed. Therefore, it is the only law in case this "Environment Protection Law" carries out environmental social consideration. Enforcement of this law is the duty of the Higher Council for Environment and Natural Resources (HCENR) established in 1991, and the Ministry for Environment and Physical Development (EPD) established in 1995.

2) Land related laws and regulations

The regulation about the land of the Sudan is prescribed by the following four laws.

- Land Settlement and Registration Act (1925): The regulation about rights of land ownership, and its registration
- Land Acquisition Act (1930): This law specifies that the government can expropriate required land by compensation for the use of the public purpose.
- The Civil Transaction Act (1984): This law is a regulation about deal of land.
- Disposition of Lands and Physical Planning Act (1984): The regulation which specified the national land using plan and the land distribution classified by use

However, most lands of the Sudan are managed not by laws and regulations but under the custom or the traditional rule.

Land expropriation rights of the project aiming at public benefit is specified in an above-mentioned regulation and the Interim Constitution. However, there is no example which expropriated the land for public projects in the State of Kassala. Usually, the land acquisition concerning public works is carried out based on agreement of project owner and the landowner.

(2) Environmental Impact Assessment Process adopted for this Project

At present, there is no guideline concerning environmental social consideration in Sudan. Therefore, based on the contents specified in Environment Protection Law (2001), the outline of environmental social consideration procedure is assumed as follows. (refer to Figure 2.1)

- In all development projects, the Environmental Feasibility Study (EFS) is required.
- The contents of EFS consist of outline of project, adverse impacts expected, mitigation measures, and examination of alternatives. Therefore, the EFS is considered to be the contents equivalent to Initial Environmental Examination (IEE).
- According to the policy of decentralization as specified to the Interim Constitution, application of EFS is submitted to the State's Council
- If it is judged that adverse impacts on nature and social economy environment by project are within the limits permitted, or sufficient mitigation measures are planned, it will be thought that "environmental approval" is accepted.
- When the range of adverse impacts exceeds the boundary of state or country, it is presumed that EFS is examined in the Higher Council for Environment and Natural Resources (HCENR) or the Ministry for Environment and Physical Development (MEPD) which are organization of national level.

The above is considered to be the procedure of environmental social consideration. However, there is no project which submitted EFS in the Kassala State.

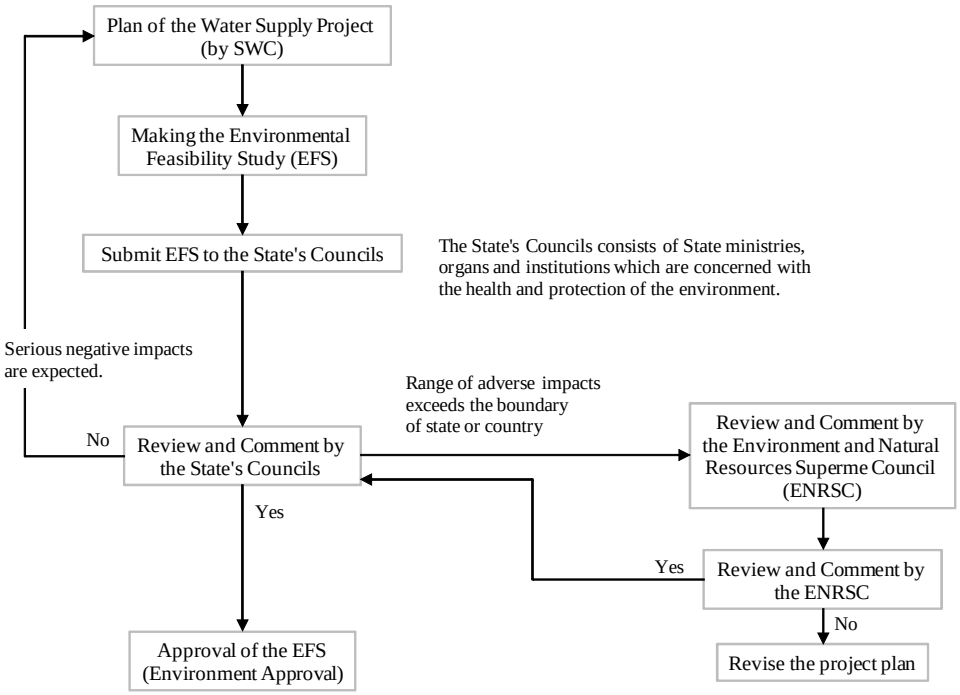


Fig. 2.1 Procedure of the environmental social consideration (assumption)

(3) Environmental Social Consideration adopted for this Project

Since generating of the serious adverse impact in the following items by implementation of project is not expected, based on a JICA guideline for environmental and social consideration, the initial environmental Examination (IEE) is carried out.

- Involuntary resettlement of residents
- Influence on groundwater
- Occurrence of secondary contamination
- Disappearance and damage to cultural properties and heritage
- Influence of natural reservation areas
- Adverse impact which straddles states or countries.

1-4 Comparison Examination of Alternatives (zero option is included)

Examination of alternatives is only two cases of "With project" and "Without project."

(1) No project plan

The object of the alternatives examination concerning this project is two alternative plans. One is no project plan and another is project implementation plan. The outline of these two alternatives plans is described below.

- According to the results of the social economic condition survey, about 25% of households use the purchase water from water vender. However, the purchase water is expensive compared with water rates of water supply, and the amount used is also restricted. Continuation of this economic liability and restriction of the amount of the water used may worsen residents' living environment.
- When the water supply situation does not improve, in order to obtain water, a women child's labor burden is expanded.
- When extension of water supply facilities according to increase in population cannot be carried out, development of local economy of Kassala city may be delayed significantly.
- The superannuated reservoir tanks in the Mahat and Galbe WTP have the large possibility of breakage, and when it damages, it has serious influence on a resident life and economic activity in kassala city.

(2) Implementation of the project for improvement of water supply facilities in the eastern part of Kassala city

When the project for improvement of water supply facilities in the eastern part of Kassala city is carried out, it can expect to avoid or mitigate problems in the proposal of “No project”. However, in order to maintain water supply service of Kassala city continuously, it is thought that supports from further soft and hard both sides are required.

1-5 Scoping

The implementation of Project is expected to have several positive impacts. During the construction and operation stages, working opportunities for local people will be generated. In the operation stage, the project will facilitate supply of clean, hygienic and sufficient amount of water to citizen of the project area. However, the project is also likely to cause some adverse impacts. The adverse impact items expected are shown in a scoping matrix. (refer to Table 2.5)

Table 2.5 Scoping Matrix for the Project

Environmental Elements		Preparatory stage				Construction stage				Operation stage			
		Mahat /Galbe WTP	South WTP	Conveyance pipes & Distribution main	New source wells	Mahat /Galbe WTP	South WTP	Conveyance pipes & Distribution main	New source wells	Mahat /Galbe WTP	South WTP	Conveyance pipes & Distribution main	New source wells
Social Environment	Land acquisition, resettlement												
	Local economy											○	
	Utilization of land and local resources												
	Social institutions												
	Exiting social infrastructures and services					○	○	○	○				
	Poor and indigenous peoples												
	Equality of benefits and losses												
	Local conflicts of interest												
	Cultural heritage												
	Water right and so on												
	Health and sanitation					○	○	○	○				
	Infectious diseases such as HIV/AIDS					○	○	○	○				
	Hazard and security risks					○	○	○	○				
	Accidents					○	○	○	○				
Natural Environment	Topography and geology												
	Soil erosion												
	Groundwater												○
	Flow and hydrological features												
	Situation of estuary												
	Biota and ecosystems												
	Landscape												
	Local climate												
	Global warming												
Pollution	Air pollution					○	○	○	○				
	Water pollution												
	Soil pollution												
	Pollution of bottom layer												
	Waste												
	Noise and vibration					○	○	○	○				
	Ground subsidence												
	Offensive odor												

Note: ○: Indicate that the development scheme is foreseen to have some impact on the environmental element.

1-6 TOR of Environmental and Social Considerations Investigation

Based on the scoping matrix of the previous clause, environmental and social considerations investigations for collecting information about expected adverse impacts with project implementation are conducted.

The project activities are divided into a repair portion of the existing water supply facilities, and an extended portion of new facilities construction. Since the former is the existing facilities, it is not necessary to acquire any new land for the repair portion of project. Although new land acquisition is required for the latter, the project site is already prepared. Therefore, there is no necessity for the environmental and social considerations investigation concerning the preparatory stage.

The required investigation items about adverse impacts in the construction and operation stages are shown in Table 2.6.

Table 2.6 Outline of Environmental and Social Considerations Investigation

Environmental Elements	Project Activities	Subject of Investigation	Contents of Investigation
Social institutions	Construction activities of facilities	Surrounding areas of water treatment plants and access roads	Situation of institutions which are easy to be affected by influence, residential zone, community institutions, roads and etc.
		Surrounding area along route of main distributions and raw water mains	-ditto-
Local economy (Livelihood and employment)	Improvement of the water supply situation by the project efficiency	Water venders of the survey area	Situation of business operating, water sources, number of water venders and etc.

1-7 Results of Environmental and Social Considerations Investigation

(1) Situations of Surrounding Areas of Water Treatment Plants and Access Roads

1) Mahta Water Treatment Plant

The water treatment plant is located in the east side of a bridge (Gash River) which connects the eastern and western area in Kassala city, and this road is main trunk roads in the city. The sports club office has adjoined the east side of the water treatment plant, and the government relation institutions under construction are located on the north side. There is Gash River in the west side of the plant, and on the south is agricultural land. A most close residential area is located in the position about 300 m away northeastward.

Fig.2.2 Surrounding Area of Mahta WTP

2) Galbe Water Treatment Plant

The Galbe water treatment plant is located in the central zone of the western part of Kassara city, and there are schools, mosque, and market zone adjacently. There is a residential area in the east side of the school. Furthermore, there are an university, a school and market zone along the access road from a main trunk road to the water treatment plant.

Fig.2.3 Surrounding Area of Galbe WTP

3) South Treatment Plant

The south water treatment plant is located at the south end of the survey area. The surrounding area is agricultural area and the east side is dotted with residences. An access road to this water treatment plant is a community road in a residential zone.

Fig.2.4 Surrounding Area of South WTP

4) Situation of Areas along Route of Main Distributions and Raw Water Mains

The results of the investigation about the route of main distributions and raw water mains relevant to the south water treatment plant are shown below. The following points in route of main distributions which should be considered became clear. There is no problem about environmental and social considerations in the route of raw water mains.

- An elementary school adjoins the main distributions route, and a sufficient consideration for school children is required.
- Roads of the partial section of the main distributions route have narrow width.

5) Situation of Business Activities of Water Venders

It is expected that an adverse impact concerning regional economy, such as employment and livelihood, occurs on water venders by project implementation. For this reason, the present condition of water venders was investigated as one of the environmental and social consideration investigations.

Water venders in the survey area use the dray shown in the following photograph, and carry water from water supply points to each household, and obtain profits. The situation of the water venders which became clear from results of the investigation is summarized below.

- Water venders obtain water for sale from the water taps of SWC.
- The tank capacity of a dray is about 360 litters.
- The cost prices of water are 1 SDG / tank, and the selling prices are 5 SDG / tank.
- The number of sales cycles per day is an average of 5 times (five tanks).
- 21 water taps are registered as a water tap which water venders can purchase. (These water taps are registered as contract type of business use) 15 water taps were operating among those at the time of investigation. (refer to Figure 2.5)
- The tank of dray can be removed easily, and it can use as a dray for goods.
- The water sale business using the dray has spread widely in the State of Kassala, and in the non-served area of water supply, it is important business.
- According to the results of the social economic condition survey, the population which has purchased water from water venders is about 40,800 persons (24.6 %), and the average amount of water purchase is presumed to be 23 lcd.
- Although this number of water sale persons is unknown, it is presumed that the number of water venders increases to the dry season, and decreases in the rainy season.
- According to the information acquired in investigations, the number of water venders in the dry season is considered to be the range of 300 to 500 persons.

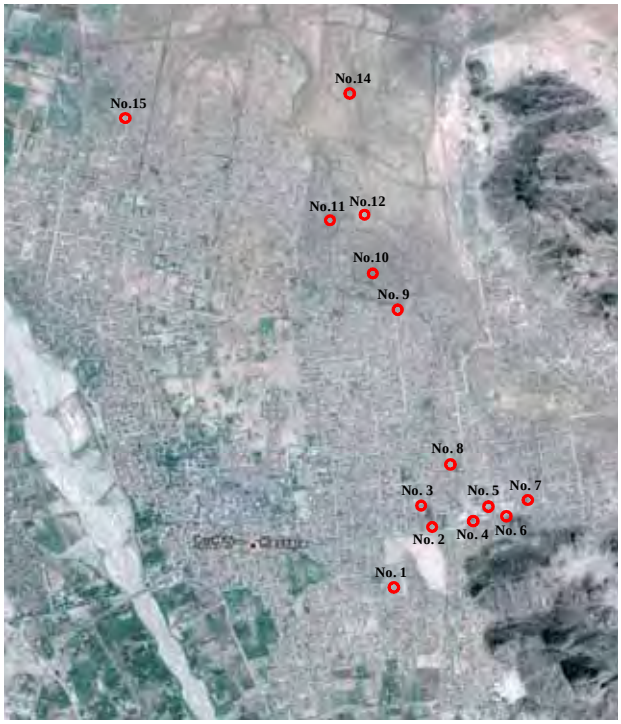


Figure 2.5 Locations of Water Tap for Water Vender

1-8 Initial Environmental Examination

The outline of predicted adverse impacts and grade of impact are shown in Table 2.7.

Table 2.7 Predicted Adverse Impacts

Environmental Elements			Grade	Reason
Social condition	1	Land acquisition and involuntary resettlement	D	Areas required for construction of water supply facilities are already acquired and it is not necessary to acquire any new land. The land use permission (Ministry of Agriculture) for new well construction is acquired.
	2	Local economy (Livelihood and employment)	B	<u>Operation Stage</u> Water vender's operating activities may decrease or lose with the improvement of water supply service
	3	Utilization of land and local resources	D	None
	4	Social institutions (Social capital and local decision-making institutions)	D	Public participation and information disclosure will be actively promoted about the project, so that understanding and cooperation of residents will be sought. (Stakeholder meetings were held twice in September and December, 2010.)
	5	Existing social infrastructures and services	B	<u>Operation Stage</u> 1) During construction of conveyance pipes and distribution main, closing of roads (one line alternate traffic), or use of detour may be necessary resulting in traffic congestion and inconvenience of access to public facilities 2) Traffic congestion may occur due to carrying in and out of construction materials and wastes.
	6	Vulnerable social groups such ad poor and indigenous peoples	D	Little possibility of benefit or adverse impacts to specific communities or residents. It is expected that improvement of water supply system may surely contribute to reduction of load for women and children's daily work of water collection.
	7	Equality of benefits and losses and equality in the development process	D	This project is targeting whole area of the eastern part of Kassala city. Implementation of the project does not harm equality of benefits as the same as the above.
	8	Local conflicts of interest	D	None
	9	Cultural heritage	D	None
	10	Water right and so on	D	There is no water area where rights, such as water rights, were set up. Moreover, this project does not have water intake of the surface water.

	11	Health and sanitation	B	Construction Stage Adverse impacts due to generation of the particulates and noise by vehicles at construction stage are envisaged, which will affect health and sanitation of residents living near access road.
	12	Infectious diseases such as HIV/AIDS	C	Construction Stage Possibility of occurrence of infectious diseases such as HIV/AIDS due to lodging of construction workers and contact to women is envisaged. However, it is difficult to assess the impacts at present.
	13	Hazards and security risks	C	Construction Stage Possibility of deterioration of security due to occurrence of crimes caused by lodging of construction workers is envisaged. However, the actual impacts are not clear as the above.
	14	Accidents (Traffic accidents etc.)	B	Construction Stage Possibility of traffic accidents will increase as traffic of vehicles will increase due to construction. Fully attention is required if schools and hospitals are located along the route of conveyance pipes and distribution main.
Natural conditions	15	Topography and geology	D	The project is not a large scale development which changes topography and geology.
	16	Soil erosion	D	The project is not a development which accompanies with large scale land reclamation and earth and sand mining.
	17	Groundwater	C	Operation Stage Although it depends for the source of water supply on groundwater, it has decided upon the pumping plan under which it was fully considered. Therefore, it is thought that the influence on groundwater is not generated.
	18	Flow and hydrological features	D	Water intake from river is not planned.
	19	Situation of Coastal Zone	D	The project area is inland area and there is no estuary.
	20	Flora and Fauna	D	Planned construction sites are provincial capital of the State of Kassala, and are the urbanized zone. Impacts to ecosystems at both construction and operation stages are considered to be negligible.
	21	Landscape	D	Configuration and scale of WTP do not cause adverse impact to landscape.
	22	Local climate	D	The project is not a large scale development which affects local climate.
	23	Global warming	D	Generation of green house gases such as CO_2 due to electricity consumption at WTP is considered to be negligible.

	24	Air pollution	B	Construction Stage Emission of particulates is envisaged from construction machines and vehicles during construction although its duration is short. Moreover, generating of particulates (dust) by construction vehicles is assumed
Public farm				
	25	Water pollution	D	Although a possibility that the amount of wastewater will increase by improvement of water supply service can be considered, wastewater is not discharged by wastewater treatment facilities (leaching pit) to a drainage canal. Therefore, it is thought that there is no influence on public water bodies. Moreover, in the dry season, there is no water in the public water bodies, and there is no concern of water pollution.
	26	Soil pollution	D	There is no discharge of the drainage and waste from WTP, and there is no soil pollution.
	27	Pollution of bottom layer	D	There is no discharge of the drainage and waste from WTP, and there is no pollution of bottom layer.
	28	Waste	D	There is no waste from WTP.
	29	Noise and vibration	B	Construction Stage Generation of noise and vibration from construction machinery and vehicles is envisaged. Operation Stage All of the sources of noise and vibration at operation stage are designed to be housed in buildings, and there is no effect outside of WTP.
	30	Ground subsidence	D	Although it depends for the source of water supply on groundwater, it has decided upon the pumping plan under which it was fully considered. Therefore, it is thought that there is no generating of land subsidence.
	31	Offensive odor	D	There is no source of offensive odor

Note: Grade is classified as follows
A: Significant effect is envisaged.
B: Some impact is envisaged.
C: Impact is not quite sure (examination is necessary).
D: No impact is envisaged.

Results of scoping are described below.

There is no “A” (significant effect is envisaged.) impact.

There are six “B” (some impact is envisaged.) impacts, five (existing social infrastructures and services, health and sanitation, accidents, air pollution, and noise and vibration) at construction stage and one (Local economy (Livelihood and employment)) at operation stage.
There are three “C” impacts which are not quite sure at present, viz. infectious diseases due to lodging of construction workers, security risks, and influence on groundwater by pumping.

1-9 Mitigation Measures

(1) Mitigation Measures for Adverse Impacts during Construction and Operation Stages

The impacts have been discussed in detail in the previous Section. Major impacts are not expected either at construction stage or operation stage and only minor impacts are envisaged. These impacts could be mitigated or minimized through measures undertaken during construction and operation stages of the proposed Project. These measures have been discussed in detail in this Section and presented in the following Table. In addition, the measure against mitigation in a construction stage is implemented by SWC which is a project proprietor, and the construction contractor.

Table 2.8 Mitigation Measures for Potential Adverse Impacts (Construction Stage)

Items	Adverse Impacts	Main Countermeasures
Existing social infrastructures and services	- Obstruction to traffic during construction of conveyance pipes and distribution line. - Possible adverse impacts such as air pollution (particulates), noise and vibration due to transportation of construction materials and waste.	• Publication of construction contents and its schedule • Agreement and observation regarding construction contents, operation and working hours of vehicles for transportation of materials • Arrangement of staff for traffic control. • Attentive operation and speed restrictions of construction vehicles • Instructions to drivers operators and workers about traffic manners by contractor • Water sprinkling at roads to prevent dust • Provision of cover on the bed of lorry to prevent scattering • Arrangement of information desk and deployment of a responsible person to receive complaints from residents living in the neighborhood of construction site (quick response to complaints)
Health and sanitation	- Same as above, air pollution and noise to the residents living in the neighborhood of the construction sites	Same as above

Items	Adverse Impacts	Main Countermeasures
Accidents (Traffic accidents etc.)	- Risks of occurrence of traffic increase due to increase of traffic of vehicles related to construction - Reduction of road width due to construction of conveyance pipe and distribution line, particular attention should be paid for vulnerable institutions such as schools and hospitals	• Publication of construction contents and its schedule • Agreement and observation regarding construction contents, operation and working hours of vehicles for transportation of materials • Arrangement of staff for traffic control. • Attentive operation and speed restrictions of construction vehicles • Instructions to drivers operators and workers about traffic manners by contractor • Arrangement of information desk and deployment of a responsible person to receive complaints
Air pollution	- Generation of particulates due to transportation of materials and construction activities - Exhausted gases from construction vehicles and machines	• Attentive operation of construction vehicles and machined, and speed restrictions • Preventive maintenance of construction vehicles and machines • Positive use of construction machines with countermeasures against exhausted gases • Arrangement of an information desk and deployment of a responsible person to receive complaints from residents, and monitoring of number and contents complaints
Noise and Vibration	- Noise and vibration due to construction vehicles and machines	• Attentive operation of construction vehicles and machined, and speed restrictions • Preventive maintenance of construction vehicles and machines • Positive use of low noise and low vibration construction machines • Arrangement of an information desk and deployment of a responsible person to receive complaints from residents, and monitoring of number and contents of complaints
Infectious diseases such as HIV/AIDS	- Possibility of occurrence of infectious diseases by persons relating to construction	• Education and enhancement of awareness to persons relating to construction (employee) by construction management company
Hazards and security risks	- Industrial accidents due to construction work - Possibility of deterioration in terms of safety such as climes caused persons relating to construction	• Safety education to persons relating to construction, and provision of safety measures • Obstruction of law relating to labor environment • Education to persons relating to construction (employee) by construction management company

Table 2.9 Mitigation Measures for Potential Adverse Impacts (Operation Stage)

Items	Adverse Impacts	Main Countermeasures
Local economy (Livelihood and employment)	- Reduction and loss of a water vender's operating activities	• The public announcement of the information and the recommendation of change of occupation by the state government and Kassala locality government • The positive job development of SWC
Groundwater	- Decline of the groundwater level	• The groundwater level is monitored, and change of a water level is grasped. • If required, it will prepare so that measures can be implemented promptly. (SWC and Water Research Department of the state government)

1-10 Environmental Management Plan and Monitoring Plan

(1) Environmental Management Plan

Adverse impacts in this project are expected in the construction and the operation stage. Therefore, in each stage, the suitable measure against mitigation to adverse impacts and the monitoring plan need to be carried out.

The in the construction stage is based on construction work activities,
Adverse impacts in the construction stage occur by construction work activities, and implementation of mitigation measures is construction constructor's duty (or construction supervisor's duty). At the same time, SWC which is project owner arranges information desks for receiving the request and complaint from residents. Furthermore, according to the results of mitigation measures, monitoring and complaint/opinion from residents, it is required that SWC should consider strengthening of mitigation measures.

Adverse impacts of the operation stage are classified into two. One is adverse impacts to the operating activities on water vender, the state government, the locality government and SWC need to take measures together against adverse impacts.

Another is adverse impacts expected with operation of water facilities, and SWC takes duty to these impacts. Based on the results of the monitoring, if required, SWC will implement mitigation measures.
However, monitoring concerning water quality has the necessity for the improvement in water analysis capability of the SWC personnel, and supplement of analysis reagents and instruments. The

technical cooperation to the SWC staff containing analysis reagents and instruments is required at the time of project implementation.

(2) Monitoring Plan

It is proposed to undertake following monitoring plans related to the adverse impacts that has been described earlier. The monitoring plan is categorized under construction stage and operation stage. For preparing the monitoring plan, it is considered that during construction stage influence will be short duration and therefore it is important to have measurement result immediately rather than caring for the level of accuracy and accordingly measurement methods should be selected. However, in the operation stage it is required to evaluate the level of influence and make judgment. Also, it is required to find out if any new adverse impact has come up during operation stage. Therefore, measuring method should be selected considering sufficiency in terms of accuracy and its simplicity in use. In case when new influence is expected in future, the measuring method should be improved based on the need of new impacts and desired accuracy or measured parameters. Monitoring programs for construction and operation stages are described below.

1) Construction Stage

On the access road and construction site, the noise generated by operation of vehicles carrying materials in/out of construction site and due to use of heavy construction machines should be measured using a portable noise level meter. Simultaneously, a complaint window is installed at a construction site and it monitors about the complaint and its contents from residents. When complaints are received from residents, the measurement result should be referred, and the reduction of operating speed of vehicles and sound reductions measures are implemented. Also, sound insulating wall should be installed if needed.

During construction activities, on the access road and the construction site, the particulates are generated by operation of vehicles carrying materials in/out and heavy construction machines. When complaints are received from residents, watering on the road and the reduction of operating speed of vehicles are implemented. (refer to Table 2.10)

Table 2.10 Monitoring Program for Construction Stage

Object	Monitoring Location	Parameters	Frequency	Implementing Agency	Monitoring Cost*
Noise	– Access road – WTP and Constructio n sites	Noise (maximum level)	Arbitrary number of times during the construction period, especially when the level is high.	SWC	about 30,000Yen (Expenses on buying equipments for measurement)
Request and complaint from residents	– surrounding area of access road and construction sites	Contents and number of requests and complaints	During the construction, a reception counter to be installed to respond any time.	SSUWC	No expense

* Personnel costs are not included.

2) Operation Stage

Monitoring in an operation stage is three items of supplied water quality, noise, and groundwater level. (refer to Table 2.11)

Periodical water quality measurement of supplied water shall be performed. Especially, the sample of distribution facilities, measurement should be carried out for presence of hazardous substances in four times a year.

The level of noise shall be measured outside the buildings of the pumps and generator, and at the boundary of WTP. Although, it is judged that there is no influence on the neighborhoods, especially measurement of sound level at night is recommended.

Monitoring of the groundwater level is measured in order to grasp the influence of pumping of groundwater. The wells used as the candidate for monitoring are test wells which are not selected as a source well.

These monitoring results are periodically reported to the Ministry of Physical Panning and Public Utilities of the State government which is a higher organization of SWC. Especially the monitoring result of the groundwater level is considered that deliberations with the Water Resources Department of the State government are important.

Table 2.11 Monitoring Program for Operation Stage

Object	Monitoring Location	Parameters	Frequency	Implementing Agency	Monitoring Cost*
Water Quality	– Distribution Facilities	pH, Turbidity	daily	SWC	No Expenses
		E Coli , Residual Chlorine	Weekly		about 60,000 Yen/Year (Expenses on buying equipments for measurement)
		Hazardous Substances (Fluoride, NO_2-N, NO_3-N)	4 times per year		No Expenses
Noise	Outside the buildings of: – Pump – Generator WTP Site boundary	Noise (maximum level)	Monthly	SWC	No Expenses Measurement apparatus purchased for monitoring at construction stage is used.

Object	Monitoring Location	Parameters	Frequency	Implementing Agency	Monitoring Cost*
Groundwater level	South WTP and surrounding area	Groundwater level	Weekly	SWC	No Expenses

* Personnel costs are not included.

1-11 Public Consultation (Stakeholder Meeting)

Two stakeholder meetings were held on September 22, 2010 and December 8, 2010. The purpose of this meeting is to explain the project for improvement of water supply facilities in the eastern part of Kassala city to residents, communities, and stakeholders. It is making requests and opinions from attendants reflect in project plan. Moreover, it is also one of the purposes to obtain comprehension of residents and administration officials through two stakeholder meetings. The outline as results of two stakeholder meetings is shown below.

(1) The 1st Stakeholder Meetings

It was held by the 1st stakeholder meetings by the total of 34 persons' participation containing eight resident representatives of district and nine administration officials, SWC, and the JICA survey team members. SWC explained the importance of the water service project the present condition of Kassala, city and in the future. The JICA survey team explained result outline of results of field survey, overall plan, and environmental social consideration.

The results of the first stakeholder meetings are summarized below.

- It is thought that the participants have fully understood the overall plan of the water supply facilities.
- It was asserted that Kassala city has been suffering, for quite long period of time, from shortage of safe water supply.
- The opinion which desires prompt rehabilitation of the existing reservoir in Mahta and Galbe WTP was offered.
- The opinion that the rehabilitation of a service pipe is also required was shown.
- As a participant's opinion, it was judged that it was the satisfying water service plan fundamentally. However, in order to obtain sufficient understanding, it is thought that it is necessary to release information positively.
- SWC requested resident representatives to explain the overall plan of the water supply facilities to residents.

(2) The 2nd Stakeholder Meetings

The State Water Corporation (SWC) of Kassala city organized the second stakeholder meetings on December 8, 2010. The second meeting explained the project for improvement of water supply

facilities in the eastern part of Kassala city (overall plan) in detail following the first stakeholder meeting. Furthermore, the approved final components of the project which was prepared by the JICA survey team and construction of water reservoirs in Mahta and Galbe WTP as an urgent rehabilitation project were clearly explained.

Moreover, the meeting was aimed at presenting and discussing the expected environmental and social impact of the project and the mitigation measures that would be adopted to control these impacts. A total of 36 persons of the resident representative of the survey area, administration officials of state and locality governments, SWC, and JICA survey team member participated in this meeting.
The results of the second stakeholder meetings are summarized below.

- Kassala State Government is committed to provide local components for the project which is quite essential for the implementation of the project
- All attendants including resident representation wished prompt implementation of project, and the intention of asking for the improvement of water service was shown.
- About replacement of asbestos pipe required for leakage problem solving, SWC promised promotion of the continuous rehabilitation project.
- The strong request about capacity building and technical training to SWC was shown.
- The opinion was shown about the importance of groundwater level and water quality monitoring as measures against the influence of groundwater and the safety of water supply.

According to the results of two stakeholder meetings, there is no opinion which is opposed to the project for improvement of water supply facilities in the eastern part of Kassala city, and it became clear that all attendants including resident representation wished prompt implementation of project. Moreover, although influences in construction and operation stage are expected as adverse impacts by implementation of project, it could reduce by taking suitable measures. After understanding these adverse impacts, it was judged that project promotion was supported.

1-12 Conclusions

Environmental items which require particular attention, in other words items which may cause significant impacts or which cannot be recovered easily are following five items. It is judged that there is no adverse impact on these items due to the implementation of the project except “local economy such as employment and livelihood etc.” as adverse impact.

Table 1.12 Environmental Items which Require Particular Attention

Environmental Items	Yes/No	Adverse Impacts
Involuntary resettlement of residents	No	The construction site of WTP is already acquired, acquisition of new land is unnecessary. Involuntary resettlement of residents does not occur.
Local economy such as	Yes	The operating activities of water vender may be decreased or

employment and livelihood etc.		lost by improvement of project.
Occurrence of secondary contamination (environmental contamination caused by heavy metals and hazardous materials)	No	There are no drainage from WTP and no discharge of sludge, and there is no possibility of generating of the source of secondary contamination.
Disappearance of and damage to cultural properties and heritage	No	There is no structure relating to cultural properties and heritage at the construction sites for WTP, conveyance pipes and distribution main.
Effect of natural reservation areas	No	There is no natural reservation area in the project area.

Although reduction of water vender operating activities or the possibility of loss as “local economy such as employment and livelihood” were expected, it was judged that it was possible to make influence reduce by the following items and implementation of suitable measures of SWC, state, and the locality government.

- The necessity for the water vender by the residents who increase in Kassala city and circumference zone is continued for a long period of time. (Continuous necessity)
- Water venders increase the period when suspension of water supply has occurred. Water venders increasing in number is people of the small-scale transport industry who are carrying the load in a market or in the city, and usually does business using the same dray as water sale. (Possibility of change of employment)
- In SWC, it is possible to employ for construction and maintenance of distribution and service pipes.

In conclusion, it is judged that there is no significant adverse effect due to the implementation of the project. However, some environmental items (minor adverse impacts) require attention at both construction stage and operation stage. Mitigation measures and monitoring of these environmental items are required.

On the other hand, it is expected that implementation of the project will contribute to improvement of the water supply situation of the eastern part of Kassala city, and reduction of water conveyance labor of woman and children is also expected.

2 Land acquisition and Involuntary Resettlement

2-1 Necessity of Land acquisition and Involuntary Resettlement

As the clause of "Outline of Project Components of having Environmental and Social Impacts” described, facilities lands for this project are already prepared. Therefore, there is no necessity for a new facilities land, and there is no occurrence of an involuntary resettlement.

2-2 Others

2-2-1 Monitoring Form (draft)

It is necessary to report the result of monitoring in construction and the operation stage of the project to the Kassala State Government which is a higher organization. The monitoring form (draft) of

using in order to report the monitoring result is shown below.

Table 2.13 Monitoring Form for Surrounding Environment (Construction Stage)

Monitoring Item	Monitoring Results during Report Period
Number of requests and complaints	
Content of requests/complaints	

Table 2.14 Monitoring Form for Noise (Construction Stage)

Item	Unit	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				85 dB*	

* The regulation value in Japan (during construction work period)

Table 2.15 Monitoring Form for Supplied Treated Water (Operation Stage)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
pH	-			6.5 – 8.5			
Turbidity	NTU			5 NTU			
Residual Chlorine	mg/l			0.1*		5**	
E. Coli	n/100 ml			ND			
Fluoride	mg/l			1.5 mg/l			
NO_2-N	mg/l			2 mg/l as NO_2			
NO_3-N	mg/l			50 mg/l as NO_3			

* Usually, 0.1 mg/l is secured in order to maintain disinfection property.
** In the WHO guideline, 5 mg/l is shown as upper limit.

Table 2.16 Monitoring Form for Noise (Operation Stage)

Item	Unit	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				40 dB*	

* The regulation value in Japan (during night time)

Table 2.17 Monitoring Form for Noise (Operation Stage)

Item	Unit	Measured Value	Country's Standards	Standards for	Referred International	Remarks (Measurement Point, Frequency,

				Contract	Standards	Method, etc.)
Groundwater Level	m					

2-2-2 Environmental Check List

The environmental check list is shown in Table 2.18.

Table 2.18 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) N (c) N (d) Y	(a) , (b), (c), Although EIA report is unnecessary, "Environmental Feasibility Study" specified from Environment Protection Act needs to be submitted. The contents of "Environmental Feasibility Study" are included in the contents of the initial environmental examination survey. (d) The approvals about construction of source wells and raw water mains were acquired.
	(2) Explanation to the Public	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design	(a) Y (b) Y	(a) , (b) Two stakeholder meetings were held. Suitable explanations for the local resident and stakeholders who participated in the meeting were given, and participant's understandings have been obtained. Moreover, participant's opinions are made to reflect in the project.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	Examination of alternatives is only two cases of "With project" and "Without project."

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) N (b) N	(a) Although gaseous chlorine is used for disinfection in the existing institution, the considered storage facility is planned. (b) Chlorine is not specified although there is law which specifies labor environment in the Sudan.
	(2) Water Quality	a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) N	(a) There is no drainage from WTP.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) N	(a) There is no generating of the water purifying sludge.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) Y	(a) The machines which generate noise and vibration are installed in a building, and it takes noise control measures. Therefore, it is presumed that adverse impacts by noise and vibration are not generated in the operation stage.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) It was decided upon the pumping plan based on the detailed existing well investigation. Therefore, it is judged that land subsidence does not occur.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There is no protected area appointed by the Sudan government, an international treaty, etc. in the survey area.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) N (b) N (c) N (d) N	(a) , (b), (c), (d) There are no primeval forests, tropical rain forests, ecologically valuable habitats in the survey area. No adverse impact on the ecosystem is envisaged.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?		(a) The detailed existing well investigation was conducted and it has decided upon the pumping plan which does not have adverse impact on the existing well.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) N (c) N (d) N (e) N (f) N (g) N (h) N (i) N (j) N	(a) , (b), (c), (d), (e), (f), (g), (h), (i), (j) The construction site of WTP is already acquired, acquisition of new land is unnecessary. Involuntary resettlement of residents does not occur.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a) N (b) N	(a) The influence on the water vender by the improvement of water supply service is expected. Employment by SWC and adequate measures by the state government, the locality government and SWC are expected. (b), The detailed existing well investigation was conducted and it has decided upon the pumping plan which does not have adverse impact on the existing well.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There is no possibility that the project will damage the archeological, historical, cultural and religious heritage.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) The surrounding area of the planned site (South WTP) is mainly agricultural land and empty land, and there is no scene which should be considered.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) N	(a), (b) Ethnic minorities and indigenous people are not settled in the project area and no serious impact of project activities are expected on culture and lifestyle of ethnic minorities and indigenous people.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) N (b) N (c) N (d) N	(a) , (b), (c), (d) It is required to make safe consideration through the technical cooperation project concerning operation and management of WTP.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) N (b) N (c) N (d) N	(a) , (b), (c), (d) In the construction stage, in order to mitigate noise, vibration, and particulates, it is necessary to take suitable measures. Serious impacts on the natural environment are not anticipated.

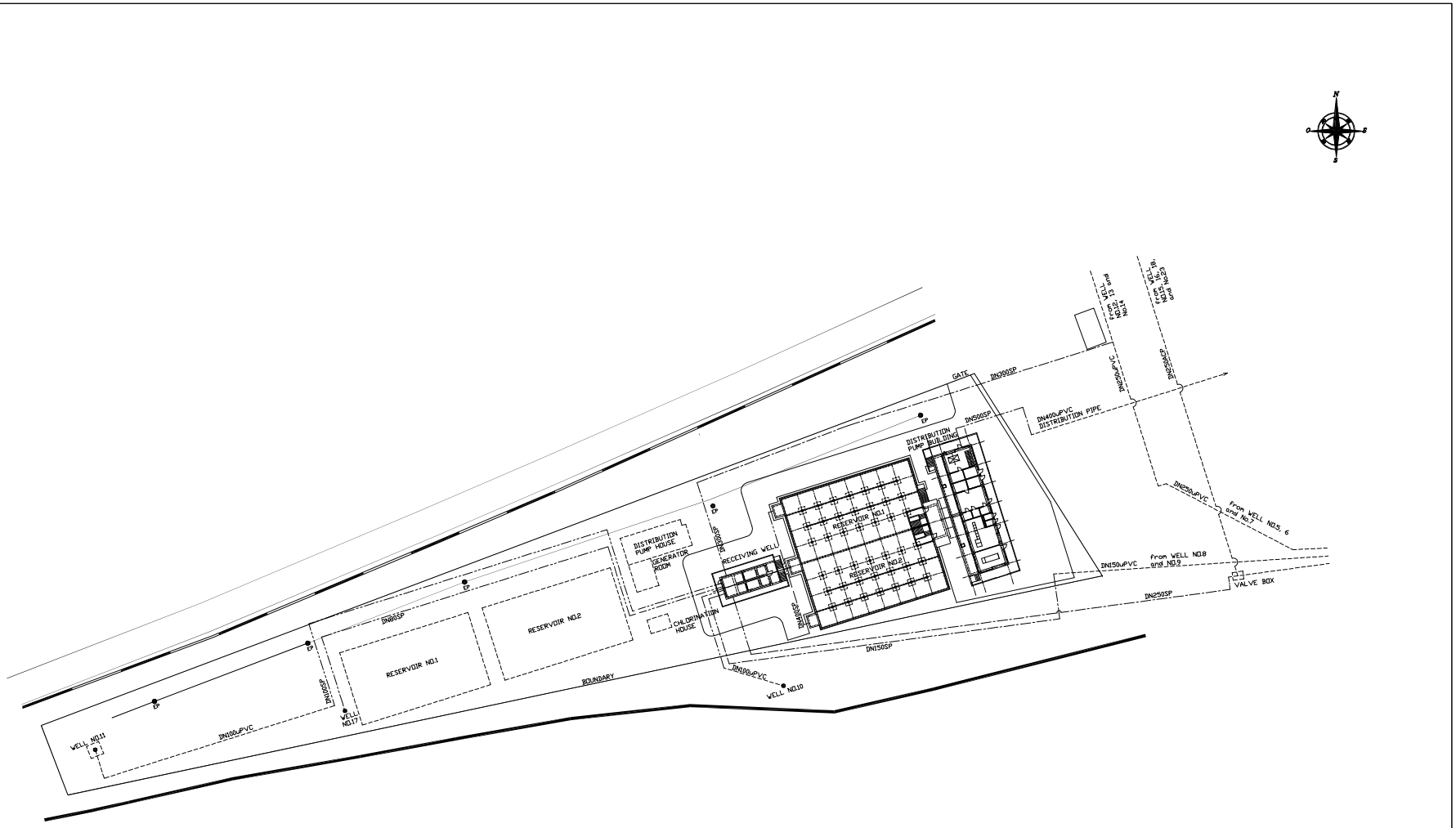
Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) N (b) N (c) N (d) N	(a) , (b), (c), (d) Monitoring plans on both construction stage and operation stage have been prepared. Monitoring is to be conducted based on these plans. Detailed environmental monitoring plan is also prepared and monitoring framework is to be established by SWC. These monitoring results are periodically reported to Ministry of Physical Panning and Public Utilities of the state government which is the higher organization of SWC. In particular, about the monitoring result of the groundwater level, the consultation with the Water Resources Department is required.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.		(a) , None
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) , The impacts to transboundary or global issues are not assumed.

Appendix-11　Outline Design Drawing

Appendix 11 Outline Design Drawing

Project	DWG. No.	Facilities	Title
Rehabilitation	M-1-1	Mahata WTP	Plan of Mahata WTP
	M-2-1		Hydraulic profile
	M-3-1		Receiving well (1)
	M-3-2		Receiving well (2)
	M-3-3		Receiving well (3)
	M-4-1		Reservoir (1)
	M-4-2		Reservoir (2)
	M-4-3		Reservoir (3)
	M-5-1		Distibution pump building Plan
	M-5-2		Distibution pump building Elevation & Section
	M-6-1		Flow diagram of chlorine dosing equiipment
	M-7-1		Single-line wiring diagram for distribution pump panel boad
	M-8-1		Instrumentation system chart
	G-1-1	Garb WTP	Plan of Garb WTP
	G-2-1		Hydraulic profile
	G-3-1		Receiving well (1)
	G-3-2		Receiving well (2)
	G-3-3		Receiving well (3)
	G-4-1		Reservoir (1)
	G-4-2		Reservoir (2)
	G-4-3		Reservoir (3)
Extension	K-1-1	Intake	Typical DWG of water source well (well structure)
	K-1-2		Typical DWG of new facilies (Plan & Section)
	K-1-3		Typical DWG of existing well facilies (Plan & Section)
	K-2-1	Khatmia WTP	Plan of Khatmia WTP
	K-3-1		Hydraulic profile
	K-4-1		Receiving well (1)
	K-4-2		Receiving well (2)
	K-4-3		Receiving well (3)
	K-5-1		Reservoir (1)
	K-5-2		Reservoir (2)
	K-5-3		Reservoir (3)
	K-6-1		Distibution pump building Plan
	K-6-2		Distibution pump building Elevation & Section
	K-7-1		Flow diagram of chlorine dosing equiipment
	K-8-1		Single-line wiring diagram for distribution pump panel boad
	K-9-1		Instrumentation system chart
	K-10-1	Piping	Raw water transmission pipe and south distribution pipe

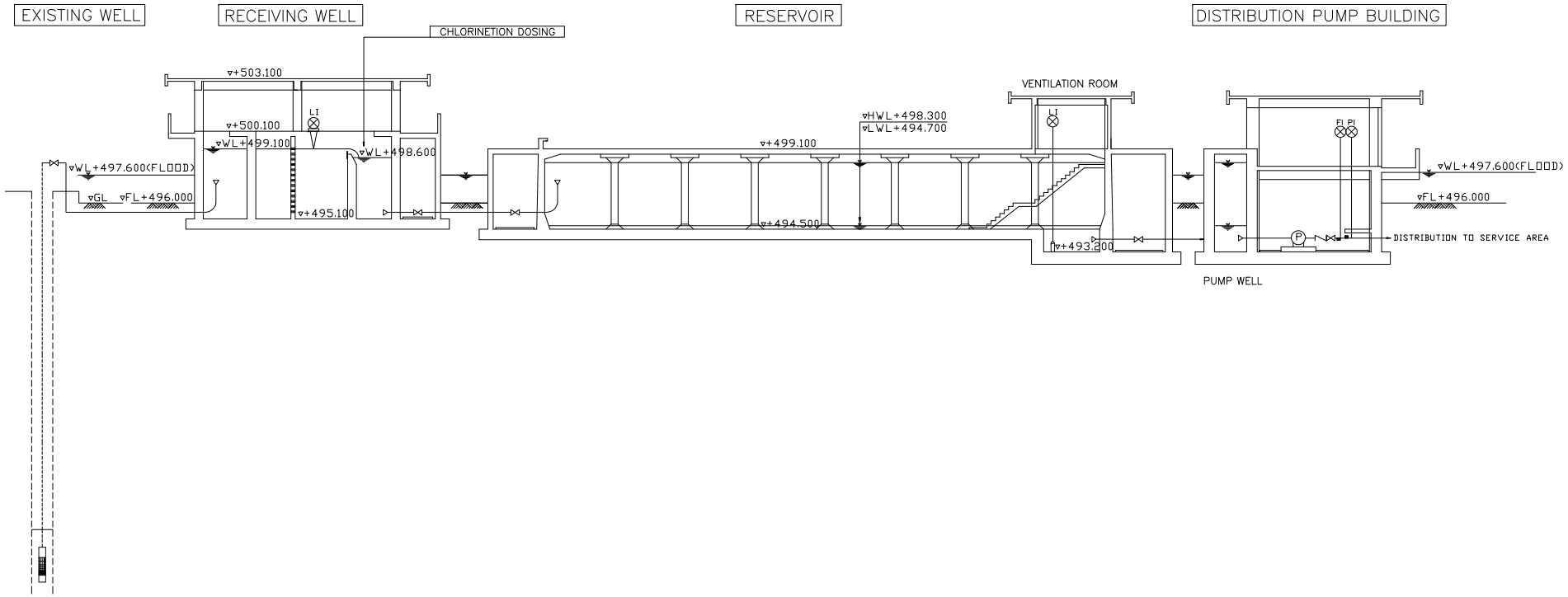
A-11-3



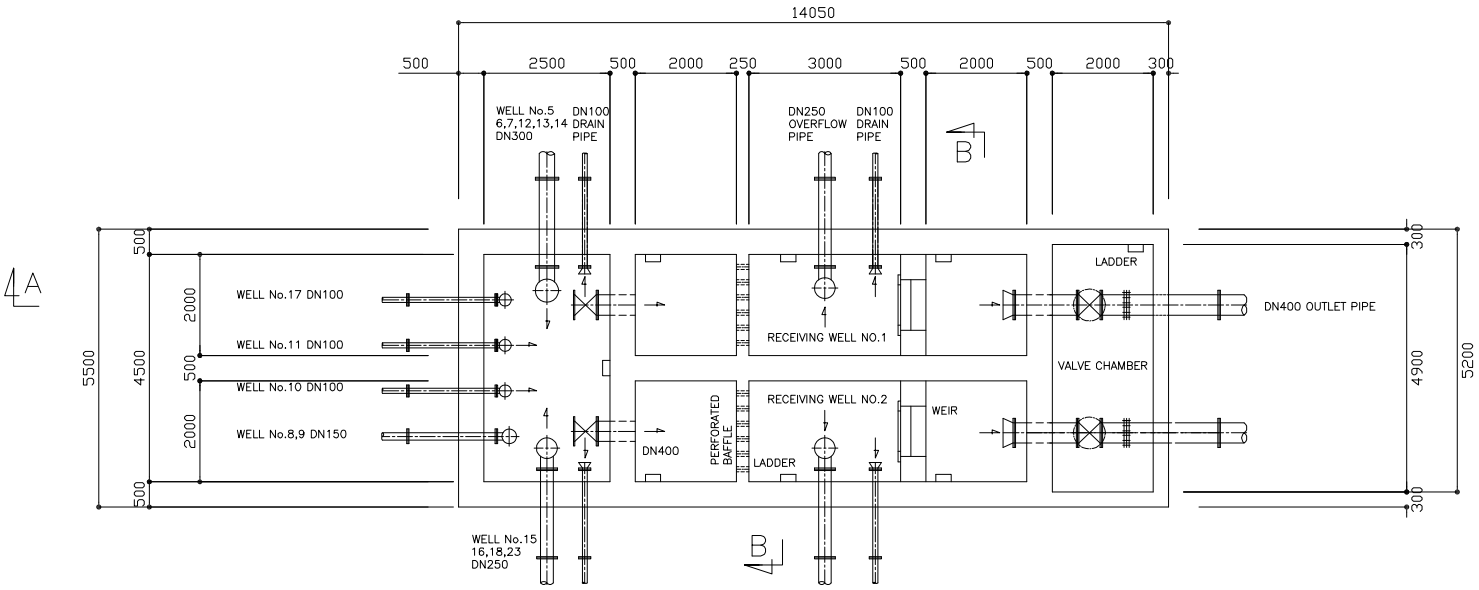
REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT	SCALE : 1:1,000	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN	PLAN OF MAHTA WATER TREATMENT PLANT MAHTA 浄水場平面図	DRAWING NO. : M−1−1	PREPARED BY : NONE
					DATE : 2010

A-11-4

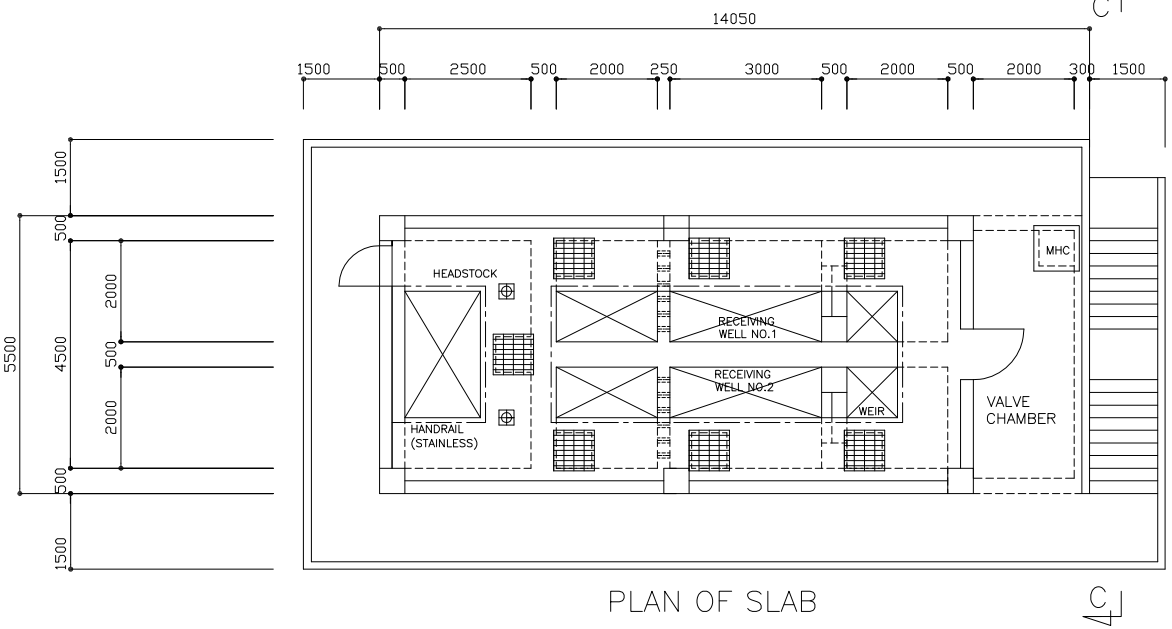
HYDRAULIC PROFILE FOR MAHTA WTP



REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT HYDRAULIC PROFILE 水位高低図	SCALE : NONE	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : M−2−1	PREPARED BY : NONE DATE : 2010

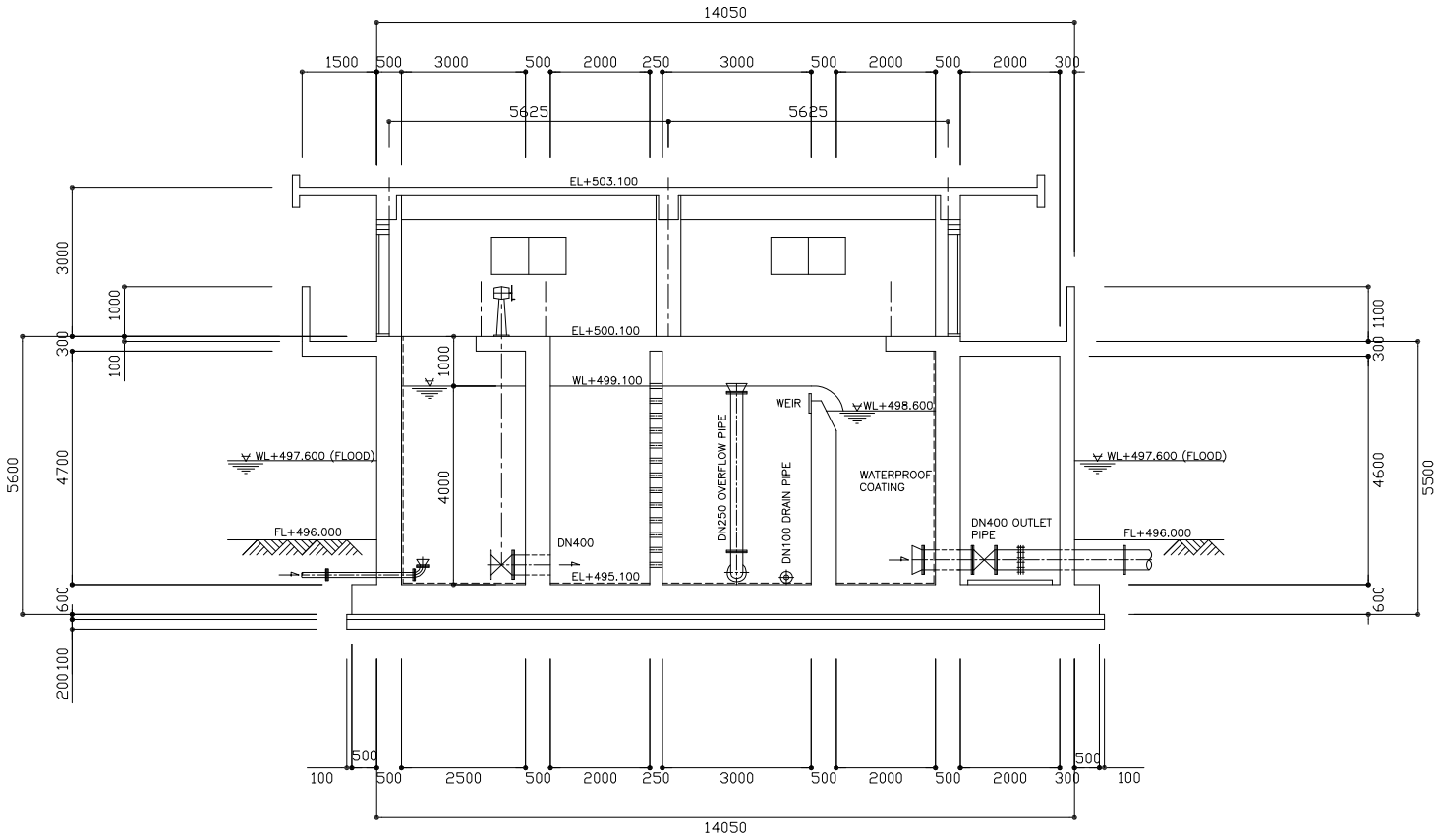


PLAN OF BASE



PLAN OF SLAB

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT	SCALE : 1:100	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN	RECEIVING WELL (1) 着水井構造図(1)	DRAWING NO. : M−3−1	PREPARED BY : NONE
					DATE : 2010



SECTION A – A

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT RECEIVING WELL (2) 着水井構造図(2)	SCALE : 1:100	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : M−3−2	PREPARED BY : NONE
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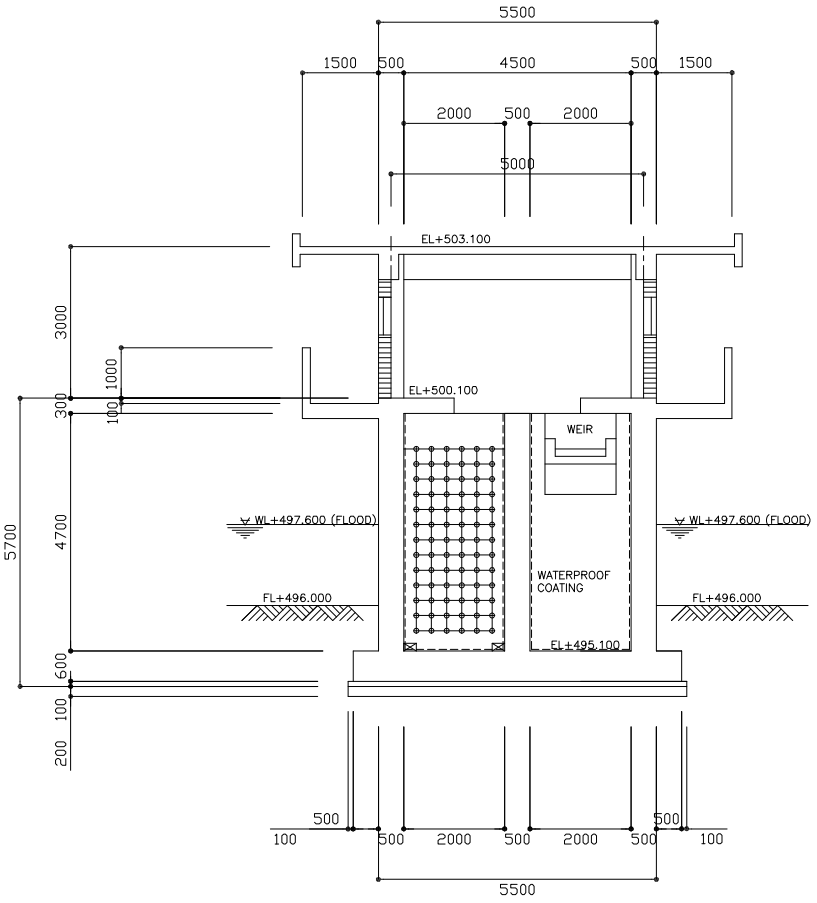
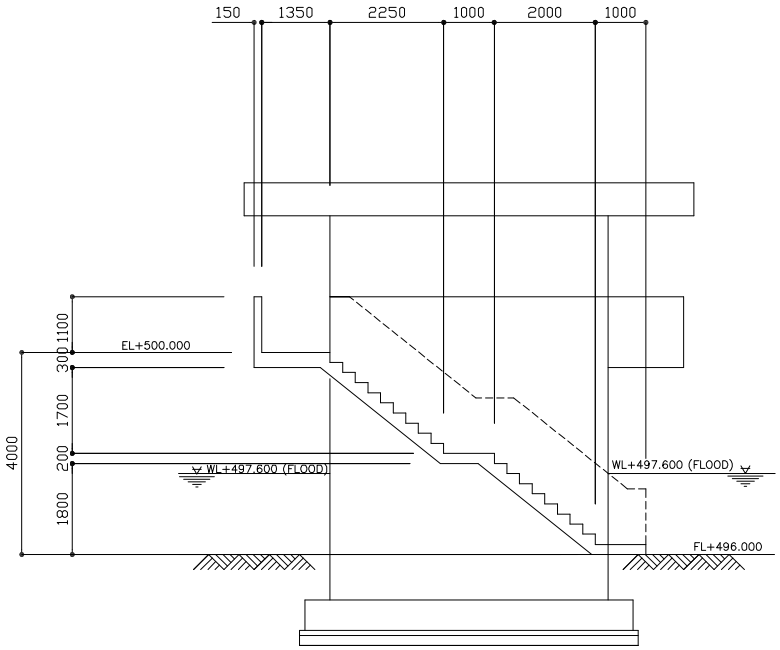
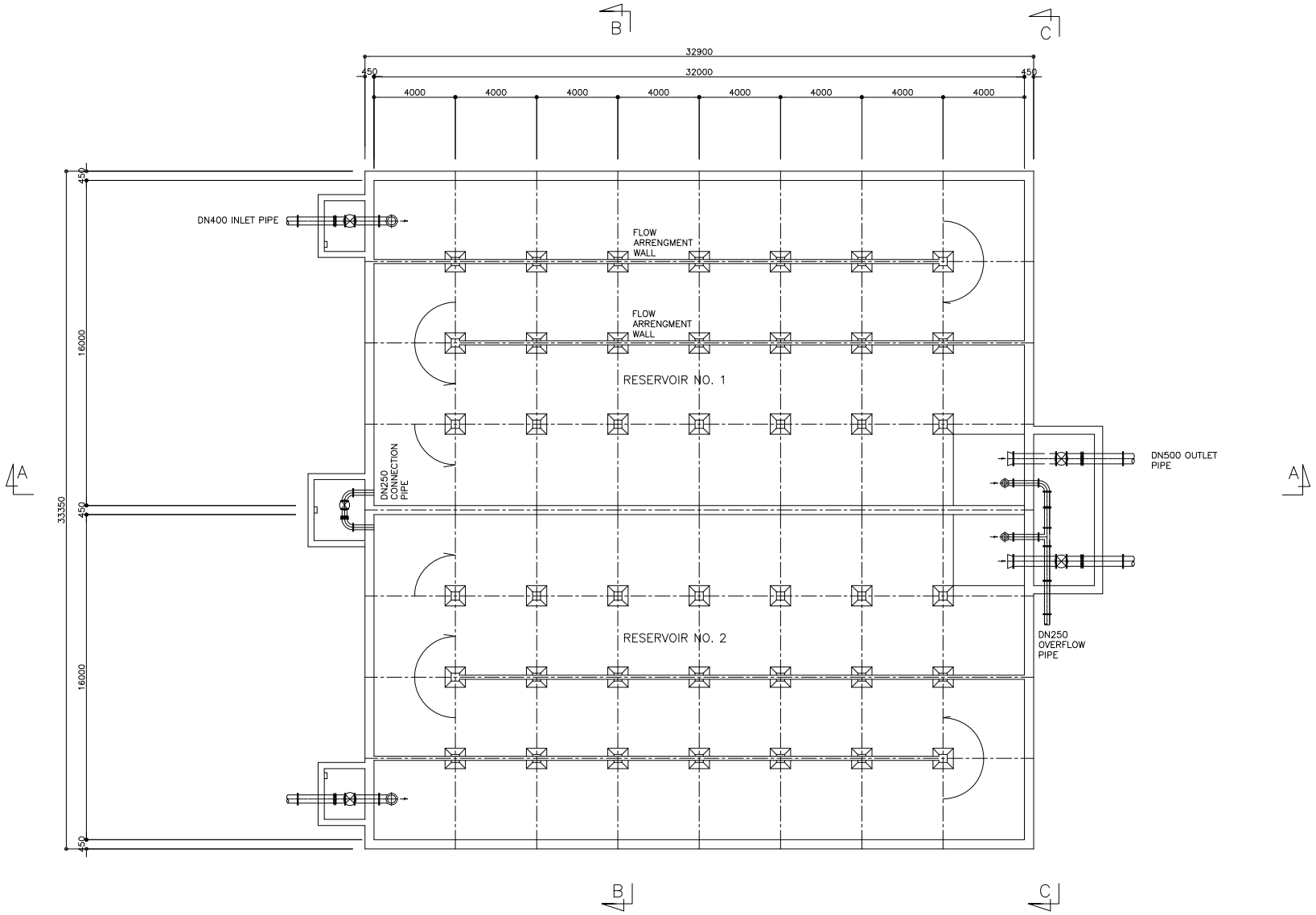


SECTION B – B



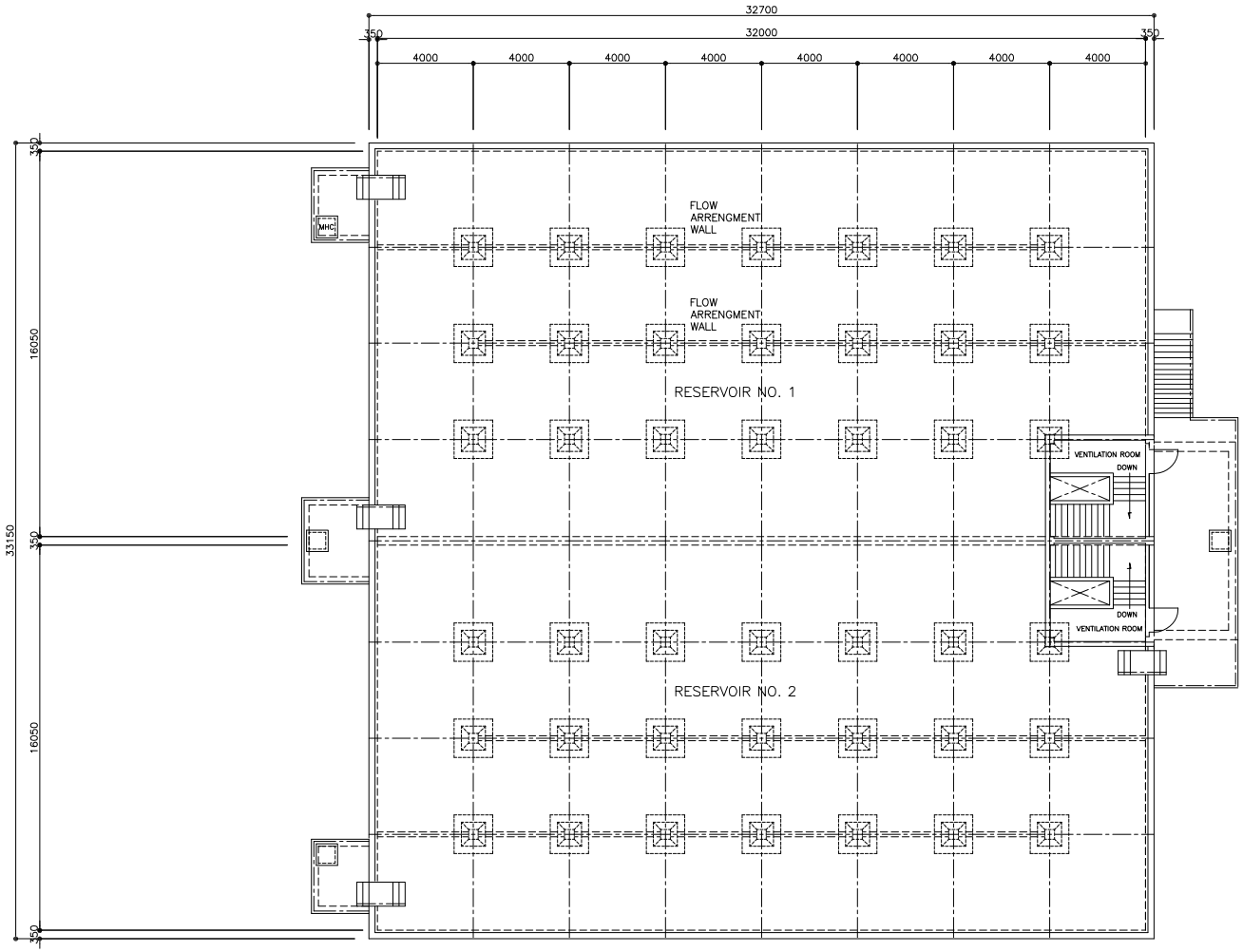
SECTION C – C

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE :	MAHTA WATER TREATMENT PLANT RECEIVING WELL (3) 着水井構造図(3)	SCALE : 1:100	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC	TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN			DRAWING NO. : M-3-3	PREPARED BY : NONE
							DATE : 2010



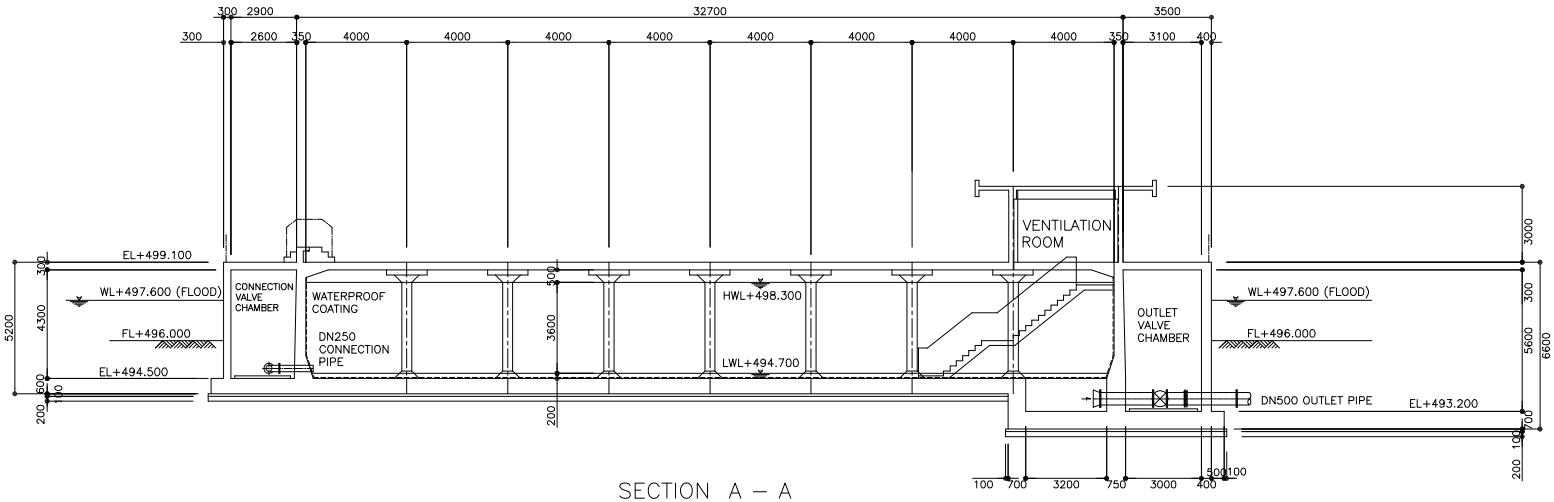
PLAN OF BASE

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT RESERVOIR (1) 配水池構造図(1)	SCALE : 1:200	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : M−4−1	PREPARED BY : NONE
					DATE : 2010

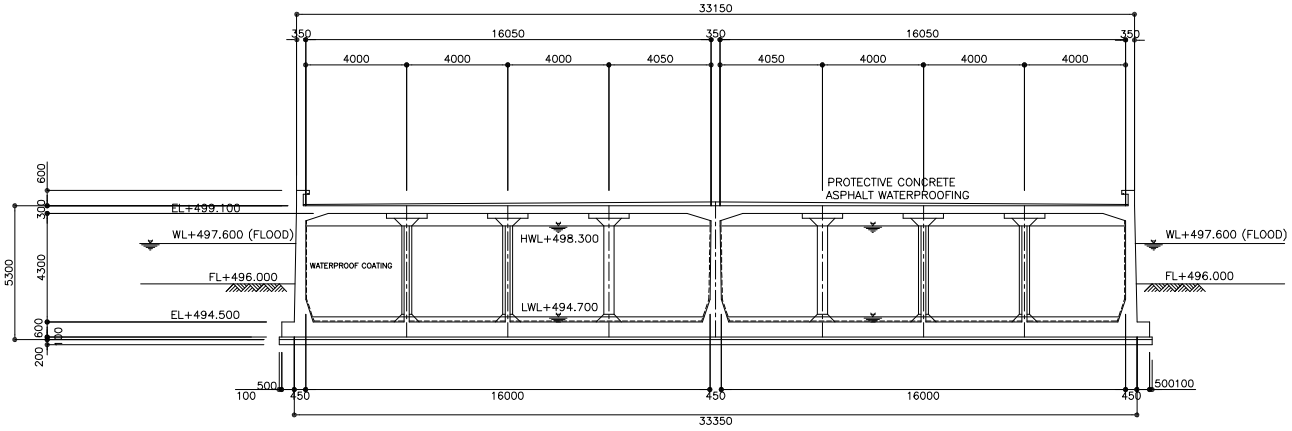


PLAN OF SLAB

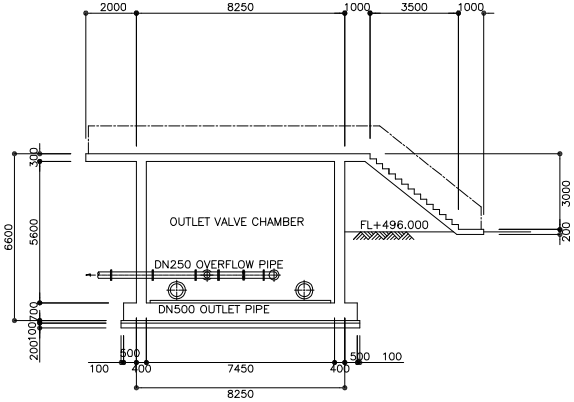
REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT	SCALE : 1:200	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN	RESERVOIR (2) 配水池構造図(2)	DRAWING NO. : M−4−2	PREPARED BY : NONE
					DATE : 2010



SECTION A – A



SECTION B – B



SECTION C – C

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT RESERVOIR (3) 配水池構造図(3)	SCALE : 1:200	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : M-4-3	PREPARED BY : NONE
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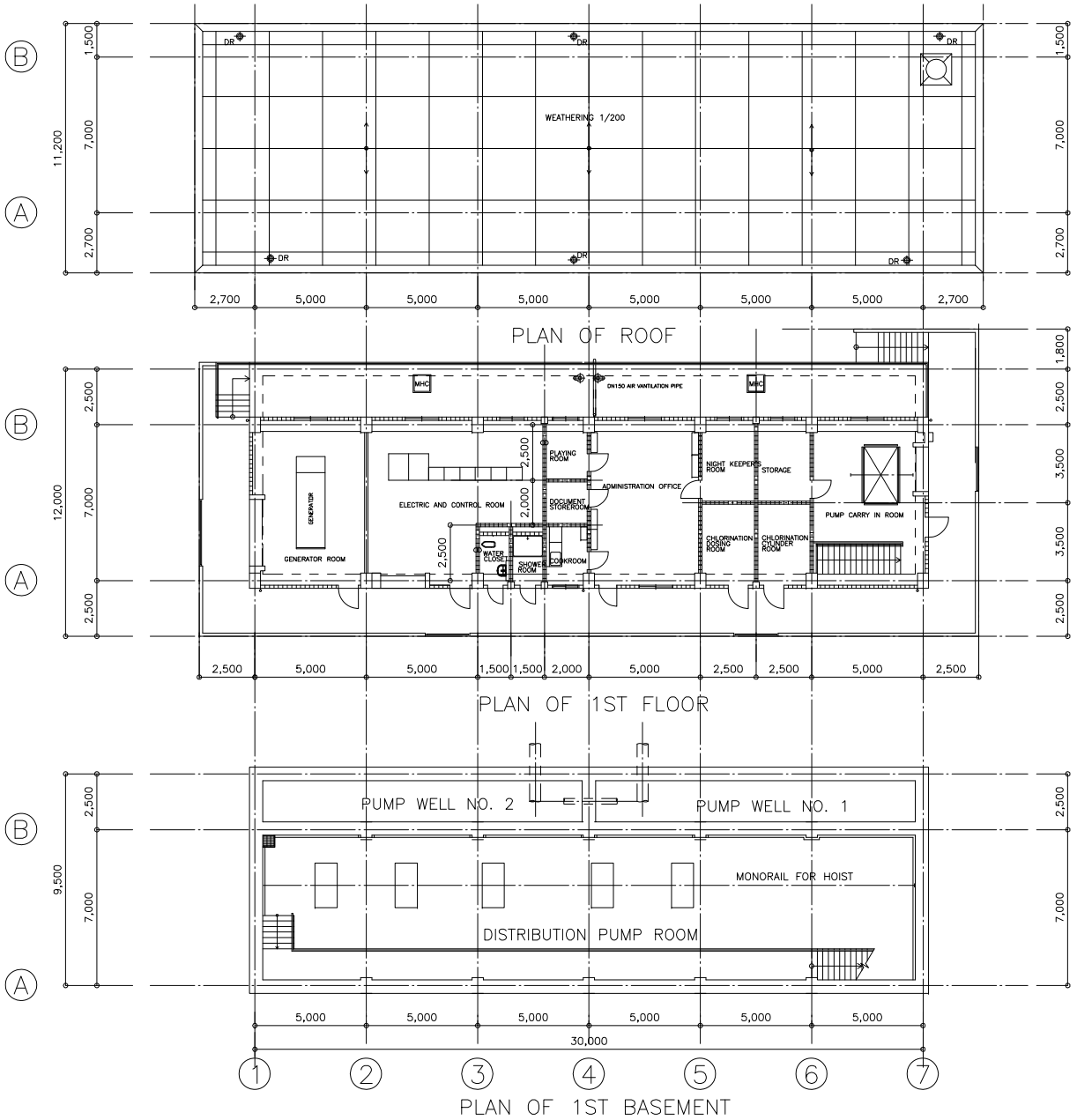

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT DISTRIBUTION PUMP BUILDING (1) 配水ポンプ棟構造図（1）	SCALE : 1:200	APPROVED BY : NONE
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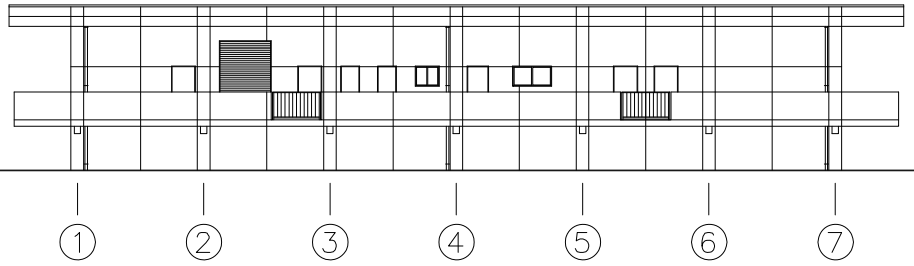
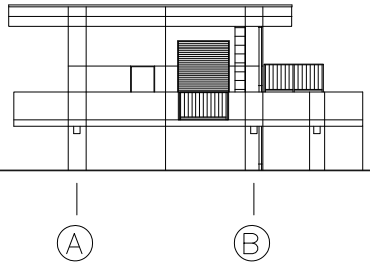
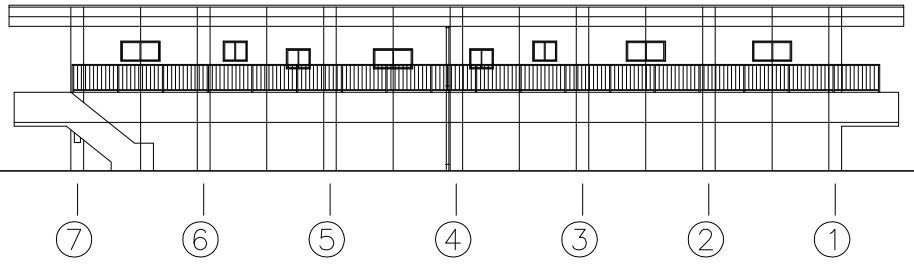


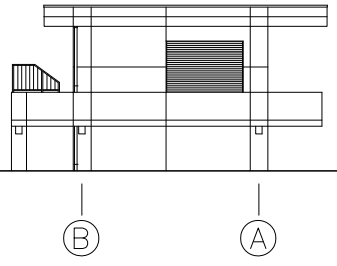
EAST ELEVATION



NORTH ELEVATION

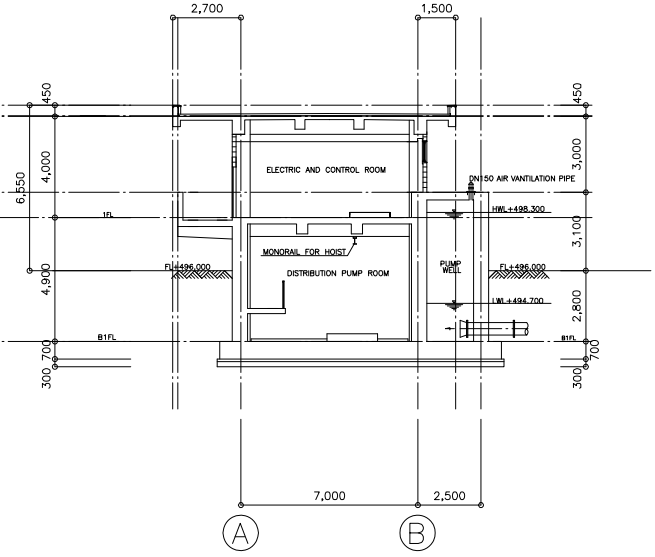


WEST ELEVATION



SOUTH ELEVATION

SECTION A – A



SECTION B – B

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT DISTRIBUTION PUMP BUILDING (2) 配水ポンプ棟構造図(2)	SCALE : 1:200	APPROVED BY : NONE
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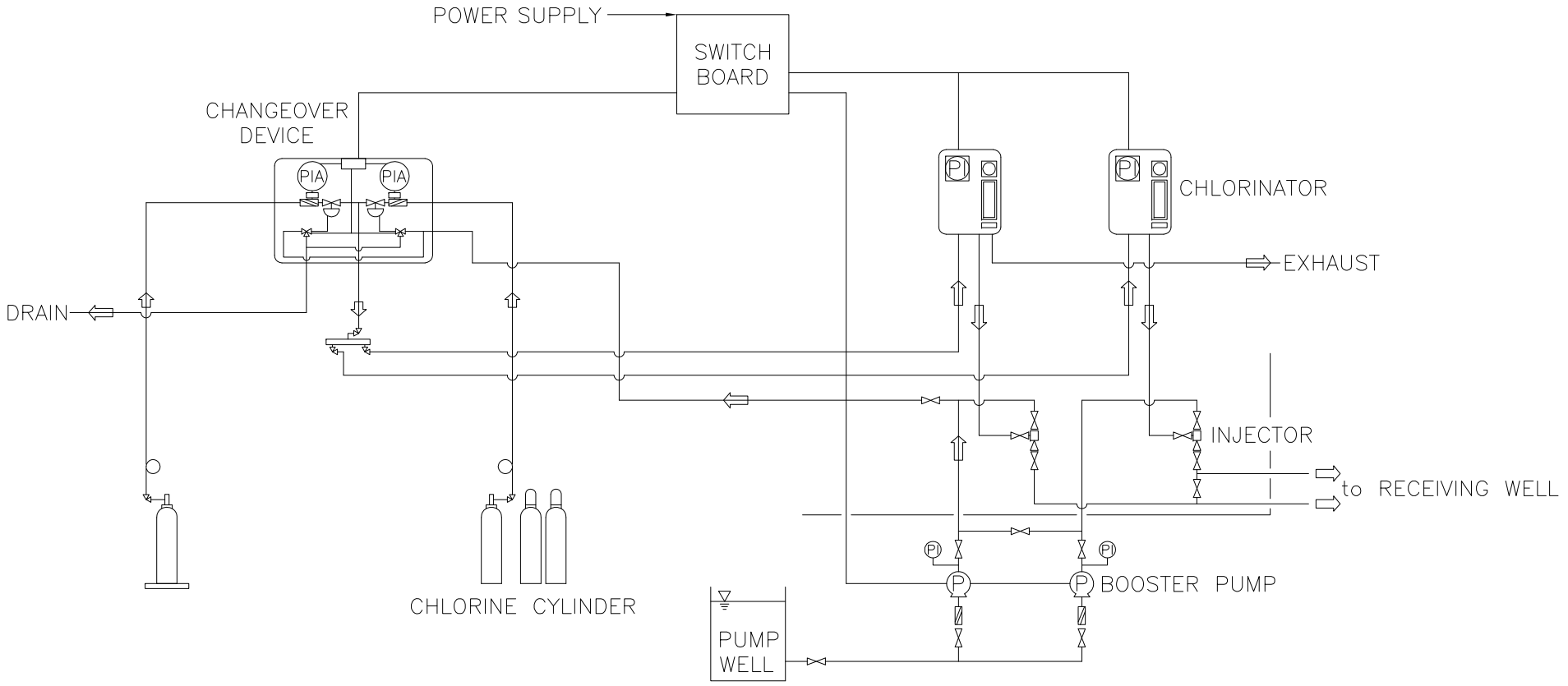
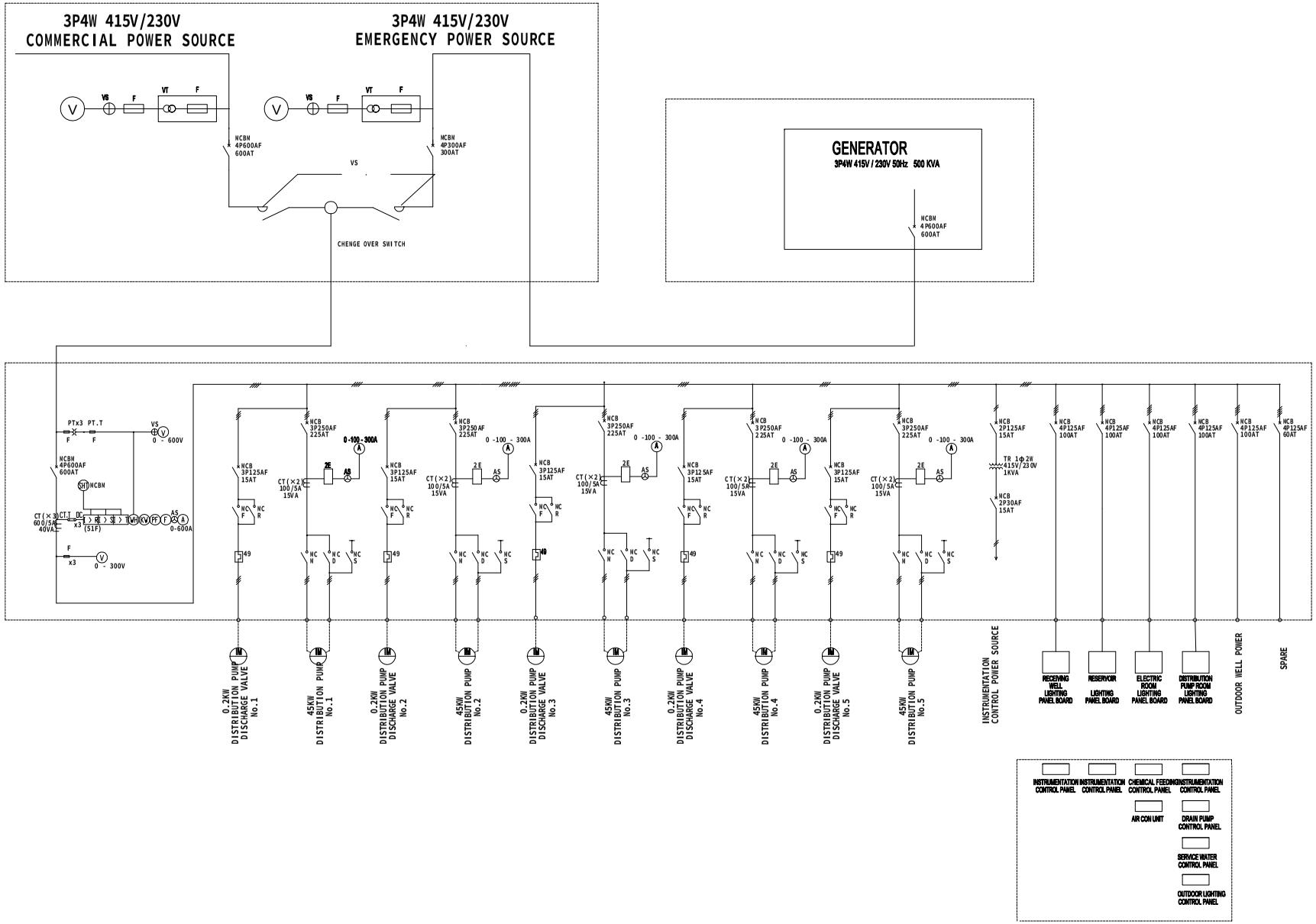
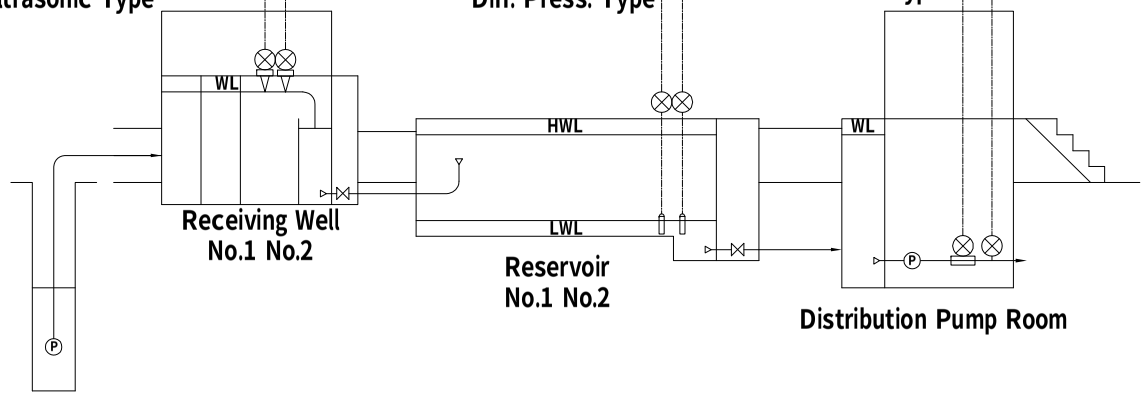


REMARKS :	THE PREPARATORY SURVEY (PHASE II) ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT	SCALE : NONE	APPROVED BY : NONE
	STATE WATER CORPORATION, SUDAN	TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN	FLOW DIAGRAM of CHLORINATION DOSING EQUIPMENT 塩素注入設備フローシート	DRAWING NO. : M－6－1	PREPARED BY : NONE
					DATE : 2010



REMARKS :	THE PREPARATORY SURVEY (PHASE II) ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT SINGLE-LINE WIRING DIAGRAM FOR DISTRIBUTION PUMP PANEL BOARD 単線結線図	SCALE : NONE	APPROVED BY : NONE
	STATE WATER CORPORATION, SUDAN	TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : M－7－1	PREPARED BY : NONE DATE : 2010

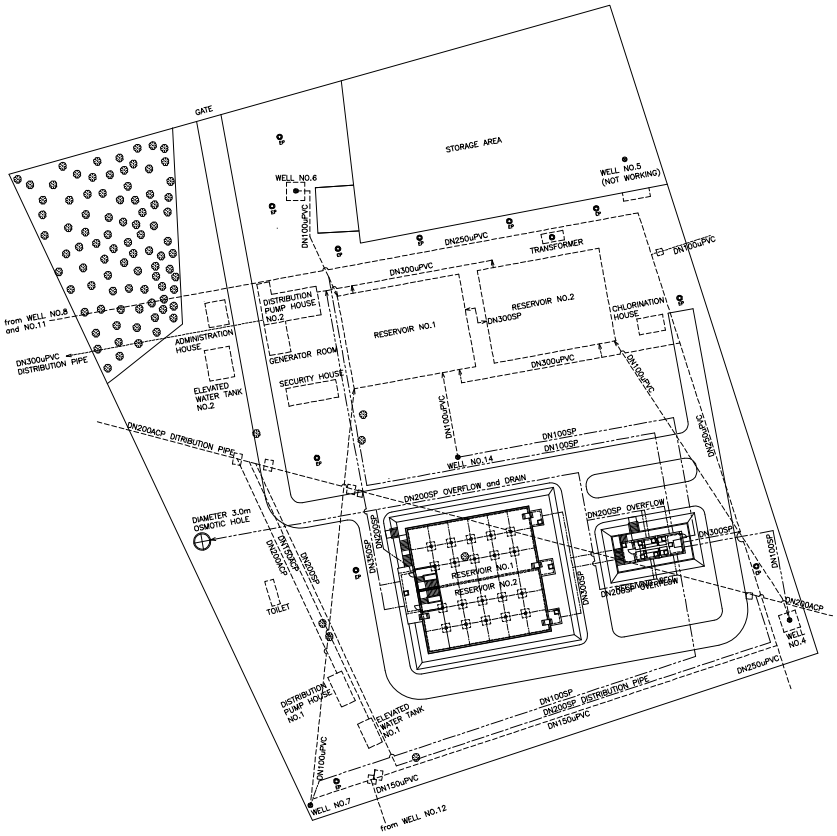
LOOP NAME	Raw Water Level & Flow Meter No.1 No.2		Resevoir Water Level No.1 No.2		Distribution Water Flow & Pressure	
SCALE	0m to 1m	0m3 to 700m3	0m to 5m	0m to 5m	0m3 to 20000m3	0m to 1Mpa
INSTRUMENTATION PANEL	LI FI FQ Power IS LA LA	LI FI Power IS LA LA	H LL LIA DS LA	H LL LIA DS LA	Ig FI FQ PI IS Power DS LA LA LA	
LOCAL PANEL	SC LA LA FI LI	SC LA LA FI LI	LA LI	LA LI	LA FI	PI
LOCAL	Ultrasonic Type		Diff. Press. Type		Ultrasonic Type	Pressure Type



NOTE:

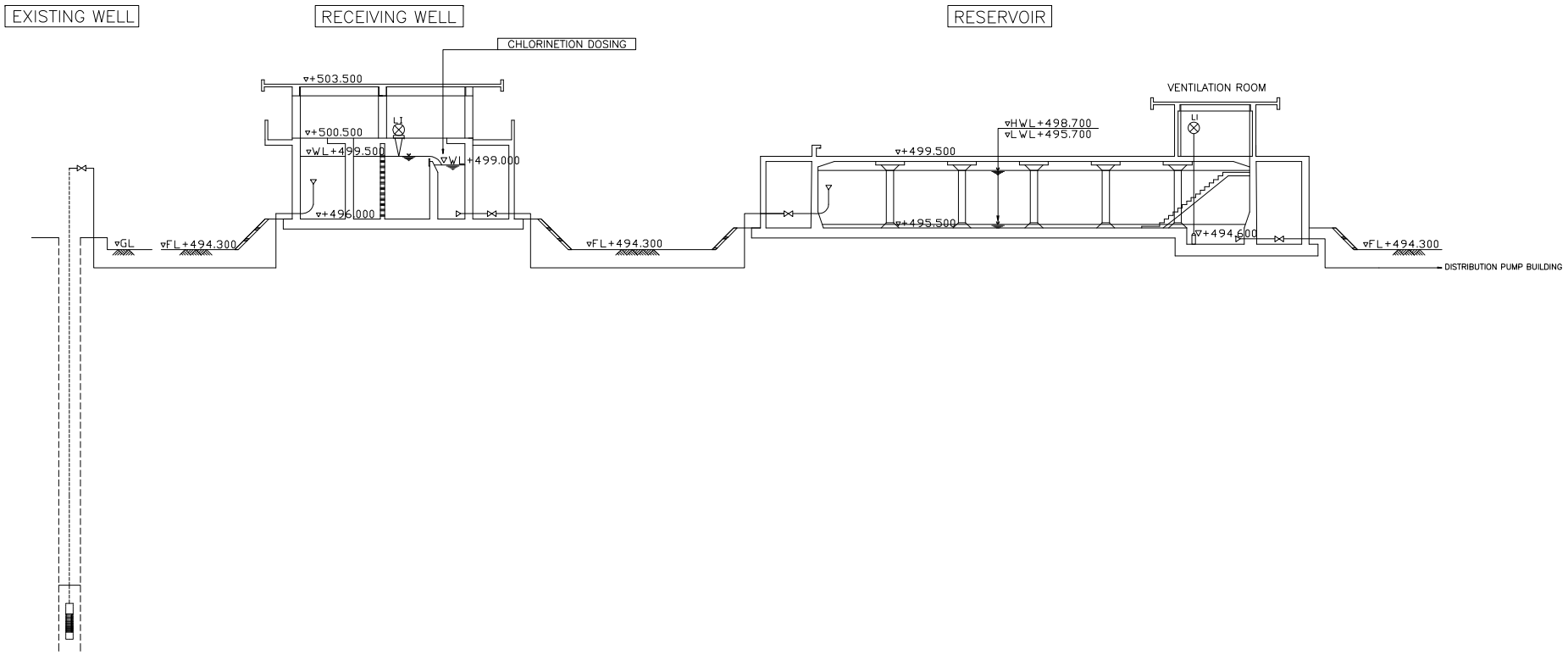
SC	Sig. Conditioner
Ig	Integrator
IS	Isolator
DS	Distlbutor
F	Flow Meter
P	Press. Meter
I	Indicator Meter
A	Alarm Unit
Q	Totalyzer
R	Recorder
⊗	Sensor
⊠	Convertor

REMARKS :	THE PREPARATORY SURVEY (PHASE II) ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : MAHTA WATER TREATMENT PLANT	SCALE : NONE	APPROVED BY : NONE
	STATE WATER CORPORATION, SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN	INSTRUMENTATION SYSTEM CHART 計装設備フローシート図	DRAWING NO. : M－8－1	PREPARED BY : NONE
					DATE : 2010

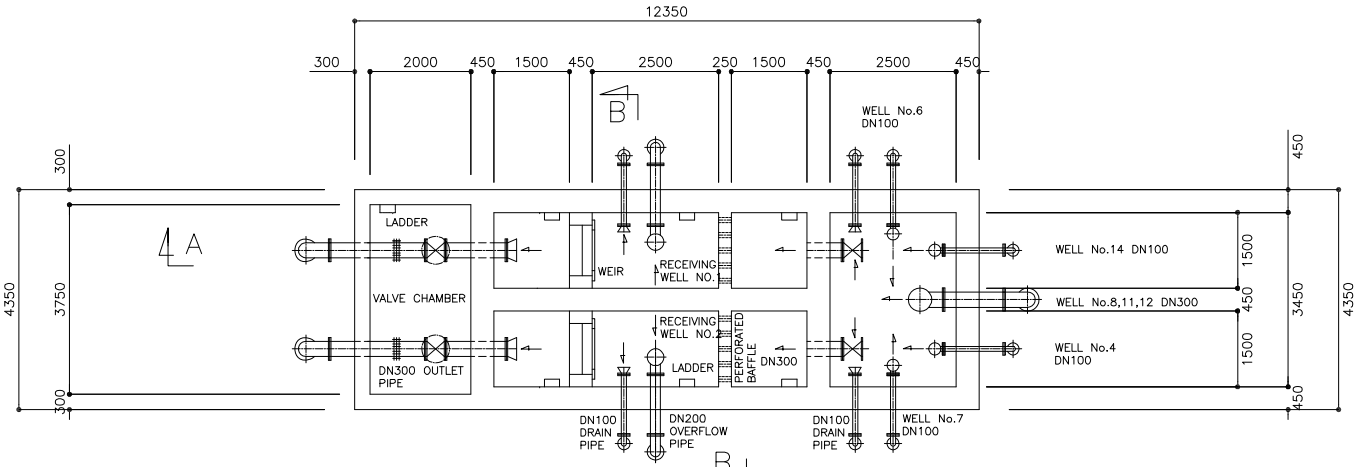


REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : GARB WATER TREATMENT PLANT PLAN OF GARB WATER TREATMENT PLANT GARB浄水場平面図	SCALE : 1:1,000	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC	TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : G−1−1	PREPARED BY : NONE DATE : 2010

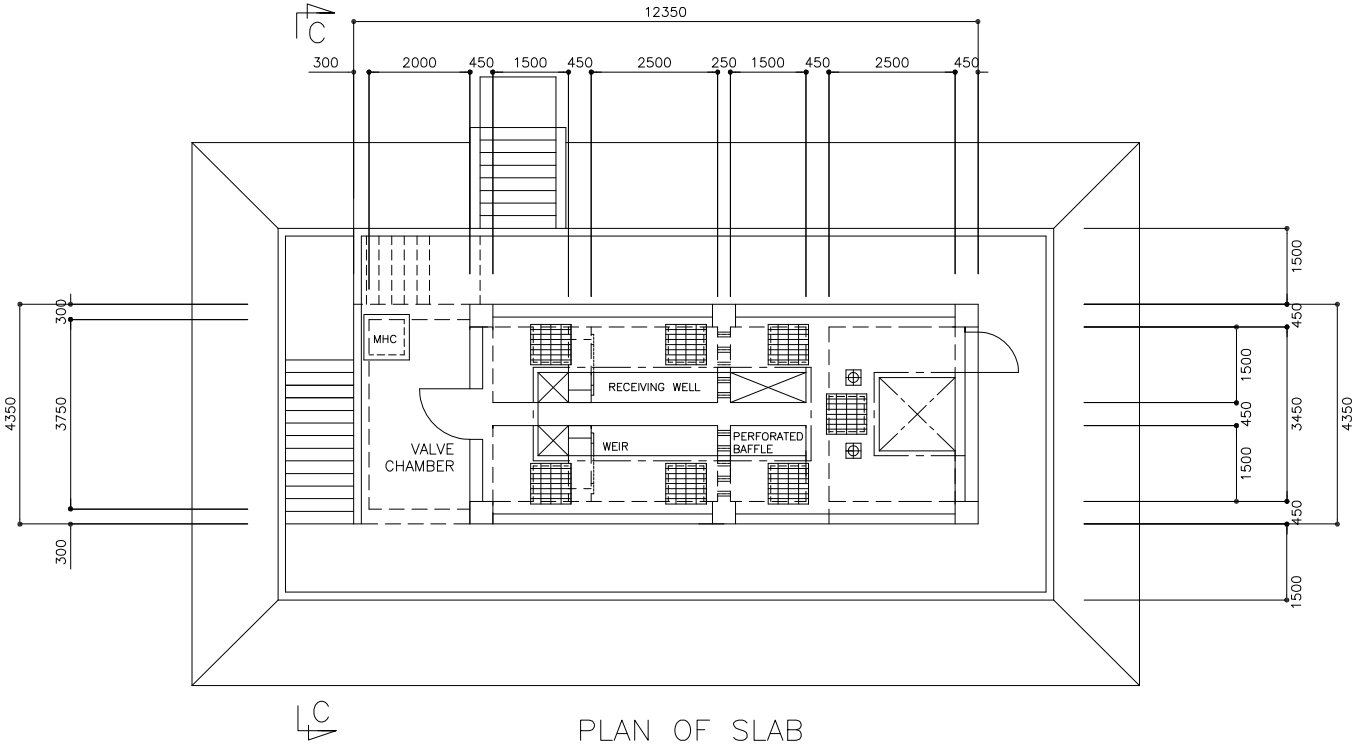
HYDRAULIC PROFILE FOR GARB WTP



REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : GARB WATER TREATMENT PLANT HYDRAULIC PROFILE 水位高低図	SCALE : NONE	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : G−2−1	PREPARED BY : NONE DATE : 2010

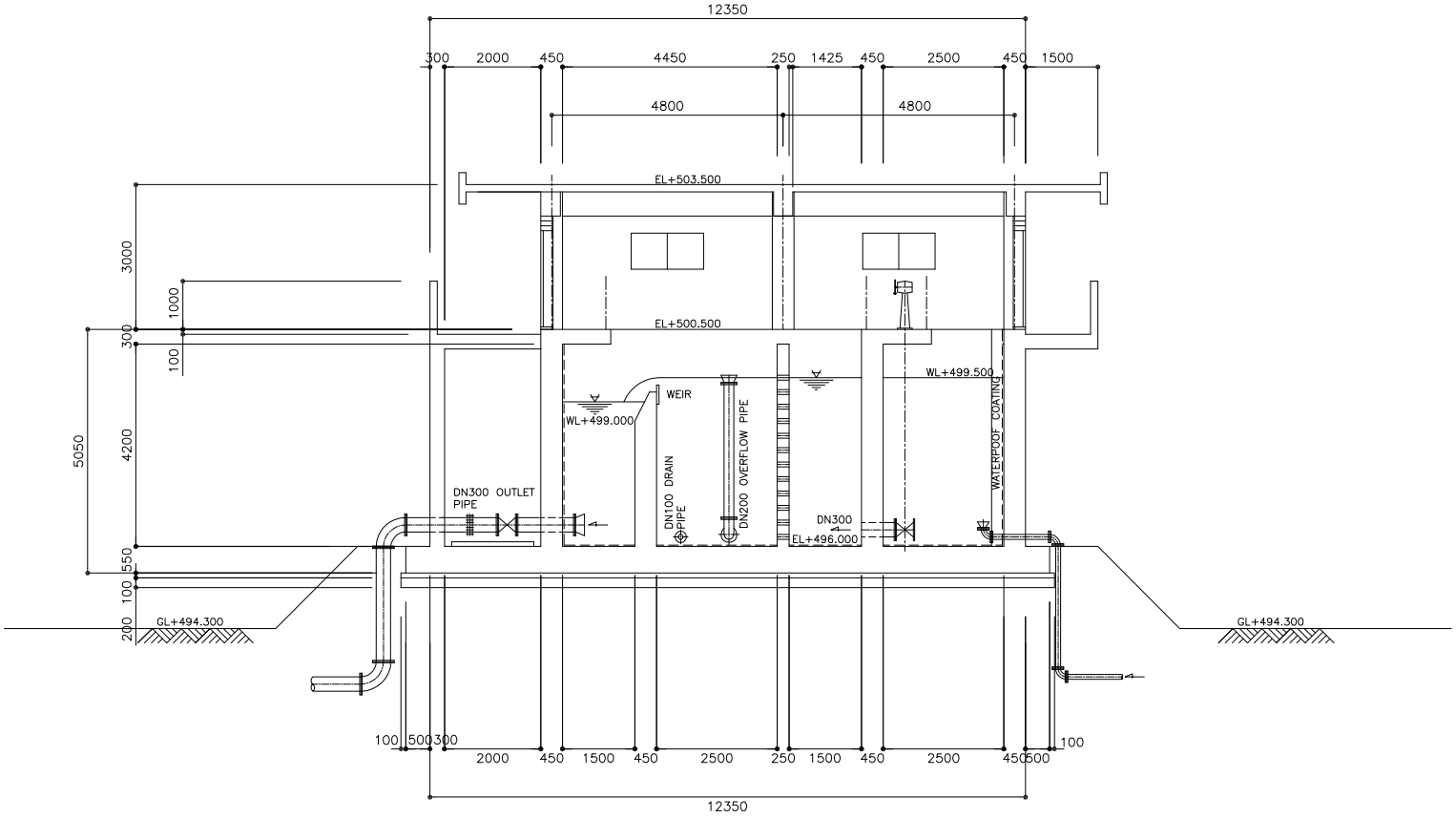


PLAN OF BASE



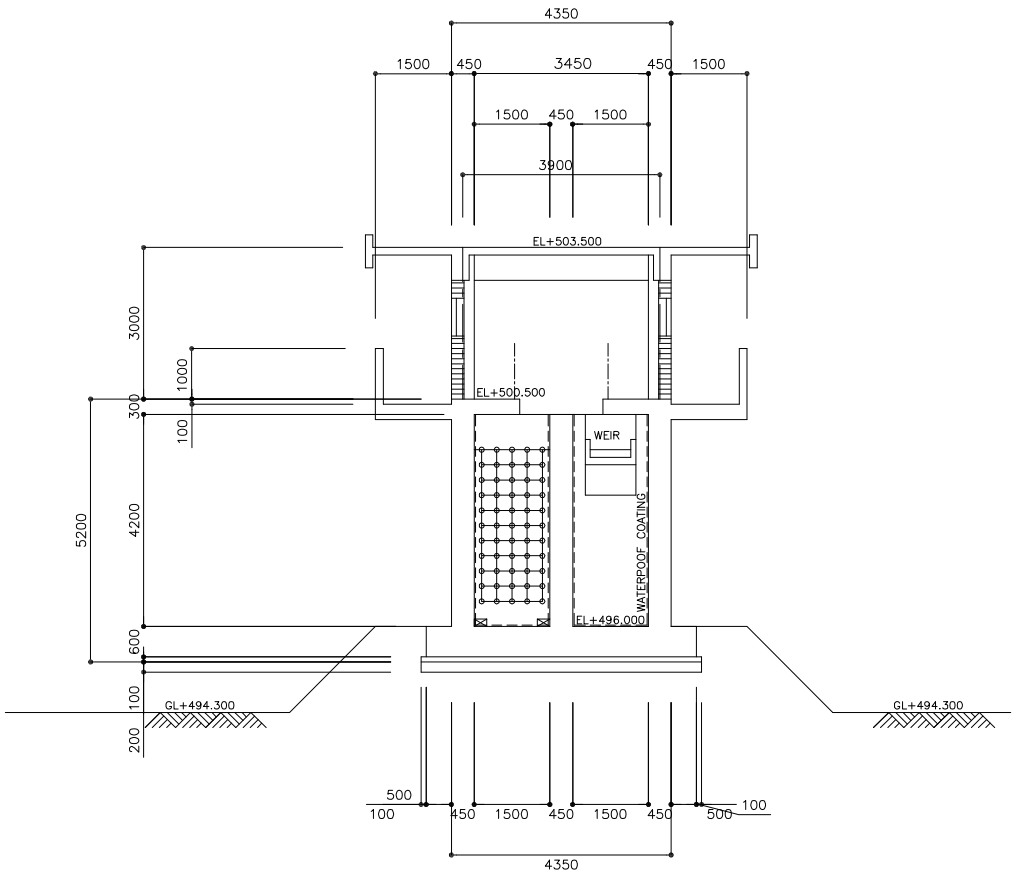
PLAN OF SLAB

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : GARB WATER TREATMENT PLANT RECEIVING WELL (1) 着水井構造図(1)	SCALE : 1:100	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : G-3-1	PREPARED BY : NONE
					DATE : 2010

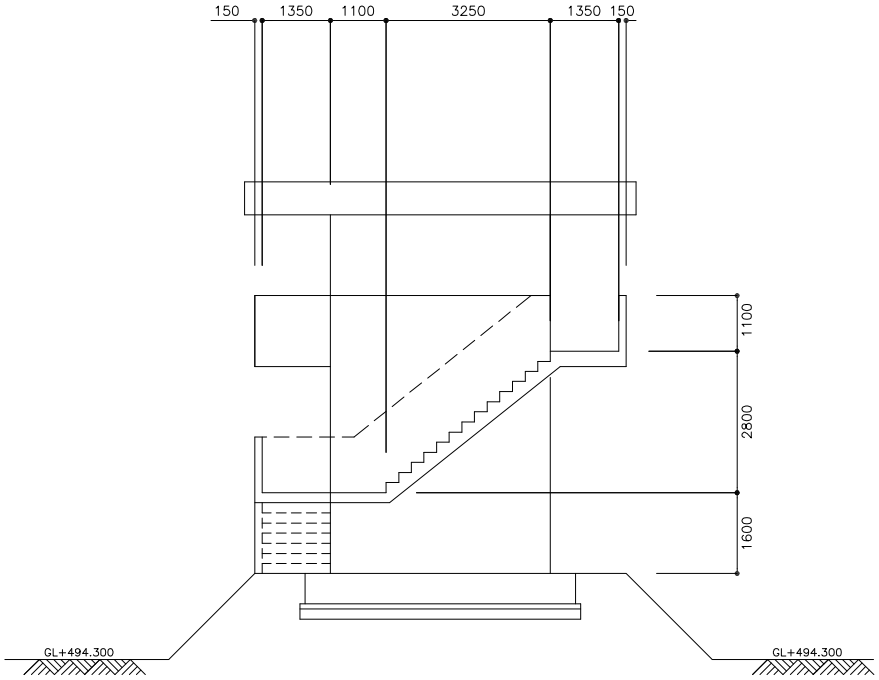


SECTION A – A

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : GARB WATER TREATMENT PLANT RECEIVING WELL (2) 着水井構造図(2)	SCALE : 1:100	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : G-3-2	PREPARED BY : NONE
					DATE : 2010

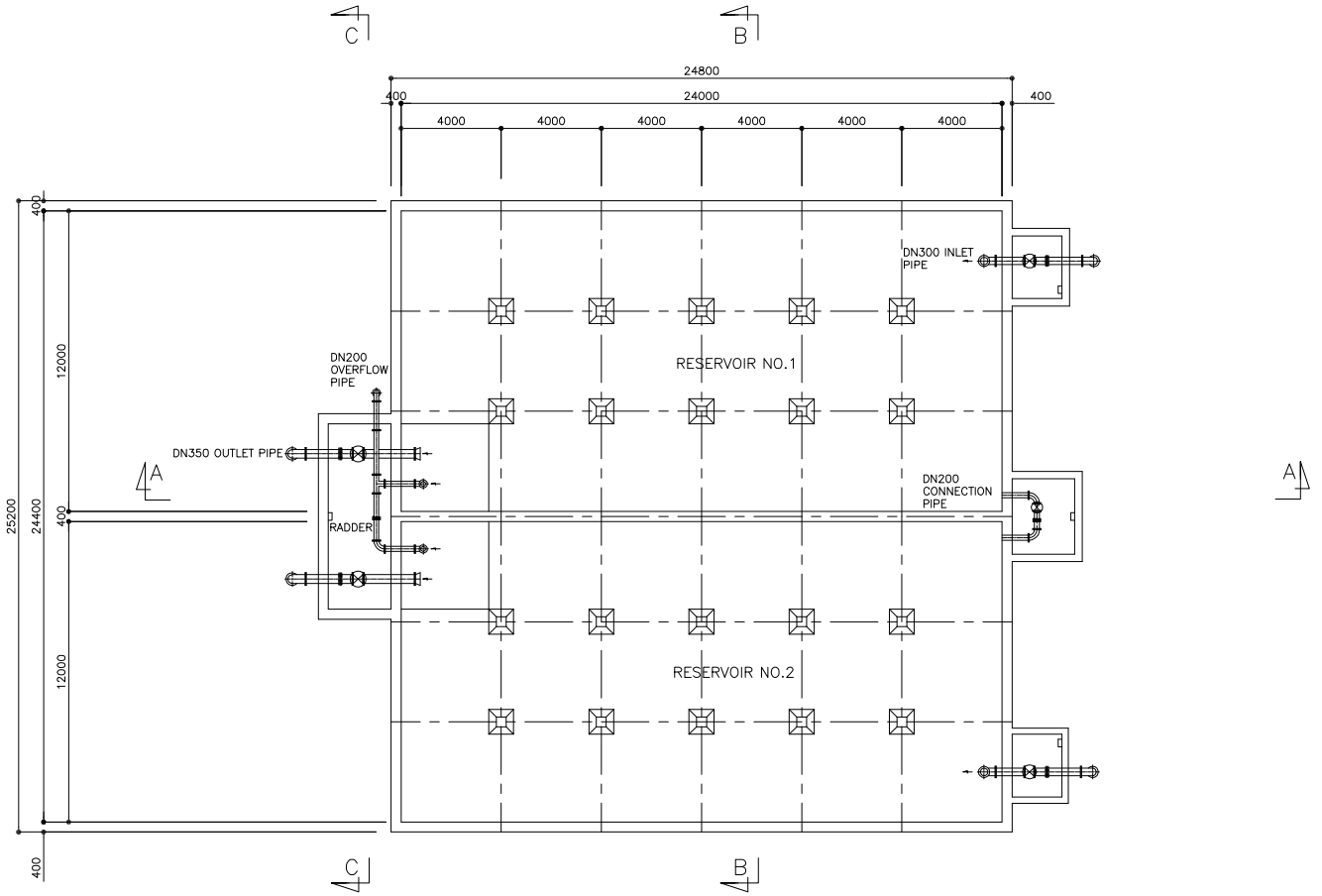


SECTION B – B



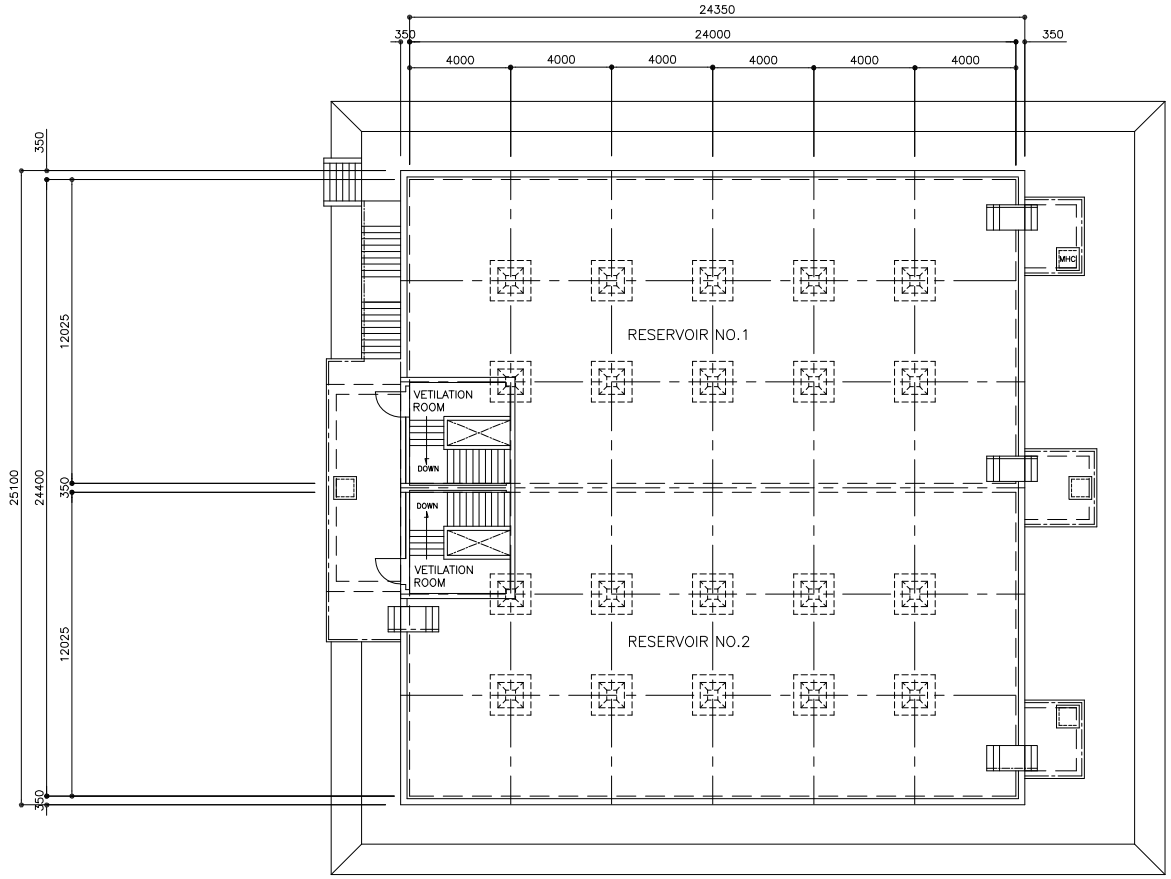
SECTION C – C

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : GARB WATER TREATMENT PLANT RECEIVING WELL (3) 着水井構造図(3)	SCALE : 1:100	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : G–3–3	PREPARED BY : NONE
					DATE : 2010



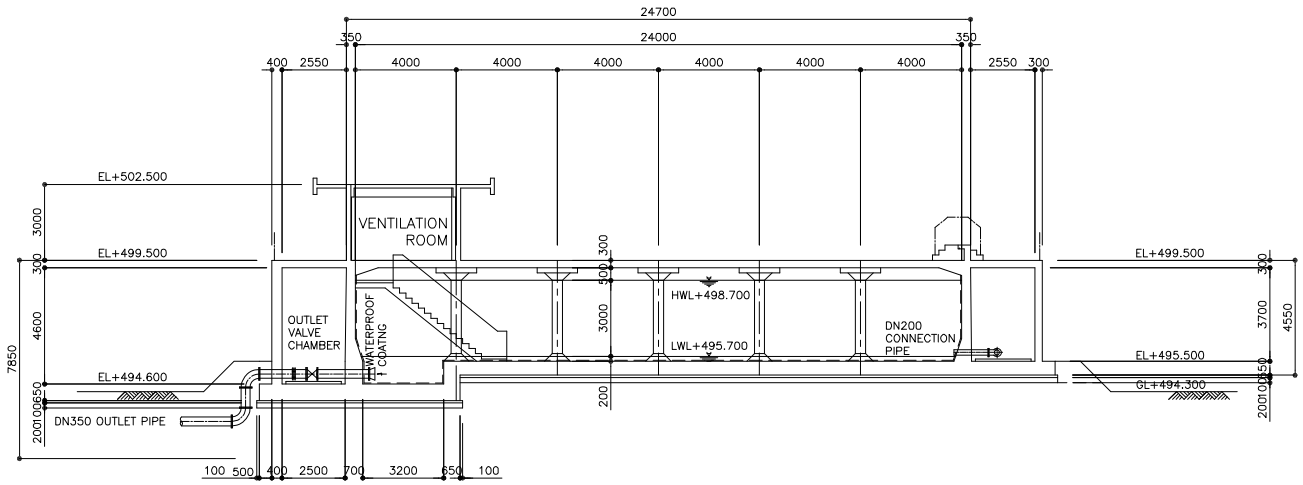
PLAN OF BASE

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : GARB WATER TREATMENT PLANT	SCALE : 1:200	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN	RESERVOIR (1) 配水池構造図(1)	DRAWING NO. : G-4-1	PREPARED BY : NONE
					DATE : 2010

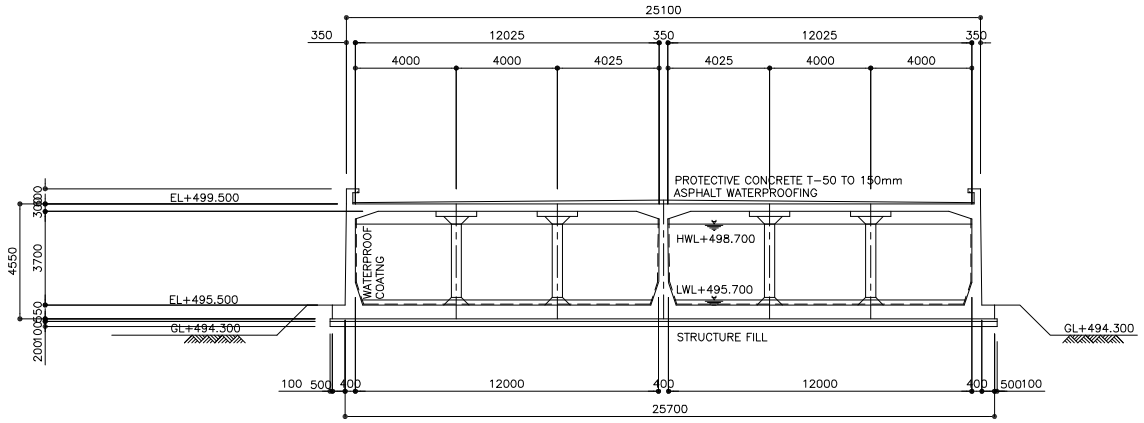


PLAN OF SLAB

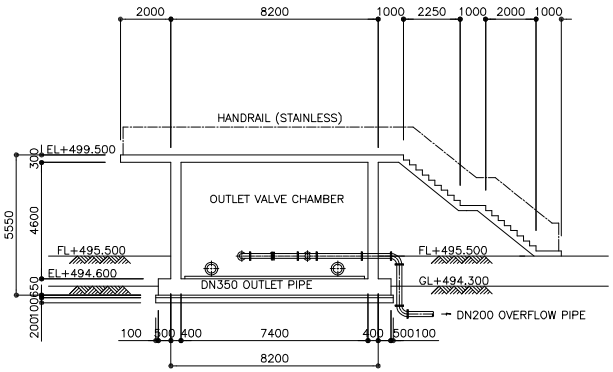
REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : GARB WATER TREATMENT PLANT RESERVOIR (2) 配水池構造図(2)	SCALE : 1:200	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : G-4-2	PREPARED BY : NONE
					DATE : 2010



SECTION A – A

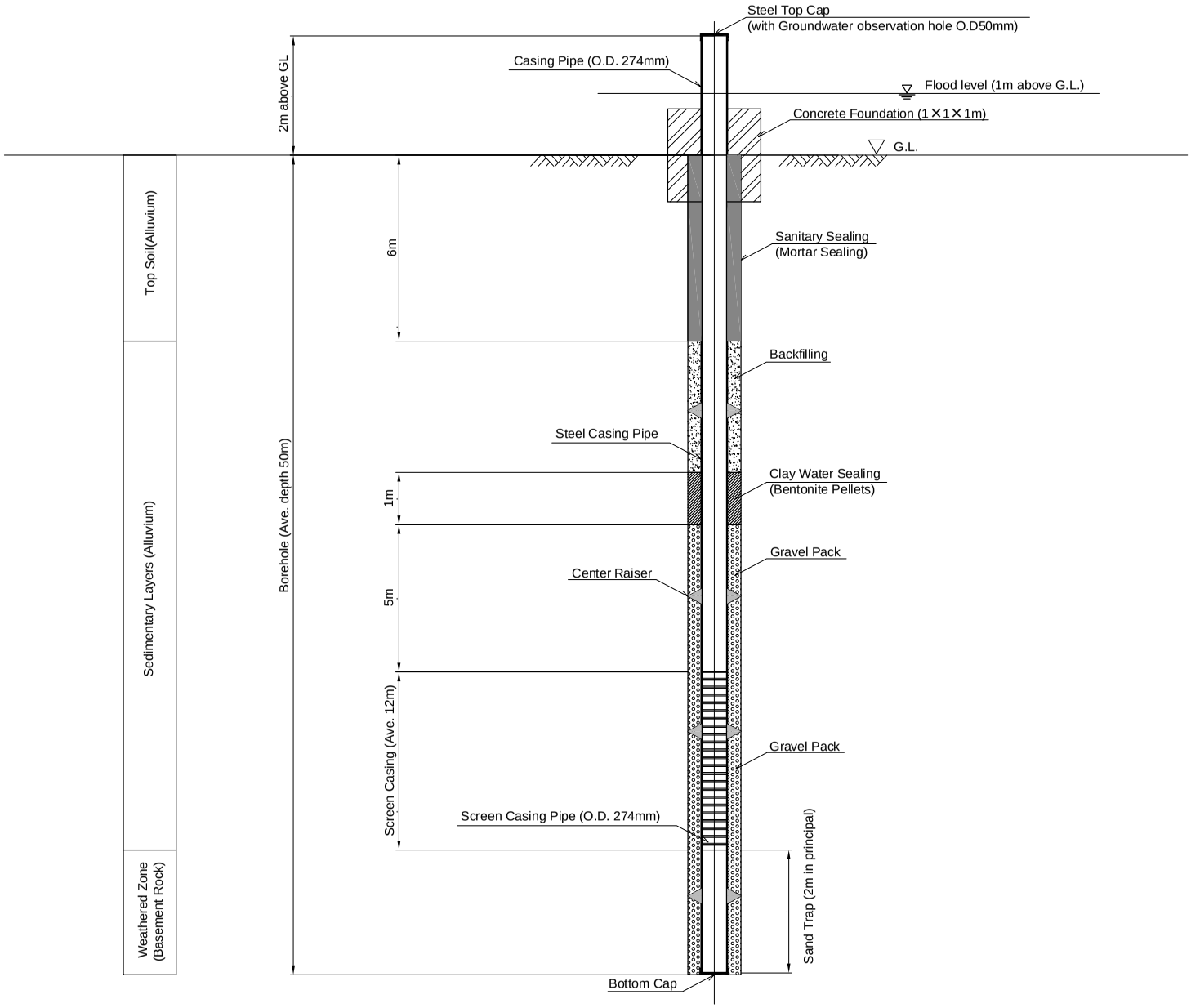


SECTION B – B

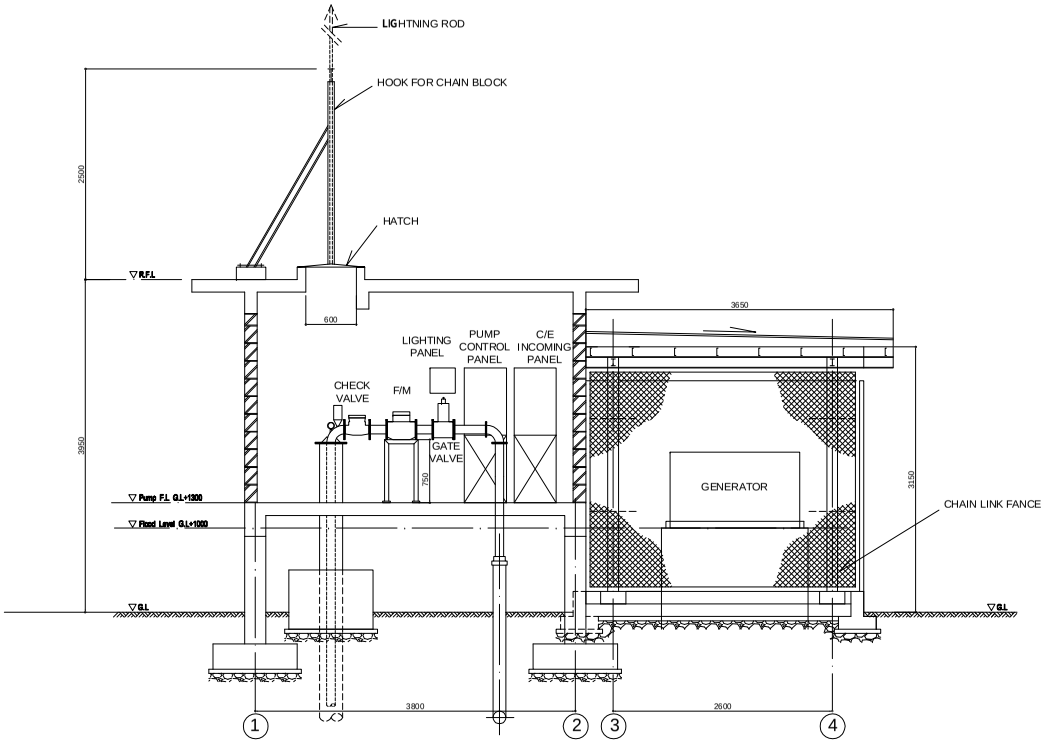


SECTION C – C

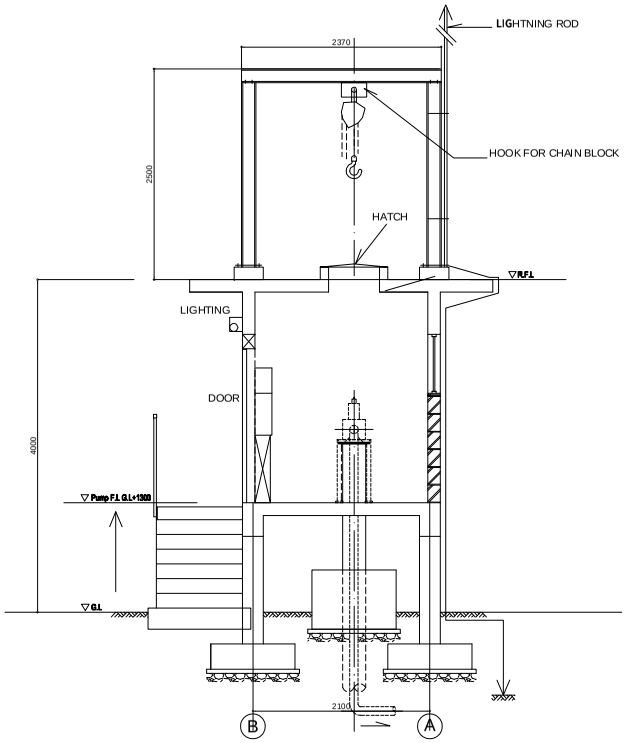
REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : GARB WATER TREATMENT PLANT RESERVOIR (3) 配水池構造図(3)	SCALE : 1:200	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : G-4-3	PREPARED BY : NONE
					DATE : 2010



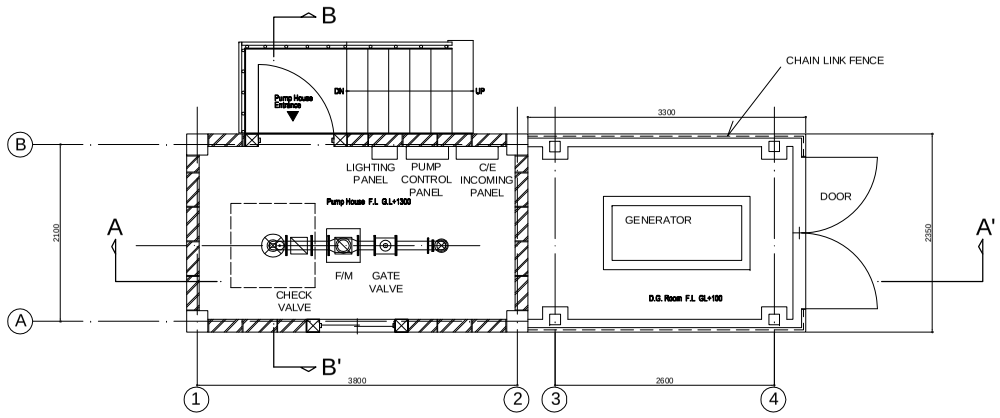
REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : TYPICAL DRAWING OF WATER SOURCE WELL (WELL STRUCTURE) 水源井戸標準図(井戸構造)	SCALE :	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : K-1-1	PREPARED BY : NONE
					DATE : 2011



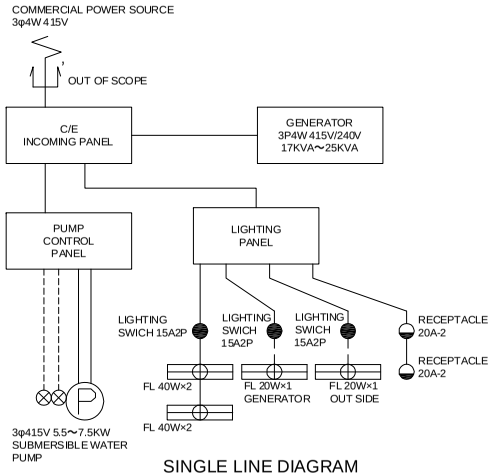
SECTION A-A' 1:60



SECTION B-B' 1:60

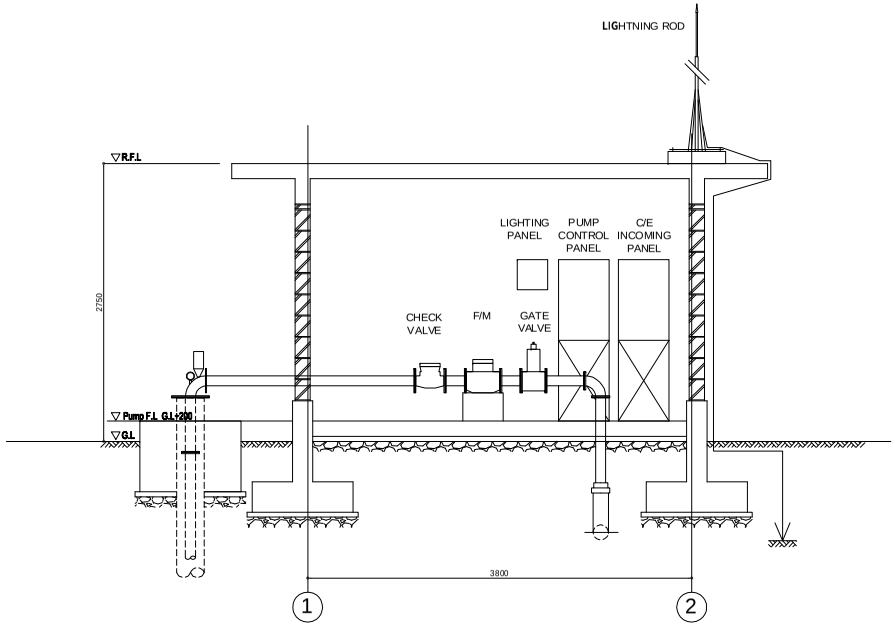


PLAN OF WELL PUMP HOUSE (New Well Site) 1:60

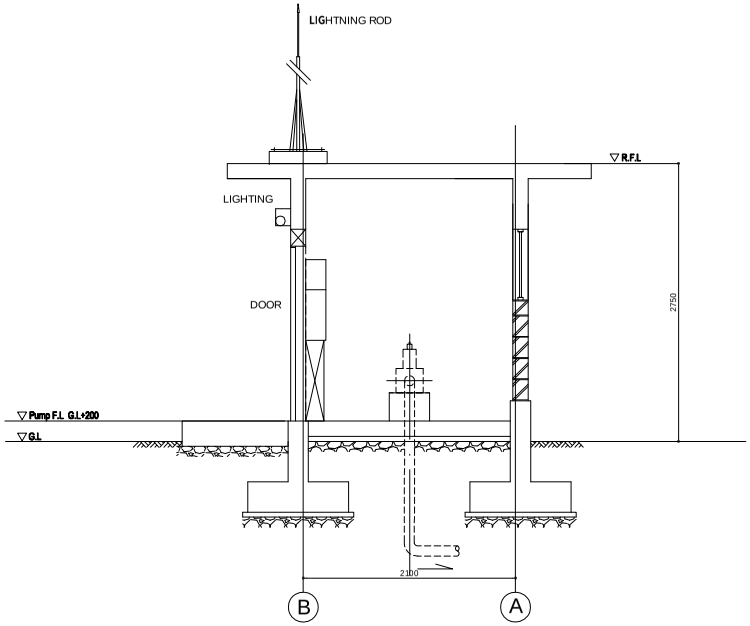


SINGLE LINE DIAGRAM

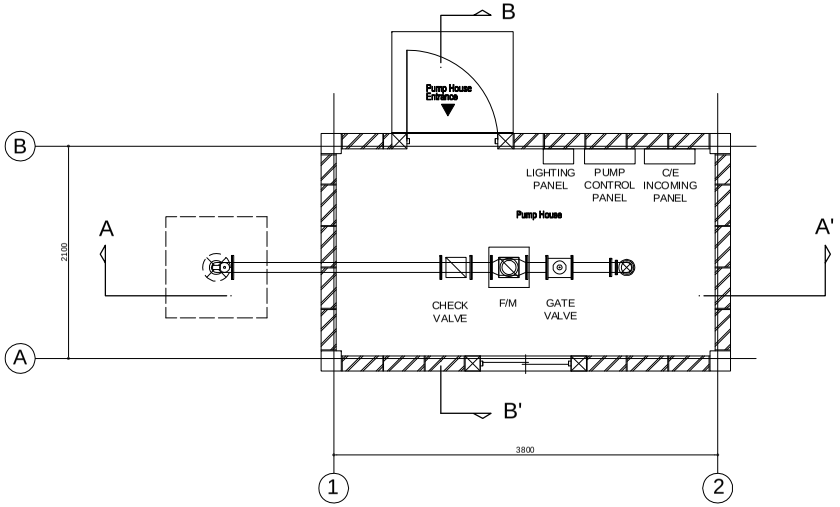
REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : TYPICAL DRAWING OF NEW WELL FACILITIES (PLAN & SECTION) 新設井戸施設標準図(平面と断面)	SCALE : 1:60	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC	TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : K-1-2	PREPARED BY : NONE
						DATE : 2011



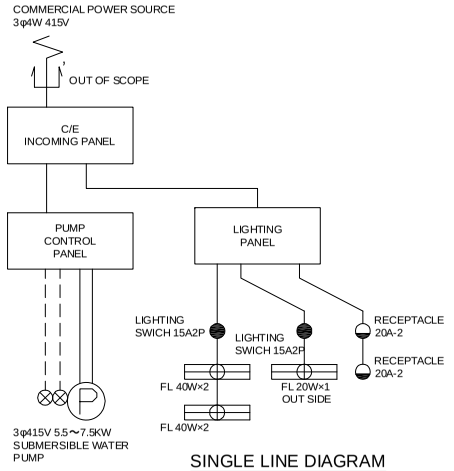
SECTION A-A' 1:50



SECTION B-B' 1:50

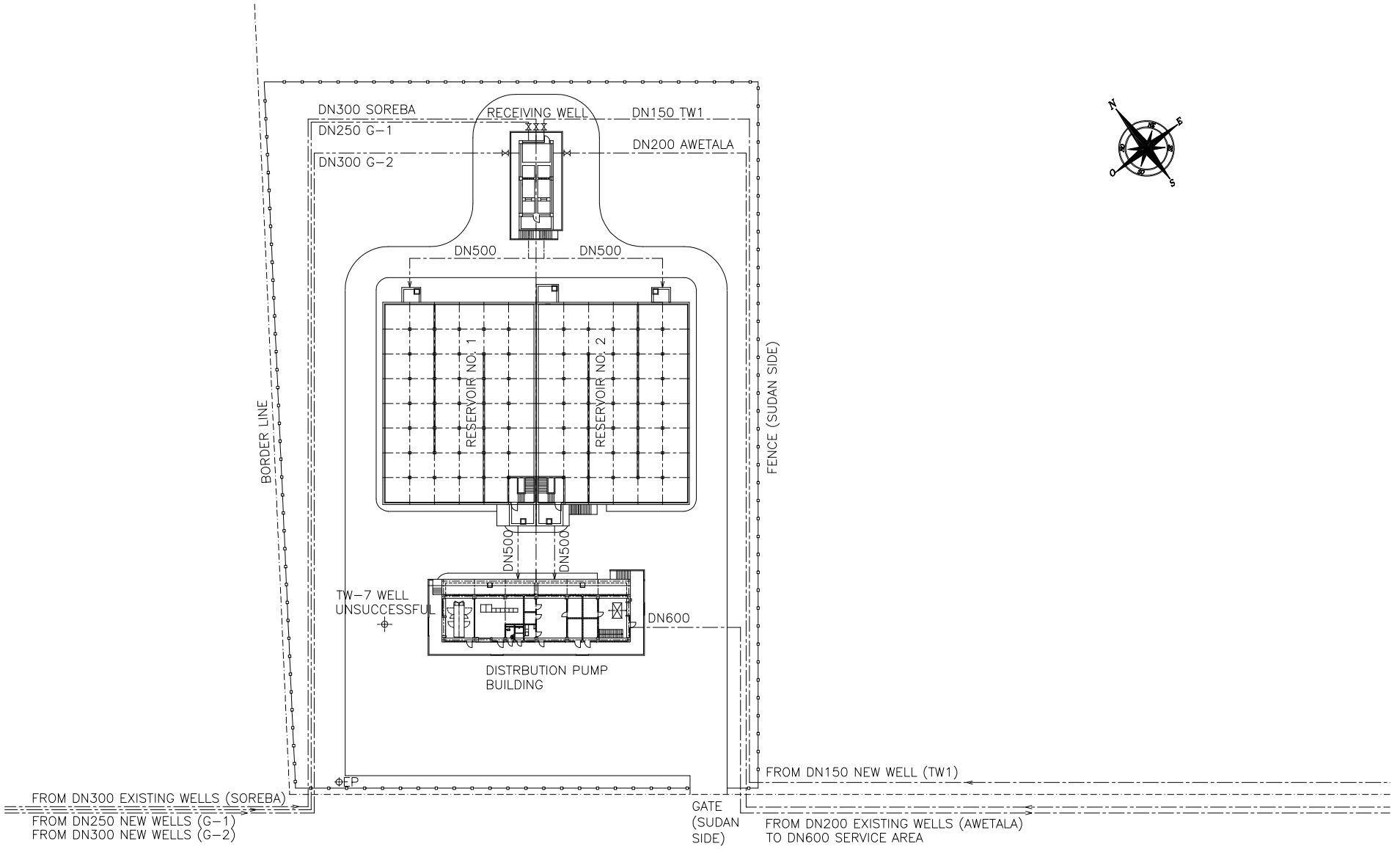


PLAN OF WELL PUMP HOUSE (Existing Well Site) 1:50



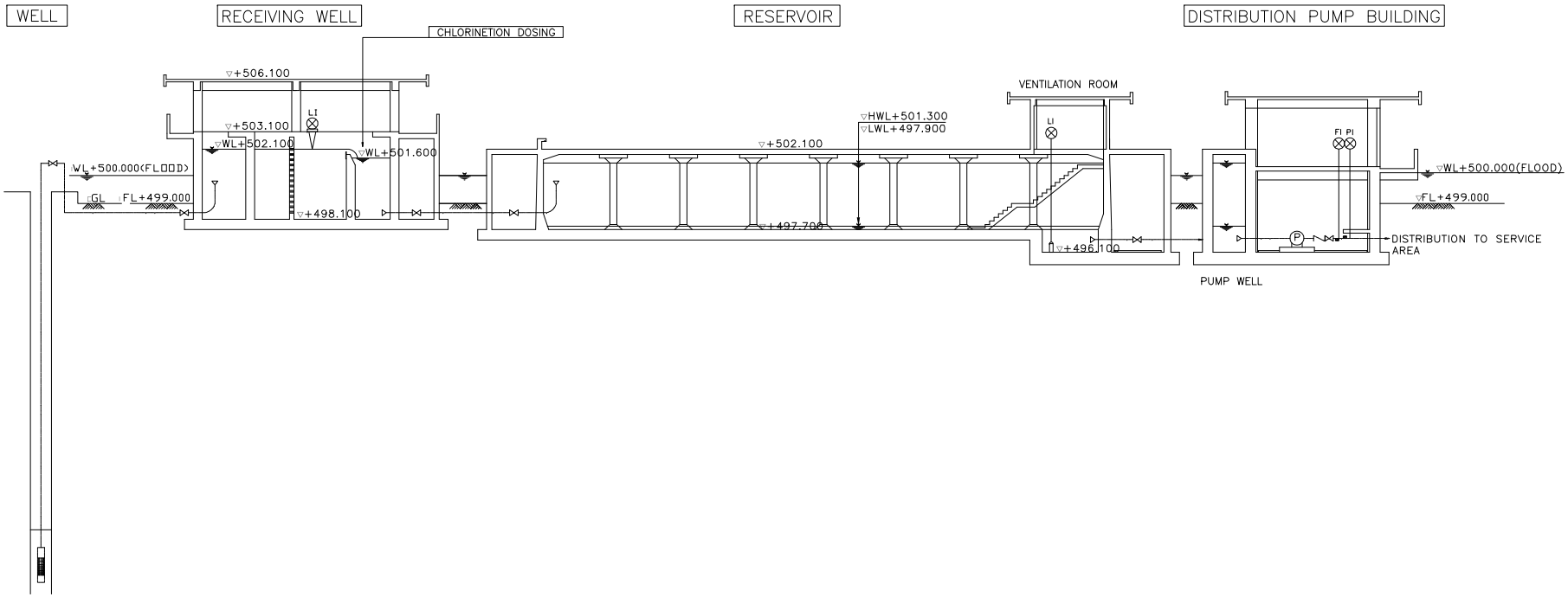
SINGLE LINE DIAGRAM

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY IN SUDAN	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : TYPICAL DRAWING OF EXISTING WELL FACILITIES (PLAN & SECTION) 既設井戸施設標準図(平面と断面)	SCALE : 1:50	APPROVED BY : NONE
	STATE WATER CORPORATION (SWC), SUDAN	TEC	TOKYO ENGINEERING CONSULTANTS CO.,LTD, JAPAN		DRAWING NO. : K-1-3	PREPARED BY : NONE
						DATE : 2011

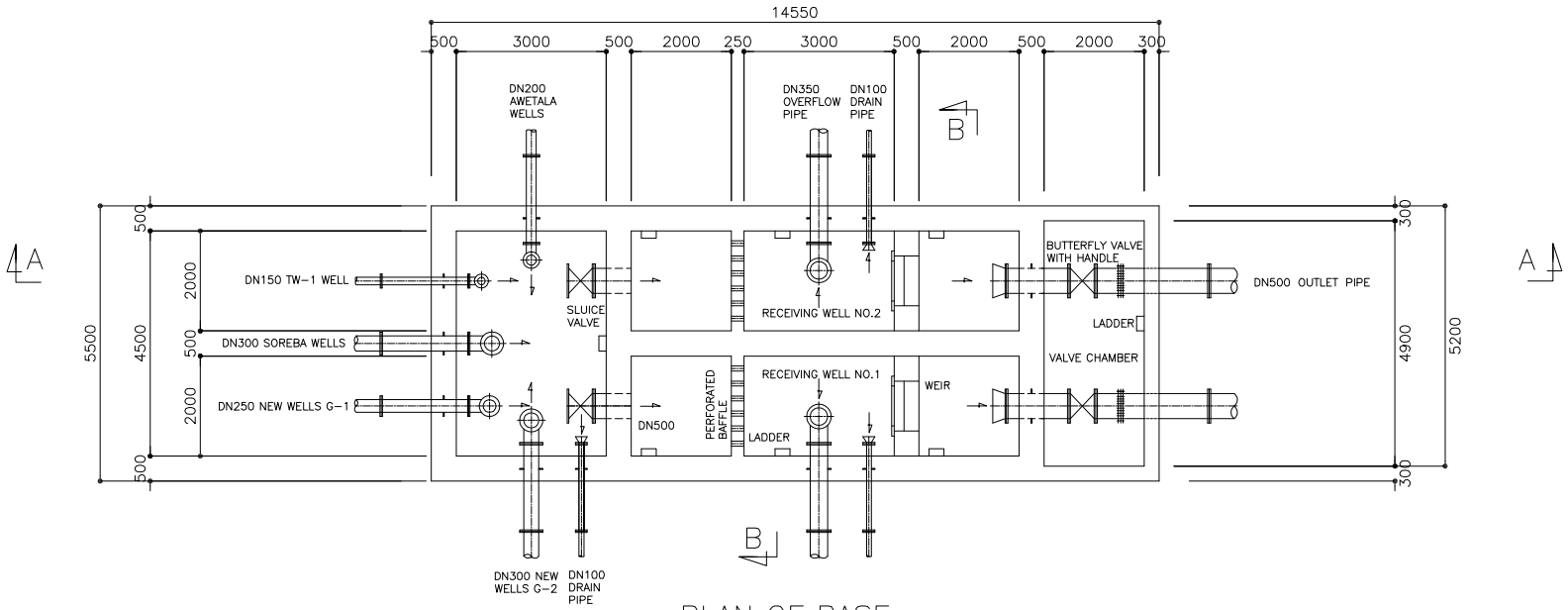


REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : KHATMIA WATER TREATMENT PLANT	SCALE : S=1:600	APPROVED BY : NONE
	KASSLA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	PLAN OF KHATMIA WATER TREATMENT PLANT ハトゥミア浄水場平面図	DRAWING NO. : K-2-1	PREPARED BY : NONE
					DATE : 2011

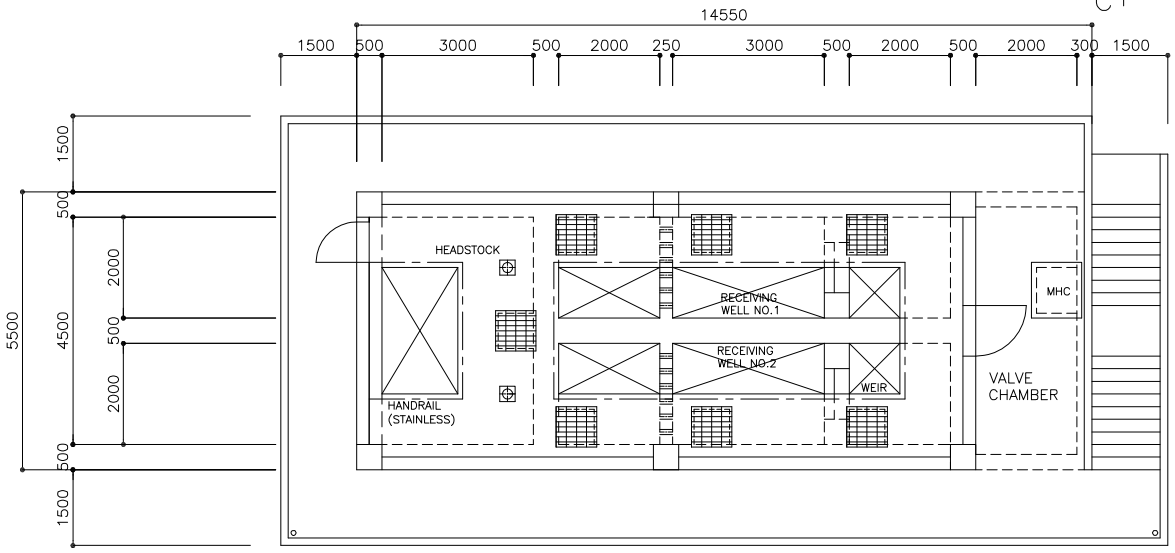
HYDRAULIC PROFILE FOR KHATMIA WATER TREATMENT PLANT



REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSLA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT HYDRAULIC PROFILE 水位高低図	SCALE : NONE DRAWING NO. : K-3-1	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011

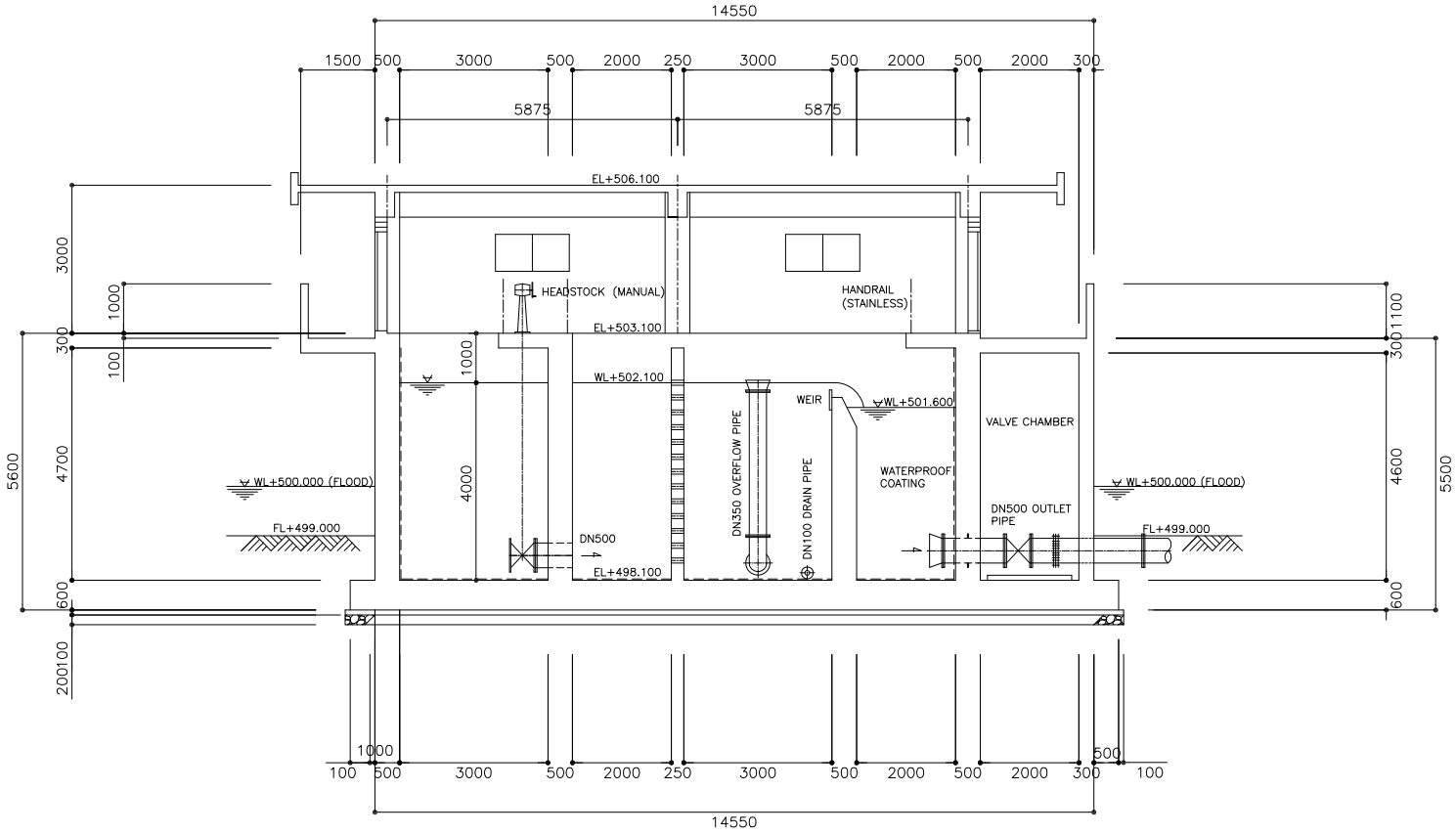


PLAN OF BASE



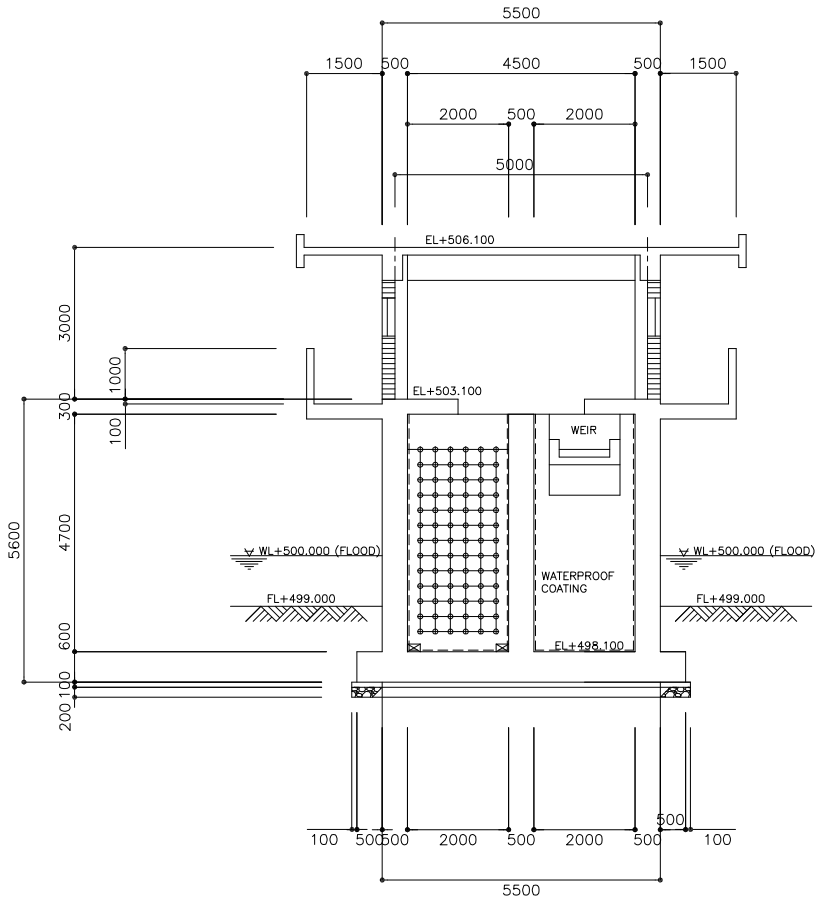
PLAN OF SLAB

REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSLA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT RECEIVING WELL (1) 着水井構造図(1)	SCALE : S=1:100 DRAWING NO. : K-4-1	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011

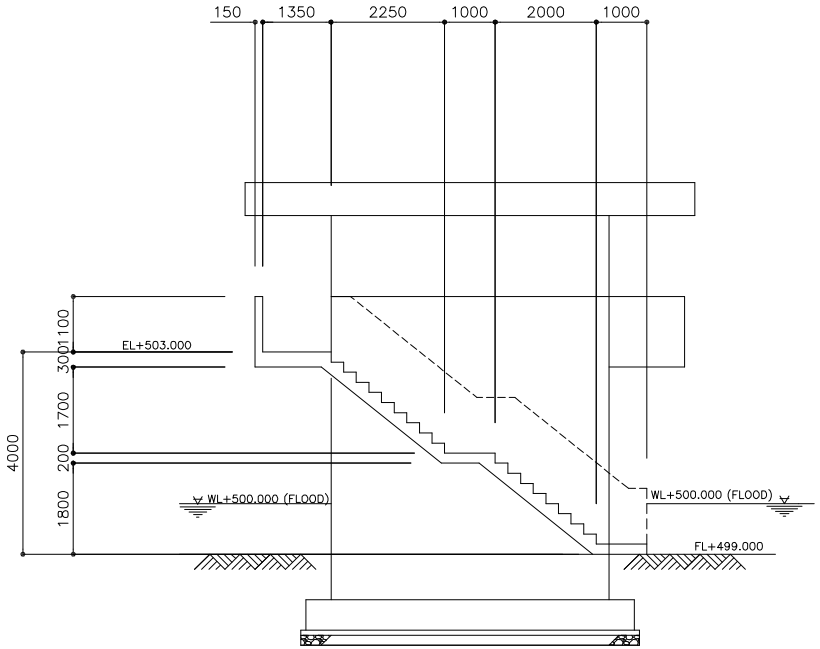


SECTION A – A

REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSLA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT RECEIVING WELL (2) 着水井構造図(2)	SCALE : S=1:100 DRAWING NO. : K-4-2	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011

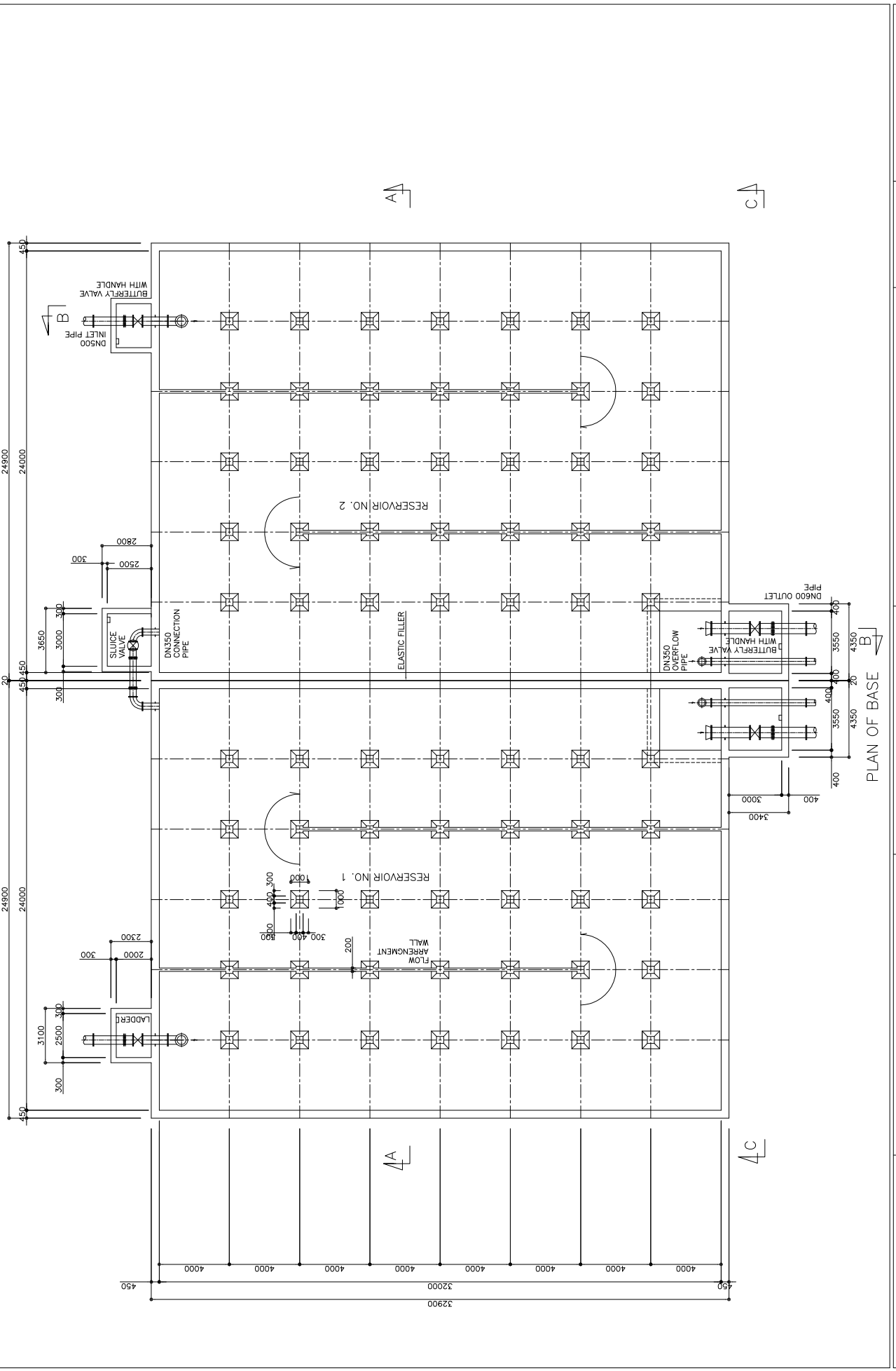


SECTION B – B



SECTION C – C

REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSLA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT RECEIVING WELL (3) 着水井構造図(3)	SCALE : S=1:100 DRAWING NO. : K-4-3	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011



TITLE : KHATMIA WATER TREATMENT PLANT
RESERVOIR (1)
配水池構造図(1)

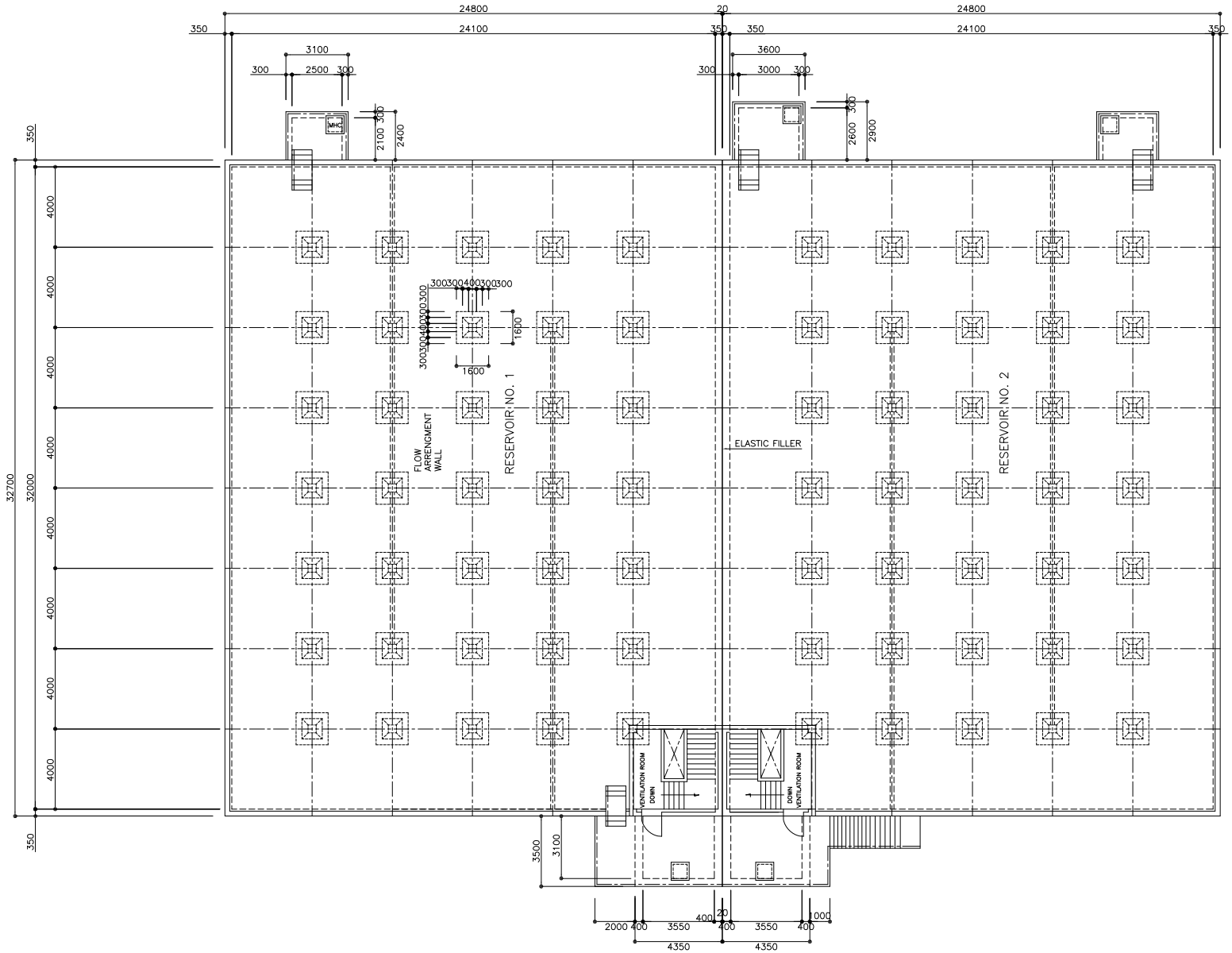
SCALE : S=1:200
DRAWING NO. : K-5-1

APPROVED BY : NONE
PREPARED BY : NONE
DATE : 2011

JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN

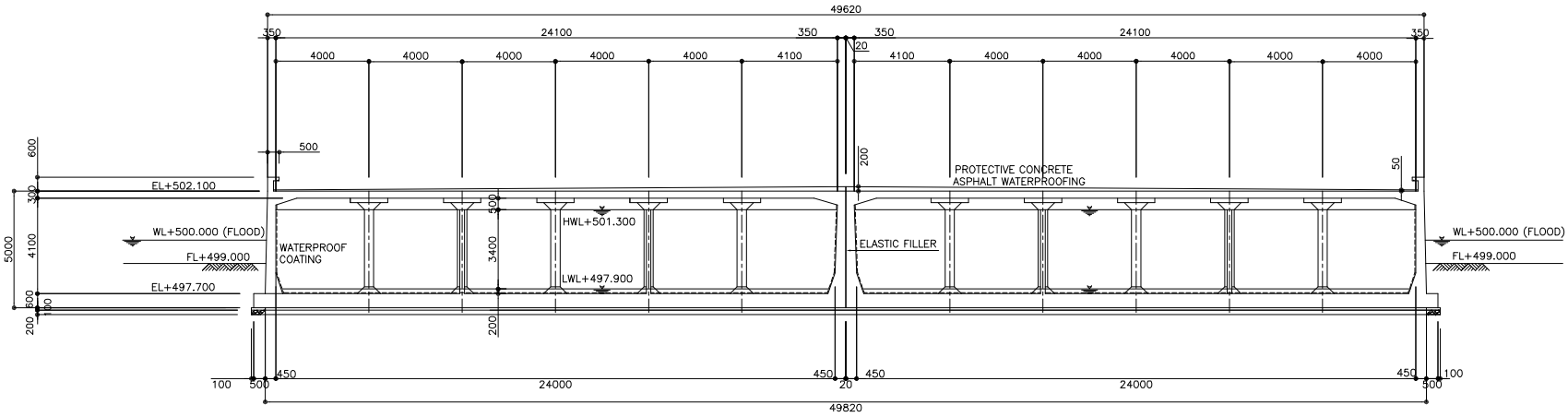
THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY
KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN

REMARKS :

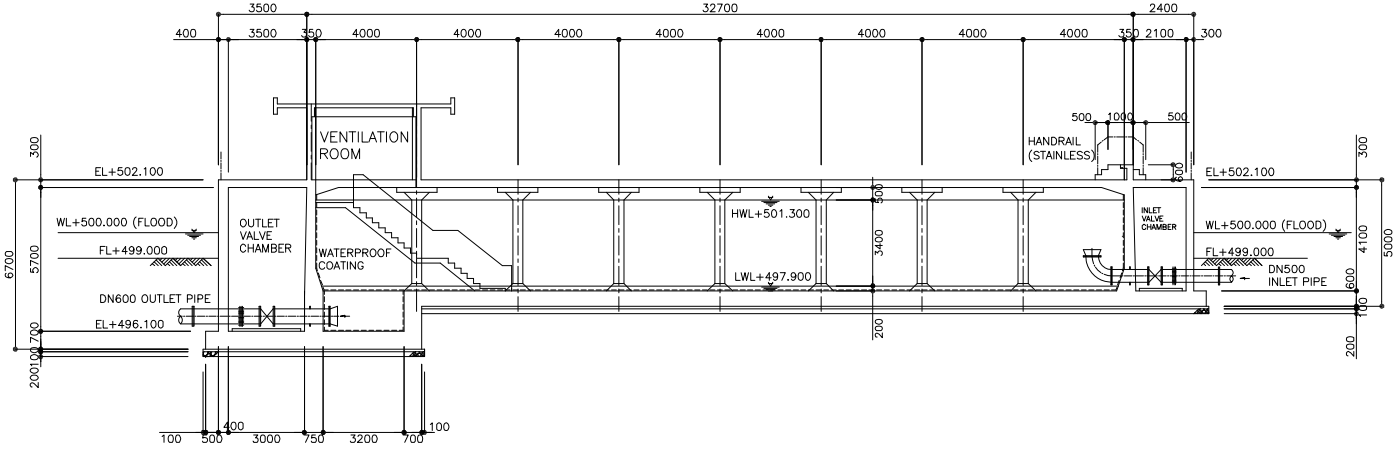


PLAN OF SLAB

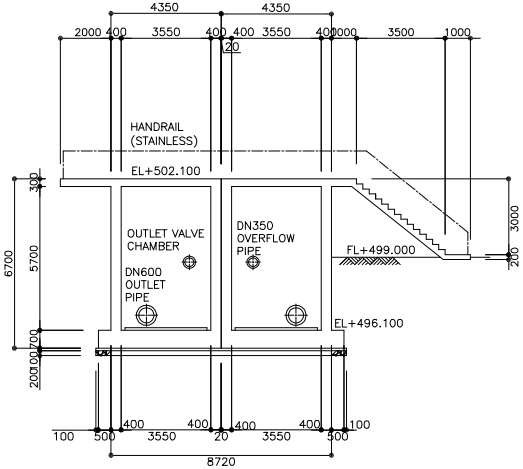
REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT RESERVOIR (2) 配水池構造図(2)	SCALE : S=1:200 DRAWING NO. : K-5-2	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011



SECTION A – A

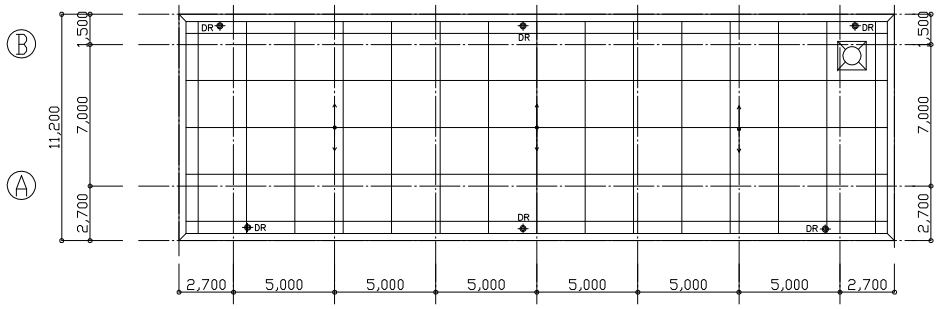


SECTION B – B

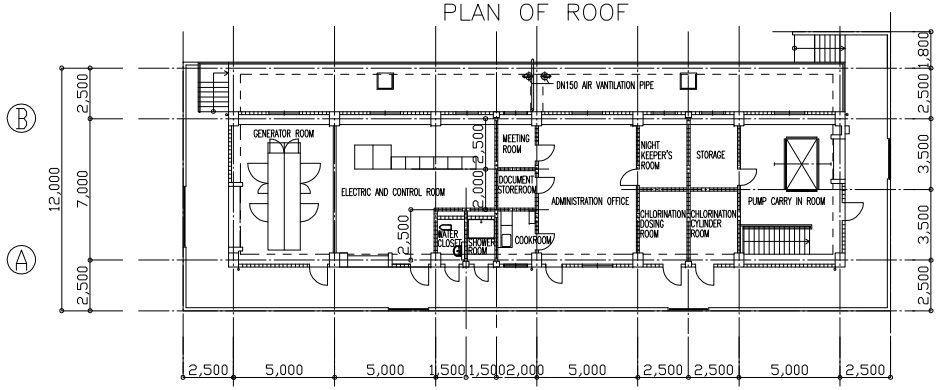


SECTION C – C

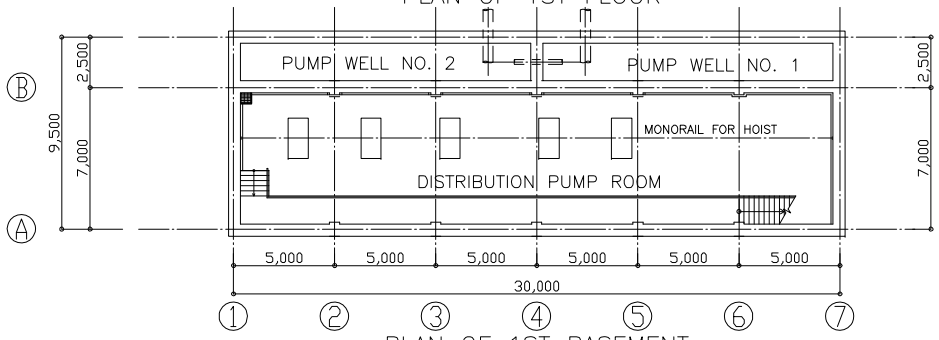
REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT RESERVOIR (3) 配水池構造図(3)	SCALE : S=1:200 DRAWING NO. : K-5-3	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011



PLAN OF ROOF

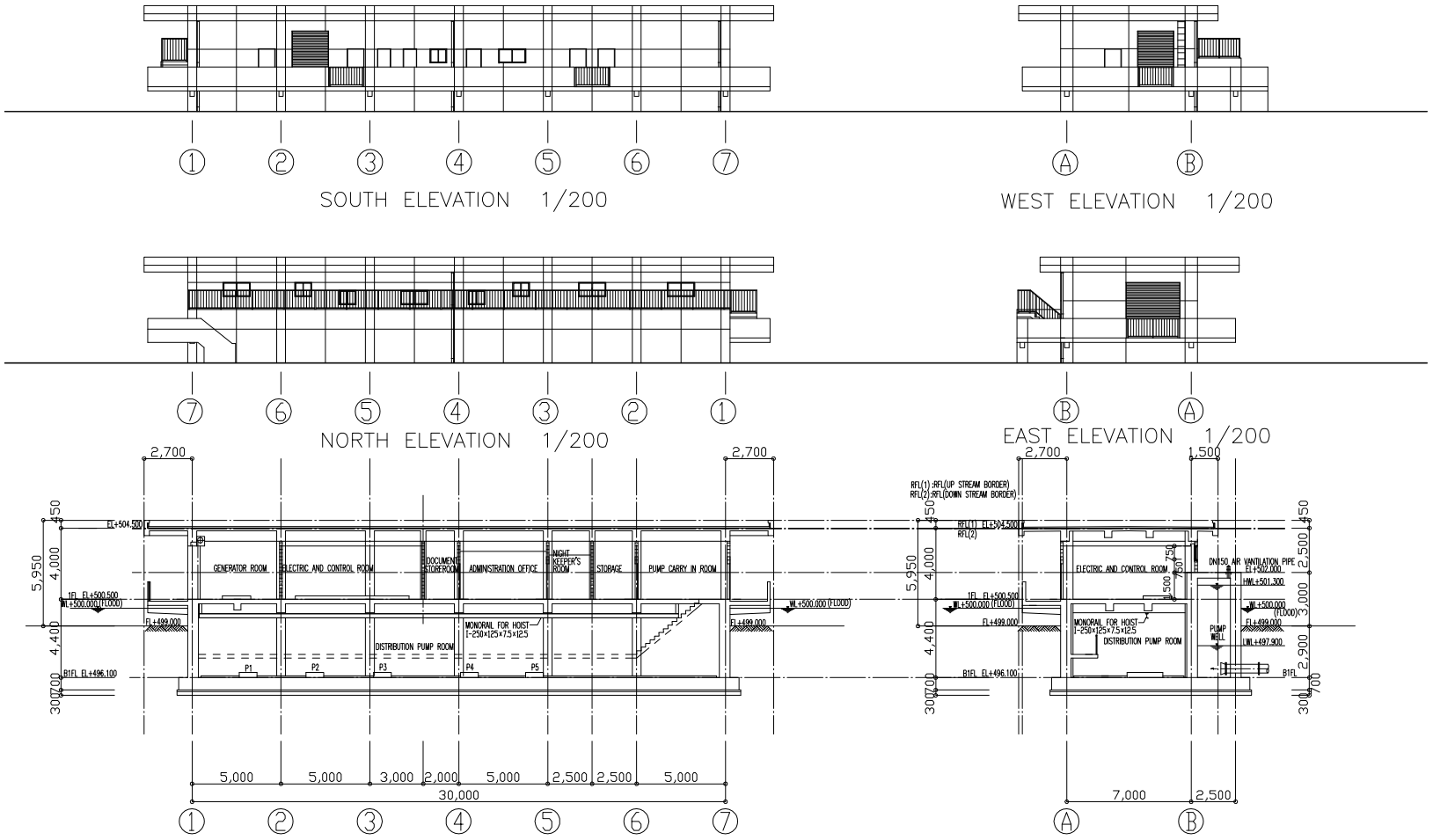


PLAN OF 1ST FLOOR

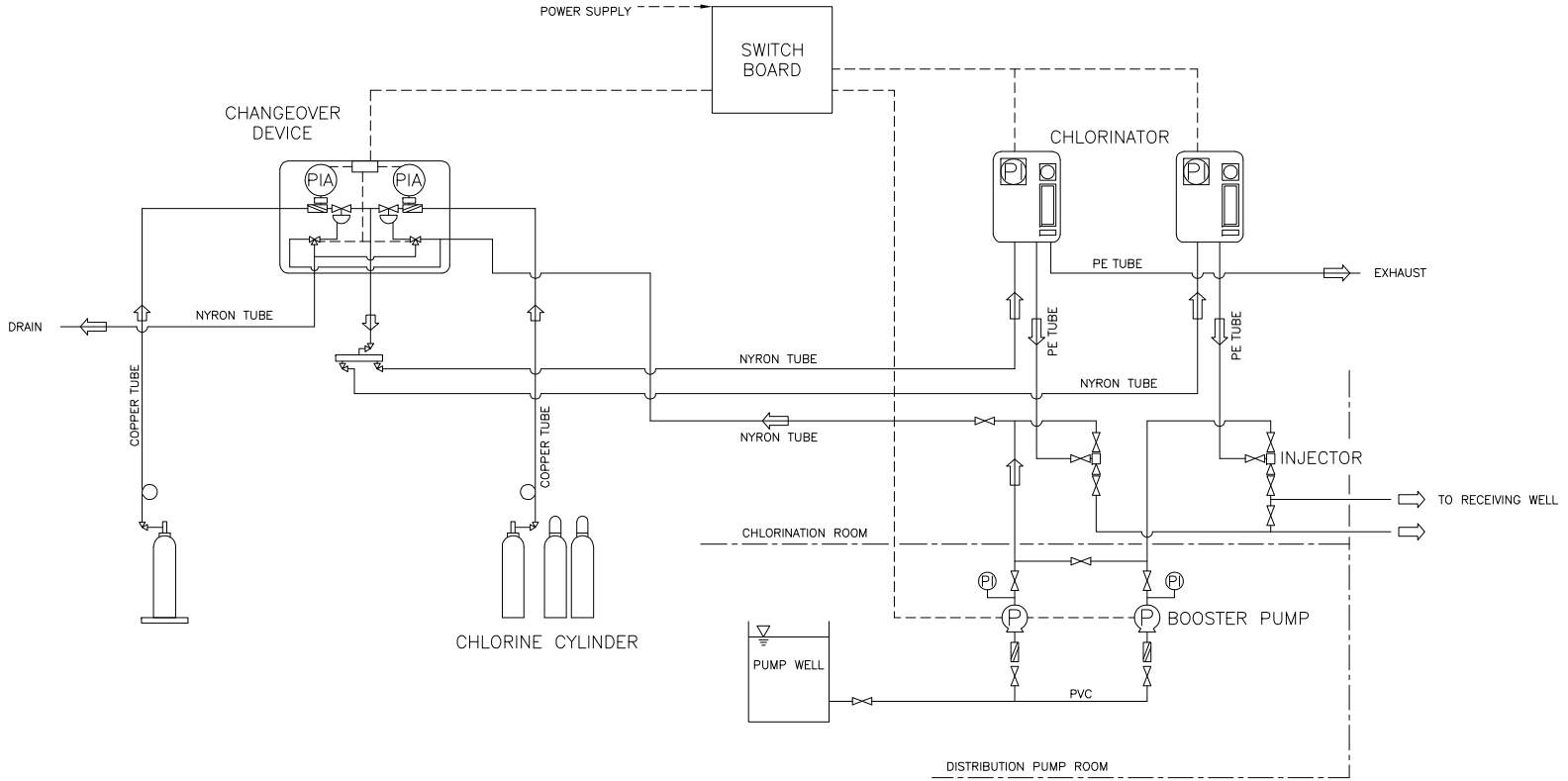


PLAN OF 1ST BASEMENT

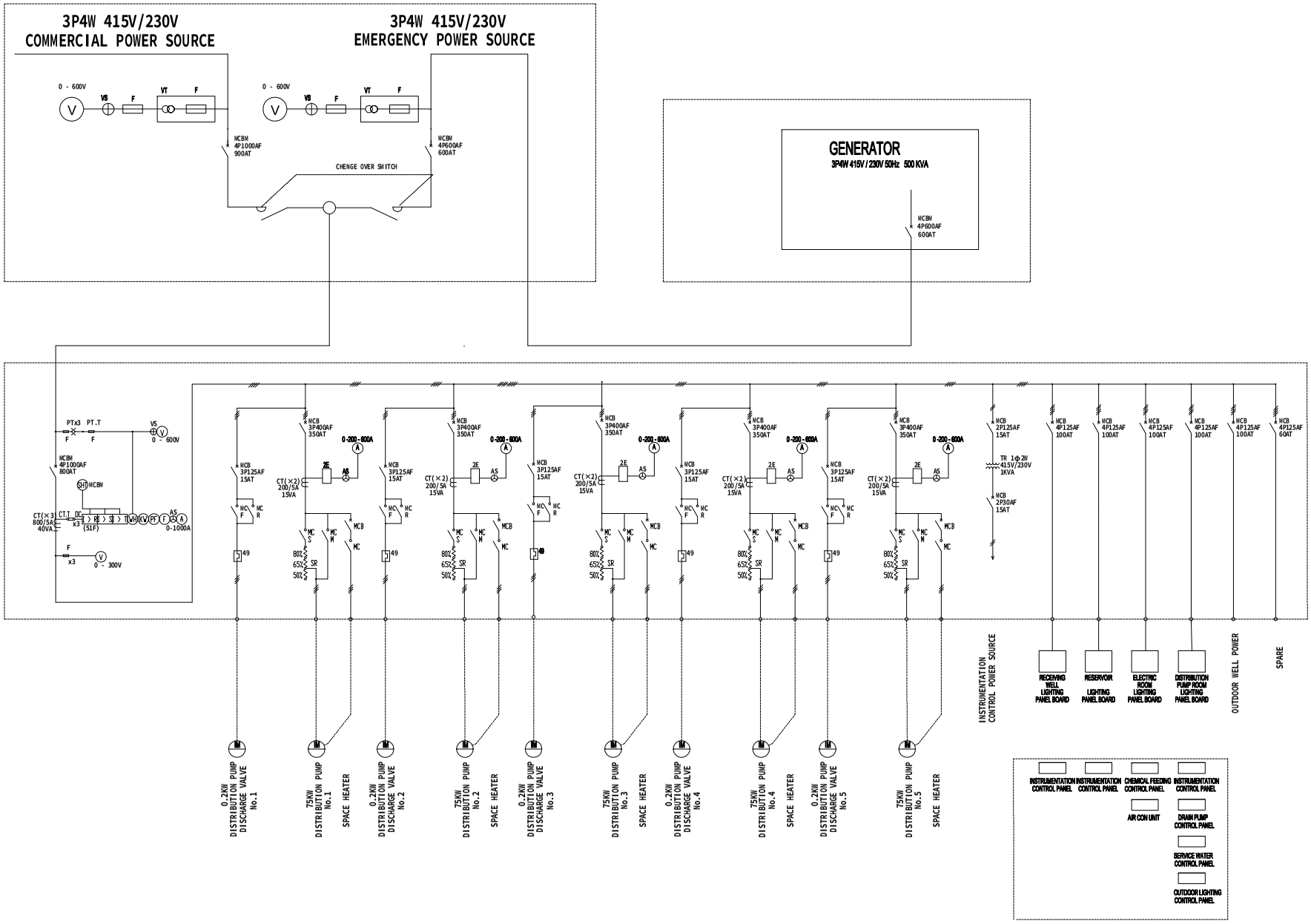
REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : KHATMIA WATER TREATMENT PLANT	SCALE : S=1:250	APPROVED BY : NONE
	KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	TEC	TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	DISTRIBUTION PUMP BUILDING PLAN 配水ポンプ棟平面図	DRAWING NO. : K-6-1	PREPARED BY : NONE
						DATE : 2011



REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : KHATMIA WATER TREATMENT PLANT	SCALE : S=1:250	APPROVED BY : NONE
	KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	DISTRIBUTION PUMP BUILDING ELEVATION AND SECTION 配水ポンプ棟立面図、断面図	DRAWING NO. : K-6-2	PREPARED BY : NONE
					DATE : 2011

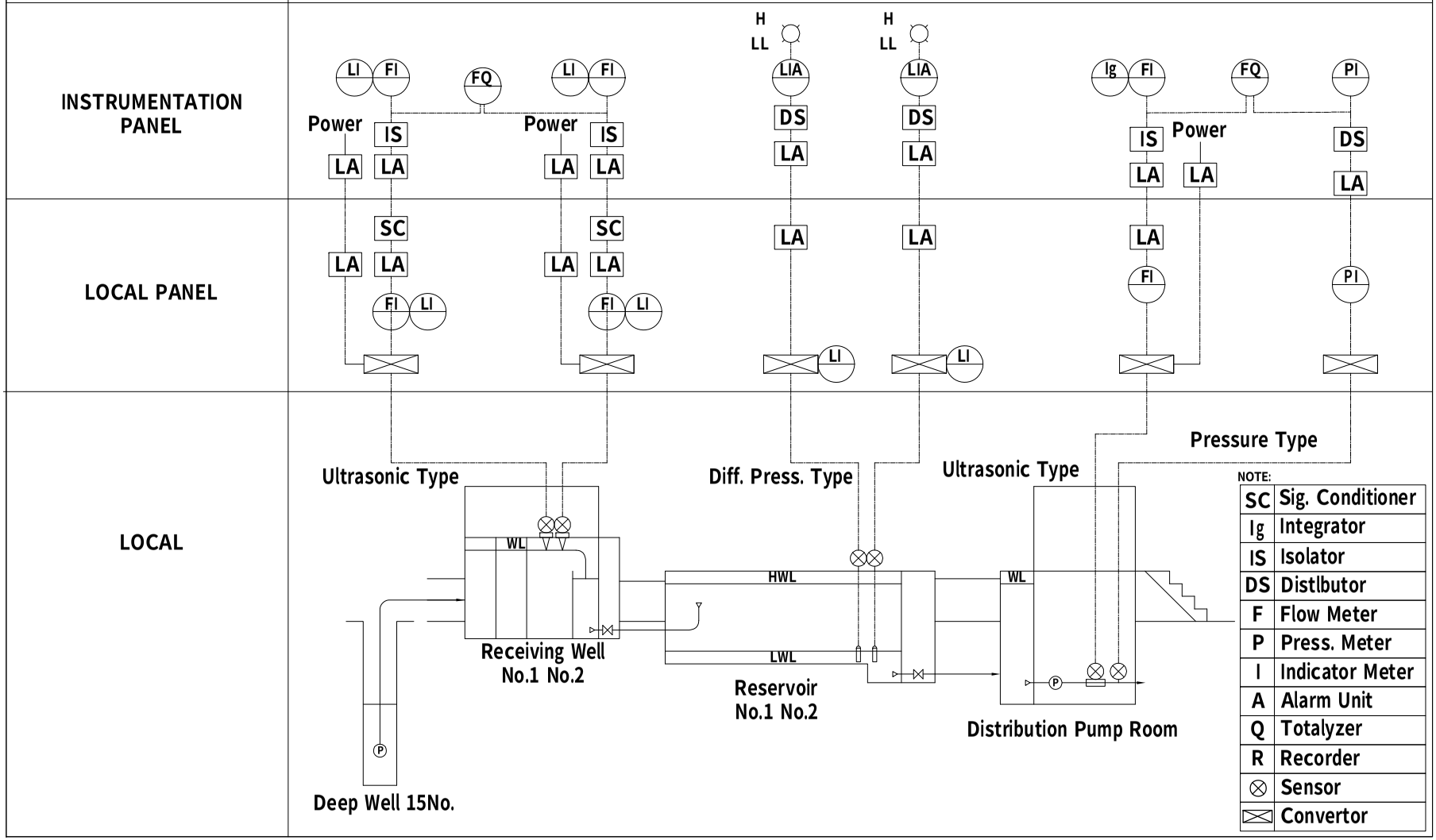


REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT FLOW DIAGRAM OF CHLORINATION DOSING EQUIPMENT 塩素注入設備フローシート図	SCALE : NONE DRAWING NO. : K−7−1	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011	



REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT SINGLE-LINE WIRING DIAGRAM FOR DISTRIBUTION PUMP PANEL BOARD 単線結線図	SCALE : NONE DRAWING NO. : K-8-1	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011

LOOP NAME	Raw Water Level & Flow Meter No.1 No.2		Resevoir Water Level No.1 No.2		Distribution Water Flow & Pressure	
SCALE	0m to 1m	0m3/h to 700m3/h	0m to 5m	0m to 5m	0m3/h to 1,000m3/h	0m to 1Mpa



REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	TITLE : KHATMIA WATER TREATMENT PLANT INSTUMENTATION SYSTEM CHART 計装フローシート図	SCALE : NONE DRAWING NO. : K−9−1	APPROVED BY : NONE PREPARED BY : NONE DATE : 2011

REMARKS :	THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM AT KASSALA CITY	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : RAW WATER TRANSMISSION PIPE (RWTP) AND SOUTH DISTRIBUTION PIPE (SDP)	SCALE : NONE	APPROVED BY : NONE
	KASSALA STATE WATER CORPORATION (KSWC) THE REPUBLIC OF THE SUDAN	TEC TOKYO ENGINEERING CONSULTANTS CO., LTD. JAPAN	PLAN OF RAW WATER TRANS. AND DISTRIBUTION PIPE 導配水管平面図	DRAWING NO. : K-10-1	PREPARED BY : NONE
					DATE : 2011