[APPENDICES]

1. Member List of the Survey Team

(1) First Field Survey in Cambodia (May 7 to July 8, 2018)

Name	Designation	Affiliation
Dr. Mimpei ITO	Leader	Director Environment Management Team 1 Environment Management Group Global Environment Department, JICA
Mr. Masanobu KASHIMURA	Survey Planning	Deputy Director Environment Management Team 1 Environment Management Group Global Environment Department, JICA
Mr. Hitoshi SHIMOKOCHI	Project Manager / Sewerage Planning 1 / Sewage Treatment Facilities (Civil) Planning 1 and Design	CTI Engineering International Co., Ltd.
Mr. Masahide HANABUSA	Deputy Project Manager / Sewerage Planning 2	Nippon Koei Co., Ltd.
Mr. Yoshinobu HASEGAWA	Sewage Treatment Facilities (Civil) Planning 2	CTI Engineering International Co., Ltd.
Mr. Tsuyoshi MATSUSHITA	Soil / Land Formation / Natural Condition Survey	CTI Engineering International Co., Ltd.
Mr. Toru ASAKURA	Construction Planning / Cost Estimation	CTI Engineering International Co., Ltd.
Mr. Makoto YAJIMA	Financial Planning	CTI Engineering International Co., Ltd.

(2) Second Field Survey in Cambodia (August 7 to October 7, 2018)

Name	Designation	Affiliation
Mr. Hitoshi SHIMOKOCHI	Project Manager / Sewerage Planning 1 / Sewage Treatment Facilities (Civil) Planning 1 and Design	CTI Engineering International Co., Ltd.
Mr. Yoshihiro TAKAMURA	Sewer Facilities (Civil) Planning/Design	Nippon Koei Co., Ltd.
Mr. Hisato TAKEDA	Sewage Treatment Facilities (Machinery and Electricity) Planning and Design	CTI Engineering International Co., Ltd.
Mr. Tsuyoshi MATSUSHITA	Soil / Land Formation / Natural Condition Survey	CTI Engineering International Co., Ltd.
Mr. Toru ASAKURA	Construction Planning / Cost Estimation	CTI Engineering International Co., Ltd.
Mr. Satoshi HIRANO	Operation and Maintenance Planning	Water and Sewer Bureau, City of Kitakyushu
Mr. Shin-ichiro TANIMOTO	Environmental and Social Considerations	Nippon Koei Co., Ltd.

(3) Explanation on Draft Final Report in Cambodia (May 15 to May 25, 2019)

Name	Designation	Affiliation
Dr. Mimpei ITO	Leader	Director Environment Management Team 1 Environment Management Group Global Environment Department, JICA
Mr. Masanobu KASHIMURA	Survey Planning	Deputy Director Environment Management Team 1 Environment Management Group Global Environment Department, JICA
Mr. Hitoshi SHIMOKOCHI	Project Manager / Sewerage Planning 1 / Sewage Treatment Facilities (Civil) Planning 1 and Design	CTI Engineering International Co., Ltd.
Mr. Masahide HANABUSA	Deputy Project Manager / Sewerage Planning 2	Nippon Koei Co., Ltd.
Mr. Toru ASAKURA	Construction Planning / Cost Estimation	CTI Engineering International Co., Ltd.

2. Survey Schedule

[First Field Survey in Cambodia]

No.	Date		Leader/ Survey Planning	Project Manager / Sewerage Planning 1 / Sewage Treatment Facilities (Civil) Planning 1 and Design	Deputy Project Manager / Sewerage Planning 2	Sewage Treatment Facilities (Civil) Planning 2	Sewer Facilities (Civil) Planning/Design	Sewage Treatment Facilities (Machinery and Electricity) Planning and Design	Soil / Land Formation / Natural Condition Survey	Construction Planning / Cost Estimation	Operation and Maintenance Planning	Financial Planning	Environmental and Social Considerations
			ITO Minpei/ KASHIMURA Masanobu	SHIMOKOCHI Hitoshi	HANABUSA Masahide	HASEGAWA Yoshinobu	TAKAMURA Yoshihiro	TAKEDA Hisato	MATSUSHITA Tsuyoshi	ASAKURA Toru	HIRANO Satoshi	YAJIMA Makoto	TANIMOTO Shin-ichiro
1	7-May	Mon		★									
2	8-May	Tue		Meeting with MPWT									
3	9-May	Wed		Meeting with DPWT									
4	10-May	Thu		Meeting with PPCC					★				
5	11-May	Fri		Meeting with JICA					Meeting with JICA				
6	12-May	Sat		Site Survey					Site Survey				
7	13-May	Sun		ditto					ditto				
8	14-May	Mon		Data Arrangement					Preparation of TOR for Natural Condition Surveys				
9	15-May	Tue		ditto					ditto				
10	16-May	Wed		Data Arrangement					Site Survey				
11	17-May	Thu		Meeting with MOE					Selection of Contractors for Natural Condition Surveys				
12	18-May	Fri		Meeting with MOE					ditto				
13	19-May	Sat		Data Arrangement					Data Arrangement				
14	20-May	Sun		ditto					ditto				
15	21-May	Mon		Meeting with MOWRAM	★				Data Collection and Analysis				
16	22-May	Tue	★	Data Arrangement	Data Arrangement				ditto				
17	23-May	Wed	AM: Meeting with MLMUPC/ PM: Meeting with PPCC						ditto				
18	24-May	Thu	AM: Meeting with PPCC/ PM: Meeting with MPWT, Site Survey						ditto				
19	25-May	Fri	AM: Meeting with JICA/ PM: MD Signing						ditto				
20	26-May	Sat	●	Data Arrangement	Data Arrangement				ditto				
21	27-May	Sun		ditto	ditto				ditto	★			
22	28-May	Mon		Finalization of Natural Condition Survey Items	Data Collection				Finalization of Natural Condition Survey Items	Data Collection			
23	29-May	Tue		ditto	Analysis on Sewerage Planning				ditto	ditto			
24	30-May	Wed		ditto	ditto				ditto	ditto			
25	31-May	Thu		ditto	ditto				ditto	ditto			
26	1-Jun	Fri		Analysis and Planning on STP facilities	ditto				Analysis on Soil Conditions	ditto			
27	2-Jun	Sat		ditto	●				ditto	ditto			
28	3-Jun	Sun		ditto		★			ditto	ditto			
29	4-Jun	Mon		ditto		Analysis on PTF			ditto	ditto			
30	5-Jun	Tue		ditto		ditto			ditto	ditto			

No.	Date		Leader/ Survey Planning	Project Manager / Sewerage Planning 1 / Sewage Treatment Facilities (Civil) Planning 1 and Design	Deputy Project Manager / Sewerage Planning 2	Sewage Treatment Facilities (Civil) Planning 2	Sewer Facilities (Civil) Planning/Design	Sewage Treatment Facilities (Machinery and Electricity) Planning and Design	Soil / Land Formation / Natural Condition Survey	Construction Planning / Cost Estimation	Operation and Maintenance Planning	Financial Planning	Environmental and Social Considerations
			ITO Mimpei/ KASHIMURA Masanobu	SHIMOKOCHI Hitoshi	HANABUSA Masahide	HASEGAWA Yoshinobu	TAKAMURA Yoshihiro	TAKEDA Hisato	MATSUSHITA Tsuyoshi	ASAKURA Toru	HIRANO Satoshi	YAJIMA Makoto	TANIMOTO Shin-ichiro
31	6-Jun	Wed		Meeting with EDC and WMD/PPCC, PPWSA		Site Survey			Analysis on Method for Reclamation	Meeting with EDC and WMD/PPCC			
32	7-Jun	Thu		Meeting with CMAC		Analysis on PTF			ditto	Analysis on Construction Planning and Cost Estimation			
33	8-Jun	Fri		Meeting in Dangkor Dumping Site		ditto			ditto	Meeting in Dangkor Dumping Site			
34	9-Jun	Sat		Data Arrangement		●			Data Arrangement	Data Arrangement			
35	10-Jun	Sun		ditto					ditto	ditto			
36	11-Jun	Mon		Analysis and Planning on STP facilities					Analysis on Method for Reclamation	Analysis on Construction Planning and Cost Estimation		★	
37	12-Jun	Tue		ditto					ditto	Reporting		Data Collection	
38	13-Jun	Wed		ditto					Reporting	ditto		ditto	
39	14-Jun	Thu		Meeting with MLMUPC					ditto	ditto		Meeting with JICA	
40	15-Jun	Fri		Analysis and Planning on STP facilities					ditto	ditto		Data Collection	
41	16-Jun	Sat		ditto					ditto	ditto		ditto	
42	17-Jun	Sun		ditto					●	●		ditto	
43	18-Jun	Mon		ditto								Data Analysis	
44	19-Jun	Tue		Compiling Technical Note								ditto	
45	20-Jun	Wed		ditto								ditto	
46	21-Jun	Thu		ditto								ditto	
47	22-Jun	Fri		ditto								ditto	
48	23-Jun	Sat		ditto								ditto	
49	24-Jun	Sun		ditto								ditto	
50	25-Jun	Mon		ditto									
51	26-Jun	Tue		ditto								Meeting with MPWT/PPWSA	
52	27-Jun	Wed		ditto									
53	28-Jun	Thu		ditto									
54	29-Jun	Fri		ditto								Meeting with PPCC	
55	30-Jun	Sat		ditto								●	
56	1-Jul	Sun		ditto									
57	2-Jul	Mon		ditto									
58	3-Jul	Tue		ditto									
59	4-Jul	Wed		Meeting with MEF									
60	5-Jul	Thu		Reporting									
61	6-Jul	Fri		Meeting with DPWT and JICA									
62	7-Jul	Sat		Reporting									
63	8-Jul	Sun		●									

[Second Field Survey in Cambodia]

No.	Date		Leader/ Survey Planning	Project Manager / Sewerage Planning 1 / Sewage Treatment Facilities (Civil) Planning 1 and Design	Deputy Project Manager / Sewerage Planning 2	Sewage Treatment Facilities (Civil) Planning 2	Sewer Facilities (Civil) Planning/Design	Sewage Treatment Facilities (Machinery and Electricity) Planning and Design	Soil / Land Formation / Natural Condition Survey	Construction Planning / Cost Estimation	Operation and Maintenance Planning	Financial Planning	Environmental and Social Considerations
			ITO Minpei/ KASHIMURA Masanobu	SHIMOKOCHI Hitoshi	HANABUSA Masahide	HASEGAWA Yoshinobu	TAKAMURA Yoshihiro	TAKEDA Hisato	MATSUSHITA Tsuyoshi	ASAKURA Toru	HIRANO Satoshi	YAJIMA Makoto	TANIMOTO Shin-ichiro
1	6-Aug	Mon											
2	7-Aug	Tue						★					
3	8-Aug	Wed						Site Survey					
4	9-Aug	Thu						Data Collection					
5	10-Aug	Fri						ditto					
6	11-Aug	Sat						ditto		★			
7	12-Aug	Sun						ditto		Analysis on Construction Planning			
8	13-Aug	Mon						Planning on M&E Facilities		ditto	★		
9	14-Aug	Tue						ditto		ditto	Site Survey		
10	15-Aug	Wed						ditto		ditto	Meeting with DPWT		
11	16-Aug	Thu						ditto		ditto	Data Collection		
12	17-Aug	Fri						ditto		ditto	ditto		
13	18-Aug	Sat						ditto		ditto	ditto		
14	19-Aug	Sun						ditto		ditto	ditto		
15	20-Aug	Mon					★	ditto		Analysis on Cost Estimation	Reporting		
16	21-Aug	Tue		★			Data Collection	ditto		ditto	ditto		★
17	22-Aug	Wed		Analysis and Planning on STP facilities			Site Survey	Site Survey		ditto	ditto		Site Survey
18	23-Aug	Thu		ditto			Data Collection	Planning on M&E Facilities		ditto	ditto		Confirmation on EIA regulations
19	24-Aug	Fri		ditto			ditto	ditto		ditto	ditto		ditto
20	25-Aug	Sat		ditto			ditto	ditto		ditto	ditto		Data Arrangement
21	26-Aug	Sun		ditto			ditto	ditto		ditto	ditto		ditto
22	27-Aug	Mon		ditto			Planning on Sewer Facilities	Reporting		ditto			Preparation of TOR for EIA and RAP
23	28-Aug	Tue		ditto			ditto	ditto	Analysis on Soil Conditions	ditto			Data Collection
24	29-Aug	Wed		Meeting with DPWT			Meeting with DPWT	Meeting with EDC	ditto	Meeting with EDC			ditto
25	30-Aug	Thu		Analysis and Planning on STP facilities			Planning on Sewer Facilities	Reporting	ditto	Reporting			ditto
26	31-Aug	Fri		ditto			ditto	●	ditto	ditto			ditto
27	1-Sep	Sat		ditto			ditto		ditto	●			ditto
28	2-Sep	Sun		ditto			ditto		ditto				ditto
29	3-Sep	Mon		ditto			ditto		ditto				Selection of Contractors
30	4-Sep	Tue		ditto			ditto		ditto				Data Collection

No.	Date		Leader/ Survey Planning	Project Manager / Sewerage Planning 1 / Sewage Treatment Facilities (Civil) Planning 1 and Design	Deputy Project Manager / Sewerage Planning 2	Sewage Treatment Facilities (Civil) Planning 2	Sewer Facilities (Civil) Planning/Design	Sewage Treatment Facilities (Machinery and Electricity) Planning and Design	Soil / Land Formation / Natural Condition Survey	Construction Planning / Cost Estimation	Operation and Maintenance Planning	Financial Planning	Environmental and Social Considerations
			ITO Mimpei/ KASHIMURA Masanobu	SHIMOKOCHI Hitoshi	HANABUSA Masahide	HASEGAWA Yoshinobu	TAKAMURA Yoshihiro	TAKEDA Hisato	MATSUSHITA Tsuyoshi	ASAKURA Toru	HIRANO Satoshi	YAJIMA Makoto	TANIMOTO Shin-ichiro
31	5-Sep	Wed		Analysis and Planning on STP facilities			Reporting		Planning of Ground Formulation				Data Collection
32	6-Sep	Thu		ditto			ditto		ditto				ditto
33	7-Sep	Fri		ditto			ditto		ditto				ditto
34	8-Sep	Sat		ditto			●		ditto				ditto
35	9-Sep	Sun		ditto					ditto				ditto
36	10-Sep	Mon		Analysis and Planning on STP facilities					ditto				Reporting
37	11-Sep	Tue		ditto					ditto				ditto
38	12-Sep	Wed		ditto					ditto				ditto
39	13-Sep	Thu		ditto					ditto				ditto
40	14-Sep	Fri		ditto					ditto				ditto
41	15-Sep	Sat		ditto					ditto				ditto
42	16-Sep	Sun		ditto					ditto				●
43	17-Sep	Mon		ditto					Reporting				
44	18-Sep	Tue		ditto					ditto				
45	19-Sep	Wed		ditto					ditto				
46	20-Sep	Thu		ditto					ditto				
47	21-Sep	Fri		ditto					ditto				
48	22-Sep	Sat		ditto					ditto				
49	23-Sep	Sun		ditto					●				
50	24-Sep	Mon		ditto									
51	25-Sep	Tue		ditto									
52	26-Sep	Wed		ditto									
53	27-Sep	Thu		ditto									
54	28-Sep	Fri		Meeting with DPWT									
55	29-Sep	Sat		ditto									
56	30-Sep	Sun		ditto									
57	1-Oct	Mon		ditto									
58	2-Oct	Tue		Meeting with PPCC									
59	3-Oct	Wed		ditto									
60	4-Oct	Thu		ditto									
61	5-Oct	Fri		ditto									
62	6-Oct	Sat		ditto									
63	7-Oct	Sun		•									

MPWT : Ministry of Public Works and Transport

MLMUPC: Ministry of Land Management and, Urban Planning and Construction

PPCC : Phnom Penh Capital City

DPWT : Department of Public Works and Transport

PPWSA : Phnom Penh Water Supply Authority

★Mobilization to Phnom Penh

●Demobilization from Phnom Penh

Saturday	Saturday
Sunday	Sunday
Holiday	Holiday

[Explanation on Draft Final Report in Cambodia]

No.	Date		Leader	Survey Planning	Project Manager / Sewerage Planning 1 / Sewage Treatment Facilities (Civil) Planning 1 and Design	Deputy Project Manager / Sewerage Planning 2	Construction Planning / Cost Estimation
			ITO Mimpei	KASHIMURA Masanobu	SHIMOKOCHI Hitoshi	HANABUSA Masahide	ASAKURA Toru
1	15-May	Wed			★		
2	16-May	Thu			Data Arrangement Site Survey		
3	17-May	Fri			Meeting with DPWT Meeting with PPCC		
4	18-May	Sat			Data Arrangement		
5	19-May	Sun			ditto		
6	20-May	Mon	★	★	Data Arrangement	Data Arrangement	Data Arrangement
7	21-May	Tue	Discuss Minutes of Discussion (M/D) with PPCC including DPWT				
8	22-May	Wed	Data Arrangement	Data Arrangement	Data Arrangement	Data Arrangement	Data Arrangement
9	23-May	Thu	Discuss and Sign Minutes of Discussion (M/D) between JICA Mission and PPCC				
10	24-May	Fri	●	Data Arrangement	Data Arrangement	Data Arrangement	Data Arrangement
11	25-May	Sat		●	●	●	●

PPCC : Phnom Penh Capital City

DPWT : Department of Public Works and Transport

3. List of Parties Concerned in Cambodia

Name	Designation	Organization
Phnom Penh Capital City: PPCC (Head Office)		
H.E. Koeut Chhe	Vice Governor	PPCC
H.E. Nuon Pharath	Vice Governor	PPCC
H.E. Suy Serith	Vice Governor	PPCC
Hok Kimeang	Deputy Director	Urbanization Division
Leng Thida	Vice Chief	Urbanization Division
Thai Srun	Vice Chief	Urbanization Division
Sor Dara	Chief	Urbanization Division
Sor Phara	Chief	Urbanization Division
Moa Kolmarde	Director	Waste Management Division
Nuon Samnavuth	Deputy Director	Waste Management Division
Kim Vathanak Thida	Deputy Director	Waste Management Division
Chhay Sopeara	Assistant	Administration
Theam Rithdeka	Director	Public Relations and International Cooperation Office
Soth Rothanurak	Deputy Director	Public Relations and International Cooperation Office
Keo Channarith	Chief of Landfill	Dangkor Landfill Site
Department of Public Works and Transport : DPWT/PPCC		
Sam Piseth	Director	DPWT/PPCC
Chou Kimtry	Deputy Director	DPWT/PPCC
Moeung Sophan	Advisor	DPWT/PPCC
Pheng Pharinet	Officer	DPWT/PPCC
Drainage Pumping Station and Sewage Treatment Plant Office : DSO/DPWT		
Dourng Chansarath	Deputy Chief	DSO
Chhorng Vantha	Deputy Chief	DSO
Men Sokkhen	Deputy Chief	DSO
Department of Land Management, Urban Planning and Construction: DLMUPC/PPCC		
Mey Chettra	Deputy Director	DLMUPC/PPCC
Hoeung Rathsokha	Vice Chief	DLMUPC/PPCC
Som Meakhbormey		DLMUPC/PPCC
Department of Environment : DOE/PPCC		
Keo Chanarith	Director	DOE/PPCC
Khuon Dara	Deputy Director	DOE/PPCC
Khans in Phnom Penh Capital City		
Ma Sopheap	Deputy Governor	Khan Meanchey
Tema Sophea	Deputy Governor	Khan Dangkor
Keo Samol	Deputy Governor	Khan Chamkarmon
Neang Sophary	Deputy Governor	Khan Po Senchey
Huot Leapiseth	Deputy Governor	Khan Prek Pnov
Nu Keosokun	Chief	Khan Po Senchey, District Office of Public Works
Minister of Public Works and Transport: MPWT		
Heng Rathpiseth	Director General	General Directorate of Public Works
Chao Sopheak Phibal	Director	Sewerage Management and Construction Department
Dr. Lim Soktay	Deputy Director	Sewerage Management and Construction Department
Ministry of Land Management, Urban Planning and Construction: MLMUPC		
Dr. Pen Sophal	Secretary of State	MLMUPC
Dr. Chhann Sorphal	General Director	General Department of Construction
Dr. Chea Phalry	Deputy General Director	General Department of Construction
Ministry of Environment : MOE		
Pak Sokharavuth	Deputy Director General	General Directorate of Environmental Protection
Chandath Him	Deputy Director	General Directorate of Environmental Protection
Chea Nara	Deputy Director	Department of Air Quality and Noise Management
Phnom Penh Water Supply Authority : PPWSA		
Samreth Sovithiea	Deputy General Director	
Chea Satephoat	Director	Planning and Project Department

Embassy of Japan in Cambodia		
Atsushi Hirose	Second Secretary	Embassy of Japan
Electricité du Cambodge		
Chreng Karodine	Deputy Chief Officer	Corporate Planning and Projects Department
Sim Chanthea	Deputy Chief	System Analysis and GIS Office
Oeng Lysorng	Technical Officer	Corporate Planning and Projects Department
Cambodian Mine Action Center		
Oum Phumro	Deputy Director General	
JICA Cambodia		
Yuichi Sugano	Chief Representative	JICA, Cambodia Office
Kotaro Tanaka	Deputy Chief Representative	JICA, Cambodia Office
Masashi Nishikawa	Project Formulation Advisor	JICA, Cambodia Office
Tomoyuki Yamada	Project Formulation Advisor	JICA, Cambodia Office
Say Bora	Program Officer	JICA, Cambodia Office
Veng Samnang	Interpreter	

4. Minutes of Discussions

4.1 Minutes of Discussions (May 25, 2018)

MINUTES OF DISCUSSIONS

ON

THE PREPARATORY SURVEY ON

THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT

IN THE PHNOM PENH CAPITAL CITY

In response to the request from the Government of the Kingdom of Cambodia (hereinafter referred to as " Cambodia "), the Government of Japan decided to conduct a Preparatory Survey on the Project for Sewerage System Development in the Phnom Penh Capital City (hereinafter referred to as "the Project"), and entrusted the Preparatory Survey to Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") to Cambodia, headed by Dr. Ito Mimpei, Director of Environmental Management Team, Environmental Management Group, Global Environment Department, and the Team stayed in Cambodia from 22nd to 25th May, 2018.

The Team held a series of discussions with the officials concerned of the Government of Cambodia and conducted field surveys in the Project sites. In the course of the discussions, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Phnom Penh, 25th May, 2018

伊藤 文平

Dr.Ito Mimpei
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

H.E. Khuong Sreng
Governor
Phnom Penh Capital City
Cambodia

ATTACHMENT

1. Objective of the Project
   The objective of the Project is to minimize water pollution load to Cheung Aek Lake through construction of new sewerage treatment facilities, thereby contributing to protect and improve water and sanitation environment of Cheung Aek Lake.

2. Title of the Preparatory Survey
   Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey on the Project for Sewerage System Development in the Phnom Penh Capital City".

3. Project Site
   Cambodian side requested to change the original site (total 16.3 ha including 3.5 ha for the Project) of Sewerage Treatment Plant (hereinafter referred to as "STP") near St. 371 in Khan Mean Chey which was proposed in Pre-Feasibility Study on Priority Project of Sewage Management in "The Study on Drainage and Sewerage Improvement Project in Phnom Penh Metropolitan Area" with letter from Governor of Phnom Penh Capital Administration (hereinafter referred to as "PPCA") because many impacts to the underground utilities such as water networks, drainage networks, electricity networks, and optical cables networks as well as the people living there. Both sides agreed that the alternative site is fixed as shown in Annex 2 and the site will not be changed again in any reason.

4. Process of obtaining land title for STP
   Both sides confirmed that the processes of obtaining of land title for STP are as follows;
   1) To obtain permission from Prime Minister's office to change the status of land from National Public Land to Private State Land requested by PPCA
   2) To prepare Sub-decree on transferring land title from National Public Land to Private State Land by PPCA in coordination with relevant ministries and institutions

   Both sides also agreed that those two processes shall be completed by the end of 2018.

5. Sewer Line
   The Team explained that there are two possibilities for developing sewer line. The first possibility is to develop under the road inside the private housing development area. The second possibility is to develop sewer line under the embankment of improved drainage channel. In either case, the Team requested PPCA to identify the position of sewer line by August, 2018. PPCA replied that PPCA needs to discuss with developer on the possibility of constructing sewer line under the road since the developer has a plan to construct road soon. PPCA further explained that the timing of identifying the route of sewer line depends on the meeting between PPCA and developer. Both sides confirmed the necessity of identifying the route as soon as possible and make their effort with the technical support from consultant team.
   The Team also explained that the cost for constructing road inside the private housing developing area or improved drainage channel shall be borne by Cambodian side. The Cambodian side agreed it.

6. Line Agency and Executing Agency
   Both sides confirmed the line agency and the executing agency as follows:

   6-1. The line agency is the Phnom Penh Capital Administration (hereinafter referred to as "PPCA"), which would supervise the executing organization.

   6-2. The executing agency is the Department of Public Works and Transport of PPCA (hereinafter referred to as "DPWT"), which shall coordinate with all the relevant

agencies/line departments to ensure smooth implementation of the Project and ensure that the Undertakings are taken by them properly and on schedule. The organization charts are shown in Annex 3.

7. Items requested by the Government of Cambodia

7-1. As a result of discussions, both sides confirmed that the items requested by the Government of Cambodia for the Project are as shown in the Table below.

Components	Detailed Contents (will be studied in the Preparatory Survey)
Construction of Sewerage Treatment Plant (STP) (including Interception Facilities)	- Capacity: 5,000m^3 - Treatment method: Pre-treated Trickling Filtration (PTF)
Access Road/Sewer pipe from Trabek Pumping Station to STP	- Length: 2,000m - Diameter of Sewer pipe: 500mm

7-2. JICA will assess the appropriateness of the above requested items through the survey and will report findings to the Government of Japan. The final components of the Project would be decided by the Government of Japan.

8. Japanese Grant Aid Scheme

8-1. The Cambodian side understands the Japanese Grant Scheme and its procedures as described in Annex 4, Annex 5 and Annex 6, and necessary measures to be taken by the Government of Cambodia.

8-2. The Cambodian side agreed to take the necessary measures, as described in Annex 7 for smooth implementation of the Project. The contents of the Annex 7 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report. The contents of Annex 7 will be updated as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

9. Schedule of the Survey

9-1. The Team will proceed with further survey in Cambodia until the end of September 2018.

9-2. JICA will prepare a draft Preparatory Survey Report in English and will dispatch another mission to Cambodia in order to explain its contents around middle of April 2019.

9-3. If the contents of the Draft Preparatory Survey Report is accepted in principle and the undertakings are fully agreed by the Cambodian side, JICA will complete the final report in English and send it to the Government of Cambodia around July 2019.

9-4. The above schedule is tentative and subject to change due to the progress of the Survey.

10. Environmental and Social Considerations

10-1. The Cambodian side confirmed to give due environmental and social considerations during implementation of the Project, and after completion of the Project, in accordance with "the JICA Guidelines for Environmental and Social Considerations [April, 2010]".

10-2. The Project is categorized as B because the Project is not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under "the JICA guidelines for environmental and social considerations [April 2010]", and its potential adverse impacts on the environment are not likely to be significant. The Cambodian

side confirmed to conduct the necessary procedures concerning the environmental assessment (including stakeholder meetings, Environmental Impact Assessment (EIA) and information disclosure, etc.) and make EIA report of the Project. The EIA approval shall be received from the responsible authorities and submitted to JICA by April 2019.

10-3. Both sides confirmed that there is no expected PAP (Project Affected People) residing in the Project site. During the Survey, if clarified the Projects will result in involuntary resettlement, the Cambodian side confirmed to prepare a Resettlement Action Plan (RAP)/Abbreviated Resettlement Action Plan (ARAP) and make it available to the public. Both sides also confirmed that some residents living in surrounding area of STP site in Cheung Aek Lake may lose their agricultural income because of its reclamation. The Cambodian side confirmed to provide the affected people with sufficient compensation and/or support in accordance with RAP/ARAP, in a timely manner.

11. Other Relevant Issues

11-1. Formal Request

Cambodian side confirmed that Formal request of the Project shall be submitted by December 2018 at the latest.

11-2. Reclamation of Cheung Aek Lake

Cambodian side explained thatpermission fromPPCA after transferring land title isnecessary to be obtained for reclamation of STP site. Both sides confirmed that detail of the reclamation including reclamation method, volume and source of soil for reclamation, sediment of ground of reclaimed area, will be researched in the Survey.

11-3. Sludge Treatment

Sewerage Management Master Plan in "The Study on Drainage and Sewerage Improvement Project in Phnom Penh Metropolitan Area" proposed sludge from STP would be delivered to Dangkor final disposal site after primary treatment in STP. Both sides agreed that detail of the treatment, deliver and disposal will be verified in the Survey.

11-4. Taxes borne by Cambodian side and its budget allocation

With reference to Annex 4 and Annex 5, both sides confirmed that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the recipient with respect to the purchase of the products and/or the services be exempted by its designated authority without using the Grant.

11-5. Monitoring during the implementation

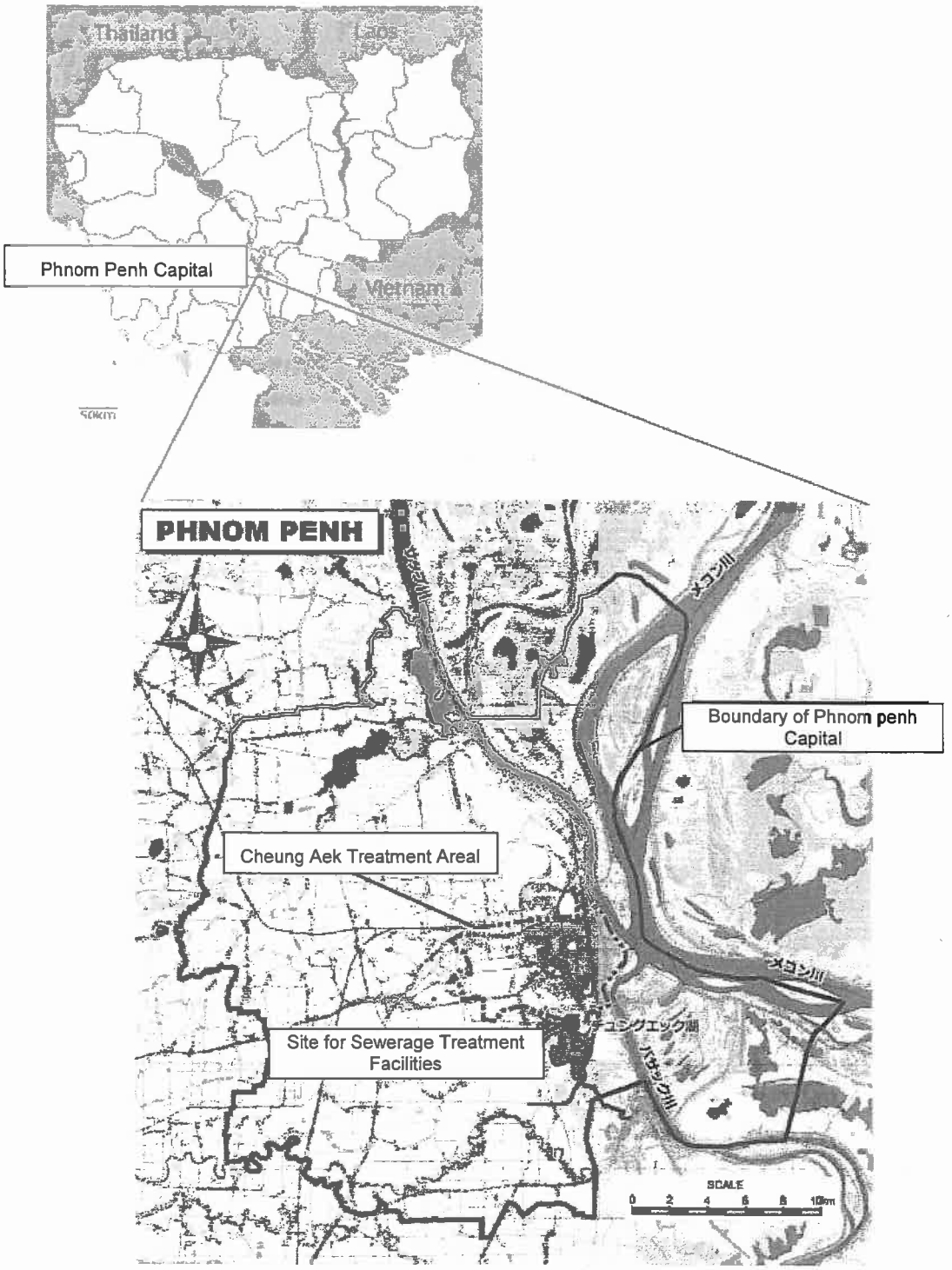
PPCA and DPWT agreed to monitor the Project every three (3) months during the implementation by using the Project Monitoring Report form as attached in Annex 8

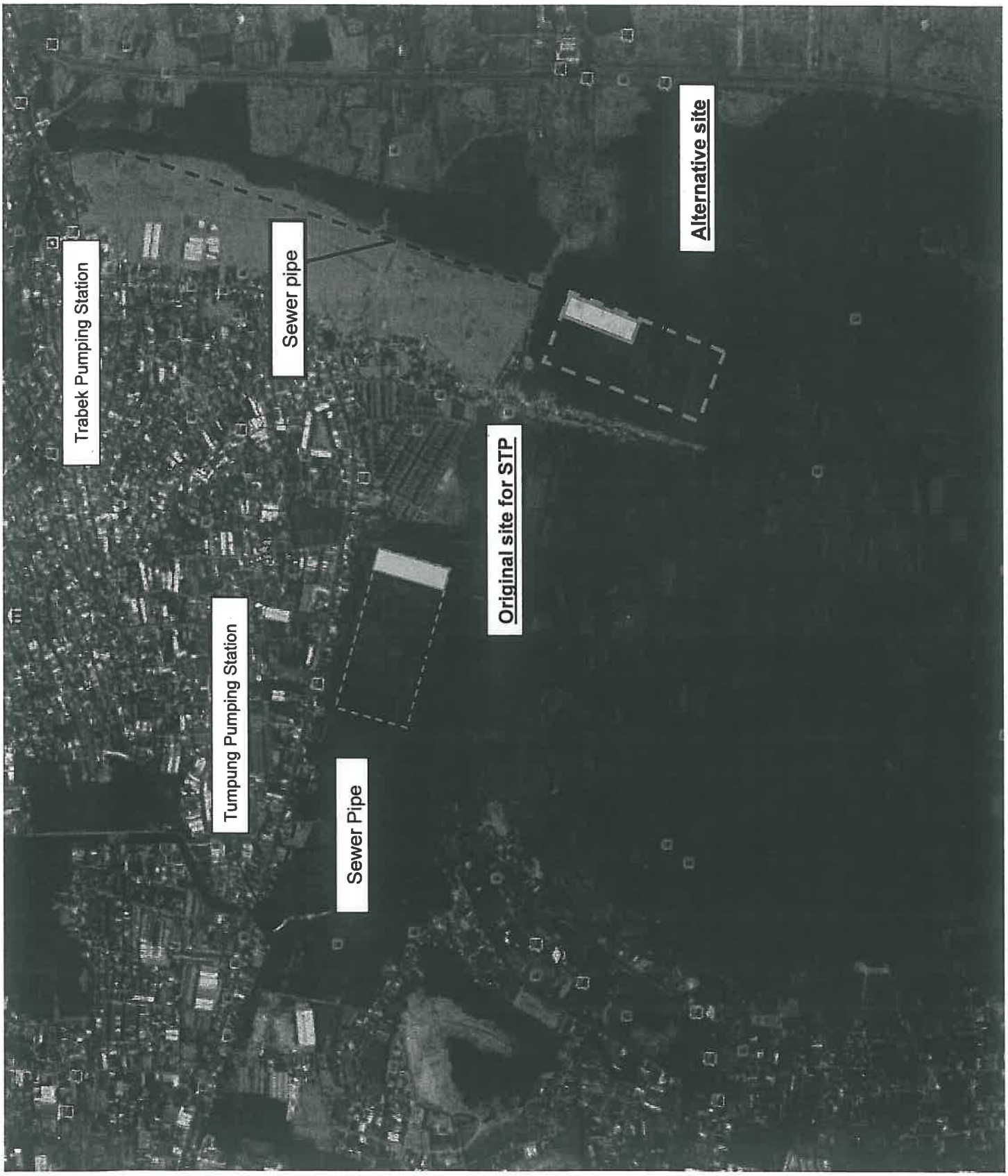
11-6. Confidentiality of the Project

The Team explained that the Preparatory Survey Report to be prepared at the end of the survey would be disclosed to the public in Japan. However, the Team also explained that a confidential part which might affect bidding process such as cost estimation should be kept undisclosed until the bidding has been completed.

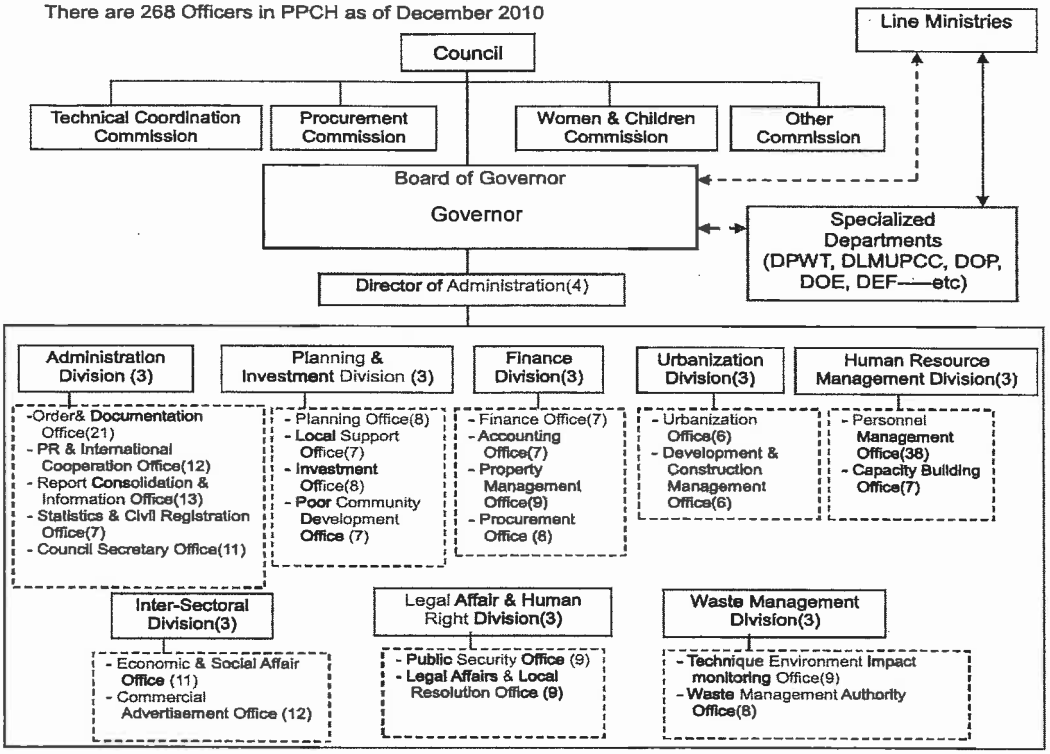
Annex 1 Project Sites
Annex 2 Comparison between original site and alternative site
Annex 3 Organization Chart
Annex 4 Japanese Grant
Annex 5 Flow Chart of Japanese Grant
Annex 6 Financial Flow of Japanese Grant
Annex 7 Major Undertakings to be taken by Recipient Government
Annex 8 Project Monitoring Report (template)

Annex 1

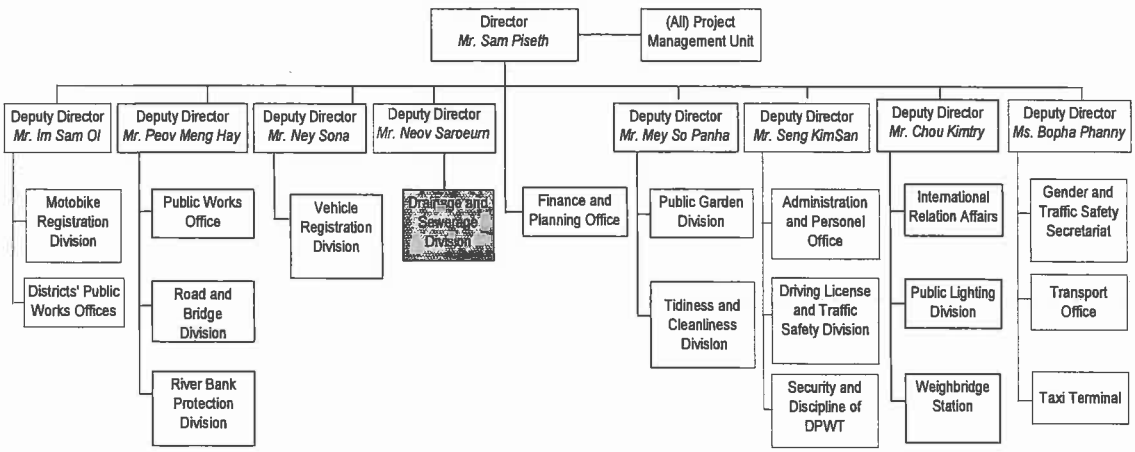

Thailand
Laos
Vietnam
Phnom Penh Capital
PHNOM PENH
Boundary of Phnom penh Capital
Cheung Aek Treatment Areal
Site for Sewerage Treatment Facilities
メコン川
トンレサップ川
SCALE


Trabek Pumping Station
Sewer pipe
Alternative site
Original site for STP
Tumpung Pumping Station
Sewer Pipe

Organization Chart of PPCA



Organization Chart of DPWT



JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of

relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the Recipient to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the

Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

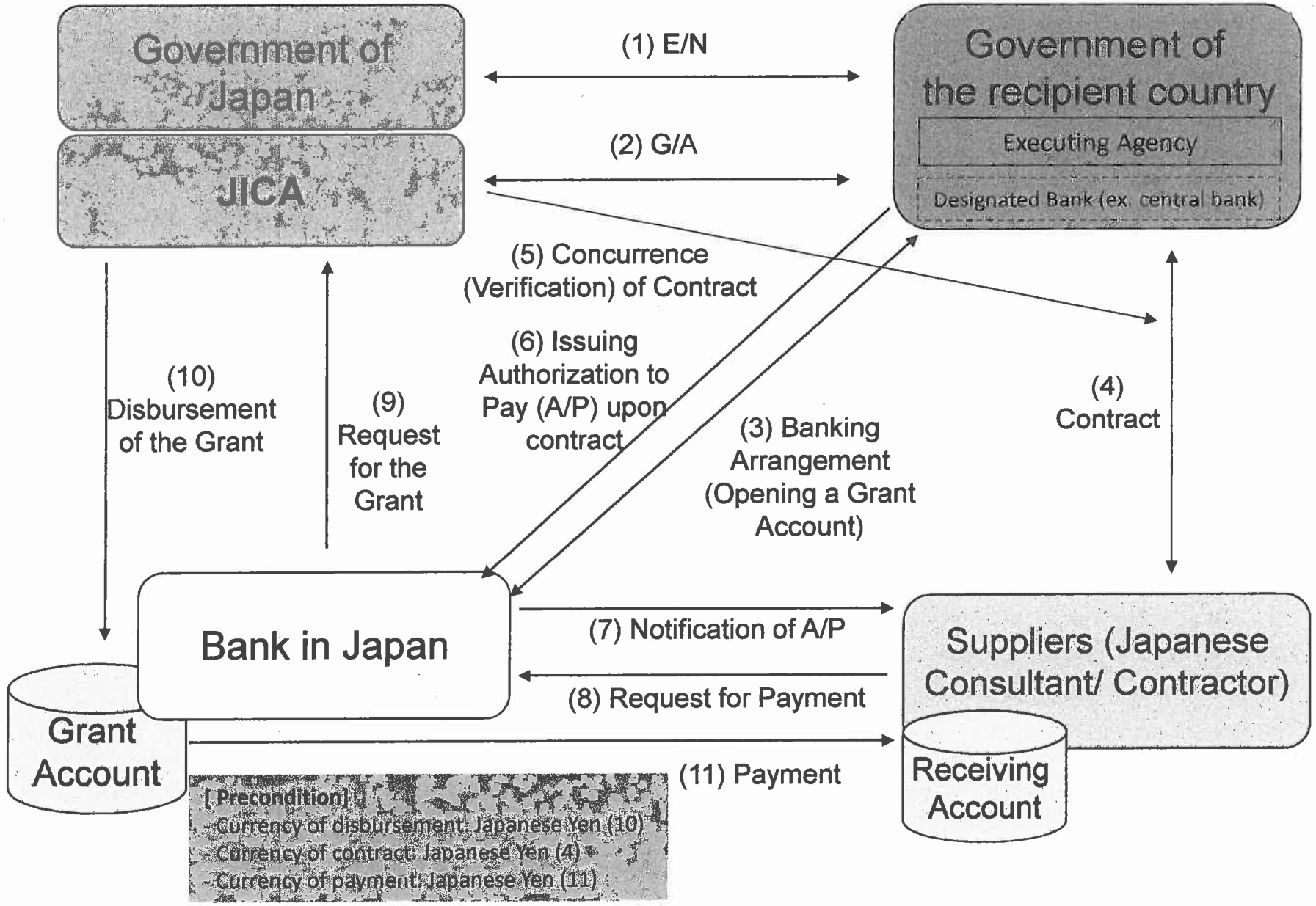
3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Financial Flow of Japanese Grant (A/P Type)



PROCEDURES OF JAPANESE GRANT

Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.

Annex 7

Major Undertakings to be taken by Recipient Government

1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	PPCC		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract	PPCC		
3	To approve EIA (Conditions of approval should be fulfilled, if any) and secure the necessary budget for implementation	By the end of April 2019	PPCC		
4	To transfer land title from National Public Land to Private State Land for STP	By the end of December 2018	PPCC DPWT		
5	To identify the position of Access road/Sewer Line	By August 2018	PPCC DPWT		
6	To secure the necessary budget and implement land acquisition and resettlement (including preparation of resettlement sites), and compensation with full replacement cost in accordance with ARAP	before start of the construction	MEF, PPCC		
7	To secure sufficient spaces at the respective Project site/s for temporary facilities such as a contractor's office, workshop, building materials storage, etc. needed for the construction work.	before notice of the Tender	PPCC		
8	To complete the investigation and removal of UXO and Mines in all construction areas (including sewer installation alignment).	before notice of the Tender	PPCC		

2) During the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	PPCC		
2	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract	PPCC		
	2) Payment commission for A/P	every payment	PPCC		
3	To ensure prompt unloading, customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation in the country of the Recipient of the products	during the Project	PPCC		
4	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	PPCC		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be exempted by its designated authority without using the Grant	during the Project	PPCC		

6	To bear all the expenses, other than those to be borne by the Japanese Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment	during the Project	PPCC		
7	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for the construction work	prior to commencement of the construction	PPCC		
8	To provide facilities for distribution of electricity, water supply, drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)				
	1) Electricity Distribution lines to the site		PPCC		
	2) Water Supply City water distribution main to the site		PPCC		
	3) Telecommunication Distribution lines to the site		PPCC		
9	To implement EMP and EMoP	during the construction	PPCC, DOE		
10	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	PPCC		
11	To implement ARAP (livelihood restoration program, if needed)	for a period based on livelihood restoration program	PPCC		
12	To secure necessary conditions and environments on the site(s) in cooperation with related authorities and local residents (e.g. Security guards, traffic control, etc.)	during the construction	PPCC		

(EMP: Environmental Management Plan, EMoP: Environmental Monitoring Plan)

3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To implement EMP and EMoP	for a period based on EMP and EMoP	PPCC, DOE		
	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between PPCC and JICA.	for three years after the Project	PPCC, DOE		
2	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	after completion of the construction	PPCC, DPWT		

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(Note) Progress of the specific obligations of the Recipient may be confirmed and updated from time to time with written agreement between JICA and the Recipient in the form other than the amendment of the G/A.

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Line Ministry	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●●, 2015	2nd ●●, 2015	3rd ●●, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-
-
-

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

4.2 Minutes of Discussions (May 23, 2019)

MINUTES OF DISCUSSIONS
ON
THE PREPARATORY SURVEY ON
THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT
IN THE PHNOM PENH CAPITAL CITY
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Phnom Penh Capital Administration (hereinafter referred to as "PPCA") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 25th May, 2018 and in response to the request from the Government of the Kingdom of Cambodia (hereinafter referred to as "Cambodia") dated 31st May, 2017, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Sewerage System Development in the Phnom Penh Capital City (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Phnom Penh, May 23rd, 2019

Dr. Ito Mimpei	H.E. Khuong Sreng
Leader	Governor
Preparatory Survey Team	Phnom Penh Capital City
Japan International Cooperation Agency	The Kingdom of Cambodia
Japan	

ATTACHEMENT

1. Objective of the Project

The objective of the Project is to minimize water pollution load to Cheung Aek Lake through construction of new sewerage treatment facilities, thereby contributing to protect and improve water and sanitation environment of Cheung Aek Lake.

2. Title of the Preparatory Survey

Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey on the Project for Sewerage System Development in the Phnom Penh Capital City".

3. Project site

Both sides confirmed that the site of the Project is in Phnom Penh Capital City (hereinafter referred to as "PPCC"), which is shown in Annex 1.

4. Responsible authority for the Project

Both sides confirmed the authorities responsible for the Project are as follows:

4-1. The Department of Public Works and Transport (hereinafter referred to as "DPWT") of PPCA will be the executing agency for the Project. The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. The organization charts are shown in Annex 2.

4-2. The line ministry of the Executing Agency is PPCA. PPCA shall be responsible for supervising the Executing Agency on behalf of the Government of Cambodia.

5. Contents of the Draft Report

After the explanation of the contents of the Draft Report by the Team, the Cambodian side agreed to its contents.

6. Cost estimate

Both sides confirmed that the cost estimate described in the Draft Report is provisional and will be examined further by the Government of Japan for its approval. Both sides confirmed that the cost estimate including the contingency explained by the Team is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

7. Confidentiality of the cost estimate and technical specifications
Both sides confirmed that the cost estimate and technical specifications of the Project should never be disclosed to any third parties until all the contracts under the Project are concluded.

8. Timeline for the project implementation
The Team explained to the Cambodian side that the expected timeline for the project implementation is as attached in Annex 3.

9. Expected outcomes and indicators
Both sides agreed that key indicators for expected outcomes are as follows. The Cambodian side will be responsible for the achievement of agreed key indicators targeted in year 2027 and shall monitor the progress based on those indicators.
[Quantitative indicators]

indicators	Present (2018)	Future(2027):three years after Completion of this Project
Wastewater treated population (person)	0	19,000
Amount of wastewater treatment (m^3/day)	0	5,000
Concentration of BOD (discharged water quality) (mg/L)	195	30

[Qualitative indicators]
- To improve water environment of public water body (Cheung Aek Lake)
- To improve citizen's living environment in target area

10. Technical assistance ("Soft Component" of the Project)
Considering the sustainable operation and maintenance of the products and services granted through the Project, a series of technical assistance is planned under the Project. The Cambodian side confirmed to deploy necessary number of counterparts who are appropriate and competent in terms of its purpose of the technical assistance as described in the Draft Report.

11. Undertakings of the Project
Both sides confirmed the undertakings of the Project as described in Annex 4 which is updated from Annex 7 in "Minutes of Discussions on the Preparatory Survey on the Project for Sewerage System Development in the Phnom Penh Capital City

signed on 25th May, 2018. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in item No. 5 at "2) During the Project" of Annex 4, both sides confirmed that such customs duties, internal taxes and other fiscal levies, which shall be clarified in the bid documents by DPWT during the implementation stage of the Project.

The Cambodian side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage. Both sides also confirmed that the Annex 4 will be used as an attachment of G/A.

12. Monitoring during the implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 5. The timing of submission of the PMR is described in Annex 4.

13. Project completion

Both sides confirmed that the Project completes when all the facilities constructed and equipment procured by the grant are in operation. The completion of the Project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

14. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability). The result of the evaluation will be publicized. The Cambodian side is required to provide necessary support for the data collection.

15. Schedule of the Study

JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Cambodian side around August, 2019.

16. Environmental and Social Considerations

16-1 General Issues

16-1-1 Environmental Guidelines and Environmental Category

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is

applicable for the Project. The Project is categorized as B because the Project is not located in a sensitive area, nor has sensitive characteristics, nor falls into sensitive sectors under the JICA guidelines for environmental and social considerations(April 2010), it is not likely to have a significant adverse impact on the environment.

16-1-2 Environmental Checklist

The environmental and social considerations including major impacts and mitigation measures for the Project are summarized in the Environmental Checklist attached as Annex 6. Both sides confirmed that in case of major modification of the content of the Environmental Checklist, the Cambodian side shall submit the modified version to JICA in a timely manner.

16-2 Environmental Issues

16-2-1 Environmental Impact Assessment (EIA)

Both sides confirmed that DPWT shall obtain approval of the EIA report from Ministry of Environment (hereinafter referred as to "MoE") by October 2019.

Cambodian side agreed JICA's disclosure of the EIA report on its website.

16-2-2 Environmental Management Plan and Environmental Monitoring Plan

Both sides confirmed Environmental Management Plan (hereinafter referred to as "EMP") and Environmental Monitoring Plan (hereinafter referred to as "EMoP") of the Project are as Annex 7, respectively. Both sides agreed that environmental mitigation measures and monitoring shall be conducted based on the EMP and EMoP, which may be updated during the detailed design stage.

16-3 Social Issues

16-3-1 Land Acquisition and Resettlement

Cambodian side explained that process of changing land title from "state public property" to "state private property" for acquiring and utilizing necessary space(197,360m^2) on Cheung Aek lake as reclaimed land for constructing Sewerage Treatment Plant (hereinafter referred to as "STP") was completed through being issued "Sub-Decree No.168 dated 13th December, 2018 on Amendment of Cheung Aek Lake area located in Meanchey District and Dangkor District, Phnom Penh Capital City and Takhmao City, Kandal Province". Both sides also confirmed no additional process is necessary for land acquisition for the Project.

Both sides confirmed that 22 households (154 persons) would be affected due to the implementation of the Project though their means of gaining income including cultivating morning glory are not legal.

Both sides also confirmed that there is no involuntary resettlement affected by the implementation of the Project because there is no residence in the Project's site.

Though "Sub-decree No. 22 ANK/BK, 2018 on the Standard Operating Procedures (SOP) for Land Acquisition and Involuntary Resettlement (LAR) for Externally Financed Projects" stipulates illegal residents and/or developer is not target on (Abbreviated) Resettlement Action Plan (hereinafter referred to as "ARAP"), both sides agreed that sufficient compensation and/or restoration of livelihood shall be implemented for Project Affected Persons (hereinafter referred to as "PAPs") based on the ARAP prepared and authorized by DPWT during the Project in line with the Guidelines. Both sides also confirmed there was no objection in public consultations which were held at October 2018 and May 2019 from cultivator of morning glory in the Project site on Cheung Aek Lake about the proposed compensation of both supplying alternative cultivation site and monetary compensation for 3 months worth of their income loss as well as no objection from other PAPs. Both sides further confirmed that the total cost for ARAP implementation is as Annex 8 and PPCA will secure budget for the cost.

16-4 Environmental and Social Monitoring

16-4-1 Environmental Monitoring

Both sides agreed that the Cambodian side will submit results of environmental monitoring to JICA with PMR by using the monitoring form attached as Annex 9. The timing of submission of the monitoring form is described in Annex 4.

In case JICA finds that there is a need for improvement in a situation with respect to environmental considerations after the agreed monitoring period, JICA may request to extend the period of monitoring and reporting until JICA confirms the issues have been properly addressed in accordance with the agreement between PPCA and JICA.

16-4-2 Social Monitoring

Both sides confirmed that the Cambodian side will implement social monitoring about affection by the Project and compensation proposed in ARAP. The Cambodian side and the Team agreed that DPWT will submit results of social monitoring to JICA with PMR by using the monitoring form attached as Annex 9.

In case there is a remaining issue that needs to be addressed (e.g. insufficient restoration of livelihood of PAPs), JICA may request to extend the period of monitoring and reporting until JICA confirms the issues have been properly addressed and solved in accordance with the agreement between PPCA and JICA.

16-4-3 Information Disclosure of Monitoring Results

Both sides confirmed that the Cambodian side will disclose results of environmental

monitoring to local stakeholders through their website / in their field offices.
The Cambodian side agreed JICA will disclose results of environmental and social monitoring submitted by the Cambodian side as the monitoring forms attached as Annex 9 on its website.

17. Other Relevant Issues

17-1. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

17-2. Clearing and Leveling the illegally reclaimed land for developing Access road/Sewer line

Cambodian side explained that the space for basic planned route for Access road/Sewer line has been reclaimed illegally by an individual as shown in Annex 10. Cambodian side explained that PPCA demolish some parts of illegal reclaimed land not for the development of Access road/Sewer line but for tackling flood in rainy season which will start from June, deterioration of canal and odor. The Team recognized the Project has no affection to the demolition because it is implemented as PPCA's own project and requested to make an enough consensus for the demolition with the person and/or entity which implemented illegal reclamation. Cambodian side agreed it.

Both sides confirmed that the demolition is not target on the Guidelines.

17-3. Sludge Management

Both sides confirmed that based on the analysis in the preparatory survey, "Sludge Digestion (Anaerobic Digestion) and Drying by Drying Bed" will be adopted for sludge treatment in the Project. Both sides also confirmed that dewatered sludge after drying will be transported to solid waste disposal sites at the expense of Cambodian side.

17-4. Future necessity of capacity expansion of STP for Cheung Aek Treatment Area

In "Sewage Management Master Plan for Phnom Penh Capital City" which was drafted in "The Study on Drainage and Sewerage Improvement Project in Phnom Penh Metropolitan Area" and drafted in 2016, "Cheung Aek Treatment Area", in which wastewater from central area of PPCC is currently discharged to Cheung Aek Lake through existing combined drainage pipes/channels was set-up and "phased

sewerage facility development plan" for the treatment area, which consists of short, medium and long-term, was established to treat expected amount of wastewater (282,000m^3/day) in 2035.

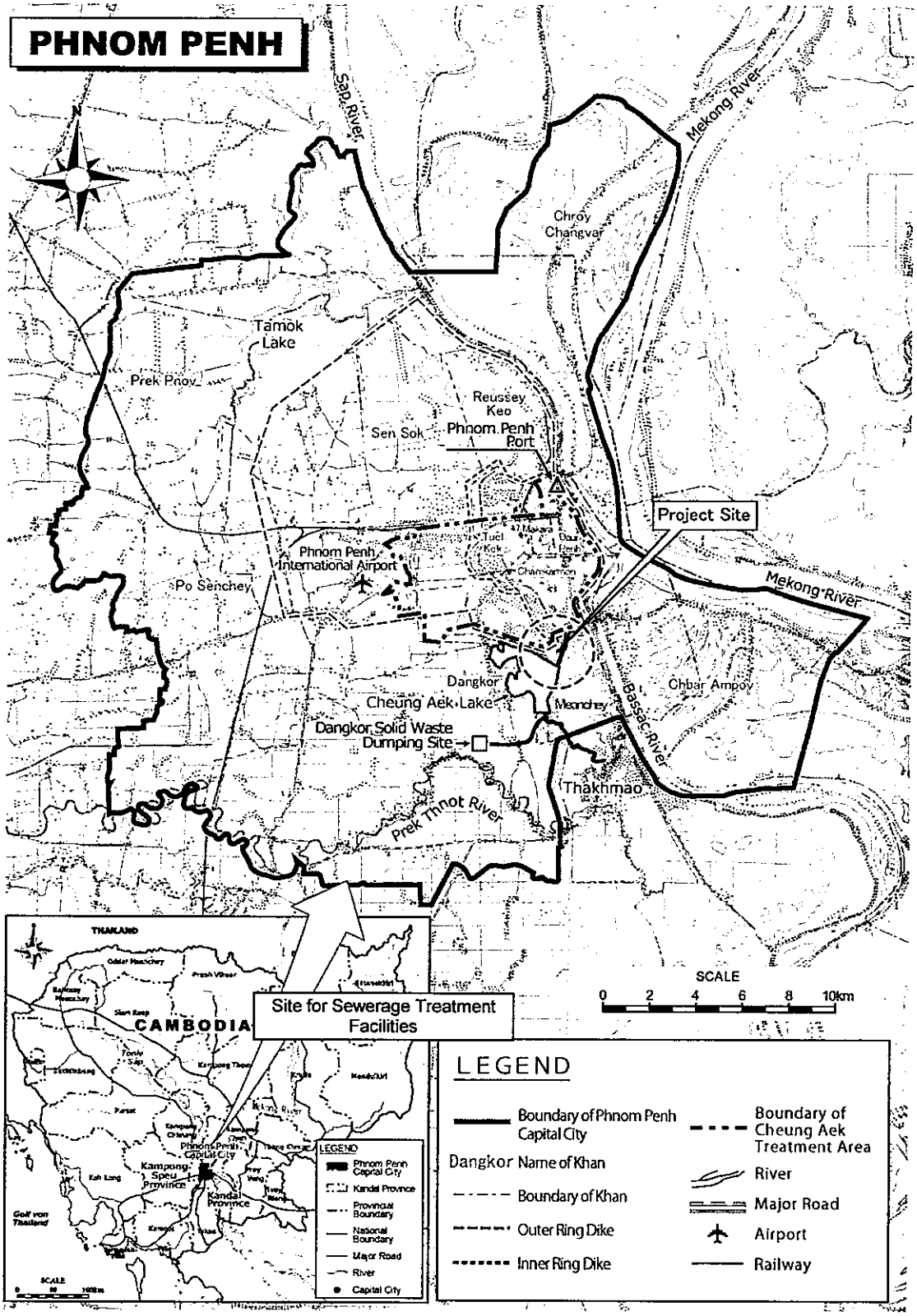
Both sides agreed to study the future expansion of STP continuously under the mutual cooperation.

17-6. Collaboration and Difference between the Project and JICA's Technical Cooperation Project

JICA's technical cooperation project "The Project for Capacity Development for Sewerage Management of Phnom Penh Capital Administration and Ministry of Public Works and Transport"(hereinafter referred to as "the technical cooperation project") has commenced from April, 2019. The main cooperation of the technical cooperation to DPWT is to strengthen legal and institutional framework mainly through drafting ordinance on sewerage management and structure of new offices/sections for sewerage management.

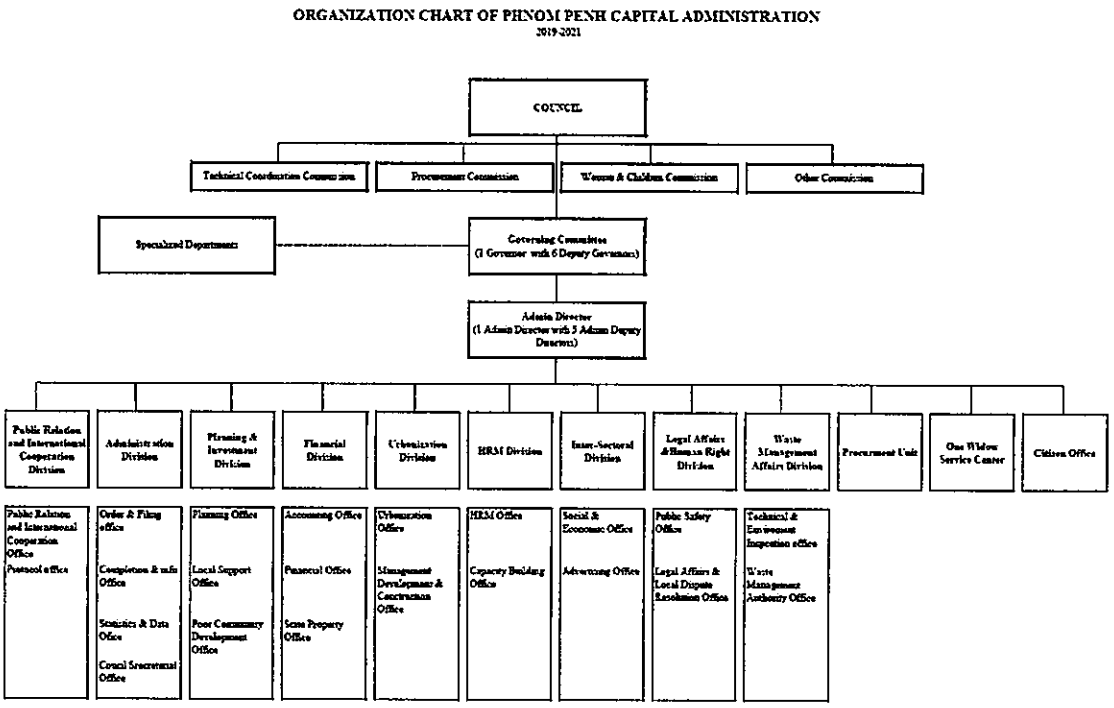
Both sides confirmed the importance of collaboration between the Project and the technical cooperation project considering difference with Soft Component of the Project.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Project Implementation Schedule
Annex 4 Major Undertakings to be taken by the Government of Cambodia
Annex 5 Project Monitoring Report (template)
Annex 6 Environmental Check List
Annex 7 Environmental Management Plan/Environmental Monitoring Plan
Annex 8 Total cost of ARAP implementation
Annex 9 Environmental and Social Monitoring Form
Annex 10 Illegal reclamation for the site of developing Access Road/Sewer Line

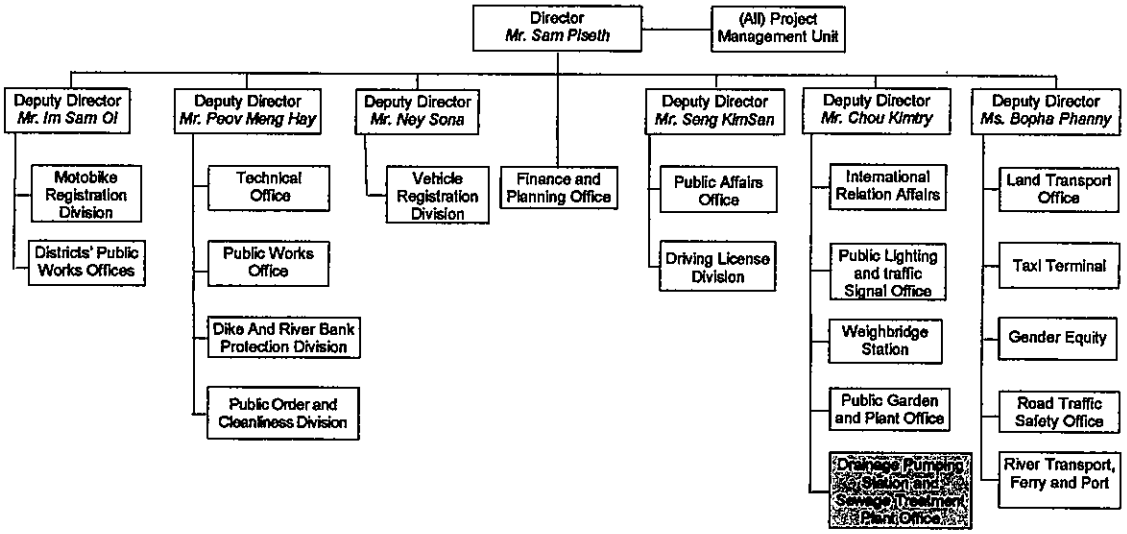

PHNOM PENH
Sap River
Mekong River
Chroy Changvar
Tamok Lake
Prek Pnov
Reussey Keo
Sen Sok
Phnom Penh Port
Project Site
Phnom Penh International Airport
Po Senchey
Mekong River
Dangkor
Cheung Aek Lake
Meanchey
Chbar Ampov
Bassac River
Dangkor Solid Waste Dumping Site
Thakhmao
Prek Thnot River
THAILAND
CAMBODIA
Site for Sewerage Treatment Facilities
SCALE
0 2 4 6 8 10km
LEGEND
Boundary of Phnom Penh Capital City
Boundary of Cheung Aek Treatment Area
Dangkor Name of Khan
River
Boundary of Khan
Major Road
Outer Ring Dike
Airport
Inner Ring Dike
Railway

Annex 2

Organization Chart of PPCA



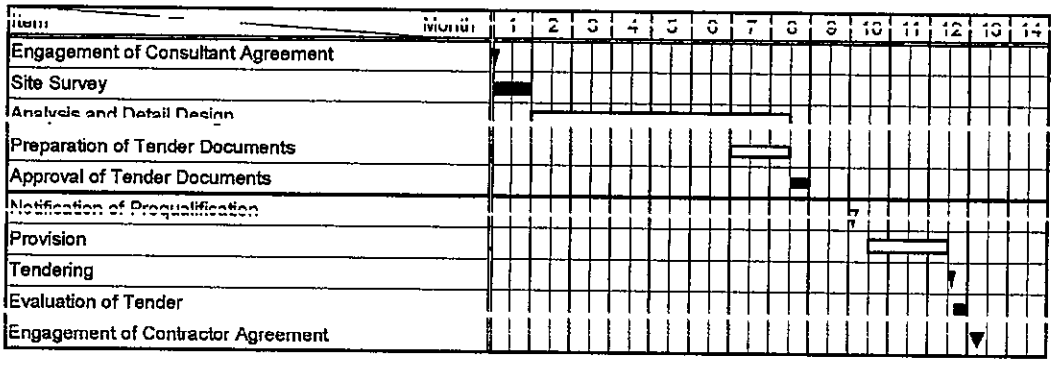
Organization Chart of DPWT



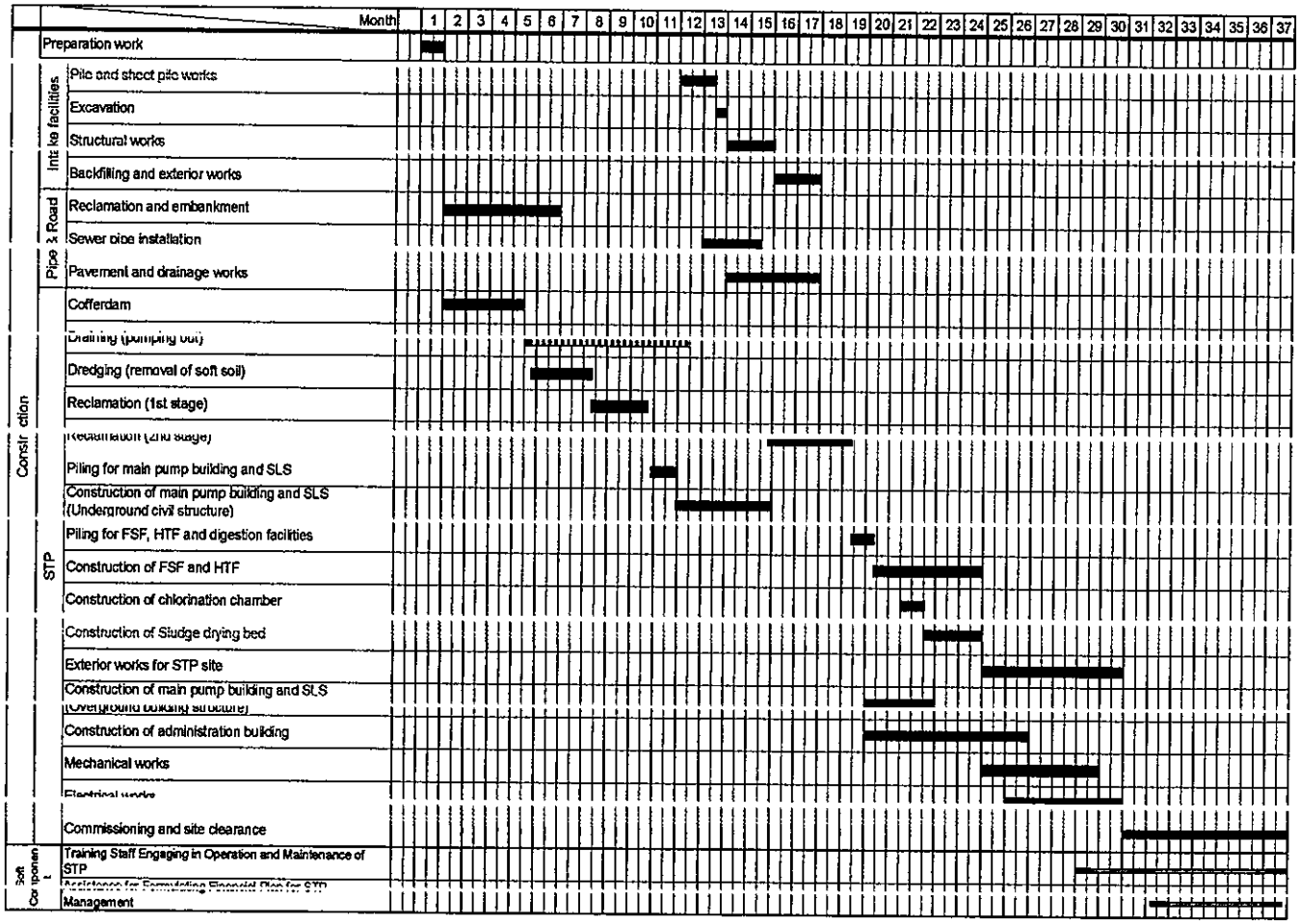
Annex 3

Timeline for the project implementation

[Detailed Design and Tendering Stage]



[Construction Stage]



Annex 4

Major Undertakings to be taken by Recipient Government

1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	PPCA		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract	PPCA		
3	To approve EIA (Conditions of approval should be fulfilled, if any) and secure the necessary budget for implementation	By the end of October 2019	PPCA		
4	To complete drafting Abbreviated Resettlement Action Plan(ARAP) including compensation policy and obtain confirmation from JICA	before signing of Grant Agreement	PPCA		
5	To obtain Land certificate for STP	Completed on December 2018	PPCA DPWT		
6	To obtain permission of developing Access road/Sewer pipe at reclaimed area	Completed on December 2018	PPCA DPWT		
7	To secure the necessary budget and implement compensation with full replacement cost in accordance with Detail Resettlement Plan (DRP)	before start of the construction	MEF, PPCA		
8	To clear and level the construction site for Access road/Sewer pipe	before notice of the Tender	PPCA		
9	To secure sufficient spaces at the respective Project site/s for temporary facilities such as a contractor's office, workshop, building materials storage, etc. needed for the construction work.	before notice of the Tender	PPCA		
10	To complete the investigation and removal of UXO and Mines in all the construction areas (including sewer installation alignment)	before notice of the Tender	PPCA		

2) During the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	PPCA		
2	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract	PPCA		
	2) Payment commission for A/P	every payment	PPCA		
3	To ensure prompt unloading, customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation in the country of the Recipient of the products	during the Project	PPCA		
4	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	PPCA		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be exempted by its designated authority without using the Grant	during the Project	PPCA		
6	To bear all the expenses, other than those to be borne by the Japanese Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment	during the Project	PPCA		

7	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for the construction work	prior to commencement of the construction	PPCA		
8	To provide facilities for distribution of electricity, water supply, drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)				
	1) Electricity Distribution lines to the site		PPCA		
	2) Water Supply City water distribution main to the site		PPCA		
9	To implement EMP and EMoP	during the construction	PPCA, DOE		
10	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	PPCA		
11	To implement DRP (livelihood restoration program, if needed)	for a period based on livelihood restoration program	PPCA		
12	To secure necessary conditions and environments on the site(s) in cooperation with related authorities and local residents (e.g. Security guards, traffic control, etc.)	during the construction	PPCA		

(EMP: Environmental Management Plan, EMoP: Environmental Monitoring Plan)

3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To implement EMP and EMoP	for a period based on EMP and EMoP	PPCA, DOE		
	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between PPCA and JICA.	for three years after the Project	PPCA, DOE		
2	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	after completion of the construction	PPCA, DPWT		

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(Note) Progress of the specific obligations of the Recipient may be confirmed and updated from time to time with written agreement between JICA and the Recipient in the form other than the amendment of the G/A.

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Line Ministry	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks (*at the time of outline design*)

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):

Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

A4-47

(3) Summary of Discussion with Contractor (if necessary)

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Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

		Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost		(A/D%)	(B/D%)	(C/D%)	
	Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
	others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost		(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost		(A/D%)	(B/D%)	(C/D%)	
Total		(A/D%)	(B/D%)	(C/D%)	

Annex 6

Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
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/A (d) N	**(a)** EIA document is under preparation by the Project and the environmental permit is expected to be granted in October 2019. **(b), (c) & (d)** Ditto
	(2) Explanation to the Local Stakeholders	**(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) N	**(a)** Public consultation meetings were held from 5 Oct. 2018 to 25 Feb. 2019, explaining potential impacts. **(b)** The comments from stakeholders shall be reflected in the detailed design.
	(3) Examination of Alternatives	**(a)** Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	**(a)** The results of examination of alternatives are shown in the final report.
2 Pollution Control	(1) Water Quality	**(a)** Do pollutants, such as SS, BOD, COD, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards? **(b)** Does untreated water contain heavy metals?"	(a) N (b) Y	**(a)** Some parameters including heavy metals such as mercury exceed the country's effluent standards, but after the treatment it will be within the standard. **(b)** Heavy metal contamination is expected in untreated water but the concentration of the treated water will be within the standard.
	(2) Wastes	**(a)** Are wastes, such as sludge generated by the facility operations properly treated and disposed of in accordance with the country's standards?	(a) Y	**(a)** Sludge will be treated at the final damping sites.
	(3) Soil Contamination	**(a)** If wastes, such as sludge are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachates from the wastes?	(a) N	**(a)** Heavy metals in sludge will be dried at the site properly and damped at the final damping sites.
	(4) Noise and Vibration	**(a)** Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	(a) Y	**(a)** Potential noise sources above ground will be installed in RC structures. If further reduction is required, necessity of hood silencer and soundproof walls for sound insulation will be considered.
	(5) Odor	**(a)** Are adequate control measures taken for odor sources, such as sludge treatment facilities?	(a) Y	**(a)** Odor reduction facilities will be designed because the site is next to a residential area.
3 Natural Environment	(1) Protected Areas	**(a)** Is the project site 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 in or near the Project site.
	(2) Ecosystem	**(a)** Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N (b) N (c) N (d) N	**(a)** No protected area or valuable habitats exist in or near the site. **(b) &(c)** According to the EIA survey, some endangered species were listed in zone B

		(b) Does the project site 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 project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?		where relatively far (about 3 km) from the project site. Considering the site environment (e.g. DO is 0.3 mg/l), the endangered species are not inhabit in and around the project site, therefore negative impact to the species by the project is negligible. Furthermore, the environment around the project site will be slightly improved by the project, thus positive impacts will be expected to ecosystem in and around the project site. **(d)** The objective of the Project is to improve water environment. Although most of the project site will be reclaimed, but as the area of the project is small and present aquatic environments are poor, negative impact is not significant.
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 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/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) Y	**(a), (b), (c), (d), (e), (f), (g), (h) & (i)** Involuntary resettlement is not expected in the Project. **(J)** The MEF will facilitate the establishment of a Municipal Grievance Redress Committee (MGRC) which will be responsible for addressing grievances for the project. The MGRC will be established by the Municipal Governor in consultation with the IRC. Any grievances of AHs in connection with the implementation of the BRP will be handled through negotiation with the aim of achieving consensus. Complaints will go through three stages before they may be elevated to a court of law as a last resort. GDR/IRC will shoulder all administrative and legal fees that will be incurred in the resolution of grievances and complaints. The handling of the complaint ends in the MGRC.
	(2) Living and Livelihood	**(a)** Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants? **(b)** 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?	(a) N (b) N/A	**(a)** The Project will contribute to improvement hygiene and public health. **(b)** Adverse impacts to inhabitants' livings are not expected in the Project. Although their agriculture land will be moved, but adequate compensation and relocation/purchase of the land will be implemented.
	(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	**(a)** No cultural heritage exists in or near the Project area.
	(4) Landscape	**(a)** Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	**(a)** Project component will not affect the landscape significantly.

	(5) Ethnic Minorities and Indigenous Peoples	**(a)** Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a) N/A (b) N/A	**(a) & (b)** No ethnic minorities or indigenous peoples live in or near the Project site.
	(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) Y (b) Y (c) Y (d) Y	**(a), (b), (c) & (d)** Safety aspects will be fully considered in the detailed design. Additionally, education programs will be carried out by the contractor to improve the workers' awareness of safety and health conditions.
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) Y (b) N (c) N (d) Y	**(a)** They are mentioned in the final report. **(b) & (c)** The Project will not cause significant adverse impact on natural and social environments. Adequate measures are described in the final report. **(d)** So far serious impact is not predicted with construction. Information on the construction activities would be disclosed to public through mass-media on a timely basis. Additionally, public consultation with the residents would be held.
	(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) Y (b) - (c) Y (d)Y	**(a), (b), (c) & (d)** Preliminary monitoring system has been established and are written in the final report based on JICA Supplemental Study. It will be developed during detail design stage referring comments of MOE.
6 Note	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) N/A	**(a)** The impacts to transboundary such as waste is not expected. The project makes positive impact to global warming

Annex 7

Environmental Management Plan

Based on Environmental Certificate issued by MOE, environmental management and monitoring should be implemented during construction and operation stages.

No.	Environmental Items	EMP	Implementing agency	Responsible Agency	Cost
Construction					
1.	Air pollution	• The contractor will have to educate the staff-workers to understand about the sanitation, not to act open defecation and keep waste in the storage. • Wet (sprinkle water) the constructing access road regularly (the dirt road, at least 4 times per day, 7 AM, 11 AM, 1:30 PM and 4 PM that are the busy time) and well cover the soil, sand, rock and cements when transport. • Contractor will educate the staff-worker about the risk of fire from the kitchen and welding as well as the fuel storage and other flammable material.	Contractor	PPCC/DPWT	Included in construction cost. Total estimated cost is $7,200.
2.	Water Pollution	• In the construction phase, the consultants that chosen by the Project will monitor carefully in soil works and concrete works as well as water pumping. • The consultant must ensure that the contractor have educated the staff-workers about the sanitation by not to act the open defecation and must keep the waste in the storage which will be built in the temporary accommodation. • Contractor must take the strong measure in wastewater management by build the temporary toilet far away from the lake and install the pipe with the depth of 1.5 to 2 m and diameter of 0.5 m as well as collect the solid waste to dump in the safe location without harm to environment. • In order to manage the waste efficient, the contractor will have to put up the sign in and near the project area in Khmer and English "Do not dump the waste" and so on. • Fuel storage must be built according to the technical standard and make sure there is no spilling and leak to the environment. • Contractors must follow the sub-degree No. 235 ANK/BK about the management of sewerage system dated on 25th December, 2017. • In case that the contractor do not follow the guideline and mitigation measure as described, the consultant must report back to DPWT and JICA to take some of contraction budget for restoring	Contractor	PPCC/DPWT	Included in construction cost. Total estimated cost is $13,600.

No.	Environmental Items	EMP	Implementing agency	Responsible Agency	Cost
		environment.			
3.	Soil pollution	• Contractors will have to construct the fuel storage according to the national technical standard to ensure no spill or leak into the soil. • Furthermore, they must maintain the machinery and generator not to spill or leak the fuel to the soil. The parking lot of vehicle and machinery must have the concrete floor. • The contractors will have to manage all kind of waste properly: not to pour the old lubricant on the land and keep other waste safe by implementing solid-liquid waste management plan.	Contractor	PPCC/DPWT	Included in construction cost
4.	Noise/Vibration	• Contractor will use the machinery and vehicle with the exhaust pipe that install a qualified resonator and the generator is the Silent Generator type that cause slight noise and not disturb the neighbor. • Contractors will educate the staff-workers not to create loud noise at the rest time and at night.	Contractor	PPCC/DPWT	Included in construction cost. Total estimated cost is $4,800.
5.	Soil Erosion and Slope Failure	• The consultant chosen by JICA will monitor the embankment, canal and spoiled soil dumping to prevent the erosion and ensure that there will be proper grass plantation at all site stated in TOR. • The dumping of soil mixed with water from the bottom of the lake will be monitored not to slide into Cheung Aek Lake. Sludge and water taken out will be stored in the pit of 5m x 5m x 2m (width x length x depth) in order to settle sludge and dewater and finally fill back sludge into the pit. Do not dump the mixture of sludge and water into Cheung Aek Lake in/near the project area to prevent pollution.	Contractor	PPCC/DPWT	Included in construction cost
6.	Ecosystem	• Monitoring team must ensure that contractors have consulted with the Department of Environment and Ministry of Agriculture, Forestry and Fisheries to educate the staff-workers to love the wildlife and prevent the hunting and trading the wild animal illegally. • Contractors must pay high attention in environmental protection by implementing the solid-liquid waste management plan and build the bathroom and toilet, install pipe with 0.5 m of diameter, 1.5 to 2 m depth according to the number of workers not to drain the wastewater to the lake directly or build the toilet on the water. • The contractor will have to manage all kind of waste by storing at the safe place	Contractor	PPCC/DPWT	Included in construction cost

No.	Environmental Items	EMP	Implementing agency	Responsible Agency	Cost
		according to the technical standard and CINTRI which is in charge of collect the waste to the city landfill. • Educate the staff-workers to dump solid-liquid waste especially fuel and lubricant at the safety place.			
7.	Resettlement	• Project has already set the Basic Resettlement Plan (BRP) in 2019. The BRP will be implemented by the MEF as the leader and other relevant Ministry is the member including the DPWT for resolving the effects caused by the project. • DPWT will work with ME F to monitor and track the impact on the aquatic crop to ensure that they have restored their living standard better than before the project. • No living house will be affected, except one guarding house will be relocated. The project will compensate the structure cost and transportation allowance to the AHs. Other affected secondary structures (fence and awning) and trees also will be compansated. Income restoration program will be established during detail design stage by General Department of Resettlement. Other details are shown in section 1.5.	Inter-ministerial Resettlement Committee (IRC)	MEF	Included in preparation cost. The total estimated cost is 60,198USD (excluding land cost)
8.	Employment	• The monitor team who was chosen by JICA will ensure that the contractors employ the villagers from the local community when they apply for job. • Contractors must follow the Labor Law of Kingdom of Cambodia by set work hours per day is 8 hours equal to 46 hours per week (article 137 of Labor Law). If there are works during the holiday or national ceremony day, the employers must provide them the overtime pay and increase 50% for the daytime works and 100% for the nighttime works (article 139 of Labor Law).	Contractor	PPCC/DPWT	Included in construction cost
9.	Water Use	• Must solve the issue immediately by install another pipe to replace the old system and ensure that there is no problem on the daily water use of the people.	Contractor	PPCC/DPWT	Included in construction cost
10.	Road	• The monitoring team will ensure that the contractors will access the road and use the truck as stated in TOR which has described above. • In case that there is the damage of the road by the transportation of construction material, DPWT will be responsible to repair the road.	Contractor	PPCC/DPWT	Included in construction cost
11.	Safety and Public Health	• To reduce the impact on health and safety of the staff-workers and public health and safety, the contractors must implement the mitigation measure as following:	Contractor	PPCC/DPWT	Included in construction cost

No.	Environmental Items	EMP	Implementing agency	Responsible Agency	Cost
		• Educating the staff and workers about both sanitation, self-protection from the social disease, and drinking the sterilized water or fresh water (bottle water). • Educate staff and workers about how to protect themselves and prevent the disease in every 6 months. • Reserve the medicine to prevent and treat the diseases. • Build the toilets with septic tank far from water sources. • Access clean water to the temporary accommodation before the staying of staff and worker or start of construction. • Construct the first aid room with adequate medicine for treating the injury. This mean, DPWT will implement the safety and risk management plan and the planning for accommodation, health and hygiene of project staff-workers. • Cooperate with the local authority to educate the staff-workers no to commit the sex trafficking (human trafficking) and drugs trafficking.			
Operation					
1.	Topography	• The DPWT, will have to prepare the machinery to clean the soil that fall into the waterway and take the soil to store at the safe place and immediately repair the damaged part. The place that had fallen must plant the grass or trees or cover the mortar, keeping the hole to drain out the water properly.	PPCC/DPWT	PPCC/DPWT	Included in operation and maintenance cost. Total cost for erosion protection is $15,000.
2.	Water Pollution	• DPWT, will have the staff trained by JICA to maintain the project and reserve the tool, spare part and budget to repair the faciliteis to run normally treatment process. • DPWT cooperate with the laboratory of MOE will check and monitor the surface water quality at 3 locations. Location 1 is on the upstream of intake from Boeung Trabek pumping station with the coordinate X=0491822; Y=1274363. Location 2 is in Cheung Aek Lake downstream of the outlet of treated sewage in Sangkat Chak Angre Krom, Khan Mean Chey, with the coordinate X=0491299; Y=1272570. Location 3 is in Steung Chrov, downstream of the project area, flow into Steung Prek Thnot in Sangkat Deum Mean, Takmao town, Kandal Province with the coordinate X=0493103; Y=1268628. The water quality testing is done at least twice per year, in March (dry season) and September (rainy season) and the data will store in Microsoft Excel for the analysis	PPCC/DPWT	PPCC/DPWT	Included in operation and maintenance cost. Total WQT cost is $13,500.

No.	Environmental Items	EMP	Implementing agency	Responsible Agency	Cost
		purpose in the future. • The DPWT will pay closely attention in waste management. • DPWT must maintain the treatment system regularly not to delay the process of treatment and have the budget plan for the system maintains.			
3.	Ecosystem	• Pay close attention in the environmental protection. Thus, the staff-workers will not eat or trading these aquatic birds.	PPCC/DPWT	PPCC/DPWT	Included in operation and maintenance cost
4.	Water Use	• Pay close attention to managing all kinds of solid-liquid waste including the maintenance of this treatment system, and improve the water quality of Cheung Aek Lake and improve the quality of vegetables planted by locals.	PPCC/DPWT	PPCC/DPWT	Included in operation and maintenance cost
5.	Safety and Public Health	• In this phase, the DPWT will follow the waste management plan, and when transporting treated dried sludge via truck must be well cover, do not harm to the environment and society. • DPWT will works with local authorities to prevent any accidents for STP operation.	PPCC/DPWT	PPCC/DPWT	Included in operation and maintenance cost

Environmental Monitoring Plan

For items that may be negatively impacted, monitoring would be conducted as shown in below.

Resource	Monitoring Locations	Methodology and Parameters	Monitoring Cycles	Responsible/ implementing Institutions	Monitoring Institutions
1. Project Before Construction Phase					
1.1 Socio-economy resource					
Resettlement	– Along the access road and sewerage treatment plant – Prek Takung 1 village	– The monitoring on compensation of resettlement and grievance redress	Once every 6 months	1. IRC-WG, IRC 2. DPWT 3. Local authorities	1. MoE 2. MEF 3. DoE 4. DLMUPC
2. Project Construction Phase					
2.1 Physical resource					
Topography	– Building construction site – Access road – Protection dike construction site – Spoiled soil dumping site	– The monitoring on the topography and the erosion at the infrastructure construction site – The monitoring of erosion at the road, protection dike's embankment and spoiled soil dumping site	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DoAFF 4. Local authority
Hydrology	– Canal from Boeung Trabek pumping station – Wastewater way downstream of the drainage to Hun	– Monitoring the obstruct of the flow of pumping wastewater	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DOWRAM 4. Local authority

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Resource	Monitoring Locations	Methodology and Parameters	Monitoring Cycles	Responsible/ implementing Institutions	Monitoring Institutions
	Neang road				
Surface water quality	3 Sample locations near the project area - Location 1: X=0491822, Y=1274363 - Location 2: X=0491299, Y=1272570 - Location 3: X=0493103, Y=1268628 - Solid-liquid waste storage	- Monitoring on the water quality on the parameters: temperature; pH; Turbidity, TDS; TSS; DO; BOD; COD; SO_4; TN; TP; Pb and Total Coliform - Monitoring on solid-liquid waste management	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DOWRAM 4. Local authority
Soil quality	- Infrastructure construction site, generator and machinery storage - Temporary shelter of staff-workers	- Monitoring on solid-liquid waste management - Monitoring on the spill, leak of fuel on the soil.	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DOWRAM 4. DoAFF 5. Local authority
Air Quality	- Infrastructure construction site - Access road - Temporary shelter of staff-workers - 2 location of air quality testing: location 1 X=0491356, Y=1272730, location 2 X=0491031, Y=1272740	- Monitoring the material transportation on road No. 271 - Monitoring the odor condition at construction sites - Monitoring on air quality parameters: TSP; CO; NO_2, SO_2, O_3, PM10, PM2.5 and H_2S	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DoT 4. Local authority
Noise and vibration	- Infrastructure construction site - Road construction site from road No. 271 to construction site - Temporary shelter of staff-workers - Noise and vibration testing locations are the same to air quality testing locations	- Monitoring on the noise and vibration from the material transportation, the operation of any machinery, generator and vehicle. - Monitoring on noise and vibration (Unit: dB)	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DoT 4. Local authority
2.2 Biological resources					
Ecosystem (Fish)	- Cheung Aek Lake near project area - Temporary shelter of staff-workers	- Monitoring on solid-liquid waste management - Monitoring on the water quality on the parameters temperature; pH; Turbidity, TDS; TSS; DO; BOD; COD; SO_4; TN; TP; Pb Total Coliform	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DOWRAM 4. DoAFF 5. Local authority
Ecosystem (Birds)	- Temporary shelter of staff-workers	- Monitoring the crime on wildlife especially the aquatic birds	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DoAFF 4. Local

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Resource	Monitoring Locations	Methodology and Parameters	Monitoring Cycles	Responsible/ implementing Institutions	Monitoring Institutions
					authority
2.3 Socio-economic resources					
Resettlement	- Resident of AHs loss their income in Prek Takung 1 village. - Area of 19.0736 ha for construction and expansion of the STP	- Monitoring on the livelihood of AHs loss their income 7 HHs. - Monitoring to ensure that no encroachment to the STP area.	Once every 6 months	1. DPWT 2. Local authority	1. MoE 2. MEF 3. DoE 4. DLMUPC 5. DOWRAM
Livelihood, occupations of the local community and gender	- Prek Takung 1 village - Temporary shelter of staff-workers	- Monitoring on the staff-worker selection by prioritize the locals, gender equality as well as the disability - Monitoring on work safety	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DoLVT 4. Local authority.
Road	- Road No. 271, Hun Sen Road (60m) and Okrha Hun Neang Road. - Access road	- Monitoring on the transportation (speed and load) - Monitoring on the parking - Monitoring on the repair the damaged road by the project	Once every 3 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DPWT 4. Local authority (local traffic police)
Public Health and Safety	- Infrastructure construction site - Generator, vehicle and machinery storage - Temporary shelter of staff-workers - First aid room	- Monitoring on solid-liquid waste management at temporary shelter - Monitoring the clean water supply and sanitation - Monitoring the safety equipment and work safety - Monitoring the first aid room	Once every 3 months	1. DPWT 2. contractor	1. MoE 2. MOT 3. DoE 4. DoLVT 5. DoH 6. Local authority
3. Project Operation Phase					
3.1 Physical Resources					
Surface water quality	- 3 Sample locations near the project area - Location 1: X=0491822, Y=1274363 - Location 2: X=0491299, Y=1272570 - Location 3: X=0493103, Y=1268628 - Solid-liquid waste storage and filter system cleaning site	- Monitoring on the water quality on the parameters: temperature; pH; Turbidity, TDS; TSS; DO; BOD; COD; SO_4; TN; TP; Pb and Total Coliform - Monitoring on solid-liquid waste management - Monitoring the filter system cleaning	Once every 6 months	1. DPWT 2. contractor	1. MoE 2. DoE 3. DOWRAM 4. Local authority
Air quality	- Treatment plant, filter site - Sludge storage - Solid-liquid waste storage	- Monitoring on solid-liquid waste management - Monitoring on air quality parameters: TSP; CO; NO_2; SO_2, O_3, PM10,	Once every 6 months	1. DPWT	1. MoE 2. DoE 3. DoT 4. Local authority

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Resource	Monitoring Locations	Methodology and Parameters	Monitoring Cycles	Responsible/ implementing Institutions	Monitoring Institutions
		PM2.5 and H2S - Monitoring on odor from waste storage and along the access road.			
Noise and vibration	- Treatment plant, at mechanic room, pumping room.	- Monitoring on the noise and vibration from the operation by measure its level at the locations same as air quality testing locations	Once every 6 months	1. DPWT	1. MoE 2. DoE 3. DoT 4. Local authority
3.2 Biological Resources					
Ecosystem (Fish)	- Cheung Aek Lake near the project area	- Monitoring on the water quality on the parameters: temperature ; pH; Turbidity, TDS; TSS; DO; BOD; COD;SO_4 ; TN; TP; Pb and Total Coliform - Monitoring on solid-liquid waste management Note: Comparing the increasing of fish species near the project area. Before the project, study team caught only 6 species.	Once every 6 months	1. DPWT	1. MoE 2. DoE 3. DOWRAM 4. DoAFF 5. Local authority
3.3 Socio-economic Resources					
Resettlement (living standard of affected household monitor)	- Residential of the 7 households who are affected by project	- Monitoring on the living standard of the people who get their aquatic crop by ensure that they will have a better living before the project exist.	Once every 6 months	1. DPWT 2. Local authorities	1. MoE 2. MEF 3. DoE 4. DLMUPC 5. DOWRAM
Public health and safety	- Building, the filter tanks - Place with the safety equipment, fire extinguisher, safety System, fire alarm, etc.) - Pipe system - Electricity system - Solid waste storage - Shelter - Access road	- Monitoring on the atmosphere, temperature, and airing. - Monitoring on the management and operation of the safety equipment (Fire safety system, fire extinguisher, fire alarm, etc.) - Monitoring on solid-liquid waste management - Monitoring on the clean water supply and sanitation - Monitoring on the durable and safety - Monitoring on the provision of safety equipment - Monitoring the chlorination room	Once every 6 months	1. DPWT	1. MoE 2. MOT 3. DoE 4. DoLVT 5. DoH 6. Local authority

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Resource	Monitoring Locations	Methodology and Parameters	Monitoring Cycles	Responsible/ implementing Institutions	Monitoring Institutions
		- Monitoring the medical facility for first aid			
Road	- The intersection of road No. 271 and project's road - Access road	- Monitoring the damage and repairing the road - Monitoring the safety on access road - Monitoring on the transportation, speed and traffic congestion - Monitoring the installation of the traffic sign along the access road.	Once every 6 months	1. DPWT 2. Contractor	1. MoE 2. DoE 3. DPWT 4. Local authority (traffic police)
Safety	- Households and buildings in project area - Material and fuel storage - Electric cable room or box - Place with the safety equipment, fire extinguisher, safety System, fire alarm, etc.)	- Monitoring the electricity system, emergency exit in and outside the building - Monitoring the oil and fuel storage - Monitoring on the management and operation of the safety equipment (Fire safety system, fire extinguisher, fire alarm, etc.)	Once every 6 months	1. DPWT 2. Relevant company	1. MoE 2. MoT 3. DoE 4. DoLVT 5. Local authority

No.	Items	Unit	Quantity	Rate ($/Unit)	AMOUNT (US$)
A	LAND				
1	Flooded land (Agricultural)	m^2	0	-	0
2	Filled up land (Residential)	m^2	0	-	0
B	STRUCTURES				24,281.40
3	Guarding house	m^2	106.20	110.00	11,682.00
4	Bath room	m^2	7.80	115.00	897.00
5	Shelter	m^2	73.40	25.00	1,835.00
6	Awning (AW1)	m^2	36.00	15.00	540.00
7	Awning (AW2)	m^2	120.80	23.00	2,778.40
8	Brick wall, 100mm	m^2	18.60	15.00	279.00
9	Brick fence, 100mm	m^2	90.00	27.00	2,430.00
10	Brick bund wall, 200mm	m^2	120.00	32.00	3,840.00
C	TREES AND FRUIT TREES				1,912.00
11	Mango tree	tree	37	51.00	1,887.00
12	Banana tree	tree	10	2.50	25.00
D	ALLOWANCES				5,005.20
13	Transport Allowance	AH	1	150.00	150.00
14	Income Loss[1]	person	34	142.80	4,855.20
SUBTOTAL					31,198.60
15	Administrative cost	ls	-	-	15,000.00
16	External Monitoring	ls	-	-	7,000.00
17	Livelihood Restoration Program	ls	-	-	7,000.00
GRAND TOTAL					60,198.60

[1] The National Poverty Line for Phnom Penh-2013 is 47.60 $/month/capita. The income loss allowance is calculated based on formula in entitlement matrix: **[(MPR) x (Number of members in AH) x 3]** which is equivalent to USD 4,855.20 (34person x 47.60$ x 3months).

Note: - 7 AHs (renter) equal to 34 household members.
- MPR instates a Monthly Poverty Rate.

MONITORING FORM

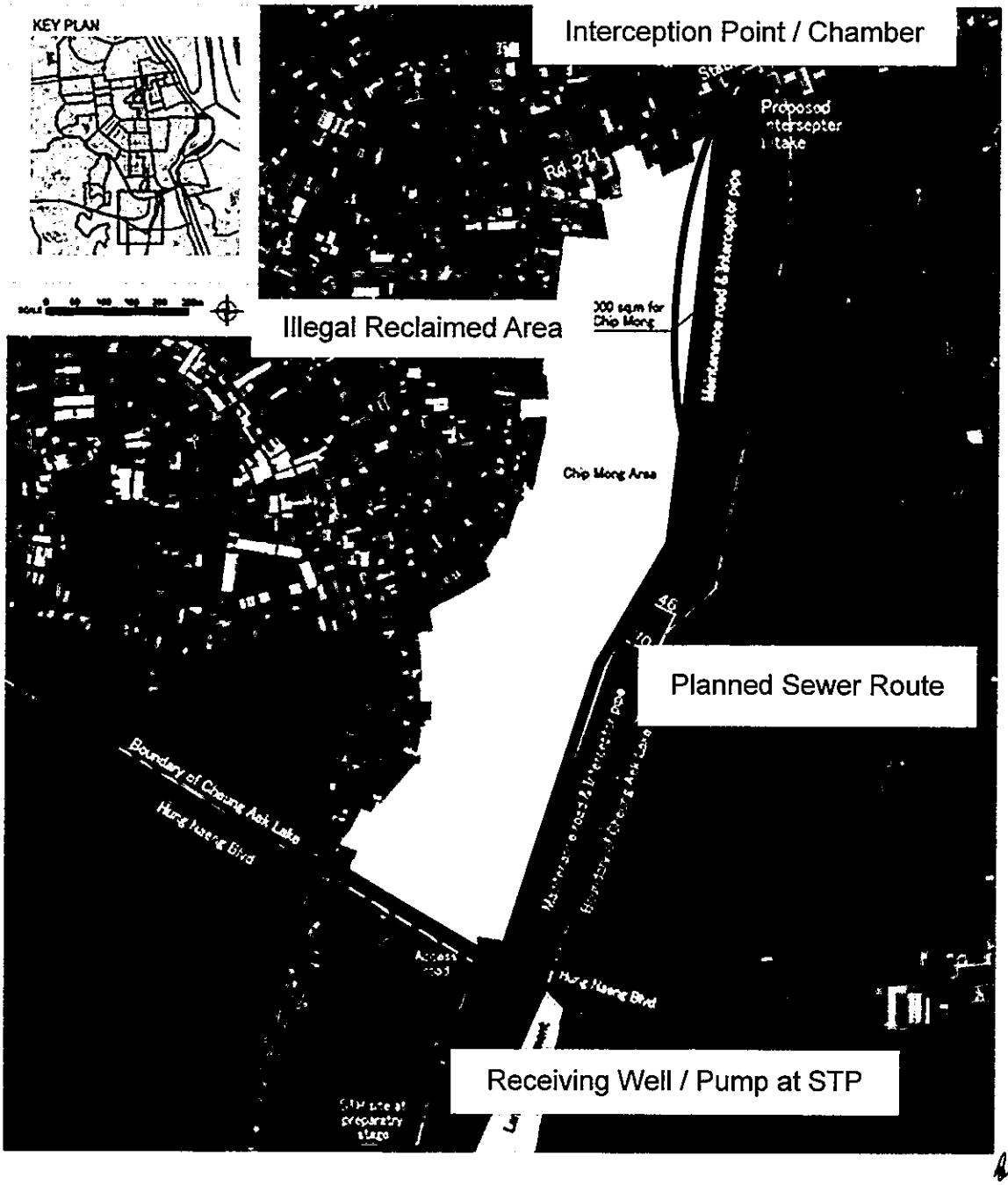
-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

Environmental Resource	Monitoring Locations	Methodology and Parameters	Monitoring Cycles	Responsible/ implementing Institutions	Monitoring Institutions
1. Project Before Construction Phase					
1.1 Socio-economy resource					
Land use and Resettlement					
2. Project Construction Phase					
2.1 Physical resource					
Topography and erosion					
Hydrology					
Surface water quality					
Soil quality					
Air Quality					
Noise and vibration					
2.2 Biological resources					
Fishes					
Protected Area / Protected Forest					
Forest					
Wildlife corridor					
Wildlife					
2.3 Socio-economic resources					
Land use and Resettlement					
Livelihood, occupations of the local community and gender					
Tradition, Culture and Religion					

Environmental Resource	Monitoring Locations	Methodology and Parameters	Monitoring Cycles	Responsible/ implementing Institutions	Monitoring Institutions
Gender					
Water use					
Recreation /Tourism site					
Road and traffic					
Public Health and Safety					
Aesthetics and landscapes					
Risk					
3. Project Operation Phase					
3.1 Physical Resources					
Topography and erosion					
Hydrology					
Surface water quality					
Soil quality					
Air Quality					
Noise and vibration					
3.2 Biological Resources					
Fishes					
Protected Area / Protected Forest					
Forest					
Wildlife corridor					
Wildlife					
3.3 Socio-economic Resources					
Land use and Resettlement					
Livelihood, occupations of the local community and gender					
Tradition, Culture and Religion					
Gender					
Water use					

Environmental Resource	Monitoring Locations	Methodology and Parameters	Monitoring Cycles	Responsible/ implementing Institutions	Monitoring Institutions
Recreation /Tourism site					
Road and traffic					
Public Health and Safety					
Aesthetics and landscapes					
Risk					


KEY PLAN
Interception Point / Chamber
Proposed
Illegal Reclaimed Area
Chip Mong Area
Planned Sewer Route
Receiving Well / Pump at STP

5. Soft Component (Technical Assistance) Plan

Table of Contents

1. BACKGROUND OF FORMULATION OF THE SOFT COMPONENT PLAN

1.1 Background of the Project

Wastewater generated in Phnom Penh Capital City (hereinafter referred to as "PPCC"), the capital city of the Kingdom of Cambodia, has been increasing mainly due to rapid urbanization and population increase (from approximately 1.0 million in 1998 to 1.5 million in 2008). In general, the wastewater from PPCC is introduced to septic tanks in each household or business establishment. Supernatant liquid from the tanks are discharged to swamps/lakes through drainage pipe/channels and purified by natural purification function to some extent. However, the water environment in PPCC is seriously deteriorated due to the insufficient maintenance of the septic tanks, decrease of natural purification function in the swamps/lakes because of unregulated land reclamation and development. In particular, Cheung Aek Lake, where wastewater is discharged from the project area, decreases its area especially from 2003 to 2015 and thus deterioration of environmental and living condition of the people around the lake is accelerated.

Fig1.1 Target Area of This Project

Taking the above conditions into consideration, Japan International Cooperation Agency (hereinafter referred to as JICA), implemented "The Study on Drainage and Sewerage Improvement Project in Phnom Penh Metropolitan Area" from year 2014 to 2016, in response to the official request from the RGC. In this Study, Sewage Management and Drainage Improvement Master Plan (hereinafter referred to as M/P), was formulated for the target year of 2035. In the M/P, Cheung Aek Treatment Area, in which wastewater from central area of PPCC is currently discharged to Cheung Aek Lake through existing combined drainage pipes/channels, is set-up, applying off-site sewage treatment. Furthermore, phased implementation plan for the treatment area, which consists of short-term (up to 2020), medium-term (from 2021 to 2030) and long-term (from 2031 to 2040), was established.

This project aims to construct Sewage Treatment Plant (STP) and Sewer (Interceptor), based on the short-term program in the phased implementation plan.

1.2 Overall Goal and Project Objective

1.2.1 Overall Goal

Sewage sector in Cambodia has overall goals/objectives, consisting of national level and capital city level, as described below.

(1) National Strategic Development Plan: NSDP

The RGC places top priority on establishing good governance (Fighting Corruption, Legal and Judicial Reforms, Public Administration Reform, Reform of Armed Forces) for national strategy that becomes the foundation of the national development plan. The RGC also set up "Rectangular Strategy", listing the most important issues: "1. Promotion of Agriculture Sector"; "2. Development of Physical Infrastructure"; "3. Private Sector Development and Employment"; and "4. Capacity Building and Human Resources Development".

The RGC announced NSDP 2009-2013 as a development plan based on rectangular strategy in June 2010. In this NSDP 2009-2013, installation and maintenance of sewage/drainage facilities is ranked as priorities in the large cities located along national highway including Phnom Penh. In the latest NSDP 2014-2018, that is also ranked as priorities.

(2) City Development Strategy: CDS

PPCC formulated CDS for the target year 2015 based on NSDP in 2005. In order to develop Phnom Penh and to improve civic life, CDS has listed the following five key visions: (1) Land use and housing; (2) Environment and natural resources; (3) Infrastructure and transportation; (4) Social services; and (5) Economic development. Under these 5 visions, there are goals such as "Prevention of water pollution", "Promotion of sewage treatment" and "Improvement of drainage system". Under the key visions, "Prevention of Water Pollution" and "Promotion of Wastewater Treatment" are listed under Vision (2) and "Drainage Improvement" is listed under Vision (3).

(3) White Book on Development and Planning of Phnom Penh

PPCC with the support of the French government and the City of Paris formulated the White Book for target year 2020 on the basis of CDS in 2007. Then, PPCC revised it by expanding the target year to 2035. It was approved by the committee for land management and urban planning for the capital which was established by the decree and finally approved by the issuance of sub-decree dated 23rd December 2015.

The White Book suggests plans such as "Development of suburbs and expansion of the capital area to prevent the overconcentration of PPCC", "Promotion of public-private partnerships in the housing and land development" and "Establishment of identity as an aesthetic and environmental city". The Book

also shows the strategy for development policy of sewage/drainage sector and suggests construction of a new sewage treatment plant at Cheung Aek Lake.

1.2.2 Project Objective

The objective of the Project is to minimize water pollution load discharged to Cheung Aek Lake through construction of new sewerage treatment facilities, thereby contributing to protect and improve water environment of the Cheung Aek Lake as well as living and sanitation condition of the people in PPCC.

1.3 Basic Concept of the Project

The outline of the project is as follows.

Table 1.1 Contents of the Request from RGC based on Minutes of Discussion (M/D)

Components	Detailed content
Construction of Sewage Treatment Plant(STP) (including Intake Facilities)	- Capacity: 5,000m^3/day - Treatment method: Pre-treated Trickling Filtration (PTF)
Maintenance Road/Sewer (interceptor) Pipe from Trabek Pumping Station to STP	- Length: 2,000m - Diameter of Sewer Pipe: 500mm

Note) As a result of the technical study, pressure pipe is to be installed with 300mm diameter.

1.4 Necessity of the Soft Component (Technical Assistance)

PPCC has so far no experience of sewage management utilizing STP and no staff who has experience in operation and maintenance of STP. Therefore, to guarantee sustainable operation of the STP constructed in this project, it is essential to train the staff of PPCC by implementing soft components in this Project. The soft components are categorised into two components, namely, "Capacity Development in Operation and Maintenance of STP" and "Assistance for Formulating Financial Plan for STP Management".

(1) Capacity Development in Operation and Maintenance of STP

As described above, PPCC has so far no experience of sewage management utilizing STP. Therefore, it is necessary to train the staff, aiming to technology transfer and capacity development for operation and maintenance of sewage treatment facilities, including wastewater treatment, sludge treatment, sludge disposal, water quality control and so on. This component also aims to develop comprehensive management skill of STP. For this purpose, basic knowledge of mechanism of wastewater treatment will be lectured and organization development and administration skill will be transferred. Thorough out those activities, DSO staffs will obtain enough capacity to manage STP operation independently.

(2) Assistance for Formulating Financial Plan for STP Management

STP regularly requires various costs such as electric power, chemicals, sludge disposal and repairing/replacing equipment. Without the budget to cover the costs, it is impossible to keep operating STP and it is important for DSO to grasp accurate cost of operation and maintenance of the STP. Therefore, the soft component to train staff to obtain knowledge of the budget and

expenditure management for the STP is also implemented.

The required activities for operation and maintenance of STP is illustrated in the following figure. In addition, the soft component includes the training of the staff as responsible officials to consult with the financial departments in PPCC for securing budget for sustainable operation and maintenance of STP.

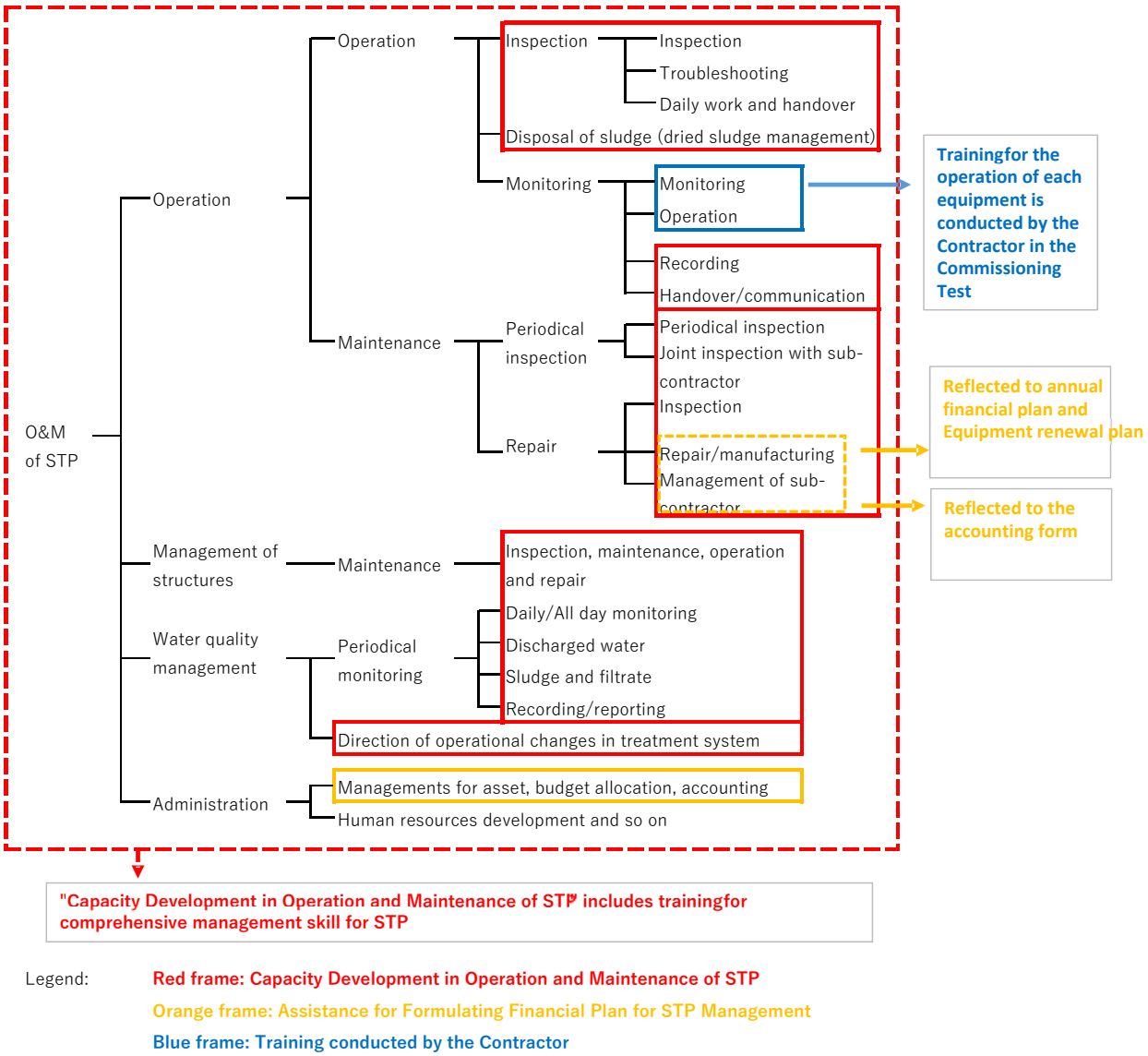


Figure 1.2 Relations between Contents for STP Management and Activities in Soft Component

1.5 Targeted Personnel for the Soft Component

1.5.1 Capacity Development in Operation and Maintenance of STP

Drainage Pumping Station and Sewage Treatment Plant Office (DSO) will be in charge of operation and maintenance of the STP. Organization chart of DSO is shown in the **Attachment (c)** with the number of staff (breakdown of the number of regular and contracted employee). As shown in the organization chart, only two regular staff in Treatment Plant Team are assigned for operation and maintenance of the

STP, belonging to “Pumping Station, STP and Pond Canal Maintenance Section”. In addition, they are at present engaged in maintenance of pumping station and canal, since STP is not in operation in PPCC.

On the other hand, the member requited to operate and maintenance of the constructed facilities in this project is shown in the **Attachment (d)**. The targeted personnels in the soft component are Custodian, Mechanical and /Electrical Engineer and Water Quality Management Engineer, four members in total. The members shall be hired by DPWT before the commencement of the soft component.

1.5.2 Assistance for Formulating Financial Plan for STP Management

Targeted personnels for this soft component are i) one staff of Finance and Planning Office, which is managing the budget of DPWT, ii) one staff of Administration and Personnel Section of DSO. This soft component focuses on transferring knowledge/skills for proper budget and expenditure management. On the other hand, transferring knowledge/skills for public enterprise accounts is not included.

In this soft component, the one staff of Administration and Personnel Section of DSO is in principle trained to have capacity of daily accounting as well as analyzing operational expenditure. On the other hand, the one staff of Finance and Planning Office is trained to have capacity for formulating budget plan of STP.

2. OBJECTIVES OF THE SOFT COMPONENT

Objectives to be achieved in the soft component are as follows:

- STP is sustainably operated, maintained and managed, and STP’s performance is optimized.
- Sound financial foundation is established for sustainable operation and maintenance of STP.

3. OUTPUT OF THE SOFT COMPONENT

3.1 Capacity Development in Operation and Maintenance of STP

Output of the training, targeting DSO’s staff, are as follows.

- DSO can achieve the operation and maintenance skills of STP, including water treatment/sludge treatment/disposal.
- DSO can formulate the maintenance plan by themselves and they can implement maintenance works based on the plan.

3.2 Assistance for Formulating Financial Plan for Management of STP

Output of the assistance, targeting DSO’s staff, are as follows.

- DSO can achieve financial planning skills for the manegement of STP.
- DSO can formulate financial report for management of STP by themselves.

4. METHODOLOGY FOR CONFIRMATION OF ACHIEVEMENT

Methodology for confirmation of achievement of the soft components is shown in the following table.

Table 4.1 Methodology for Confirmation of Achievement

Items	Point to be checked	Method for Checking
Capacity Development in Operation and Maintenance of STP	- Is the capacity of STP O&M, including O&M for equipment, water monitoring and sludge management of STP, developed?	● Conducting proficiency test of O&M and management items for STP. ● STP O&M plan is established.
	- Is the capacity of STP O&M, based on the understanding of biological treatment and countermeasures for fluctuation of water quality in operation, developed?	● Conducting proficiency test for basic knowledge of biological treatment and operation skills of wastewater treatment equipment. ● Troubleshooting methods of wastewater treatment and suggestions on operation for various case of water quality and sludge conditions will be incorporated on to the standard operational manual delivered by Contractor, to finalize operation manual for STP.
	- Is the organization for sustainable STP O&M is established?	● The members shown in the Attachment (d) are hired by DPWT.
Assistance for formulating financial plan for management of STP	- Is the capacity to use accounting form for STP developed?	● Accounting form is established. ● Conducting proficiency test of accounting form for STP.
	- Are documents related to financial plan and Equipment renewal plan for STP prepared?	● Annual financial plan for STP operation and budget plan for maintenance and renovation of STP are formulated. ● STP O&M plan and budget plan is explained by DPWT staff to the sections in charge of budgetary management in PPCC (the results are confirmed by the minutes of meeting).

5.ACTIVITIES OF THE SOFT COMPONENT

Two (2) Japanese experts, assigned as “STP Operation and Maintenance Expert” and “Financial Planning Expert”, shall be dispatched.

The STP Operation and Maintenance Expert shall be in charge of training for systematic operation of the STP. On the other hand, the Financial Planning Expert shall be in charge of assistance of financial management for STP in collaboration with the STP Operation and Maintenance Expert.

5.1 Capacity Development in Operation and Maintenance of STP

One (1) Japanese expert assigned as “STP Operation and Maintenance Expert” shall be dispatched. The expert shall be a specialist in the field of STP operation and maintenance who can provide the targeted personnel with advanced knowledge and technology. In addition, the expert shall have overall management skill to supervise all the activities during implementation of the soft component.

The STP Operation and Maintenance Expert shall train DSO staffs to understand comprehensive operation and maintenance skills, including sludge management (disposal) and water quality management. The expert shall evaluate the skill of staff by conducting proficiency test on the operation and maintenance skills in the each stage of the activities.

Since the STP is facilities introduced in PPCC for the first time, the expert shall pay attention to whether the organization proposed in this project is established and support formulation of STP operation and

maintenance plan (annually/monthly) considering smooth operation of the facilities, safety management and environmental aspects, in consultation with the DSO.

5.2 Assistance for Formulating Financial Plan for STP Management

One (1) Japanese expert, assigned as "Financial Planning Expert" shall be dispatched. The expert shall have professional knowledge and skills to train staff on financial planning for smooth and sustainable operation and management of STP.

The Financial Planning Expert shall train i) the one staff of Administration and Personnel Section of DSO to develop the capacity of daily accounting as well as analyzing operational expenditure, and ii) one staff of Finance and Planning Office to develop the capacity for formulating annual budget plan and Equipment renewal plan for STP. It is noted that the two targeted personnel shall participate all the activities to know each other's work contents. At the same time, the expert encourages PPCC to allocate the budget to sustainably operate and maintain the STP.

5.3 Inputs for the Soft Component

Inputs for the soft component is estimated at (i) 2.53 MM for dispatch of "STP Operation and Maintenance Expert", and (ii) 1.34 MM for dispatch of "Financial Planning Expert", totaling 3.87 MM. Details of inputs are as follows.

(1) STP Operation and Maintenance Expert: 2.53 MM

The STP Operation and Maintenance Expert shall be dispatched for three times to train staff. The expert shall supervise their works throughout the soft component, and report progress to JICA Cambodia office at the time of arrival and returning. On the completion of the project, the expert shall summarize all the activities of soft component.

Major Activities

- 1st Term: The Expert shall i) explain overall plan of the project to the participants in DPWT and ii) teach basic knowledge and mechanism of STP which is not limited to classroom but on-site lecture for deeper understanding, and iii) train DSO staffs to formulate work list and organization chart for STP O&M and confirm necessary staffs described in the organization chart.
- 2nd Term: The expert shall i) teach sludge and water quality management required for STP O&M, ii) check and monitor the skill of the staff obtained in the Commission Test and iii) support formulation of STP operation and maintenance plan, based on the result of the Commissioning Test
- 3rd Term: The Expert shall i) review operational method, which depends on the fluctuation of methodological condition to identify problems to solve and assist DSO staffs to make solutions, ii) finalize STP O&M plan and Operation Manual, based on the operational results in the operation experience through the dry season.

Detailed Schedule for STP Operation and Maintenance Expert is shown below.

Detailed Schedule for STP Operation and Maintenance Expert

Date		1st Term	2nd Term	3rd Term
1	Sun	Move from Japan to Cambodia		
2	Mon	- Explanation of overall plan to DPWT and DSO in 1st Term, and activities plan for each term from 2nd Term to 3rd Term - Explanation of activities to JICA Cambodia Office		
3	Tue	- Preparation of training materials (schedule, textbook and meeting memo with the Contractor) - Explanation of contents of activities in the soft component to DSO staff	- Preparation of training materials (check list for activities on the site and meeting memo with the Contractor) - Explanation of objectives and contents of activities to DSO staff	- Preparation of training materials (data analysis form for activities on the site and meeting memo with the Contractor) - Explanation of objectives and contents of activities to DSO staff
4	Wed	Training on basic of sewage treatment and O&M of STP (principles and objectives)	Training on O&M items and task responsibility (daily works such as site patrol, operational records and staff arrangement) at the site	Water sampling and analysis on the water quality of the operations in the dry season
5	Thu	Assistance for formulating list of STP O&M items and task responsibilities.	Training on O&M items and task responsibility (basic of sewage treatment, and principles and objectives of O&M) at the site	Analysis on the operational data (sludge generation and power consumption) from 2nd term and the subsequent 6 months
6	Fri	Confirmation of the list formulated by the DSO staff and follow-up of items insufficiently understood	Ditto (* Training in the Commissioning Test is conducted in parallel)	Interview with DSO staff on the O&M activities and analysis on the data collected from 2nd term and the subsequent 6 months
7	Sat	Holiday		
8	Sun	Holiday		
9	Mon	Review of the list formulated in terms of organizational setup and human resources to be secured	Training on O&M items and task responsibility (water quality management: sampling and handlining of samples) at the site	Re-training on sludge management (because character of sludge may be different between the starting of the Commissioning Test and the dry season
10	Tue	Consultation on the human resources to be secured (if any)	Training on O&M items and task responsibility (water quality management: analysis and items to be subcontract) at the site	Ditto
11	Wed	Discussion with the Contractor on the contents and schedule of the activities in 2nd Term	Training on O&M items and task responsibility (sludge management: visit sludge dumping site and confirmation of procedures) at the site	Study on the issues to sustainably operate and maintain STP, based on the analysis in the preceding week
12	Thu	Train the DSO staff at the construction site on the operation of each water treatment equipment to understand the principal and system of wastewater treatment	Training on O&M items and task responsibility (sludge management: input and output of sludge to equipment, handling of dried sludge) at the site	Implementation of activities, based on the study in the preceding day (for example, consultation with the sludge dumping site and water quality lab)
13	Fri	Train the DSO staff at the construction site on the operation of each sludge treatment equipment and water monitoring to understand the STP O&M	Conducting proficiency test on the O&M skills, based on the activities at the site	
14	Sat	Holiday		

Date		1st Term	2nd Term	3rd Term
15	Sun	Holiday		
16	Mon	Follow-up of items insufficiently understood in the Commissioning Test	Training the staff on troubleshooting, considering various situation	- Analysis on the water monitoring results in the dry season and feedback those results to the Operation Manual and STP O&M plan
17	Tue	Report to DPWT and DSO and follow-up of securing staff required for the STP O&M	Assistance for drafting of Operation Manual, which incorporate experience of troubleshooting training	Conducting proficiency test on operation skills depending on the fluctuation of water quality and follow-up of items insufficiently understood
18	Wed	Review of training contents (basic knowledge, task responsibility and activities in the Commissioning Test) and issues in the next term	Conducting proficiency test on the O&M skills, based on the O&M manual and identification of contents not understood	Review of the Operation Manual, based on the results of the consultation held in the preceding day
19	Thu	Report to JICA Cambodia Office, and move to Japan	Analysis on the sludge generation and power consumption in the Commissioning Test for formulating STP O&M plan	Analysis on the materials for simple repair, which can be procured in Cambodia
20	Fri	Arrival at Japan	Assistance for formulation of STP O&M plan by the staff of DSO	Analysis on the TOR for procurement, based on the results in the preceding day
21	Sat	-	Holiday	
22	Sun	-	Holiday	
23	Mon	-	Assistance for formulation of STP O&M plan	Assistance for finalization of STP O&M plan
24	Tue	-	Handover the information related to financial plan such as power consumption and amount of sludge disposal, to the "Financial Planning Expert"	Bookbinding and distribution of the Operation Manual and STP O&M plan and explanation to the relevant organizations
25	Wed	-	Follow-up of items insufficiently understood in the formulation of STP O&M plan, prepared by DSO	Preparation of completion report compiling all activities in the soft component
26	Thu	-	Report to DPWT and DSO, as well as review of training results and issues in the next term	- Preparation of completion report - Report to DPWT and DSO
27	Fri	-	Report to JICA Cambodia Office, and move to Japan	Report to JICA Cambodia Office, and move to Japan
28	Sat	-	Arrival at Japan	

(2) Financial Planning Expert: 1.50 MM

The Financial Planning Expert shall be dispatched for two times to carry out the following works.

Major Activities

- 1st Term: The Expert shall i) teach the importance of securing budget for operation and maintenance of the STP, ii) create the form of accounting and annual financial report for STP management and train staff to fill out them and iii) review the annual financial report based on the result of the Commission Test.
- 2nd Term: The Expert shall i) review the annual financial report based on the operational results in the dry season, especially focusing on the result of power consumption and amount of sludge disposal, ii) follow-up and improve the skill of staff in terms of utilization of accounting form and iii) train staff to compute cost for STP operation and maintenance plan, as well as Equipment renewal plan for STP. and iv) encourage PPCC to allocate budget for the sustainable STP O&M

Detailed Schedule for STP Operation and Maintenance Expert is shown below.

Detailed Schedule for STP Operation and Maintenance Expert

Date		1st Term	2nd Term
1	Sun	Move from Japan to Cambodia	
2	Mon	- Explanation of overall plan to DPWT and DSO in 1st Term, and activities plan for each term - Explanation of activities to JICA Cambodia Office	
3	Tue	- Explanation of contents of activities in the soft component to the targeted staff - Handover the information related to financial plan such as power consumption and amount of sludge disposal, from the "STP Operation and Maintenance Expert"	- Explanation of contents of activities in the soft component to the targeted staff - Handover the information related to financial plan such as impact on cost arising from fluctuation of water quality, from the "STP Operation and Maintenance Expert"
4	Wed	Training on basic of financial plan of STP O&M	Review and updating of accounting form based on the training result and follow-up items insufficiently understood
5	Thu	Training on basic of financial plan of STP O&M (continued) and follow-up of items insufficiently understood	Analysis on the O&M cost based on the operational results in the dry season
6	Fri	Training on formulation of accounting form for STP	Review and update of annual financial plan for STP
7	Sat	Holiday	
8	Sun	Holiday	
9	Mon	Follow-up of accounting form for STP prepared by DSO	Assistance for finalization of annual financial plan for STP
10	Tue	Training on formulation of annual financial plan for STP	Training on formulation of renovation plan for STP
11	Wed	Follow-up of annual financial plan for STP, prepared by DPWT	Assistance for finalization of renovation plan for STP, prepared by DPWT
12	Thu	Training on the analysis of the cost obtained in the Commissioning Test	Ditto
13	Fri	Training on updating of annual financial plan for STP	Analysis and review of activities (including conducting proficiency test)
14	Sat	Holiday	
15	Sun	Holiday	
16	Mon	Conducting proficiency test and follow-up of items insufficiently understood	Assistance for consultation carried out by the DPWT staff with departments in charge of financial matter in PPCC, on the financial plan of STP management
17	Tue	Report to and consult with DPWT and DSO about the forecast of O&M cost based on the annual financial plan	- Feedback of results of consultation held in the preceding day for the future consultation on the financial issues - Preparation of completion report
18	Wed	Analysis on the necessity of updating the annual financial plan based on the consultation held in the preceding day	Preparation of completion report
19	Thu	- Review of activities and issues for the next term - Report to JICA Cambodia Office, and move to Japan	- Report to DPWT and DSO - Report to JICA Cambodia Office, and move to Japan
20	Fri	Arrival at Japan	Arrival at Japan

Components	Month									Man/Month	
	1	2	3	4	5	6	7	8	9	Local	Domestic
Capacity Development in Operation and Maintenance of STP	0.67		0.93						0.93	2.53	0.00
Assistance for Formulating Financial Plan for STP Management				0.67					0.67	1.34	0.00
Total										3.87	0.00

Figure 5.1 Inputs Plan for the Soft Component

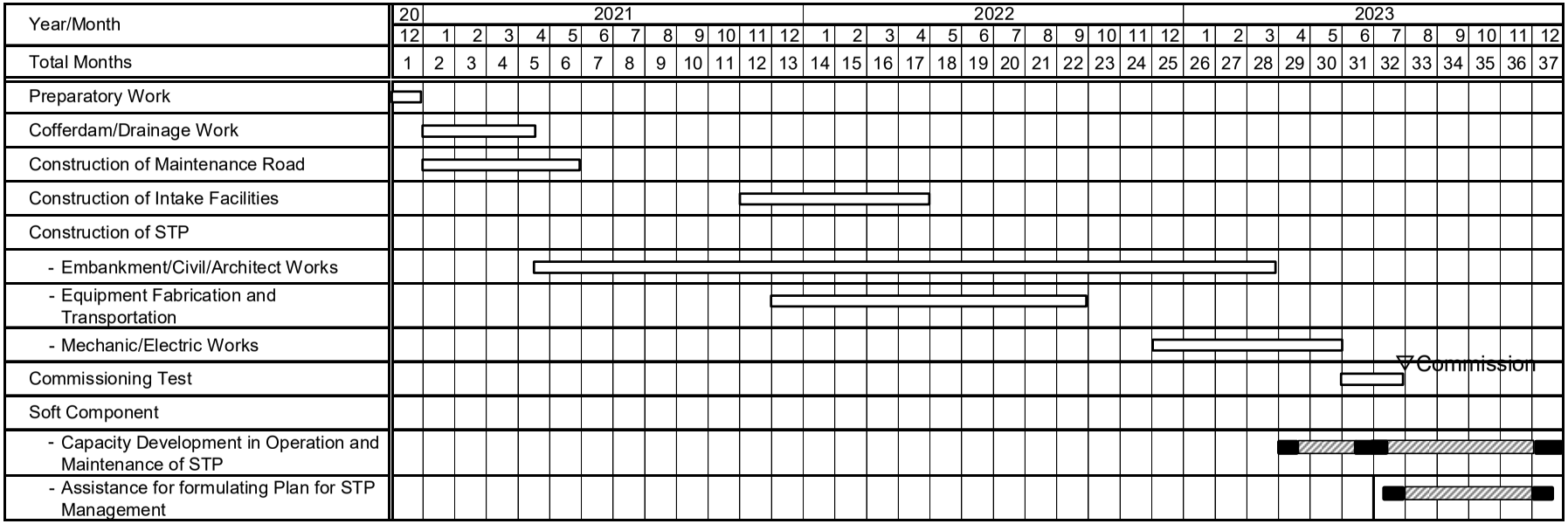
6. ARRANGEMENT AND INPUTS OF DISPATCHED EXPERTS

For the implementation of the soft component, experienced Japanese Experts shall be dispatched for the following reasons:

- PPCC has so far no experience of sewage management utilizing STP.
- There are few engineers who can strictly manage the progress of the work based on the planned schedule.
- Special knowledge and experience are required, because the STP constructed in this project applies Japan's unique technology(PTF).

7. IMPLEMENTATION SCHEDULE OF THE SOFT COMPONENT

Overall schedule of soft component is shown in the following figure.



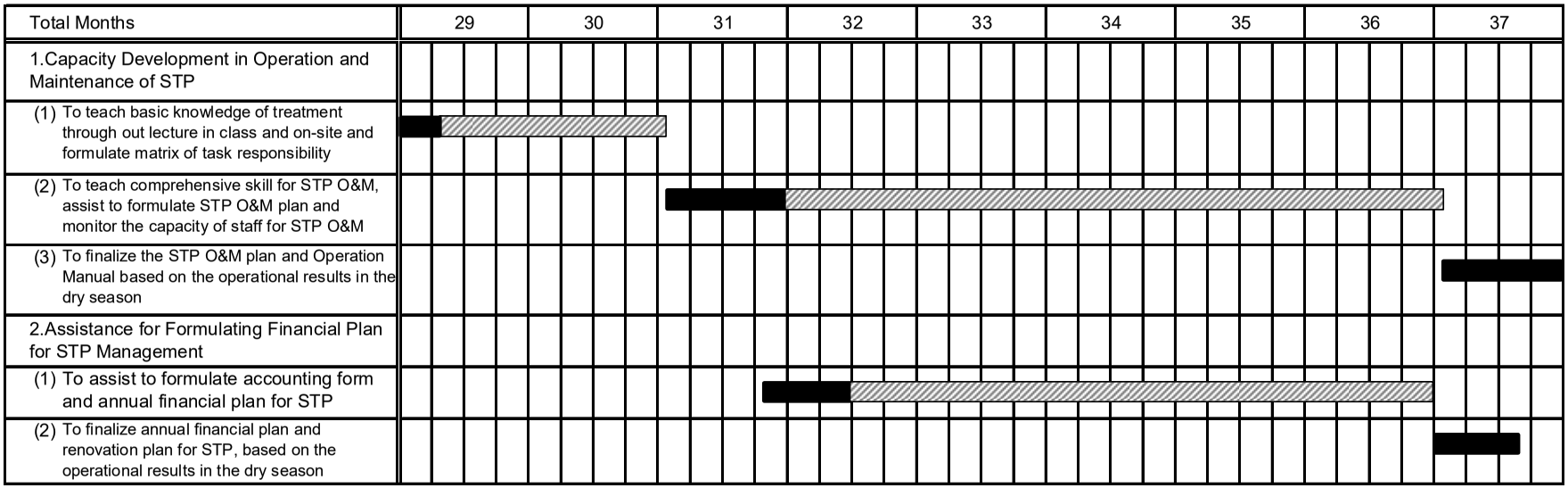


Fig.7.1 Implementation Schedule of the Soft Component

8. OUTPUT OF ACTIVITIES OF THE SOFT COMPONENT

Outputs of the soft component shall be as follows:

- STP O&M plan, which includes matrix of task responsibility, organaizations to implemete, monthly/annually timeline and manuals of O&M works.
- Operation Manual, which include troubleshooting methods of wastewater treatment and suggestions on operation for various case of water quality and sludge conditions in addition to the standard operational manual delivered by Contractor.
- Results of proficiency test on the training contents in the Commissioning Test implemented by the contoractor.
- Results of proficiency test on the other O&M items such as sludge and water quality management
- Accounting form for STP and results of proficiency test on the understandig of the form
- Annual financial plan (draft) for STP.
- Equipment renewal plan for STP.
- Meeting materials for explanation of Annual financial plan and Equipment renewal plan.
- Completion report for all activities.

9. RESPONSIBILITY OF CAMBODIAN SIDE

Responsibility of the Cambodian side for the soft component is enumerated below.

(1) Appropriate Planning

DSO shall create STP operation and maintenance plan utilizing knowledge obtained in the soft component. DPWT shall encourage PPCC to secure budget based on the financial plans prepared by the Financial and Planning Office of DPWT.

(2) Securing Budget

PPCC shall allocate the budget in accordance with the proposed plan. DPWT shall check the achievement of DSO's works of the proposed plan.

(3) Employment of Staff for Sustainable Operation and Maintenance of STP

DSO shall regularly employ young staff as human resources for the next generation. This staff shall be a civil engineer, mechanical/electrical engineer. In addition, water quality management staff shall also be employed for the future provision.

(4) Sustainable Capacity Development

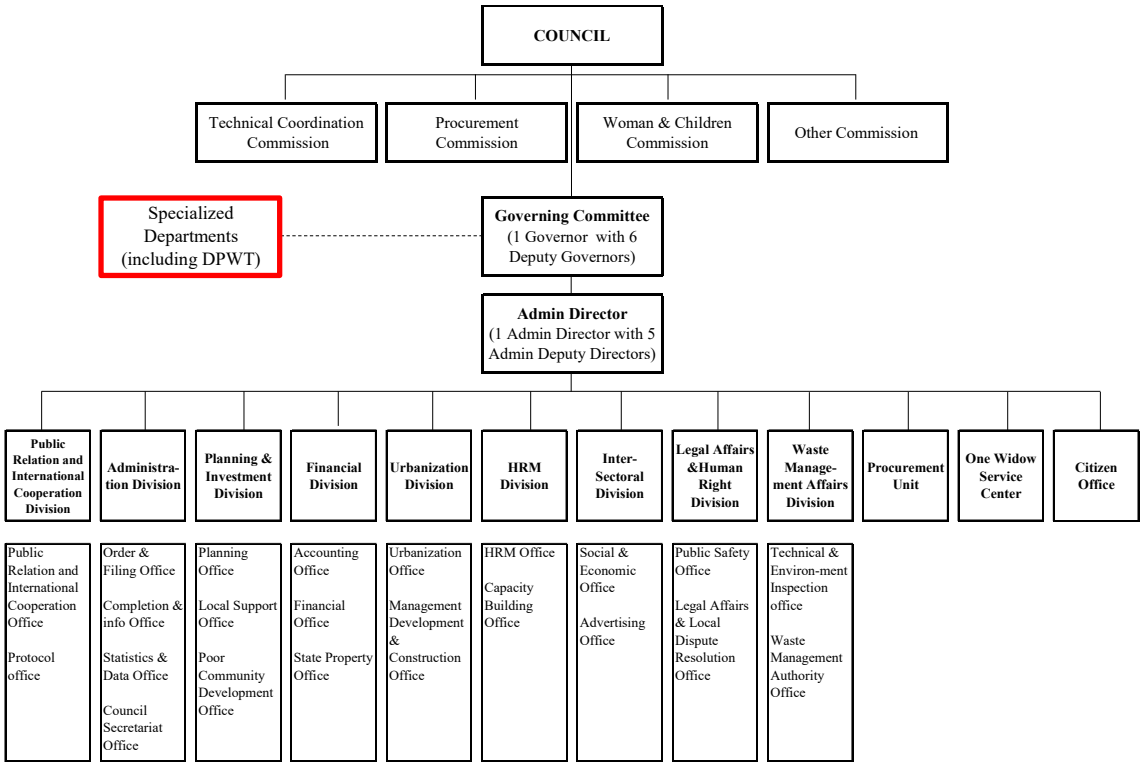
DPWT shall assign a supervisor who can supervise all the works to inherit the STP operation and maintenance skills.

(5) Establish Reporting/Monitoring System for Sustainable Activities

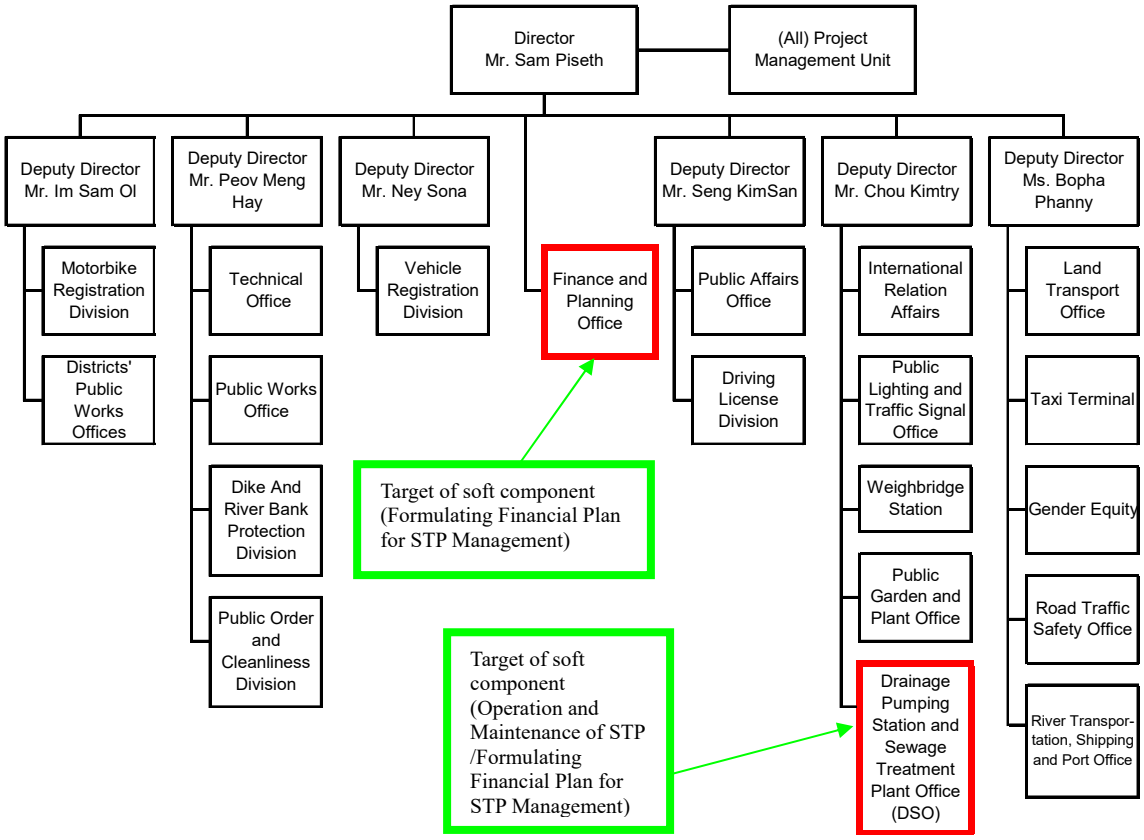
DPWT shall establish reporting system from DSO to DPWT, as well as monitoring system of DSO to record/update their activities, including formulation of STP operation and maintenance

plan sustainably, regularly and voluntarily.

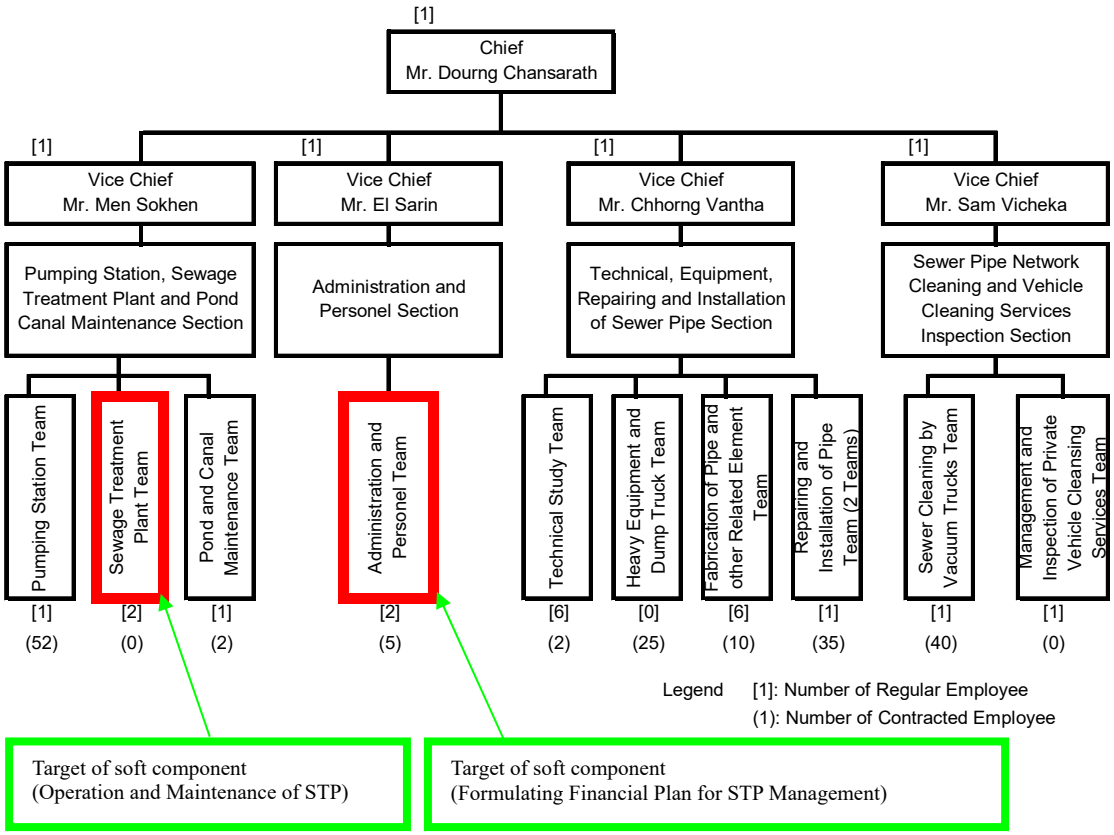
Attachment



(a) Organization Chart of PPCC and Position of DPWT



(b) Organization Chart of DPWT (Targeted Section of Soft Component is shown in Red Frame)



(c) Organization Chart of DSO (Targeted Section of Soft Component is shown in Red Frame)

Job	No.	Description
Custodian	1	Facilities manager
Mechanical/Electrical Engineer	2	O&M of sewerage treatment facilities
Water Quality Management Engineer	1	Water Quality Sampling, Test and Analysis
Clerical Officer	1	General Affairs, Public Relations (deal with visitor etc.)
Worker (Wastewater Treatment)	2	Removal of Scum
Worker (Sludge Treatment)	4	Disposal of Sludge and Cleaning of Facilities
Total	**11**	

Targeted member of soft component
(Operation and Maintenance of STP)

(d) Proposed Member of STP O&M constructed in this Project

6. References

6.1 Comparison between JICA Guidelines and Environmental Legislation in Cambodia

Items	JICA Guideline（Environmental and Social Considerations Required for Intended Projects）	Environmental Legislation in Cambodia	The measure to be held in the current project
1. Underlying Principles	1. The earliest possible environmental assessment to incorporate the avoidance/minimization /mitigation of the impact into the project plan. 2. Quantitative and qualitative analysis covering social and environment harmonizing economic, financial, institutional, social and technical analysis. 3. Provision of alternatives and mitigation measures in consideration. EIA report for the large adverse impact. 4. Organizing a committee of experts for the particularly large adverse impacts)	In Chapter III, in the Law on Environmental Protection and Natural resource Management, 1996 provides; An environmental impact assessment shall be conducted on every project and activity of the private or public, and shall be approved by the Ministry of Environment before being submitted to the Royal Government for decision. The nature and size of the proposed projects and/ or activities (proposed and existing) both private and public, that shall be subject an environmental impact assessment which shall be defined by sub-decree following a proposal of the Ministry of Environment.	No particular large gap in between.
2. Examination of Measures	1. Examination of the multiple alternatives to avoid, minimize mitigate of the impact.) 2. Preparation of appropriate follow up plans and systems such as monitoring plans and environmental management plans.	There is no particular description about alternatives in the Environmental Protection and Natural resource Management, 1996, Sub-decree on Environmental Impact Assessment (EIA) Process 1999 and Declaration on General Guideline for conducting IEIA/EIA Reports 2009. Chapter7 of Anex1 in Declaration on General Guideline for conducting IEIA1/EIA Reports 2009. Includes EMP description including fund and organizational setup, methodologies and monitoring schedule.	Although contents of the study are similar in both policies, alternative should be provided for considering Master Plan and priority projects.
3. Scope of Impacts to be Assessed	1. Impacts on human health and safety, as well as on the natural environment, transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. 2. Examining derivative, secondary, and cumulative impacts indivisible from the project.	The impacts on human health and safety, as well as on the natural environment which listed in the JICA guideline are generally covered even in the Cambodian system although those categories are slightly different. In the Annex1 in Declaration on General Guideline for conducting IEIA/EIA Reports 2009, required information in the report is described. Those are; Physical Resources: -Soil, Weather, Air quality, Hydrology Biological Resources; Forest, Fauna species, rarely species, endanger species and migration, Habitats, Biodiversity and ecology system, Wet land system, Protected areas, Sensitive environmental area, Socio-economic Resources; Demography and settlement, Economic Status, Land use, Water use,	No particular large gap in between. Although principal ideas such as contents and timing of the environmental study are covered to meet the JICA guideline, SEA application is not described in Cambodian legislation. In the study, encourage relevant organization for the environmental and social consideration at early stage explaining SEA.

Items	JICA Guideline（Environmental and Social Considerations Required for Intended Projects）	Environmental Legislation in Cambodia	The measure to be held in the current project
		Energy use, Infrastructure system, Education, Public health, Cultural heritages, Historical buildings, Ancient temples, Pagodas, religion/traditions, Ethnic minority or Indigenous people, Tourism area. There is no particular description related Examining derivative, secondary, and cumulative impacts indivisible from the project.	
4.Compliance with Laws, Standards, and Plans	1. Compliance with Laws, Standards, Policies and Plans. 2. Avoidance of the protected and conservation area of natural or cultural heritage designated by laws and ordinances.	In Protected Areas Law 2008, All clearances and bulldozing within the open land or forestland in protected areas for the purposes of building all types of public infrastructures through the core zone and conservation zone shall be strictly prohibited. (Article 36) These activities can only be carried out in the sustainable use zone and community zone with approval from the Royal Government of Cambodia at the request of the Ministry of Environment. (Article 36) Also, in Article 44, To minimize adverse impacts on the environment and to ensure that management objectives of protected areas are satisfied, an Environmental and Social Impact Assessment shall be required on all proposals and investment for development within or adjacent to protected area boundary by the Ministry of Environment with the collaboration from relevant ministries and institutions. The procedures for Environmental and Social Impact Assessment for any projects or activities shall comply with provisions pertaining to the process of Environmental and Social Impact Assessment.	No particular large gap in between.
5. Social Acceptability	1. Adequate social coordination for their acceptance. In case of the large impact, sufficient consultation with local stakeholders via information disclosure at early stage to be incorporated into project plan.) 2. Consideration of the vulnerable people	Public participation is one of the important contents in the EIA report in Annex1 in Declaration on General Guideline for conducting IEIA1/EIA Reports, 2009.	No particular large gap in between.
6. Ecosystem and Biota	1. Avoidance of the degradation of the natural resource 2. Avoidance of the illegal logging	The information related to the impact to the biological features is described in the Declaration, Anex-1, as 4.1.2 Biological resources, (Forest: forest land area, forest species and forest classification, Fauna species, rarely species, endanger species and migration, habitats, Biodiversity and	No particular large gap in between.

Items	JICA Guideline（Environmental and Social Considerations Required for Intended Projects）	Environmental Legislation in Cambodia	The measure to be held in the current project
		ecosystem, wetland system (attached with relevant maps).	
7.Involuntary Resettlement	1. Avoidance and minimization of the involuntary resettlement 2. Sufficient compensation to PAPs with timely manner 3. Appropriate participation of PAPs throughout the planning, implementation and monitoring of the RAPs with the appropriate grievance mechanisms 4. At large scale involuntary resettlement, advance information disclosure to the PAPs should be made with the understandable way covering the elements in the World Bank Safeguard Policy, OP 4.12, Annex A.)	No particular description about avoidance and minimization of the resettlement in the EIA related legislations such as Law on Environmental Protection and Natural Resource Management 1996, Sub-decree on EIA Process 1999, Declaration on General Guideline for conducting IEIA/EIA Reports 2009. But in February 2018 RGC issued Sub-Decree no. 22 ANK/BK on The Promulgation of the Standard Operating Procedures for Land Acquisition and Involuntary Resettlement for Externally Financed Project in Cambodia. Appendix and 4 as Outline Resettlement Framework and Outline Detailed Resettlement Plan, point B the project set out the measures taken to void or minimize resettlement.	No particular large gap in between. However, the living situation for resident in Cambodia are complicated especially in terms of land tenure/use right. Adequate study in later stage should be recommended.
8. Indigenous Peoples	1. Avoidance and minimizing impacts to indigenous people 2. Respect for Indigenous people's right obtaining their consent in a process of free, prior and informed consultation 3. Adequate measure to the adverse impact for indigenous people as Indigenous Peoples Plan with understandable way covering the elements of the World Bank Safeguard Policy, OP4.10, Annex B.	Land tenure by community was described in the land law. Also, situation of the indigenous people is should be included in the EIA report as one of the items, "Religion/traditions, ethnic minority or indigenous people", described in the Annex 1 in the Prakas (Declaration) on General Guideline for conducting IEIA1/EIA Reports 2009. In the Sub-Decree no. 22 ANK/BK dated February 2018 also focused on Indigenous Peoples Plan stated in para 97.	No particular large gap in between. However, the living situation for resident in Cambodia are complicated especially in terms of land tenure/use right. Adequate study in later stage should be recommended.
8. Monitoring	1. Adequate monitoring of the predicted mitigation measures and occurrence of unforeseeable situation. 2. Feasible monitoring plan at planning 3. Available monitoring process to local project stakeholders 4. Resolving problems through an occasion of the discussion and examination in public with the sufficient stakeholder's participation	There is no particular description for the implementing monitoring and detail public participation in Law and Sub-decrees refer to the IESA. But, in the sub-decree no. 22 ANK/BK dated February 2018 also have procedure of Monitoring (internal or external) for the implementations of the resettlement plan. The monitoring plan is included in the requirement in environmental management plan in the Annex1 in Declaration on General Guideline for conducting IEIA1/EIA Reports 2009. *Note:* ESIA report will subtract of Resettlement Policies and Grievant Redress from the Resettlement Plan of the Project included total affected households, assets and economic trees.	No particular large gap in between. Adequate study for developing monitoring works will be recommended.

6.2 Summary of Results of the Public Consultation

No	Stake holder	Comment on the project	*Suggestion*	Solution from the Project
1	Administrative of Phnom Penh Capital City (Project Owner)	● The necessary of this project is to improve the environment in the Phnom Penh Capital City and improve welfare of the people because this sewage treatment plant will use the latest technology from Japan which reduces the stench, water pollution in Choeung Ek Lake. In addition, there are sewage treatment system in Siem Reap and Sihanoukville, but none in Phnom Penh. ● The total construction cost is about US $ 35-38 million, including over $ 5 million worth of concrete entrance to Beoung Salang. ● Land possession issues in project areas by people are state's public land, which is provided in sub-decree 124 on September 3, 2008 for 520 ha of Choeung Ek Lake. In the project area, there hasn't the sub-division from the royal government yet. However, Administration of PPCC has already request for sub-division of 19 ha of area to develop this project and hope to hear the news soon. ● The land in the project area has not yet been issuedthe possession. In case of there is complaint with the land owner, Administrative of PPCC will solve this problem. Solving problem is the work of royal government and Administrative of PPCC has experience in this field. ● The Administrative of PPCC sent Mr. Maokol Marodi, Coordinator with the Environmental and Social Impact Assessment team.	● *Build the articulated concrete block to prevent the soil erosion.* ● *This treatment system should consider of treating antibiotics that being used in the health sector.* ● *The project will open the construction in July 2019, and JICA has already agreed.* ● *The lakes in the project area are state public lands, which are governed by sub-decree. Therefore, any possess of the land in this sub-decree is illegal.* ● *Please the team follows the JICA guidelines and work quickly and this study shall take great national interest.* ● *Please help to improve the water quality and reduce the waterborne diseases for people living there.*	● *JICA will design the embankment and the soil storage will have the articulated block and compress it accordingly to the techniques of the soil work and also plant grass to prevent landslide.* ● *This project is the latest technology from Japan and we believe that it will help to treat the toxic substance in the wastewater.* ● *JICA will try to finish this project design as quick as possible and open the public auction then open the construct as soon as possible.* ● *Administrative of PPCC will cooperate with Ministry of Economic and Finance to solve the land dispute in this project.* ● *ESIA Team will try best and carefully finish this study as planned.* ● *JICA will design the project carefully based on technical standard of Japan and the treated sewage is based on standard of Cambodia.*
2	Relevant Departments and Units	● Support this project 100% by 13 departments and 2 units in total: because it is the needs for development and it is really good to have the project of sewage	● *Please conduct the study clearly for spreading this information to sub-national level.*	● *The Environmental Impact Assessment Team is working hard and focused on detailed study, including outreach to all stakeholders to fully understand the project.*

No	Stake holder	Comment on the project	*Suggestion*	Solution from the Project
		treatment plant which is the first project of the state based on the environmental aspect. ● This project is beneficial to the general public, especially the people near the area. ● The solid waste collecting service in Phnom Penh is provided regularly by CINTRI at the city center and sub-urban twice a week. If the waste truck broke down, it will cause the service jamming and the waste will remain uncollected. ● Department of Environment hope that after this treatment plant is executed, the stench will be reduce and hope the citizens will support this project. ● Hope that citizen will understand this project through the public announcement because they also want the cleanness and dislike the stench. ● This project is really good because it will also treat the sludge from the treatment tank which make it special because there haven't any companies done like this. ● Project will improve the water quality to another level. ● Project provided many benefit to biodiversity, fishes, animal and human around the project. ● This Project will reduce the impact on the water resources. ● It is really good that the project of sewage treatment plant is developed because it is the first project of the state based on environmental aspect. ● The department will coordinate with all stakeholders to develop the project smoothly.	● *Please accelerate the construction as soon as possible.* ● *The project owner, please help to train the human resource of Cambodia on this skill.* ● *The size of sewage discharge is greater and the treatment capacity, 5000m3/day which is about 2% of the discharge. Should think of the 100% treatment in the future.* ● *Should reserve the area for the expansion later to avoid the needs of land that can be difficult to solve.* ● *Build the sewage canal with cover to avoid the stench.* ● *Please prevent further land-grabbing in order to reserve the area for expansion this project in the future.* ● *The work hour is 8 hours from Monday to Friday in a week.* ● *When there are the incidents during works, contractor must compensate to victims.* ● *If there is worker complaint or the employers dislike any workers, the contractor or employer must inform legally to department in order to find the problem.* ● *Must follow the standard of work and technical stated in work condition regulation.* ● *Please choose the workers that are 18 years old or older.* ● *Please make a proper contract.* ● *Please prevent the protest because of working during public holiday or overtime.* ● *Contractor, please follow the law, when the construction start, must register the workers in Department of labor and vocational training. Must keep the contract (long term and short term) in the department for solving the problem later.* ● *Please don't discriminate the disables. If can, please provide them suitable job.* ● *Project owner should discuss with Ministry for the sub-division of area for project construction and plan for the future.* ● *All satellite cities must have the drainage and sewage treatment system.*	● *The JICA will endeavor to complete a project plan quickly and will be auctioned publicly and will open as soon as possible.* ● *The project plans to train Cambodian staff about the skill in maintain the project well.* ● *The Phnom Penh Capital City Administration has collaborated with JICA to make a master plan for sewage treatment projects throughout Phnom Penh. But there is a shortage of funds and will try to find the budge to build it.* ● *The government issued Sub-decree No 168 dated December 13, 2018 about the sub-division of Choeung Ek Lake about 19.0736 ha that will be used to build this project and extend it to the future.* ● *JICA has planned to construct a sewage drainage pipeline (well covered) into the treatment plant already.* ● *The Capital Hall and Khan Mean Chey try to prevent land encroachment into the land in sub-decree No 123, which are 520 ha.* ● *The Capital Hall and JICA comply with Cambodia's labor laws and other formalities.* ● *Administrative of PPCC and JICA must abide by Cambodian labor law, especially the regulations and labor standards of the Ministry of Labor and Vocational Training.* ● *Projects will not discriminate against persons with disabilities and will facilitate them a suitable job.* ● *The government issued Sub-decree No 168 dated December 13, 2018 about the sub-division of Choeung Ek Lake about 19.0736 ha that will be used to build this project and extend it to the future.* ● *The Phnom Penh Capital City Administration, in cooperate with the Ministry*

No	Stake holder	Comment on the project	*Suggestion*	Solution from the Project
		• The land in Choeung Ek and Boeung Trabek area haven't registered in the system yet. • This project doesn't give the serious impact and if the project get in the state's land, it also fine since the project is the state's project. • This project will help to raise city's reputation. • It is the proud for Cambodia that the JICA support both financial and advance technology. • For the water resource, there is no impact by the project and only get the benefit as long as the construction is safe and qualify. • Project locates in the area of 520 ha in the sub-degree No. 124 under MOWRAM. • Appreciate that the JICA's project in PP are all with quality. • When the sewage is treated match the standard, then it will improve the beauty of city and attract more tourists. • This project help promoting the region's potential indicators and other region will treat it as model, meaning that good areas need to have a clean city competition. • This project doesn't impact to city landscape. • This kind of project is the future goal, both financial and technical. • This project will reduce many impact on environment both health and ecology. • This project is really good and helps to create job for engineer, workers and people and reduce the migration. • This project's capacity is smaller than the wastewater from whole PP discharge into Choeung Ek Lake, thus concern that it will be unbalanced. However, it should be fine since this is a pilot project.	• *Flat, Borey must have small scale treatment system.* • *New city has the modern building but the drainage and sewage treatment system is not modern, thus, from this hour onward, if build the building, please include the sewage treatment system in order to improve the city landscape and reduce the impacts on environment.* • *Please expand this system in order to improve the welfare for citizen and ecosystem.* • *The government, relevant ministry and department this water and sanitation, please continue to work hard on this sector and find qualify partner to work with such as JICA.* • *Please, the project owner as well as JICA trains this skill to officer and student.* • *In whole PP should have better solid and liquid waste management that will improve the environment and tourism sector.* • *Please the project owner, after constructed the project, let the tourist and student to visit this treatment plant.* • *If the project impact to poor family, please compensate them properly to restore their livelihood.* • *In general, the area with 700 families must have 1 health center. Same to satellite city, should also have the health center.* • *If possible, project owner as well as government should develop more sewage treatment system in hospital because the hospitals in Cambodia don't this system yet.* • *During the construction of this sewage treatment system, please the project owner care about the workers' health.* • *Nurse should be available in the construction site for preparing the eventual incident.* • *Please build the bathroom separately for women and men.*	*of Environment, is working hard to clean up wastewater, especially in the management of sewage drainage and sewage treatment system, in the satellite city, factories where the excess liquid waste must build the treatment plant with ability to reduce water pollution.* • *The Phnom Penh Capital City Administration has cooperated with JICA to draft a master plan for sewage treatment projects throughout Phnom Penh. But there is a shortage of funds and will try to find budget to build it.* • *The project plans to train Cambodian about the skill of the project's maintenance.* • *The Phnom Penh Capital City Administration in collaboration with the Ministry of Environment is working hard to manage waste so that Phnom Penh is a beautiful city for tourism.* • *The Administrative of PPCC will open a student-study program that will be proposed* • *The project has a plan to address the impact on the people, which is the responsibility of the Cambodian government.* • *Government and the Capital Administration are working hard to build a health center for the people of Phnom Penh and also all over Cambodia.* • *The Phnom Penh Capital Administration has cooperated with JICA to draft a Master Plan for sewage Treatment Project in Phnom Penh. But there is a shortage of funds and will try to find budget to build it.* • *Phnom Penh Capital City administration and JICA have high regard for the safety of the principal as well as the temporary accommodation of the project staff as stated in*

No	Stake holder	Comment on the project	*Suggestion*	Solution from the Project
		• In PP, especially Khan Mean Chey, the waterborne disease and Lungs diseases cover 2% only, for Malaria is 0.001%. • Before, there are a lot of communicable diseases that occur in cycle (5 years cycle). • Royal government has the policy to supply the medical such as vitamin, vaccine and deworming twice per year (once in 6 months) and the disease rate drop down. • In general, infrastructure especially the drainage system is not enough yet which cause the illness and most illness are occur in the area with insufficient infrastructure. • Thanks to JICA that support to Cambodia both financial and technical to develop this project and this project is really important that can raise awareness of the water usage and wastewater treatment. • This project is good for agriculture because the output sewage will not impact to water usage in agriculture, can reduce the pollution of water and not harmful to farmers who contact with this water. • This project has no impact on fishery or fish, because there are no Fishing lots or conservation areas to preserve fish breeds in the area, only Climbing perch, Common Snakehead, Moon light gourami, Three spot gourami and so on. • This sewage treatment system is really good; it is studies directly by Japan and also contacts us many times already. • Water Supply Authorities use around 120-150 liters per person. In present day, water supply is 500,000m^3/day and in 2024, the supply will increase to 1,000,000m^3/day. • For this treatment plant, the water will be taken from clean water treatment plant Niroth which equipped with a 1,400 mm of size of water pipe under Boeung Trabek	• *Please provide the equity for women and men of the salary for the same work.* • *If the women worker have small children or pregnant, please give them right to off from work early to have time care of their health and children.* • *Please provide women the work.* • *Please take care of women and children.* • *Please prevent the impact on people such as noise, odor and dust.* • *Please provide temporary accommodation with good atmosphere.* • *Project owner should spread the information of this development project to citizens.* • *Please cooperate with local authorities to find the solution for the effecting on local people.* • *Please conduct the study clearly about the output sewage to avoid the flood around the project area.* • *The installation of transformer in Boeung Trabek pumping station is not match the standard of EDC that is difficult to maintain and repairs. Thus, the installation of the electrical appliances in this treatment plant shall be follow the standard of EDC and when install them please get the agreement from EDC.* • *When construction, JICA and project owner please discuss with EDC again to find the suitable electricity source for the project.* • *Project owner and JICA tell to contractor to use the sand from the legal investor and cooperate with local authorities to fine the location of sand.*	*Chapters 4, 4.12 and 4.13 above.* • *The JICA Study Team will install drug box and coordinate with a nearby hospital to a backup project when there is eventual accident occurs.* • *JICA Study Team will construct toilets and bathrooms for women and men separately, according to the number of people.* • *The project will respect equality of gender, such as equal payment or equal salary for the same work.* • *Projects respect women's rights and make it easier for women to take care of children.* • *The Administrative of PPCC and JICA have been paying great attention to minimizing environmental and social impacts in the development of this project.* • *Phnom Penh Capital City administration and JICA have high regard for the safety of the principal as well as the temporary accommodation of the project staff as stated in Chapters 4, 4.12 and 4.13 above.* • *Through the ESIA Team, the meeting to announce project information and consultations with all stakeholders has been done already.* • *The Ministry of Economy and Finance and the Phnom Penh Administration will solve the effecting on citizens legally.* • *The JICA has studied and designed to avoid flooding, or harming the people around the project. The project will have a positive impact on the surrounding environment.* • *JICA will work in collaboration with EDC for electrical work in compliance with Cambodia standards.* • *Construction contractors will be choose the legal one*

No	Stake holder	Comment on the project	*Suggestion*	Solution from the Project
		pumping station to Hun Neang road is about three kilometers away. ● 10% budget get from the sewage service in clean water receipts will be given to Administrative of PPCC. ● This project is really good because the Japanese partner studied and discuss with us, EDC, directly many times already. ● EDC can supply power to JICA's needs in medium or low voltage. ● JICA has two options. One, connect from the electricity network from Boeung Trabek pumping station that managed by City Hall. Two, connect from EDC's network nearby he project area. ● The project will pay for electricity use accordingly to the use. ● About mines in project area, the department does not have ability to know it availability unless the Ministry conducts the exploration research. ● For sand to fill in project area, mostly they took it from other resources from river and deliver to the project area. ● Wish that this project will be successes.		*and requiring them to have licenses or legal registrations*
3	Relevant Authorities (Khan, Sangkat, Village)	● 100% support from Khan Mean chey, both Sangkats, and 01 village: Because it is a requirement for development and also make people healthier, free from waterborne disease. ● The sewage Treatment Project is the proud of our Khan Mean Chey because this project is the first project for Phnom Penh, especially in Khan Mean Chey, however the impact must be fairly compensated as requested. ● An environmental improvement project that will make the region gain more economic potential in the future. ● In the project area, the local authority (Khan, sangkat) is not aware of the names of the	● *For this project, it should work with local authorities to resolve land-use activities for the people. But the impact on the people is only little.* ● *Project owners please find appropriate solutions for the people affected by the project.* ● *Please help address the impact if there is an impact on residents in Sangkat Chak Angre Krom.* ● *Please implement the project with quality and technical standards.* ● *Should build treatment plant with capacity to treat all wastewater because it affects Choeung Ek Lake.* ● *The project will reduce offensive odor.*	● *Project owner and JICA are cooperating with all levels of authorities and units in addressing the challenges in order to develop this project smoothly.* ● *The Ministry of Economy and Finance and the Phnom Penh Administration will address the impact of Cambodia's citizens legally.* ● *The project owner has technical advisers that JICA is recruiting for planning and supervising the construction of the project in accordance with Japanese technical standards.* ● *The Phnom Penh Capital Administration has cooperated with JICA to draft a Master Plan for sewage Treatment Project in Phnom Penh. But there is a*

No	Stake holder	Comment on the project	*Suggestion*	Solution from the Project
		landowners because they only buy and sell themselves. To the north of the construction site, we know that there is Oknha Louk Hour possessed the land there through the construction of concrete wall and plantation. ● This project will be able to reduce diseases caused by contaminated water for people there. ● Sewage is bad water that makes the crops that people plant in this area are of poor quality. When the project runs it will improve the water, leading to the quality of crop increase and customers will buy it more with higher price. ● This project will make people healthier, free from diseases caused by water, and the authorities will cooperate well to develop country like other countries. ● People in Khan Mean Chey support this project. ● The wastewater flowing into the Choeung Ek Lake today affects the health of the people living in this area and it is difficult to resist the odor.		*shortage of funds and will try to find budget to build it.*
4	Affected families (on crops) and People near the project area	● Affect crop have six household and interviewed the representative of the families' heads, 100% because it is a need for development, and hopefully there will be a sewage treatment system with modern technology, and reduce the pollution of the environment. ● Concern about this project won't compensate for affected people. ● This project is hoped to clean the lake better than before. ● The dirty water that flows into Choeung Ek Lake today affects the health of people living in Prek Takung 1 village because the children bathe it even the elder told not to. ● Hopefully, this project reduces diseases due to direct exposure to contaminated	● *Please solve the problem of affecting the crop for people.* ● *Please compensate directly to the affected people such as effected on crop, and so on* ● *Please monitor and maintain the project properly after constructed.*	● *The Ministry of Economy and Finance and the Phnom Penh Administration will address the impact of Cambodia's citizens legally.* ● *The project owner has technical advisers that JICA is recruiting for planning and supervising the construction of the project in accordance with Japanese technical standards.*

No	Stake holder	Comment on the project	*Suggestion*	Solution from the Project
		water because many people depend on aquatic crops. ● Hopefully, this project will help to improve water quality and increase the numbers of fishes in the lake and safe for eating. The fish that fished out from the lake are not really good. ● There are concerns that floods will affect the lives of people, animals, houses, and crops of the people near the project site.		

6.3 Policy Gap Analysis between the JICA Environmental Guidelines and Cambodia's Country System (Land Acquisition and Resettlement)

No	JICA Guideline/ WB OP 4.12	Cambodian Legislation	Gap	Measures Taken for the Project
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.	According to "Circular on the Resettlement Implementation Procedure for Development Projects, No. 006 MEF, 2016", possibility of avoidance of resettlement shall be studied in feasibility study.	No Gap	In accordance to JICA Guidelines and WB OP 4.12, project design shall be considered to avoid/ mitigate land acquisition and resettlement.
2	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	Above circular indicates to minimize impact; however actual procedures have not been developed. Concession of public land is indicated; however, it will not be sufficient due to limitation of area of land, usage, etc.	No significant gap, but actual procedures are unclear.	In accordance to JICA Guidelines and WB OP 4.12, project design shall be considered to avoid/ mitigate land acquisition and resettlement. If not avoided/ mitigated, assistance shall be provided to the PAPs to improve or restore their livelihood to at least pre-project level.
3	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	According to the Circular No. 2 Illegal Holding of State Land 2007, illegal state land holders are not entitled for compensation but may receive preferential treatment in obtaining appropriate size of land for making their livelihood based on their actual situation. However actual procedures have not been issued.	No significant gap, but actual procedures are unclear.	In accordance to JICA Guidelines and WB OP 4.12, assistance shall be provided to the PAPs to minimize impact and to improve or restore their livelihood to at least pre-project level.
4	Compensation must be based on the full replacement cost as much as possible.	Land Acquisition Law indicates to secure fair and appropriate compensation before resettlement in the article 2.	No actual estimation method for compensation to secure full replacement cost.	In accordance to JICA Guidelines and WB OP 4.12, full replacement cost shall be given as much as possible.
5	Compensation and other kinds of assistance must be provided prior to displacement.	According to the Law on Expropriation 2010, expropriation of the ownership of immovable property can be exercised only if the Expropriation Committee has paid fair and just compensation to the property's owner in advance.	No gap	In accordance to JICA Guidelines and WB OP 4.12, it is encouraged Cambodian side to give compensation and supports to the PAPs in advance.
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in	SOPs indicates procedure of information disclosure. While some items to be surveyed in the ARAP may not meet JICA requirements (e.g.full-scale census survey, calculation of replacement cost)	No significant gap, but actual procedures are unclear.	In accordance to JICA Guidelines and WB OP 4.12, it is encourage Cambodian side to open information public, and also JICA WEB site is used for public disclosure.

No	JICA Guideline/ WB OP 4.12	Cambodian Legislation	Gap	Measures Taken for the Project
	the World Bank Safeguard Policy, OP 4.12, Annex A.			
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people	It is indicated that IRC is responsible to organize a public forum with relevant organization to disclose project description, resettlement policy, etc. In addition, Land Acquisition Law issues to conduct public consultation.	No significant gap, but actual procedures are unclear.	In accordance to JICA Guidelines and WB OP 4.12, public consultation would be held. Special consideration with social profile, organizations of PAPs shall be given when invitees are selected.
8	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	Sub-Decree on Social Land Concessions, 2003 indicates that commune council shall lead to make a plan, and encourage public participation. While public participation is not legal requirement.	Public participation will be voluntary basis.	In accordance to JICA Guidelines and WB OP 4.12, public participation shall be encouraged.
9	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	Land Acquisition Law issues to establish Grievance Committee; however Actual procedure for grievance mechanisms has not been set.	No significant gap, but actual procedures are unclear.	In accordance to JICA Guidelines and WB OP 4.12, it is encouraged Cambodian site to establish accessible grievance mechanisms.

6.4 Monitoring Form
6.4.1 EIA

MONITORING FORM

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

Environmental Resource	Monitoring Item	Result	Baseline	Standard (MOE)	Standard (Japan)	Remarks
1. Project Before Construction Phase						
1.1 Socio-economy resource						
Land use and Resettlement	- The monitoring on compensation of resettlement and grievance redress			-	-	
2. Project Construction Phase						
2.1 Physical resource						
Soil erosion and slope failure	- Confirmation of license issued by Ministry of Mines and Energy and Ministry of Water Resources and Meteorology			-	-	
Topography and erosion	- The monitoring on the topography and the erosion at the infrastructure construction site - The monitoring of erosion at the road, protection dike's embankment and spoiled soil dumping site			-	-	
Hydrology	- Monitoring the obstruct of the flow of pumping wastewater			-	-	
Surface water quality	- Monitoring on the water quality on the parameters: temperature; pH; Turbidity, TDS; TSS; DO;			pH:6.5-8.5 TSS:1-15 DO:>2.0-7.0 COD:<8 TN:0.5-1.0 TP:0.005-0.05 Pb:<0.01	pH:6.5-8.5 TSS:<15 DO:>5 COD:<5 TN:<1 TP<0.1 Pb:<0.01 As:<0.01 Cd:<0.003	

Environmental Resource	Monitoring Item	Result	Baseline	Standard (MOE)	Standard (Japan)	Remarks
	BOD; COD; SO_4; TN; TP; Pb and Total Coliform - Monitoring on solid-liquid waste management			As:<0.01 Cd:<0.001 Hg:<0.0005 (mg/l) Total Coliform:< 1000 (MPN/100 ml)	Hg:<0.0005 (mg/l) Total Coliform:< 50 (MPN/100 ml)	
Soil quality	- Monitoring on solid-liquid waste management - Monitoring on the spill, leak of fuel on the soil.			As:<15 Cd:<0.8 Cr:<100(Cr 6) Pb:<85 Hg:<0.3 Se:<0.7 (mg/kg-dry)	As:<150 Cd:<150 Cr:<250(Cr 6) Pb:<150 Hg:<15 Se:<150 (mg/kg)	
Air Quality	- Monitoring the material transportation on road No. 271 - Monitoring the odor condition at construction sites - Monitoring on air quality parameters: TSP; CO; NO_2; SO_2, O_3, PM10, PM2.5 and H_2S			CO:20 NO2:0.1 SO2:0.3 O3:0.2 TSP:0.33 PM10:<0.05 PM2.5:<0.025 Pb:0.005 H2S:0.001 (mg/m3)	CO:20 NO2:0.04-0.06 SO2:0.1 O3:0.06 TSP:0.2 PM2.5:<0.035 (mg/m3)	
Noise and vibration	- Monitoring on the noise and vibration from the material transportation, the operation of any machinery, generator and vehicle. - Monitoring on noise and vibration (Unit: dB)			Day: 60 Evening: 50 Night: 45 (dB)	Day: 55 Night: 45 (dB)	
2.2 Biological resources						
Fish	- Monitoring on solid-liquid waste management - Monitoring on the water quality on the parameters temperature; pH; Turbidity, TDS; TSS; DO; BOD; COD; SO_4; TN; TP; Pb Total Coliform					
Birds	- Monitoring the crime on wildlife					

Environmental Resource	Monitoring Item	Result	Baseline	Standard (MOE)	Standard (Japan)	Remarks
	especially the aquatic birds					
2.3 Socio-economic resources						
Land use and Resettlement	- Monitoring on the livelihood of AHs loss their income 7 HHs. - Monitoring to ensure that no encroachment to the STP area.					
Livelihood, occupations of the local community and gender	- Monitoring on the staff-worker selection by prioritize the locals, gender equality as well as the disability - Monitoring on work safety					
Road	- Monitoring on the transportation (speed and load) - Monitoring on the parking - Monitoring on the repair the damaged road by the project					
Public Health and Safety	- Monitoring on solid-liquid waste management at temporary shelter - Monitoring the clean water supply and sanitation - Monitoring the safety equipment and work safety - Monitoring the first aid room					
3. Project Operation Phase						
3.1 Physical Resources						
Surface water quality	- Monitoring on the water quality on the parameters: temperature; pH; Turbidity, TDS; TSS; DO; BOD; COD; SO_4; TN; TP; Pb and Total Coliform			pH:6.5-8.5 TSS:1-15 DO:>2.0-7.0 COD:<8 TN:0.5-1.0 TP:0.005-0.05 Pb:<0.01 As:<0.01 Cd:<0.001 Hg:<0.0005 (mg/l) Total	pH:6.5-8.5 TSS:<15 DO:>5 COD:<5 TN:<1 TP<0.1 Pb:<0.01 As:<0.01 Cd:<0.003 Hg:<0.0005 (mg/l) Total Coliform:<50	

Environmental Resource	Monitoring Item	Result	Baseline	Standard (MOE)	Standard (Japan)	Remarks
	- Monitoring on solid-liquid waste management - Monitoring the filter system cleaning			Coliform:< 1000 (MPN/100 ml)	(MPN/100 ml)	
Air Quality	- Monitoring on solid-liquid waste management - Monitoring on air quality parameters: TSP; CO; NO_2; SO_2, O_3, PM10, PM2.5 and H2S - Monitoring on odor from waste storage and along the access road.			CO:20 NO2:0.1 SO2:0.3 O3:0.2 TSP:0.33 PM10:0.05 PM2.5:0.025 Pb:0.005 H2S:0.001 (mg/m3)	CO:20 NO2:0.04-0.06 SO2:0.1 O3:0.06 TSP:0.2 PM2.5:<0.035 (mg/m3)	
Noise and vibration	- Monitoring on the noise and vibration from the operation by measure its level at the locations same as air quality testing locations			Day: 60 Evening: 50 Night: 45 (dB)	Day: 55 Night: 45 (dB)	
3.2 Biological Resources						
Ecosystem	- Monitoring on the water quality on the parameters: temperature ; pH; Turbidity, TDS; TSS; DO; BOD; COD;SO_4 ; TN; TP; Pb and Total Coliform - Monitoring on solid-liquid waste management Note: Comparing the increasing of fish species near the project area. Before the project, study team caught only 6 species.					
3.3 Socio-economic Resources						
Land use and Resettlement	- Monitoring on the living standard of the people who get					

Environmental Resource	Monitoring Item	Result	Baseline	Standard (MOE)	Standard (Japan)	Remarks
	their aquatic crop by ensure that they will have a better living before the project exist.					
Road	- Monitoring the damage and repairing the road - Monitoring the safety on access road - Monitoring on the transportation, speed and traffic congestion - Monitoring the installation of the traffic sign along the access road.					
Public Health and Safety	- Monitoring the electricity system, emergency exit in and outside the building - Monitoring the oil and fuel storage - Monitoring on the management and operation of the safety equipment (Fire safety system, fire extinguisher, fire alarm, etc.)					

6.4.2 Land Acquisition / Involuntary Resettlement

Draft Monitoring Form (Land Acquisition / Involuntary Resettlement)

Name of person in charge and filling this monitoring form:

Date of filling this monitoring form:

A. Preparation of Resettlement Site (*If needed)

No.	Explanation of the site	Status	Details such as: (1) Site selection process and identification of candidate sites (2) Discussion record with PAPs (3) Development of the site including infrastructure (4) Main reasons for delay (if delayed) (5) Additional information (if any)	Complete Date or Expected Date of Completion
1	Location: Area: Number of Households:		(1) (2) (3) (4) (5)	
2	Location: Area: Number of Households:		(1) (2) (3) (4) (5)	
3	Location: Area: Number of Households:		(1) (2) (3) (4) (5)	

B. Public Consultations

No.	Date	Place	Contents of the consultation / main comments and answers
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

C. Resettlement Activities

Activities	**Planned Total**	**Unit**	**Progress in Quantity**			**Progress in %**		**Expected Date of Completion**	**Responsible Organizations**
			During the Quarter	**Till the Last Quarter**	**Up to the Quarter**	**Till the Last Quarter**	**Up to the Quarter**		
Preparation of resettlement									
Approval of BRP and submission to IRC									MPWT
Approval of BRP									MEF
BRP disclosure on JICA Website									JICA
Budget securing for resettlement activities									MEF, MPWT

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Loan Agreement / Exchange of Notes									GOC, JICA
Contract with Independent consultant for Replacement Cost Survey		MM							MEF, MPWT, IRC
Contract with Independent consultant for Income Restoration Program		MM							MEF, MPWT, IRC
Contract with External Monitoring Agency		MM							MEF, MPWT, IRC
Establishment of necessary organizations such as IRC-WG		Number of Organizations							MEF, MPWT, IRC
Income Restoration Program (IRP) preparation									Independent Consultant
Detailed Measurement Survey (DMS)		Number of PAPs							IRC
Finalization of PAPs List based on DMS		Number of PAPs							IRC
Submission of Replacement Cost Survey report									Independent Consultant
Calculation of compensation amount to be paid to PAPs									IRC
BRP Updating (DRP) and submit to JICA for Review and									IRC

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Concurrence									
Approval of DRP									IRC
Disclosure of Approval DRP at Commune Office									IRC, Commune Office
Submission of External monitoring report									External Monitoring Agency
Implementation of resettlement									
Negotiation		**Number of PAPs**							
Section 1 *** Elaborated later**		Number of PAPs							
Section 2		Number of PAPs							
Section 3		Number of PAPs							
Payment of compensation		**Number of PAPs**							
Section 1		Number of PAPs							
Section 2		Number of PAPs							
Section 3		Number of PAPs							
Provision of land plots		**Number of PAPs**							

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Section 1		Number of PAPs							
Section 2		Number of PAPs							
Section 3		Number of PAPs							
Provision of apartment in resettlement sites		**Number of PAPs**							
Section 1		Number of PAPs							
Section 2		Number of PAPs							
Section 3		Number of PAPs							
Provision of assistance for Vulnerable PAPs		**Number of PAPs**							
Section 1		Number of PAPs							
Section 2		Number of PAPs							
Section 3		Number of PAPs							
Provision of assistance for Business		**Number of affected businesses**							
Section 1		Number of affected businesses							

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Section 2 Section		Number of affected businesses							
Section 3		Number of affected businesses							
Site clearance		**Number of PAPs**							
Section 1		Number of PAPs							
Section 2		Number of PAPs							
Section 3		Number of PAPs							
Income Restoration Program (IRP) implementation		**Number of PAPs**							
Section 1		Number of PAPs							
Section 2		Number of PAPs							
Section 3		Number of PAPs							
Grievance Redress	-	**Number of cases**							
Section 1	-	Number of cases							
Section 2	-	Number of cases							

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Section 3	-	Number of cases							

D. Record of Grievances

No.	Date	Place	Status (Received/On Going/Solved)	Contents of Grievance	Response against Grievance	Responsible organization
1						
2						
3						
4						
5						
6						
7						
8						

END

6.5 Environmental Check List

Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
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/A (d) N	**(a)** EIA document is under preparation by the Project and the environmental permit is expected to be granted in October 2019. **(b), (c) & (d)** Ditto
	(2) Explanation to the Local Stakeholders	**(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) N	**(a)** Public consultation meetings were held from 5 Oct. 2018 to 25 Feb. 2019, explaining potential impacts. **(b)** The comments from stakeholders shall be reflected in the detailed design.
	(3) Examination of Alternatives	**(a)** Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	**(a)** The results of examination of alternatives are shown in the final report.
2 Pollution Control	(1) Water Quality	**(a)** Do pollutants, such as SS, BOD, COD, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards? **(b)** Does untreated water contain heavy metals?"	(a) N (b) Y	**(a)** Some parameters including heavy metals such as mercury exceed the country's effluent standards, but after the treatment it will be within the standard. **(b)** Heavy metal contamination is expected in untreated water but the concentration of the treated water will be within the standard.
	(2) Wastes	**(a)** Are wastes, such as sludge generated by the facility operations properly treated and disposed of in accordance with the country's standards?	(a) Y	**(a)** Sludge will be treated at the final damping sites.
	(3) Soil Contamination	**(a)** If wastes, such as sludge are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachates from the wastes?	(a) N	**(a)** Heavy metals in sludge will be dried at the site properly and damped at the final damping sites.
	(4) Noise and Vibration	**(a)** Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	(a) Y	**(a)** Potential noise sources above ground will be installed in RC structures. If further reduction is required, necessity of hood silencer and soundproof walls for sound insulation will be considered.
	(5) Odor	**(a)** Are adequate control measures taken for odor sources, such as sludge treatment facilities?	(a) Y	**(a)** Odor reduction facilities will be designed because the site is next to a residential area.
3 Natural Environment	(1) Protected Areas	**(a)** Is the project site 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 in or near the Project site.
	(2) Ecosystem	**(a)** Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N (b) N (c) N (d) N	**(a)** No protected area or valuable habitats exist in or near the site. **(b) &(c)** According to the EIA survey, some endangered species were listed in zone B

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(b) Does the project site 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 project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?		where relatively far (about 3 km) from the project site. Considering the site environment (e.g. DO is 0.3 mg/l), the endangered species are not inhabit in and around the project site, therefore negative impact to the species by the project is negligible. Furthermore, the environment around the project site will be slightly improved by the project, thus positive impacts will be expected to ecosystem in and around the project site. **(d)** The objective of the Project is to improve water environment. Although most of the project site will be reclaimed, but as the area of the project is small and present aquatic environments are poor, negative impact is not significant.
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 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/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) Y	**(a), (b), (c), (d), (e), (f), (g), (h) & (i)** Involuntary resettlement is not expected in the Project. **(J)** The MEF will facilitate the establishment of a Municipal Grievance Redress Committee (MGRC) which will be responsible for addressing grievances for the project. The MGRC will be established by the Municipal Governor in consultation with the IRC. Any grievances of AHs in connection with the implementation of the BRP will be handled through negotiation with the aim of achieving consensus. Complaints will go through three stages before they may be elevated to a court of law as a last resort. GDR/IRC will shoulder all administrative and legal fees that will be incurred in the resolution of grievances and complaints. The handling of the complaint ends in the MGRC.
	(2) Living and Livelihood	**(a)** Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants? **(b)** 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?	(a) N (b) N/A	**(a)** The Project will contribute to improvement hygiene and public health. **(b)** Adverse impacts to inhabitants' livings are not expected in the Project. Although their agriculture land will be moved, but adequate compensation and relocation/purchase of the land will be implemented.
	(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	**(a)** No cultural heritage exists in or near the Project area.
	(4) Landscape	**(a)** Is there a possibility that the project	(a) N	**(a)** Project component will not affect the

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		will adversely affect the local landscape? Are necessary measures taken?		landscape significantly.
	(5) Ethnic Minorities and Indigenous Peoples	**(a)** Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a) N/A (b) N/A	**(a) & (b)** No ethnic minorities or indigenous peoples live in or near the Project site.
	(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) Y (b) Y (c) Y (d) Y	**(a), (b), (c) & (d)** Safety aspects will be fully considered in the detailed design. Additionally, education programs will be carried out by the contractor to improve the workers' awareness of safety and health conditions.
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) Y (b) N (c) N (d) Y	**(a)** They are mentioned in the final report. **(b) & (c)** The Project will not cause significant adverse impact on natural and social environments. Adequate measures are described in the final report. **(d)** So far serious impact is not predicted with construction. Information on the construction activities would be disclosed to public through mass-media on a timely basis. Additionally, public consultation with the residents would be held.
	(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) Y (b) - (c) Y (d)Y	**(a), (b), (c) & (d)** Preliminary monitoring system has been established and are written in the final report based on JICA Supplemental Study. It will be developed during detail design stage referring comments of MOE.
6 Note	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) N/A	**(a)** The impacts to transboundary such as waste is not expected. The project makes positive impact to global warming

6.6 Water Quality Standards related to the Project

(1) Water Quality and Effluent Standard

The Sub-Decree on Water Pollution Control, 1999 was enacted on 6th April 1999, aiming to prevent water pollution in Cambodia. This sub-decree defines "Classification of waste and hazard discharge", "Water Quality Standard", "Effluent Standard", "Responsibility of polluter", "Monitoring", "Discharge Permit", "Inspection" and "Penalty", etc.

Water quality standard in public water areas such as river, lakes, reservoirs and coastal water is set for bio-diversity conservation (**Table 1**). In addition, twenty-five parameters are set as water quality standard in public water areas for public health protection (**Table 2**).

Table 1 Water Quality Standard for Bio-Diversity Conservation

	No	Parameter	Unit	Standard Value
1. River	1	pH	-	6.5 – 8.5
	2	BOD_5	mg/l	1 – 10
	3	Suspended Solid	mg/l	2.4 – 100
	4	Dissolved Oxygen	mg/l	2.0 – 7.5
	5	Coliform	MPN/100ml	< 5,000
2. Lakes and Reservoirs	1	pH	-	6.5 – 8.5
	2	COD_{Mn}	mg/l	1 – 8
	3	Suspended Solid	mg/l	1 – 15
	4	Dissolved Oxygen	mg/l	2.0 – 7.5
	5	Coliform	MPN/100ml	< 1,000
	6	Total Nitrogen	mg/l	1.0 – 0.6
	7	Total Phosphorus	mg/l	0.005 – 0.05
3. Coastal Water	1	pH	-	7.0 – 8.3
	2	COD_{Mn}	mg/l	2 – 8
	3	Suspended Solid	mg/l	2 – 7.5
	4	Coliform	MPN/100ml	< 1,000
	5	Oil Content	mg/l	0
	6	Total Nitrogen	mg/l	0.2 – 1.0
	7	Total Phosphorus	mg/l	0.02 – 0.09

* Some parameters have 'lower limit' and 'upper limit'. As the result of inquiry to MOE about 'lower limit', setting up of the 'lower limit' (excluding pH) is not correct and those should be revised but the schedule of the revision is not fixed.

Source: Sub-Decree on Water Pollution Control, Annex 4: Water Quality Standard in public water areas for bio-diversity conservation.

Table 2 Water Quality Standard for Public Health Protection

No.	Parameter	Standard Value (μg/l)
1	Carbon tetrachloride	< 12
2	Hexachloro-benzene	< 0.03
3	DDT	< 10
4	Endrin	< 0.01
5	Diedrin	< 0.01
6	Aldrin	< 0.005
7	Isodrin	< 0.005
8	Perchloroethylene	< 10
9	Hexachlorobutadiene	< 0.1
10	Chloroform	< 12
11	1,2 Trichloroethylene	< 10
12	Trichloroethylene	< 10
13	Trichlorobenzene	< 0.4

No.	Parameter	Standard Value (µg/l)
14	Hexachloroethylene	< 0.05
15	Benzene	< 10
16	Tetrachloroethylene	< 10
17	Cadmium	< 1
18	Total mercury	< 0.5
19	Organic mercury	0
20	Lead	< 10
21	Chromium, valent 6	< 50
22	Arsenic	< 10
23	Selenium	< 10
24	Polychlorobiohenyl	0
25	Cyanide	< 0.005

Source: Sub-decree on Water Pollution Control, Annex 5: Water Quality Standard in public water areas for public health protection.

"Effluent standard for pollution sources discharging wastewater to public water areas or sewer" is defined in this sub-decree (**Table 3**). "Protected public water area" is set in this standard. All effluent including industries in PPCC should comply with the standard for "Public water area and sewer" since the protected area is currently not yet specified.

Table 3 Effluent Standard for Public Water Areas or Sewer

No	Parameter	Unit	Standard	
			Protected Public Water Area	Public Water Area and Sewer
1	Temperature	^{0}C	< 45	< 45
2	pH		6 – 9	5 – 9
3	BOD_5 (5 days at 20℃)	mg/l	< 30	< 80
4	COD_{Cr}	mg/l	< 50	< 100
5	Total Suspended Solids	mg/l	< 60	< 120
6	Total Dissolved Solids	mg/l	< 1,000	< 2,000
7	Grease and Oil	mg/l	< 5.0	< 15
8	Detergents	mg/l	< 5.0	< 15
9	Phenols	mg/l	< 0.1	< 1.2
10	Nitrate (NO_3)	mg/l	< 10	< 20
11	Chlorine (free)	mg/l	< 1.0	< 2.0
12	Chloride (ion)	mg/l	< 500	< 700
13	Sulphate (as SO_4)	mg/l	< 300	< 500
14	Sulphate (as Sulphur)	mg/l	< 0.2	< 1.0
15	Phosphate (PO_4)	mg/l	< 3.0	< 6.0
16	Cyanide (CN)	mg/l	< 0.2	< 1.5
17	Barium (Ba)	mg/l	< 4.0	< 7.0
18	Arsenic (As)	mg/l	< 0.10	< 1.0
19	Tin (Sn)	mg/l	< 2.0	< 8.0
20	Iron (Fe)	mg/l	< 1.0	< 20
21	Boron (B)	mg/l	< 1.0	< 5.0
22	Manganese (Mn)	mg/l	< 1.0	< 5.0
23	Cadmium (Cd)	mg/l	< 0.1	< 0.5
24	Chromium (Cr^{+3})	mg/l	< 0.2	< 1.0
25	Chromium (Cr^{+6})	mg/l	< 0.05	< 0.5
26	Copper (Cu)	mg/l	< 0.2	< 1.0
27	Lead (Pb)	mg/l	< 0.1	< 1.0
28	Mercury (Hg)	mg/l	< 0.002	< 0.05
29	Nickel (Ni)	mg/l	< 0.2	< 1.0
30	Selenium (Se)	mg/l	< 0.05	< 0.5
31	Silver (Ag)	mg/l	< 0.1	< 0.5
32	Zinc (Zn)	mg/l	< 1.0	< 3.0
33	Molybdenum (Mo)	mg/l	< 0.1	< 1.0
34	Ammonia (NH_3)	mg/l	< 5.0	< 7.0
35	DO	mg/l	>2.0	>1.0

No	Parameter	Unit	Standard	
			Protected Public Water Area	Public Water Area and Sewer
36	Polychlorinated Byphenyl	mg/l	<0.003	<0.003
37	Calcium	mg/l	<150	<200
38	Magnesium	mg/l	<150	<200
39	Carbon tetrachloride	mg/l	<3	<3
40	Hexachloro benzene	mg/l	<2	<2
41	DTT (Dithiothreitol)	mg/l	<1.3	<1.3
42	Endrin	mg/l	<0.01	<0.01
43	Dieldrin	mg/l	<0.01	<0.01
44	Aldrin	mg/l	<0.01	<0.01
45	Isodrin	mg/l	<0.01	<0.01
46	Perchloro ethylene	mg/l	<2.4	<2.4
47	Hexachloro butadiene	mg/l	<3	<3
48	Chloroform	mg/l	<1	<1
49	1,2 Dichloro ethylene	mg/l	<2.4	<2.4
50	Trichloro ethylene	mg/l	<1	<1
51	Trichloro benzene	mg/l	<2	<2
52	Hexaxhloro cyclohexene	mg/l	<2	<2

Note: "Protected public water area" is set in this standard. All effluents including those of industries should be subject to the standard of "Public water area and sewer" since the protected area is not yet currently specified.
Source: Sub-Decree on Water Pollution Control, Annex 2: Effluent standard for pollution sources discharging wastewater to public water areas or sewer

1.1.2 Sub-decree on the Management of Drainage and Wastewater Treatment System

This sub-decree is updated one related to management of drainage and wastewater treatment system, which was issued on 25th November 2017. This sub-decree stipulates 1) demarcation of responsibility of related ministries (MPWT, MOE and MOI) as well as local governments such as capital and provincial administrations, 2) measures for the management of wastewater, drainage and wastewater treatment system, 3) duties of related authorities for managing and providing services for sewerage and wastewater treatment system, 4) Monitoring and inspection and 5) penalties. In this sub-decree, effluent discharge standards for commercial building, private residential development area and resort or recreation centers are provided as shown in **Table 4**.

Table 4 Effluent Discharge Standard from Commercial Building, Borey, Satellite City and Resort or Recreation Center

No.	Parameter	Unit	Permissible Standard	
			Discharged to the Drainage/Sewerage System connected to Centralized Wastewater Treatment Plant	Discharges Directly to the Public Waterbody or Drainage/Sewerage System
1	pH	-	5-9	6-8
2	Total Suspended Solids (TSS)	mg/l	< 150	< 80
3	Oil or Grease	Mg/l	< 20	< 5
4	BOD_5 (5 days at 20℃)	mg/l	< 80	< 30
5	COD_{Cr}	mg/l	< 120	< 50
6	Detergents- LAS	mg/l	< 15	< 7
7	Total Nitrogen (T-N)	mg/l	< 10	< 6
8	Total Phosphorus (T-P)	mg/l	< 1	< 0.5
9	Ammonium Nitrogen (NH_4^+-N)	mg/l	< 8	< 5
10	Coliform		-	500-2,500

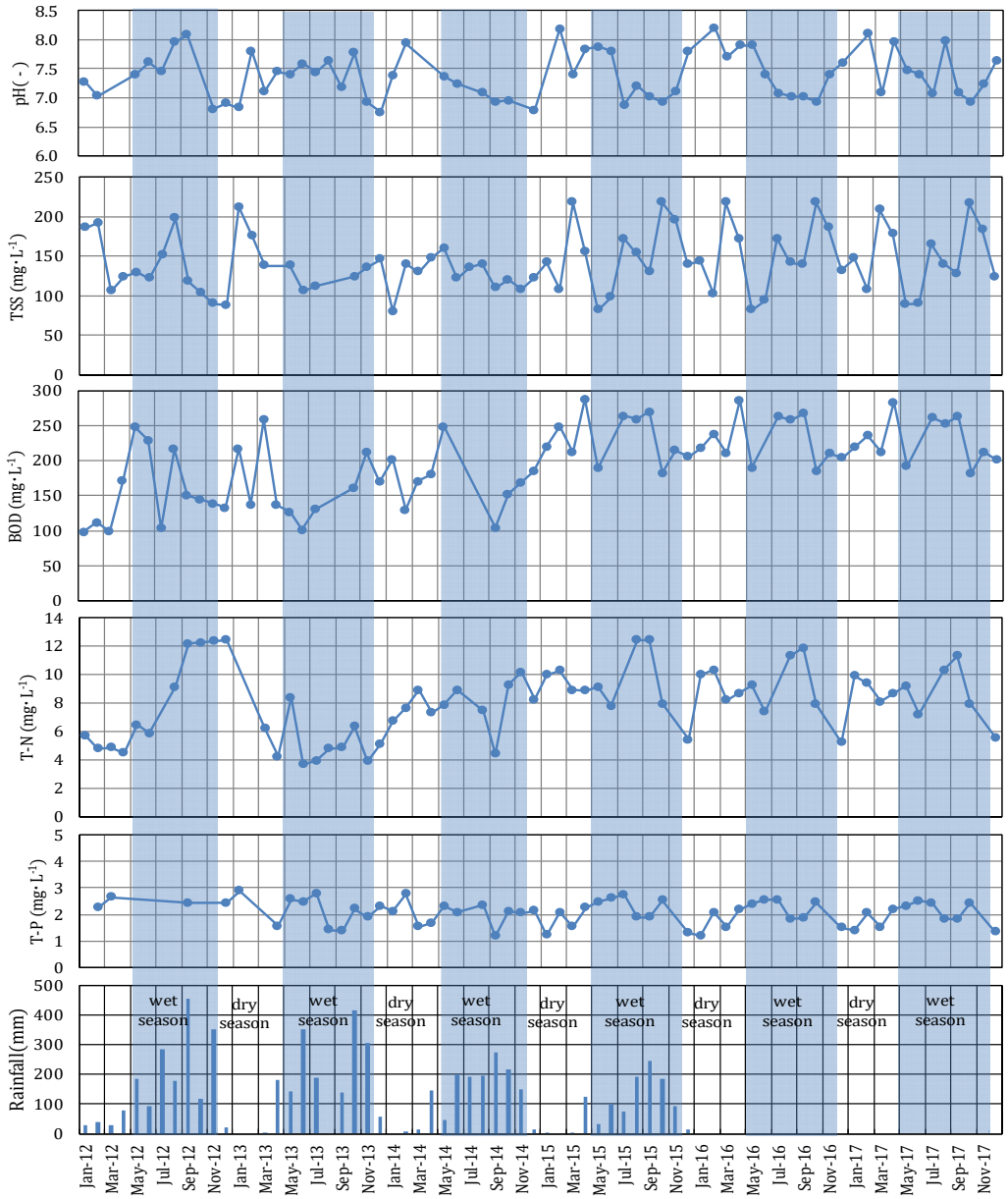
Source: Sub-decree on the Management of Drainage and Wastewater Treatment System (Table of Annex 1 and Annex 2)

6.7 Discussion on Water Quality

1. Influent Condition

1.1 Wastewater Analysis Result by MOE

MOE has been implementing analysis work of wastewater sampled around the Trabek pumping station from January 2012 to December 2017. The analysis results might be applicable for the STP design because the sampling point is close to the planned intake point. Since the data was widely fluctuated regardless season but reason of fluctuation was unclear, the data was statistically examined applying Smirnov-Grubbs test in order to be minimized error. **Figure 1-1** shows the wastewater analysis data after carried out the statistical test, **Table 1-1** shows that the summarized figures.



Source: Survey Team, based on data provided by MOE

Figure 1-1 Change of Wastewater Quality around Trabek Pumping Station (After Smirnov-Grubbs Test)

Table 1-1 Analysis Data Summary (After Smirnov-Grubbs Test)

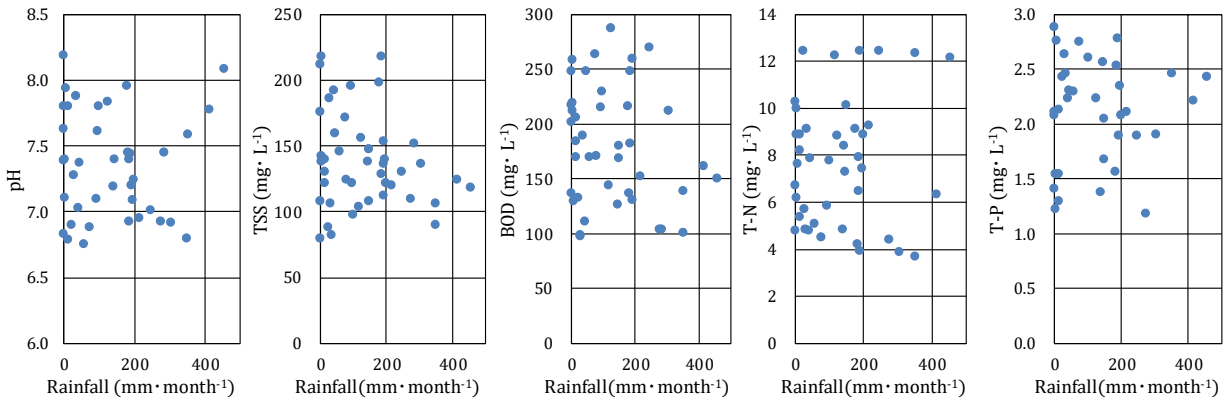
	pH (-)	TSS (mg/L)	BOD (mg/L)	T-N (mg/L)	T-P (mg/L)
Average	7.39	142	197	8.1	2.1
Median	7.40	138	205	8.2	2.1
Maximum	8.20	218	288	12.4	2.9
Minimum	6.75	80	98	3.7	1.2
Standard Deviation	0.41	38.4	53	2.5	0.5

Source: Survey Team, based on data provided by MOE

Simple average of pH, Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), Total Nitrogen (T-N), and Total Phosphorus (T-P) in wastewater sampled during said period are 7.39, 142, 197 8.1, and 2.1 respectively.

1.2 Difference between Wet Season and Dry Season

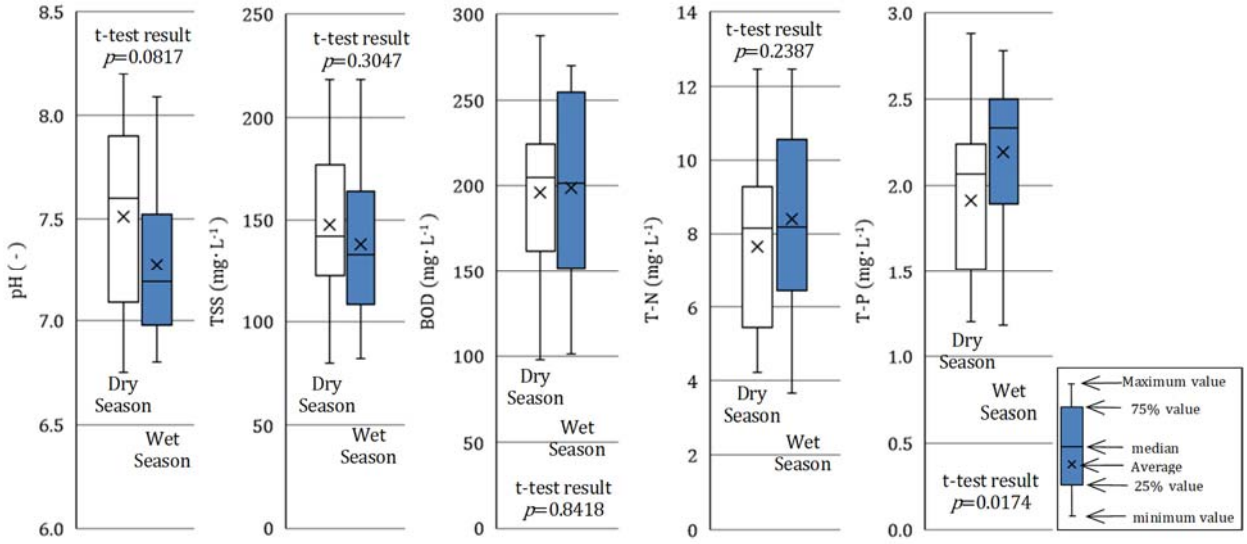
Climate in Cambodia is classified into 2 seasons, namely dry season which generally runs from December to April, and wet season from May to November. Since wastewater treated by the project comes with rainwater, amount of rainfall may directly affect the wastewater quality. **Figure 1-1** also shows rainfall data from year 2012 to 2015 and classifies seasons by color. **Figure 1-2** shows relationship between amount of monthly rainfall and wastewater quality, correlation however among them is not clearly confirmed.



Source: Survey Team

Figure 1-2 Relationship between Rainfall and Wastewater Quality

Thus, comparison by statistical approach was tried, in order to confirm whether differences between dry and wet season are found or not. **Figure 1-3** shows box plot of indicators comparing between dry and wet season using data collected in year 2012 to 2017. Dry season is set from December to April and remaining is wet season. The result of each *p-value* obtained by *t-test* is also shown in the Figure. In general, in case p-value>0.05, the average on each data is presumed not different, based on this understanding, it is concluded that only T-P differs among the season. One of the reasons may be that the sampling has not been carried out during raining, and the influence of rainwater becomes small at timing of sampling after stop raining, because rainwater runs faster.



Source: Survey Team

Figure 1-3 Comparison between Dry and Wet Season

1.3 Wastewater Analysis Result by this Survey

In order to confirm the accuracy of data provided by MOE, wastewater sampling was carried out on 22nd August 2018 at Trabek Pumping station. At upstream and downstream of the pumping station, 4 samples were collected when the pumps were being operated. **Figure 1-4** shows the location of Sampling points, and **Table 1-2** shows the analysis result. T-BOD was fluctuated between 115 and 180 mg/L and average was 149 mg/L. Average of TSS was 54.5 mg/L, considerably smaller than the data provided by MOE. T-N and T-P in average were 30.3 mg/L and 1.38 mg/L respectively.

Source: Google Earth Pro®

Figure 1-4 Sampling Points

Photo 1-1 Sampling Work at Trabek pumping Station

Table 1-2 Summary of Wastewater Analysis Result

Sampling No	W1 Upstream-1	W1 Downstream-1	W1 Upstream-2	W1 Downstream-2	Average
Sampling Time	10:30am	10:30am	14:00pm	14:00pm	(min-max)
pH	6.95	7.18	7.09	7.26	7.12 (6.95-7.26)
T-BOD (mg/L)	115	180	155	145	149 (115-180)
S-BOD (mg/L)	63.0	61.0	65.0	59.0	62.0 (59.0-65.0)
TSS (mg/L)	62.0	42.0	46.0	68.0	54.5 (42.0-68.0)
T-N (mg/L)	29.4	32.2	30.1	29.5	30.3 (29.4-32.2)
NH^{4+}-N (mg/L)	11.2	14.0	12.6	11.8	12.4 (11.2-14.0)
T-P (mg/L)	1.43	1.34	1.35	1.40	1.38 (1.34-1.43)

Sampling date: 22nd August 2018
Source: Survey Team

1.4 Wastewater Quality set for STP Design

BOD in wastewater in the Master Plan (M/P) is set at 195mg/l which is calculated from loading rate of each segment (domestic/commercial and industrials), and TSS is calculated by BOD X 105%. Since the average of BOD shown in **Table 1-1** is very close to the figure in M/P, 195mg/l is applicable. TSS in **Table 1-1** is smaller than the M/P's figure but higher figure namely 205mg/l should be adopted from a conservative point of view for plant design. Value of pH is set at 7.5. **Table 1-3** summarizes the set wastewater quality for STP design. Since the planned STP is adopted PTF system which does not fundamentally remove nitrogen and phosphorus, T-N and T-P in final discharge is not be regulated. Thus, these figures are not set in wastewater as well.

Table 1-3 Wastewater Quality set for STP design

	pH (-)	TSS (mg/L)	BOD (mg/L)
Adopted Value for STP Design	7.5	205	195

Source: Survey Team

2. Limitation of Nitrogen and Phosphorus removal by PTF

A guideline[1] for introducing PTF describes that PTF is applicable for STP with final discharge standard of BOD is exceeding 10 mg/l and not more than 15 mg/l, not applicable with standalone to any advanced treatment facility to remove nitrogen and phosphorus. On the other hand, a result of PTF pilot plant test[2] performed in Da Nang city in Vietnam shows that some of nitrogen and phosphorus were removed. **Table 2-1** shows average on pilot plant test result. The report has not shown organic nitrogen (Org-N) but it is calculated by total nitrogen (T-N) minus nitrate (NO_3^--N) and minus nitrite (NO_2^--N).

Table 2-1 Average of Water Quality Analysis Result on each Process

	BOD ($mg \cdot L^{-1}$)	SS ($mg \cdot L^{-1}$)	T-N ($mg \cdot L^{-1}$)	*Org-N* *2 ($mg \cdot L^{-1}$)	*NH_4^+-N* ($mg \cdot L^{-1}$)	*NO_2^--N* ($mg \cdot L^{-1}$)	*NO_3^--N* ($mg \cdot L^{-1}$)	T-P ($mg \cdot L^{-1}$)
Influent	65.8	101.6	19.4	*6.6*	*12.4*	*0.1*	*0.3*	4.4
FSF Effluent	51.8	46.8	16.3	*4.7*	*11.2*	*0.1*	*0.3*	-
HTF Effluent	16.2	28	8.9	*2.5*	*2.6*	*0.1*	*3.7*	-
SLS Effluent *1	7.3	7	8.2	*1.6*	*2.1*	*1.1*	*3.4*	0.7
Removal Efficiency	88.9%	93.1%	57.7%					84.1%

*1 with filter

*2 Org-N caluculated by (T-N) - [(NH_4^+-N)+(NO_2^--N)+(NO_3^--N)]

Source: Japan Sewage Works Agency, Technology Verification Report Advanced Energy Saving Wastewater Treatment Process (March 2014).

Average of T-N in wastewater was 19.4 mg/L, final discharge, namely effluent from SLS was 8.2 mg/L, total removal efficiency was obtained at 57.7%. In case of phosphorus, total removal efficiency was achieved at 84.1% calculated by 4.4 mg/L, in wastewater and 0.7 mg/L, in final discharge.

In this project, Nitrogen and Phosphorus in wastewater are not set because of no regulation. Average of actual analysis result of T-N and T-P sampled near intake point show in **Table 1-1**, and **Table 1-2** but these figures are considerably higher than the case of Da Nang.

In addition, the planed STP for Phnom Penh will equip sludge digestion process in order to minimize amount of sludge disposal and GHG emission. By biodegradation in anaerobic digestion process, organic matter decomposes into low molecules, nitrogen and phosphorus in organic matter are transferred to ammonia (NH_4^+-N) and phosphate (PO_4^{3-}-P) and dissolved into supernatant. The supernatant is returned to wastewater treatment system to treat again. Therefore, it is said that anaerobic digestion process affects to wastewater treatment process, concentration of nitrogen (T-N) and phosphorus (T-P) in the final discharge may be higher.

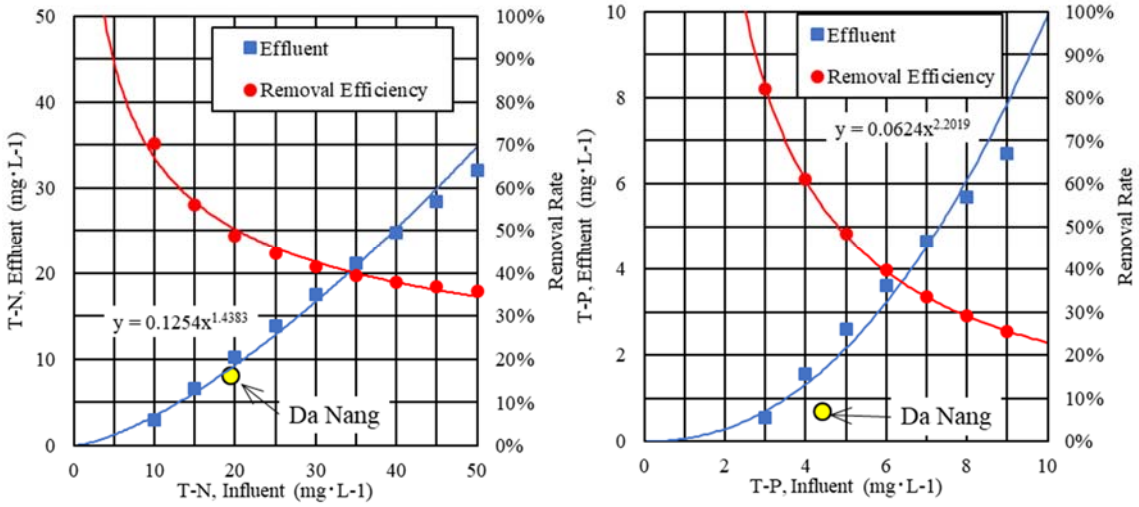
Considering these points, JICA Study team made a simulation to clarify how much T-N and T-P could be reduced. **Figure 2-1** shows the simulation result, relationship between influent and effluent concentration

[1] National Institute for Land and Infrastructure Management, MLITT Japan, B-DASH project No.12 Guideline for introducing a Technology for Advanced Pre-Treatment Trickling Filter System, ISSN1346-7238, No.951 (February 2017).

[2] Japan Sewage Works Agency, Technology Verification Report Advanced Energy Saving Wastewater Treatment Process (March 2014).

of T-N and T-P, as well as removal efficiency.

The removal efficiency of T-N and T-P is depending on influent concentration, decreasing when influent concentration becomes high. For instance, when T-N in influent is 20 mg/L, effluent is expected at 9.8 mg/L, removal efficiency is 49%, should T-N in influent be 40 mg/L, effluent is 25 mg/L, removal efficiency is 38%. Comparing with the result of Da Nang at 19.4 mg/L of influent T-N, difference of effluent among them is approximately 0.8 mg/L higher than Da Nang. Also Difference at 4.4 mg/L of T-P influent is approximately 1.0 mg/L higher. These differences come from sludge digestion.



Source: Survey Team

Figure 2-1 Expected T-N and T-P in Final Discharge and Removal Efficiency

3. Estimation of Effluent T-N and T-P for STP proposed in the Project

Based on the simulation discussed in the previous chapter, possible effluent T-N and T-P applying proposed process is estimated as summarized in the following table

Table 3-1 Estimation of Effluent T-N and T-P for STP proposed in the Project

	Influent	Estimated Effluent	Removal Efficiency	Remarks
	(mg/L)	(mg/L)	(%)	
T-N, Case 1	8.1[1)]	2.5	69	1) average of MOE' data (see Table 1-1)
T-N, Case 2	30.3[2)]	16.9	44	2) average of water monitoring result at W-1 (see Table 1-2)
T-P, Case-1	2.1[3)]	0.3	86	3) average of MOE' data (see Table 1-1)
T-P, Case-2	1.38[4)]	0.13	91	4) average of water monitoring result at W-1 (see Table 1-2)

Source: Survey Team

6.8 Alternative Study on Sludge Treatment Method (Detailed Calculation)

1. CAPEX

Table 1.1 shows estimate of CAPEX (direct cost) of each case. *Case 2* is the most expensive than others.

Table 1.1 Estimate Result of CAPEX of Sludge Treatment System

Case	Case 1	Case 2	Case 3	Case 4
Treatment System	Sludge Dewatering by Mechanical Dehydrator	Sludge Digestion + Dewatering by Mechanical Dehydrator	Sludge Drying by Drying Bed	Sludge Digestion + Drying by Drying Bed
Civil and Structural	USD31,900.00	USD52,200.00	USD397,800.00	USD219,300.00
Mechanical and Piping	USD479,300.00	USD622,700.00	USD75,100.00	USD252,700.00
Electrical and Instrumentation	USD3,100.00	USD17,100.00	USD1,700.00	USD15,600.00
Others	USD10,400.00	USD11,300.00	USD1,100.00	USD2,000.00
Total	USD524,700.00	USD703,300.00	USD475,700.00	USD489,600.00

Source: Survey Team

2. OPEX

Table 1.2 shows estimate of OPEX of each case. It includes personnel cost, sludge transportation cost and maintenance cost of sludge treatment facility, but not include sludge disposal cost. Maintenance cost of civil & structural, mechanical & piping and electrical & instrumental are estimated at 1%, 3% and 2% of each CAPEX respectively. *Case 1* and *2* are extremely expensive than *Case 3* and *4*, due to polymer consumption for dewatering, also highly skilled technician for operation of mechanical dehydrator is required.

Table 1.2 OPEX of Sludge Treatment System

Case			Case 1		Case 2		Case 3		Case 4		Remark
		Unit Cost (USD)	Sludge Dewatering by Mechanical Dehydrator		Sludge Digestion + Dewatering by Mechanical Dehydrator		Sludge Drying by Drying Bed		Sludge Digestion + Drying by Drying Bed		
			Amount	Cost (USD/year)	Amount	Cost (USD/year)	Amount	Cost (USD/year)	Amount	Cost (USD/year)	
Electricity		0.15USD/kWh	24,700kWh/year	3,705.00	54,200kWh/year	8,130.00	4,000kWh/year	600.00	39,500kWh/year	5,925.00	
Chemicals	Polymer	4.00USD/kg	6,643kg/year	26,572.00	3,541kg/year	14,164.00	0kg/year	0.00	0kg/year	0.00	
Personnel	Technician Class	3,600USD/year	2person	7,200.00	2.5person	9,000.00	0.5person	1,800.00	1person	3,600.00	
	Labor Class	1,800USD/year	1person	1,800.00	1person	1,800.00	6person	10,800.00	3person	5,400.00	
	Truck Driver	1,800USD/year	2person	3,600.00	1person	1,800.00	1person	1,800.00	0.5person	900.00	
Vehicle Fuel for Sludge Transportation		1.00USD/L	7,384L/year	7,384.00	2,347L/year	2,347.00	2,464L/year	2,464.00	1,174L/year	1,174.00	3tons/times, Distance:20km(round trip), Fuel Consumption:2km/L
Sludge Disposal		0USD/kg	2,215tons/year	0.00	704tons/year	0.00	739tons/year	0.00	352tons/year	0.00	No charge for sludge disposal
Mentenance	Civil & Structural	1% of CAPEX		320.00		530.00		3,980.00		2,190.00	
	Mechanical & Piping	3% of CAPEX		14,380.00		18,690.00		2,260.00		7,580.00	
	Electrical and Instrumental	2% of CAPEX		70.00		350.00		40.00		310.00	
Total				65,031.00		56,811.00		23,744.00		27,079.00	

Source: Survey Team

3. Comparison of Greenhouse Gases (GHGs) Emission

Nitrous Oxide (N_2O). Also, biodegradable matter in sludge decomposes and generates CH_4 at the final disposal site. The total amount of GHGs generated through sludge treatment and disposal is calculated by following formula;

$$\boldsymbol{GHGs_{Total} = GHGs_{Electricity} + GHGs_{Fuel} + GHGs_{Disposal}} \quad (1)$$

Where,

$GHGs_{Total}$: Greenhouse Gases Emission in Total (kg-CO_{2Eq}/year)

$GHGs_{Electricity}$: Greenhouse Gases Emission caused by electricity consumption (kg-CO_{2Eq}/year)

$GHGs_{Fuel}$: Greenhouse Gases Emission caused by vehicle fuel consumption (kg-CO_{2Eq}/year)

$GHGs_{Disposal}$: Greenhouse Gases Emission caused by sludge disposal (kg-CO_{2Eq}/year)

3.1 GHGs Emission caused by Electricity Consumption

GHGs generated by electricity consumed is calculated by following formula;

$$\boldsymbol{GHGs_{Electricity} = EF_{Grid} \cdot EC_{Grid}} \quad (2)$$

Where,

EF_{Grid} : Emission Factor by electricity consumption (625.7 kg-CO_{2Eq}/MWh*)

*Source)https://www.env.go.jp/earth/coop/lowcarbon-asia/localgov2/data/FY2013_FS16_JP_V1.pdf

EC_{Grid} : Electricity Consumption (MWh/year)

Table 3.1 shows GHGs emission by electricity consumed. GHGs emission is proportional with electricity consumption, sludge treatment system having digestion system generates much GHGs due to power consumption for agitation in the digester.

Table 3.1 GHGs Emission by Electricity Consumed

Treatment System	EF_{Grid}	EC_{Grid}	$GHGs_{Electricity}$
Sludge Dewatering by Mechanical Dehydrator	625.7 kg-CO_{2Eq}/MWh	24.7MWh/year	15,455 kg-CO_{2Eq}/year
Sludge Digestion + Dewatering by Mechanical Dehydrator		54.2MWh/year	33,913 kg-CO_{2Eq}/year
Sludge Drying by Drying Bed		4.0MWh/year	2,503 kg-CO_{2Eq}/year
Sludge Digestion + Drying by Drying Bed		39.5MWh/year	24,715 kg-CO_{2Eq}/year

Source: Survey Team

3.2 GHG Emission caused by Vehicle Fuel Consumption for Sludge Disposal

By consuming vehicle fuel, not only CO_2, but also CH_4 and N_2O are generated. Since the conversion factor of CH_4 and N_2O into CO_2 are 25 and 298 respectively, GHGs generated by vehicle fuel consumed is calculated by following formula;

$$GHGs_{Fuel} = (EF_{CO2} + 25 \cdot EF_{CH4} + 298 \cdot EF_{N2O}) \cdot Fuel_{Diesel} \quad (3)$$

Where,

EF_{CO2} : Emission Factor (CO_2) by fuel consumption (74,100 kg-CO_2/TJ*)

EF_{CH4} : Emission Factor (CH_4) by fuel consumption (3.9 kg-CH_4/TJ*)

EF_{N2O} : Emission Factor (N_2O) by fuel consumption (3.9 kg-N_2O/TJ*)

$Fuel_{Diesel}$: Diesel Fuel Consumed (= Fuel Consumed X LHV of Diesel fuel; 37.7MJ/L)

* Source) 2006 IPCC Guideline for National Greenhouse Gas Inventories, Vol.2 Energy, Chapter 3 Mobile Combustion

Table 3.2 shows GHGs emission by vehicle fuel consumed. GHGs emission is proportional with sludge generation amount to be disposed. Since sludge drying after digestion generates minimizes sludge disposal, this system is the best way to be minimize of GHGs emission.

Table 3.2 GHGs Emission by Vehicle Fuel Consumed

Treatment System	*Fuel Consumed*	*Fuel $_{Diesel}$*	*GHGs $_{Fuel}$*
Sludge Dewatering by Mechanical Dehydrator	7,690L/year	0.290TJ/year	21,848 kg-CO_{2Eq}/year
Sludge Digestion + Dewatering by Mechanical Dehydrator	2,444L/year	0.092TJ/year	6,944 kg-CO_{2Eq}/year
Sludge Drying by Drying Bed	2,567L/year	0.097TJ/year	7,293 kg-CO_{2Eq}/year
Sludge Digestion + Drying by Drying Bed	1,224L/year	0.046TJ/year	3,477 kg-CO_{2Eq}/year

Source: Survey Team

3.3 GHSs Emission caused by Sludge Disposal

Disposed sludge generates CH_4 at the final disposal site. The CH_4 generation potential of the sludge that is disposed in a certain year will decrease gradually throughout the following decades. In this process, the release of CH_4 from this specific amount of sludge decreases gradually.

The equations for estimating the CH_4 generation are given by "2006 IPCC Guideline for National Greenhouse Gas Inventories, Vol.5 Waste, Chapter 3 Solid Waste Disposal". The CH_4 potential that is generated throughout the years can be estimated on the basis of the amounts and composition of the waste disposed into disposal site and the management practices at the sites.

$$DDOC_m = W \cdot DOC \cdot DOC_f \cdot MCF \quad (4)$$

Where,

$DDDC_m$: mass of decomposable degradable organic carbon deposited (Gg/year)

W : mass of sludge deposited (Gg/year)

DOC : degradable organic carbon in the year of deposition, fraction (Gg-Carbon/Gg-Sludge)

DOC_f : fraction of DOC that can decompose (=0.5*)

MCF : CH_4 correction factor for aerobic decomposition in the year of deposition (=0.8*, in case of unmanaged -deep (>5m waste) and/or high water table)

* Source) 2006 IPCC Guideline for National Greenhouse Gas Inventories, Vol.5 Waste, Chapter 3 Solid Waste Disposal

$$DDOC_{m\ decomp_T} = DDOC_{ma_{T-1}} \cdot \left(1 - e^{-k}\right) \quad (5)$$

Where,

$DDOC_{mdecomp_T}$: $DDOC_m$ decomposed in the disposal site in year T, (Gg)

$DDOC_{ma_{T-1}}$: $DDOC_m$ accumulated in the disposal site at the end of year T-1, (Gg)

T : Inventory year (=20years)

k : reaction constant (0.4 year^{-1}*)

* Source) 2006 IPCC Guideline for National Greenhouse Gas Inventories, Vol.5 Waste, Chapter 3 Solid Waste Disposal

$$CH_{4\ generated_T} = DDOC_{m\ decomp_T} \cdot F \cdot \frac{16}{12} \quad (6)$$

$$GHGs_{Disposal} = 25 \cdot CH_{4\ Generated_T} \cdot 1,000,000 / T \quad (7)$$

Where,

$CH_{4\ Generated\ T}$: amount of CH_4 generated from decomposable material (Gg)

$DDOC_{m\ decomp\ T}$: $DDOC_m$ decomposed in year, T (Gg)

F : fraction of CH4, by volume, in generated landfill gas (=0.5*)

* Source) 2006 IPCC Guideline for National Greenhouse Gas Inventories, Vol.5 Waste, Chapter 3 Solid Waste Disposal

Table 3.3 shows GHGs emission by sludge disposal in case the inventory year set at 20years. $GHGs_{Disposal}$ in the table shows the average value for 20years. Sludge treatment system having sludge digestion generates smaller amount of GHGs than without digestion because organic carbon in sludge is already digested in STP.

Table 3.3 GHGs Emission by Sludge Disposal

Treatment System	W	DOC	$DDOC_m$	$DDOC_{m\ decomp\ T}$	$CH_{4\ generated\ T}$	$GHGs_{Disposal}$
Sludge Dewatering by Mechanical Dehydrator	2.3068 Gg/year	0.03	0.0277 Gg/year	0.8056 Gg/20years	0.5371 Gg/20years	671,343 kg-CO_{2Eq}/year
Sludge Digestion + Dewatering by Mechanical Dehydrator	0.7329 Gg/year	0.0375	0.0110 Gg/year	0.3200 Gg/20years	0.2133 Gg/20years	266,625 kg-CO_{2Eq}/year
Sludge Drying by Drying Bed	0.7691 Gg/year	0.09	0.0277 Gg/year	0.8057 Gg/20years	0.5371 Gg/20years	671,343 kg-CO_{2Eq}/year
Sludge Digestion + Drying by Drying Bed	0.3665 Gg/year	0.075	0.0110 Gg/year	0.3200 Gg/20years	0.2133 Gg/20years	266,625 kg-CO_{2Eq}/year

Source: Survey Team

3.4 Total GHSs Emission

From the above, GHGs in total is calculated as shown in **Table 3.4**. Sludge drying after digestion can minimize GHGs emission in 4 types of sludge treatment system.

Table 3.4 Total GHGs Emission of Sludge Treatment and Disposal

(unit: kg-CO_{2Eq}/year)

Treatment System	$GHGs_{Electricity}$	$GHGs_{Fuel}$	$GHGs_{Disposal}$	$GHGs_{Total}$
Sludge Dewatering by Mechanical Dehydrator	15,455	21,848	671,343	708,646
Sludge Digestion + Dewatering by Mechanical Dehydrator	33,913	6,944	266,625	307,482
Sludge Drying by Drying Bed	2,503	7,293	671,343	681,139
Sludge Digestion + Drying by Drying Bed	24,715	3,477	266,625	294,818

Source: Survey Team

6.9 Capacity Calculation

1. Design Criteria

(1) Flow Rate (Max. Daily, Fixed) 5,000 m^3/day

(2) Characteristics of Raw Wastewater

	Dry Season		Rainy Season	
T-BOD	195 mg/l,	975 kg/day	100 mg/l,	500 kg/day
S-BOD	130 mg/l,	650 kg/day	70 mg/l,	350 kg/day
TSS	205 mg/l,	1,025 kg/day	90 mg/l,	450 kg/day

2.Design

2.1. Grit Chamber

(1) Design Conditions

- Surface Loading Rate: 1,800 m^3/m^2/day
- No of Series: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Section Area of the Chamber

5,000 m^3/day / 1,800 m^3/m^2/day / 1 chamber = 2.8 m^2

Grid Chamber

Dimension: 3.0 m X 1.0 m X 0.5 m H(Water Depth)

- Surface Area: 3.0 m^2
- Surface Loading Rate: 1,667 m^3/m^2/day

2.2. Automatic Bar Screen

(1) Design Conditions

- No of Series: 1 for duty
- Width of Channel: 1.0 m

(2) Design

Automatic Bar Screen

W 1,000mm x H 2,000mm x Op. 15mm x 0.025kW x 1unit duty

2.3. Fixed Bar Screen

(1) Design Conditions

- No of Series: 1 for Stand-by
- Width of Channel: 1.0 m

(2) Design

Fixed Bar Screen W 1,000mm x H 2,000mm x Op. 15mm x 1unit stand-by

2.4. Reservoir Tank

(1) Design Conditions

- Flow Rate:

	Dry Season	Rainy Season
Raw Wastewater	5,000 m^3/day	5,000 m^3/day
Overflow from HTF	284.5 m^3/day	285.4 m^3/day
Supernatant from Primary Sedimentation Tank	1,119.6 m^3/day	570.5 m^3/day
Supernatant from Biogas Settler	35.7 m^3/day	11.5 m^3/day
Leachate from Sludge Drying Bed	8.8 m^3/day	2.8 m^3/day
Total	6,448.6 m^3/day	5,870.2 m^3/day

- Adopted Flow Rate: 6,448.6 m^3/day
- No of the Tank: 1
- Retention Time: 0.5 hours

(2) Design Calculation

- Capacity of the Tank:

6,448.6 m^3/day X 0.5 / 24 = 135 m^3

Reservoir Tank Dimension: 5.5 m X 7.0 m X 3.5 m H(Water Depth) Capacity: 135 m^3

2.5. Reservoir Tank Mixer

(1) Design Conditions

- Capacity of the Tank: 135 m^3
- Mixing Method: Submergible Mixer
- Mixing Strength: 1.0 m^3/m^3/hour
- No of Mixer: 1

(2) Design Calculation

- Capacity of the Mixer:

135 m^3 X 1.0 m^3/m^3/hour / 60 / 1 unit = 2.3 m^3/min

Reservoir Tank Mixer									
Capacity:	2.6	m^3/min X	dia.	250	mm X	1.5	kW X	1	Unit

2.6. Raw Water Pump

(1) Design Conditions

- Flow Rate: 6,448.6 m^3/day
- No of Pump: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Capacity of the Pump:

6,448.6 m^3/day /24/60 / 1 unit = 4.5 m^3/min

Raw Water Pump										
Capacity:	5.1	m^3/min X	17	mH X dia	250	mm X	30	kW X	2	Units

2.7. Distribution Gutter 1

(1) Design Conditions

- Flow Rate from Raw Water Pump: 6,448.6 m^3/day(Dry Season) 5,870.2 m^3/day(Rainy Season)
- Adopted Flow Rate: 6,448.6 m^3/day
- No of Chamber: 1
- Retention Time: 1 min

(2) Design Calculation

- Capacity of the Chamber:

6,448.6 m^3/day X 1 min / 60 / 24 = 4.5 m^3

Distribution Gutter 1					
Dimension:	1.0	m X	3.9	m X	1.7 m H(Water Depth)
Capacity:	6.63	m^3			

2.8. Floating Sponge Filtration Tank (FSF)

(1) Design Conditions

- No of Tank: 2
- Wastewater Flow Rate and Quality:

Calculated Flow Rate and Quality (Dry Season)

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Raw Wastewater	5,000.0	195	975.0	130	650.0	205	1,025.0
Overflow from HTF	284.5	116	33.0	98	27.9	50	14.2
Supernatant from PST	1,119.6	122	136.2	85	94.8	212	237.1
Supernatant from BS	35.7	541	19.3	500	17.9	1,528	54.6
Leachate from Drying Bed	8.8	529	4.7	500	4.4	1,114	9.8
Total	6,448.6	181	1,168.2	123	795.0	208	1,340.7

Calculated Flow Rate and Quality (Rainy Season)

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Raw Wastewater	5,000.0	100	500.0	70	350.0	90	450.0
Overflow from HTF	285.4	71	20.3	54	15.4	50	14.3
Supernatant from PST	570.5	67	38.0	41	23.1	114	65.1
Supernatant from BS	11.5	590	6.8	500	5.8	1,522	17.5
Leachate from Drying Bed	2.8	562	1.6	500	1.4	1,107	3.1
Total	5,870.2	97	566.7	67	395.7	94	550.0

Input Value for Convergent Calculation

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Total (Dry Season)	6,448.6	181	1,168.2	123	795.3	208	1,340.6
Total (Rainy Season)	5,885.2	96	566.9	67	395.7	93	549.9

- Adopted Flow Rate: 6,448.6 m^3/day
- Surface Loading Rate: 150 m^3/m^2/day
- Height of Sponge Media: 0.6 m
- TSS after filtration: 50 mg/l
- P-BOD Removal Rate by FSF: 0.9143 X (TSS Removal Rate) (%)
  (P-BOD) = (T-BOD) - (S-BOD)
- S-BOD Removal Rate by FSF: 20 %
- Frequency of Backwashing: TSS Conc. X Surface Loading rate / 0.83

(2) Design Calculation

- Surface Area:
  6,448.6 m^3/day / 150 m^3/m^2/day / 2 units = 22 m^2/Tank

Floating Sponge Filtration Tank (FSF)
Dimension: 3 m X 8 m X 0.6 m H(height of Sponge Media) X 2 Tanks
Surface Area of Sponge Media Required: 24.2 m^2/Tank Adopted: 24 m^2/Tank
Surface Loading: 134 m^3/m^2/day(Dry Season)
122 m^3/m^2/day(Rainy Season)

- TSS and BOD Removal

TSS

Dry Season

Removed: 208 mg/l - 50 mg/l = 158 mg/l

Removal Rate: (208 mg/l - 50 mg/l) / 208 mg/l = 76.0 %

Rainy Season

Removed: 93 mg/l - 50 mg/l = 43 mg/l

Removal Rate: (93 mg/l - 50 mg/l) / 93 mg/l = 46.2 %

S-BOD

Dry Season:

Removed: 123 mg/l X 20 %= 25 mg/l

Remaining: 123 mg/l - 25 mg/l = 98 mg/l

Rainy Season

Removed: 67 mg/l X 20 %= 13 mg/l

Remaining: 67 mg/l - 13 mg/l = 54 mg/l

P-BOD

Dry Season:

Removed: (181 mg/l - 123 mg/l) X 76.0 X 0.9143 %= 40 mg/l

Remaining: 181 mg/l - 123 mg/l - 40 mg/l = 18 mg/l

Rainy Season

Removed: (96 mg/l - 67 mg/l) X 46.2 X 0.9143 %= 12 mg/l

Remaining: 96 mg/l - 67 mg/l - 12 mg/l = 17 mg/l

T-BOD

Dry Season:

Removed: 25 mg/l + 40 mg/l = 65 mg/l

Remaining: 181 mg/l - 65 mg/l = 116 mg/l

Rainy Season

Removed: 13 mg/l + 12 mg/l = 25 mg/l

Remaining: 96 mg/l - 25 mg/l = 71 mg/l

- Amount of Backwashing Water per event

24.2 m^2 /Tank X 1.2 mH = 29 m^3/Tank/time

- Frequency of Backwashing

Dry Season: 208 mg/l X 134 m^3/m^2/day / 2 Tanks X 0.83kg/m^2/day /1,000

= 17 times/day/Tank

Rainy Season: 93 mg/l X 122 m^3/m^2/day / 2 Tanks X 0.83kg/m^2/day /1,000

= 7 times/day/Tank

- Total Amount of Backwashing Water per day

Dry Season: 29 m^3/Tank/time X 2 Tanks X 17 times/day/Tank = 986.0 m^3/day

Rainy Season: 29 m^3/Tank/time X 2 Tanks X 7 times/day/Tank = 406.0 m^3/day

- Flow Rate and Quality of Effluent from FSF

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	5,462.6	116	633.7	98	535.3	50	273.1
Rainy Season	5,479.2	71	389.0	54	295.9	50	274.0

- Flow Rate and Quality of Backwashing Water

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	986.0	278	274.5	98	96.6	1,083	1,067.5
Rainy Season	406.0	192	78.1	54	21.9	680	275.9

2.9. Distribution Gutter 2

(1) Design Conditions

- Flow Rate from Raw Water Pump: 5,462.6 m^3/day(Dry Season) 5,479.2 m^3/day(Rainy Season)
- Adopted Flow Rate: 5,479.2 m^3/day
- No of Chamber: 1
- Retention Time: 0.5 min

(2) Design Calculation

- Capacity of the Chamber:

5,479.2 m^3/day X 0.5 min / 60 / 24 = 2.0 m^3

Distribution Gutter 2
Dimension: 1.6 m X 2 m X 0.65 m H(Water Depth)
Capacity: 2.08 m^3

2.10. High Rate Trickling Filter (HTF)

(1) Design Conditions

- No of Tank: 2
- No of Chamber: 4 /Tank (8 chambers, total)
- BOD Loading Rate: 1.6 kg-BOD/m^3/day (*A*)
- height of Filter Media: 2.5 m (*B*)
- TSS in Effluent from HTF: 6.2335 X Ln(*A*) + 22.233
- S-BOD in Effluent from HTF: (0.7538 X Ln(*A*) +2.6562) X (9.87715 X $B^{-0.92}$) / 4.25
- P-BOD in Effluent from HTF: 0.9143 X (TSS in Effluent)
- Frequency of Backwashing: Every 8 days
- Soaking Time: 10 hours/time
- Media Porosity: 90%

(2) Design Calculation

- Flow Rate and Quality of Influent to HTF

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	5,462.6	116	633.7	98	535.3	50	273.1
Rainy Season	5,479.2	71	389.0	54	295.9	50	274.0

- Capacity of HTF:

From BOD Loading Rate:

Dry Season: 633.7 kg/day / 1.6 kg/m^3/day / 2 units = 199 m^3/Tank
199 m^3/Tank / 2.5 m = 80 m^2/Tank

Rainy Season: 389.0 kg/day / 1.6 kg/m^3/day / 2 units = 122 m^3/Tank
122 m^3/Tank / 2.5 m = 49 m^2/Tank

Adopted Surface Area 80 m^2/Tank

High Rate Trickling Filter (HTF)
Dimension: Octagon Dia. 10.0 m X 2.5 m H(Height of Filter Media) X 2 Tanks
Capacity: 205 m^3, Surface Area of HTF: 82 m^2/Tank
Surface Loading: 16.7 m^3/m^2/day(Dry Season) 16.8 m^3/m^2/day(Rainy Season)
BOD Loading: 1.6 kg-BOD/m^3/day(Dry Season) 1 kg-BOD/m^3/day(Rainy Season)

- TSS in Effluent

6.2335 X Ln(1.6 kg-BOD/m^3/day) + 22.233 = 26 mg/l

-P-BOD in Effluent

0.9143 X 26 mg/l = 24 mg/l

-S-BOD in Effluent

(0.7538 X Ln(1.6 kg-BOD/m^3/day) +2.6562) X (9.87715 X 2.5 $m^{-0.92}$) / 4.25 = 4 mg/l

From conservative point of view, S-BOD in Effluent is set at 10 mg/l

-T-BOD in Effluent

24 mg/l + 10 mg/l = 34 mg/l

- Amount of Overflow

Dry Season:

5,462.6 m^3/day / 2 tanks / 4 chambers/tank X 10 hours/24 = 284.5 m^3/day

Rainy Season:

5,479.2 m^3/day / 2 tanks / 4 chambers/tank X 10 hours/24 = 285.4 m^3/day

- Amount of Wastewater per event per chamber

π/4 X (Dia. 10.0 m)^2 X 2.5 mH / 4 chamber/Tank = 49.1 m^3/time/chamber

- Daily Average of Wastewater

49.1 m^3/time/chamber X 4 chamber/Tank X 2 Tanks / 8 days = 49.1 m^3/day

- Flow Rate and Quality of Overflow from HTF

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	284.5	116	33.0	98	27.9	50	14.2
Rainy Season	285.4	71	20.3	54	15.4	50	14.3

- Flow Rate and Quality of Effluent from HTF

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	5,129.0	34	174.4	10	51.3	26	133.4
Rainy Season	5,144.7	34	174.9	10	51.4	26	133.8

- Flow Rate and Quality of Wastewater from HTF per event

	Flow Rate (m^3/event)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	49.1	34	1.7	10	0.5	26	1.3
Rainy Season	49.1	34	1.7	10	0.5	26	1.3

2.11. Distribution Gutter 3

(1) Design Conditions

- Flow Rate from Raw Water Pump: 5,129.0 m^3/day(Dry Season) 5,144.7 m^3/day(Rainy Season)
- Adopted Flow Rate: 5,144.7 m^3/day
- No of Chamber: 1
- Retention Time: 1 min

(2) Design Calculation

- Capacity of the Chamber:

5,144.7 m^3/day X 1 min / 60 / 24 = 3.6 m^3

Distribution Gutter 3				
Dimension:	3.9 m X	1.1 m X	1.3 m H(Water Depth)	
Capacity:	5.577 m^3			

2.12. Final Solid Liquid Separation Tank(SLS)

(1) Design Conditions

- No of Tank: 2
- Adopted Flow Rate: 5,144.7 m^3/day
- Surface Loading Rate: 150 m^3/m^2/day at Filtering Part
- Height of Sponge Media: 0.7 m
- TSS Removal Rate by SLS: 0.2549 X (TSS conc. in Influent to SLS) +78.088 (%)
- P-BOD in Effluent from SLS: 1.4008 X (TSS conc. in Effluent from SLS) (mg/l)
- S-BOD Removal Rate by SLS: Not Removed
- Concentration of Settled Sludge: 5,000 mg/l
- TSS Collection Rate by Settling: 0.8
- Frequency of Washing: Every 3 kg-TSS/m^2
- Time for Backwashing: 30 min

(2) Design Calculation

- Surface Area of Filtering Part:

5,145 m^3/day / 150 m^3/m^2/day / 2 Tanks = 18 m^2/Tank

Final Solid Liquid Separation Tank(SLS)				
Dimension:	4.0 m X	5.0 m X	0.7 m H(height of Filter) (Filtering Part)	
Surface Area of Filter:	20.0 m^2/Tank			
Surface Loading of Filtering Part:			129 m^3/m^2/day(Dry Season)	
			129 m^3/m^2/day(Rainy Season)	

- TSS Removal Rate: 0.2549 X 26 mg/l +78.088 = 84.7 %
From conservative point of view, TSS Removal Rate is set at 60 %
- TSS in Effluent: 26 mg/l X (1 - 60 %) = 11.0 mg/l
Dry Season 4,999.0 m^3/day X 11.0 mg/l / 1000 = 55.0 kg/day
Rainy Season 5,014.7 m^3/day X 11.0 mg/l / 1000 = 55.2 kg/day
-P-BOD in Effluent 1.4008 X 11.0 mg/l = 16.0 mg/l
-S-BOD in Effluent : 10 mg/l
-T-BOD in Effluent
16.0 mg/l + 10.0 mg/l = 26.0 mg/l
- Frequency of Washing
Dry Season 24 hours/day /(133 kg/day / 2 Tanks / 20.0 m^2/Tank / 3 kg-TSS/m^2)
= every 22 hours/Tank
Rainy Season 24 hours/day /(134 kg/day / 2 Tanks / 20.0 $m^{2/}$Tank / 3 kg-TSS/m^2)
= every 22 hours/Tank
- Amount of Settled Sludge (Daily Average)
Dry Season (133.4 kg/day - 55 kg/day) X 0.8 = 62.7 kg/day
62.7 kg/day / 5,000 mg/l /1000 = 12.6 m^3/day
Rainy Season (133.8 kg/day - 55.2 kg/day) X 0.8 = 62.9 kg/day
62.9 kg/day / 5,000 mg/l /1000 = 12.6 m^3/day
- Amount of TSS reaching to the Filter (Daily Average)
Dry Season 133.4 kg/day - 55.0 kg/day- 62.7 kg/day = 15.7 kg/day
Rainy Season 133.8 kg/day - 55.2 kg/day- 62.9 kg/day = 15.7 kg/day
-Amount of Washing Water
Dry Season
129 m^3/m^2/day X 20.0 m^2/Tank X 30 min/time / 1,440 = 53.8 m^3/Tank/time
53.8 m^3/Tank/time X 24 / 22 X 2 Tanks = 117.4 m^3/day
Rainy Season
129 m^3/m^2/day X 20.0 m^3/Tank X 30 min/time / 1,440 = 53.8 m^3/Tank/time
53.8 m^3/Tank/time X 24 / 22 X 2 Tanks = 117.4 m^3/day

- Flow Rate and Quality of Effluent from SLS (Daily Average)

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	4,999.0	26.0	130.0	10.0	50.0	11.0	55.0
Rainy Season	5,014.7	26.0	130.4	10.0	50.1	11.0	55.2

- Flow Rate and Quality of Settled Sludge from SLS (Daily Average)

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	12.6	2,817	35.5	10	0.1	5,000	62.7
Rainy Season	12.6	2,825	35.6	10	0.1	5,000	63.0

- Flow Rate and Quality of Washing Water from SLS (Daily Average)

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	117.4	76	8.9	10	1.2	134	15.7
Rainy Season	117.4	76	8.9	10	1.2	134	15.7

2.13. Chlorination Tank

(1) Design Conditions

- Flow Rate:
- Adopted Flow Rate: 5,014.7 m^3/day
- No of the Tank: 1
- Retention Time: 15 min

(2) Design Calculation

- Capacity of the Tank:

5,014.7 m^3/day X 15 / 60 / 24 = 53 m^3

Chlorination Tank							
Dimension:	2.0 m X	16.2 m X	2.0 m H(Water Depth)				
Capacity required:	58.3 m^3		Adopted:	64.8 m^3/Tank			

2.14. Chlorine Dosing Pump

(1) Design Conditions

- Chlorine Dosing Rate: 3 mg/l
- Effective Chlorine Conc.: 70%
- Conc. of Chlorine Solution: 12%
- No of Pump: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Chlorine Consumption:

Dry Season

4,999.0 m3/day X 3 mg/l = 15 kg/day

15 kg/day / 70% = 21.5 kg/day (Solid Chemical)

15 kg/day / 12% = 125 L/day (Solution)

Rainy Season:

5,014.7 m3/day X 3 mg/l = 15.1 kg/day

15.1 kg/day / 70% = 21.6 kg/day (Solid Chemical)

15.1 kg/day / 12% = 126 L/day (Solution)

Adopted Flow Rate: 126 L/day

- Capacity of the Pump:

126.0 L/day / 24 /60 / 1 unit = 0.09 L/min

Chlorine Dosing Pump									
Capacity:	0.4 L/min X	0.3	MPa X	0.2	kW X	2	Units		

2.15. Chlorine Solution Tank

(1) Design Conditions

- Polymer Consumption: 126 L/day
- No of the Tank: 1
- Retention Time: 10 day

(2) Design Calculation

- Capacity of the Tank:

126 L/day X 10 day / 1 Tank /1000= 1.26 m^3/Tank

Chlorine Solution Tank						
Dimension:	Dia.	1.2 m X	1.5 m H X	1	Tanks	
Capacity:	1.6 m^3/Tank X	1	Tanks			

2.16. Storage Tank

(1) Design Conditions

- No of the Tank: 1
- Retention Time: 2 hours
- Flow Rate of Inlet

	Dry Season	Rainy Season
Backwashing Water from FSF	986.0 m^3/day	406.0 m^3/day
Backwashing Water from SLS	117.4 m^3/day	117.4 m^3/day
Wastewater from HTF	49.1 m^3/day	49.1 m^3/day
Supernatant from ST	62.0 m^3/day	24.1 m^3/day
Total	1,214.5 m^3/day	596.6 m^3/day

- Adopted Flow Rate: 1,214.5 m^3/day

(2) Design Calculation

- Capacity of the Tank:

1,214.5 m^3/day X 2 / 24 = 102 m^3

Storage Tank
Dimension: 5.5 m X 7 m X 3 m H(Water Depth)
Capacity: 115.5 m^3

2.17. Storage Tank Mixer

(1) Design Conditions

- Capacity of the Tank: 115.5 m^3
- Mixing Method: Submergible Mixer
- Mixing Strength: 1.0 m^3/m^3/hour
- No of Mixer: 1

(2) Design Calculation

- Capacity of the Mixer:

115.5 m^3 X 1.0 m^3/m^3/hour / 60 / 1 unit = 2 m^3/min

Storage Tank Mixer
Capacity: 2.2 m^3/min X dia. 250 mm X 1.5 kW X 1 Unit

2.18. Backwashing Water Transfer Pump

(1) Design Conditions

- Flow Rate: 1,214.5 m^3/day
- No of Pump: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Capacity of the Pump:

1,214.5 m^3/day) /24/60 / 1 unit = 0.9 m^3/min

Backwashing Water Transfer Pump								
Capacity:	1.1 m^3/min X	6	mH X dia	125x100	mm X	3.7	kW X	2 Units

2.19. Primary Sedimentation Tank

(1) Design Conditions

- Flow Rate and Quality

Dry Season

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Backwashing Water from FSF	986.0	278	274.5	98.00	96.6	1,083	1,067.5
Wastewater from HTF	49.1	34	1.7	10	0.5	26	1.3
Backwashing Water from SLS	117.4	76	8.9	10	1.2	134	15.7
Supernatant from ST	62.0	400	24.8	76	4.6	1,631	101.1
Total	1,214.5	255	309.8	85	102.9	976	1,185.6

Rainy Season

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Backwashing Water from FSF	406.0	192	78.0	54	21.9	680	276.1
Wastewater from HTF	49.1	34	1.7	10	0.5	26	1.3
Backwashing Water from SLS	117.4	76	8.9	10	1.2	134	15.7
Supernatant from ST	24.1	424	10.2	31	0.6	1,340	32.3
Total	596.6	166	98.8	41	24.2	545	325.4

- Adopted Flow Rate: 1,214.5 m^3/day
- Surface Loading Rate: 35 m^3/m^2/day
- Concentration of Settled Sludge: 10,000 mg/l
- TSS Collection Rate by Settling: 0.8
- P-BOD Removal Rate by Sedimentation: 0.8
- S-BOD Removal Rate by Sedimentation: 0
- No of the Tank: 1
- Effective Depth: 3 m

(2) Design Calculation

- Surface Area:

1,214.5 m^3/day / 35 m^3/m^2/day / 1 units = 35.0 m^2/Tank

Primary Sedimentation Tank
Dimension: Dia. 7.0 m X 3.0 m H
Surface Area: 38.4 m^2 Retention Time: 2.3 hours
Surface Loading Rate: 31.63 m^3/m^2/day

- Amount of TSS in Settled Sludge

Dry Season 1,185.6 kg/day X 0.8 = 948.5 kg/day
Rainy Season 325.4 kg/day X 0.8 = 260.3 kg/day

- Flow Rate of Settled Sludge

Dry Season 948.5 kg/day / 10,000 mg/l /1000 = 94.9 m^3/day
Rainy Season 260.3 kg/day / 10,000 mg/l /1000 = 26.1 m^3/day

- Amount of TSS in Supernatant

Dry Season 1,185.6 kg/day - 948.5 kg/day = 237.1 kg/day
Rainy Season 325.4 kg/day - 260.3 kg/day = 65.1 kg/day

- Flow Rate of Supernatant

Dry Season 1,214.5 m^3/day - 94.9 m^3/day = 1119.6 m^3/day
Rainy Season 596.6 m^3/day - 26.1 m^3/day = 570.5 m^3/day

- Flow Rate and Quality of Settled Sludge

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	94.9	1,829.8	173.7	85.0	8.1	10,000	948.5
Rainy Season	26.1	2,328.9	60.8	41.0	1.1	10,000	260.3

- Flow Rate and Quality of Supernatant

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	1,119.6	121.6	136.2	85.0	94.8	211.8	237.1
Rainy Season	570.5	66.7	38.0	41.0	23.1	114.1	65.1

2.20. Settled Sludge Transfer Pump

(1) Design Conditions

- Flow Rate: 94.9 m^3/day
- No of Pump: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Capacity of the Pump:

94.9 m^3/day) /24/60 / 1 unit = 0.1 m^3/min

Sludge Transfer Pump								
Capacity:	0.2 m^3/min X	6	mH X dia	50	mm X	0.75	kW X	2 Units

2.21. Sludge Thickener

(1) Design Conditions

- Sludge Loading Rate: 60 kg/m^2/day
- Surface Loading Rate: 20 m^3/m^2/day
- Water Depth: 4 m
- No of the Tank: 1
- Sludge Recovery Rate: 90%
- Thickened Sludge Conc.: 20,000 mg/l
- Flow Rate and Quality of Inlet

Dry Season

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Thickened Sludge from PST	94.9	1,830	173.7	85	8.1	10,000	948.5
Settled Sludge from SLS	12.6	2,817	35.5	10	0.1	5,000	62.7
Total	107.5	1,946	209.2	76	8.2	9,407	1,011.2

Rainy Season

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Thickened Sludge from PST	26.1	2,329	60.8	41	1.1	10,000	260.3
Settled Sludge from SLS	12.6	2,825	35.6	10	0.1	5,000	63.0
Total	38.7	2,491	96.4	31	1.2	8,354	323.3

- Adopted Flow Rate: 107.5 m^3/day
- Adopted Amount of TSS: 1,011.2 kg/day

(2) Design Calculation

- Surface Area of the Thickener:

From Sludge Loading Rate

1,011.2 kg/day / 60 kg/m^2/day / 1 Tank = 16.9 m^2

From Surface Loading Rate

107.5 m^3/day / 20 m^3/m^2/day / 1 Tank = 6.0 m^2

Adopted Surface Area 16.9 m^2

Sludge Thickener			
Dimension:	Dia. 5.5 m X	4.0 m H	
Surface Area:	23.7 m^2	Retention Time:	21.2 hours
Sludge Loading Rate:	42.67 kg/m^2/day	Surface Loading Rate:	4.536 m^3/m^2/day

- Amount of Thickened Sludge

Dry Season 1,011.2 kg/day X 90% = 910.1 kg/day

910.1 kg/day / 20,000 mg/l X 1,000 = 45.5 m^3/day

Rainy Season 323.3 kg/day X 90% = 291.0 kg/day

291.0 kg/day / 20,000 mg/l X 1,000 = 14.6 m^3/day

- Amount of Supernatant

Dry Season 1,011.2 kg/day - 910.1 kg/day = 101.1 kg/day

107.5 m^3/day - 45.5 m^3/day = 62.0 m^3/day

Rainy Season 323.3 kg/day - 291.0 kg/day = 32.3 kg/day

38.7 m^3/day - 14.6 m^3/day = 24.1 m^3/day

- Flow Rate and Quality of Thickened Sludge (Daily Average)

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	45.5	4,052	184.4	76	3.5	20,000	910.1
Rainy Season	14.6	5,902	86.2	31	0.5	20,000	291.0

- Flow Rate and Quality of Supernatant (Daily Average)

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	62.0	400	24.8	76	4.6	1,631	101.1
Rainy Season	24.1	424	10.2	31	0.6	1,340	32.3

2.22. Thickened Sludge Transfer Pump

(1) Design Conditions

- Flow Rate: 45.5 m^3/day
- No of Pump: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Capacity of the Pump:

45.5 m^3/day /24/60 / 1 unit = 0.04 m^3/min

Raw Water Pump									
Capacity:	0.1 m^3/min X	18	mH X dia	50x40	mm X	2.2	kW X	2	Units

2.23. Biogas Digester and Biogas Settler

(1) Design Conditions

- Flow Rate: 45.5 m^3/day
- Loading Rate of Digester: 4 kg-TSS/m^3/day
- TSS conc. In Thickened Sludge: 910.1 kg-TSS/day
- Hydraulic Retention Time (HRT): 20 days (Digester + Settler)
- Removal Rate of TSS: 40%
- Removal Rate of BOD: 80%
- CH_4 Generation Rate: 0.3 m^3_N-CH_4/kg-TSS Removed
- CH_4 Conc. In Biogas 60 $\%^V/_V$
- Settled Sludge conc.: 50,000 mg/l
- Sludge Recovery Rate: 90%

(2) Design Calculation

- Capacity of the Digester and Settler:
  45.5 m^3/day X 20 days = 910 m^3
- Capacity of the Digester:
  910.1 kg-TSS/day 4 kg-TSS/m^3/day = 228 m^3

Biogas Digester							
Dimension:	Dia.	7.5 m X	11.0 m H (Water Depth)				
Tank Volume:	485.9 m^2	TSS Loading Rate:	1.87	kg-TSS/m^3/day	HRT	10.6	days
Biogas Settler							
Dimension:	Dia.	7.5 m X	10.0 m H (Water Depth)				
Tank Volume:	441.7 m^2				HRT	9.7	days
Total Volume	927.6 m^3	HRT total	20.3 m^3				

- TSS after digestion

Dry Season	910.1 kg/day X (1 -	40%)=	546.1	kg/day
Rainy Season	291.0 kg/day X (1 -	40%)=	174.6	kg/day

- Amount of Digested Sludge

Dry Season	546.1 kg/day X	90% =	491.5	kg/day
	491.5 kg/day /	50,000 mg/l X 1,000 =	9.8	m^3/day
Rainy Season	174.6 kg/day X	90% =	157.1	kg/day
	157.1 kg/day /	50,000 mg/l X 1,000 =	3.1	m^3/day

- Amount of Supernatant

Dry Season	546.1	kg/day -	491.5	kg/day =	54.6	kg/day
	45.5	m^3/day -	9.8	m^3/day =	35.7	m^3/day
Rainy Season	174.6	kg/day -	157.1	kg/day =	17.5	kg/day
	14.6	m^3/day -	3.1	m^3/day =	11.5	m^3/day

- BOD after digestion

Dry Season	184.4 kg/day X (1 -	80%	)=	36.9	kg/day
Rainy Season	86.2 kg/day X (1 -	80%	)=	17.2	kg/day

- Flow Rate and Quality of Digested Sludge

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	9.8	1,792	17.6	500	4.9	50,000	491.5
Rainy Season	3.1	3,371	10.4	500	1.6	50,000	157.1

- Flow Rate and Quality of Supernatant

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	35.7	541	19.3	500	17.9	1,528	54.6
Rainy Season	11.5	590	6.8	500	5.8	1,522	17.5

- Flow Rate of CH_4 Generated

Dry Season	910.1 kg/day X	40%	X	0.3	m^3_N-CH_4/kg =	109.2	m^3_N-CH_4/day
Rainy Season	291.0 kg/day X	40%	X	0.3	m^3_N-CH_4/kg =	34.9	m^3_N-CH_4/day

- Flow Rate of Biogas Generated

Dry Season	109.2 m^3_N-CH_4/day /	60	$\%^v/_v$X =	182.0	m^3_N-Biogas/day
Rainy Season	34.9 m^3_N-CH_4/day /	60	$\%^v/_v$X =	58.2	m^3_N-Biogas/day

2.24. Digested Sludge Transfer Pump

(1) Design Conditions

- Flow Rate: 9.8 m^3/day
- Operation Hour for sludge return: 23 hours/day, 7 days/week
- Operation Hour for desludging: 1 hours/day, 5 days/week
- Sludge Return Rate: 200% of Feeding
- No of Pump: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Capacity of the Pump for sludge returning:

9.8 m^3/day X 200% X 7 / 7 X 24/ 23 / 60 / 1 unit = 0.35 m^3/min

- Capacity of the Pump for desludging:

9.8 m^3/day / 1 hours/day X 7 / 5 / 60 / 1 unit = 0.23 m^3/min

- Adopted Design Value 0.35 m^3/min

Digested Sludge Transfer Pump									
Capacity:	0.4 m^3/min X	18	mH X dia	80x65	mm X	5.5	kW X	2	Units

2.25. Gas Holder

(1) Design Conditions

- Flow Rate of Biogas: 182.0 m^3_N/day
- Retention Time: 2 hours
- Gas temperature: 35 °C
- Gas Pressure: 2 kPa

(2) Design Calculation

- Flow Rate of Biogas(actual):
  182.0 m^3_N/day X (273.15 + 35) / 273.15 X (101.325 + 2) / 101.325 = 209.4 m^3/day
- Capacity of Flare Stack:
  209.4 m^3/day X 2 / 24 = 17 m^3

Gas Holder	
Tank Volume:	20.0 m^2
Retention Time	2.3 hours

2.26. Flare Stack

(1) Design Conditions

- Flow Rate of Biogas: 209.4 m^3/day
- Capacity: 3 times of Biogas Flow generated

(2) Design Calculation

- Capacity of Flare Stack:
  209.4 m^3/day / 24 X 3 times = 26 m^3/hour

Flare Stack	
Capacity:	30.0 m^3/hour
Operation Hours	7.0 hours/day

2.27. Sludge Drying Bed

(1) Design Conditions

- Flow Rate: 9.8 m^3/day
- Solid Conc. in Feeding Sludge: 50,000 mg/l
- Operation Hour: 1 hours/day, 5 days/week

- Moisture Content of Dried Sludge: 50%
- Solid Recovery Rate: 98%
- Retention Time: 20 days
- No of Drying Beds: 20 Beds
- Sludge Depth of Drying Beds 0.3 m

(2) Design Calculation

- Amount of Dried Sludge:

Dry Season	491.5 kg/day X	98% kg/day =	481.7 kg-DB/day
	481.7 kg/day / (1-	50%) =	963 kg-WB/day
Rainy Season	157.1 kg/day X	98% kg/day =	154.0 kg-DB/day
	154.0 kg/day / (1-	50%) =	308 kg-WB/day

- Surface Area of Drying Bed

9.8 m^3/day / 0.3 m = 32.7 m^2/day

Sludge Drying Bed				
Dimension:	8 m X	5 m X	0.3 m H (Sludge Depth)
Surface Area:	40 m^2 X	20 Beds	

- Amount of Leachate

Dry Season

9.8 m^3/day - 0.963 tons/day = 8.8 m^3/day

Rainy Season:

3.1 m^3/day - 0.308 tons/day = 2.8 m^3/day

- Flow Rate and Quality of Leachate (Daily Average)

	Flow Rate (m^3/day)	T-BOD		S-BOD		TSS	
		(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
Dry Season	8.8	529	4.7	500	4.4	1,114	9.8
Rainy Season	2.8	562	1.6	500	1.4	1,107	3.1

2.28. Air Compressor

(1) Design Conditions

- LV for FSF : 1.0 m/min
- Surface Area of FSF : 24.0 m^2/Tank
- Compressed Air Requirement for Actuators: 0.1 m^3/min
- No of Air Compressor: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Air Compressor Capacity:

24.0 m^2/Tank X 1.0 m/min + 0.1 m^3_N/min = 24.1 m^3_N/min

Air Compressor
Capacity: 500.0 L_N/min X 0.8 MPa X 5.5 kW X 2 Units

2.29. Air Blower

(1) Design Conditions

- LV for HTF : 1.5 m/min
- LV for SLS : 0.4 m/min
- Surface Area of HTF : 82.0 m^2/Tank
- No of Chamber: 4 /Tank
- Surface Area of SLS : 20.0 m^2/Tank
- No of Blower: 2 (1 for duty, 1 for stand-by)

(2) Design Calculation

- Air Requirement for HTF:

82.0 m^2/Tank / 4 chambers X 1.5 m/min = 30.8 m^3_N/min

- Air Requirement for SLS:

20.0 m^2/Tank X 0.4 m/min = 8.0 m^3_N/min

- Blower Capacity: 30.8 m^3_N/min

Air Blower
Capacity: 32.7 m^3_N/min X 3,000 mmH_2O X 30 kW X 2 Units

2.30. Exhaust Fan

(1) Design Conditions

- Flow Rate of HTF Inlet : 5,479.2 m^3/day
- G/L: 6 m^3_N-Air / m^3-Wastewater
- No of HTF: 2
- Blower Air Flow Rate to HTF 32.7 m^3_N/min/series
- Capacity of Exhaust Fan: 110% of Air Flow
- No of Fan: 2

(2) Design Calculation

- Required Air for Ventilation:

5,479.2 m^3/day /24/60 X 6 m^3_N-Air / m^3-Wastewater / 2 = 11.5 m^3_N/min/unit

11.5 m^3_N/min/unit < 30.8 m^3_N/min

- Capacity of the Fan:

30.8 m^3_N/min X 110% = 33.9 m^3_N/min

Exhaust Fan
Capacity: 36.1 m^3_N/min X 3.0 kPa X 3.7 kW X 2 Units

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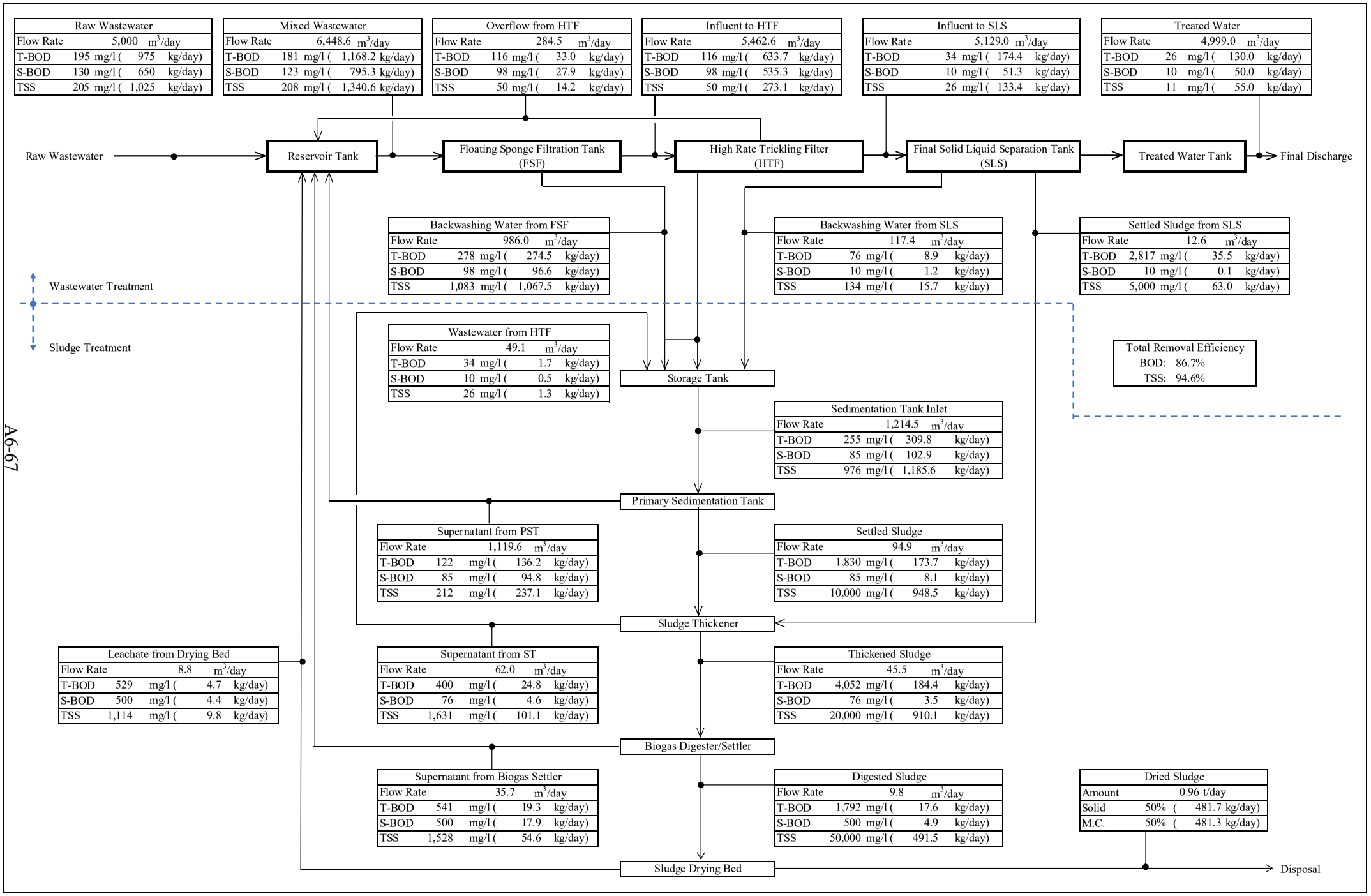
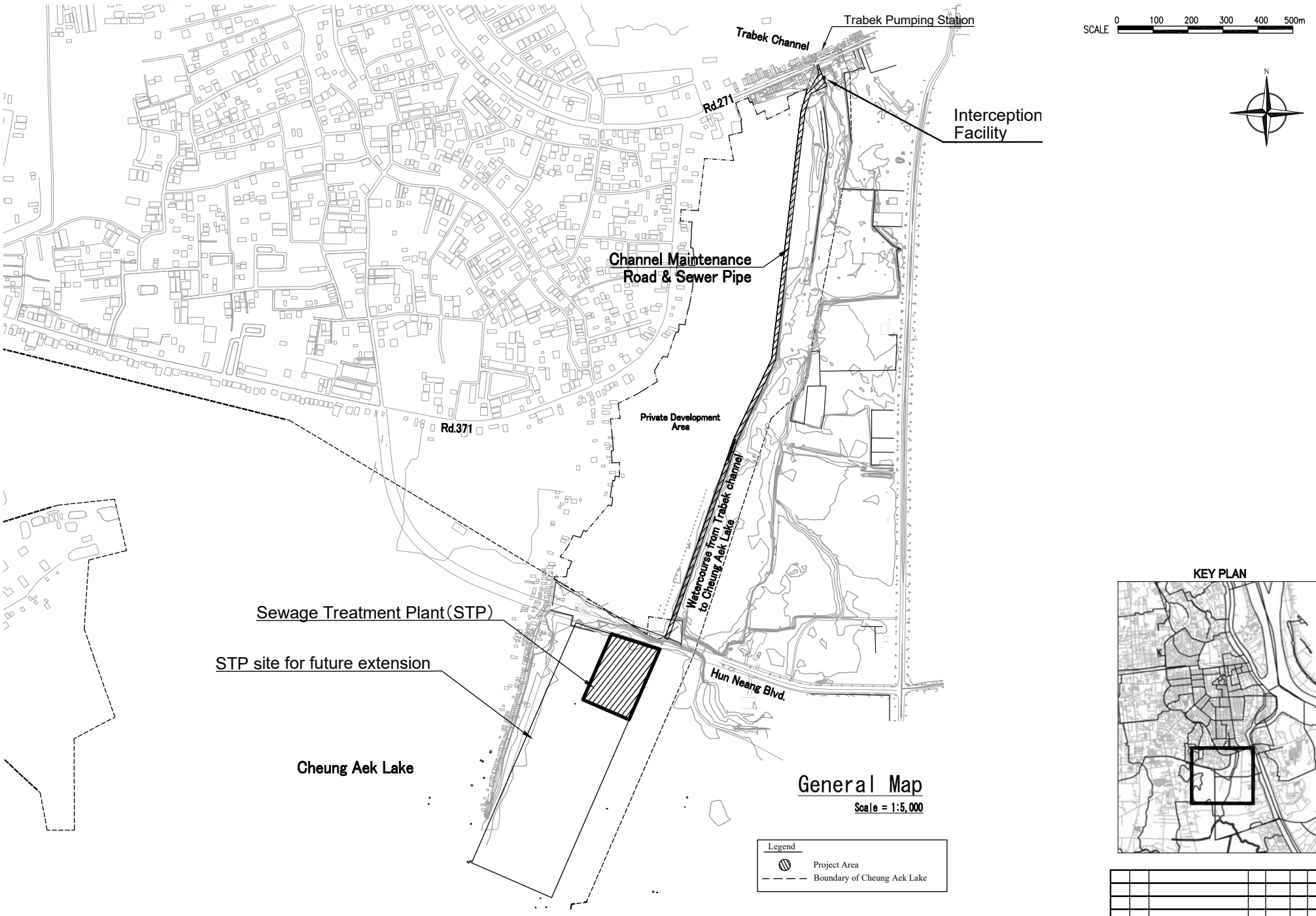

Raw Wastewater
Flow Rate 5,000 m3/day
T-BOD 195 mg/l (975 kg/day)
S-BOD 130 mg/l (650 kg/day)
TSS 205 mg/l (1,025 kg/day)
Mixed Wastewater
Flow Rate 6,448.6 m3/day
T-BOD 181 mg/l (1,168.2 kg/day)
S-BOD 123 mg/l (795.3 kg/day)
TSS 208 mg/l (1,340.6 kg/day)
Overflow from HTF
Flow Rate 284.5 m3/day
T-BOD 116 mg/l (33.0 kg/day)
S-BOD 98 mg/l (27.9 kg/day)
TSS 50 mg/l (14.2 kg/day)
Influent to HTF
Flow Rate 5,462.6 m3/day
T-BOD 116 mg/l (633.7 kg/day)
S-BOD 98 mg/l (535.3 kg/day)
TSS 50 mg/l (273.1 kg/day)
Influent to SLS
Flow Rate 5,129.0 m3/day
T-BOD 34 mg/l (174.4 kg/day)
S-BOD 10 mg/l (51.3 kg/day)
TSS 26 mg/l (133.4 kg/day)
Treated Water
Flow Rate 4,999.0 m3/day
T-BOD 26 mg/l (130.0 kg/day)
S-BOD 10 mg/l (50.0 kg/day)
TSS 11 mg/l (55.0 kg/day)
Raw Wastewater
Reservoir Tank
Floating Sponge Filtration Tank (FSF)
High Rate Trickling Filter (HTF)
Final Solid Liquid Separation Tank (SLS)
Treated Water Tank
Final Discharge
Backwashing Water from FSF
Flow Rate 986.0 m3/day
T-BOD 278 mg/l (274.5 kg/day)
S-BOD 98 mg/l (96.6 kg/day)
TSS 1,083 mg/l (1,067.5 kg/day)
Backwashing Water from SLS
Flow Rate 117.4 m3/day
T-BOD 76 mg/l (8.9 kg/day)
S-BOD 10 mg/l (1.2 kg/day)
TSS 134 mg/l (15.7 kg/day)
Settled Sludge from SLS
Flow Rate 12.6 m3/day
T-BOD 2,817 mg/l (35.5 kg/day)
S-BOD 10 mg/l (0.1 kg/day)
TSS 5,000 mg/l (63.0 kg/day)
Wastewater Treatment
Sludge Treatment
Wastewater from HTF
Flow Rate 49.1 m3/day
T-BOD 34 mg/l (1.7 kg/day)
S-BOD 10 mg/l (0.5 kg/day)
TSS 26 mg/l (1.3 kg/day)
Storage Tank
Total Removal Efficiency
BOD: 86.7%
TSS: 94.6%
Sedimentation Tank Inlet
Flow Rate 1,214.5 m3/day
T-BOD 255 mg/l (309.8 kg/day)
S-BOD 85 mg/l (102.9 kg/day)
TSS 976 mg/l (1,185.6 kg/day)
Primary Sedimentation Tank
Supernatant from PST
Flow Rate 1,119.6 m3/day
T-BOD 122 mg/l (136.2 kg/day)
S-BOD 85 mg/l (94.8 kg/day)
TSS 212 mg/l (237.1 kg/day)
Settled Sludge
Flow Rate 94.9 m3/day
T-BOD 1,830 mg/l (173.7 kg/day)
S-BOD 85 mg/l (8.1 kg/day)
TSS 10,000 mg/l (948.5 kg/day)
Sludge Thickener
Leachate from Drying Bed
Flow Rate 8.8 m3/day
T-BOD 529 mg/l (4.7 kg/day)
S-BOD 500 mg/l (4.4 kg/day)
TSS 1,114 mg/l (9.8 kg/day)
Supernatant from ST
Flow Rate 62.0 m3/day
T-BOD 400 mg/l (24.8 kg/day)
S-BOD 76 mg/l (4.6 kg/day)
TSS 1,631 mg/l (101.1 kg/day)
Thickened Sludge
Flow Rate 45.5 m3/day
T-BOD 4,052 mg/l (184.4 kg/day)
S-BOD 76 mg/l (3.5 kg/day)
TSS 20,000 mg/l (910.1 kg/day)
Biogas Digester/Settler
Supernatant from Biogas Settler
Flow Rate 35.7 m3/day
T-BOD 541 mg/l (19.3 kg/day)
S-BOD 500 mg/l (17.9 kg/day)
TSS 1,528 mg/l (54.6 kg/day)
Digested Sludge
Flow Rate 9.8 m3/day
T-BOD 1,792 mg/l (17.6 kg/day)
S-BOD 500 mg/l (4.9 kg/day)
TSS 50,000 mg/l (491.5 kg/day)
Dried Sludge
Amount 0.96 t/day
Solid 50% (481.7 kg/day)
M.C. 50% (481.3 kg/day)
Sludge Drying Bed
Disposal

[ANNEX]
OUTLINE DESIGN DRAWINGS

THE PREPARATORY SURVEY ON THE PROJECT SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY
LIST OF DRAWINGS

TITLE	SCALE	DWG NO.	TITLE	SCALE	DWG NO.	TITLE	SCALE	DWG NO.
GENERAL MAP			**Administration Building**			**MECHANICAL AND ELECTRICAL WORK**		
General Map		GM-001	Administration Building Floor Plan		STP-AB-001	**Mechanical Work**		
General Note		GM-002	Administration Building Elevation		STP-AB-002	General Flow Diagram		MW-001
			Administration Building Detail Section		STP-AB-003	Mechanical Equipment Layout for Main Pump Building (1/2)		MW-002
SEWAGE TREATMENT PLANT			Administration Building Finish Schedule		STP-AB-004	Mechanical Equipment Layout for Main Pump Building (2/2)		MW-003
General			Administration Building Structural Drawing		STP-AB-005	Mechanical Equipment Section Layout for Main Pump Building (1/4)		MW-004
General Layout of Sewage Treatment Plant		STP-GN-001	Administration Building Door & Window Schedule 1		STP-AB-006	Mechanical Equipment Section Layout for Main Pump Building (2/4)		MW-005
Hydraulic Profile		STP-GN-002	Administration Building Door & Window Schedule 2		STP-AB-007	Mechanical Equipment Section Layout for Main Pump Building (3/4)		MW-006
General Layout of Wastewater Treatment Facilities		STP-GN-003				Mechanical Equipment Section Layout for Main Pump Building (4/4)		MW-007
			Landscaping			Mechanical Equipment Layout for Filtering Tank (1/4)		MW-008
Main Pump Building			Layout of Yard Piping		STP-LS-001	Mechanical Equipment Layout for Filtering Tank (2/4)		MW-009
Main Pump Building Plan (1/3)		STP-MB-001	Profile and Detail of Yard Piping		STP-LS-002	Mechanical Equipment Layout for Filtering Tank (3/4)		MW-010
Main Pump Building Plan (2/3)		STP-MB-002	Layout of Pavement, Drainage, Gate & Wall		STP-LS-003	Mechanical Equipment Layout for Filtering Tank (4/4)		MW-011
Main Pump Building Plan (3/3)		STP-MB-003	Detail of Pavement & Drainage		STP-LS-004	Mechanical Equipment Section Layout for Filtering Tank (1/4)		MW-012
Main Pump Building Section (1/4)		STP-MB-004	Detail of Outfall (1/2)		STP-LS-005	Mechanical Equipment Section Layout for Filtering Tank (2/4)		MW-013
Main Pump Building Section (2/4)		STP-MB-005	Detail of Outfall (2/2)		STP-LS-006	Mechanical Equipment Section Layout for Filtering Tank (3/4)		MW-014
Main Pump Building Section (3/4)		STP-MB-006	Detail of Gate & Wall		STP-LS-007	Mechanical Equipment Section Layout for Filtering Tank (4/4)		MW-015
Main Pump Building Section (4/4)		STP-MB-007	Landscaping Pond		STP-LS-008	Mechanical Equipment Layout for Solid-liquid Separation Tank		MW-016
Main Pump Building Elevation		STP-MB-008	Layout of Yard Cabling & Lighting		STP-LS-009	Mechanical Equipment Section Layout for Solid-liquid Separation Tank		MW-017
Main Pump Building Finish Schedule		STP-MB-009	Detail of Handhole, Trench Excavation and Yard Lighting		STP-LS-010	Mechanical Equipment Plan & Section for Chlorination Tank		MW-018
Main Pump Building Door & Window List		STP-MB-010				Mechanical Equipment Layout for Sludge Digestion Facilities(1/2)		MW-019
			Land Fill			Mechanical Equipment Layout for Sludge Digestion Facilities(2/2)		MW-020
Filtering Tank (FSF and HTF)			Layout Plan of Cofferdam		STP-LF-001			
Filtering Tank Plan (1/4)		STP-HT-001	Section of Cofferdam(1/2)		STP-LF-002	**Electrical Work**		
Filtering Tank Plan (2/4)		STP-HT-002	Section of Cofferdam(2/2)		STP-LF-003	Single Line Diagram for Sewage Treatment Plant (1/2)		EW-001
Filtering Tank Plan (3/4)		STP-HT-003	Layout Plan of Dredging		STP-LF-004	Single Line Diagram for Sewage Treatment Plant (2/2)		EW-002
Filtering Tank Plan (4/4)		STP-HT-004	Section of Dredging(1/2)		STP-LF-005	Single Line Diagram for Interception Facility		EW-003
Filtering Tank Section (1/4)		STP-HT-005	Section of Dredging(2/2)		STP-LF-006	System Configuration		EW-004
Filtering Tank Section (2/4)		STP-HT-006	Layout Plan of Landfill		STP-LF-007	Cabling Layout for Power Supply (1/4)		EW-005
Filtering Tank Section (3/4)		STP-HT-007	Section of Landfill(1/2)		STP-LF-008	Cabling Layout for Power Supply (2/4)		EW-006
Filtering Tank Section (4/4)		STP-HT-008	Section of Landfill(2/2)		STP-LF-009	Cabling Layout for Power Supply (3/4)		EW-007
						Cabling Layout for Power Supply (4/4)		EW-008
Solid-Liquid Sepatration Tank (SLS)			**INTERCEPTION FACILITY & SEWER PIPE**					
Solid-Liquid Sepatration Tank Plan		STP-SL-001	General Layout of Interception Facility & Sewer Pipe (all)		ISP-001	**Transformer House**		
Solid-Liquid Sepatration Tank Section		STP-SL-002	General Layout of Interception Facility & Sewer Pipe (1/3)		ISP-002	Transformer House Plan and Section & Elevation		TH-001
			General Layout of Interception Facility & Sewer Pipe (2/3)		ISP-003	Transformer House Finish Schedule and Door &Window List		TH-002
Chlorination Tank			General Layout of Interception Facility & Sewer Pipe (3/3)		ISP-004			
Chlorination Tank Plan & Section		STP-CT-001	Channel Maintenance Road Detail		ISP-005			
Chlorination Tank Elevation		STP-CT-002	Channel Maintenance Road Section (1/2)		ISP-006			
Chlorination Tank House Finish Schedule and Door & Window List		STP-CT-003	Channel Maintenance Road Section (2/2)		ISP-007			
			Site Plan of Interception Facility		ISP-008			
Sludge Digestion Facilities			Section of Interception Facility (1/2)		ISP-009			
Sludge Digestion Facilities Plan & Section (1/2)		STP-SD-001	Section of Interception Facility (2/2)		ISP-010			
Sludge Digestion Facilities Plan & Section (2/2)		STP-SD-002	Layout Plan & Sections of Interception Facility		ISP-011			
Sludge Drying Bed								
Sludge Drying Bed Plan		STP-DB-001						
Sludge Drying Bed Plan & Section		STP-DB-002						



THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	GM-001	General Map

GENERAL NOTES

1. GENERAL

1.1 THESE NOTES SHALL APPLY UNLESS SPECIFICATION OTHERWISE INDICATED IN THE RESPECTIVE DRAWINGS.

1.2 UNLESS OTHERWISE SPECIFIED, ALL DIMENSION SHOWN ON THE DRAWINGS ARE IN MILLIMETERS.

1.3 ALL DIMENSIONS RELATING TO THE EXISTING STRUCTURES AND FACILITIES SHALL BE VERIFIED BY THE CONTRACTOR BEFORE COMMENCEMENT OF THE WORKS.

2. EARTHWORK

2.1 AREAS FOR PERMANENT STRUCTURES AND ALL BORROW PITS, QUARRY AND STOCKPILE SITES SHALL BE CLEARED AND GRUBBED. TOP SOIL SHALL BE STRIPPED BEFORE COMMENCEMENT OF CONSTRUCTION.

2.2 BACKFILL SHALL BE PLACED IN HORIZONTAL LAYERS NOT MORE THAN 30 CENTIMETERS THICK AND BE THOROUGHLY COMPACTED IN ACCORDANCE WITH THE SPECIFICATIONS. MAXIMUM SIZE OF ROCK IN THE BACKFILL SHALL BE 150mm.

3. CONCRETE WORK

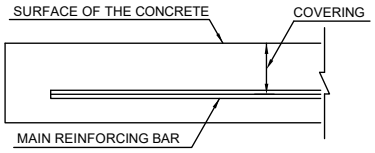
3.1 CLASSIFICATION OF CONCRETE IS AS SHOWN BELOW :

CLASS	USAGE	MINIMUM COMPRESSIVE STRENGTH (28DAYS)	
		Kgf/cm^2	N/mm^2
A	PRE-STRESSED CONCRETE PILE (PRE-STRESS: MORE THAN 4 N/mm^2)	400	40
B1	REINFORCED CONCRETE (RELATED SEDIMENT CHAMBER AT Rd.240, MANHOLE, DRAINAGE PIPE AND ETC.)	240	24
B2	NON-REINFORCED CONCRETE	210	21
C	LEVELING CONCRETE AND LEAN CONCRETE	180	18

TYPE OF CONCRETE SHALL BE AS SHOWN IN THE SPECIFICATIONS AND DIRECTED BY THE CONSULTANT.

3.2 ALL STRUCTURAL CONCRETE MEMBERS OF ABOVE-GROUND PART SHALL BE PROVIDED WITH 20mm MINIMUM CHAMBER ON ALL EXTERIOR EDGES AND CORNERS.

3.3 COVERING IN THE DRAWINGS RELATING TO REINFORCING BAR ARRANGEMENT OF MANHOLE SHALL MEAN THE DISTANCE FROM SURFACE OF THE CONCRETE TO CENTER OF THE MAIN REINFORCING BAR (SEE THE FOLLOWING ILLUSTRATION).



3.4 UNLESS OTHERWISE SPECIFIED, THE MINIMUM CONCRETE COVER FOR REINFORCEMENTS MEASURED FROM THE SURFACE OF THE CONCRETE TO THE FACE OF REINFORCING BARS SHALL NOT BE LESS THAN 50 mm.

3.5 CONSTRUCTION JOINTS OTHER THAN THOSE SHOWN ON THE PLANS SHALL HAVE THE CONSULTANT'S PRIOR APPROVAL.

3.6 ALL REINFORCING STEEL SHALL BE DEFORMED BAR CONFORMING TO JIS G3112.

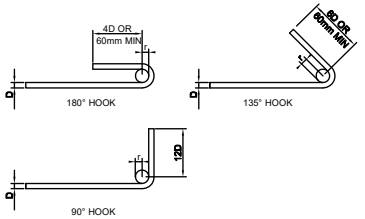
3.7 CLEAR DISTANCE BETWEEN PARALLEL BARS EXCEPT IN COLUMNS AND BETWEEN MULTIPLE LAYERS, SHALL BE NOT LESS THAN 4/3 TIMES MAXIMUM SIZE OF COARSE AGGREGATE.

3.8 ALL BAR SPLICE LAPS AND BENDS SHALL CONFORM TO THE MINIMUM REQUIREMENT AS FOLLOWS:

(1) LAP SPLICE, BENDING RADIUS AND LENGTH

BAR SIZE (SD295)	LAP SPLICE, BENDING RADIUS AND LENGTH			
	LAP LENGTH (mm)		BENDING RADIUS AND LENGTH (mm)	
	MANHOLE	BOX CULVERT	RADIUS (R)	LENGTH (L)
	(30D)	(35D)	(10.5D)	
D13	390	455	140	220
D16	480	560	170	267
D19	570	665	200	314
D22	660	770	240	377
D25	750	875	270	424

(2) HOOKS



BAR SIZE (SD295)	BENDING RADIUS (r) (mm)	
	HOOKS	STIRRUP AND HOOP BAR
	(2.5D)	(2.0D)
D13	33	26
D16	40	32
D19	48	38
D22	55	44
D25	63	50

4. OTHER WORKS

4.1 UNLESS OTHERWISE SPECIFIED, CEMENT MORTAR FOR STRUCTURES SHALL BE PROPORTIONED BY VOLUME OF ONE (1) PART OF CEMENT TO THREE (3) PARTS OF SAND AND FOR REVETMENT.

4.2 PROVISION AND REMOVAL OF THE FALSE WORKS AND CENTERINGS SHALL BE SUBJECT TO APPROVAL BY THE CONSULTANT.

4.3 LOCATIONS OF EXISTING DRAINAGE STRUCTURES INDICATED ON THE PLANS SHALL BE VERIFIED IN THE FIELD AND THE LOCATIONS OF PURPOSED DRAINAGE STRUCTURES SHALL BE ADJUSTED TO SUIT FIELD CONDITIONS.

4.4 THE FINAL PC PILE LENGTH SHALL BE DETERMINED BY THE RESULT OF STATIC LOAD AND MECHANICAL BORING DATA DURING THE IMPLEMENTATION PERIOD.

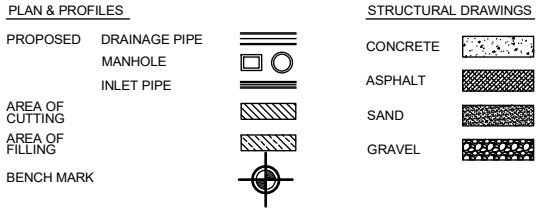
5. OTHERS

ABBREVIATIONS

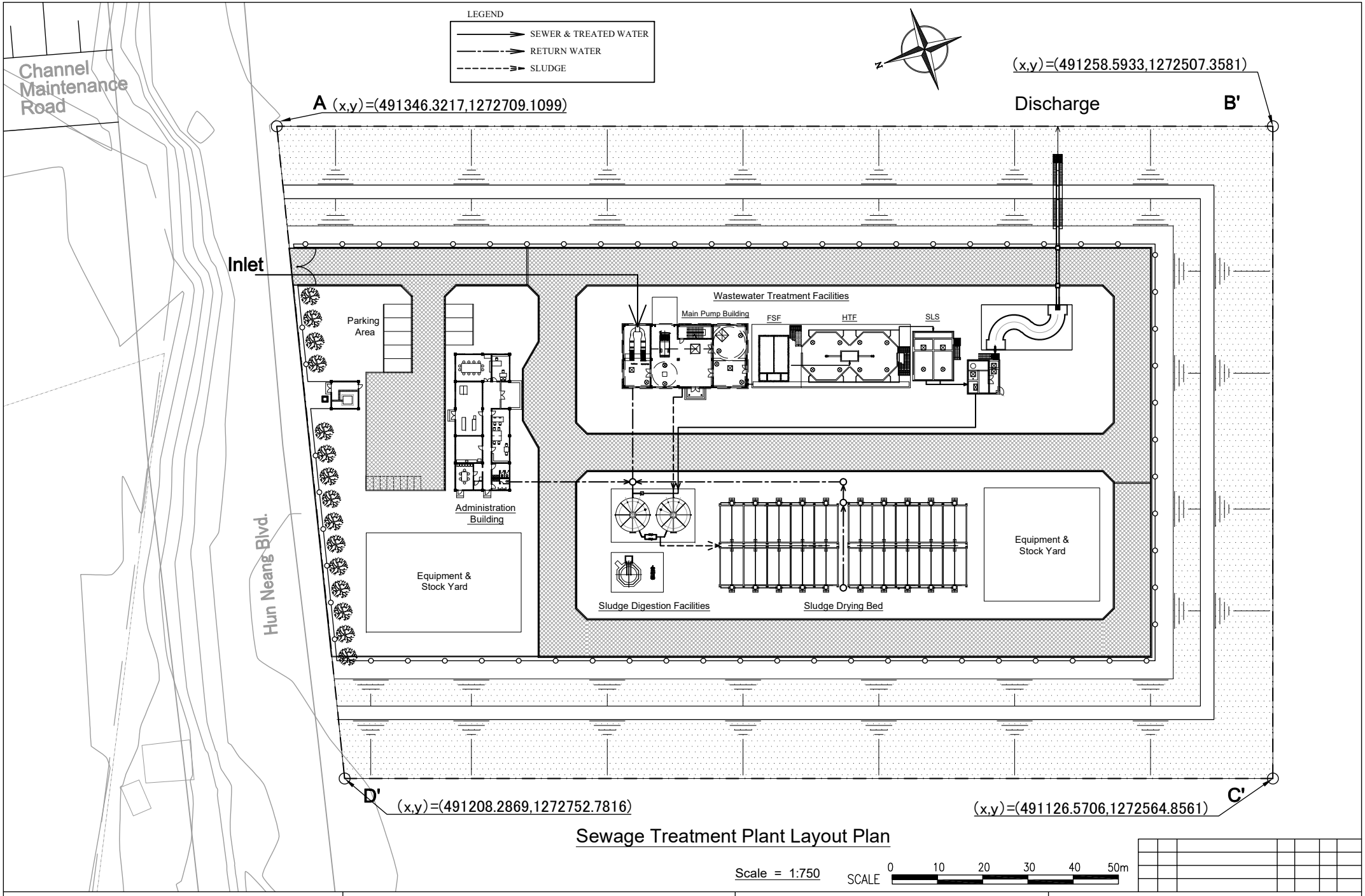
-GENERAL-

B	WIDTH	MIN	MINIMUM
CTC	CENTER TO CENTER	N	NORTH
D	DIAMETER OF DEFORMED BAR	NO	NUMBER
DWG	DRAWING	R	RADIUS
E	EAST	RB	REINFORCING BAR
EL	ELEVATION	S	SOUTH
GL	GROUND LEVEL	T,t	THICKNESS
GH	GROUND HEIGHT	W	WEST
FH	FORMATION HEIGHT	@	SPACING OF REINFORCING BAR
H	HEIGHT	Ø	DIAMETER OF ROUND BAR
L	LENGTH		
MAX	MAXIMUM		

LEGEND



THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	GM-002	General Note

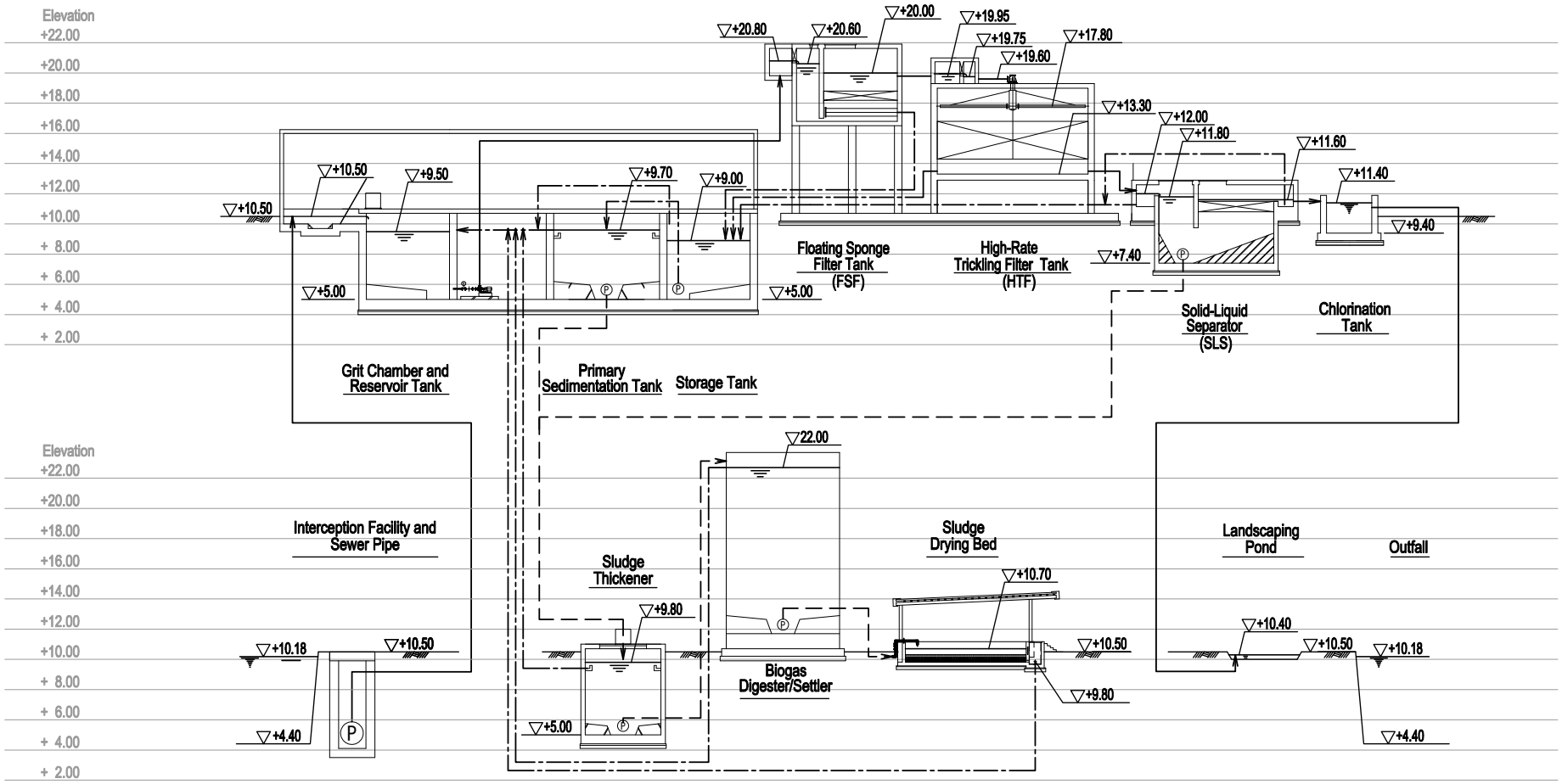


Sewage Treatment Plant Layout Plan

Scale = 1:750

SCALE 0 10 20 30 40 50m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-GN-001	SEWAGE TREATMENT PLANT General Layout of Sewage Treatment Plant

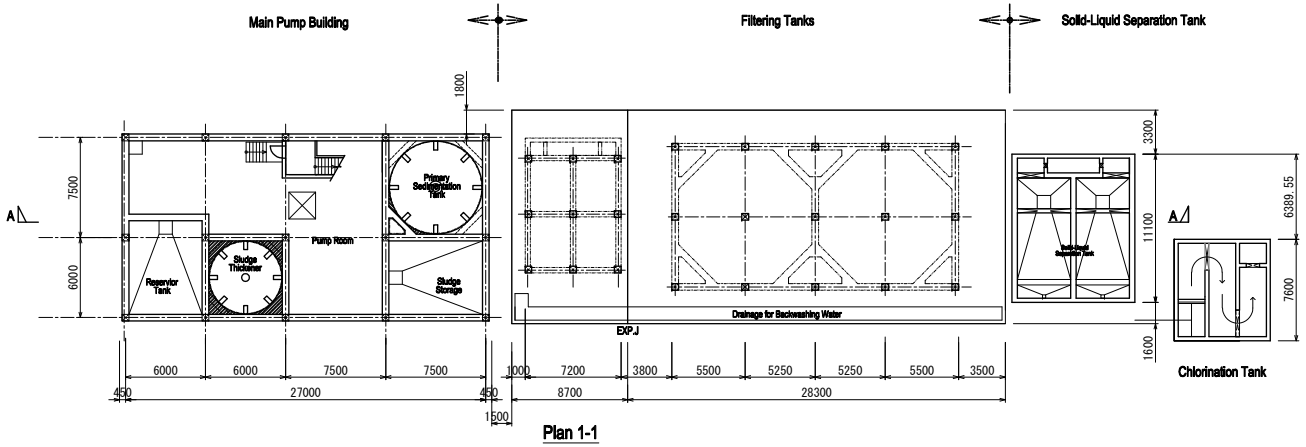


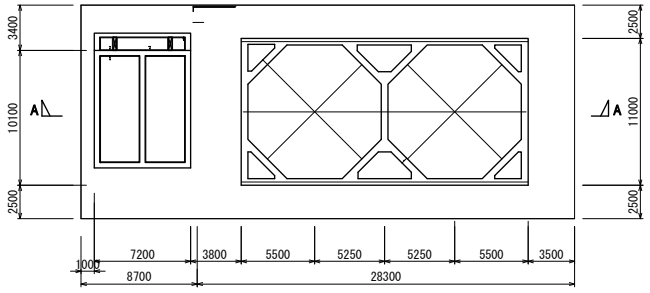
Sewage Treatment Plant Hydraulic Profile

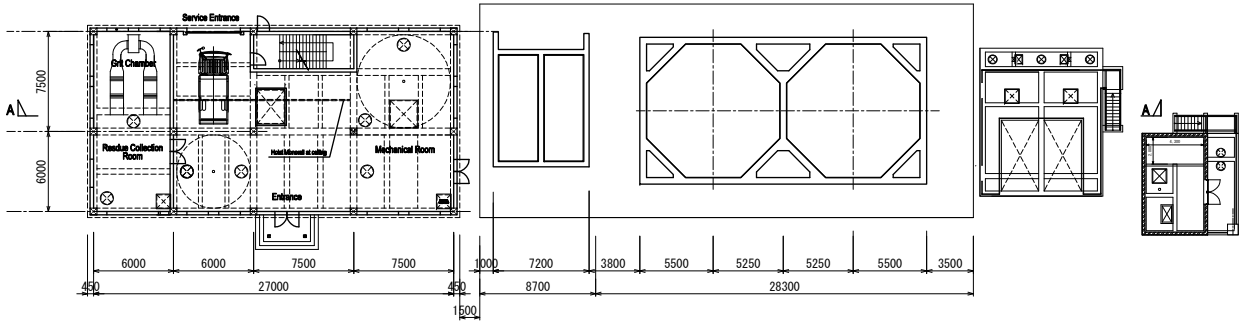
V-Scale = 1:150

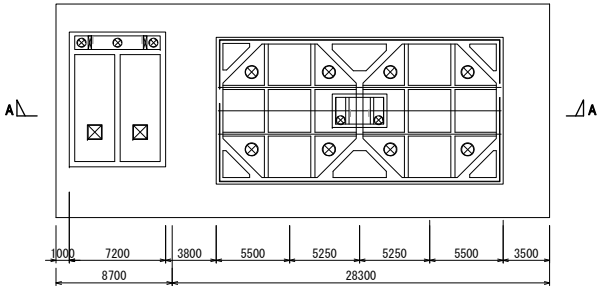
H-Scale = Non

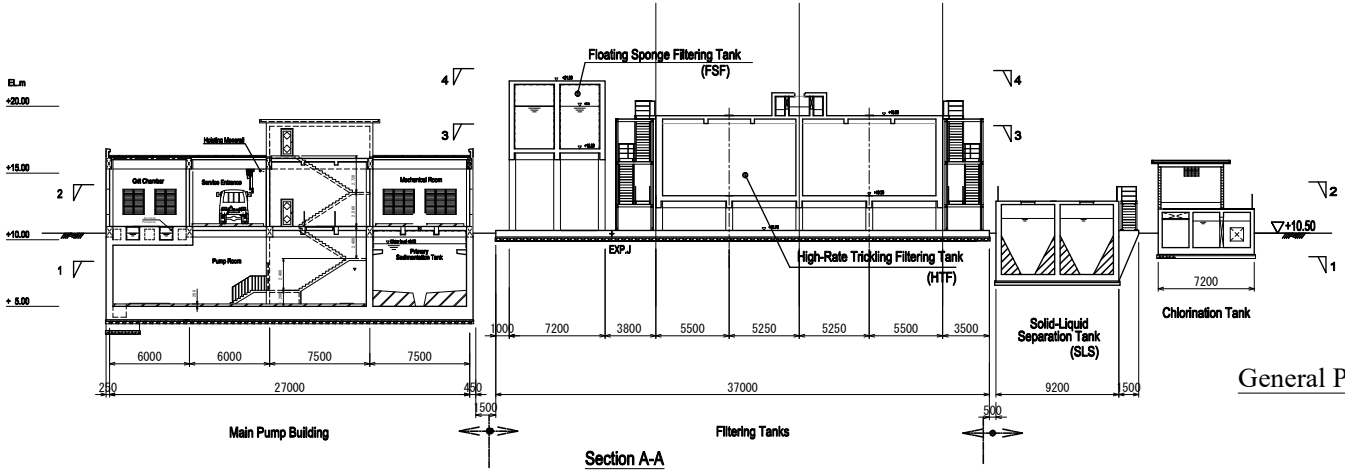
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-GN-002	SEWAGE TREATMENT PLANT Hydraulic Profile









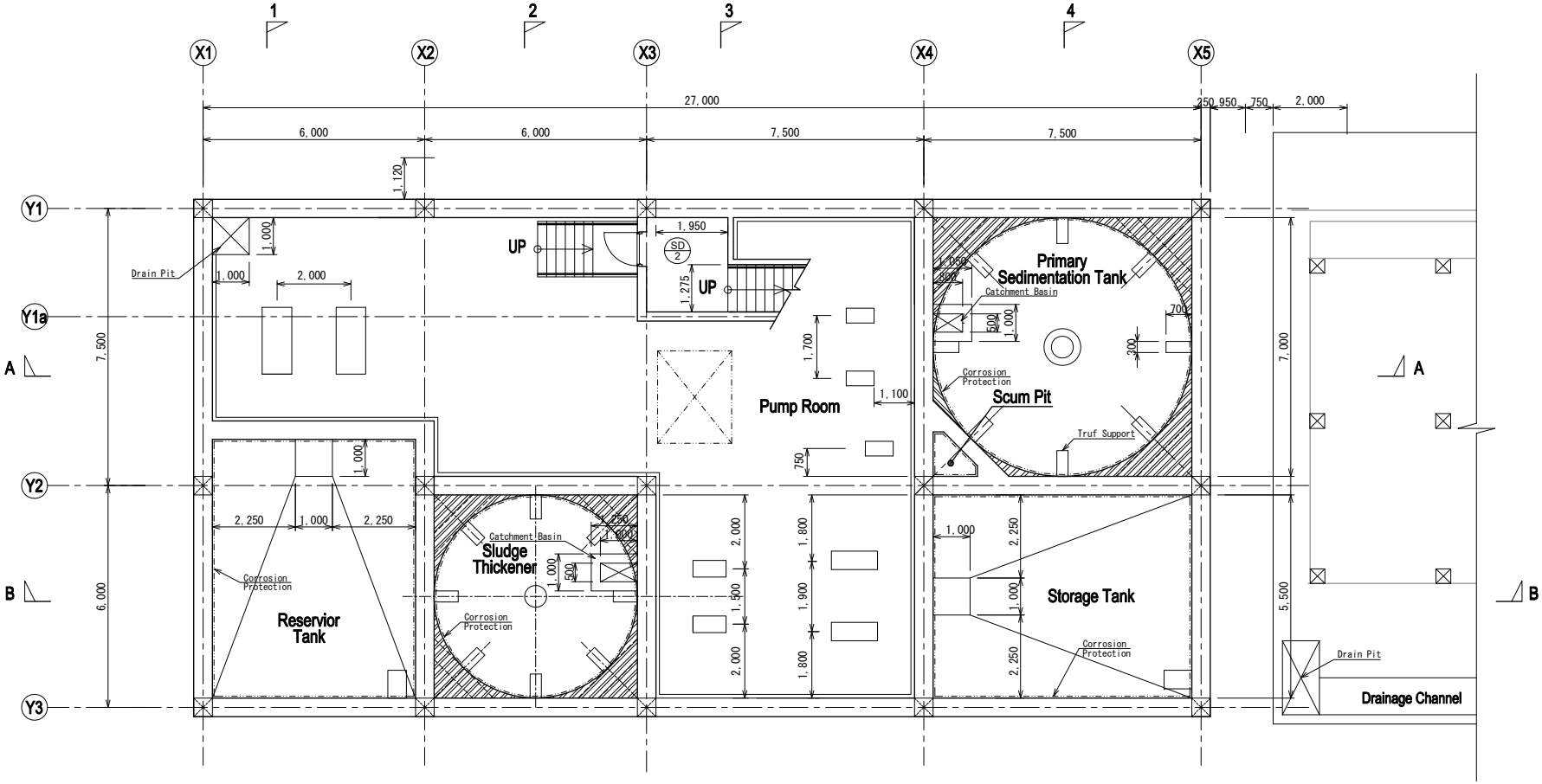


LEGEND

SEWER & TREATED WATER
BACK WASHING WATER
SLUDGE

General Plan & Cross Section of Wastewater Treatment Facilities

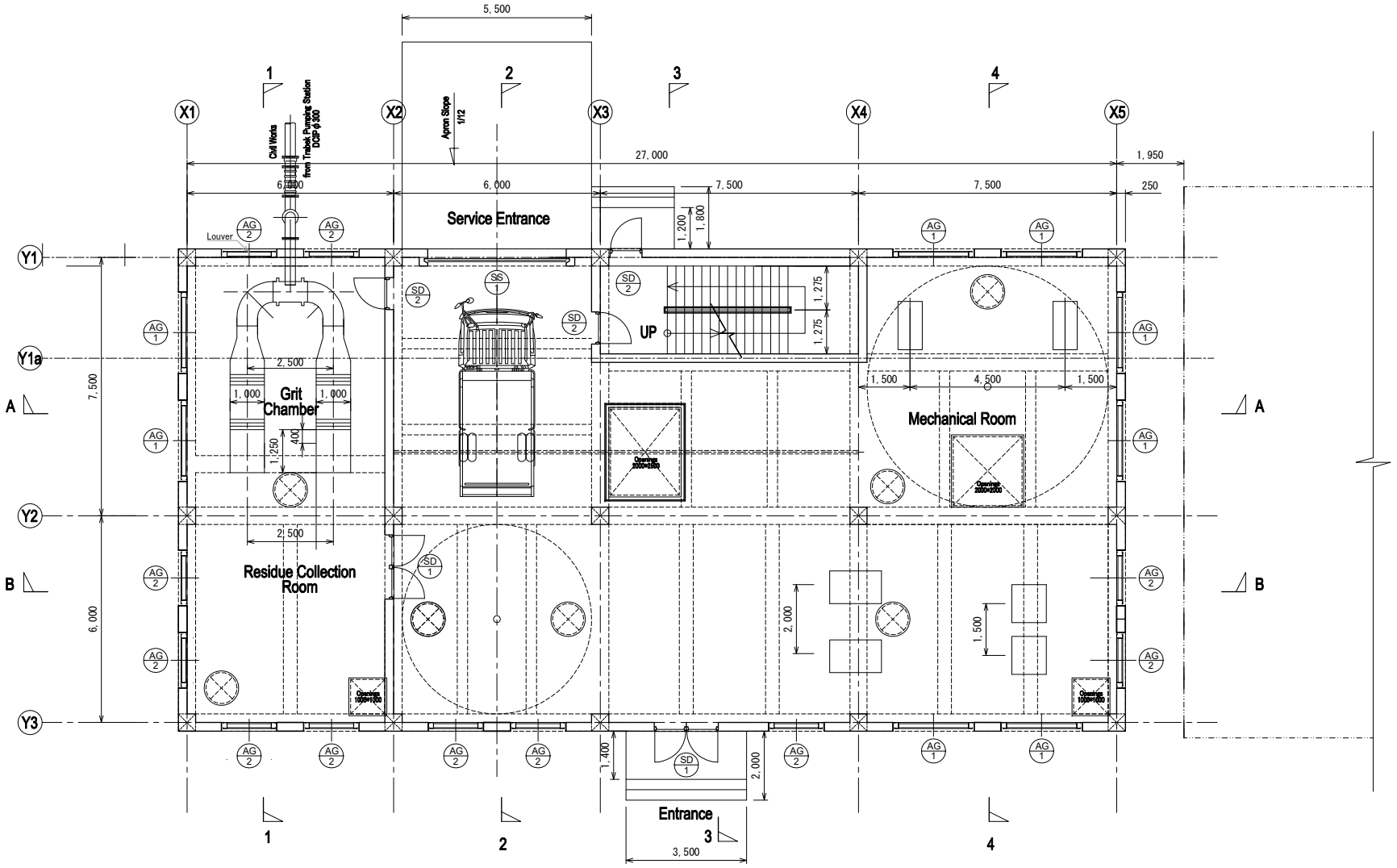
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP- GN-003	SEWAGE TREATMENT PLANT General Layout of Wastewater Treatment Facilities



Basement Floor (BF) PLAN

Scale = 1:125

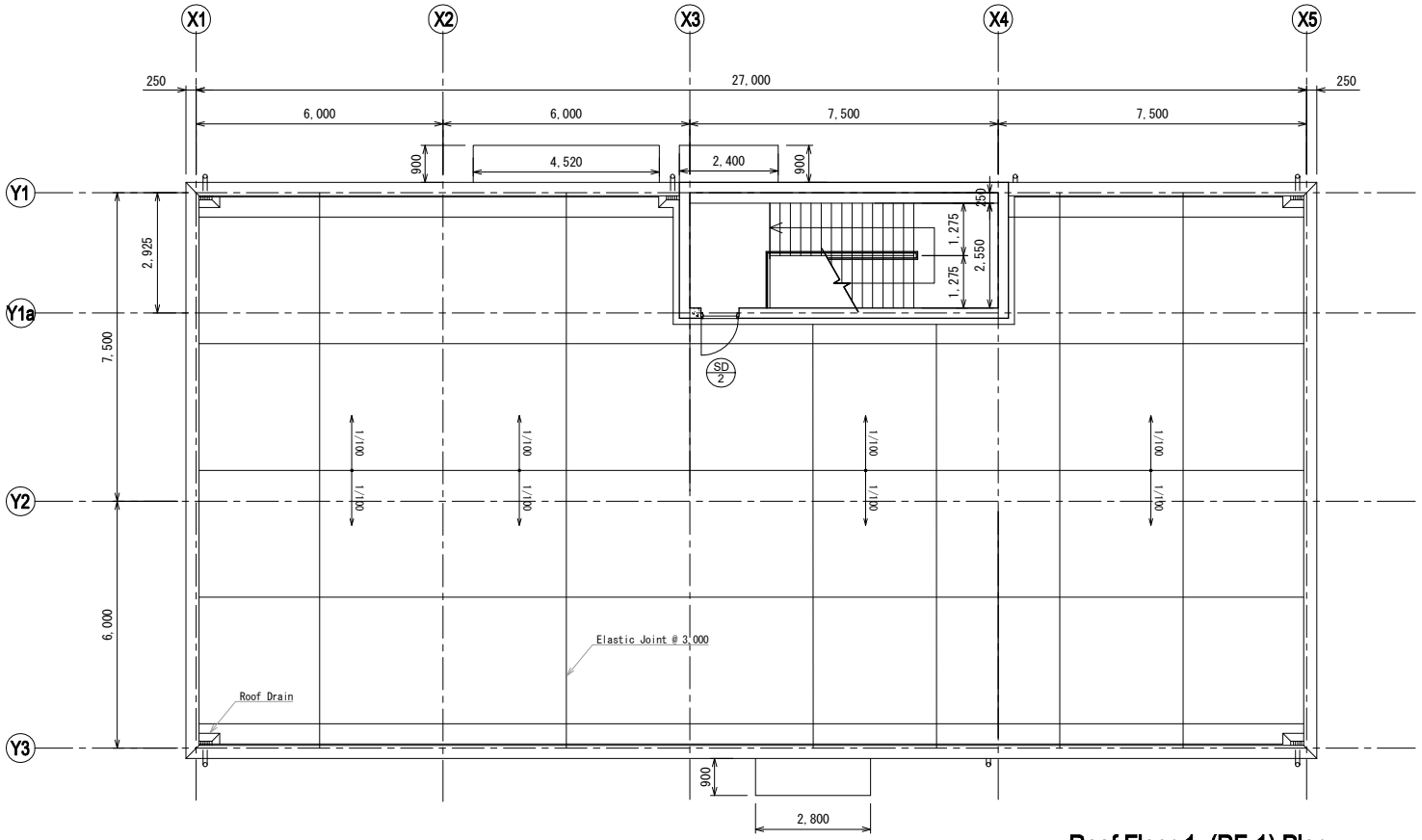
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-001	SEWAGE TREATMENT PLANT Main Pump Building Plan (1/3)



Ground Floor (GF) PLAN

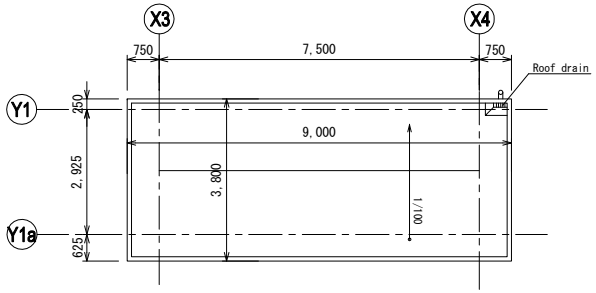
Scale = 1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-002	SEWAGE TREATMENT PLANT Main Pump Building Plan (2/3)



Roof Floor-1 (RF-1) Plan

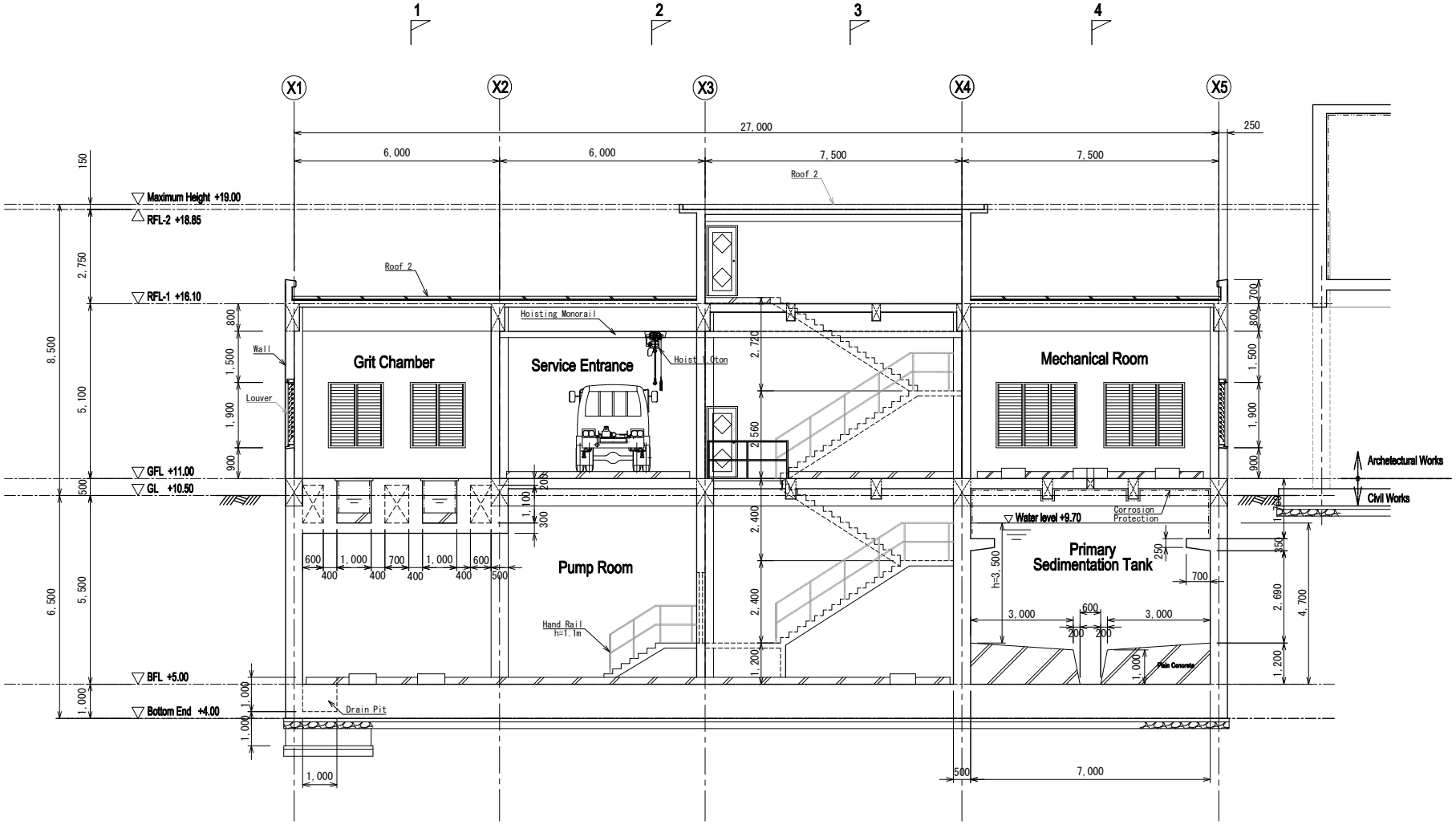
Scale = 1:125



Roof Floor - 2 (RF-2) Plan

Scale = 1:125

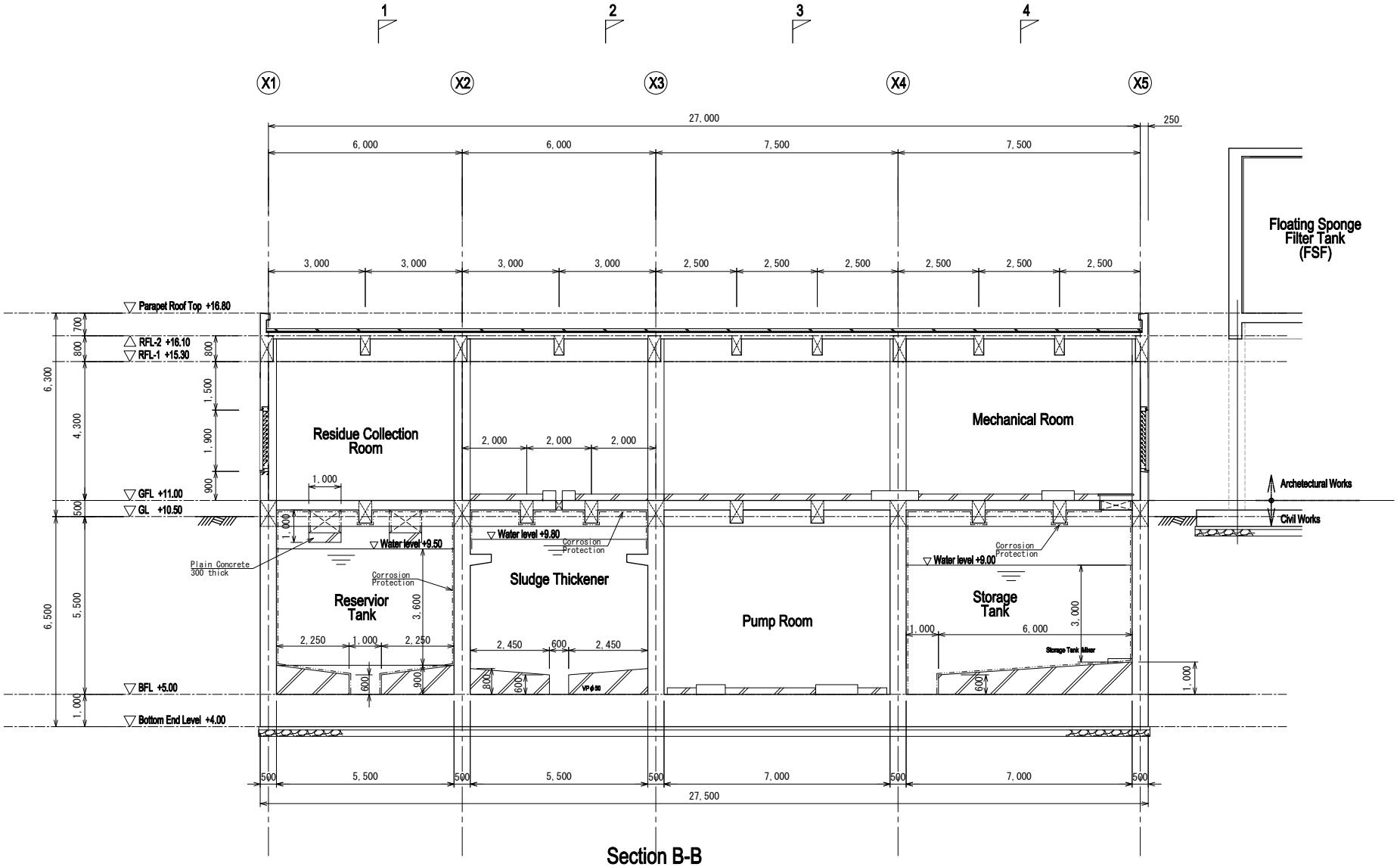
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-003	SEWAGE TREATMENT PLANT Main Pump Building Plan(3/3)



Section A-A

Scale = 1:125

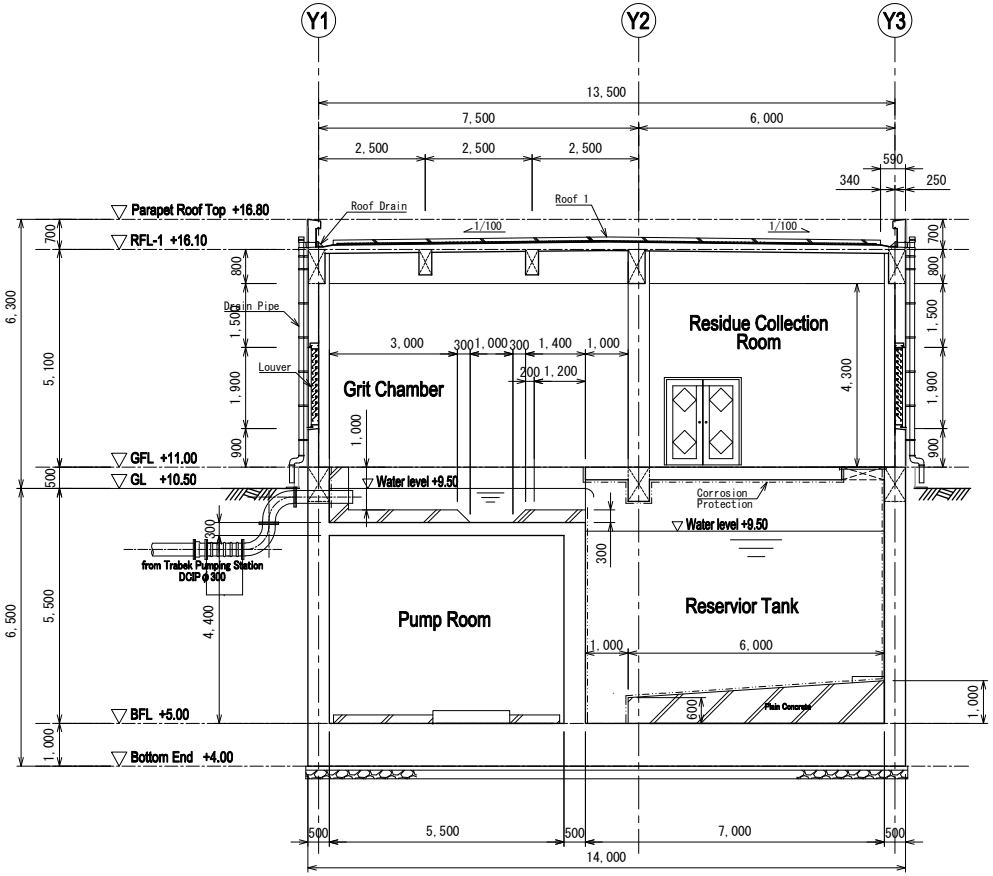
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-004	SEWAGE TREATMENT PLANT Main Pump Building Section (1/4)



Section B-B

Scale = 1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-005	SEWAGE TREATMENT PLANT Main Pump Building Section (2/4)



Section 1-1

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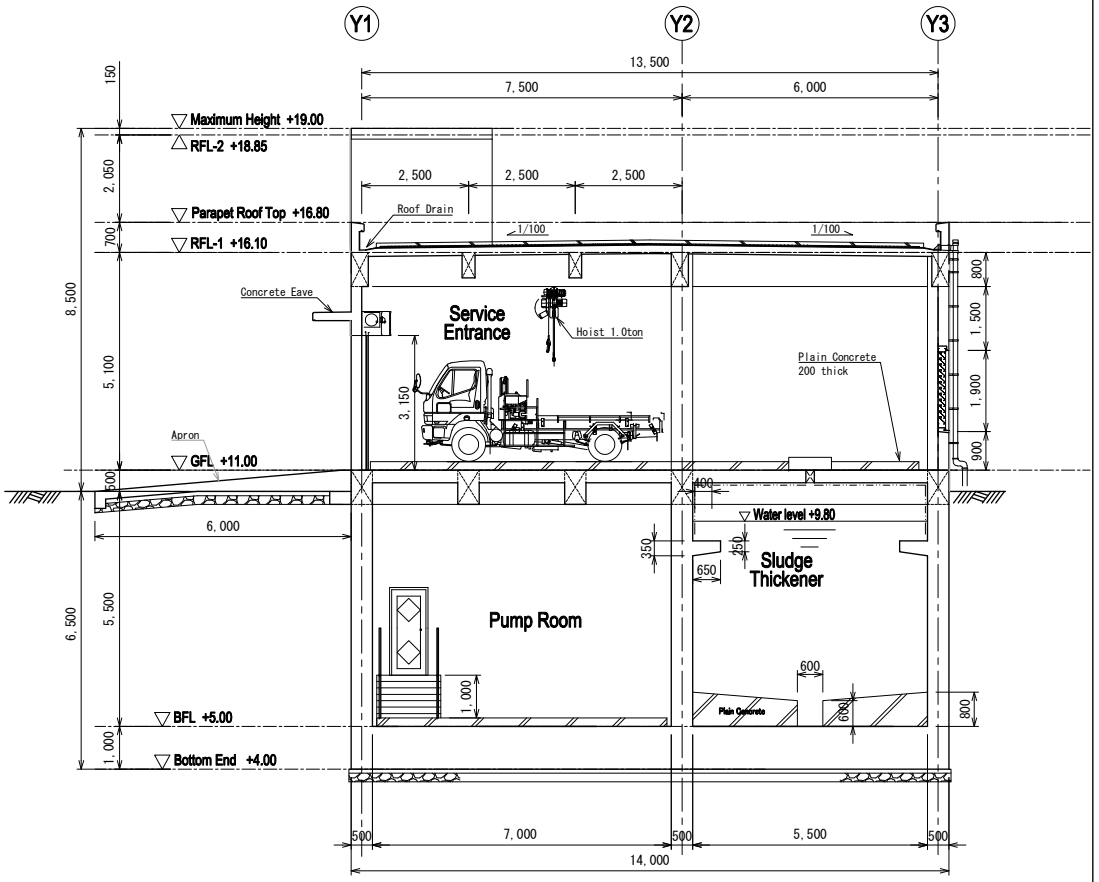
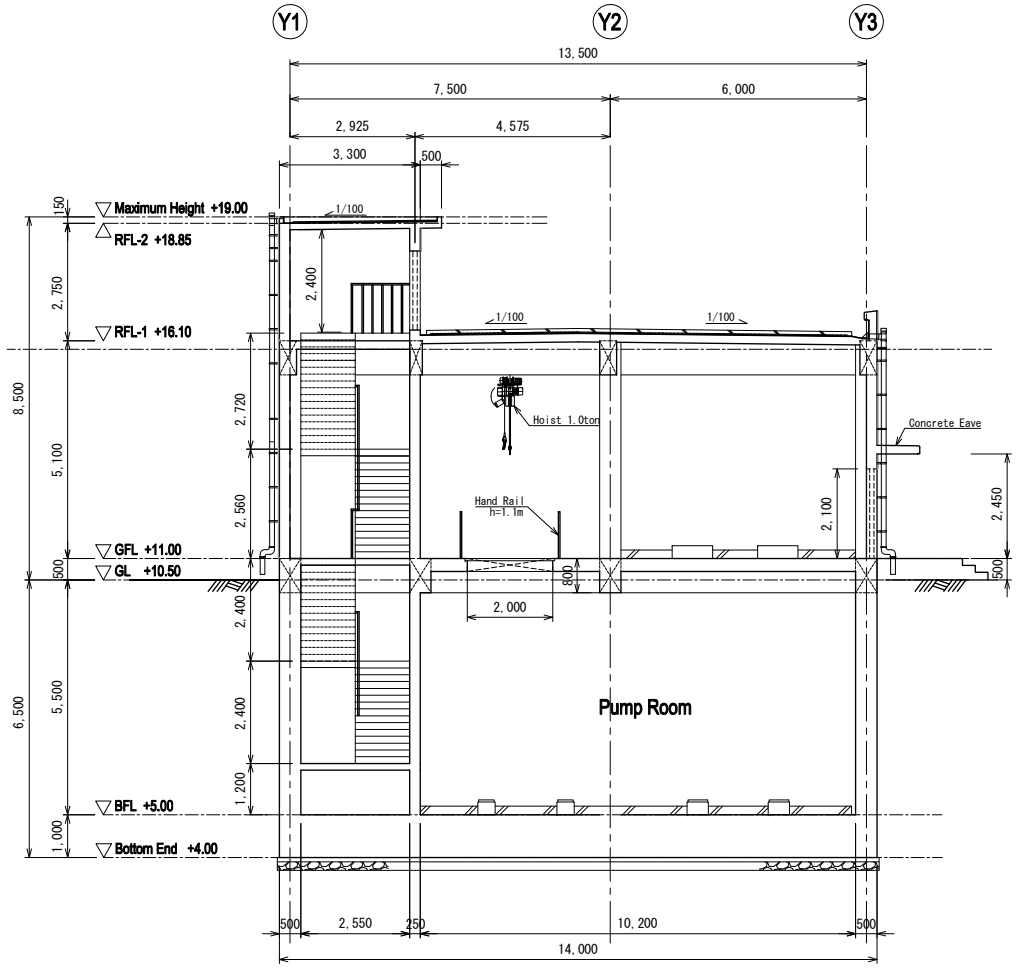


Section 2-2

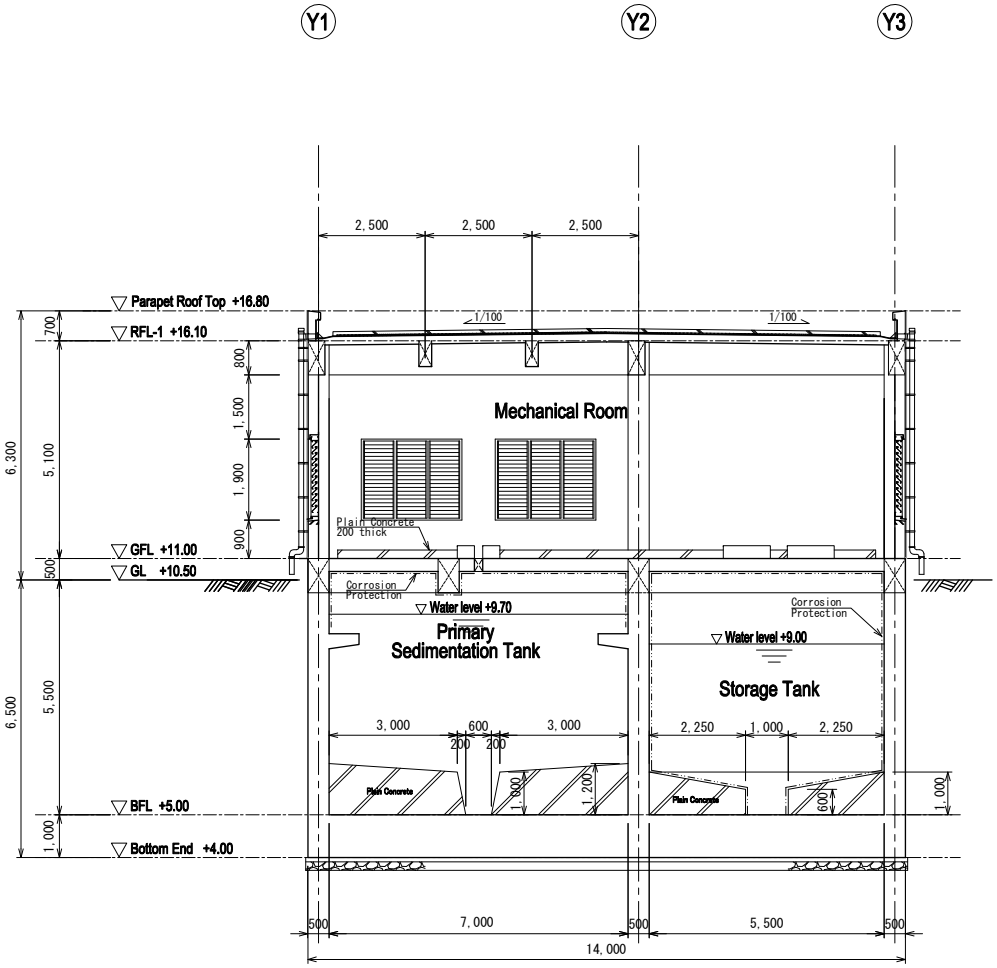
Scale = 1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-006	SEWAGE TREATMENT PLANT Main Pump Building Section (3/4)



Section 3-3

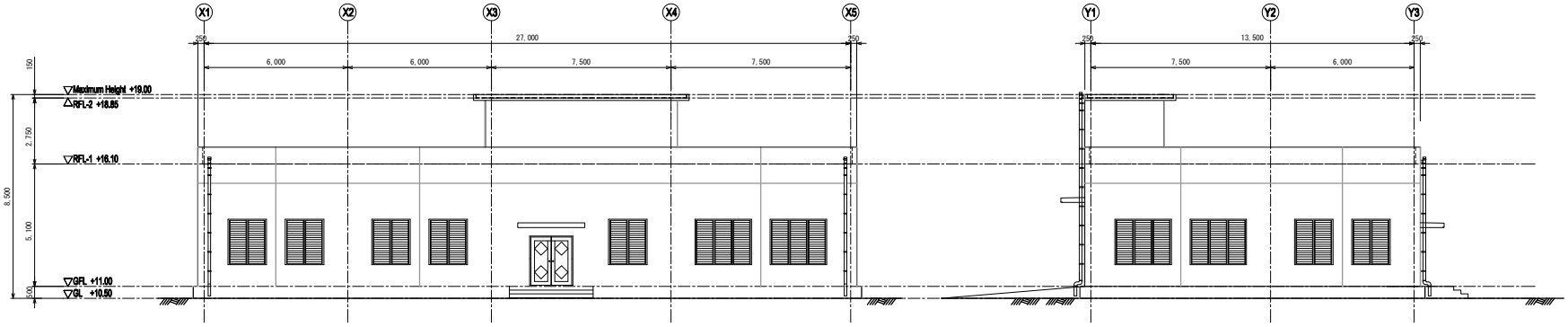
Scale = 1:125



Section 4-4

Scale = 1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-007	SEWAGE TREATMENT PLANT Main Pump Building Section (4/4)

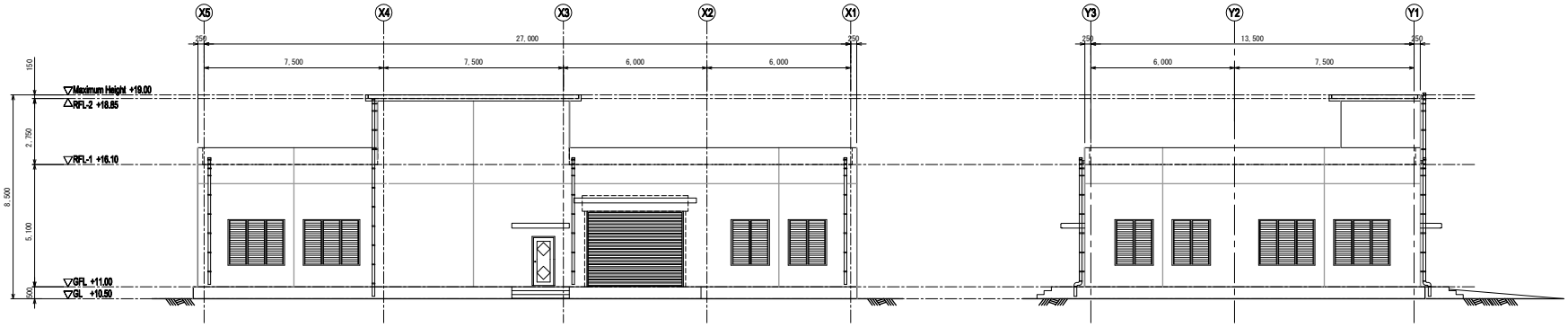


Elevation Front View

Scale = 1:200

Elevation Left View

Scale = 1:200



Elevation Back View

Scale = 1:200

Elevation Right View

Scale = 1:200

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-008	SEWAGE TREATMENT PLANT Main Pump Building Elevation

EXTERIOR FINISH SCHEDULE

	MAIN PUMP BUILDING	CHLORINE SOLUTION TANK HOUSE
ROOF	PORCH Protection : Concrete thickness 80mm with wire mesh Isolation cloth : Flat yarn cloth Insulator board : Polystyrene foam board Waterproofing : Asphalt prepared roofing 30kg/roll Concrete face : Concrete steel trowel finish ROOF TOP STAIR HOUSE & PORCH Protection : Concrete thickness 80mm with wire mesh Isolation cloth : Flat yarn cloth Insulator board : Polystyrene foam board Waterproofing : Asphalt prepared roofing 30kg/roll Concrete face : Concrete steel trowel finish	
WALL	Fair-faced concrete AEP	
BASEBOARD	Cement mortar steel trowel finish H=250 and joint	
DOORS & WINDOWS	WINDOWS : Aluminum fixed louver DOORS : Steel door SOP	
THE OTHER	PORCH Floor : Concrete steel trowel finish Column : Fair-faced concrete AEP Ceiling : Fair-faced concrete AEP APRON : Concrete steel trowel finish	

BUILDING OUTLINE

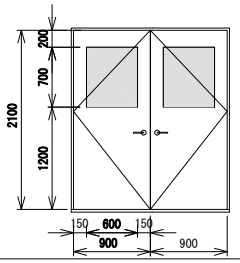
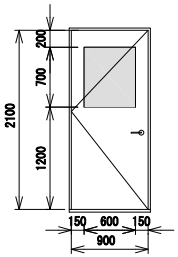
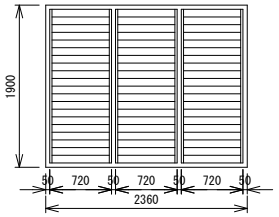
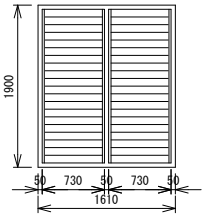
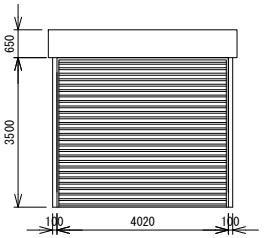
	MAIN PUMP BUILDING	CHLORINE SOLUTION TANK HOUSE
FLOOR AREA	364.50m²	34.78m²
USE	MECHANICAL ROOM, RESIDUE COLLECTION ROOM	CHLORINE SOLUTION TANK ROOM
STRUCTURE	REINFORCE CONCRETE STRUCTURE	CONCRETE BLOCK STRUCTURE
SCOPE	ONE-STORY BUILDING	ONE-STORY BUILDING
HEIGHT	8,500mm (from GROUND LEVEL) 8,000mm (from SURFACE OF CIVIL STRUCTURE)	5,200mm (from GROUND LEVEL) 3,400mm (from SURFACE OF CIVIL STRUCTURE)
REMARKS		

INTERIOR FINISH SCHEDULE

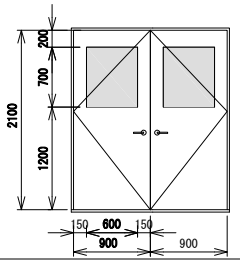
	ROOM NAME	FLOOR LEVEL	FLOOR	BASEBOARD	WALL	CEILING	CEILING HEIGHT (mm)	REMARKS
MAIN PUMP BUILDING	MECHANICAL ROOM	±0	Concrete steel trowel finish W/Epoxy resin coating Light-weight concrete t300	Concrete mortar t200 AEP H300	Fair-faced concrete AEP	Fair-faced concrete AEP	5,000	Side ditch with steel lid
	RESIDUE COLLECTION ROOM	±0	Concrete steel trowel finish W/Epoxy resin coating Light-weight concrete t300	Concrete mortar t200 AEP H300	Fair-faced concrete AEP	Fair-faced concrete AEP	5,000	Side ditch with steel lid
	STAIR ROOM	±0	Concrete steel trowel finish	Concrete mortar t200 AEP H150	Fair-faced concrete AEP	Fair-faced concrete AEP	Varies	
CHROLINE SOLUTION TANK HOUSE	CHLORINE SOLUTION TANK ROOM	±0	Concrete steel trowel finish	Concrete mortar t200 AEP H150	Concrete mortar t200 AEP on concrete block wall	Fair-faced concrete AEP	3400	

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-009	SEWAGE TREATMENT PLANT Main Pump Building Finish Schedule

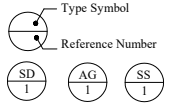
MAIN PUMP BUILDING

KEY NUMBER / TYPE & QUANTITY	SD 1	SD 2	AG 1	AG 2	SS 1
	Steel Double Swinging Door — 4	Steel Single Swinging Door — 3	Aluminium Fixed Louver — 9	Aluminium Fixed Louver — 6	Steel Shutter — 1
ELEVATION					
LOCATION	Entrance, Mechanical Room, Residue Collection Room	Stairs	Entrance, Mechanical Room, Residue Collection Room	Residue Collection Room	Service Entrance
FRAME ; MATERIAL & FINISH	Steel S.O.P.	Steel S.O.P.	Aluminium electro coloring	Aluminium electro coloring	Steel S.O.P.
THRESHOLD or SILL	SUS	SUS	——	——	——
DOOR WINDOW & LOUVER — MATERIAL & FINISH	Steel S.O.P.	Steel S.O.P.	Aluminium electro coloring	Aluminium electro coloring	Steel S.O.P.
DOOR WINDOW & LOUVER — THICKNESS	40 mm	40 mm	——	——	——
DOOR WINDOW & LOUVER — GLASS & SCREEN	TP 5mm	TP 5mm	——	——	——
HARDWARE	Door check, Door knob, Hinge(SUS), Lock, Door stop, Hardware set	Door check, Door knob, Hinge(SUS), Lock, Door stop, Hardware set	Flashing, Hardware set	Flashing, Hardware set	Shutter Box, Hardware set
REMARKS					

CHLORINATION TANK HOUSE

KEY NUMBER / TYPE & QUANTITY	SD 1
	Steel Double Swinging Door — 1
ELEVATION	
LOCATION	Entrance, Mechanical Room, Residue Collection Room
FRAME ; MATERIAL & FINISH	Steel S.O.P.
THRESHOLD or SILL	SUS
DOOR WINDOW & LOUVER — MATERIAL & FINISH	Steel S.O.P.
DOOR WINDOW & LOUVER — THICKNESS	40 mm
DOOR WINDOW & LOUVER — GLASS & SCREEN	TP 5mm
HARDWARE	
REMARKS	

NOTES or REVISIONS :



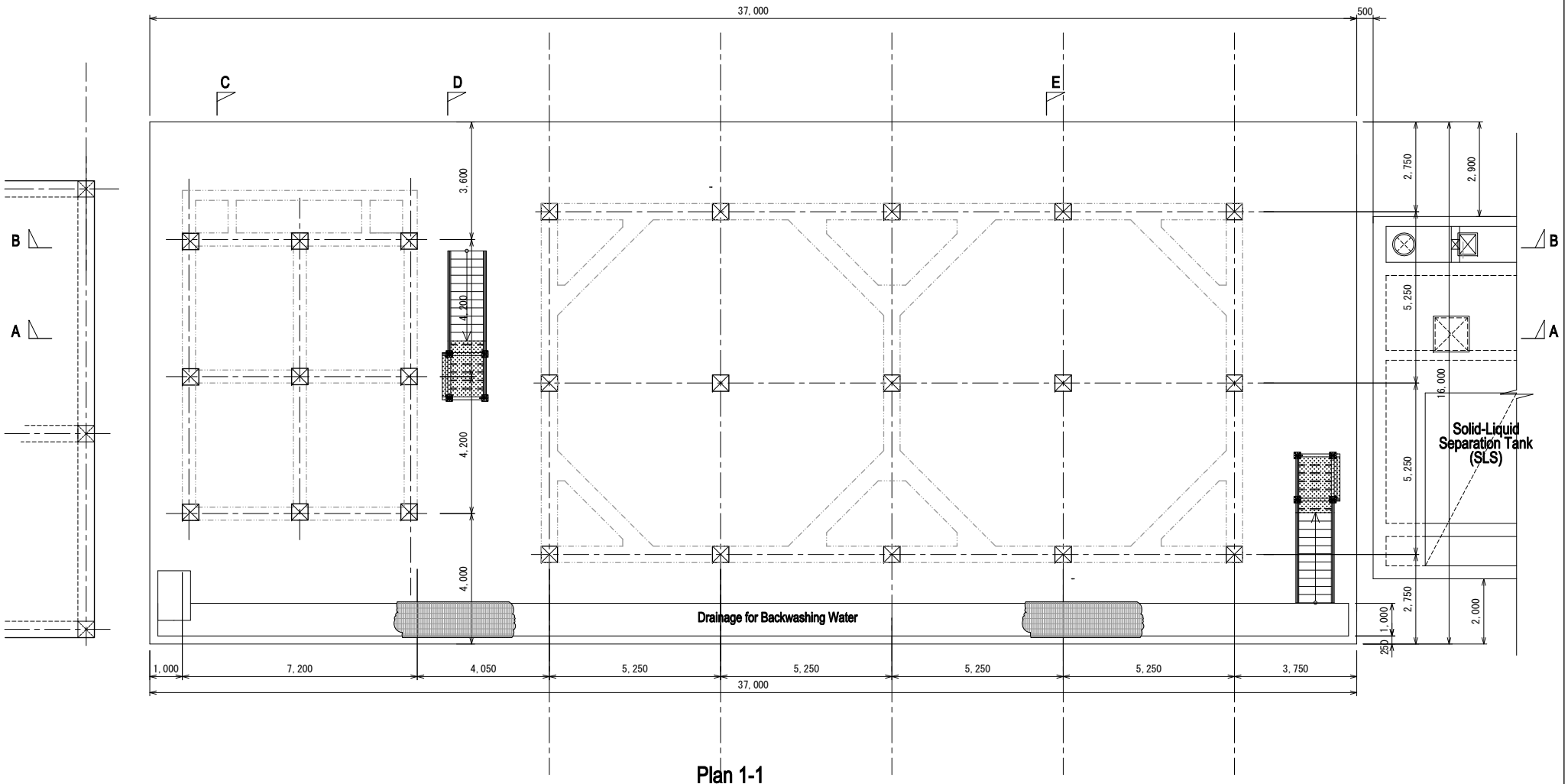
SYMBOL LEGEND

WD	:	Wooden Door
WWL	:	Wooden Window Louver
AWL	:	Aluminum Window Louver
AW	:	Aluminum Window
AD	:	Aluminum Door
SD	:	Steel Door
SG	:	Steel Louver
AG	:	Aluminum Louver

FINISH LEGEND

C.W.P.	:	Clear Wood Preservative
S.O.P.	:	Ready-mixed Synthetic Resin Paint
A.E.P.	:	Acrylic Resin Emulsion Paint
S.V	:	Oil Stain Varnish

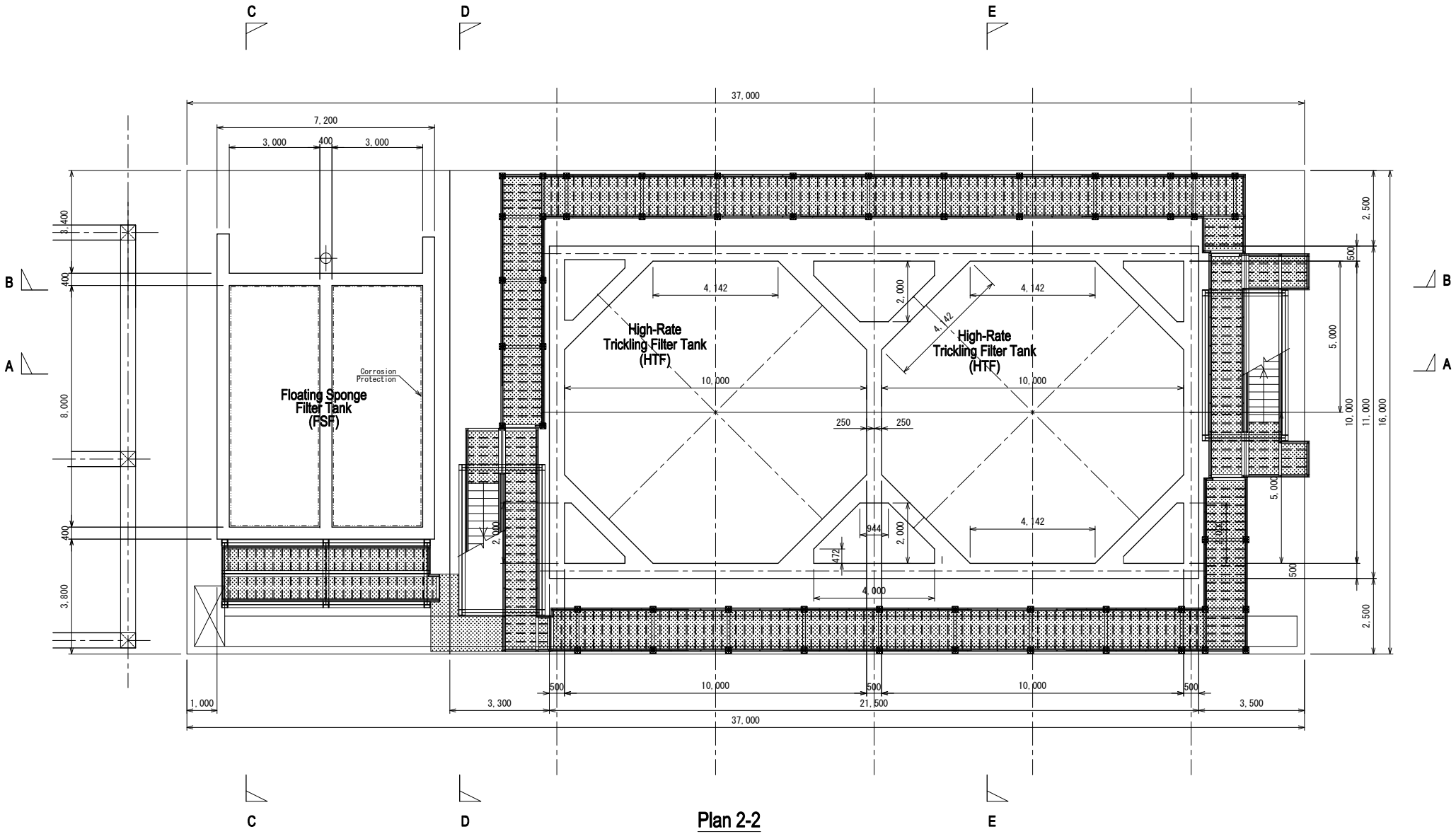
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-010	SEWAGE TREATMENT PLANT Main Pump Building Door & Window List



Plan 1-1

Scale = 1:125

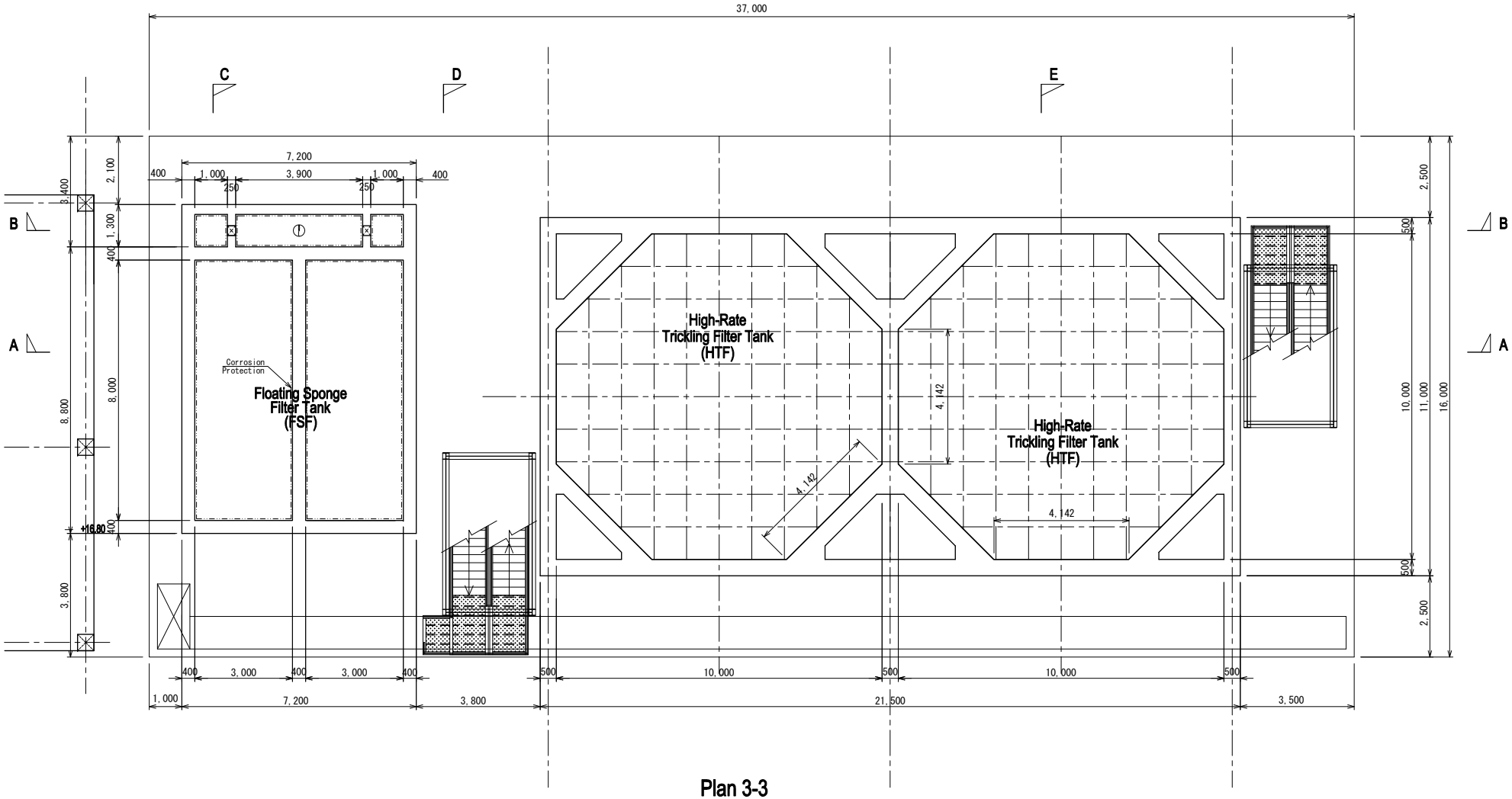
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-001	SEWAGE TREATMENT PLANT Filtering Tank Plan (1/4)



Plan 2-2

Scale = 1:125

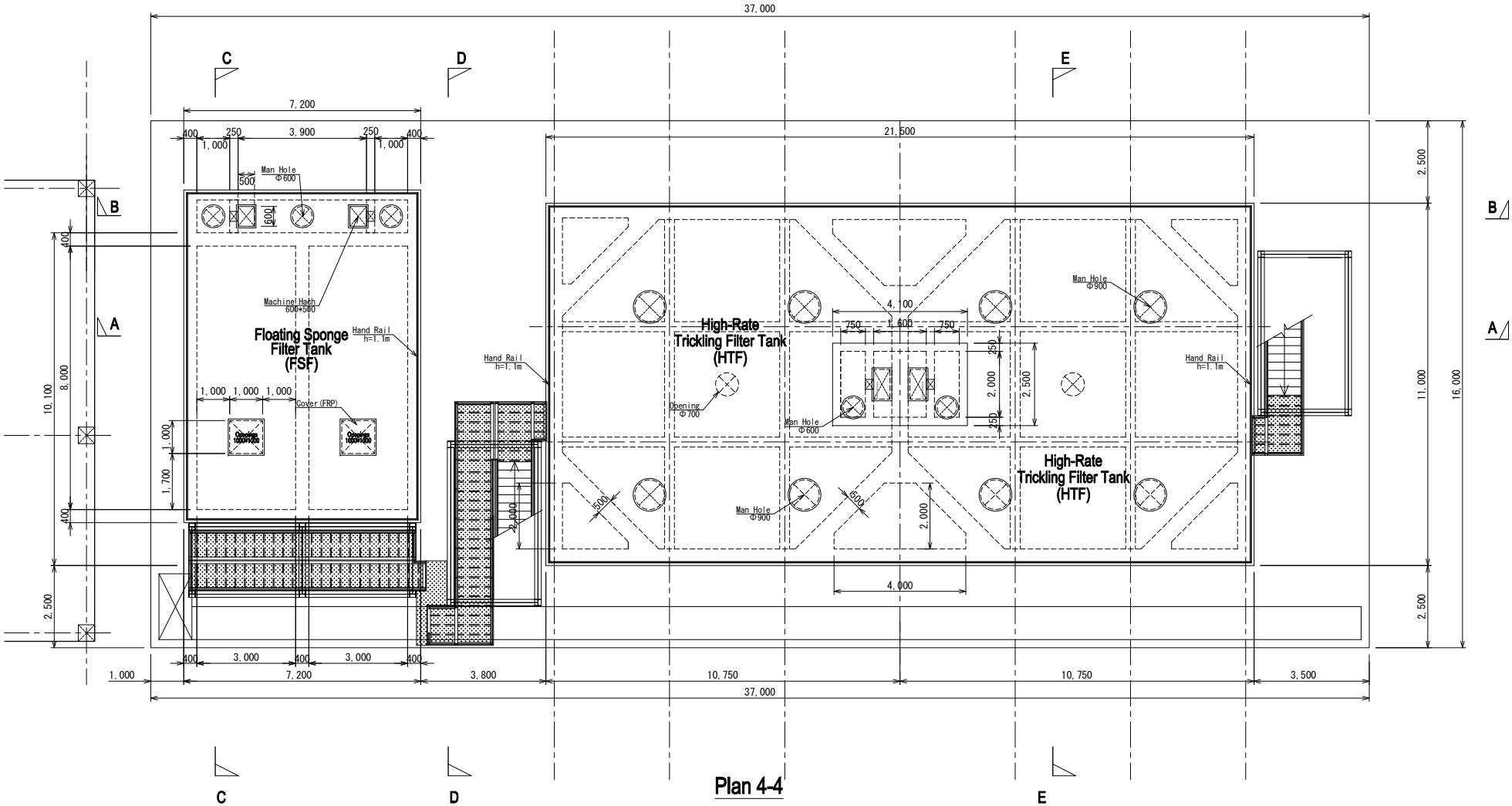
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-002	SEWAGE TREATMENT PLANT Filtering Tank Plan (2/4)



Plan 3-3

Scale = 1:125

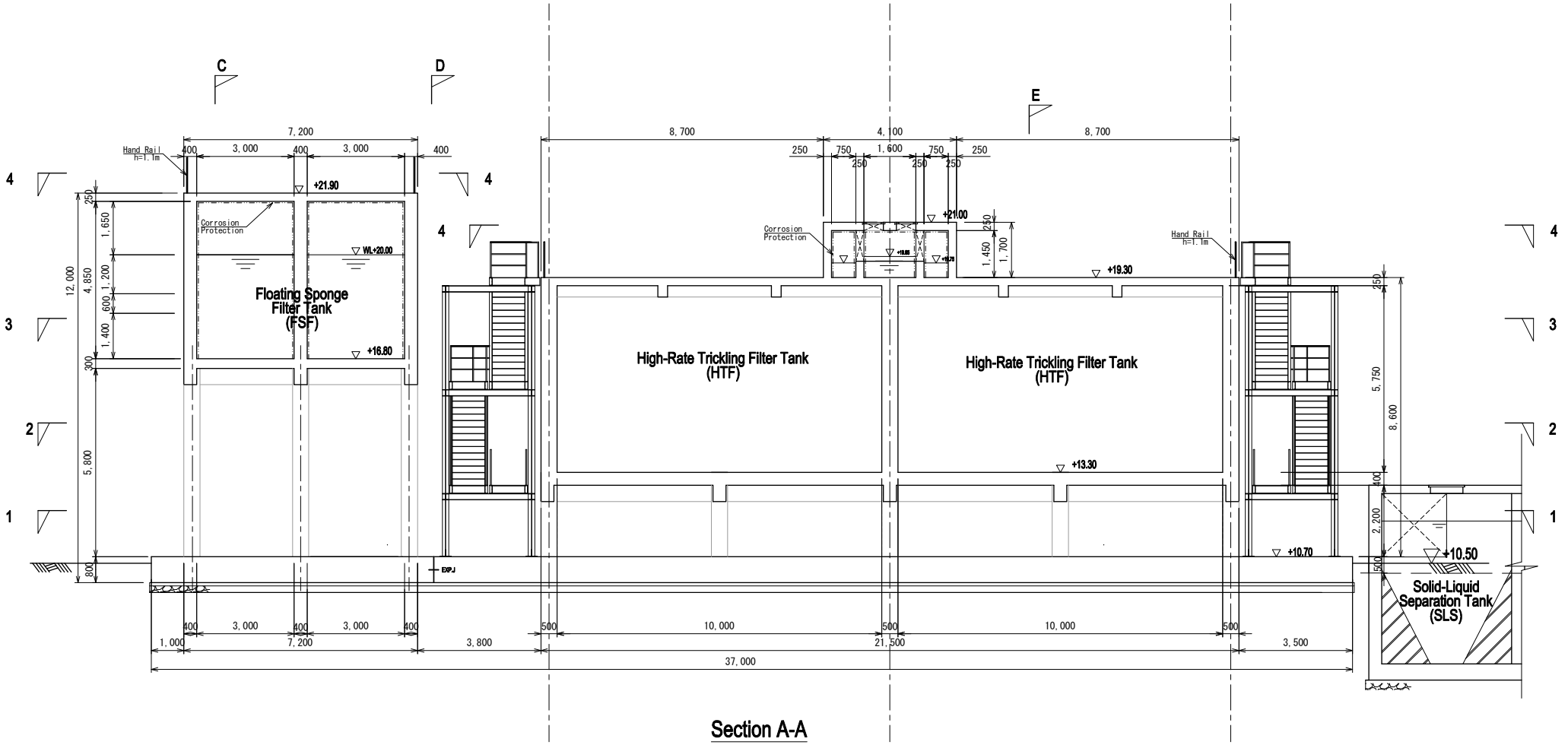
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-003	SEWAGE TREATMENT PLANT Filtering Tank Plan (3/4)



Plan 4-4

Scale = 1:125

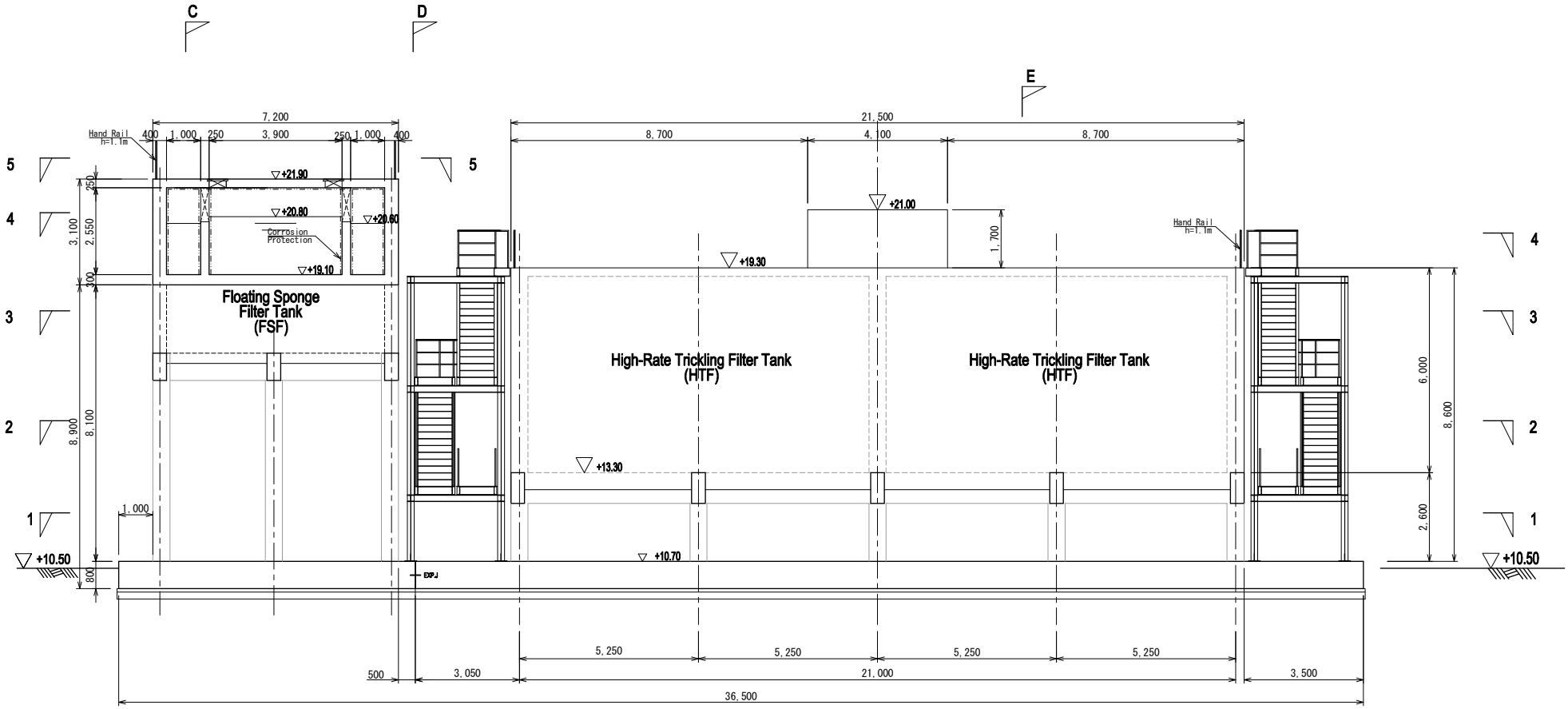
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-004	SEWAGE TREATMENT PLANT Filtering Tank Plan (4/4)



Section A-A

Scale = 1:125

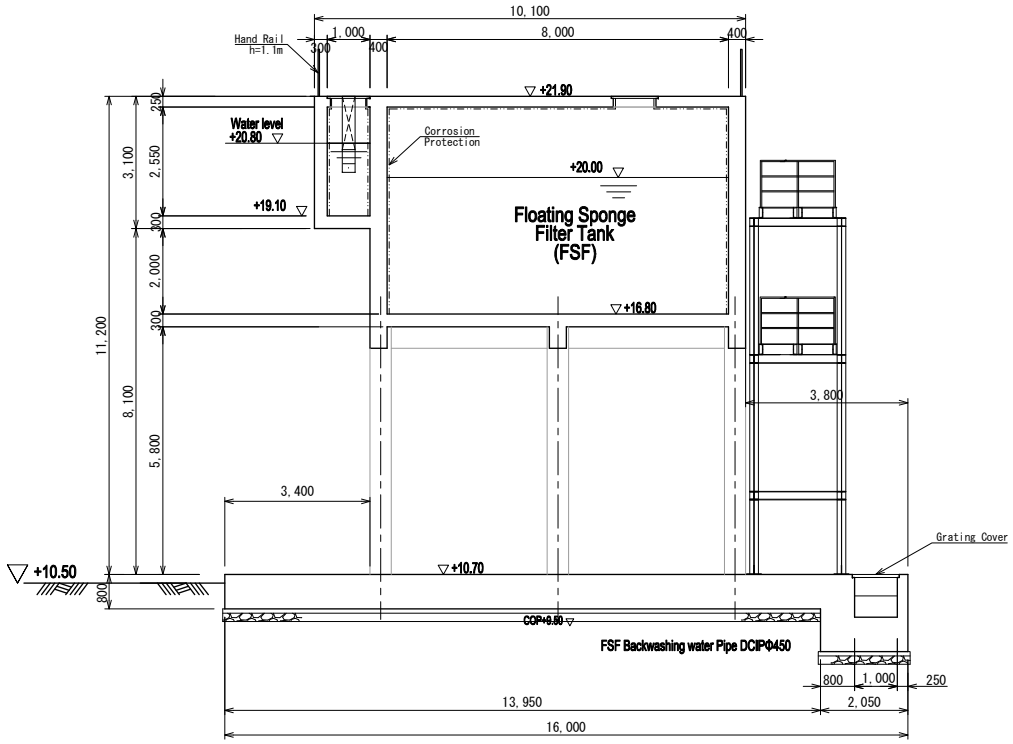
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-005	SEWAGE TREATMENT PLANT Filtering Tank Section (1/4)



Section B-B

Scale = 1:125

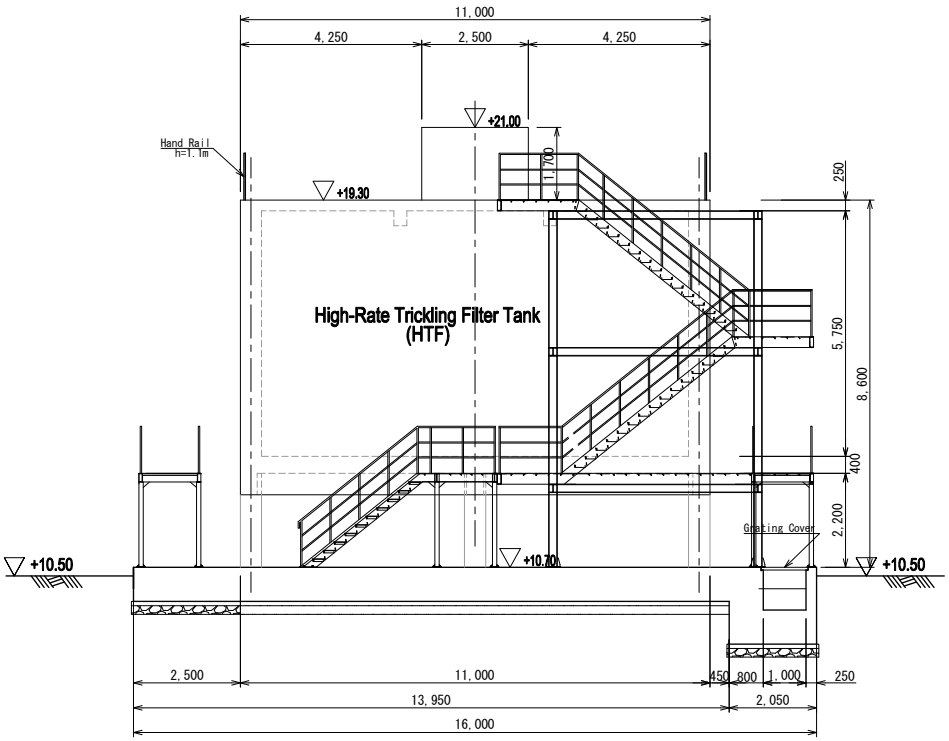
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-006	SEWAGE TREATMENT PLANT Filtering Tank Section (2/4)



Section C-C

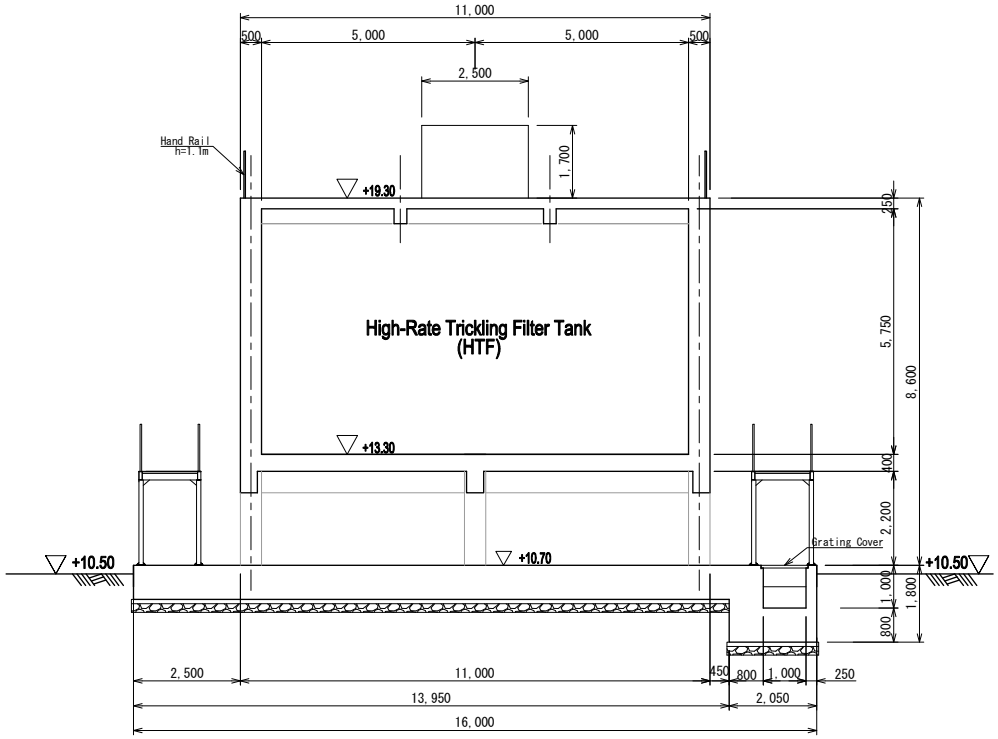
Scale = 1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-007	SEWAGE TREATMENT PLANT Firtering Tank Section (3/4)



Section D-D

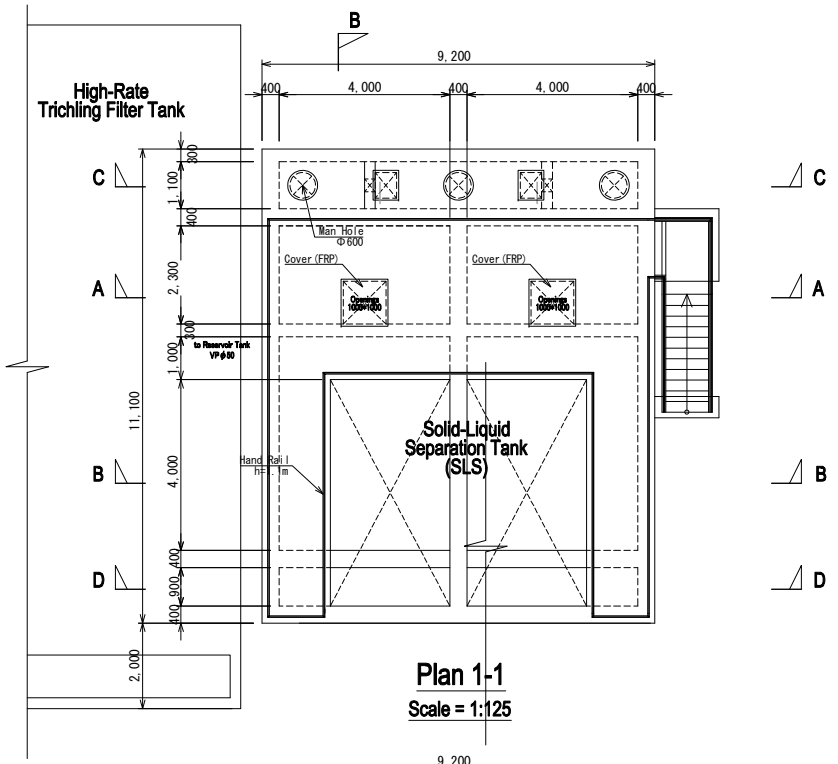
Scale = 1:125



Section E-E

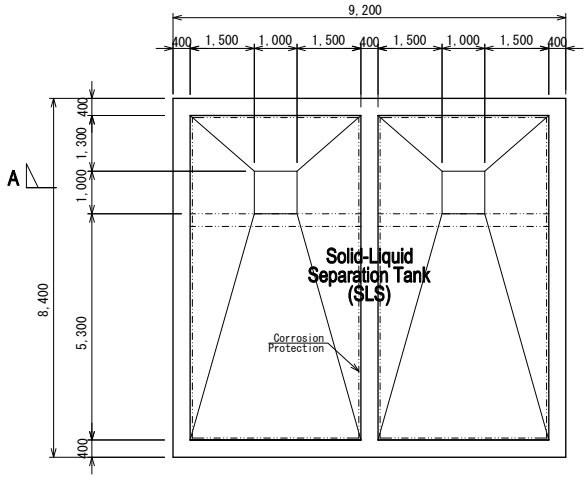
Scale = 1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-008	SEWAGE TREATMENT PLANT Filtering Tank Section (4/4)



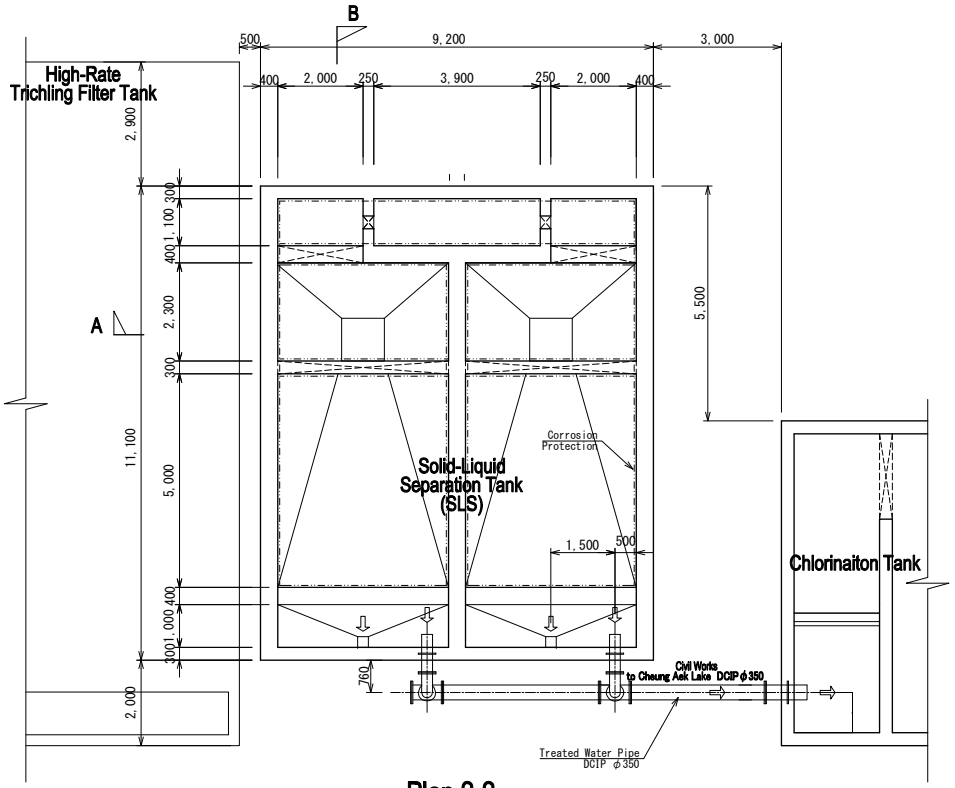
Plan 1-1

Scale = 1:125



Plan 3-3

Scale = 1:125

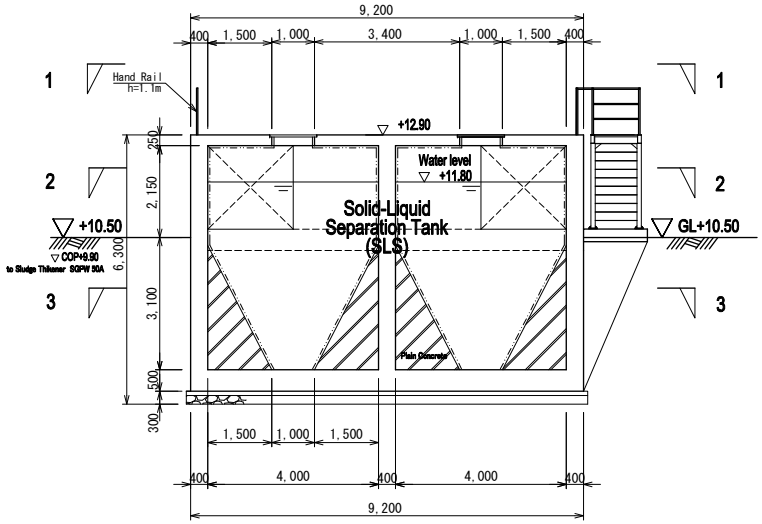


Plan 2-2

Scale = 1:125

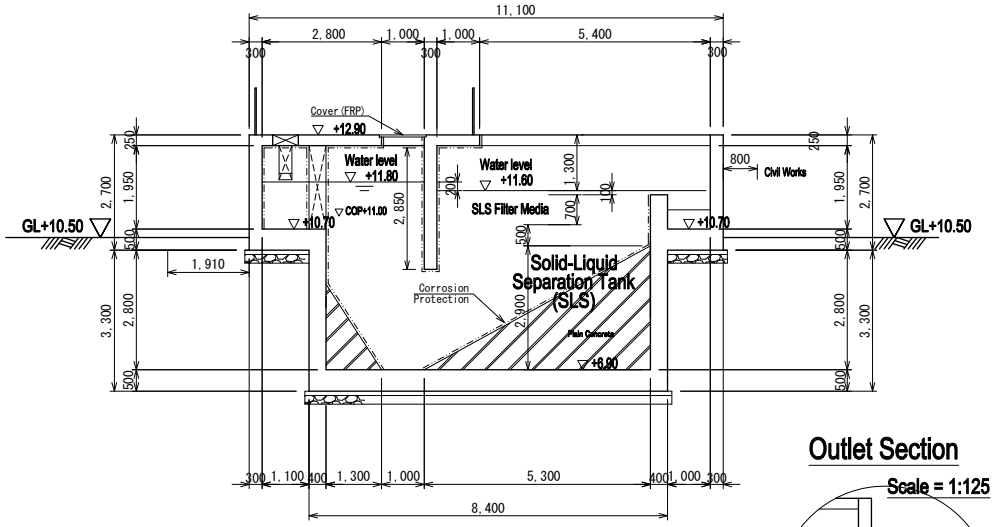
SCALE 0 1.0 2.0 3.0 4.0 5.0m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-SL-001	SEWAGE TREATMENT PLANT Solid-Liquid Separation Tank Plan



Section A-A

Scale = 1:125

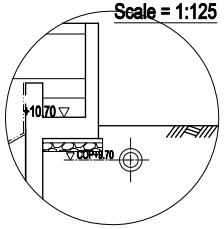


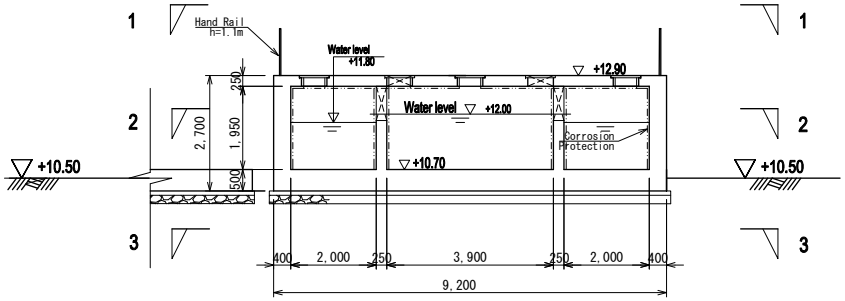
Section B-B

Scale = 1:125

Outlet Section

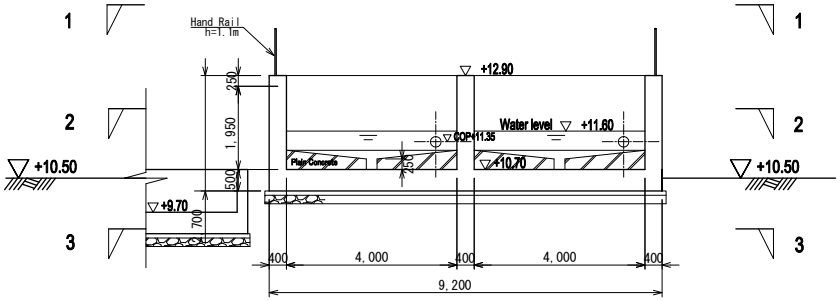
Scale = 1:125





Section C-C

Scale = 1:125

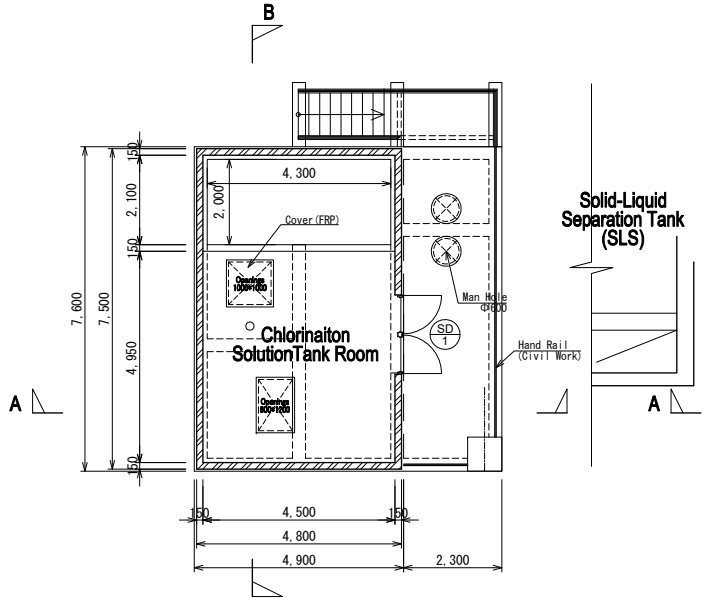


Section D-D

Scale = 1:125

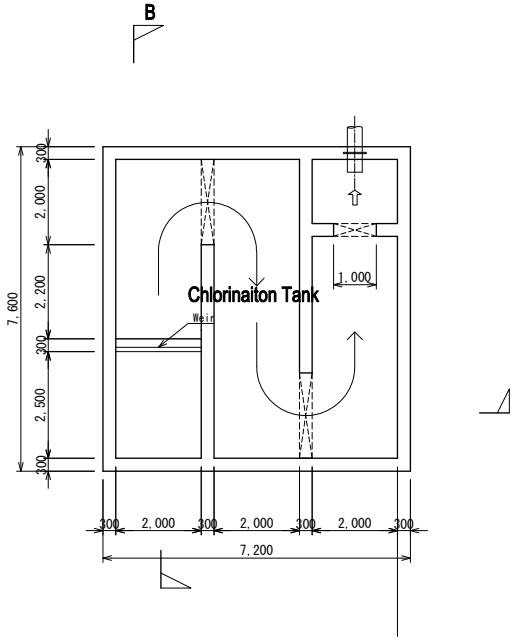
SCALE 0 1.0 2.0 3.0 4.0 5.0m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-SL-002	SEWAGE TREATMENT PLANT Solid-Liquid Separation Tank Section



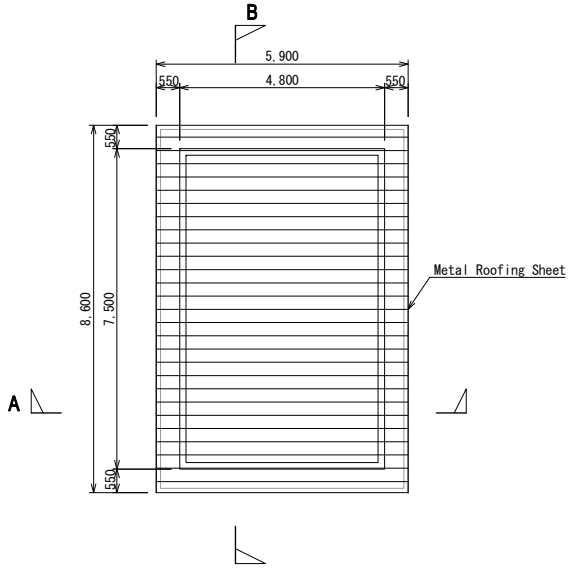
Plan 1-1

Scale = 1:125



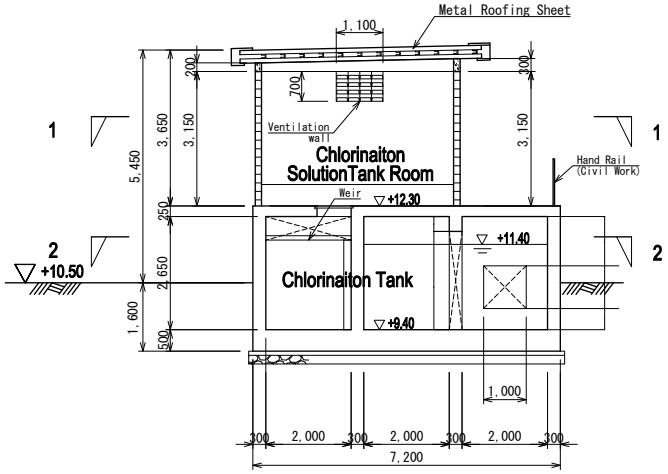
Plan 2-2

Scale = 1:125



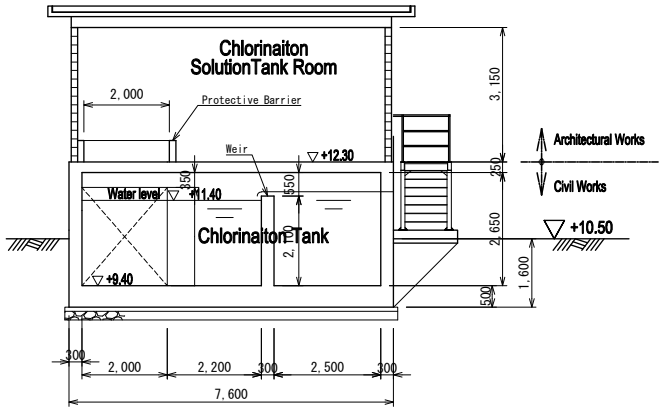
Roof Plan

Scale = 1:125



Section A-A

Scale = 1:125

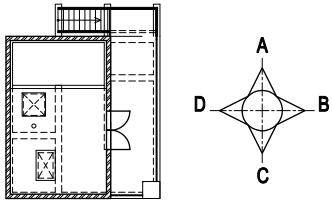


Section B-B

Scale = 1:125

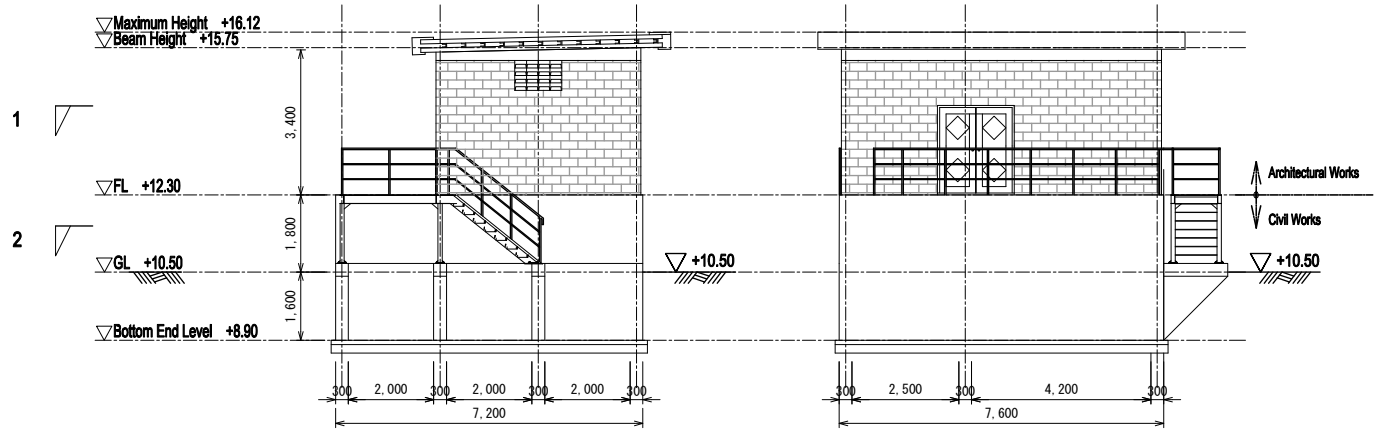
SCALE 0 1.0 2.0 3.0 4.0 5.0m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-CT-001	SEWAGE TREATMENT PLANT Chlorination Tank Plan & Section



Direction for Elevations

Scale = 1:250

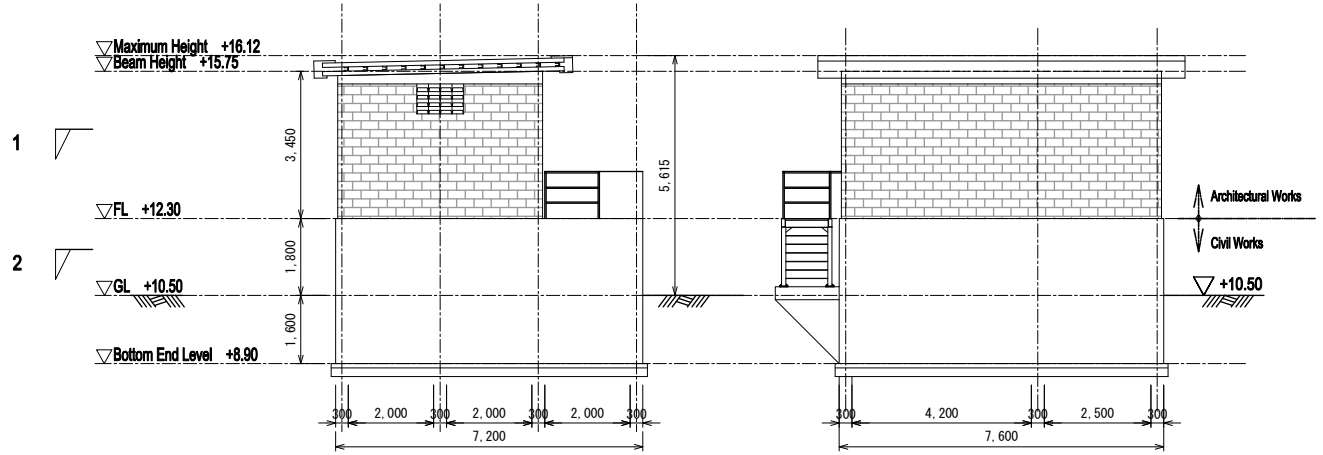


Elevation "A" View

Scale = 1:125

Elevation "B" View

Scale = 1:125



Elevation "C" View

Scale = 1:125

Elevation "D" View

Scale = 1:125

SCALE 0 1.0 2.0 3.0 4.0 5.0m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-CT-002	SEWAGE TREATMENT PLANT Chlorination Tank Elevation

EXTERIOR FINISH SCHEDULE

	CHLORINE SOLUTION TANK HOUSE	
ROOF		
WALL		
BASEBOARD		
DOORS & WINDOWS		

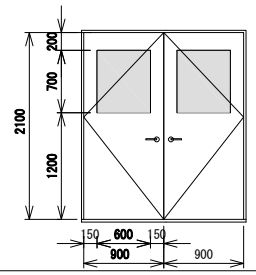
BUILDING OUTLINE

	CHLORINE SOLUTION TANK HOUSE	
THE OTHER		
FLOOR AREA	34.78m²	
USE	CHLORINE SOLUTION TANK ROOM	
STRUCTURE	CONCRETE BLOCK STRUCTURE	
SCOPE	ONE-STORY BUILDING	
HEIGHT	5,200mm (from GROUND LEVEL) 3,400mm (from SURFACE OF CIVIL STRUCTURE)	

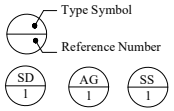
INTERIOR FINISH SCHEDULE

	ROOM NAME	FLOOR LEVEL	FLOOR	BASEBOARD	WALL	CEILING	CEILING HEIGHT (mm)	REMARKS
CHROLINE SOLUTION TANK HOUSE	CHLORINE SOLUTION TANK ROOM	±0	Concrete steel trowel finish	Concrete mortar t200 AEP H150	Concrete mortar t200 AEP on concrete block wall	Fair-faced concrete AEP	3400	

CHLORINATION TANK HOUSE

KEY NUMBER	TYPE & QUANTITY	SD 1	Steel Double Swinging Door 1
ELEVATION			
LOCATION		Entrance, Mechanical Room, Residue Collection Room	
FRAME ; MATERIAL & FINISH		Steel S.O.P.	
THRESHOLD or SILL		SUS	
DOOR WINDOW & LOUVER	MATERIAL & FINISH	Steel S.O.P.	
	THICKNESS	40 mm	
	GLASS & SCREEN	TP 5mm	
HARDWARE			
REMARKS			

NOTES or REVISIONS :



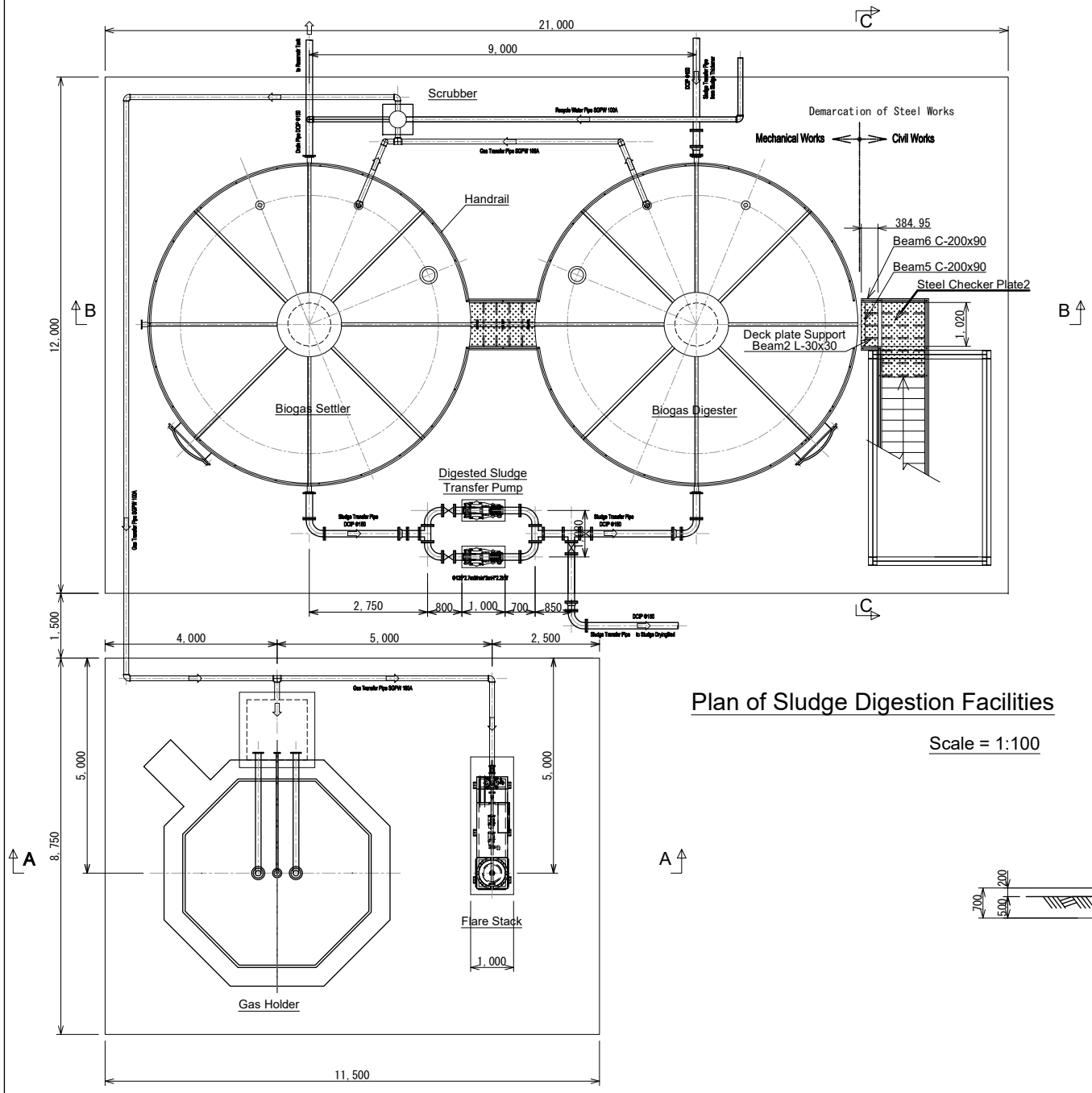
SYMBOL LEGEND

WD	:	Wooden Door
WWL	:	Wooden Window Louver
AWL	:	Aluminum Window Louver
AW	:	Aluminum Window
AD	:	Aluminum Door
SD	:	Steel Door
SG	:	Steel Louver
AG	:	Aluminum Louver

FINISH LEGEND

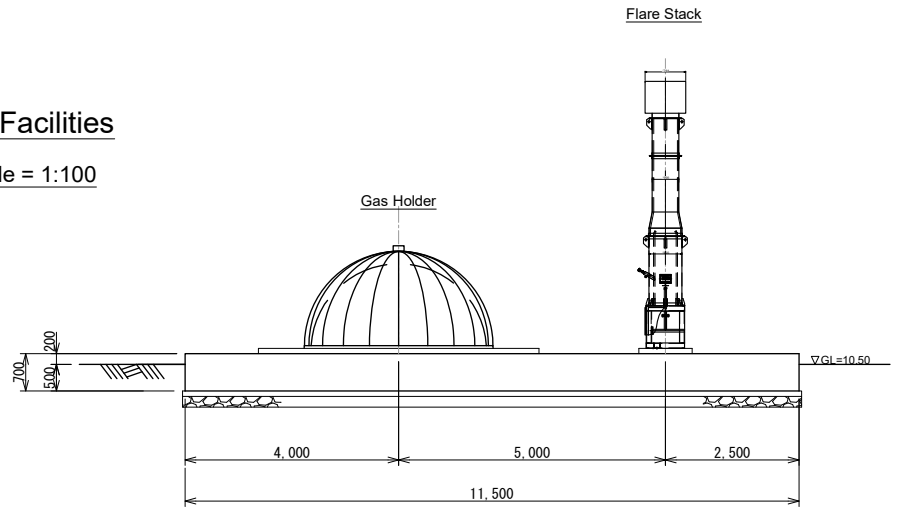
C.W.P.	:	Clear Wood Preservative
S.O.P.	:	Ready-mixed Synthetic Resin Paint
A.E.P.	:	Acrylic Resin Emulsion Paint
S.V	:	Oil Stain Varnish

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-CT-003	SEWAGE TREATMENT PLANT Chlorination Tank House Finish Schedule and Door & Window List



Plan of Sludge Digestion Facilities

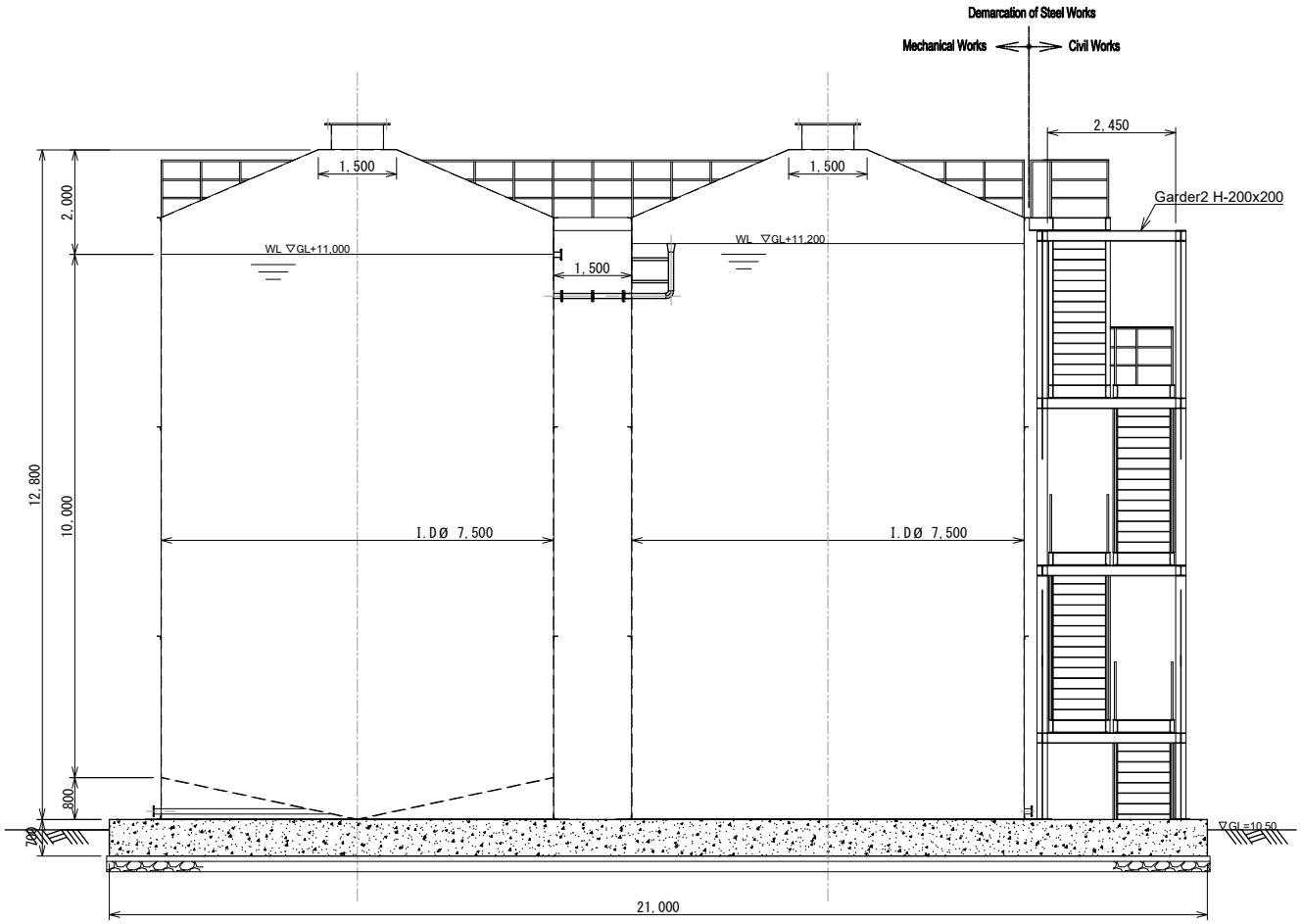
Scale = 1:100



Section A-A

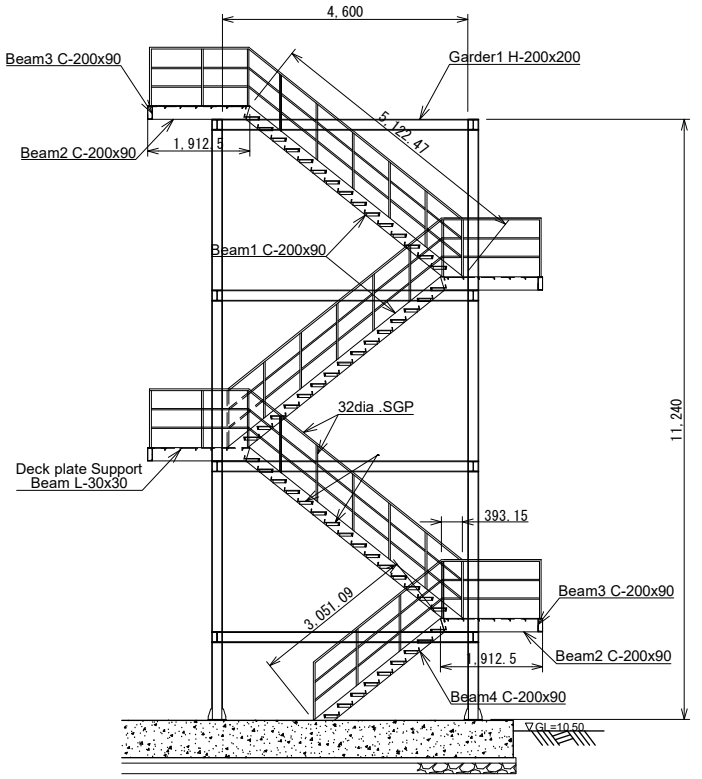
Scale = 1:100

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-SD-001	SEWAGE TREATMENT PLANT Sludge Digestion Facilities Plan & Section (1/2)

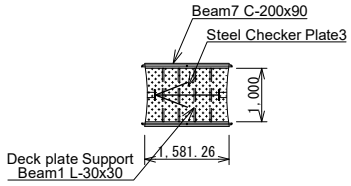


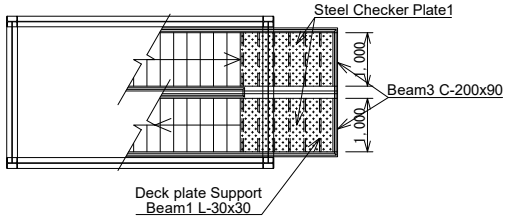
Section B-B

Scale = 1:100



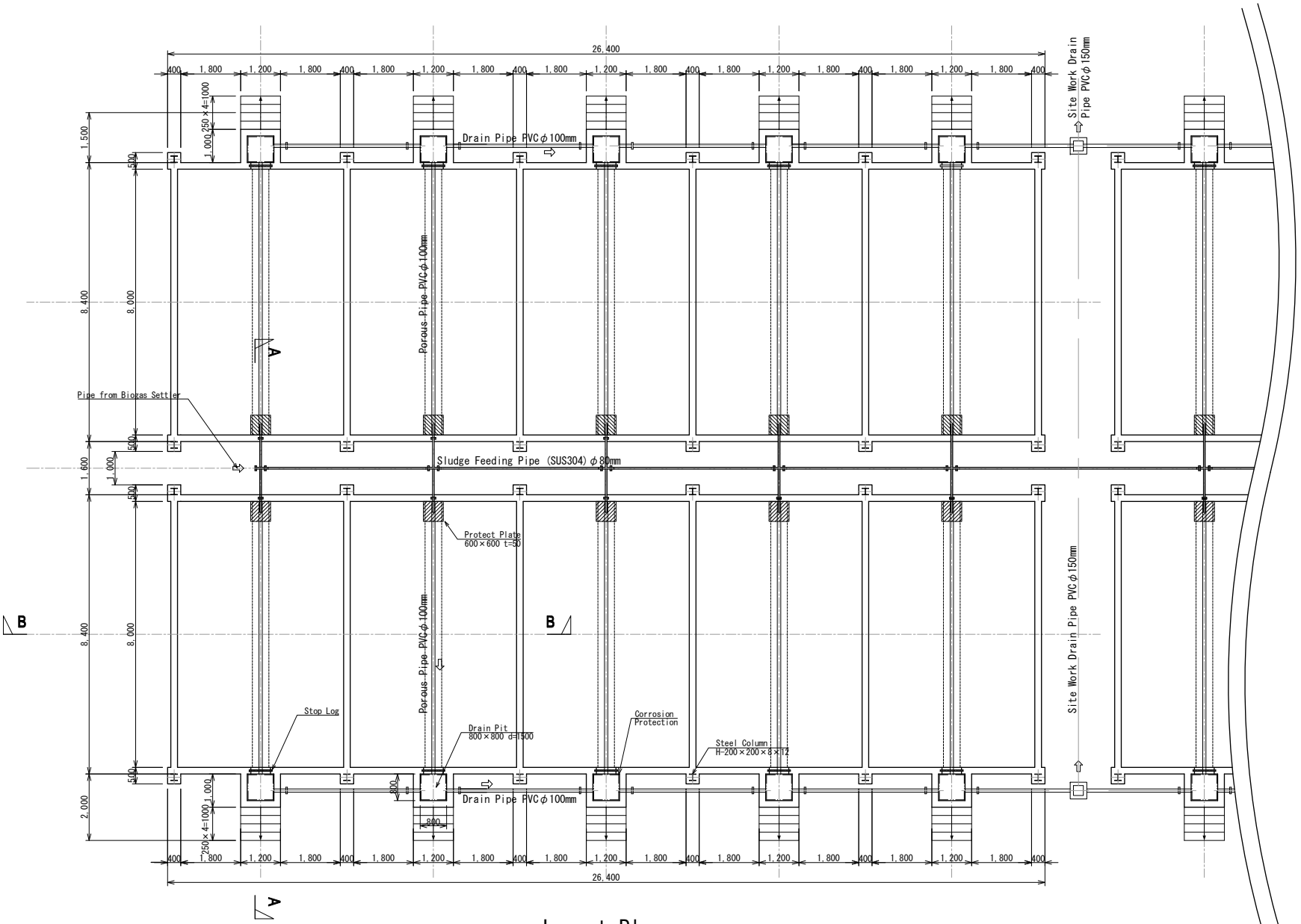
Section C-C





Detail Plan of Steel Walkway Scale = 1:100

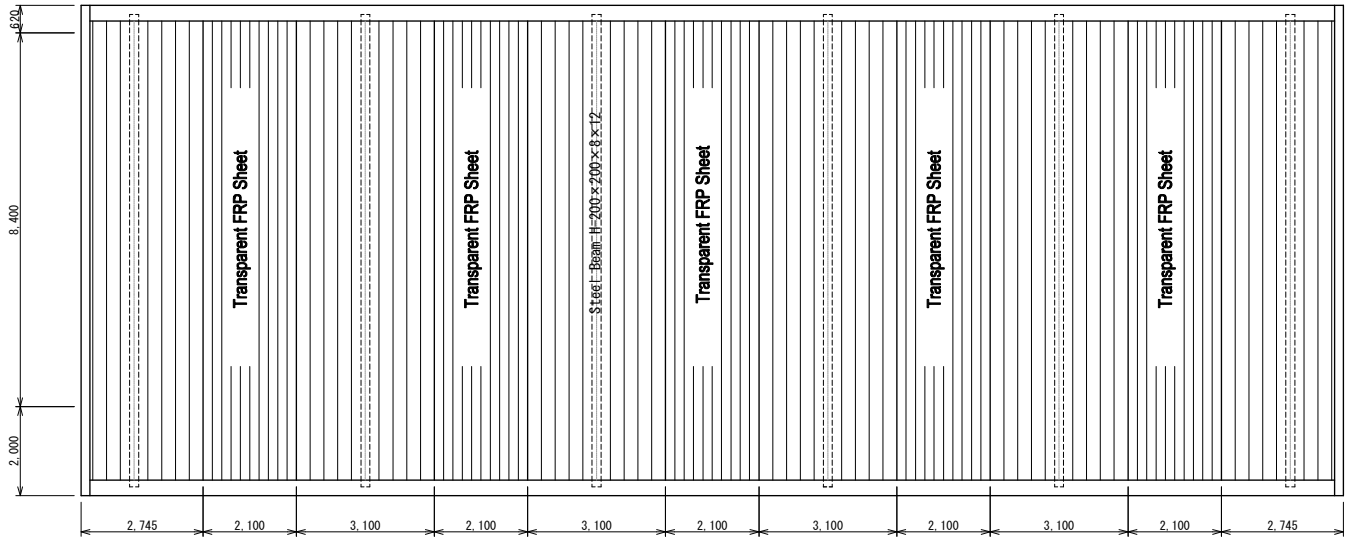
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-SD-002	SEWAGE TREATMENT PLANT Sludge Digestion Facilities Plan & Section (2/2)



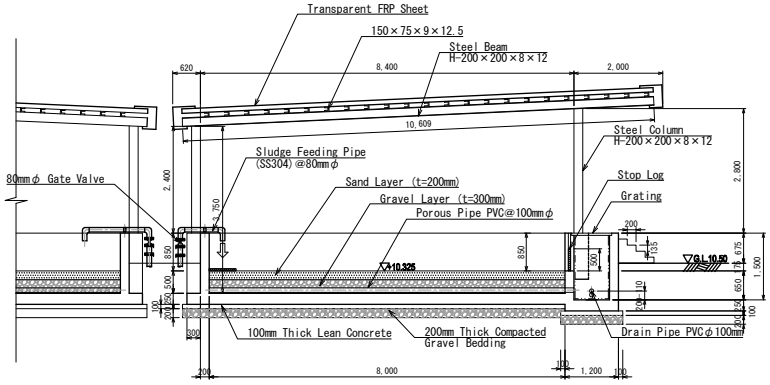
Layout Plan

Scale = 1:120

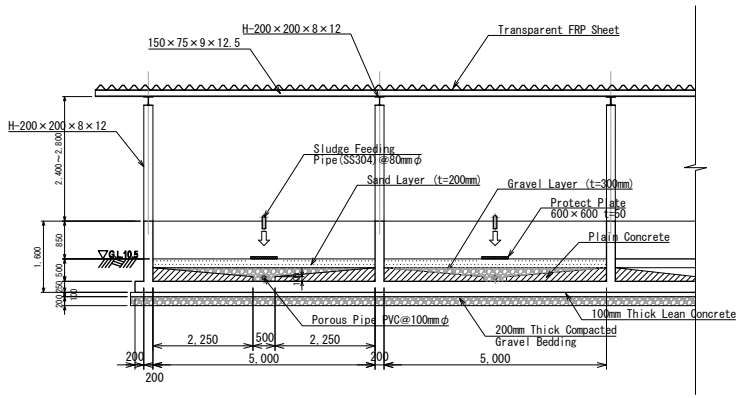
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-DB-001	SEWAGE TREATMENT PLANT Sludge Drying Bedd Plan



Roofing Plan



Section A-A

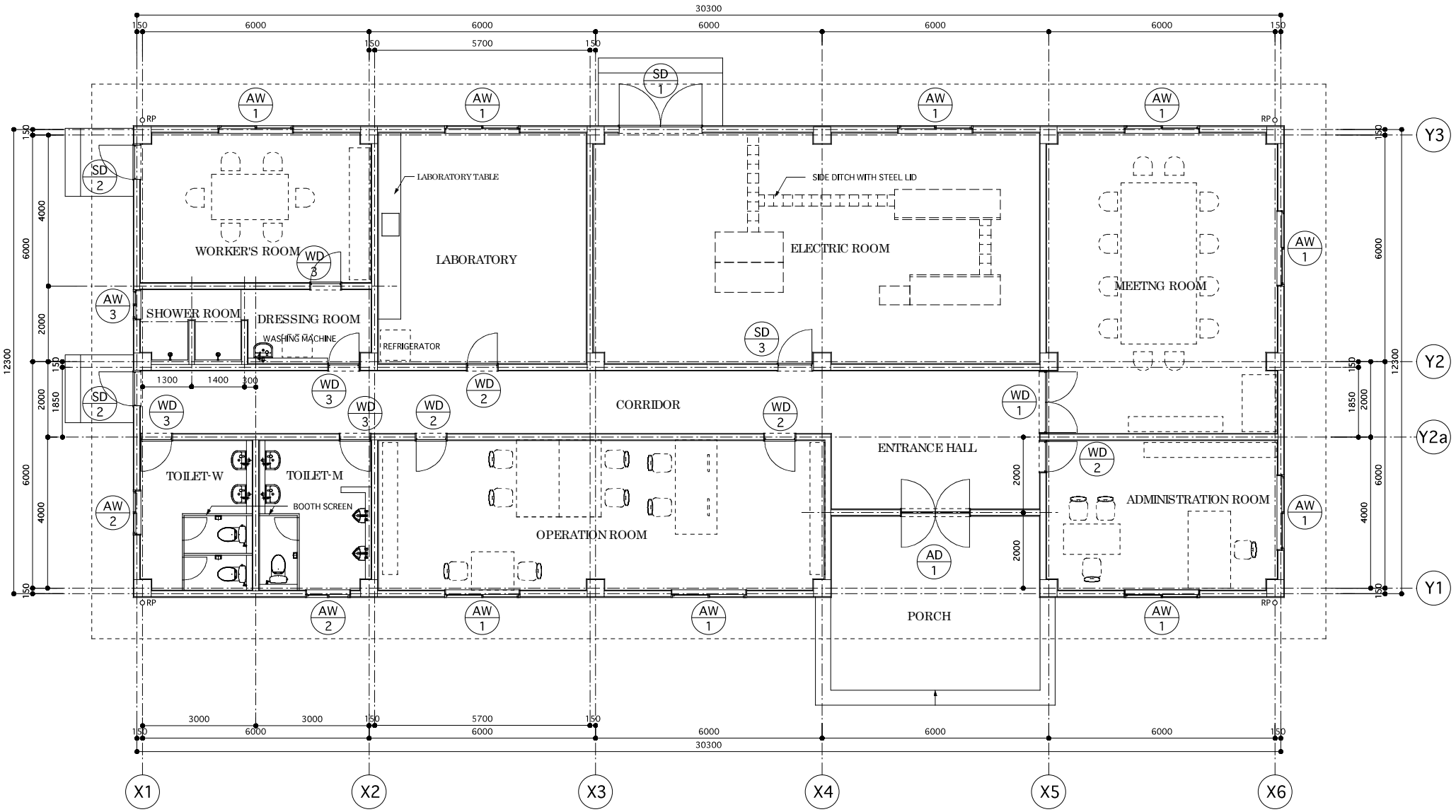


Section B-B

Sludge Drying Bed Plan & Sections

Scale = 1:120

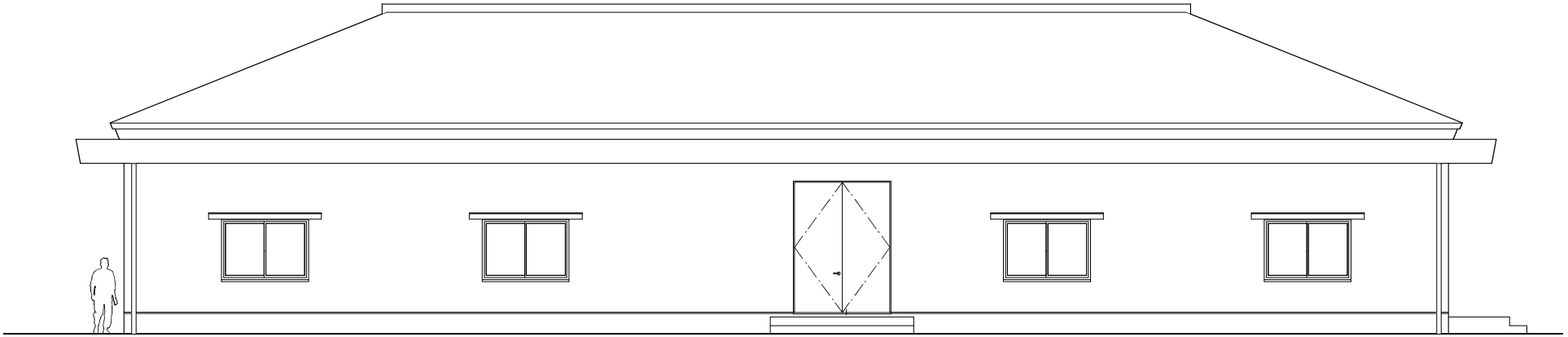
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-DB-002	SEWAGE TREATMENT PLANT Sludge Drying Bedd Plan & Section



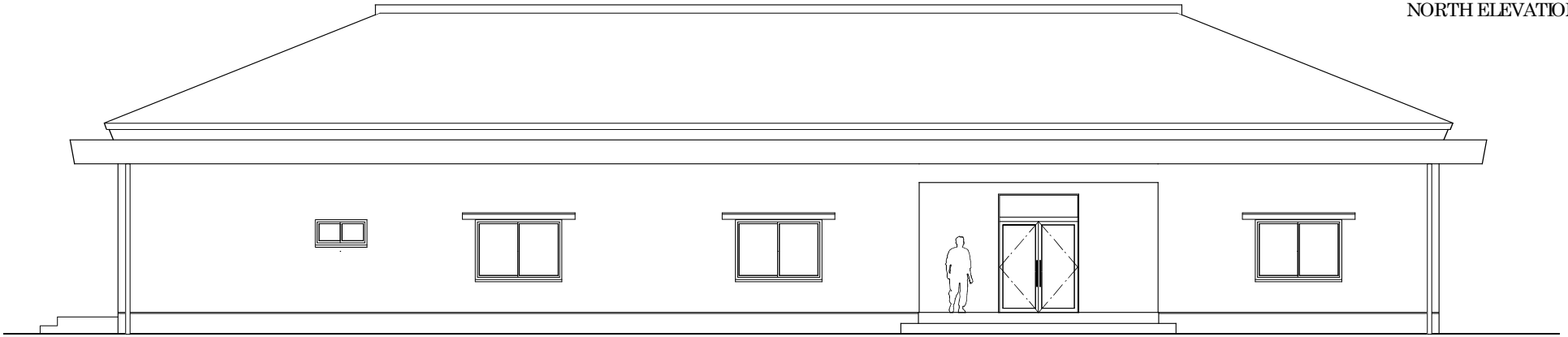
FLOOR PLAN

SCALE 1:100

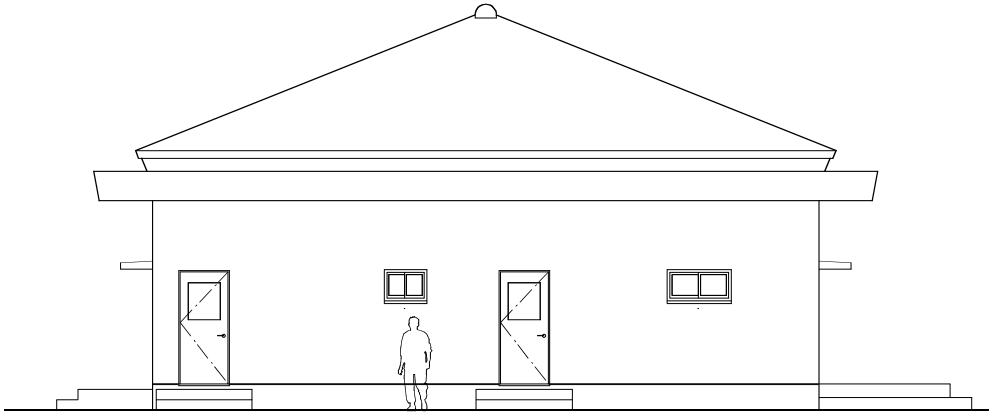
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-AB-001	SEWAGE TREATMENT PLANT Administration Building Floor Plan



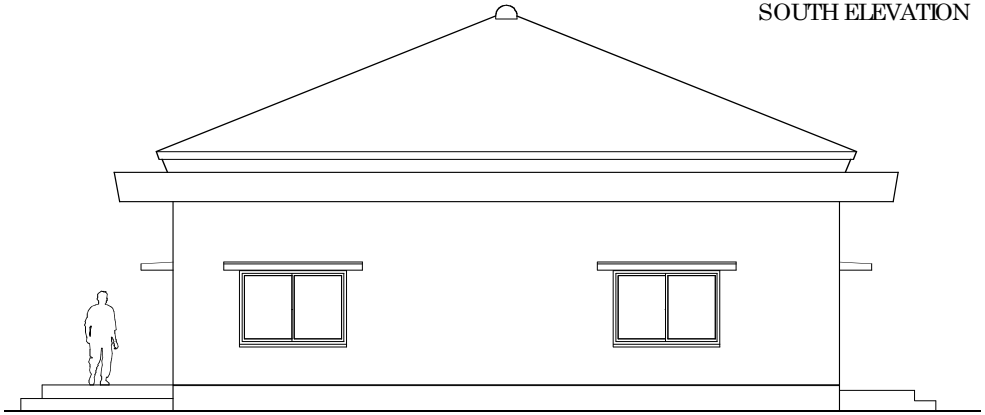
NORTH ELEVATION



SOUTH ELEVATION



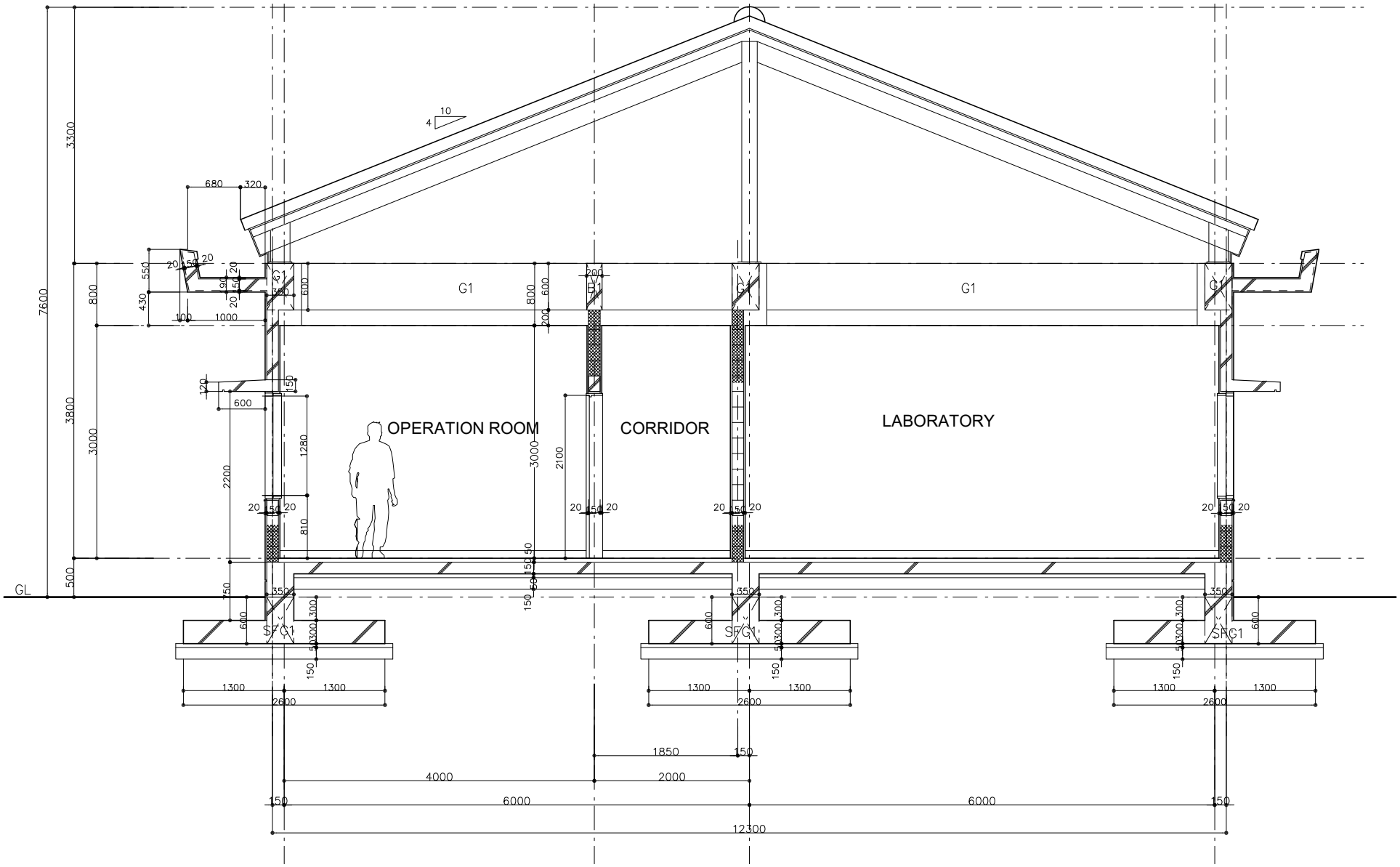
WEST ELEVATION



EAST ELEVATION

SCALE 1:100

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-AB-002	SEWAGE TREATMENT PLANT Administration Building Elevation



THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-AB-003	SEWAGE TREATMENT PLANT Administration Building Detail Section

EXTERIOR FINISH SCHEDULE

ADMINISTRATION BUILDING	
ROOF	Monier roof tile /resinous batten @300 Waterproofing: Asphalt prepared roofing 30kg/roll Roof Board: Cemented excelsior board t25 Purlin: C-100×50×20×2.3@450 Verge board: Calcium silicate board t16 AEP EAVES GUTTER: Cement mortar t20 AEP on concrete t150
WALL	Cement mortar t20 AEP on concrete block t150
BASEBOARD	Cement plaster t20
DOORS & WINDOWS	WINDOWS: Aluminum sash Window DOORS: Steel door SOP
THE OTHERS	PORCH Floor:Ceramic tile 300×300 on cement mortar Wall:Cement mortar t20 AEP on concrete block t150 Ceiling:Calcium silicate board t6 AEP OTHER ENT. Floor:Concrete steel trowel finish

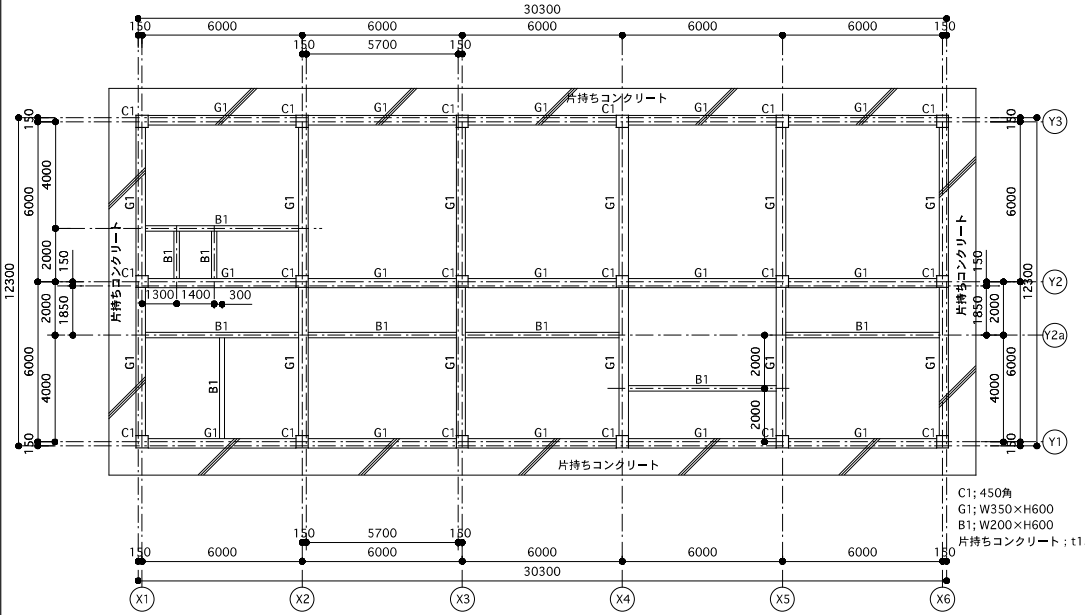
BUILDING OUTLINE

ADMINISTRATION BUILDING	
FROOR AREA	372.69m2
USE	ADMINISTRATION ROOM, OPERATION ROOM, MEETING ROOM LABORATORY, TOILET, WORKER'S ROOM
STRUCTURE	REINFORCED CONCRETE STURUCTURE
SCOPE	ONE-STORY BUILDING
HEIGHT	7600mm (RIDGE LEVEL)
REMARKS	

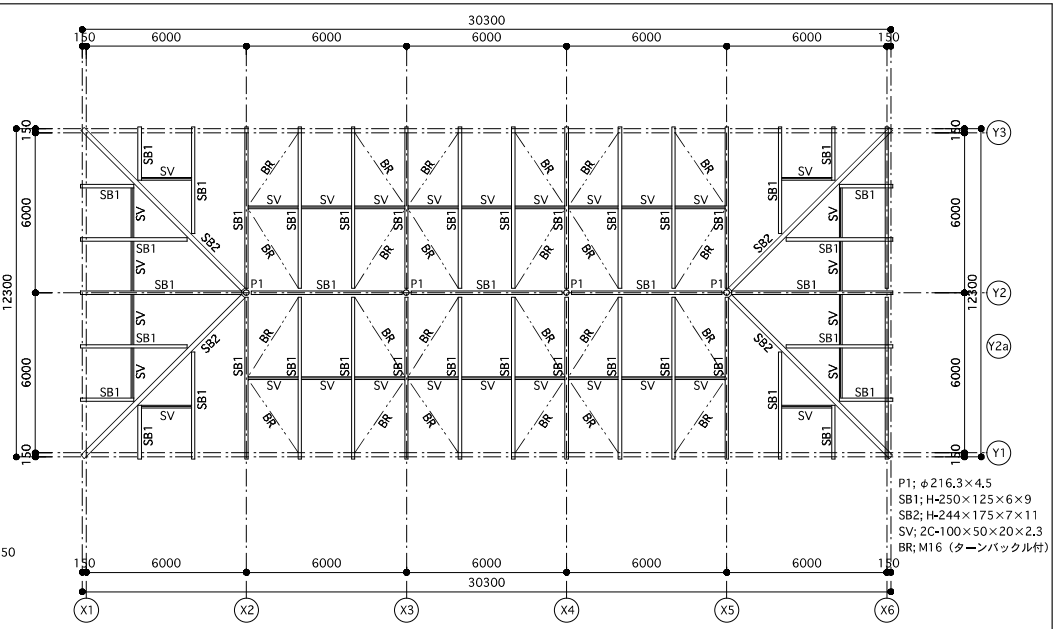
INTERIOR FINISH SCHEDULE

	ROOM NAME	FLOOR LEVEL	FLOOR	BASEBOARD	WALL	CEILING	CEILING HIGHT (mm)	REMARKS
ADMINISTRATION BUILDING	ADMINISTRATION ROOM	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3000	
	OPERATION ROOM	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3000	
	MEETNG ROOM	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3000	
	LABORATORY	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3000	Laboratory table
	ELECTRIC ROOM	70	Concrete steel trowel finish W/Floor paint Light-weight concrete t300	Cement mortar t20 AEP H150	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3500	Side ditch with steel lid Concrete base
	WORKER'S ROOM	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3000	
	TOILET-W,M	±0	Porcelain tile on concrete steel trowel finish	Porcelain tile	Porcelain tile on concrete block t150	Calcium silicate board t6 AEP /LGS	2400	Booth screen:Polyester plywood Lining:Porcelain tile on concrete block
	DRESSING ROOM	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	2400	Lining: Cement mortar t20 AEP on concrete block
	SHOWER ROOM	±0	Porcelain tile on concrete steel trowel finish W/Waterploof coating	Porcelain tile	Porcelain tile on concrete block t150 W/Waterploof coating H1800	Calcium silicate board t6 AEP /LGS	2400	Lining:Porcelain tile on concrete block
	ENTRANCE HALL	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3000	
	CORRIDOR	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3000	

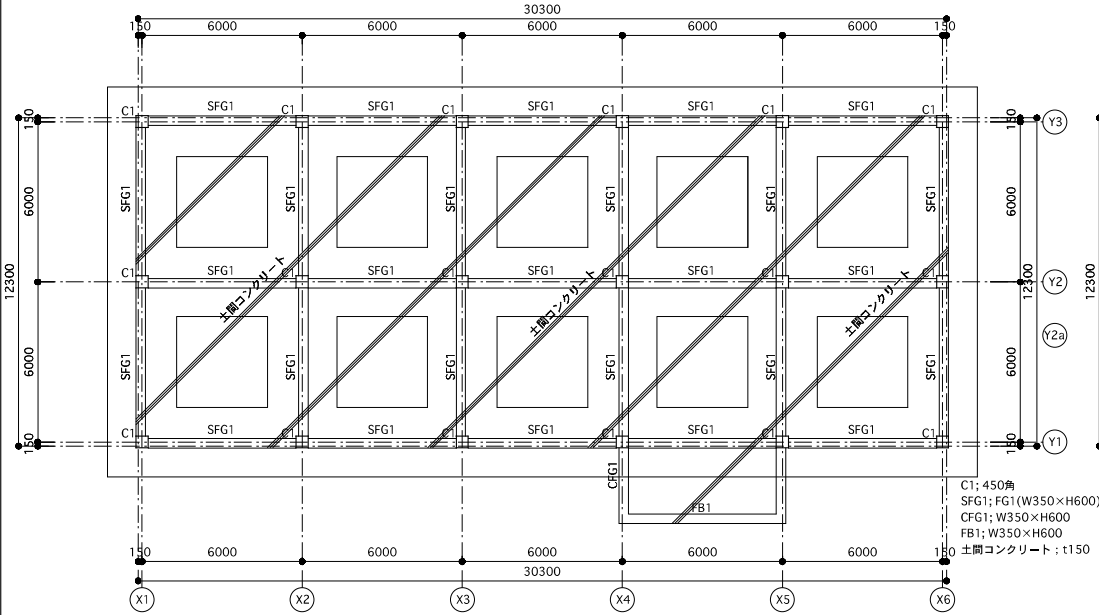
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-AB-004	SEWAGE TREATMENT PLANT Administration Building Finish Schedule



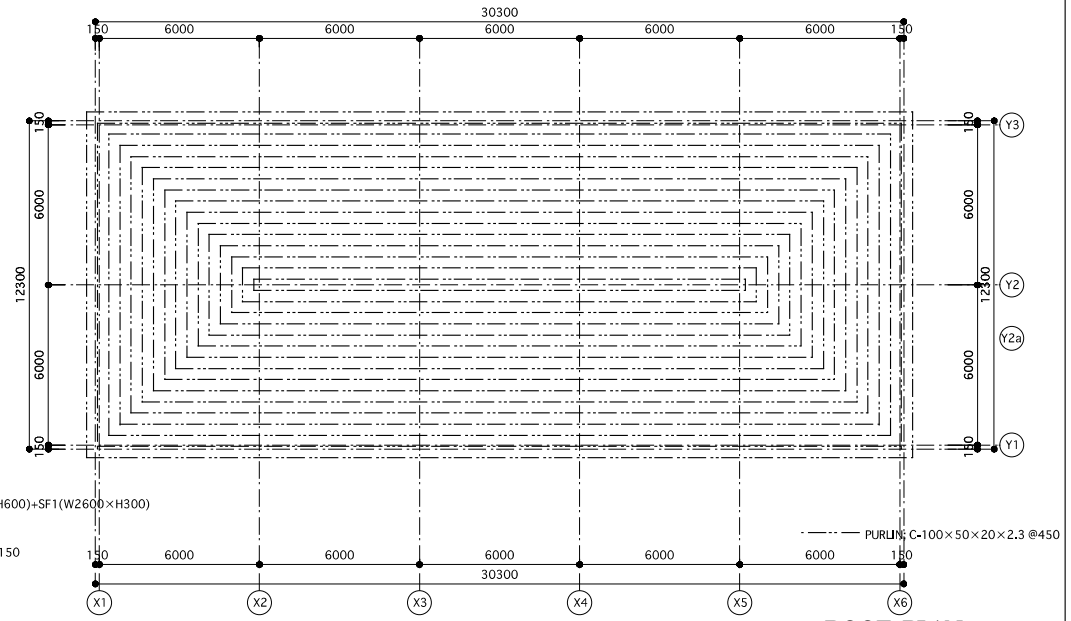
BEAM PLAN



ROOF FLAMING PLAN



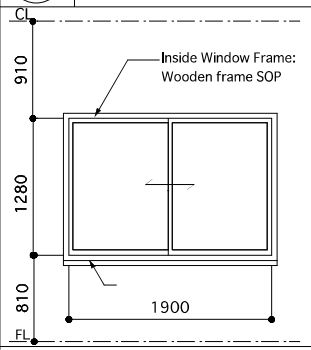
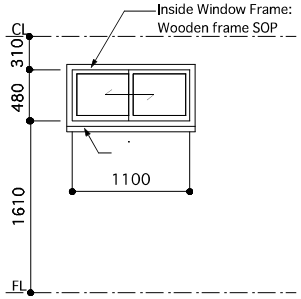
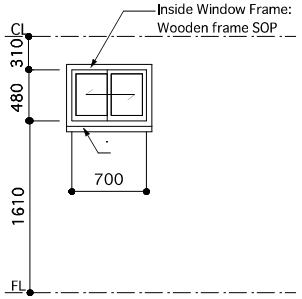
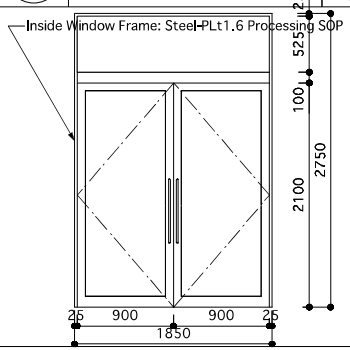
FOUNDATION PLAN

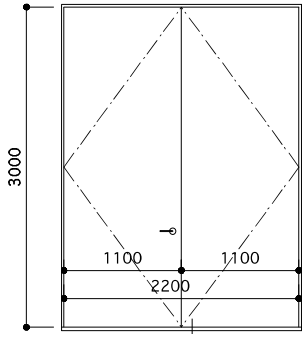
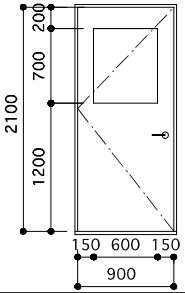
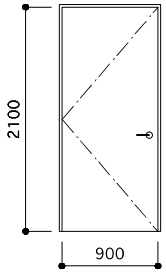


ROOF PLAN

SCALE 1:200

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-AB-005	SEWAGE TREATMENT PLANT Administration Building Structural Drawing

KEY NUMBER	TYPE & QUANTITY	AW 1	AW 2	AW 3	AD 1
		Aluminium Double Sliding Window 9	Aluminium Double Sliding Window 2	Aluminium Double Sliding Window 1	Aluminium Double Swinging Doors 1
ELEVATION					
LOCATION		ADMINISTRATION ROOM MEETNG ROOM ELECTRIC ROOM OPERATION ROOM LABORATORY WORKER'S ROOM	TOILET-W,M	SHOWER ROOM	ENTRANCE HALL
FRAME: MATERIAL & FINISH		Alminium electro coloring	Alminium electro coloring	Alminium electro coloring	Alminium electro coloring
THRESHOLD or SILL		——	——	——	SUS
DOOR, WINDOW & LOUVER	MATERIAL & FINISH	Alminium electro coloring	Alminium electro coloring	Alminium electro coloring	Alminium electro coloring
	THICKNESS	6mm	5mm	5mm	6mm
	GLASS & SCREEN	FL	FL	FL	TP
HARDWARE		Flashing, Crescent, Hardware set Fly Net (Mosquito Gauze)	Flashing, Crescent, Hardware set Fly Net (Mosquito Gauze)	Flashing, Crescent, Hardware set Fly Net (Mosquito Gauze)	Door handle(SUS), Floor Hinge, Lock, Hardware set
REMARKS		Inside Window Frame	Inside Window Frame	Inside Window Frame	Inside Window Frame

KEY NUMBER	TYPE & QUANTITY	SD 1	SD 2	SD 1
		Steel Double Swinging Door 1	Steel Single Swinging Door 2	Steel Single Swinging Door 1
ELEVATION				
LOCATION		ELECTRIC ROOM	WORKER'S ROOM CORRIDOR	ELECTRIC ROOM
FRAME: MATERIAL & FINISH		Steel S.O.P.	Steel S.O.P.	Steel S.O.P.
THRESHOLD or SILL		SUS	SUS	——
DOOR, WINDOW & LOUVER	MATERIAL & FINISH	Steel S.O.P.	Steel S.O.P.	Steel S.O.P.
	THICKNESS	50 mm	40 mm	40 mm
	GLASS & SCREEN	——	TP 5mm	
HARDWARE		Door check, Door knob, Hinge(SUS), Lock, Flush Bolt, Door stop, Hardware set	Door check, Door knob, Hinge(SUS), Lock, Door stop, Hardware set	Door check, Door knob, Hinge(SUS), Lock, Door stop, Hardware set
REMARKS				

NOTES or REVISONS:

Type Symbol
Reference Number

AW 1 AD 1 WD 1

SIMBOL LEGEND

WD	: Wooden Door
WWL	: Wooden Window Louver
AWL	: Aluminum Window Louver
AW	: Aluminum Window
AD	: Aluminum Door
SD	: Steel Door
SG	: Steel Louver
AG	: Aluminum Louver

FINISH LEGEND

C.W.P.	: Clear Wood Preservative
S.O.P	: Ready-mixed Synthetic Resin Paint
A.E.P	: Acrylic Resin Emulsion Paint
S.V	: Oil Stain Varnish

GLASS

FL	: Float Glass
CW	: Cross Wired Sheet Glass
TP	: Tempered Glass
F	: Figured Glass

LOCK

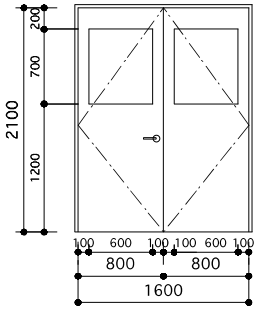
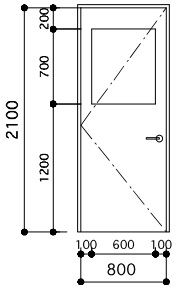
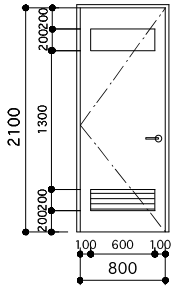
C.P	: Pintumblers Lock
C.P.T	: Pintumblers Lock with Thumb-turn
S.B	: Slide Bolt

OTHER ABBREVIATION

DK	: Door Knob
FMH	: Full-Mortise Hinge
LJH	: Loose Joint Hinge
GH	: Gravity Hinge
DC	: Door Closer
DH	: DoorHolder
DS	: Door Stop
FB	: Flush Bolt

SCALE 1:50

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-AB-006	SEWAGE TREATMENT PLANT Administration Building Door & Window Schedule 1

KEY NUMBER / TYPE & QUANTITY	WD 1	WD 2	WD 3		
	Wooden Double Swinging Door 1	Wooden Single Swinging Door 4	Wooden Single Swinging Door 4		
ELEVATION					
LOCATION	MEETNG ROOM	ADMINISTRATION ROOM OPERATION ROOM LABORATORY	TOILET-W,M DRESSING ROOM		
FRAME ; MATERIAL & FINISH	Hard Wood Straight Grain Timber S.O.P.	Hard Wood Straight Grain Timber S.O.P.	Hard Wood Straight Grain Timber S.O.P.		
THRESHOLD or SILL	——	——	——		
DOOR, WINDOW & LOUVER — MATERIAL & FINISH	Polyester plywood	Polyester plywood	Polyester plywood		
DOOR, WINDOW & LOUVER — THICKNESS	40 mm	40 mm	40 mm		
DOOR, WINDOW & LOUVER — GLASS & SCREEN	FL 5mm	FL 5mm	F 4mm Wood Louver SOP		
HARDWARE	Door check, Door knob, Hinge, Lock, Flush Bolt Door stop, Hardware set	Door check, Door knob, Hinge, Lock, Door stop Hardware set	Door check, Door knob, Hinge, Lock, Door stop Hardware set		
REMARKS					

KEY NUMBER / TYPE & QUANTITY					
ELEVATION					
LOCATION					
FRAME ; MATERIAL & FINISH					
THRESHOLD or SILL					
DOOR, WINDOW & LOUVER — MATERIAL & FINISH					
DOOR, WINDOW & LOUVER — THICKNESS					
DOOR, WINDOW & LOUVER — GLASS & SCREEN					
HARDWARE					
REMARKS					

NOTES or REVISONS :

Type Symbol
Reference Number

AW 1 AD 1 WD 1

SIMBOL LEGEND
- WD : Wooden Door
- WWL : Wooden Window Louver
- AWL : Aluminum Window Louver
- AW : Aluminum Window
- AD : Aluminum Door
- SD : Steel Door
- SG : Steel Louver
- AG : Aluminum Louver

FINISH LEGEND
- C.W.P. : Clear Wood Preservative
- S.O.P : Ready-mixed Synthetic Resin Paint
- A.E.P : Acrylic Resin Emulsion Paint
- S.V : Oil Stain Varnish

GLASS
- FL : Float Glass
- CW : Cross Wired Sheet Glass
- TP : Tempered Glass
- F : Figured Glass

LOCK
- C.P : Pintumblers Lock
- C.P.T : Pintumblers Lock with Thumb-turn
- S.B : Slide Bolt

OTHER ABBREVIATION
- DK : Door Knob
- FMH : Full-Mortise Hinge
- LJH : Loose Joint Hinge
- GH : Gravity Hinge
- DC : Door Closer
- DH : DoorHolder
- DS : Door Stop
- FB : Flush Bolt

SCALE 1:50

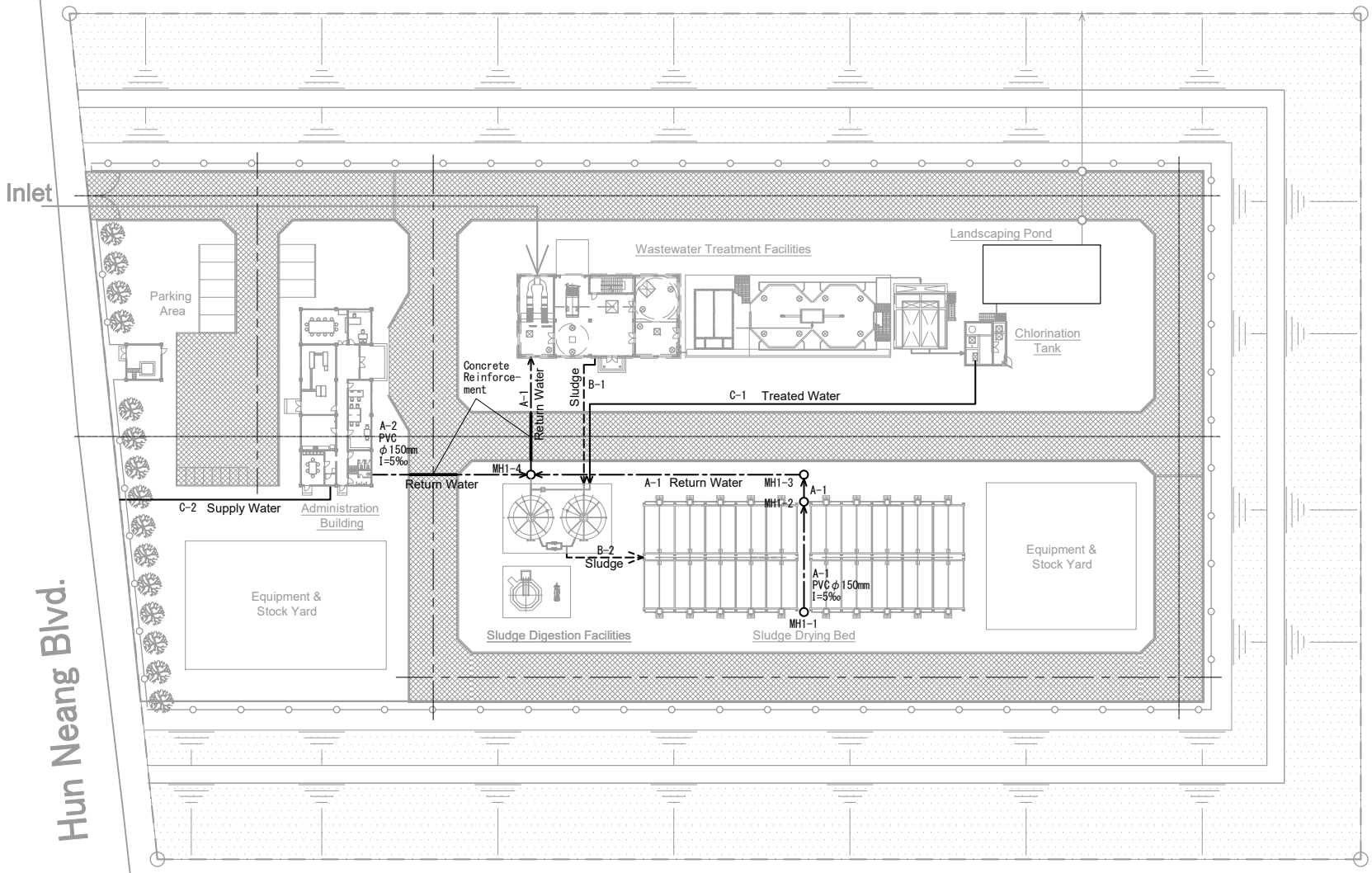
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-AB-007	SEWAGE TREATMENT PLANT Administration Building Door & Window Schedule 2

LEGEND

- TREATED WATER
- SEWER & RETURN WATER
- SLUDGE

List of Outdoor Pipline

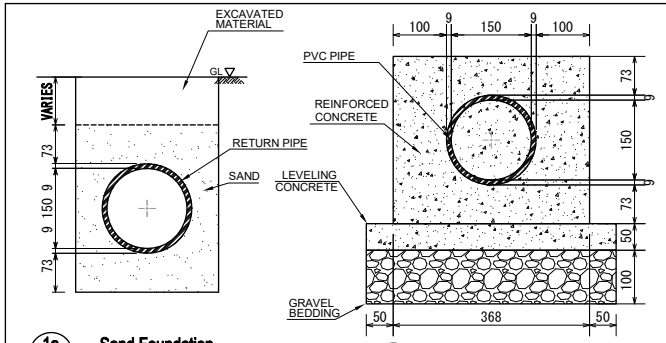
No	Usage	Flow Type	Material / Dia.	Length(m) / Length under pavement
A-1	Return Water	Gravity	PVC / φ150mm	89.906 / 8.569
A-2	Seweage	Gravity	PVC / φ150mm	27.073 / 8.724
B-1	Sludge	Pressure	PVC / φ40mm	23.476 / 8.569
B-2	Sludge	Pressure	PVC / φ65mm	13.742
C-1	Treated Water	Pressure	PVC / φ50mm	86.610 / 8.569
C-2	Supply Water	Pressure	PVC / φ20mm	38.147



Layout of Yard Piping

Scale = 1:750

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-001	SEWAGE TREATMENT PLANT Layout of Yard Piping

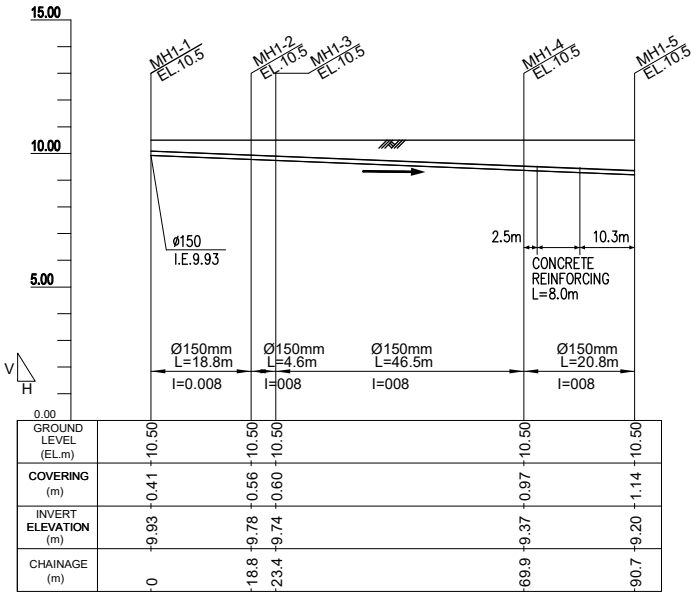


1a Sand Foundation

1b Concrete Protection (under pavement)

1 Cross Sections for Pipe A-1 and A-2

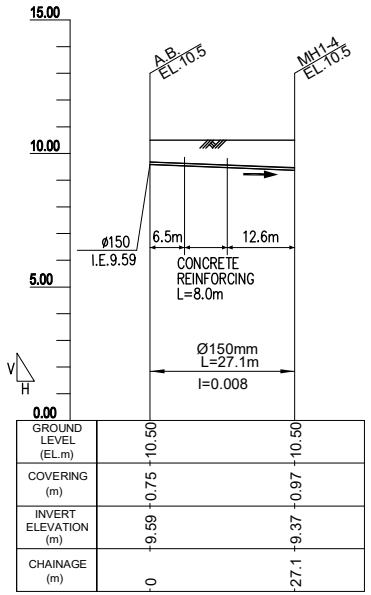
Scale 1:20



GROUND LEVEL (EL.m)	10.50	10.50	10.50	10.50	10.50
COVERING (m)	0.41	0.56	0.60	0.97	1.14
INVERT ELEVATION (m)	9.93	9.78	9.74	9.37	9.20
CHAINAGE (m)	0	18.8	23.4	69.9	90.7

Profile (A-1)

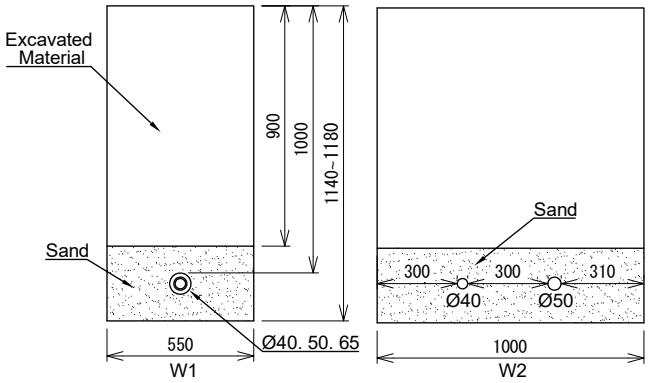
H-Scale 1:1,000 V-Scale 1:200



GROUND LEVEL (EL.m)	10.50	10.50
COVERING (m)	0.75	0.97
INVERT ELEVATION (m)	9.59	9.37
CHAINAGE (m)	0	27.1

Profile (A-2)

H-Scale 1:1,000 V-Scale 1:200

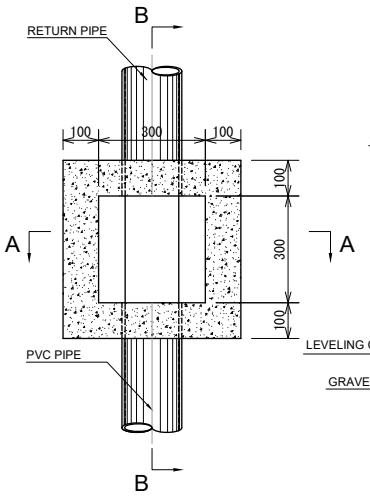


2a Section Type 1

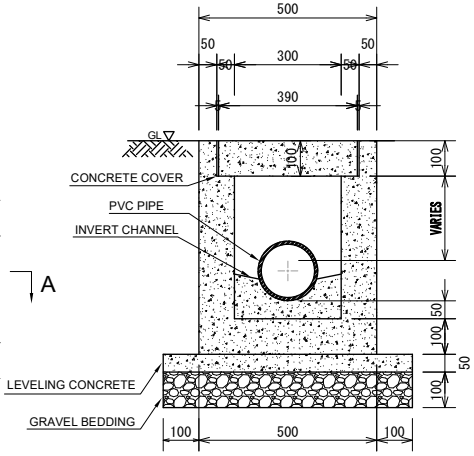
2b Section Type 2

2 Cross Sections of B-1, B-2, and C-1

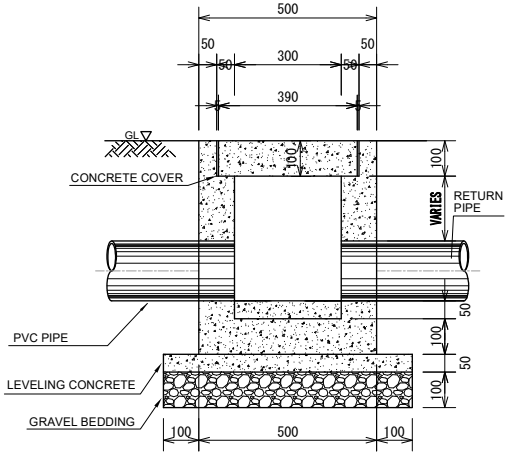
Scale 1:20



3a Plan of Manhole



3b Section A-A



3c Section B-B

3 Sections of Manhole

Scale 1:15

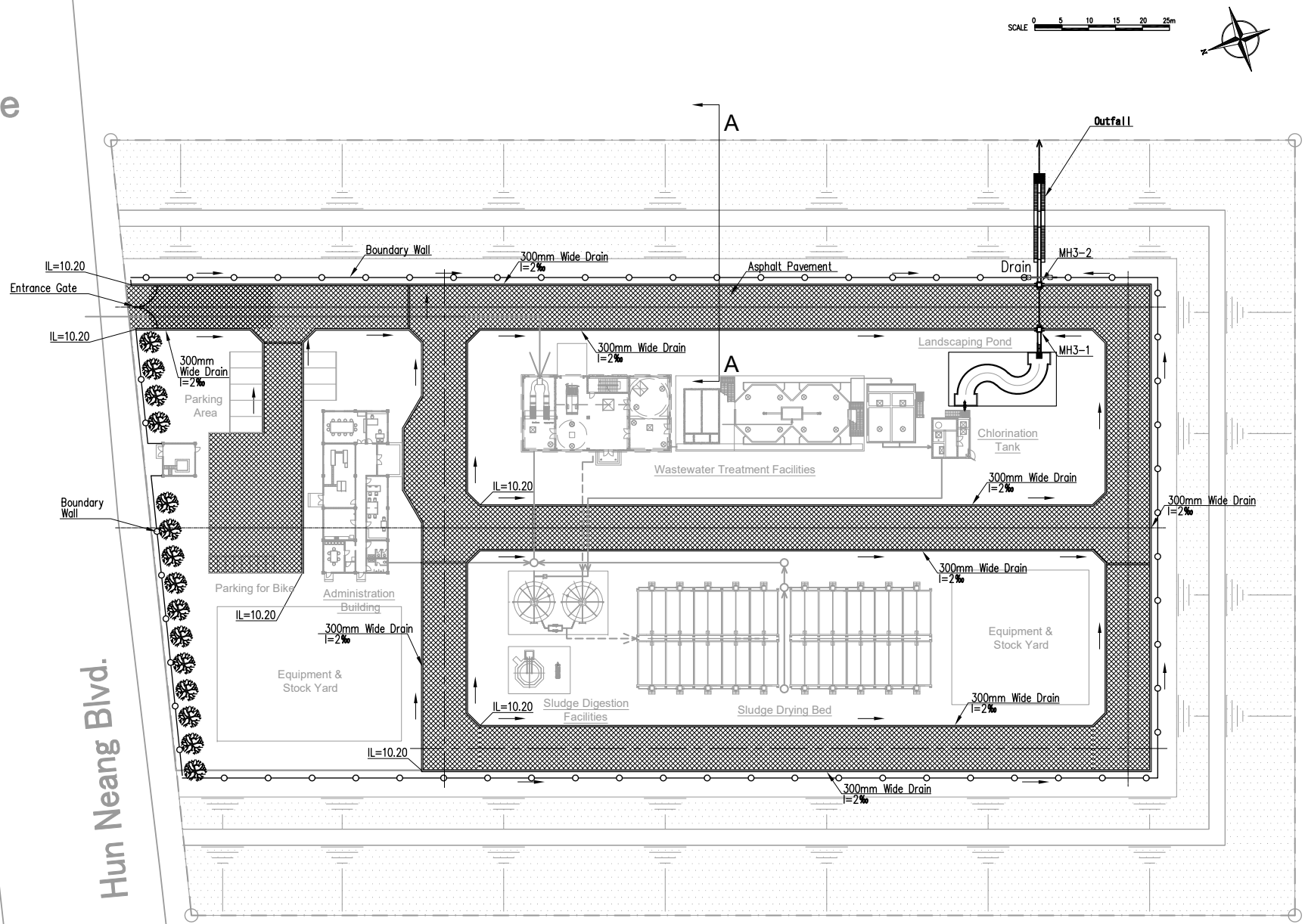
SCALE A (1:1,000) 0 10 20 30 40 50m

SCALE B (1:200) 0 2 4 6 8 10m

SCALE C (1:20) 0 0.1 0.2 0.3 0.4 0.5m

SCALE D (1:15) 0 0.1 0.2 0.3 0.4m

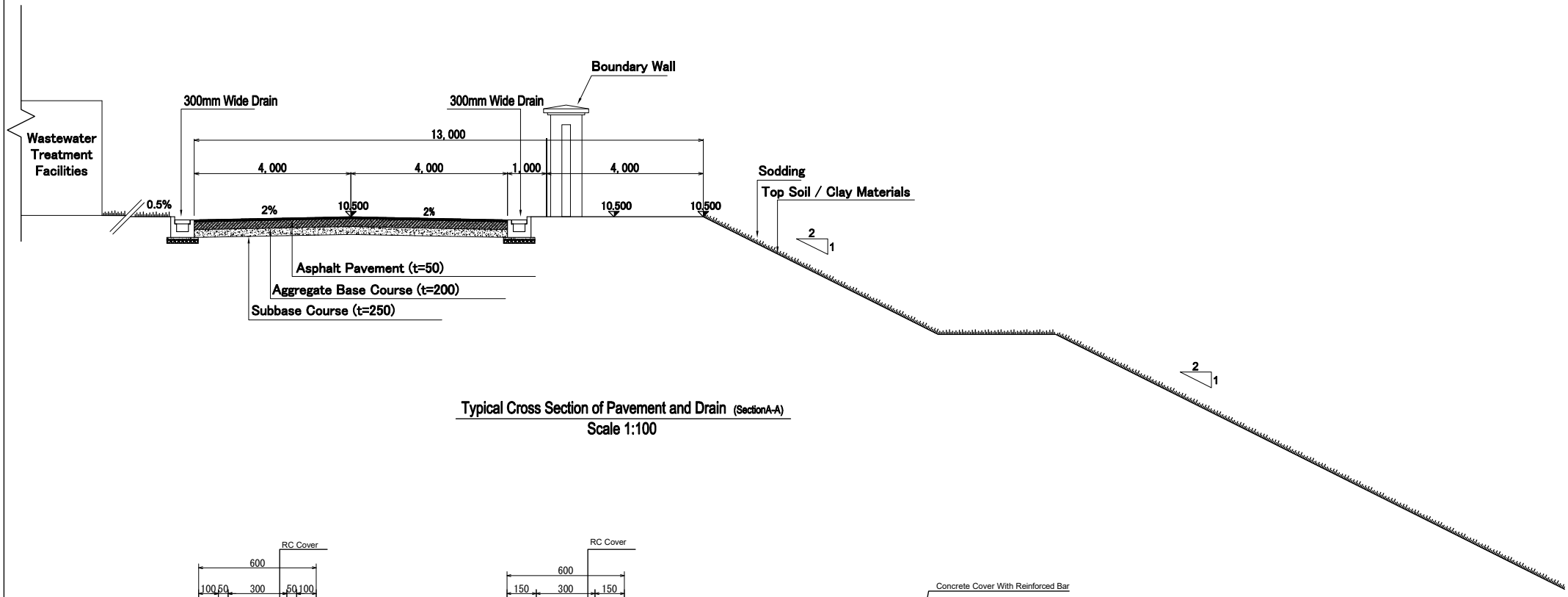
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-002	SEWAGE TREATMENT PLANT Profile and Detail of Yard Piping



Layout of Pavement, Drainage, Gate & Wall

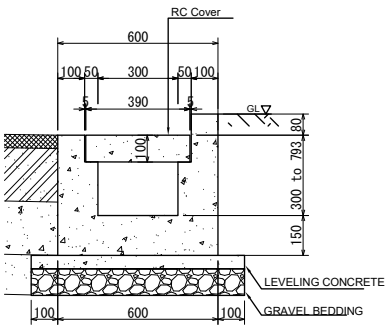
Scale = 1:750

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-003	SEWAGE TREATMENT PLANT Layout of Pavement, Drainage, Gate & Wall

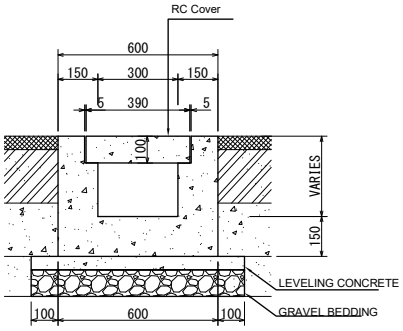


Typical Cross Section of Pavement and Drain (SectionA-A)

Scale 1:100

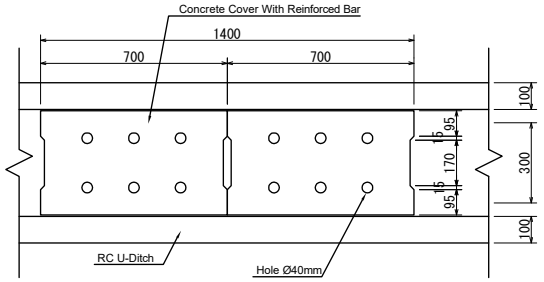


1a 300 Wide Drain



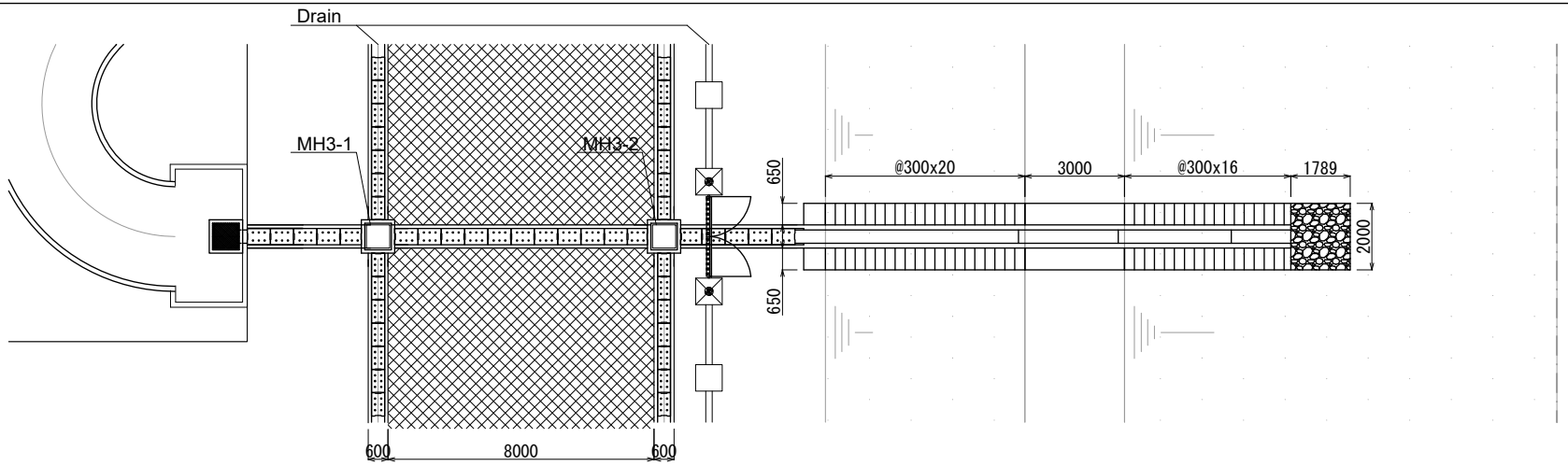
1b 300 Wide Drain (Road Cross Section)

1 Sections of Drain
Scale 1:20



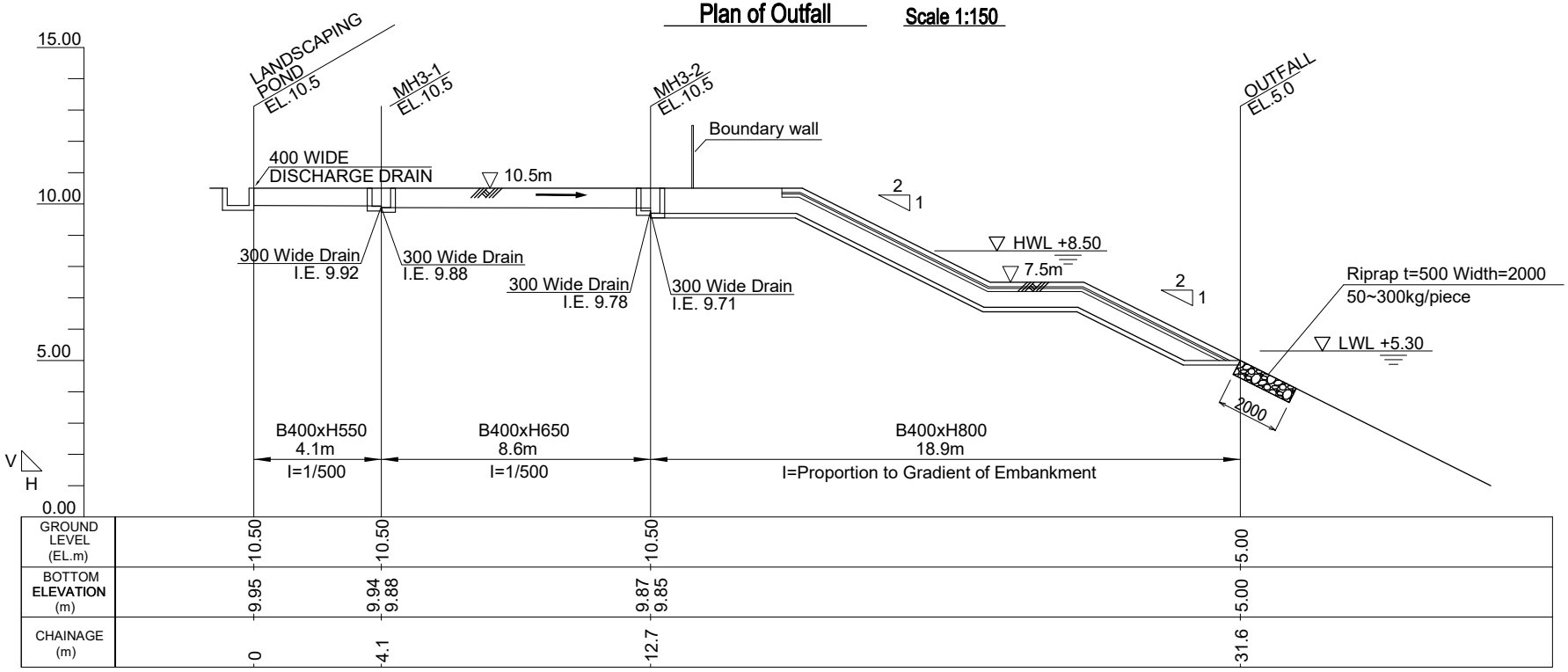
1c Concrete Cover

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-004	SEWAGE TREATMENT PLANT Detail of Pavement & Drainage



Plan of Outfall

Scale 1:150



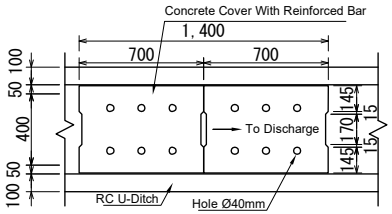
GROUND LEVEL (EL.m)	10.50	10.50	10.50		5.00
BOTTOM ELEVATION (m)	9.95	9.94 / 9.88	9.87 / 9.85		5.00
CHAINAGE (m)	0	4.1	12.7		31.6

Profile of Outfall

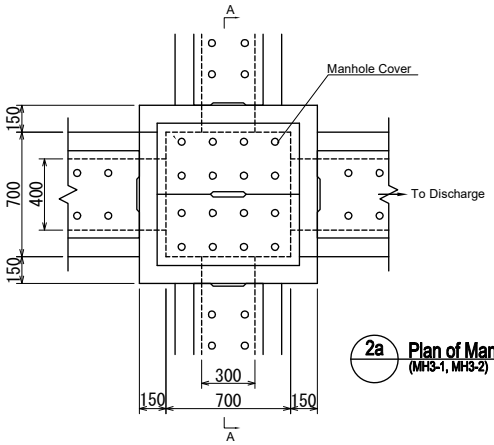
Scale(V=H) 1:150

SCALE (1:150) 0 2 4 6 8 10m

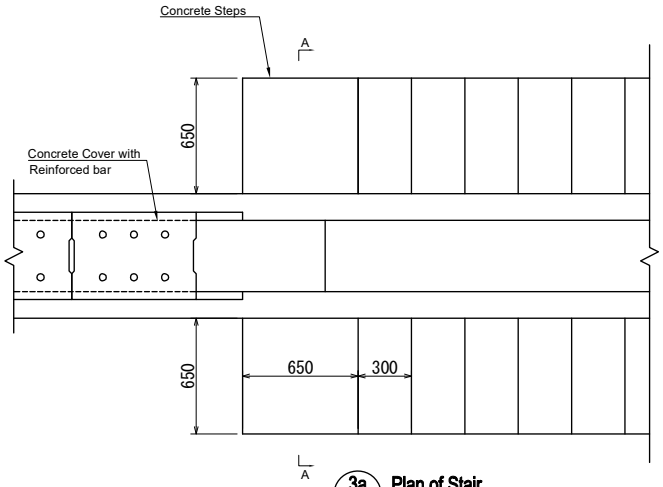
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-005	SEWAGE TREATMENT PLANT Detail of Outfall (1/2)



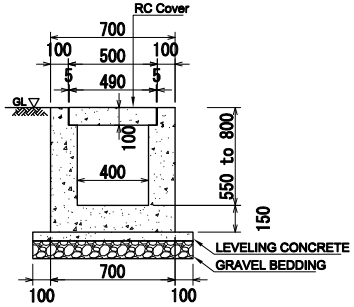
1b Concrete Cover



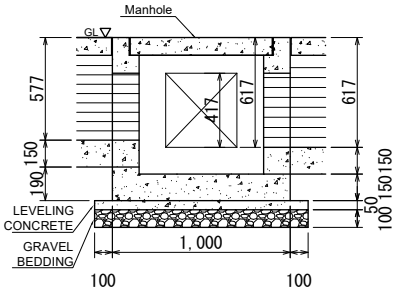
2a Plan of Manhole (MH3-1, MH3-2)



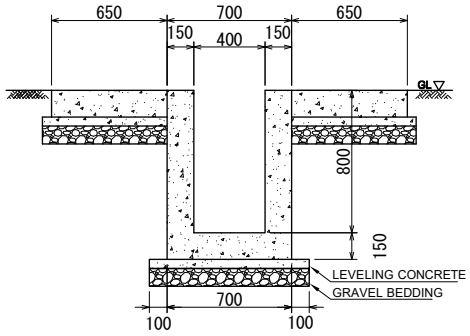
3a Plan of Stair



1a Typical 400 Wide Discharge Drain (Depth 550-633) With Cover

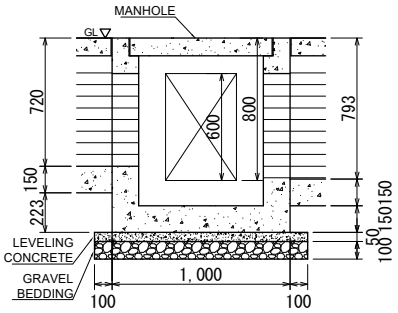


2b Section A-A (MH3-1)

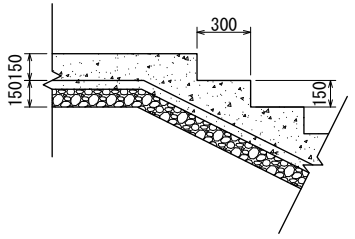


3b Typical 400 Wide Discharge Drain (Depth 800) Without Cover

1 Sections of Discharge Drain
Scale 1:30



2c Section A-A (MH3-2)



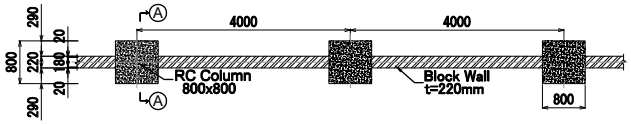
3c Section A-A

2 Sections of Discharge Manhole
Scale 1:30

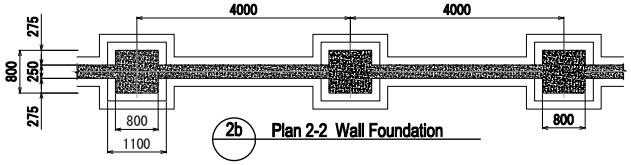
3 Sections of Discharge Stair & Drain
Scale 1:30

SCALE A (1:150) 0 0.5 1.0

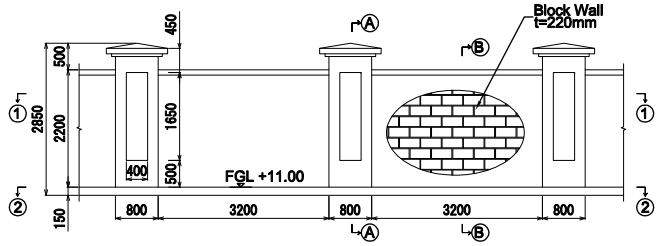
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-006	SEWAGE TREATMENT PLANT Detail of Outfall (2/2)



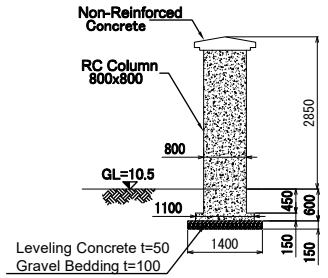
2a Plan 1-1 Column and Wall



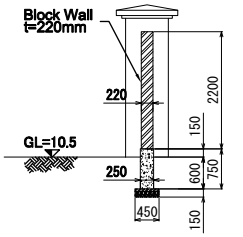
2b Plan 2-2 Wall Foundation



2c Front Elevation

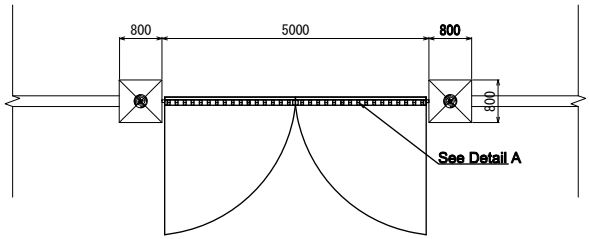


2d Section A-A

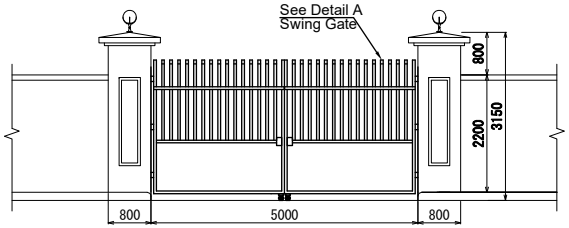


2e Section B-B

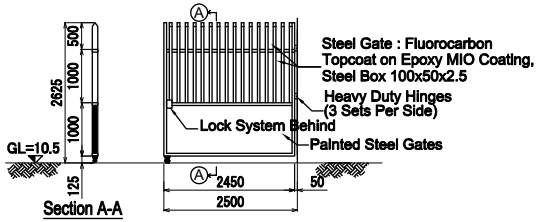
2 Detail of Boudary Wall
Scale 1:100



1a Plan



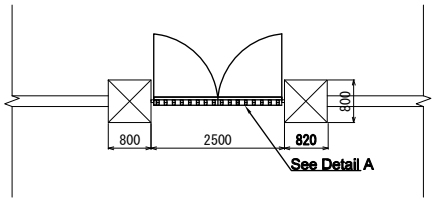
1b Front Elevation



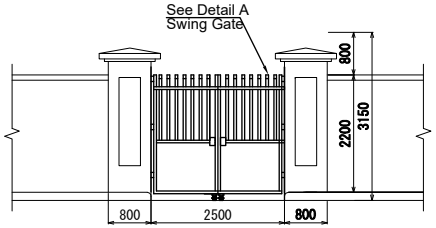
Section A-A

1c Detail A

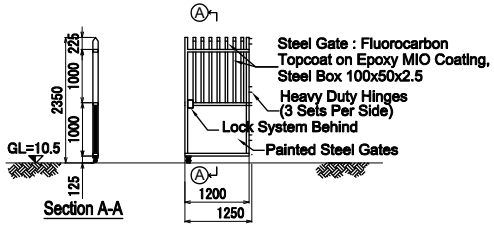
1 Detail of Main Entrance Gate
Scale 1:100



1a Plan



1b Front Elevation



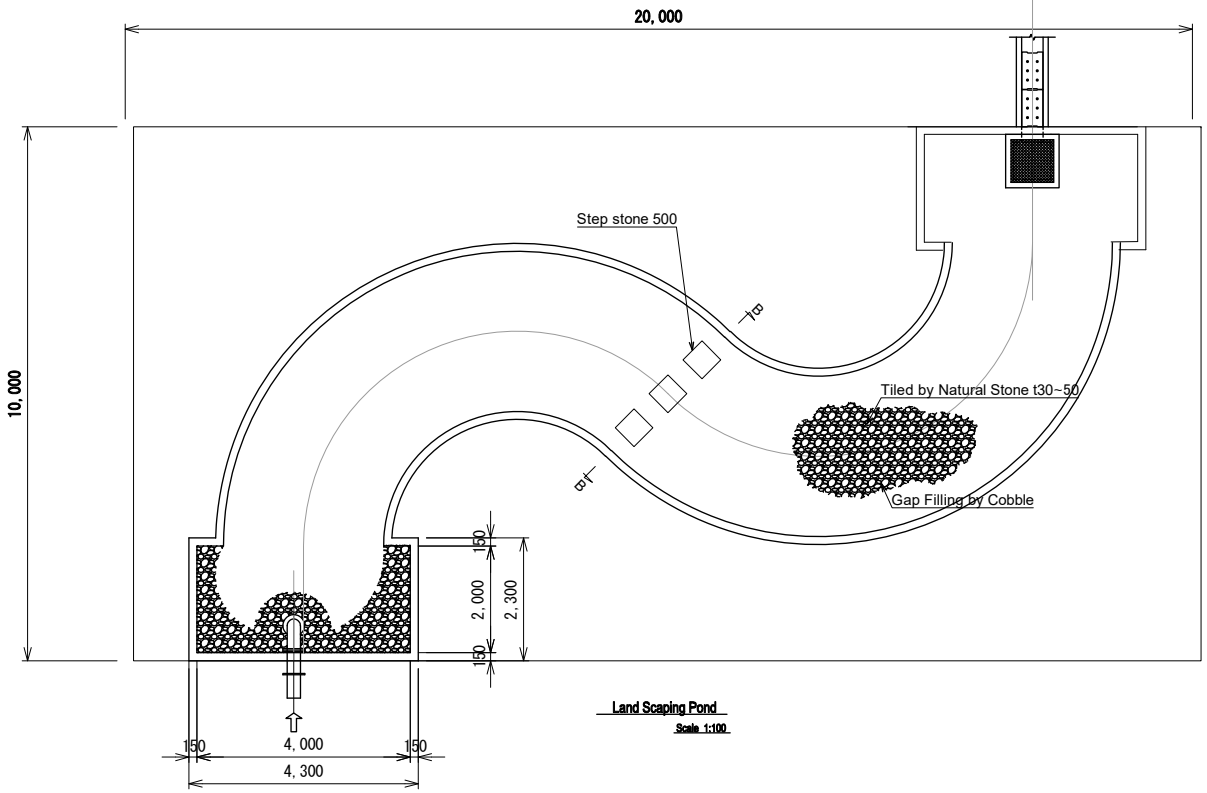
Section A-A

1c Detail A

3 Detail of Side Entrance Gate
Scale 1:100

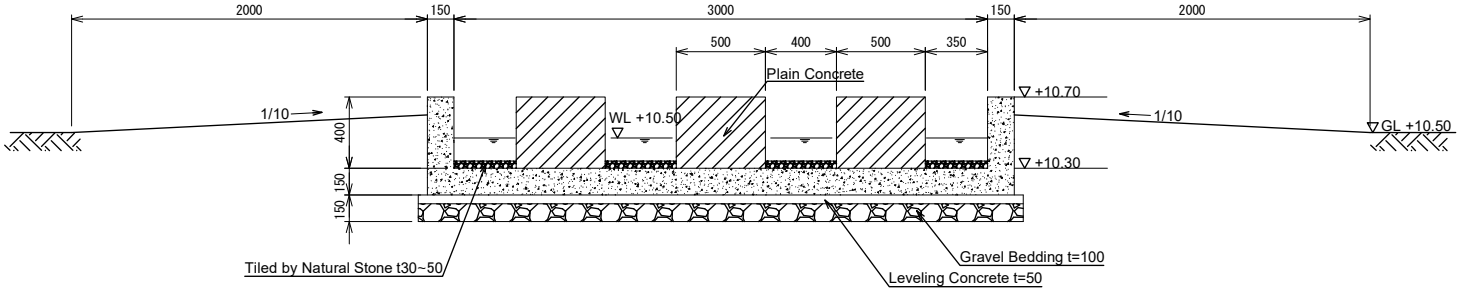
SCALE A (1:150) 0 1 2 3 4

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-007	SEWAGE TREATMENT PLANT Detail of Gate & Wall



Land Scaping Pond

Scale 1:100



Section A-A

Scale 1:30

SCALE A (1:100) 0 2 4 6 8 10m

SCALE B (1:30) 0 0.5 1.0 1.5m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-008	SEWAGE TREATMENT PLANT Landscaping Pond

List of Flexible Electric Pipe

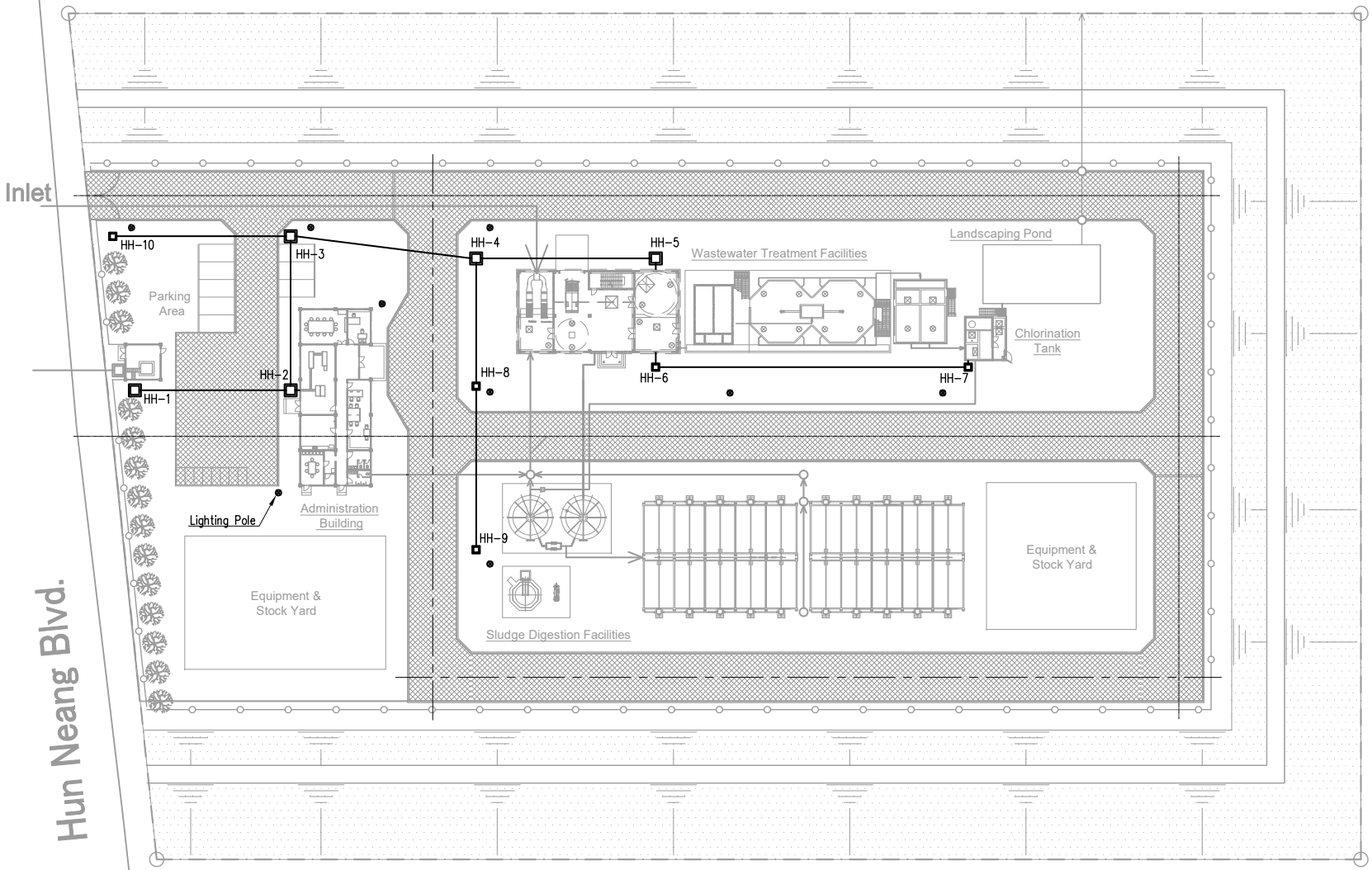
Route No	Origine ~ Destination	Length (m) / under pavement	High Voltage	Low Voltage	Signaling
A	HH-1 ~ HH-2	19.463 / 17.612	200 x 1		40 x 1
B	HH-2 ~ HH-3	27.148	200 x 1	150 x 1	40 x 1
C	HH-2 ~ HH-4	30.308 / 8.667		150 x 1	40 x 1
D	HH-4 ~ HH-5	29.069		150 x 1	40 x 1
E	HH-5 ~ HH-6	17.319		150 x 1	40 x 1

Route No	Origine ~ Destination	Length (m) / under pavement	High Voltage	Low Voltage	Signaling
F	HH-6 ~ HH-7	52.305		150 x 1	40 x 1
G	HH-4 ~ HH-8	20.530		150 x 1	40 x 1
H	HH-8 ~ HH-9	26.945 / 8.569		150 x 1	40 x 1
I	HH-3 ~ HH-10	29.425 / 7.600		150 x 1	40 x 1

SCALE 0 5 10 15 20 25m

List of Handhole

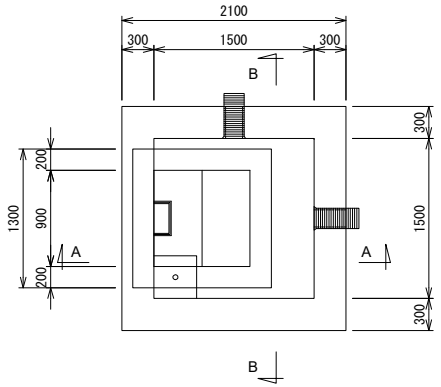
No	Handhole Type
HH-1 ~ HH-5	Type A
HH-6 ~ HH-10	Type B



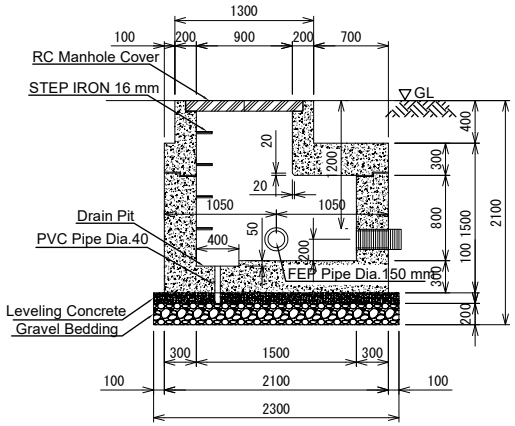
Layout of Yard Cabling

Scale = 1:750

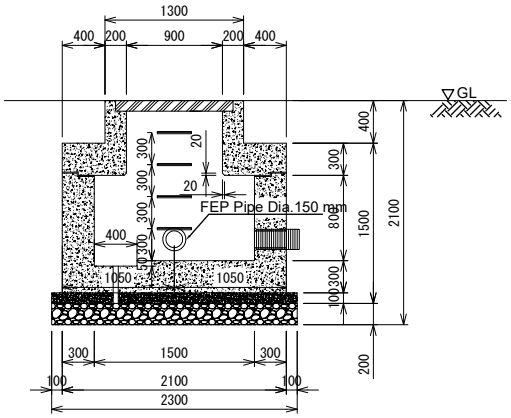
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-009	SEWAGE TREATMENT PLANT Layout of Yard Cabling & Lighting



1a Plan

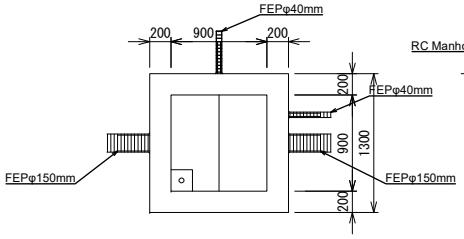


1b Section A-A

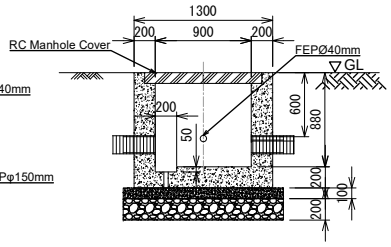


1c Section B-B

1 Electrical Manhole Type-A (1500x1500)

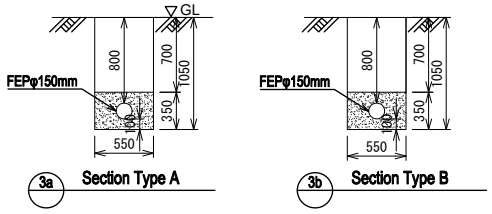


2a Plan



2b Section A-A

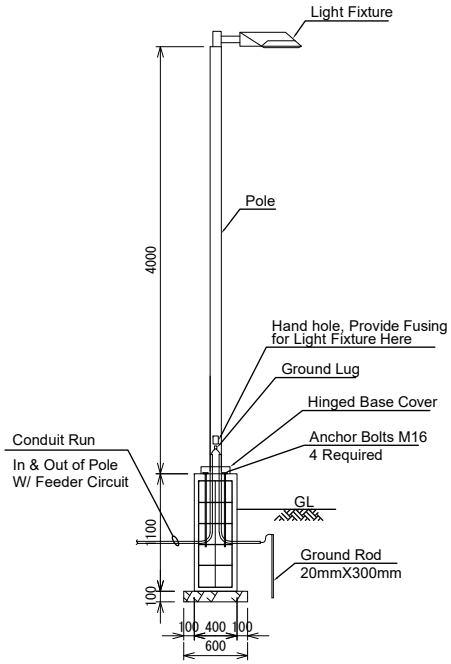
2 Electrical Manhole Type-B (900x900)



3a Section Type A

3b Section Type B

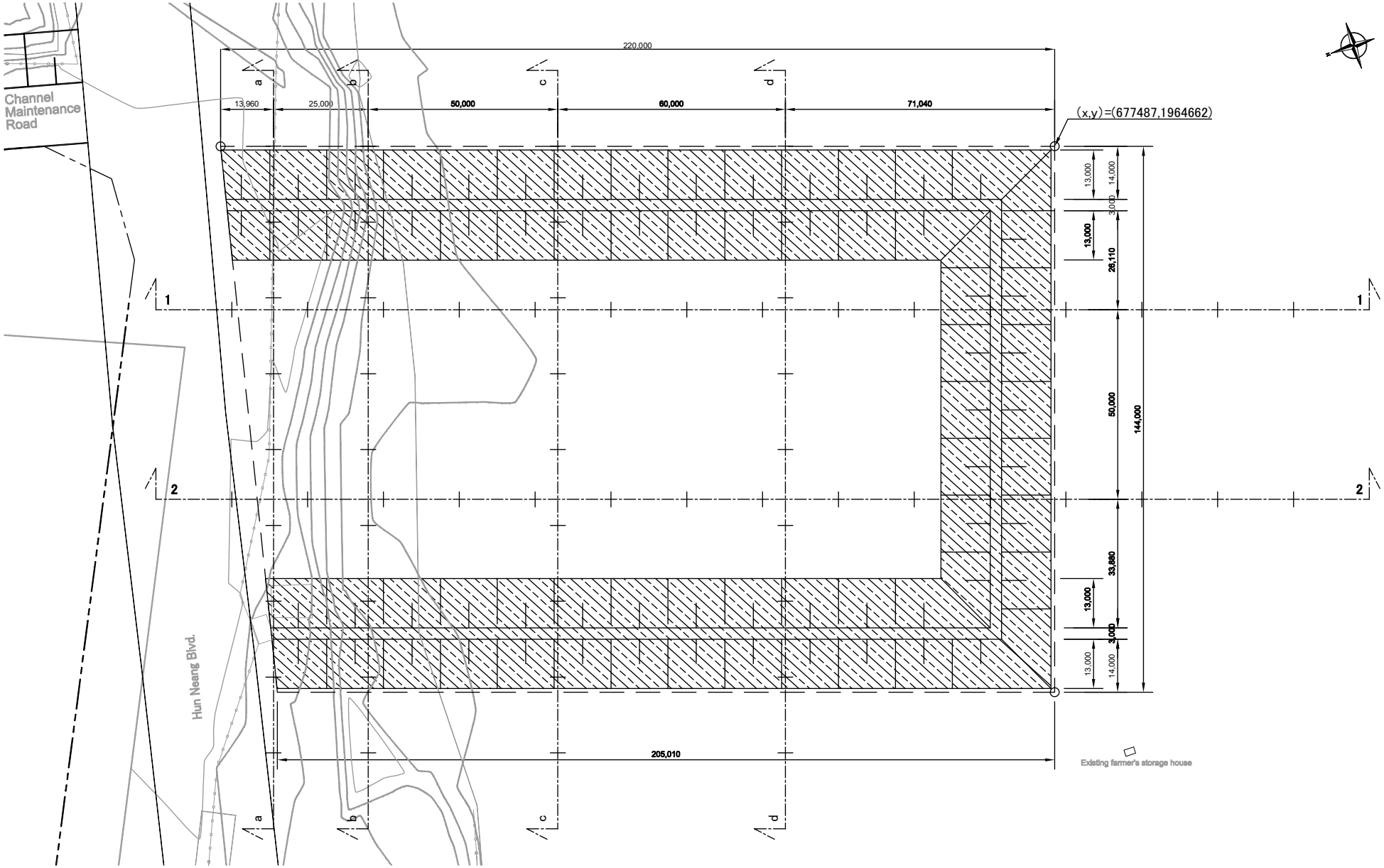
3 Typical Section of Trench Excavation for Electrical Cable



4 Yard Lighting Pole (1500x1500)

SCALE 0 1.0 2.0 3.0m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU
STP-LS-010	SEWAGE TREATMENT PLANT Detail of Handhole, Trench Excavation and Yard Lighting

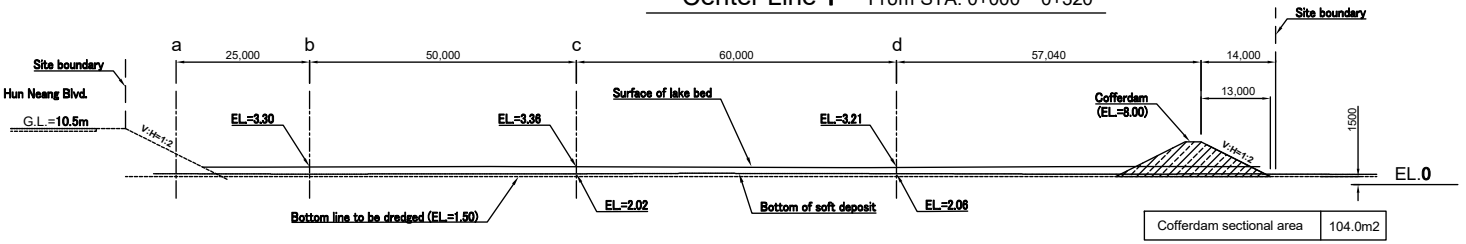


Layout Plan of Cofferdam

Scale = 1:1000

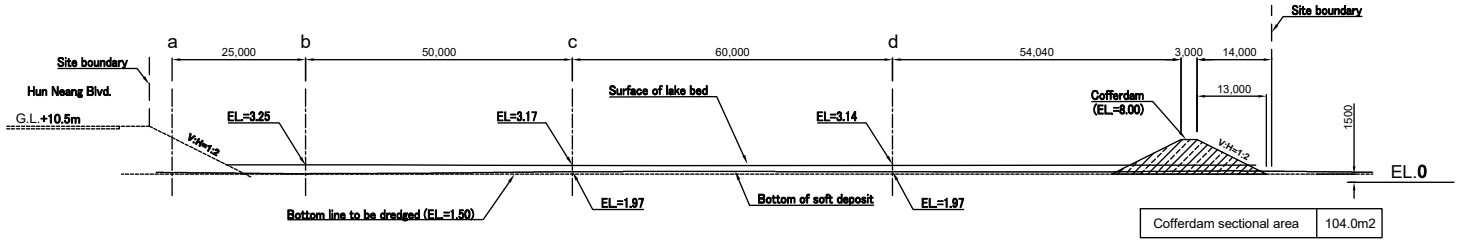
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-001	SEWAGE TREATMENT PLANT Layout Plan of Cofferdam

Center Line 1 From STA: 0+000 ~ 0+320

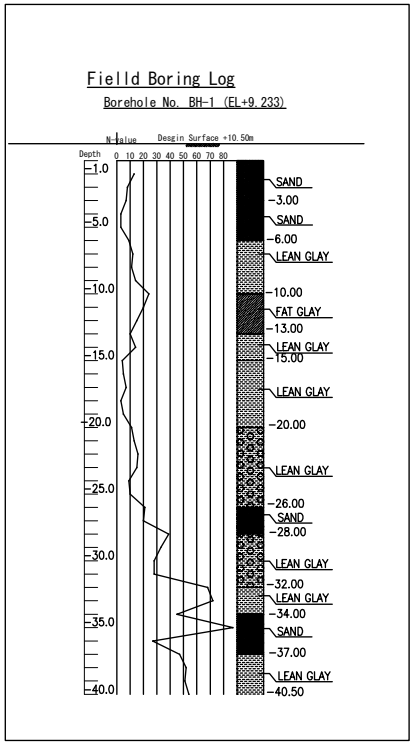


Cofferdam sectional area	104.0m2

Center Line 2 From STA: 0+000 ~ 0+320



Cofferdam sectional area	104.0m2



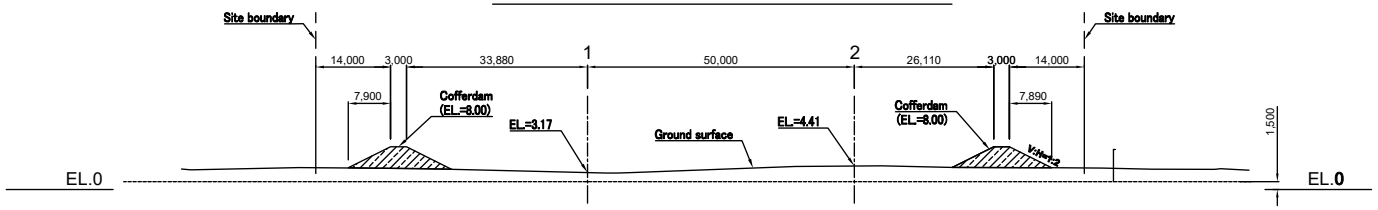
Section of Cofferdam (1/2)

Scale = 1:1000

SCALE 0 10 20 30 40 50m

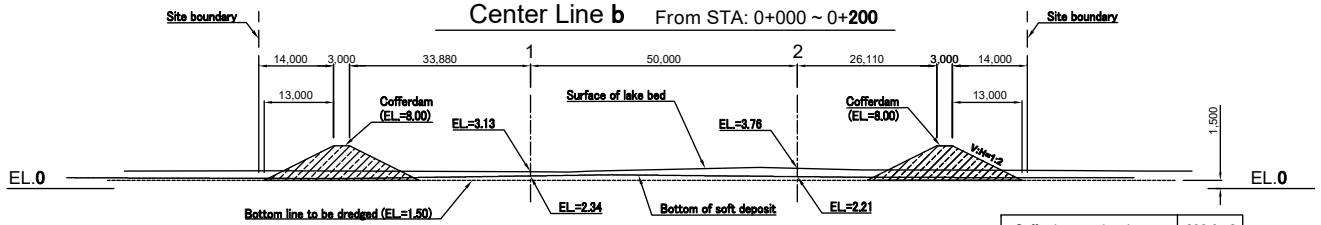
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-002	SEWAGE TREATMENT PLANT Section of Cofferdam (1/2)

Center Line **a** From STA: 0+000 ~ 0+**200**



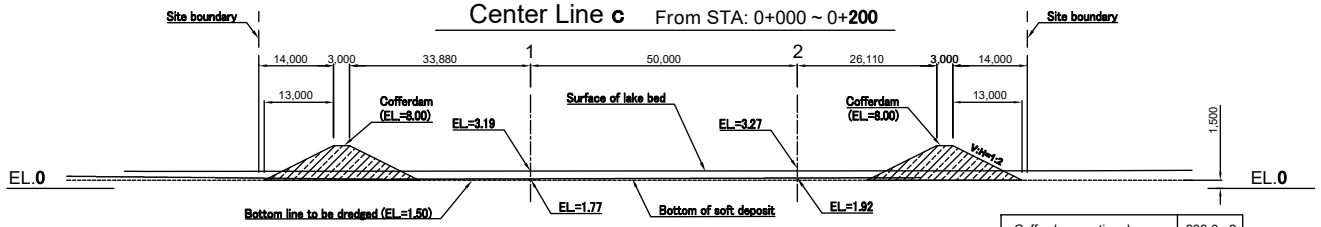
Cofferdam sectional area	87.6m2

Center Line **b** From STA: 0+000 ~ 0+**200**



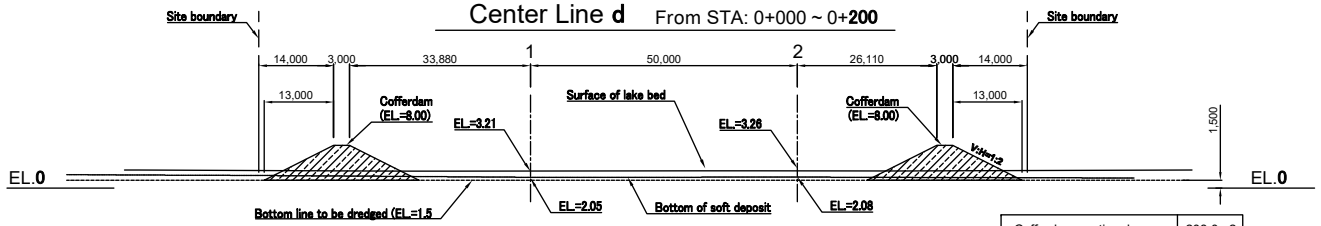
Cofferdam sectional area	208.0m2

Center Line **c** From STA: 0+000 ~ 0+**200**



Cofferdam sectional area	208.0m2

Center Line **d** From STA: 0+000 ~ 0+**200**



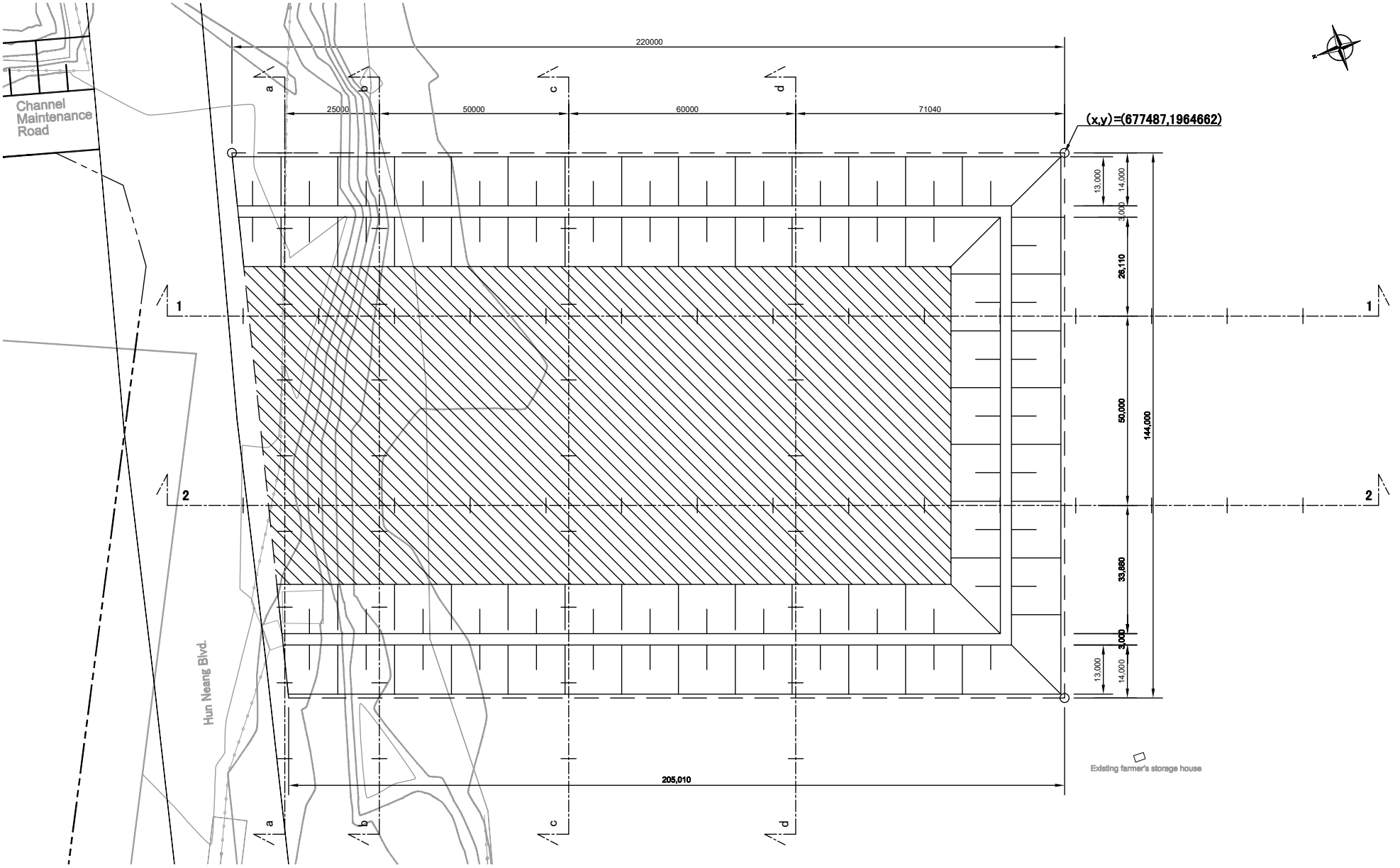
Cofferdam sectional area	208.0m2

SCALE 0 10 20 30 40 50m

Section of Cofferdam (2/2)

Scale = 1:1000

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-003	SEWAGE TREATMENT PLANT Section of Cofferdam (2/2)



Layout Plan of Dredging

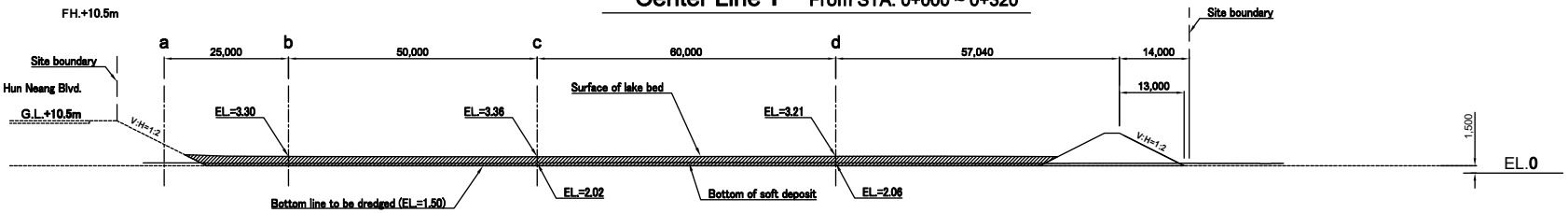
Scale = 1:1000

Legend

Site boundary
Lake boundary
Dredging area

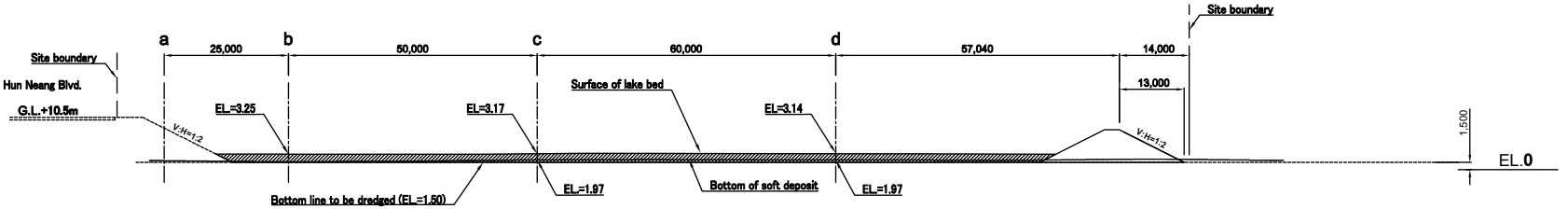
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-004	SEWAGE TREATMENT PLANT Layout Plan of Dredging

Center Line 1 From STA: 0+000 ~ 0+320



Dredging sectional area	313m2

Center Line 2 From STA: 0+000 ~ 0+320



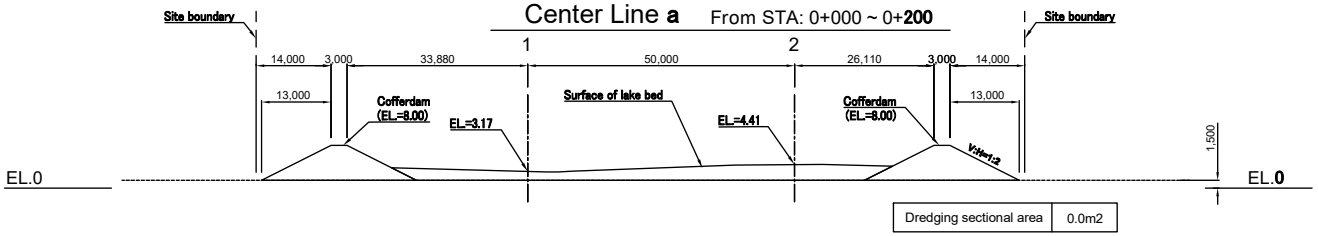
Dredging sectional area	278.5m2

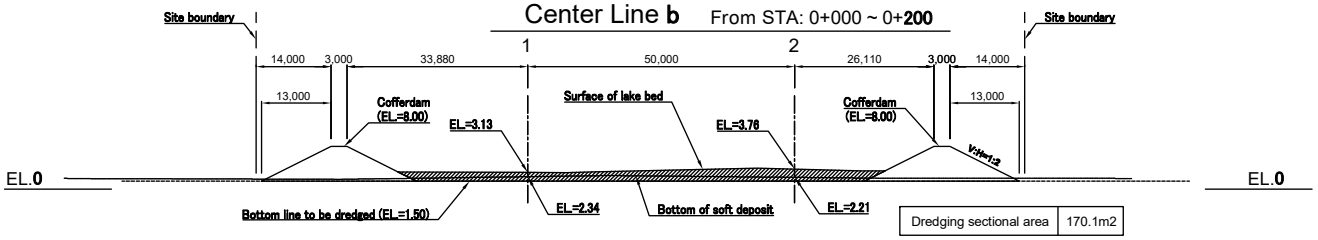
Section of Dredging (1/2)

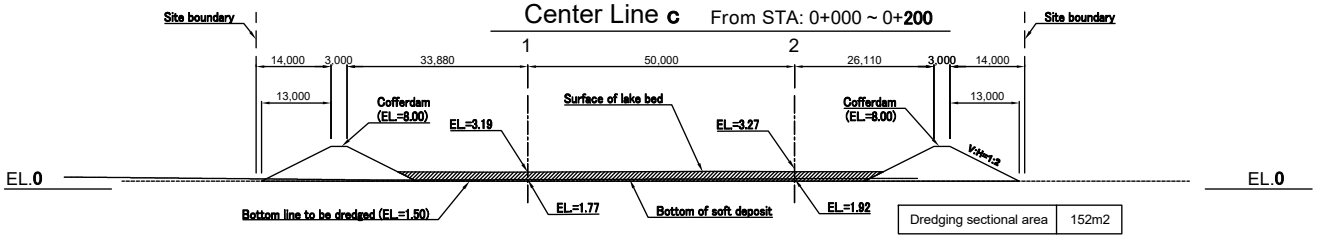
Scale = 1:1000

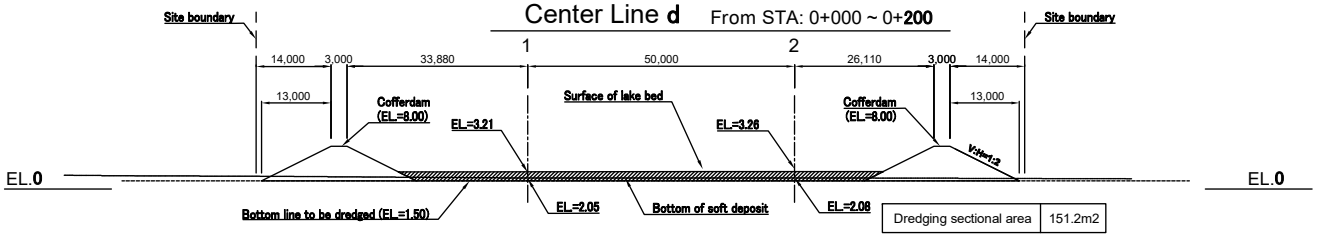
SCALE 0 10 20 30 40 50m

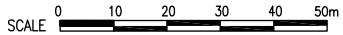
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-005	SEWAGE TREATMENT PLANT Section of Dredging (1/2)







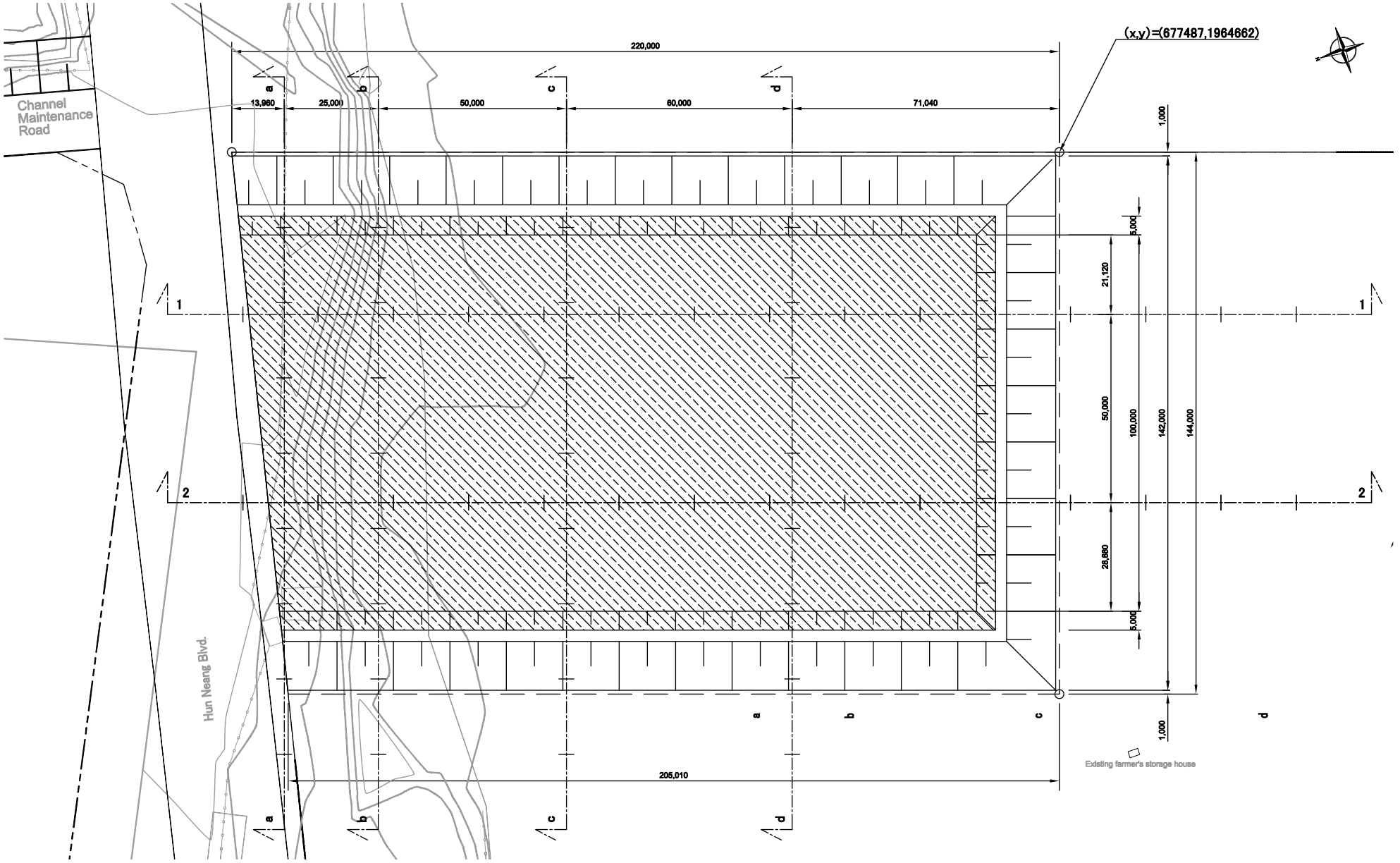




Section of Dredging (2/2)

Scale = 1:1000

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-006	SEWAGE TREATMENT PLANT Section of Dredging (2/2)



Layout Plan of Landfill

Scale = 1:1000

Legend

Site boundary

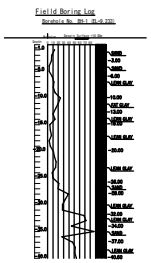
Filling area

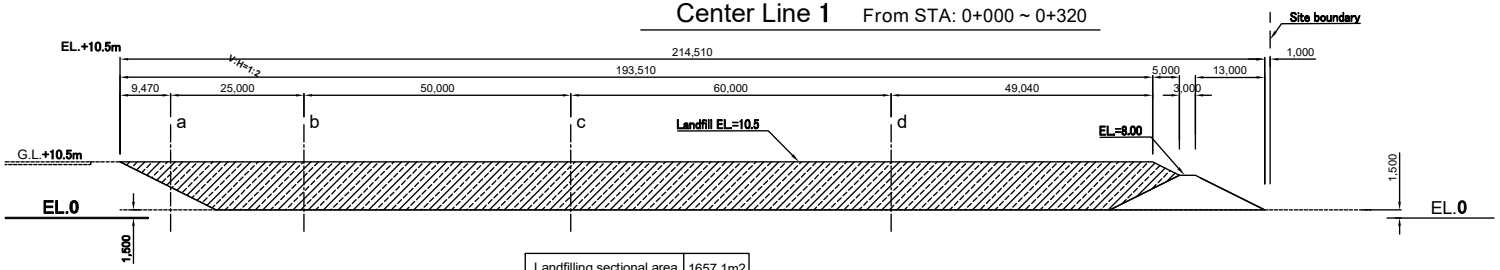
Lake boundary

SCALE 0 10 20 30 40 50m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-007	SEWAGE TREATMENT PLANT Layout Plan of Landfill

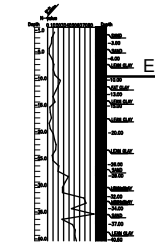
Center Line 1 From STA: 0+000 ~ 0+320

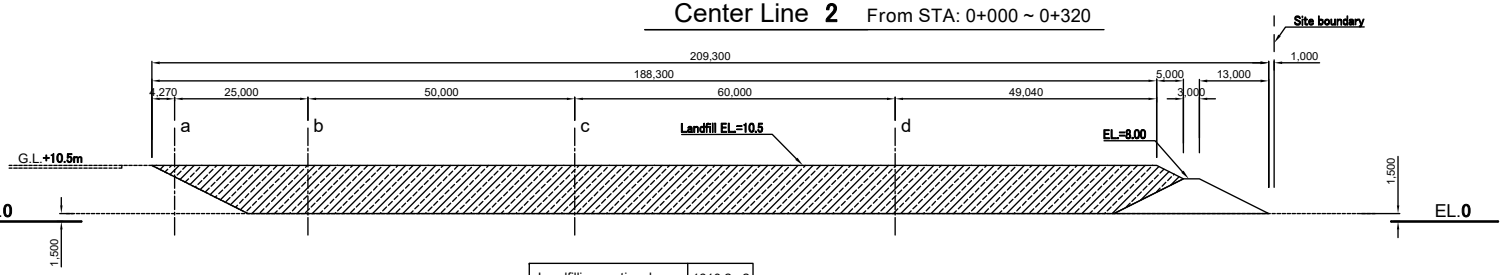




Landfilling sectional area	1657.1m2

Center Line 2 From STA: 0+000 ~ 0+320





Landfilling sectional area	1610.2m2

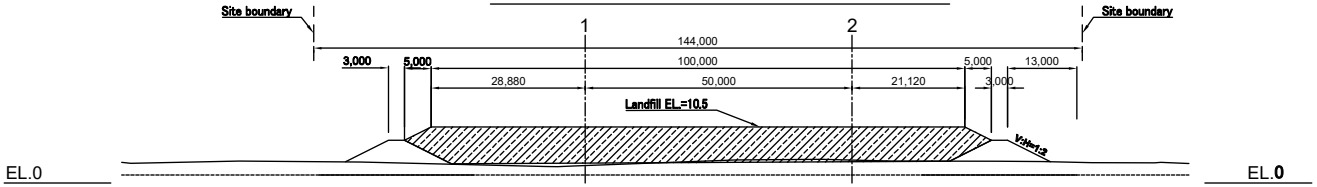
Section of Landfill (1/2)

Scale = 1:1000

SCALE 0 10 20 30 40 50m

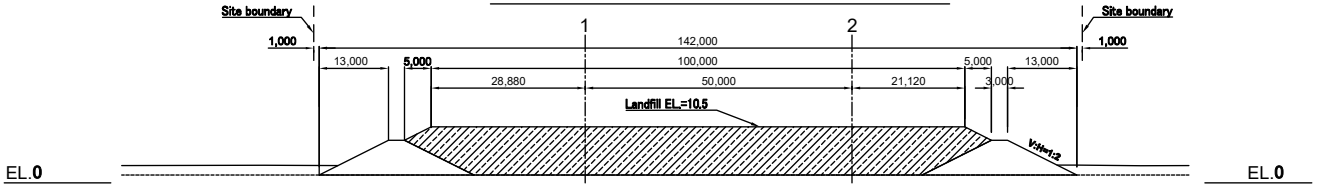
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-008	SEWAGE TREATMENT PLANT Section of Landfill (1/2)

Center Line **a** From STA: 0+000 ~ 0+**200**



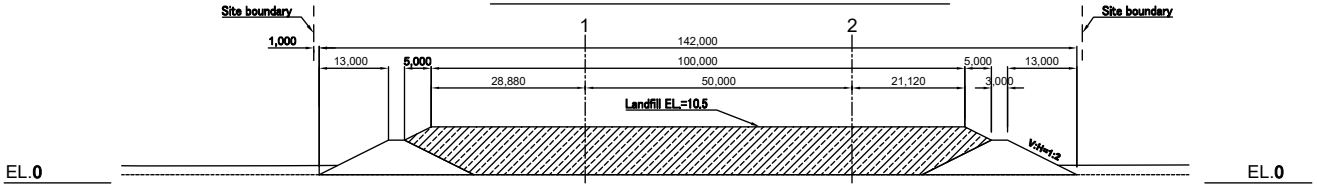
Landfilling sectional area	686.3m2

Center Line **b** From STA: 0+000 ~ 0+**200**



Landfilling sectional area	893.0m2

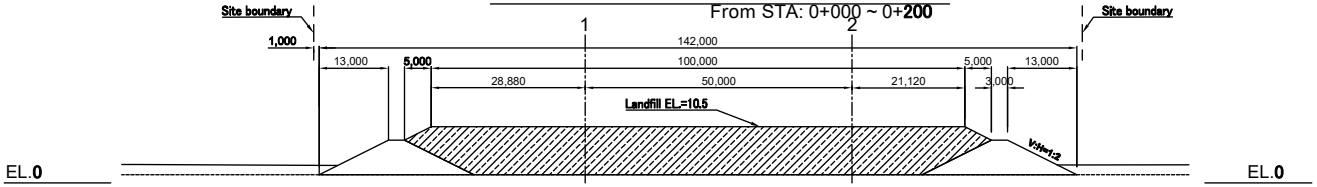
Center Line **c** From STA: 0+000 ~ 0+**200**



Landfilling sectional area	893.0m2

Center Line **d** From STA: 0+000 ~ 0+**200**

From STA: 0+000 ~ 0+**200**



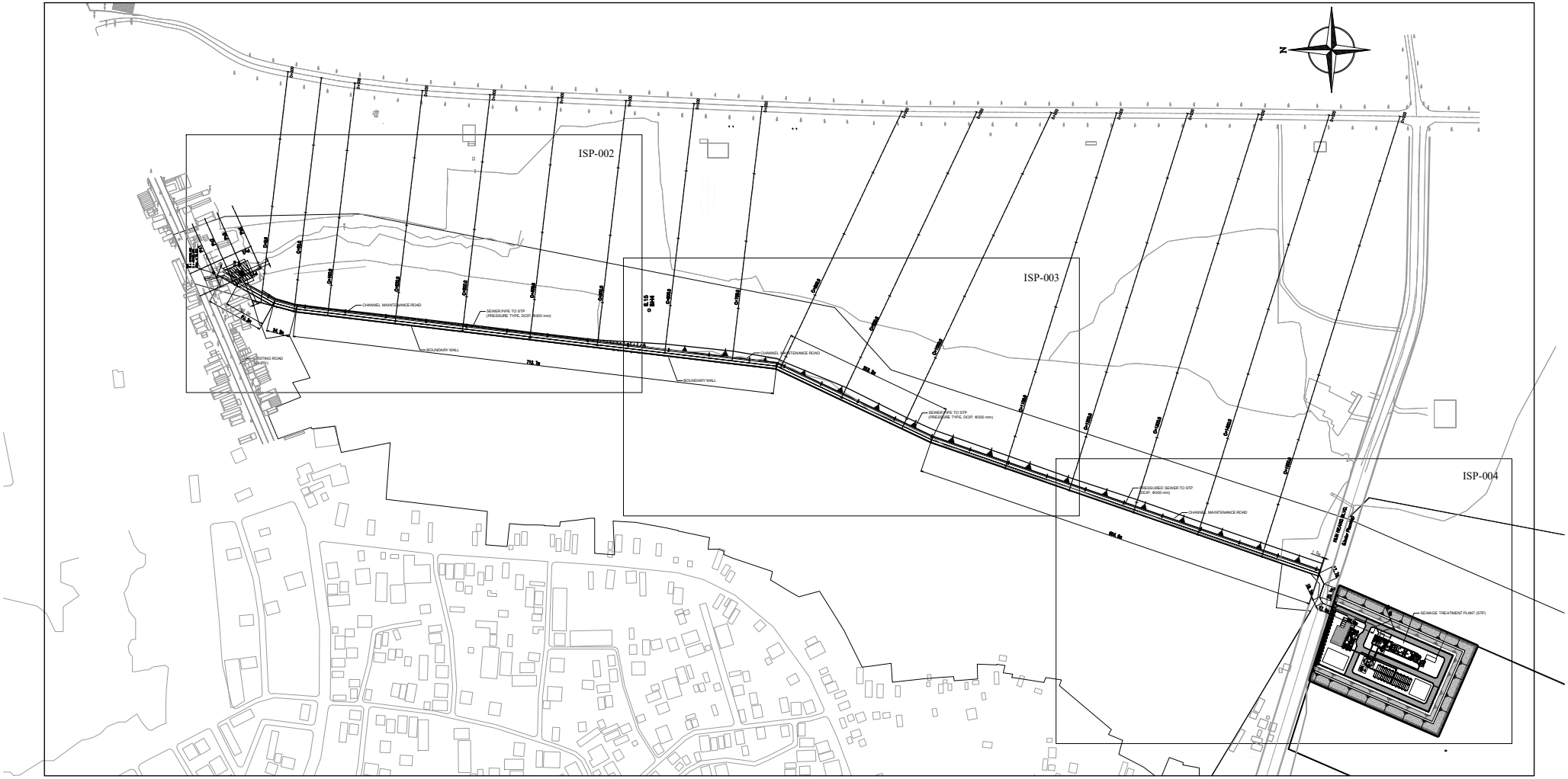
Landfilling sectional area	893.0m2

SCALE 0 10 20 30 40 50m

Section of Landfill (2/2)

Scale = 1:1000

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-009	SEWAGE TREATMENT PLANT Section of Landfill (2/2)



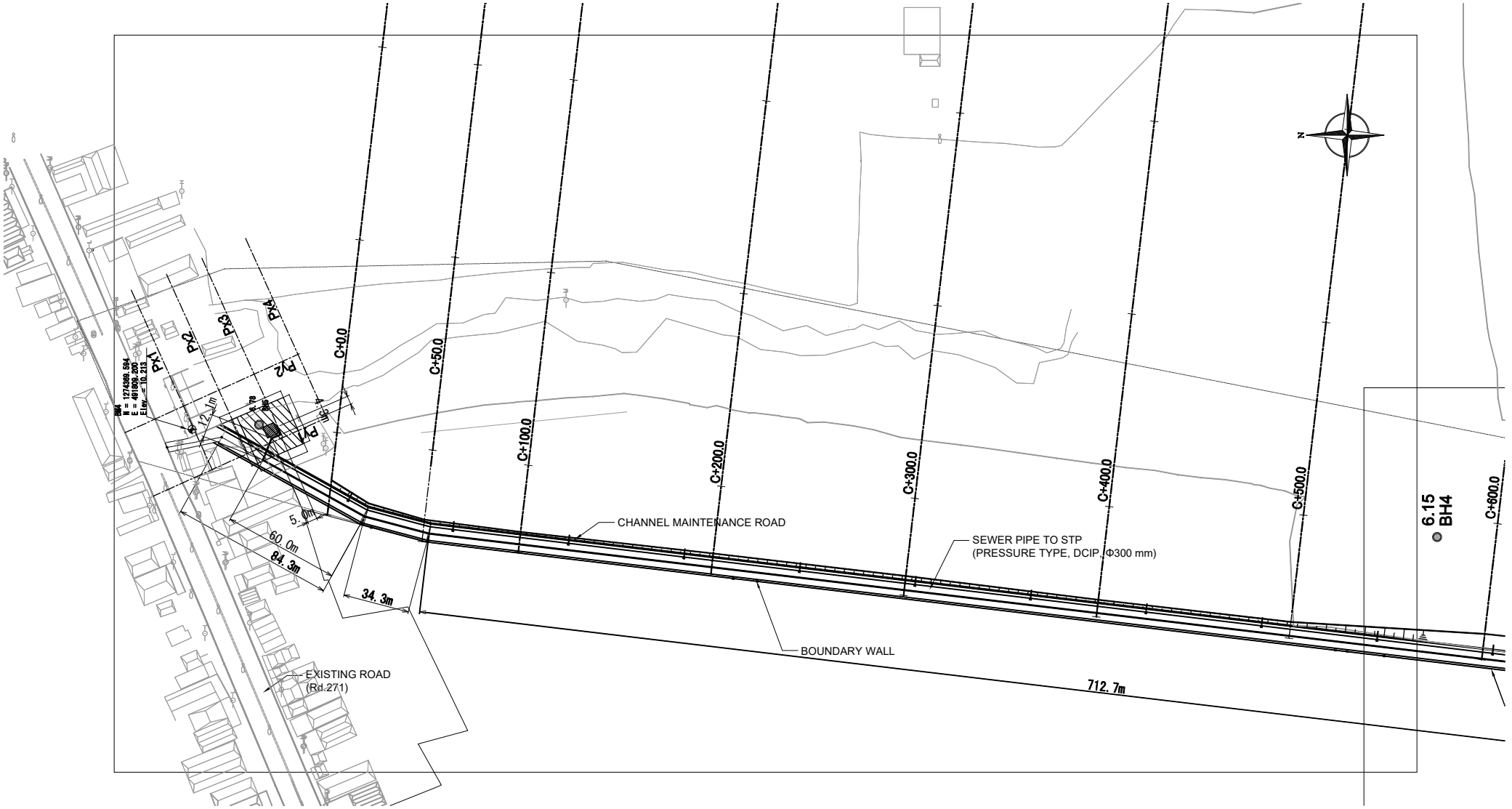
Intake & Sewer Pipe

General Layout Plan (all)

Scale = 1:6,000

SCALE (1:6,000) 0 20 40 60 80 100m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-001	INTERCEPTION FACILITY & SEWER PIPE General Layout of Interception Facility & Sewer Pipe (all)

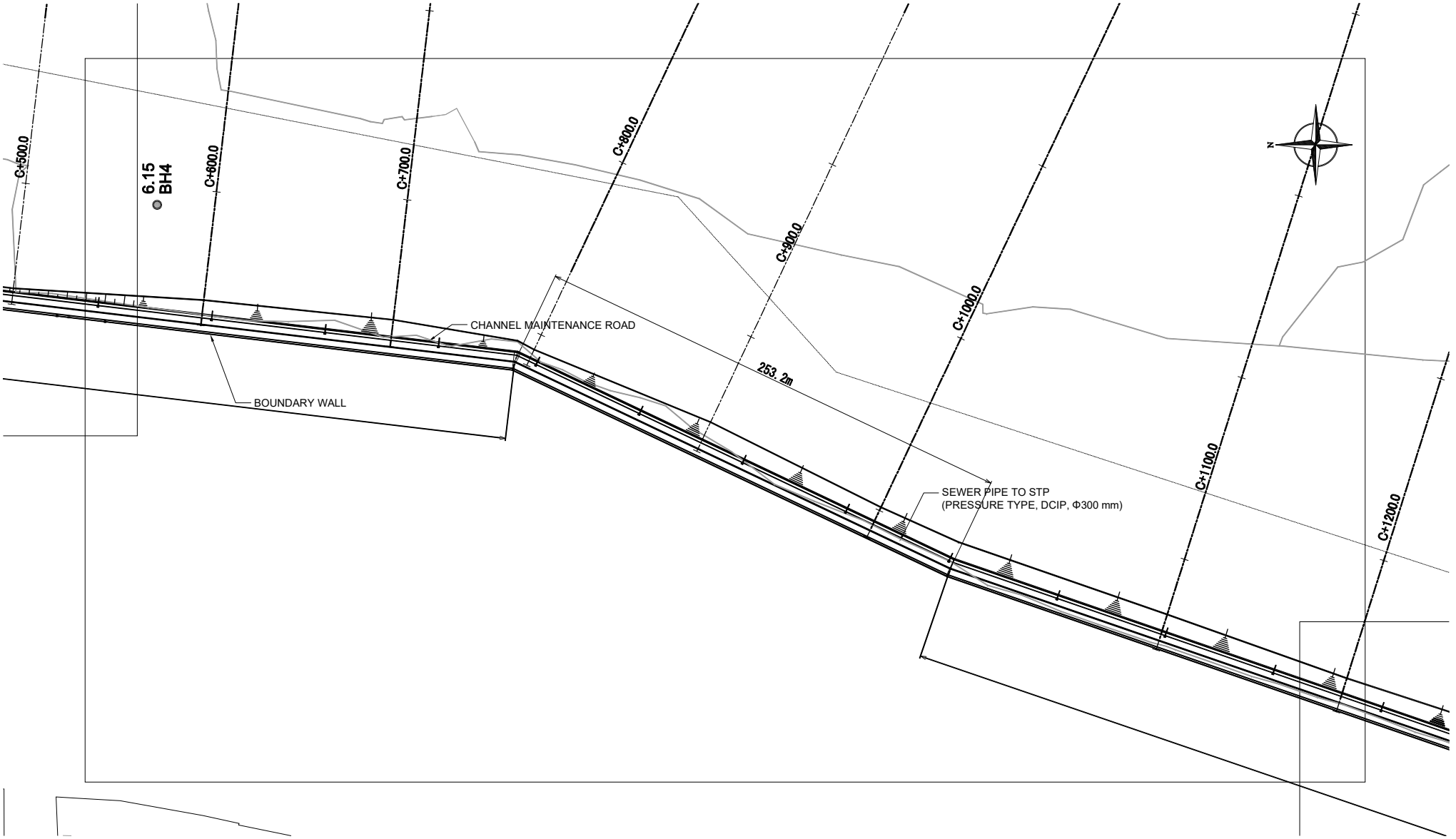


Interception Facility & Sewer Pipe

Layout Plan (1/3)

Scale = 1 : 2,000

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-002	INTERCEPTION FACILITY & SEWER PIPE General Layout of Interception Facility & Sewer Pipe (1/3)

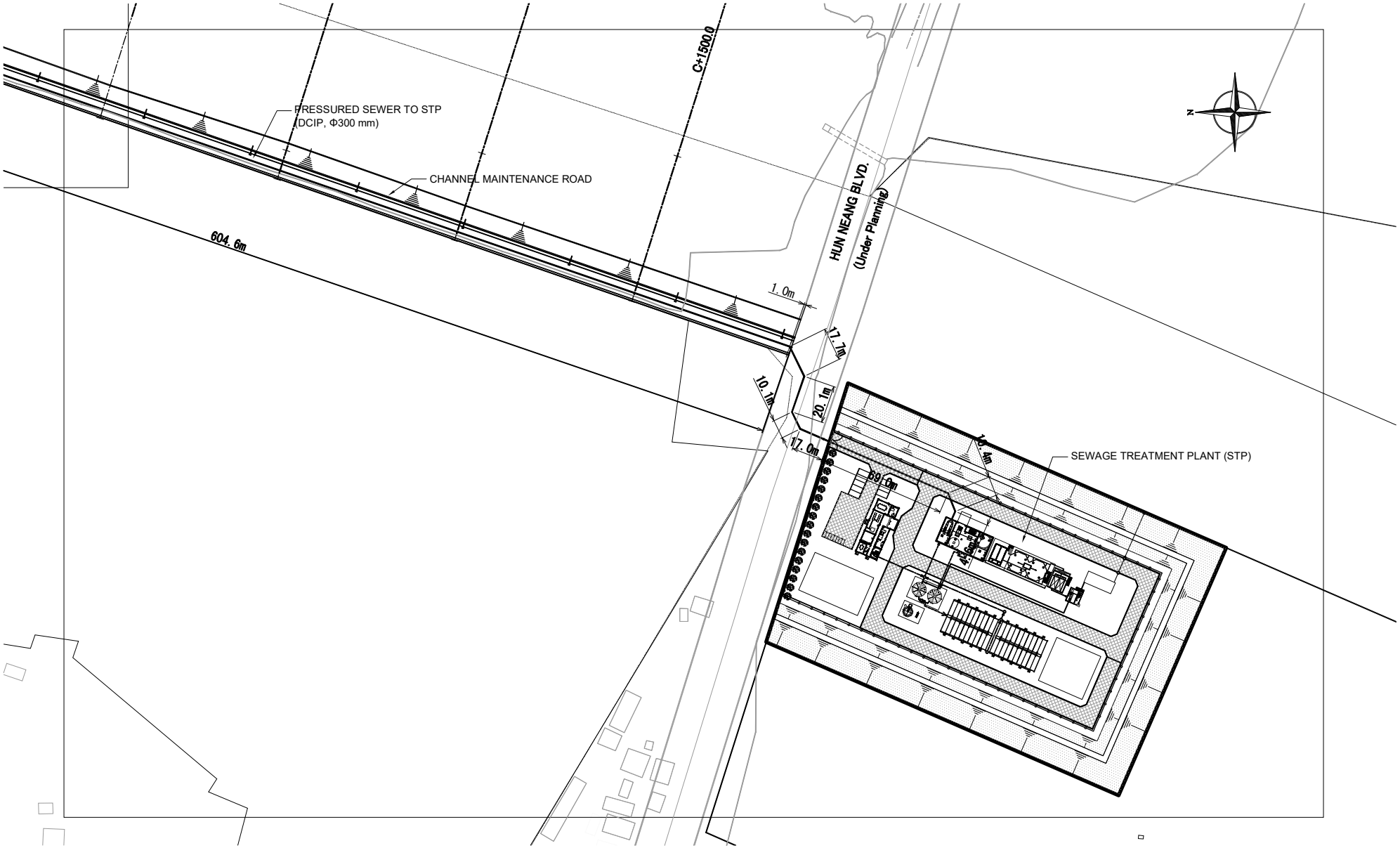


Interception Facility & Sewer Pipe

Layout Plan (2/3)

Scale = 1 : 2,000

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-003	INTERCEPTION FACILITY & SEWER PIPE General Layout of Interception Facility & Sewer Pipe (2/3)



Interception Facility & Sewer Pipe

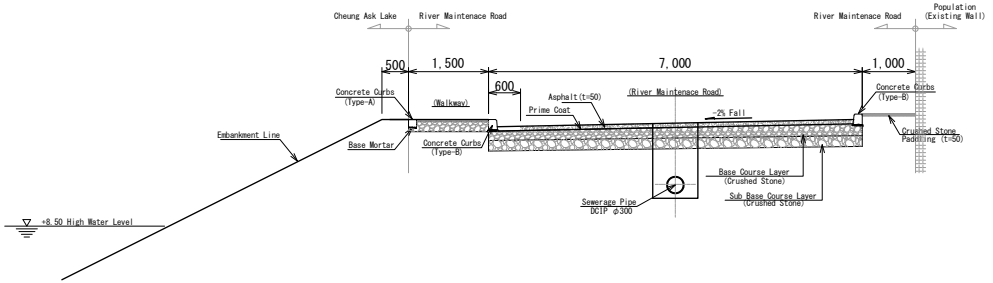
Layout Plan (3/3)

Scale = 1 : 2,000

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-004	INTERCEPTION FACILITY & SEWER PIPE General Layout of Interception Facility & Sewer Pipe (3/3)

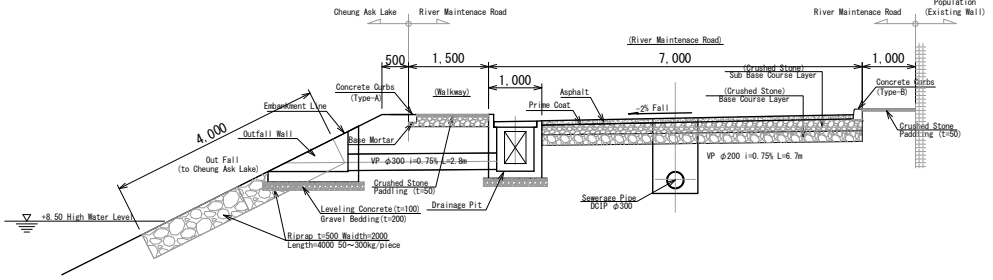
A-A Section

Scale A 1:100



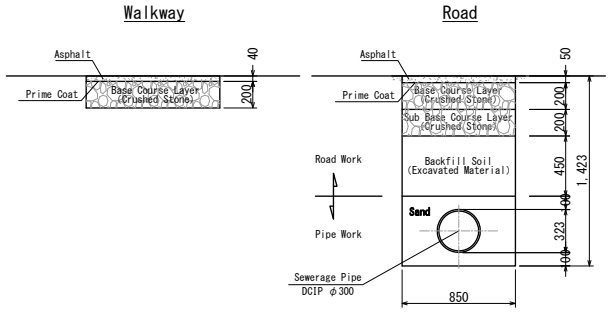
B-B Section (Out Fall)

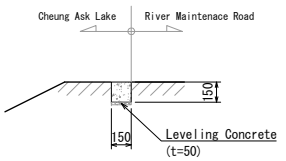
Scale A 1:100



Pavement Structure

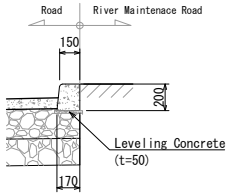
(Scale:B 1:40)





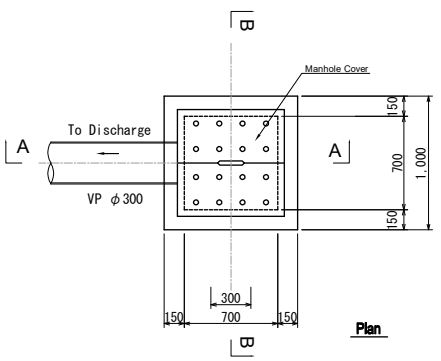
Concrete Curbs (Type-A) Section

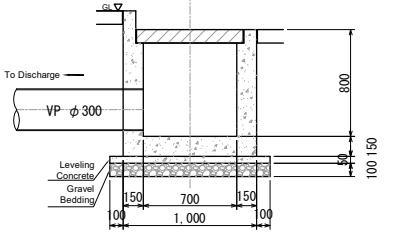
Scale 1:40



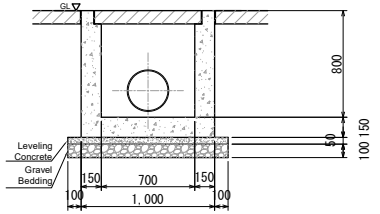
Concrete Curbs (Type-B) Section

Scale 1:40





Section A-A

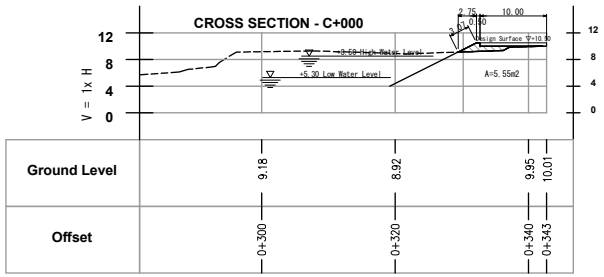


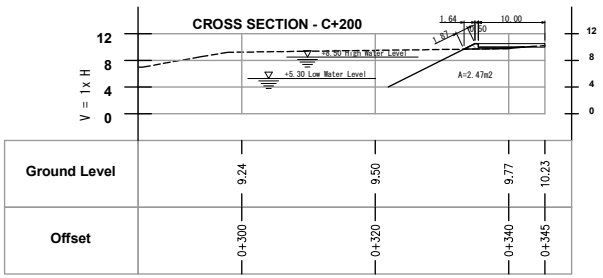
Section B-B

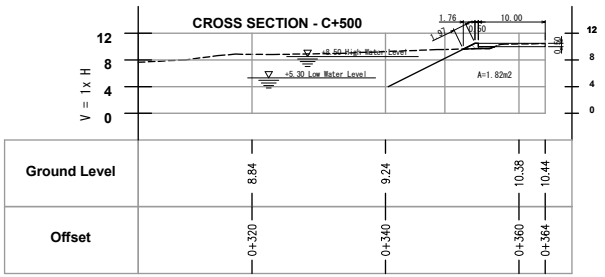
Drainage Pit

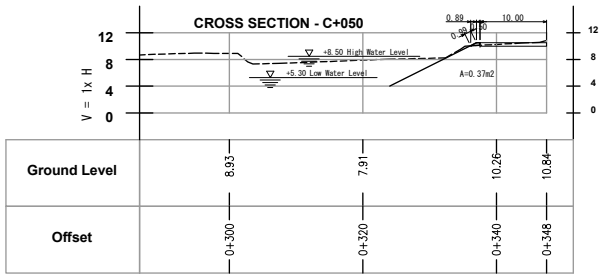
Scale 1:40

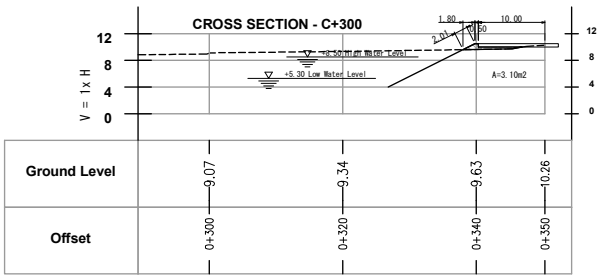
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-005	INTERCEPTION FACILITY & SEWER PIPE Channel Maintenance Road Detail

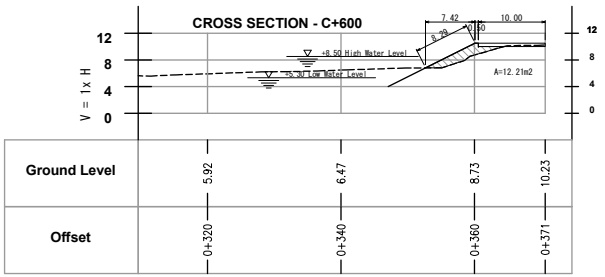


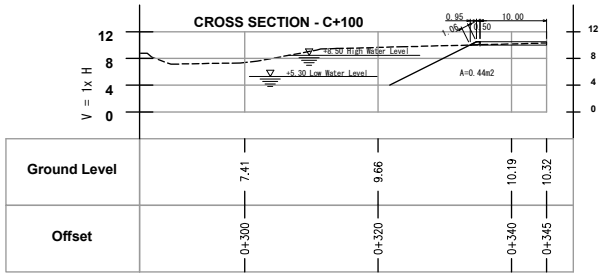


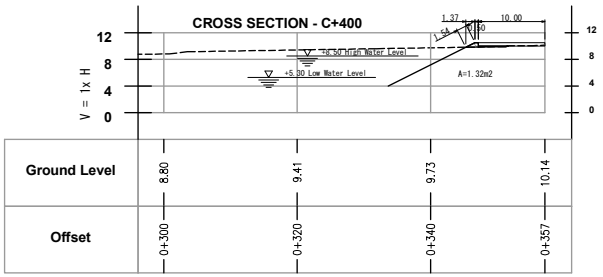


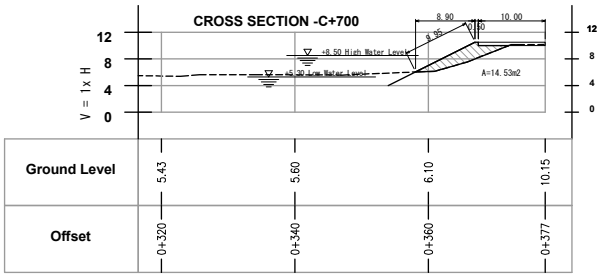








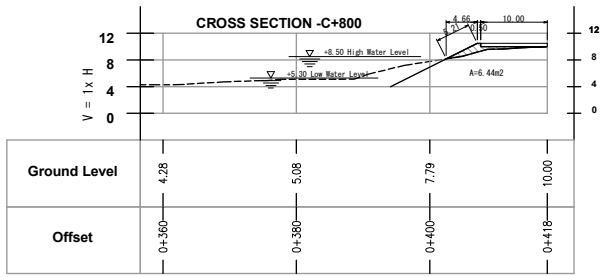


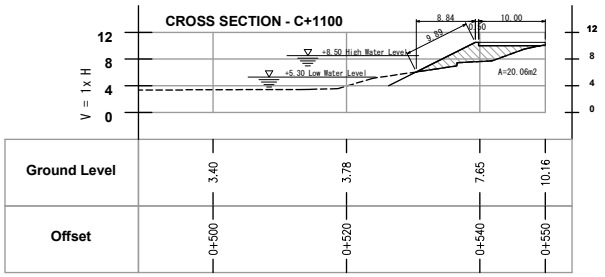


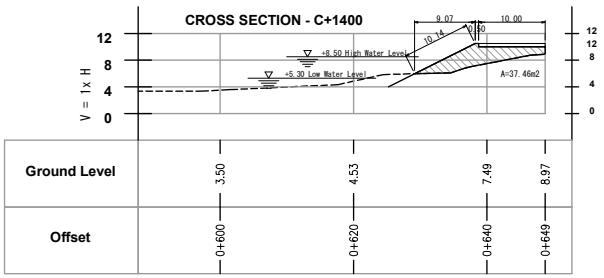
Channel Maintenance Road

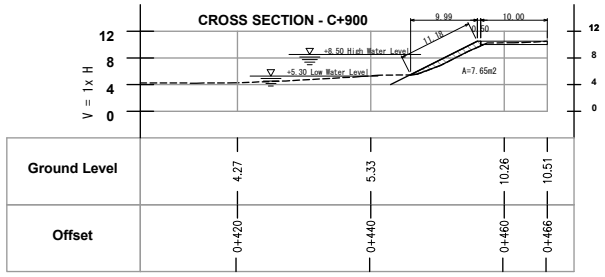
Section(1/2) Scale 1:800

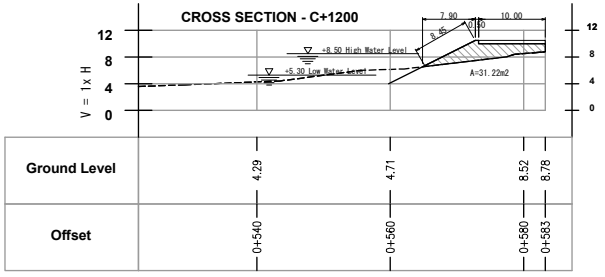
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-006	INTERCEPTION FACILITY & SEWER PIPE Channel Maintenance Road Section (1/2)

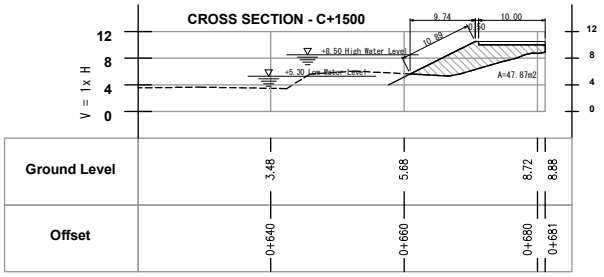


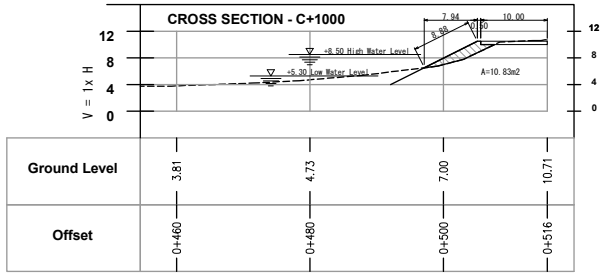


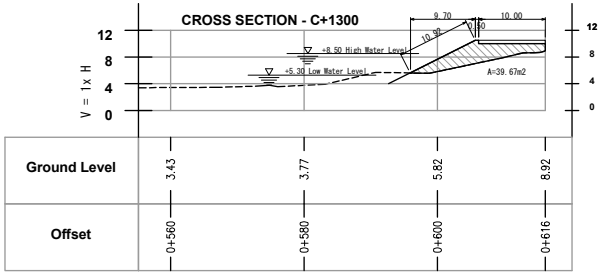












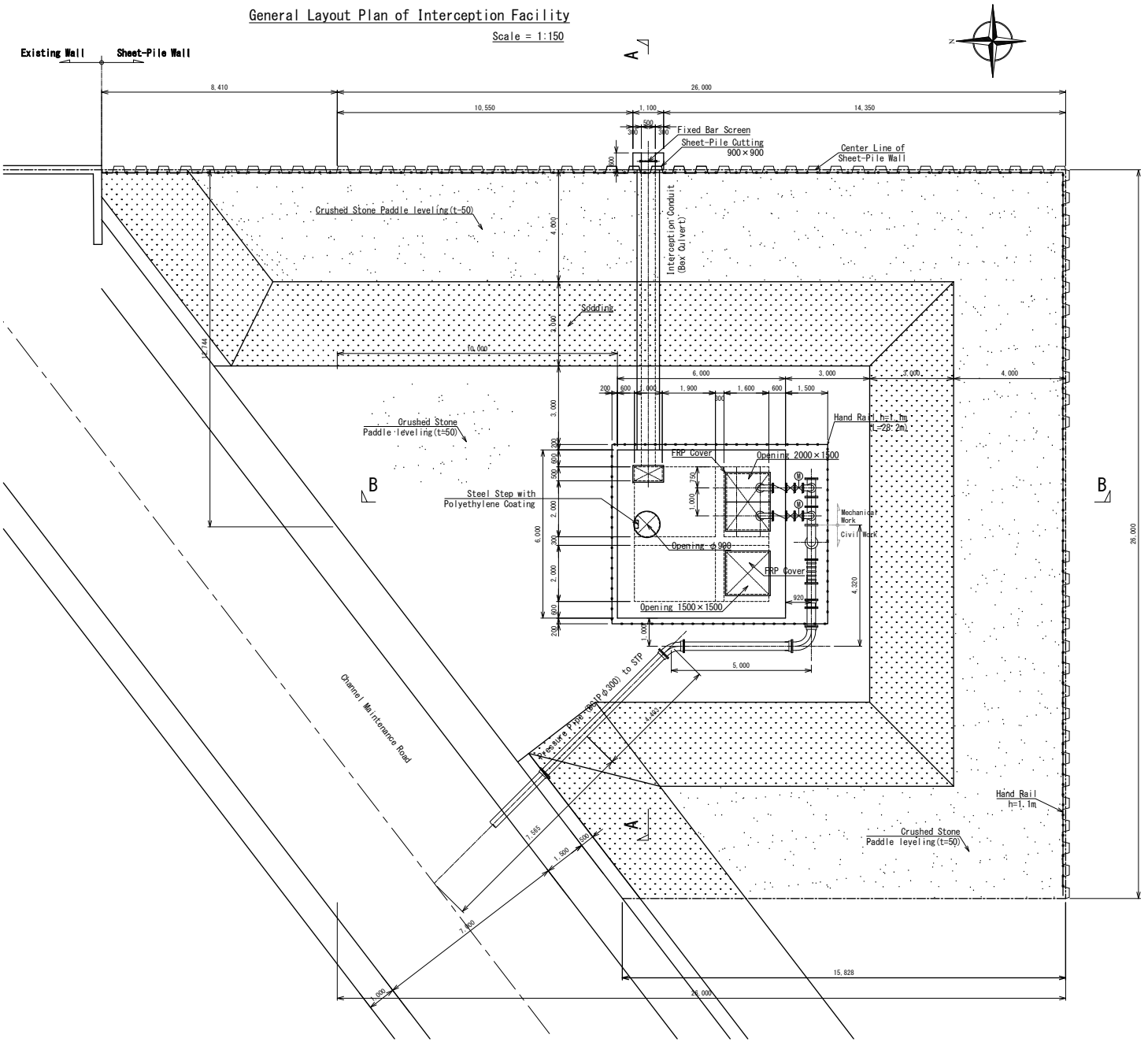
Channel Maintenance Road

Section(2/2) Scale 1:800

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-007	INTERCEPTION FACILITY & SEWER PIPE Channel Maintenance Road Section (2/2)

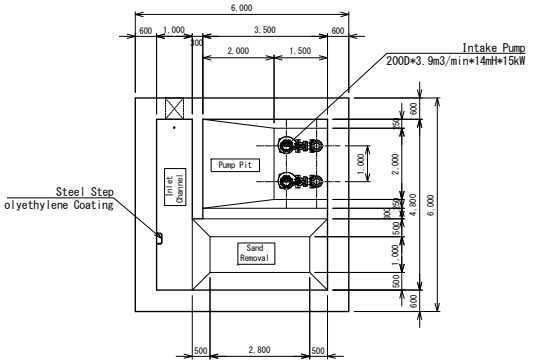
General Layout Plan of Interception Facility

Scale = 1:150



Bottom Plan at+3.5m

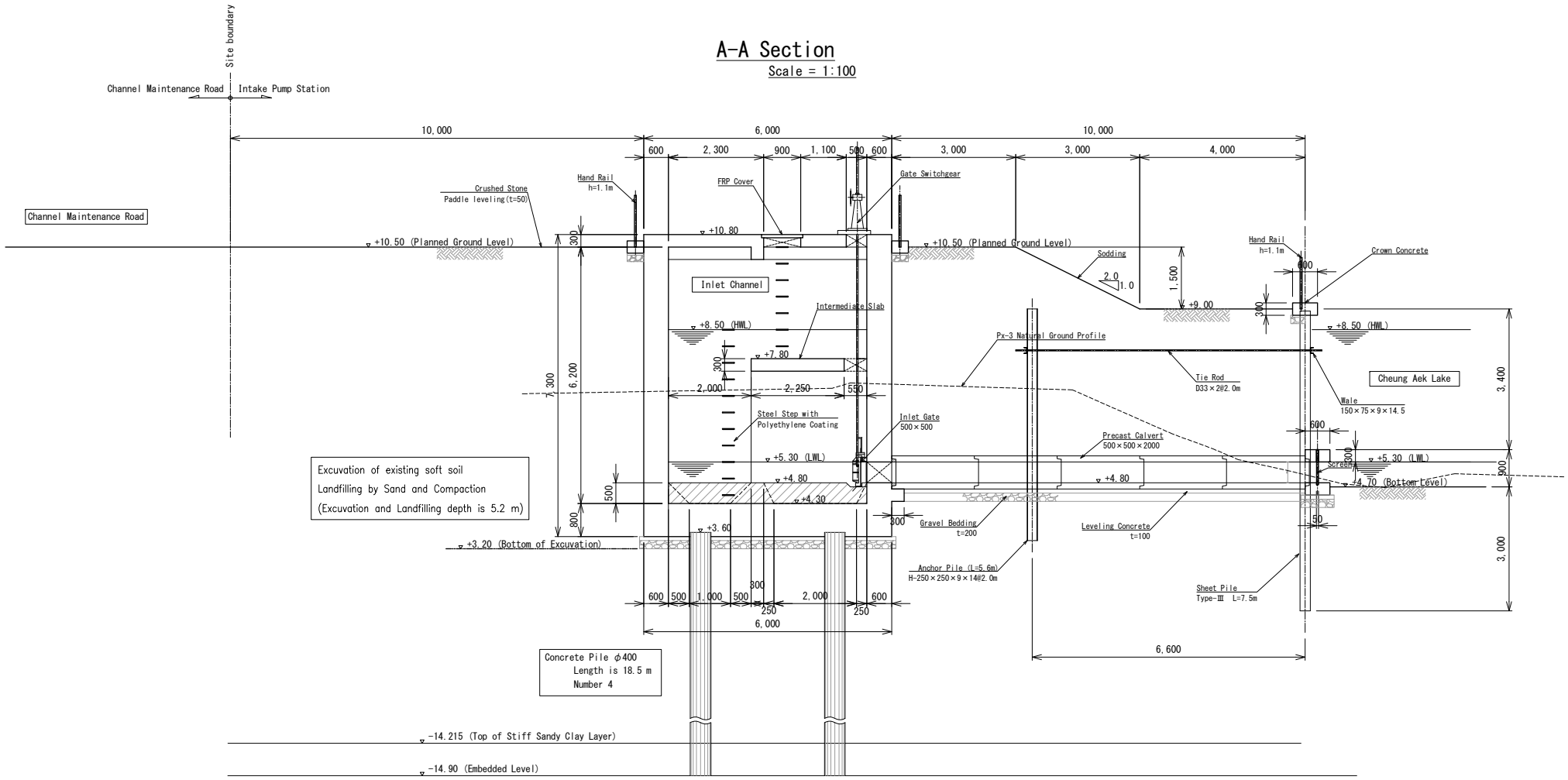
Scale = 1:150



THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-008	INTERCEPTION FACILITY & SEWER PIPE Site Plan of Interception Facility

A-A Section

Scale = 1:100



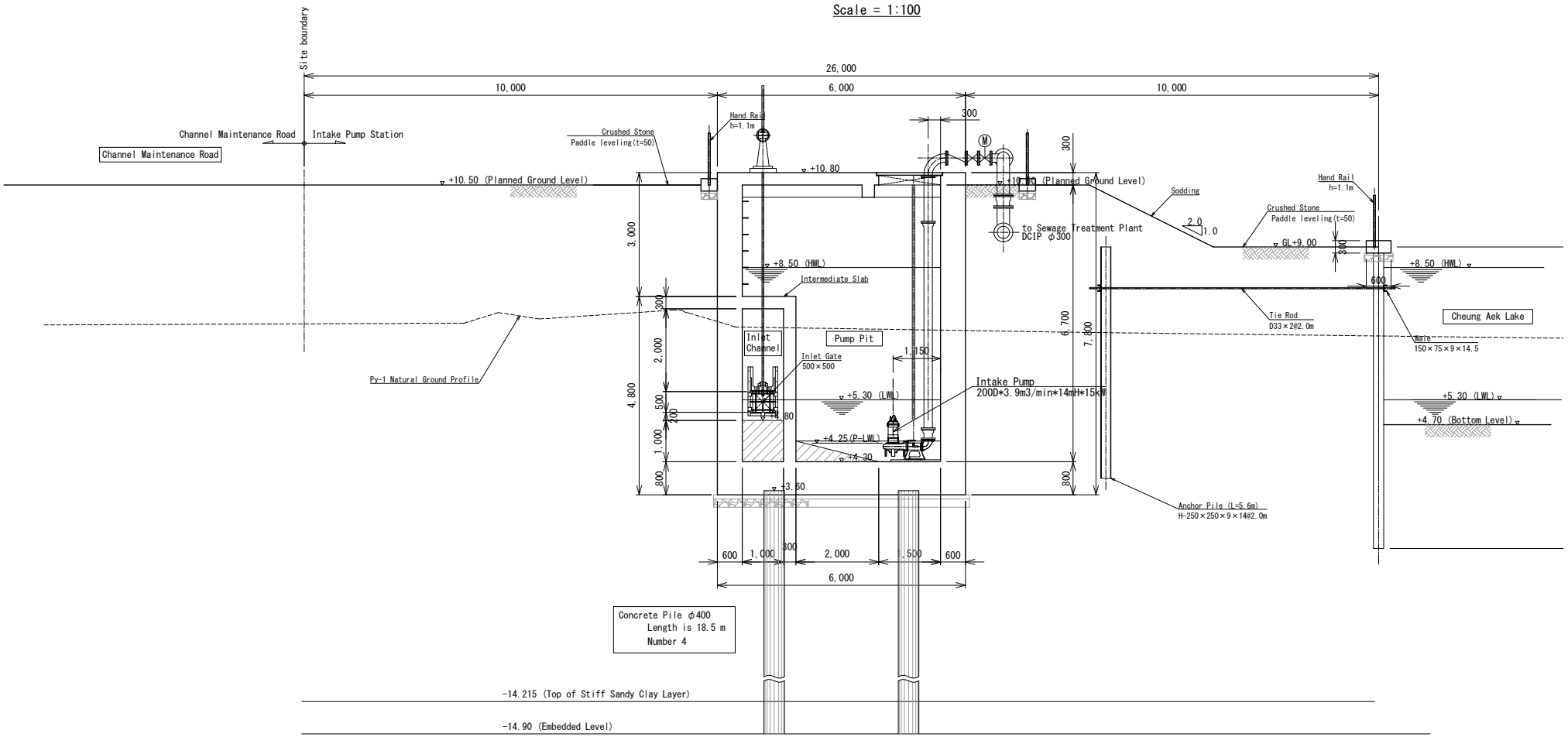
Interception Facility

Section (1/2) Scale = 1 : 100

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-009	INTERCEPTION FACILITY & SEWER PIPE Section of Interception Facility (1/2)

B-B Section

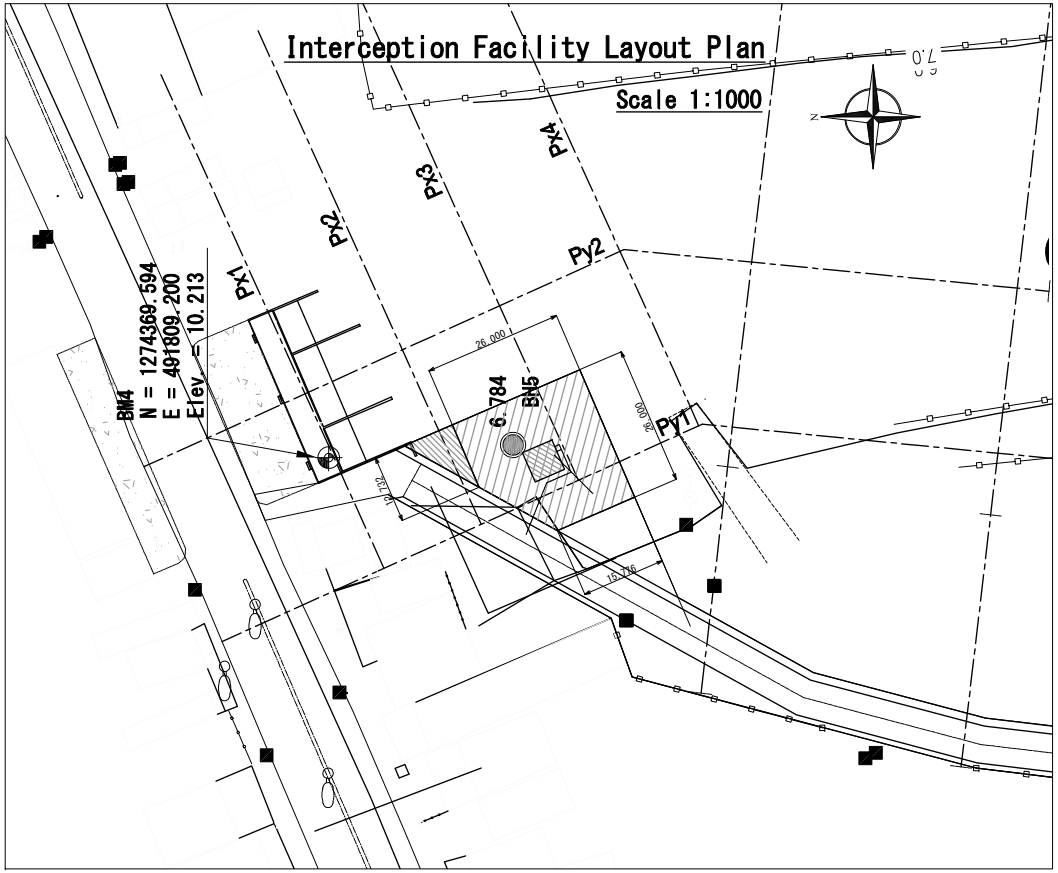
Scale = 1:100



Interception Facility

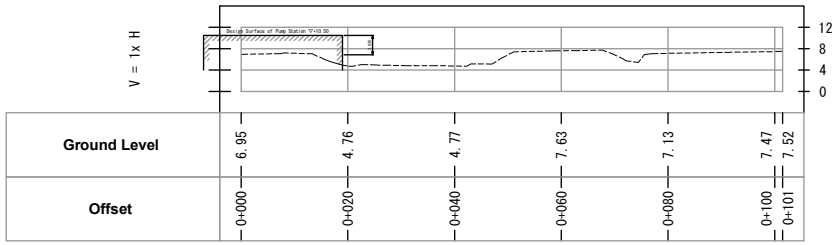
Section (2/2) Scale = 1 : 100

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-010	INTERCEPTION FACILITY & SEWER PIPE Section of Interception Facility (2/2)



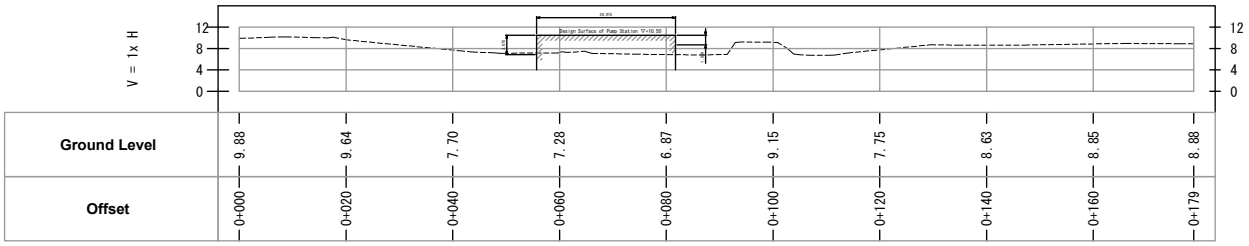
CROSS SECTION - PX3

From **STA: 0+000 ~ 0+101**



CROSS SECTION - PY1

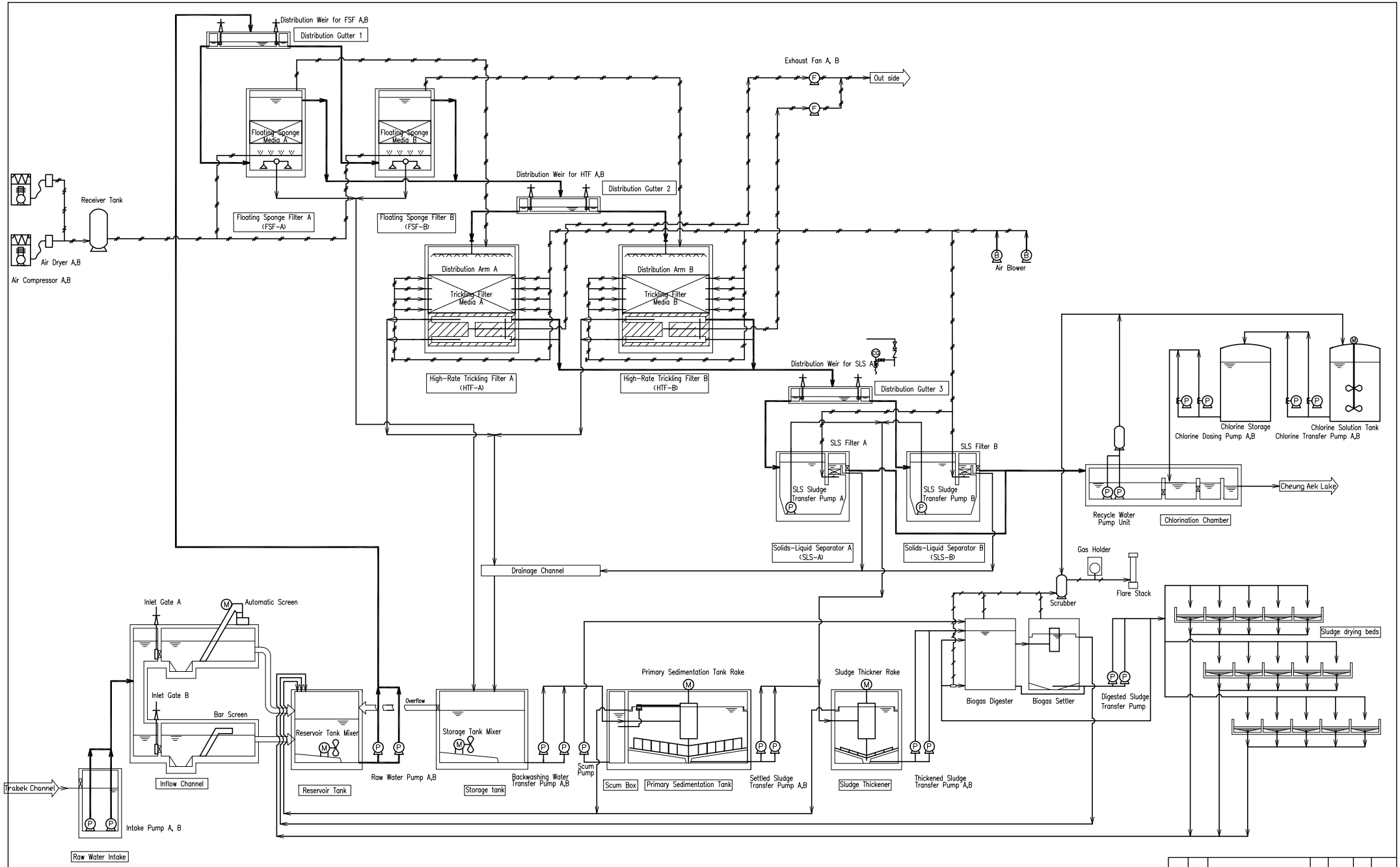
From **STA: 0+000 ~ 0+179**



Interception Facility Section

Scale = 1:1000

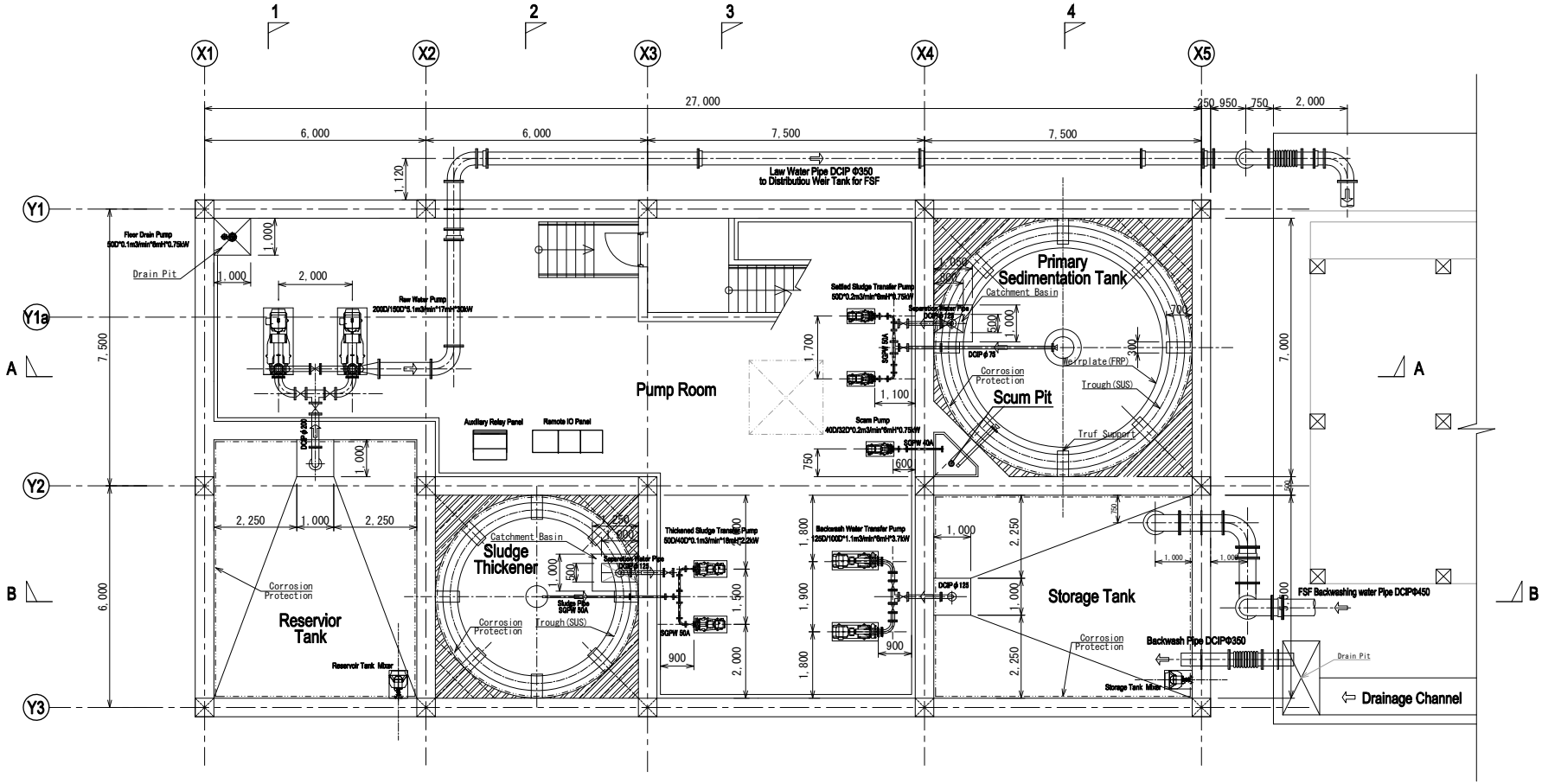
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-011	INTERCEPTION FACILITY & SEWER PIPE Layout Plan & Sections of Interception Facility



General Flow Diagram

Scale = Non

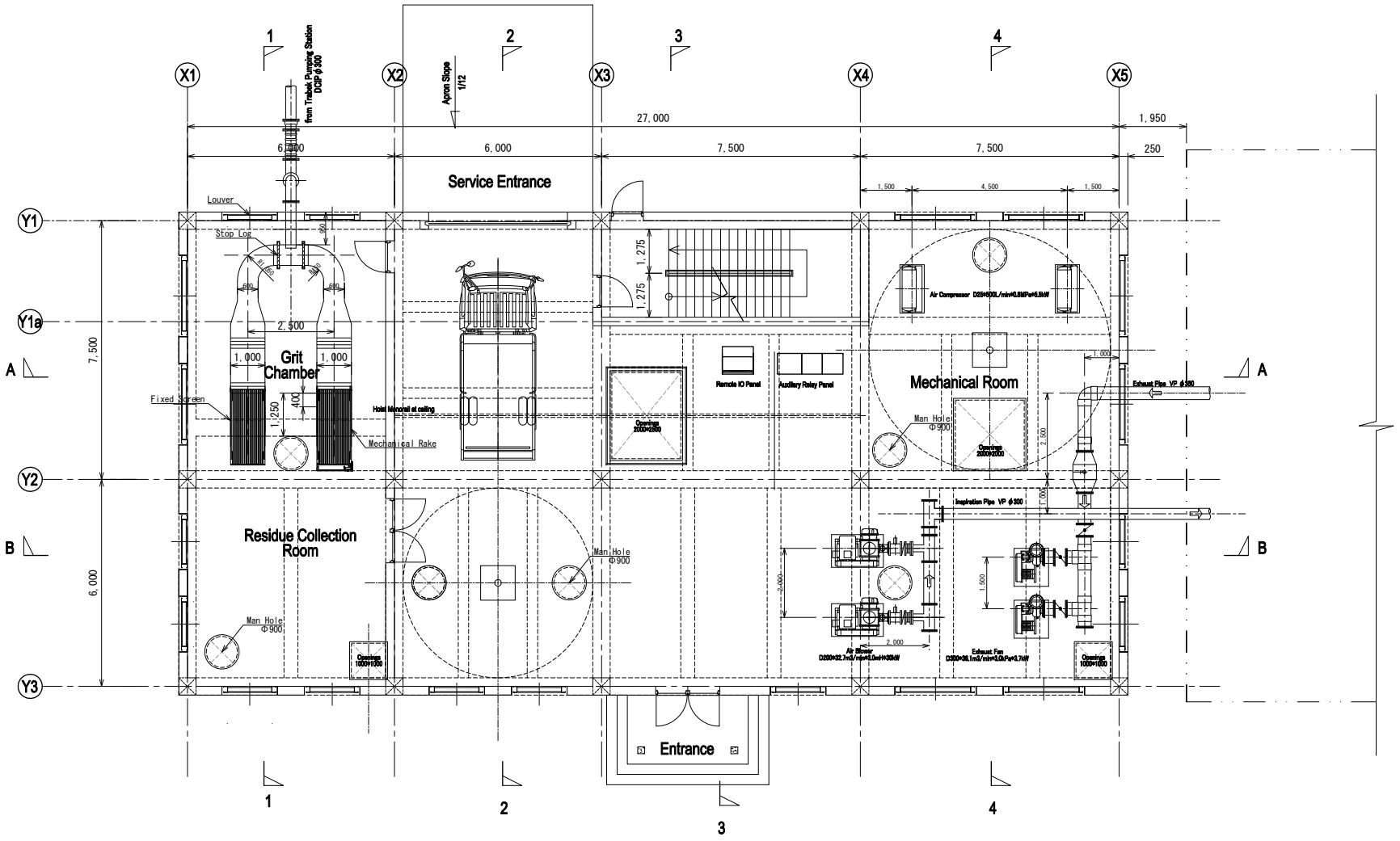
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-001	MECHANICAL AND ELECTRICAL WORK General Flow Diagram



Basement Floor (BF) PLAN

Scale=1:125

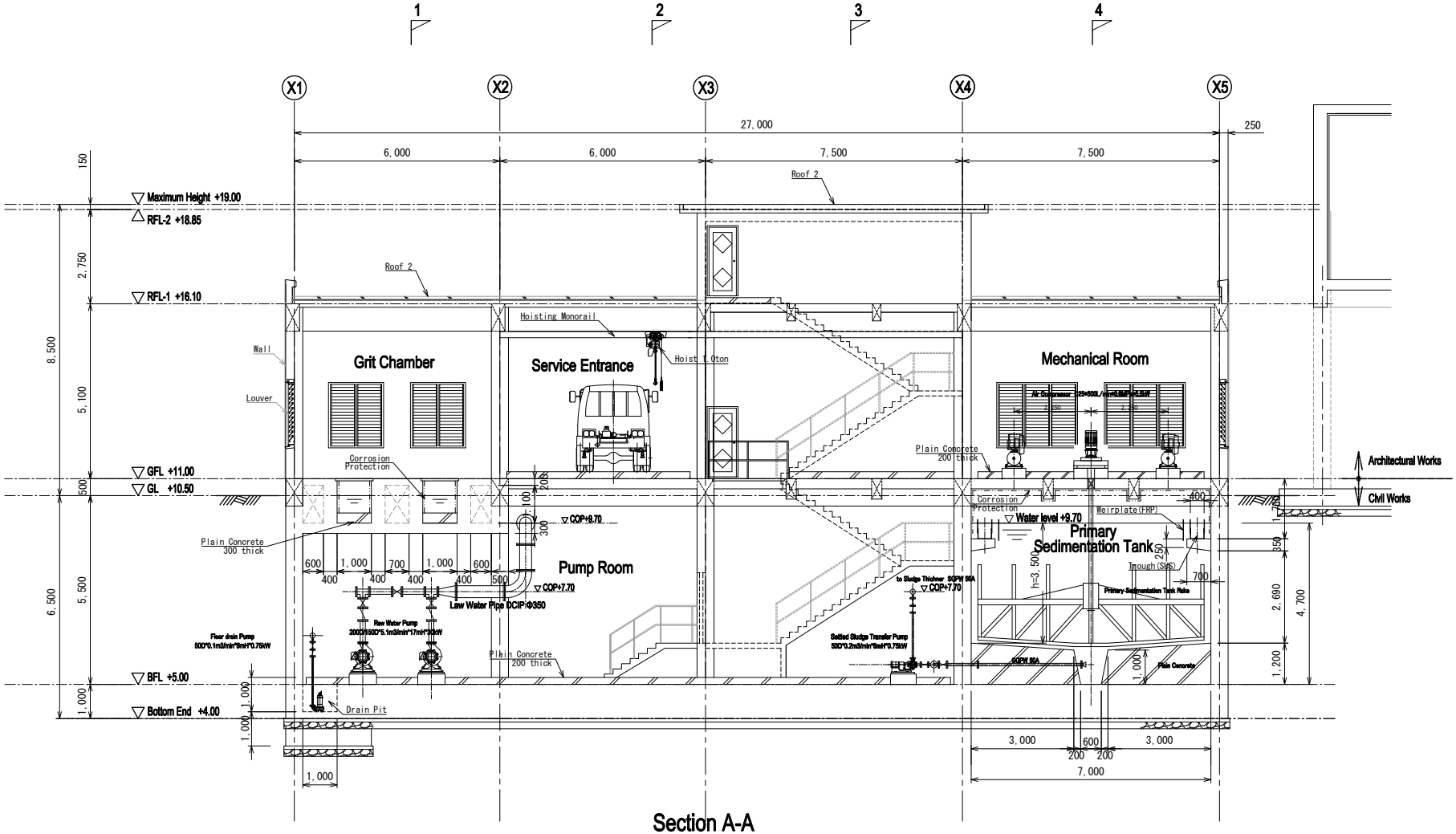
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-002	MECHANICAL AND ELECTRICAL WORK Mecahnical Equipment Layout for Main Pump Building (1/2)



Ground Floor (GF) PLAN

Scale=1:125

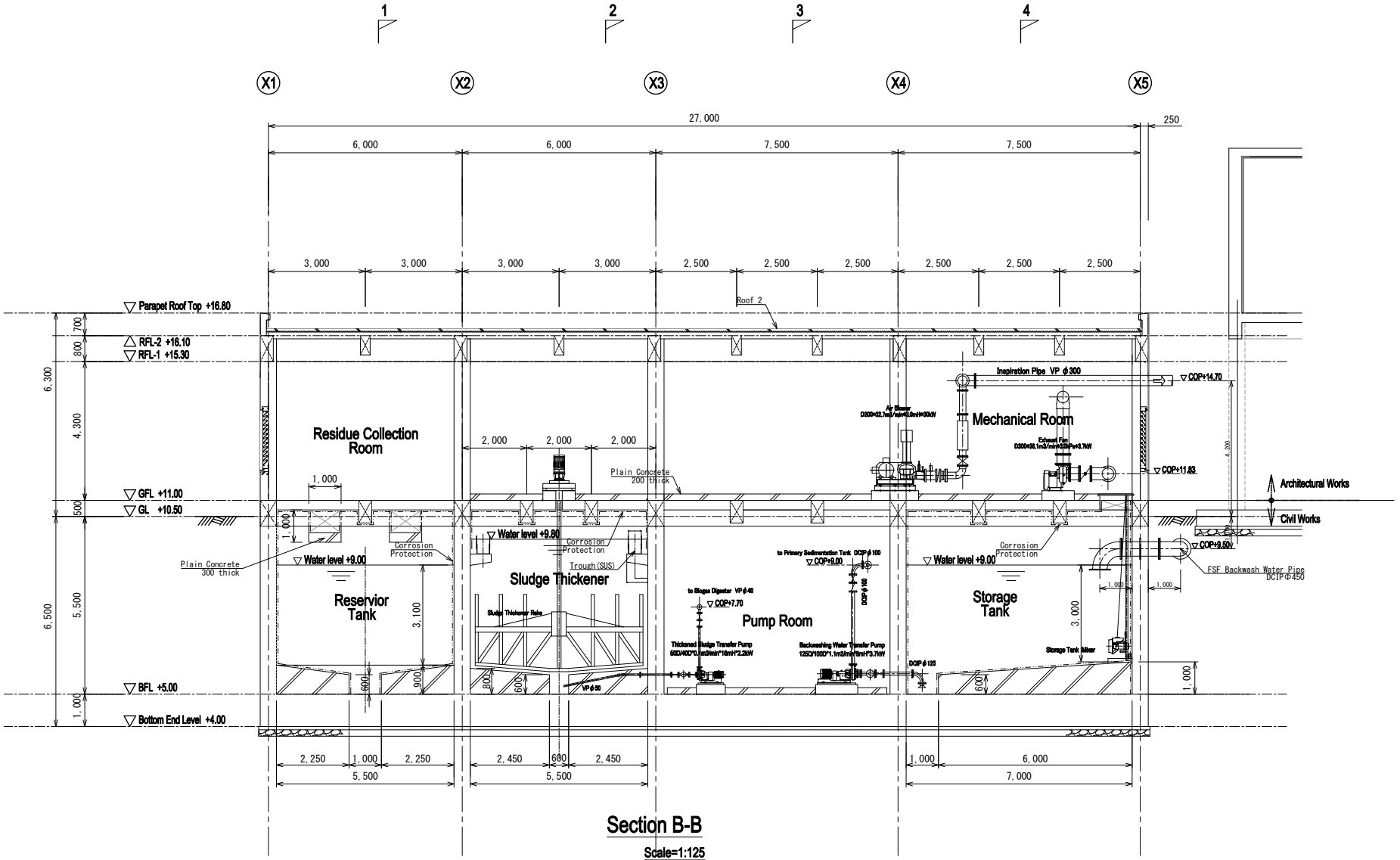
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-003	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout Plan for Main Pump Building (2/2)



Section A-A

Scale=1:125

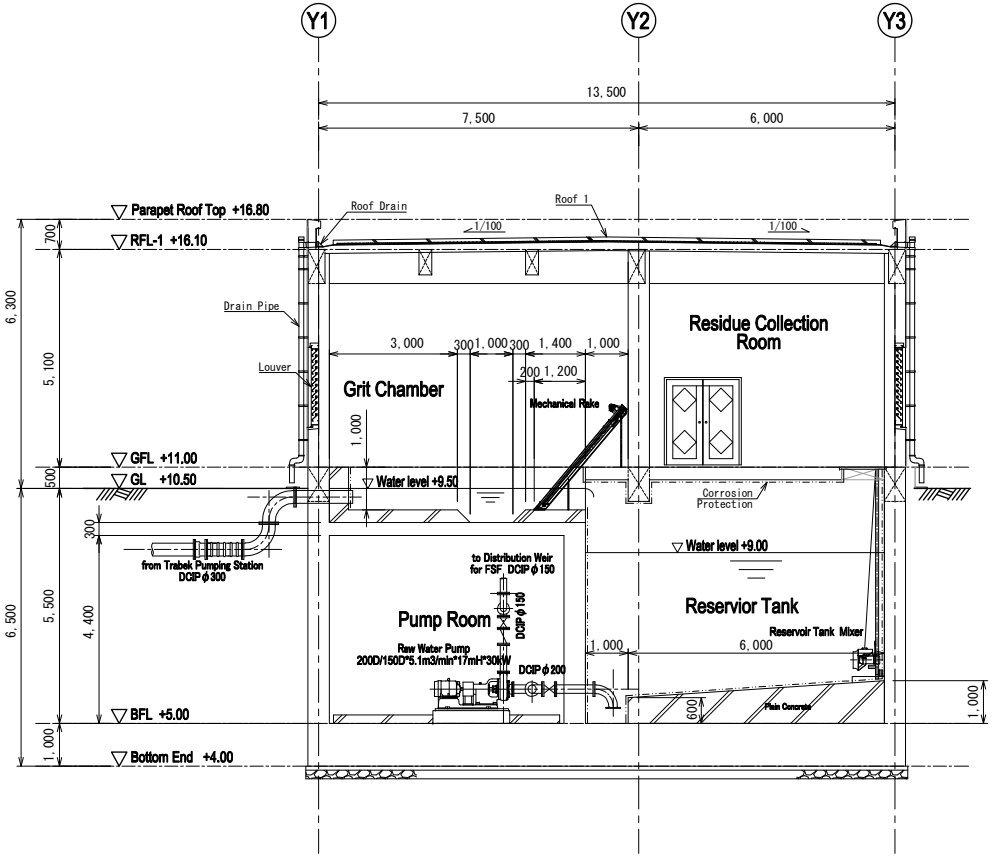
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-004	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Main Pump Building (1/4)



Section B-B

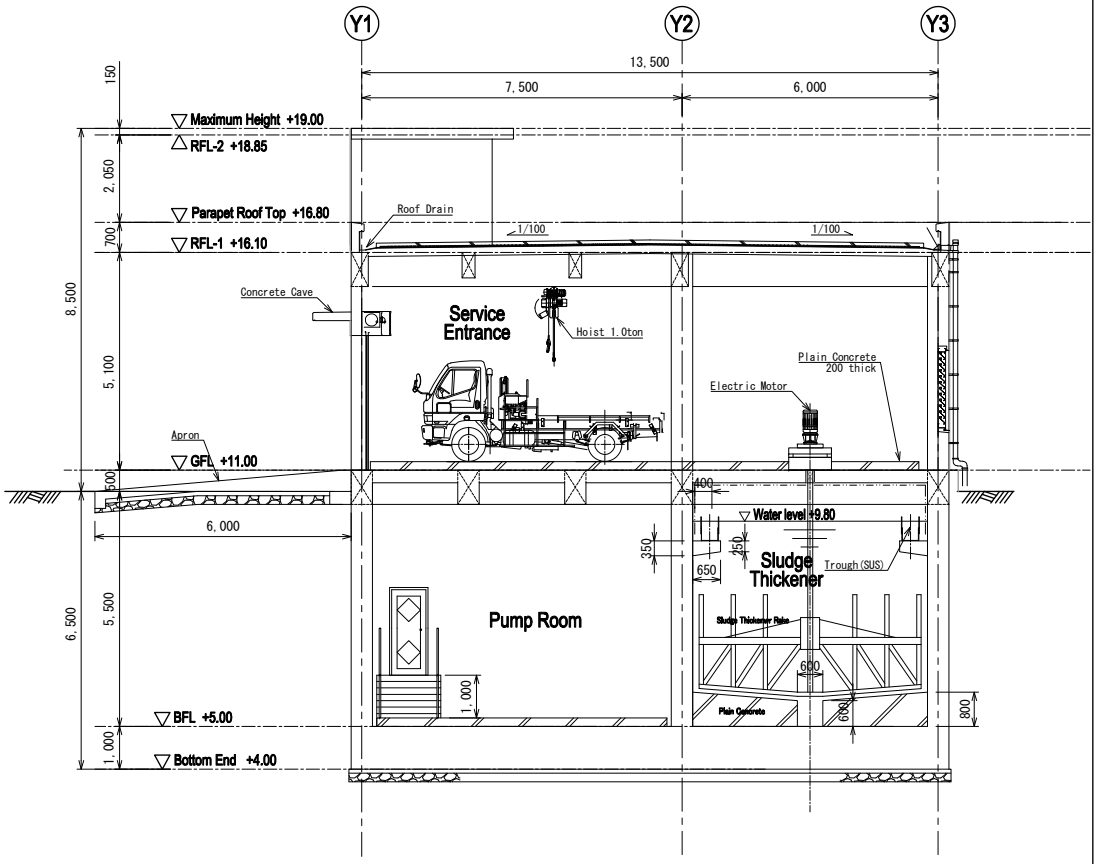
Scale=1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-005	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Main Pump Building (2/4)



Section 1-1

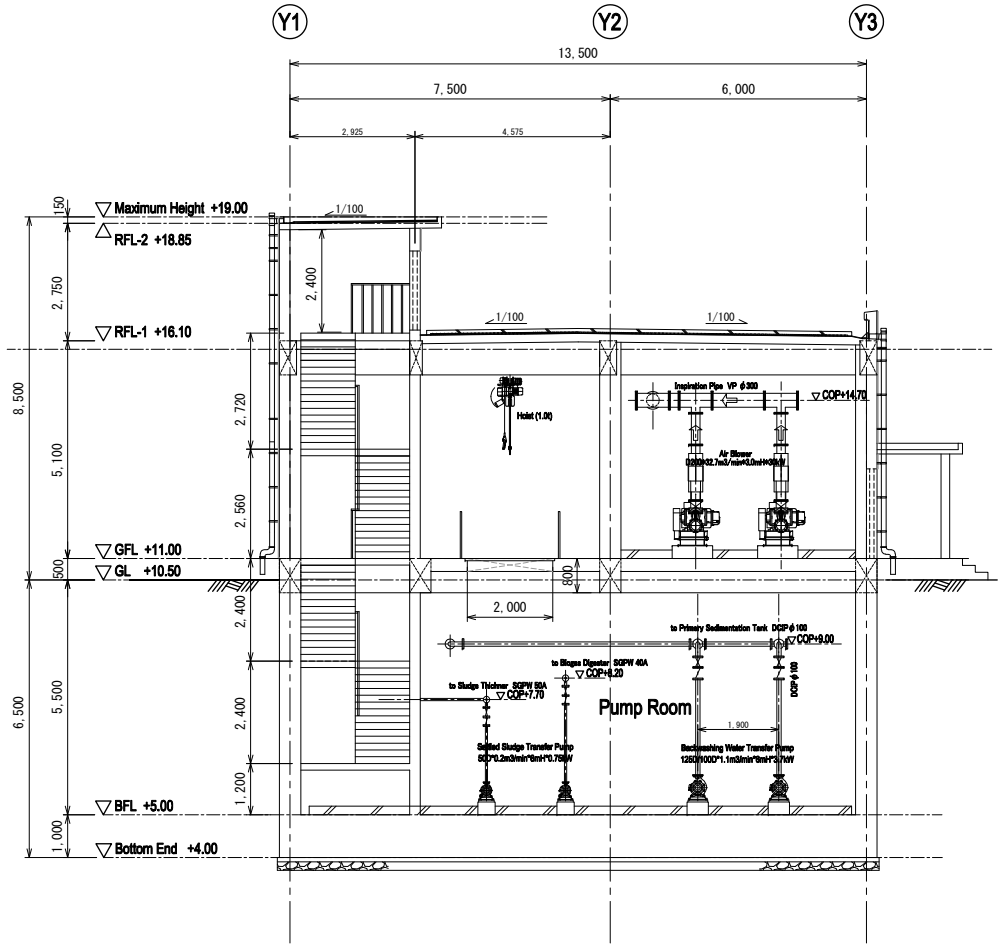
Scale=1:125



Section 2-2

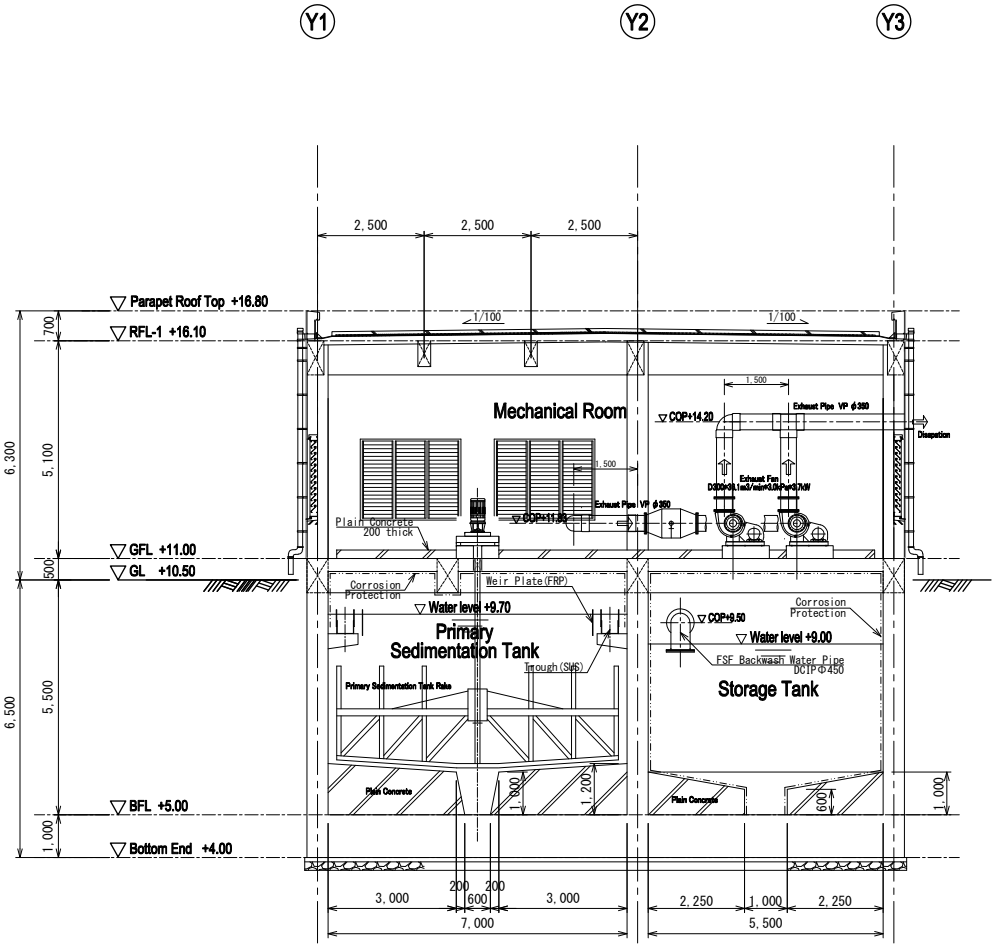
Scale=1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-006	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Main Pump Building (3/4)



Section 3-3

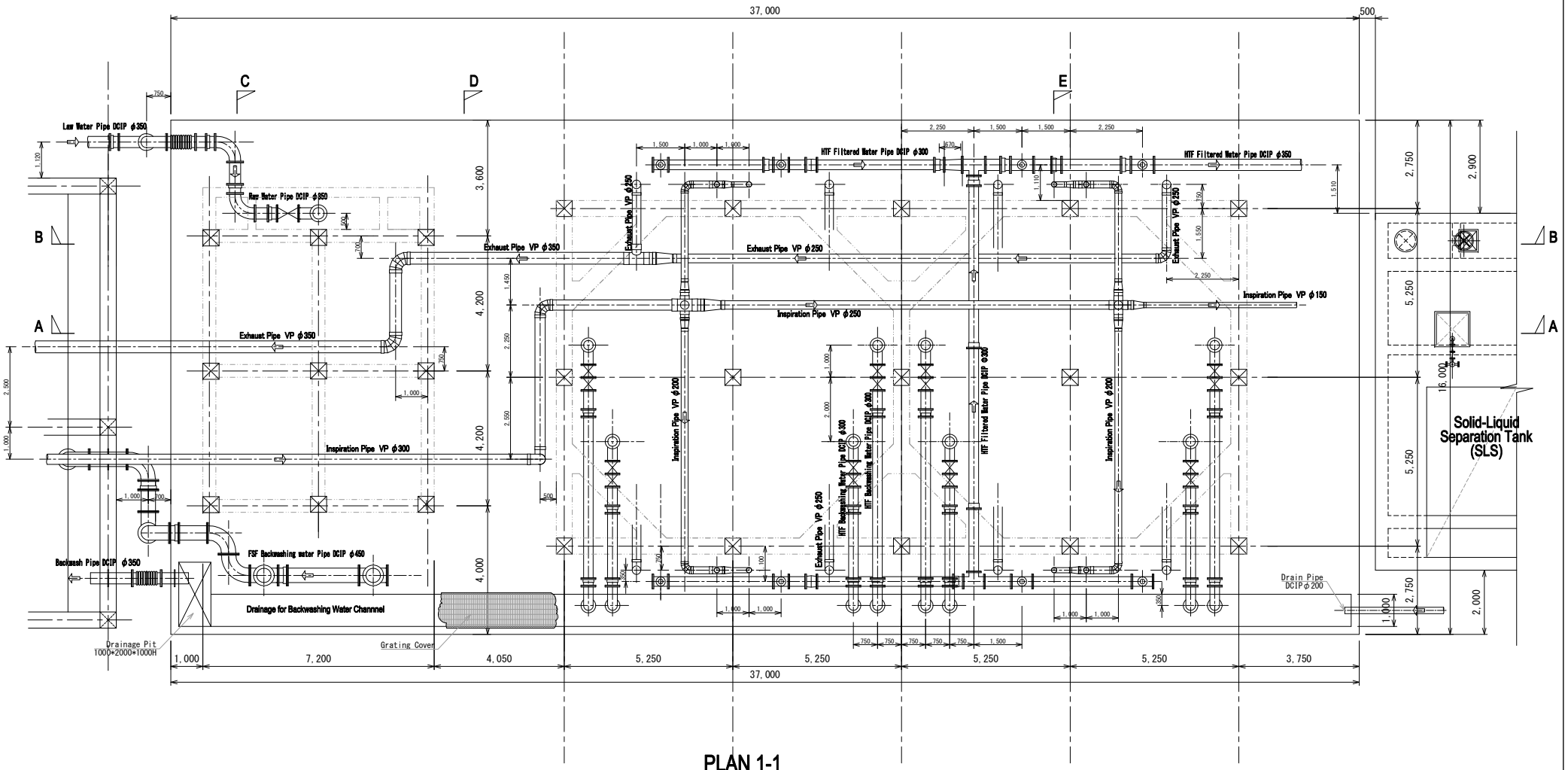
Scale=1:125



Section 4-4

Scale=1:125

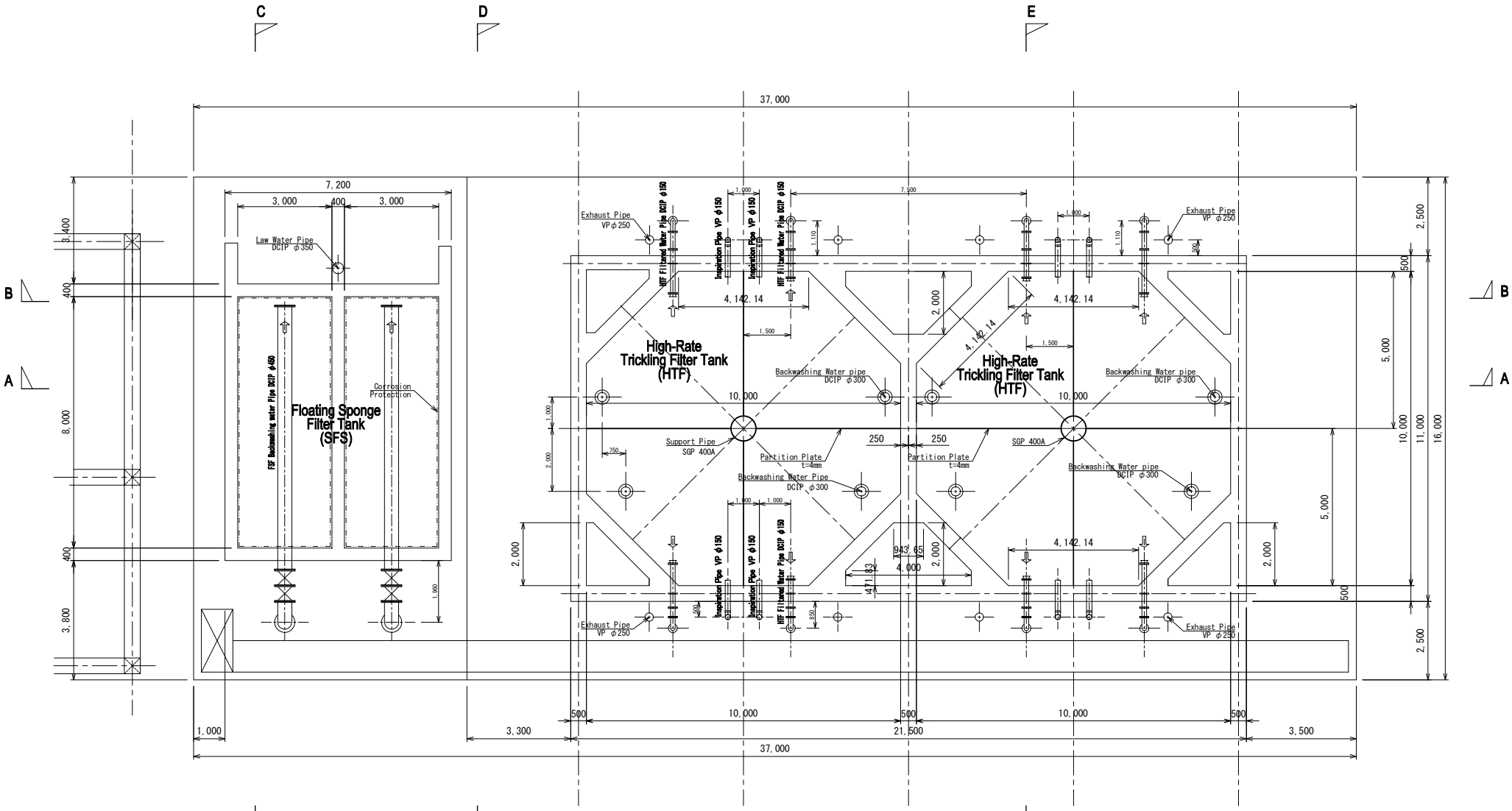
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-007	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Main Pump Building (4/4)



PLAN 1-1

Scale=1:125

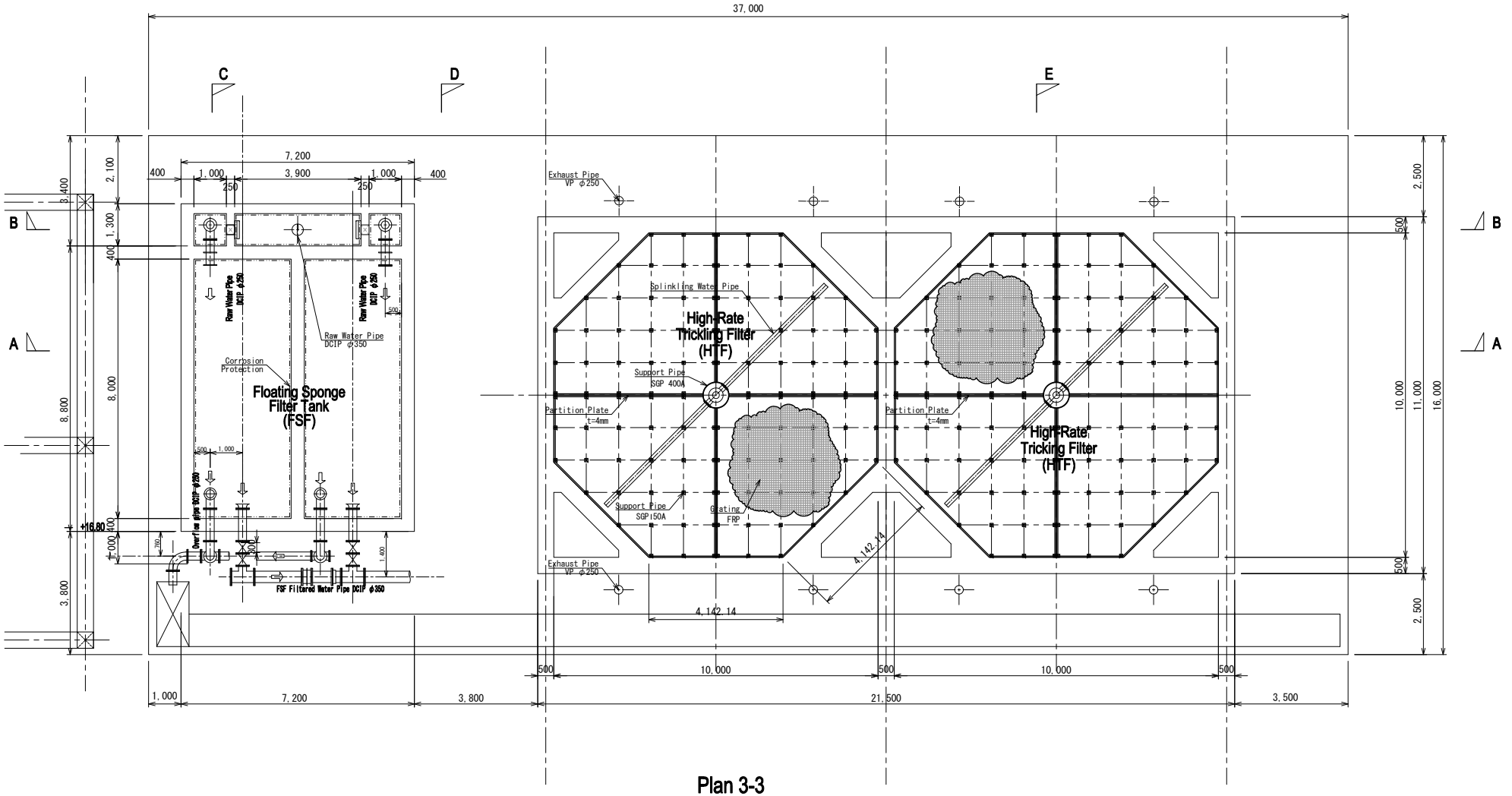
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-008	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Filtering Tank (1/4)



PLAN 2-2

Scale=1:125

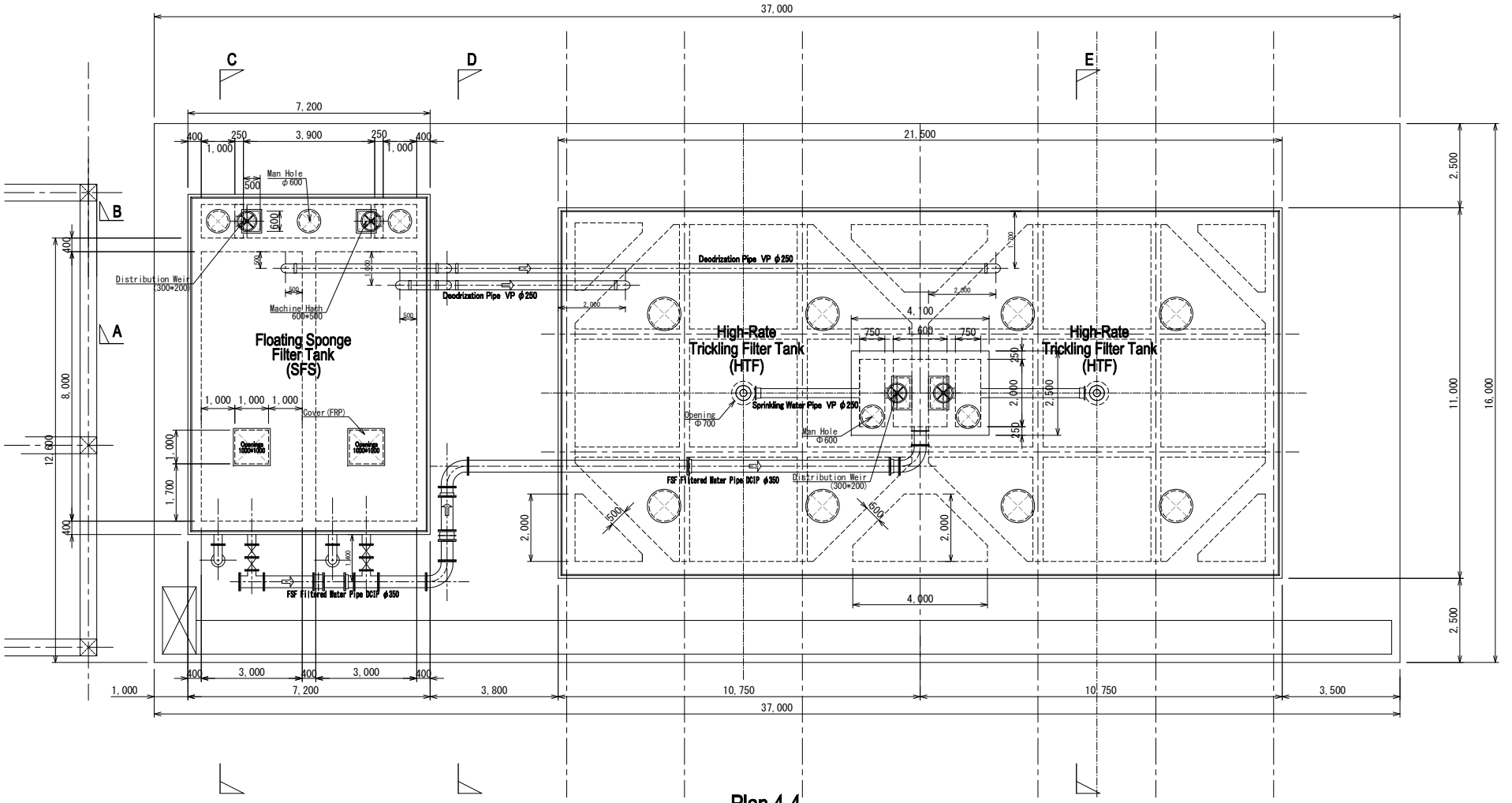
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-009	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Filtering Tank (2/4)



Plan 3-3

Scale=1:125

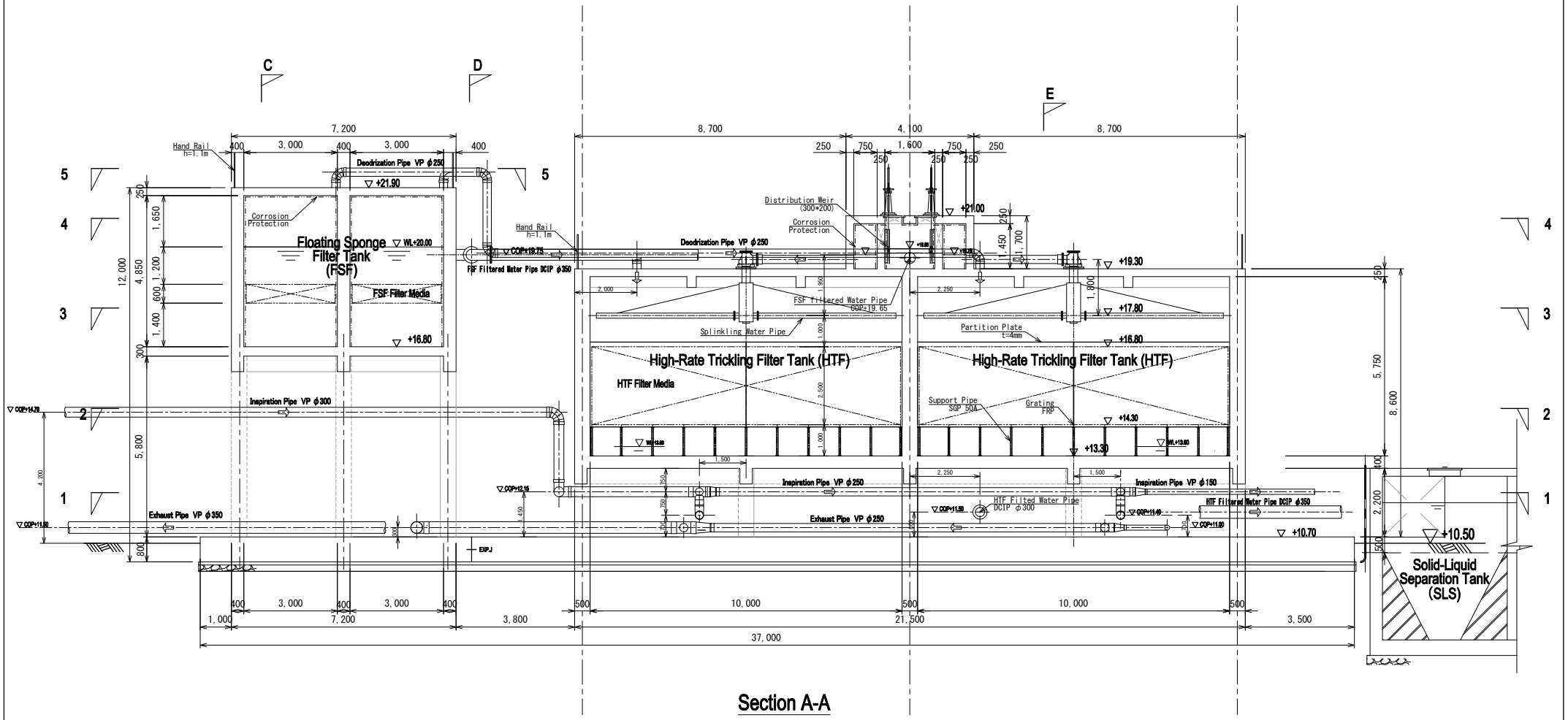
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-010	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Filtering Tank (3/4)



Plan 4-4

Scale=1:125

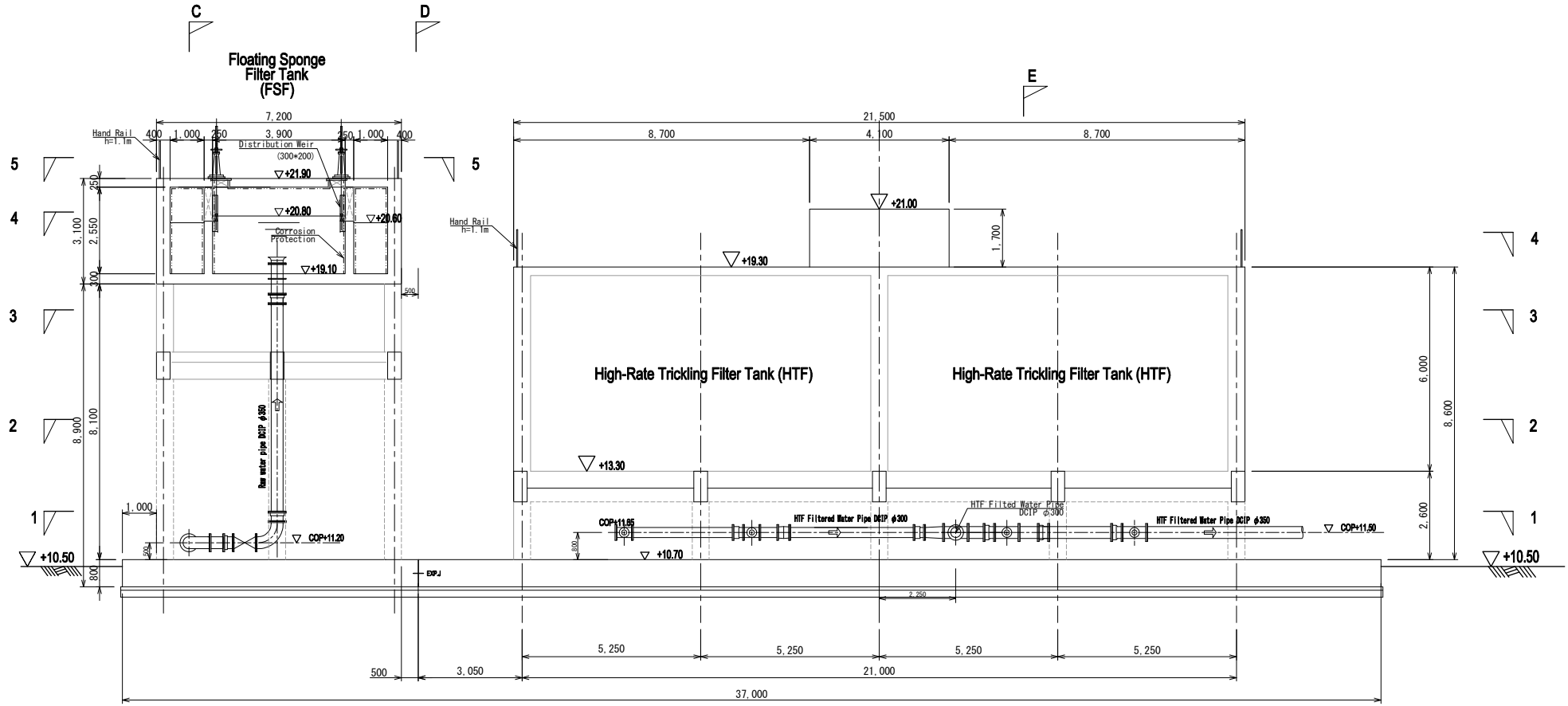
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-011	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Filtering Tank (4/4)



Section A-A

Scale=1:125

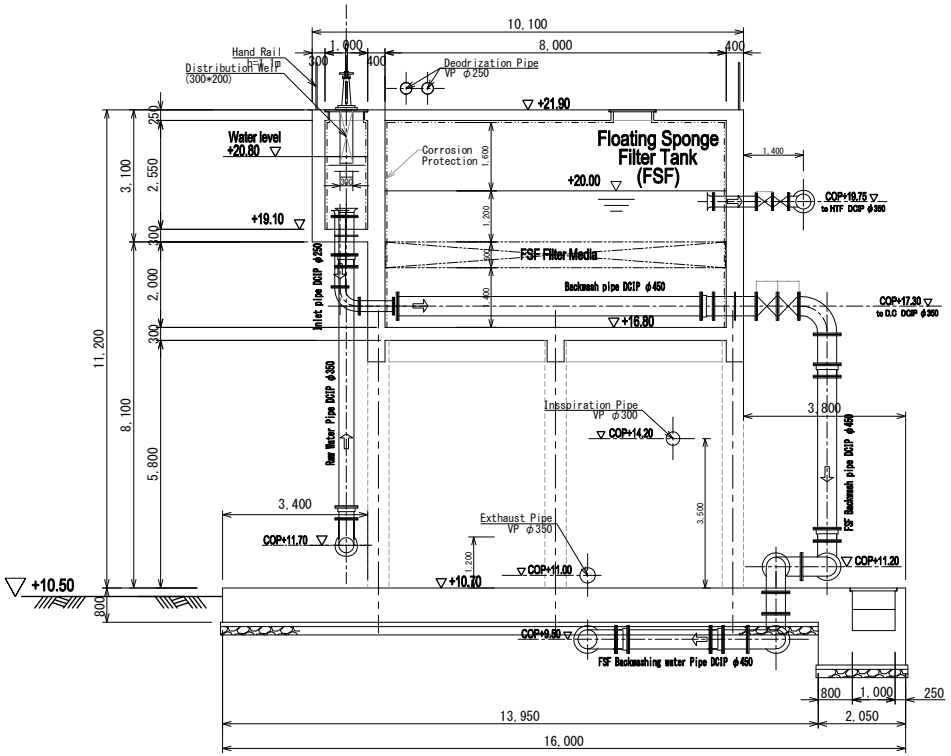
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-012	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Filtering Tank (1/4)



Section B-B

Scale=1:125

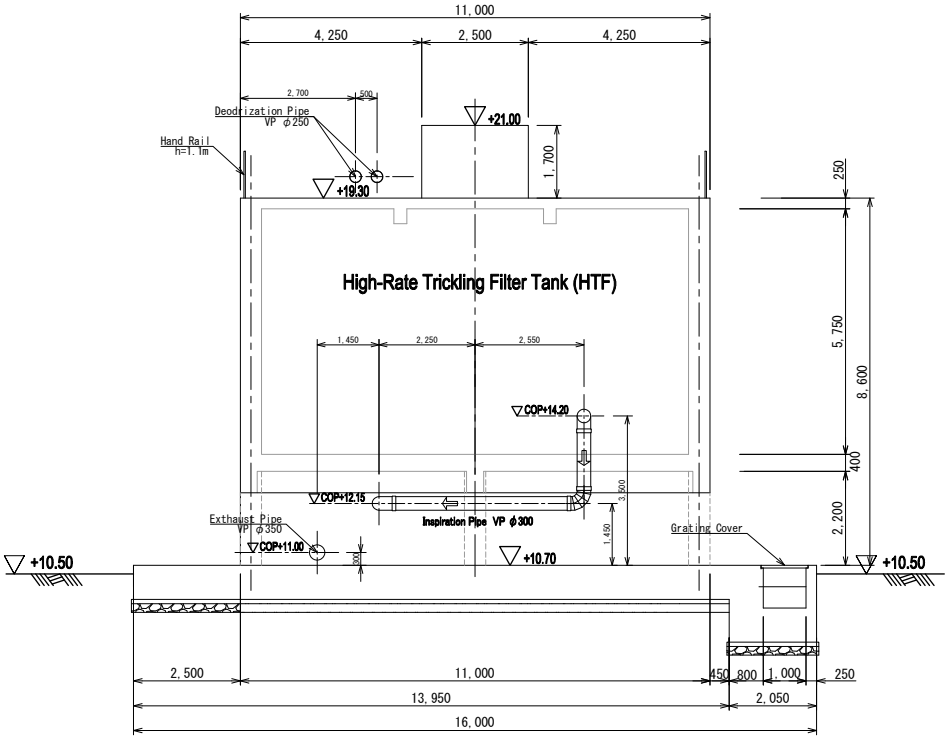
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-013	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Filtering Tank (2/4)



Section C-C

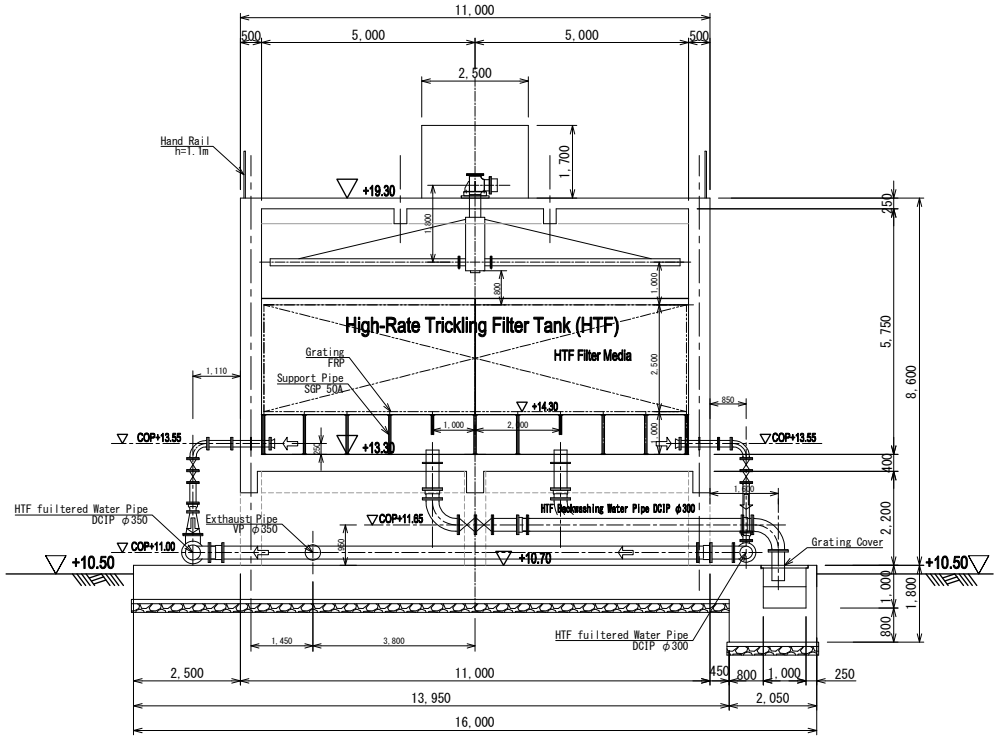
Scale=1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-014	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Filtering Tank (3/4)



Section D-D

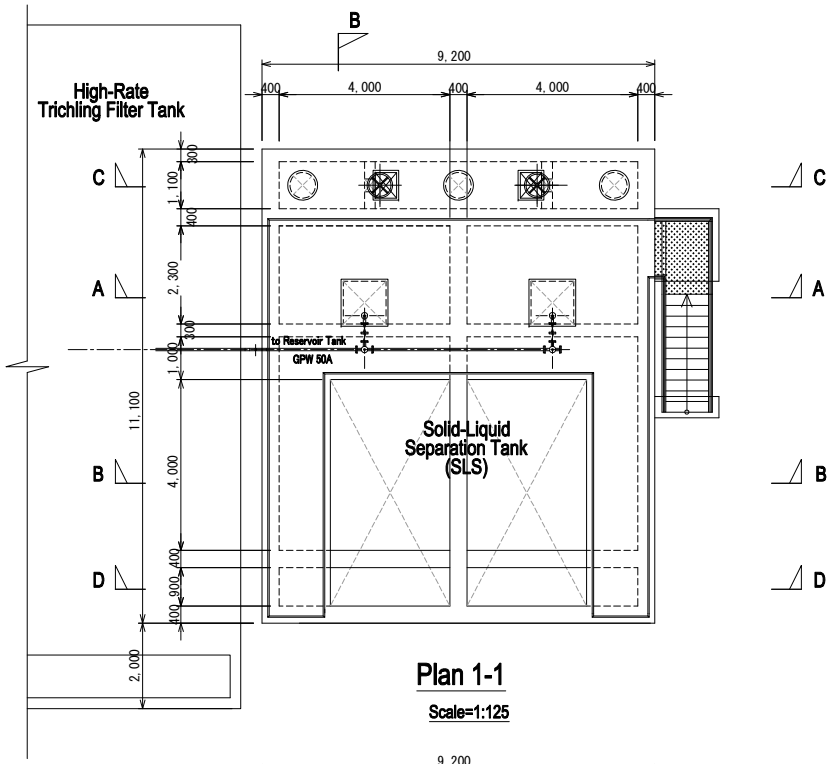
Scale=1:125



Section E-E

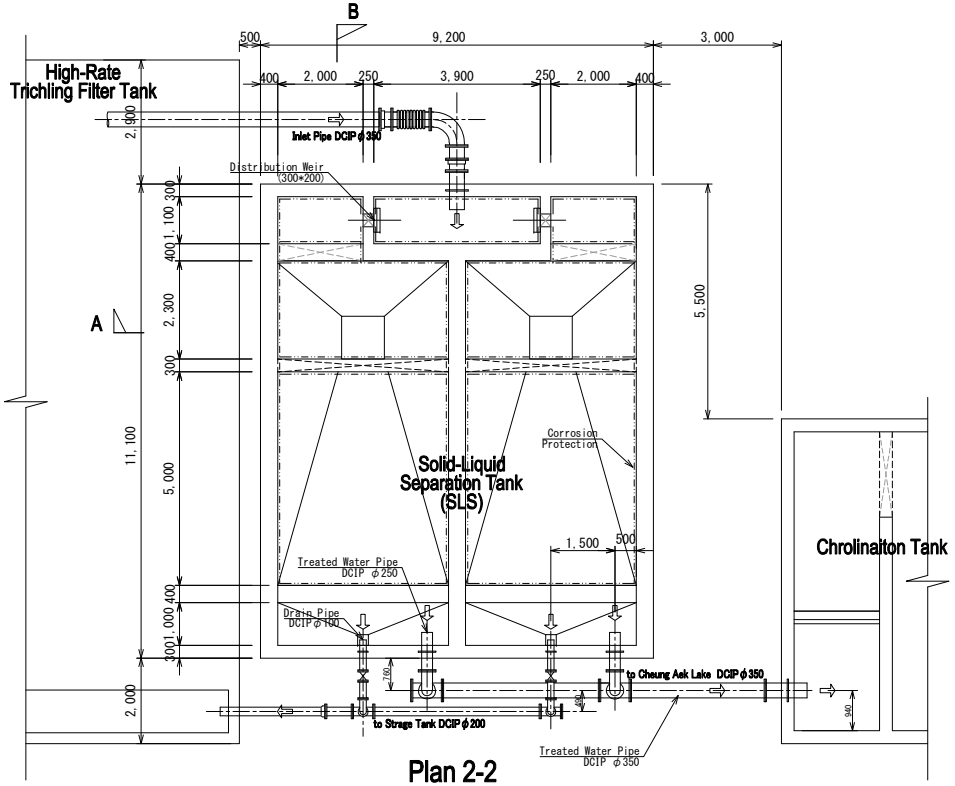
Scale=1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-015	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Filtering Tank (4/4)



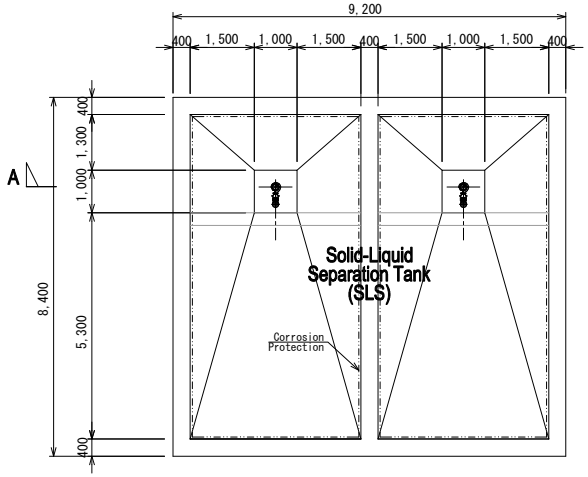
Plan 1-1

Scale=1:125



Plan 2-2

Scale=1:125

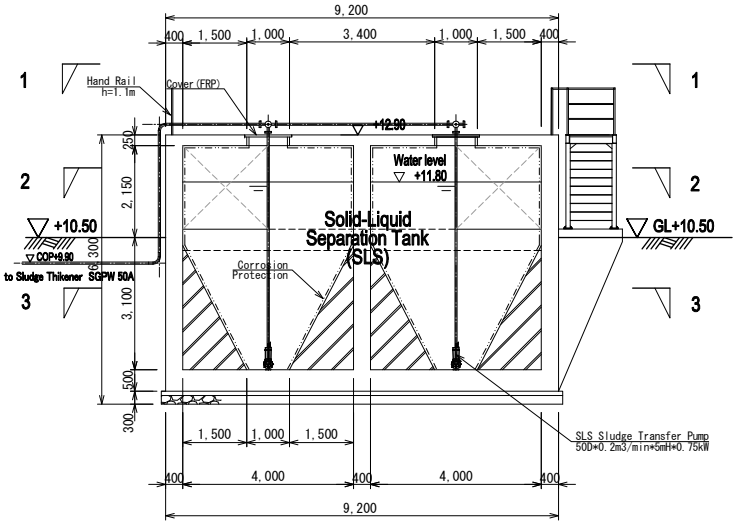


Plan 3-3

Scale=1:125

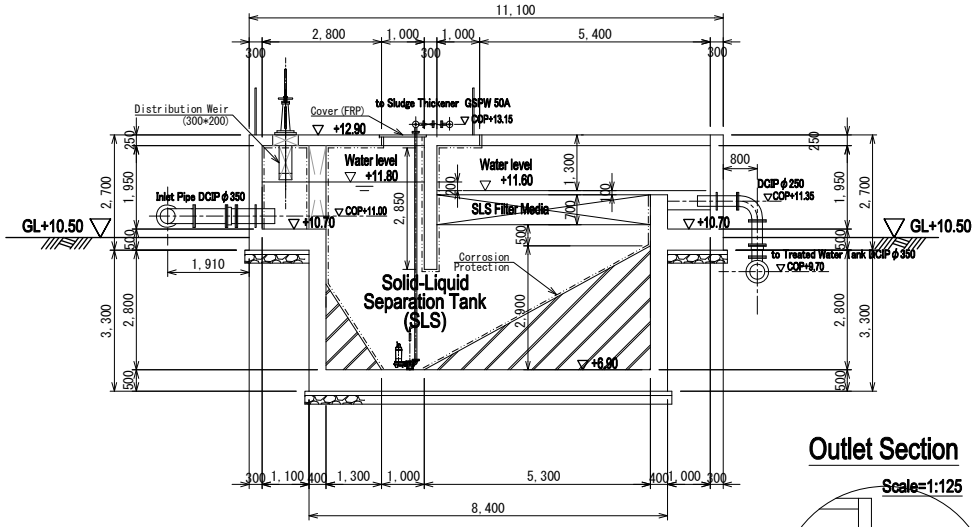
SCALE 0 1.0 2.0 3.0 4.0 5.0m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-016	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Solid-Liquid Separation Tank



Section A-A

Scale=1:125

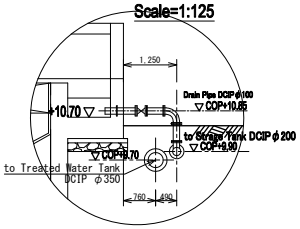


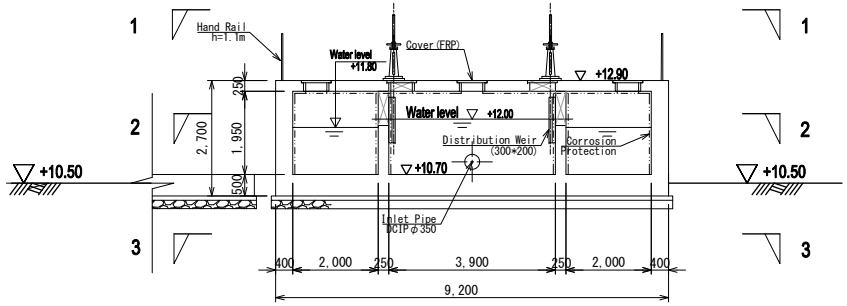
Section B-B

Scale=1:125

Outlet Section

Scale=1:125





Section C-C

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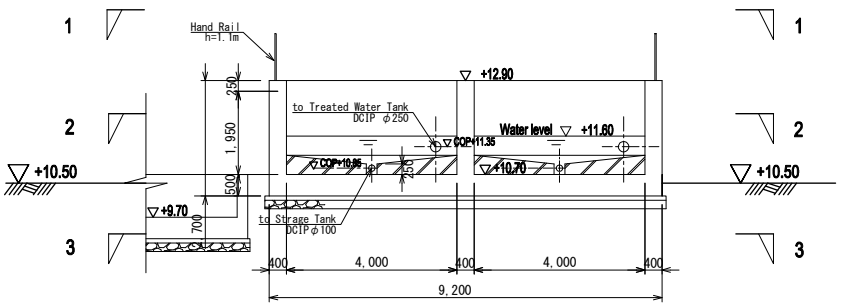

Section D-D

Scale=1:125

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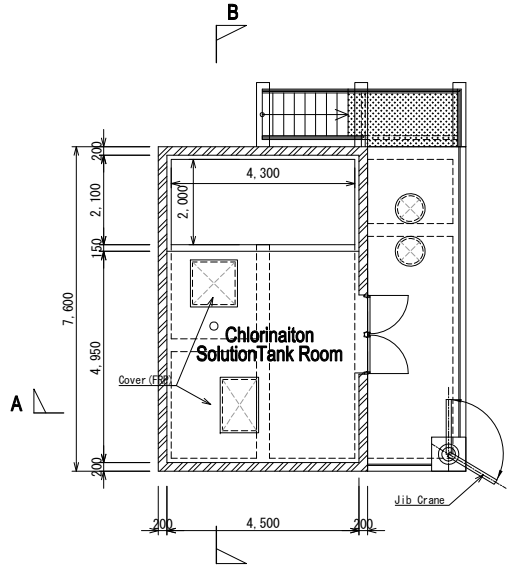
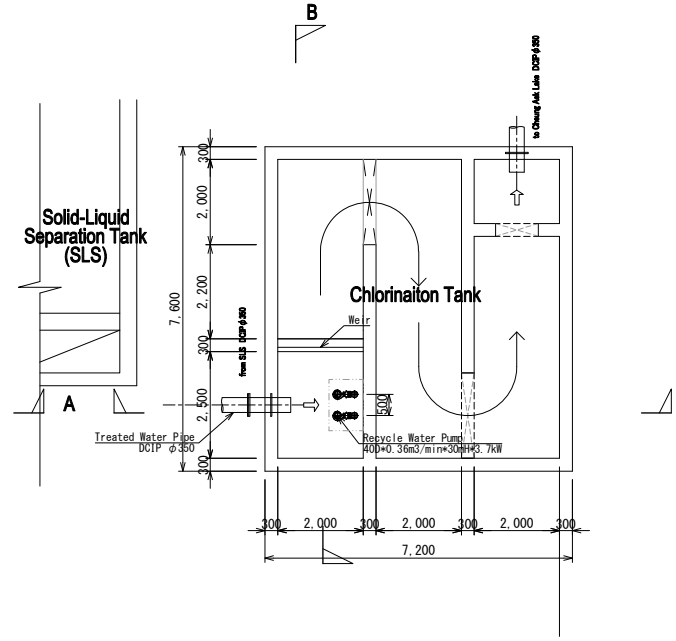
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-017	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Solid-Liquid Separation Tank



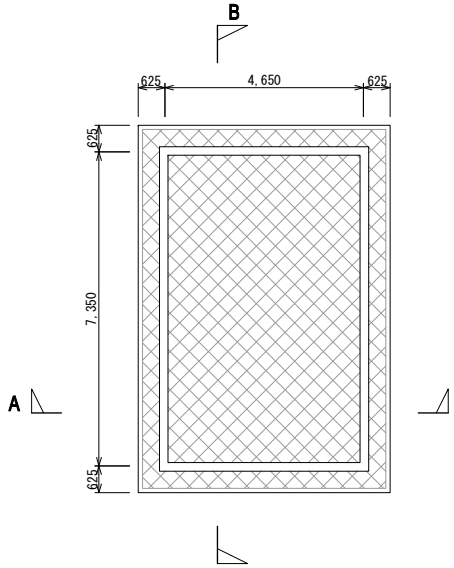
Plan 1-1

Scale=1:125



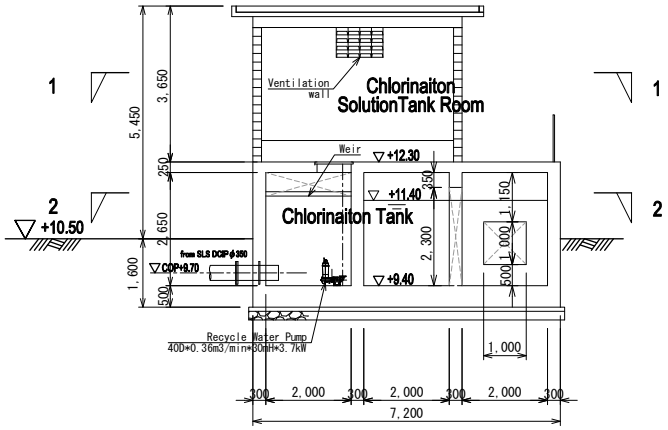
Plan 2-2

Scale=1:125



Roof Plan

Scale=1:125



Section A-A

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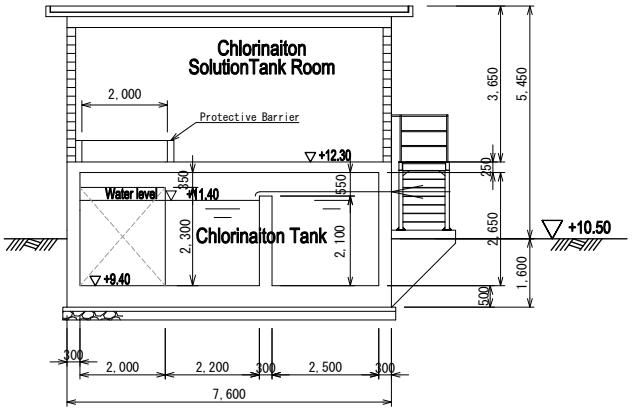
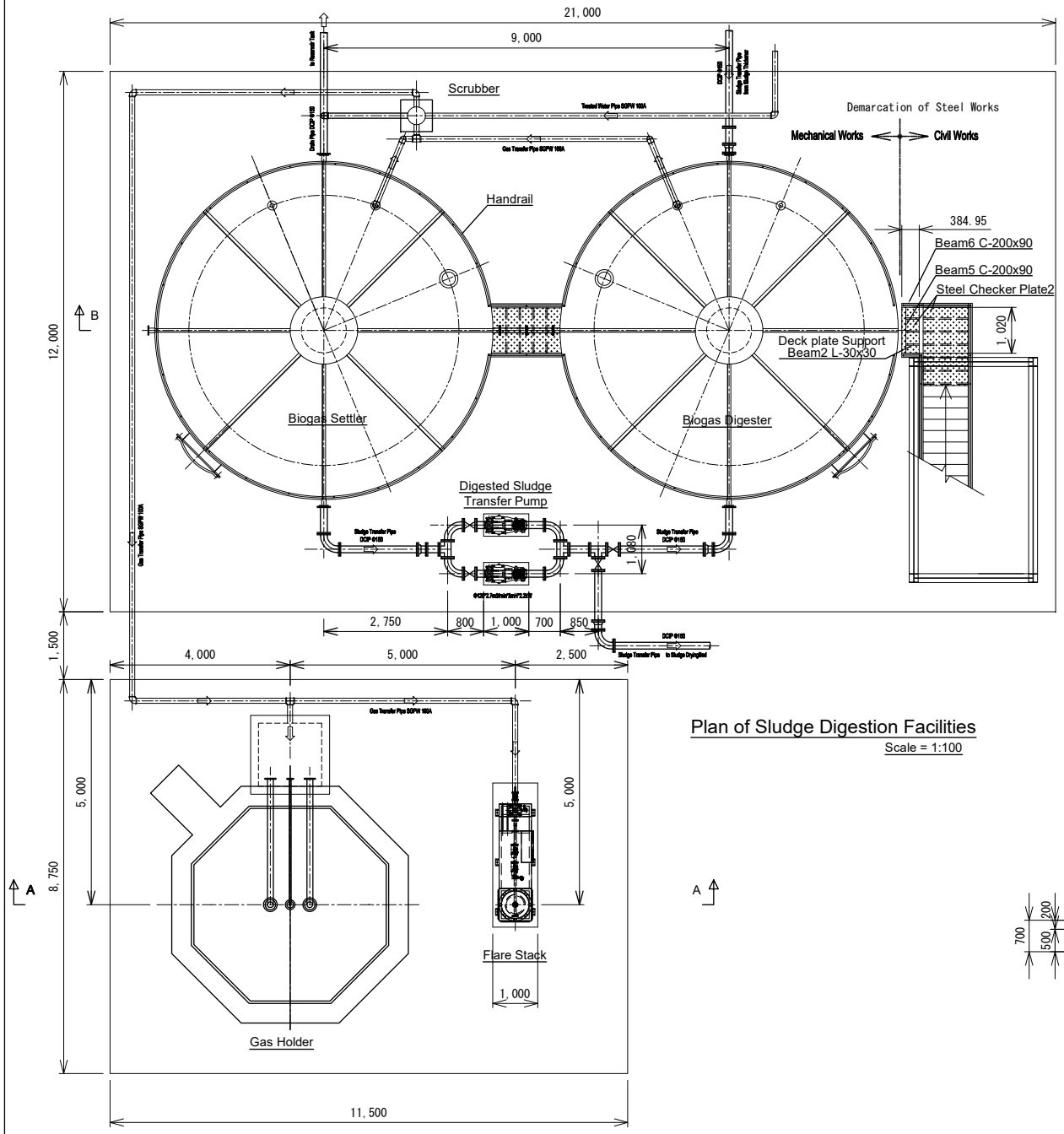


Section B-B

Scale=1:125

SCALE 0 1.0 2.0 3.0 4.0 5.0m

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-018	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Plan & Section for Chlorination Tank

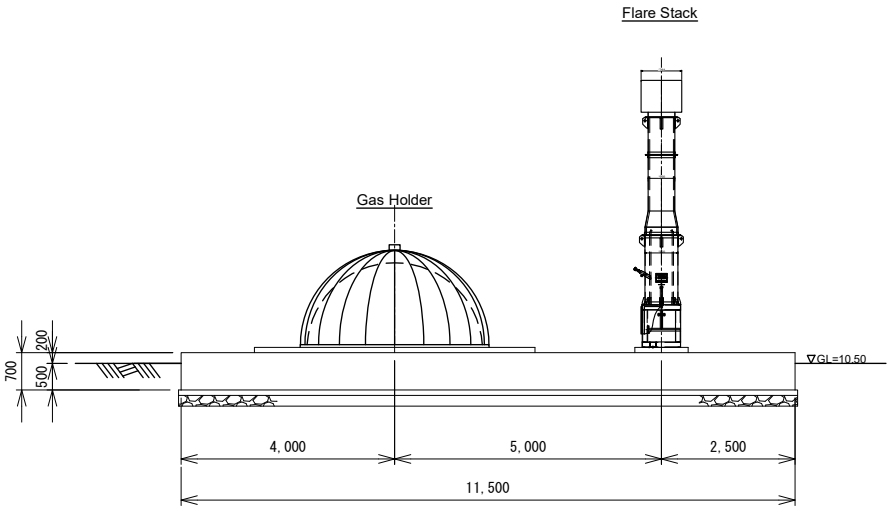


LEGEND

- TREATED WATER
- SEWER & RETURN WATER
- SLUDGE
- BIOGAS

Plan of Sludge Digestion Facilities

Scale = 1:100



Section A-A

Scale = 1:100

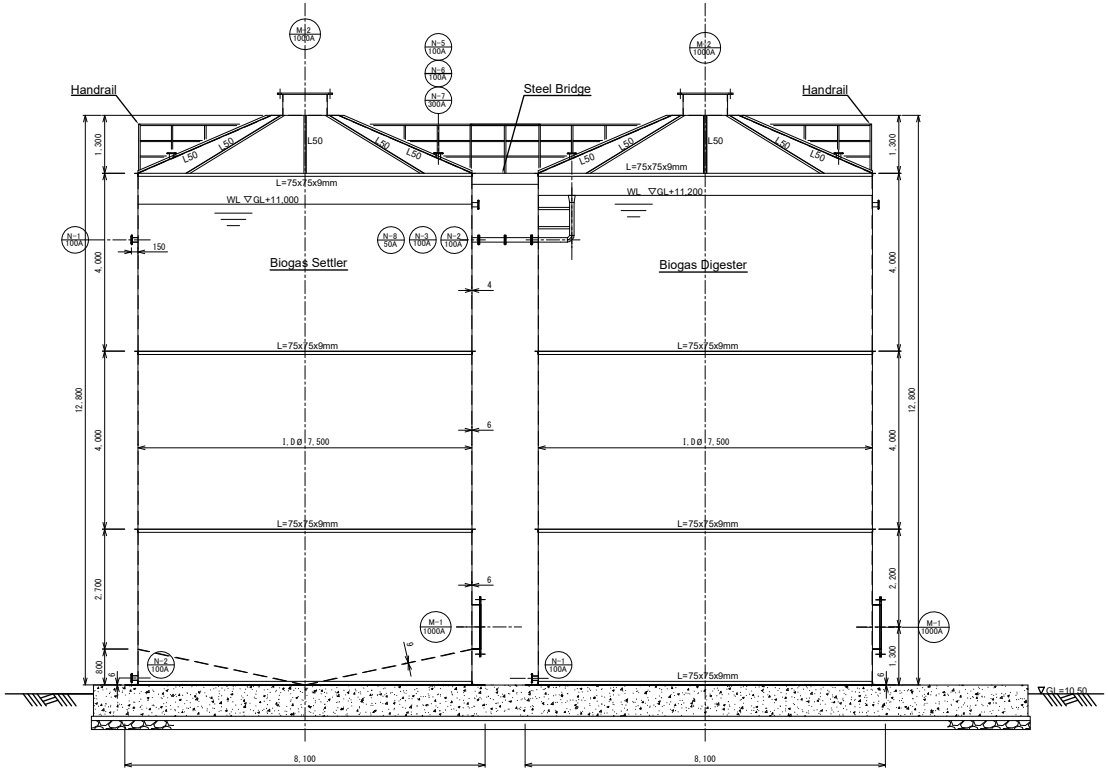
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-019	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Sludge Digestion Facilities(1/2)

Nozzle List

No	Use	Size
N-1	Inlet	100A
N-2	Outlet (Sludge)	100A
N-3	Outlet (Supernatant)	100A
N-4	Drain	100A
N-5	Biogas Outlet	100A
N-6	Biogas Relief Valve	100A
N-7	Sight Glass	300A
M-1	Manhole	1000A
M-2	Manhole	1000A

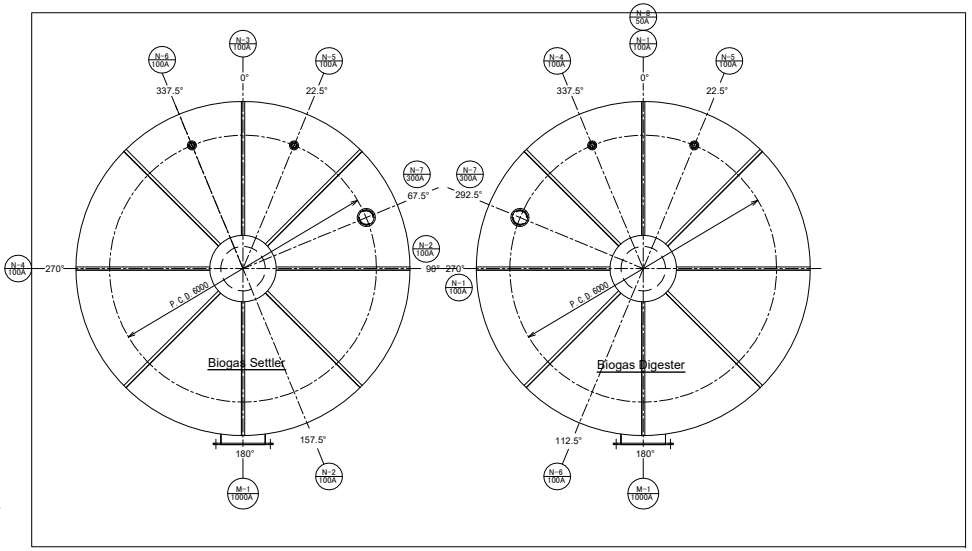
Nozzle List

No	Use	Size
N-1	Inlet	100A
N-2	Outlet	100A
N-3	Drain	100A
N-4	Biogas Outlet	100A
N-5	Biogas Relief Valve	100A
N-6	Inlet(Return Sludge)	100A
N-7	Sight Glass	300A
N-8	Temperature Meter	50A
M-1	Manhole	1000A
M-2	Manhole	1000A



Elevation of Biogas Digester and Settler

Scale = 1:70



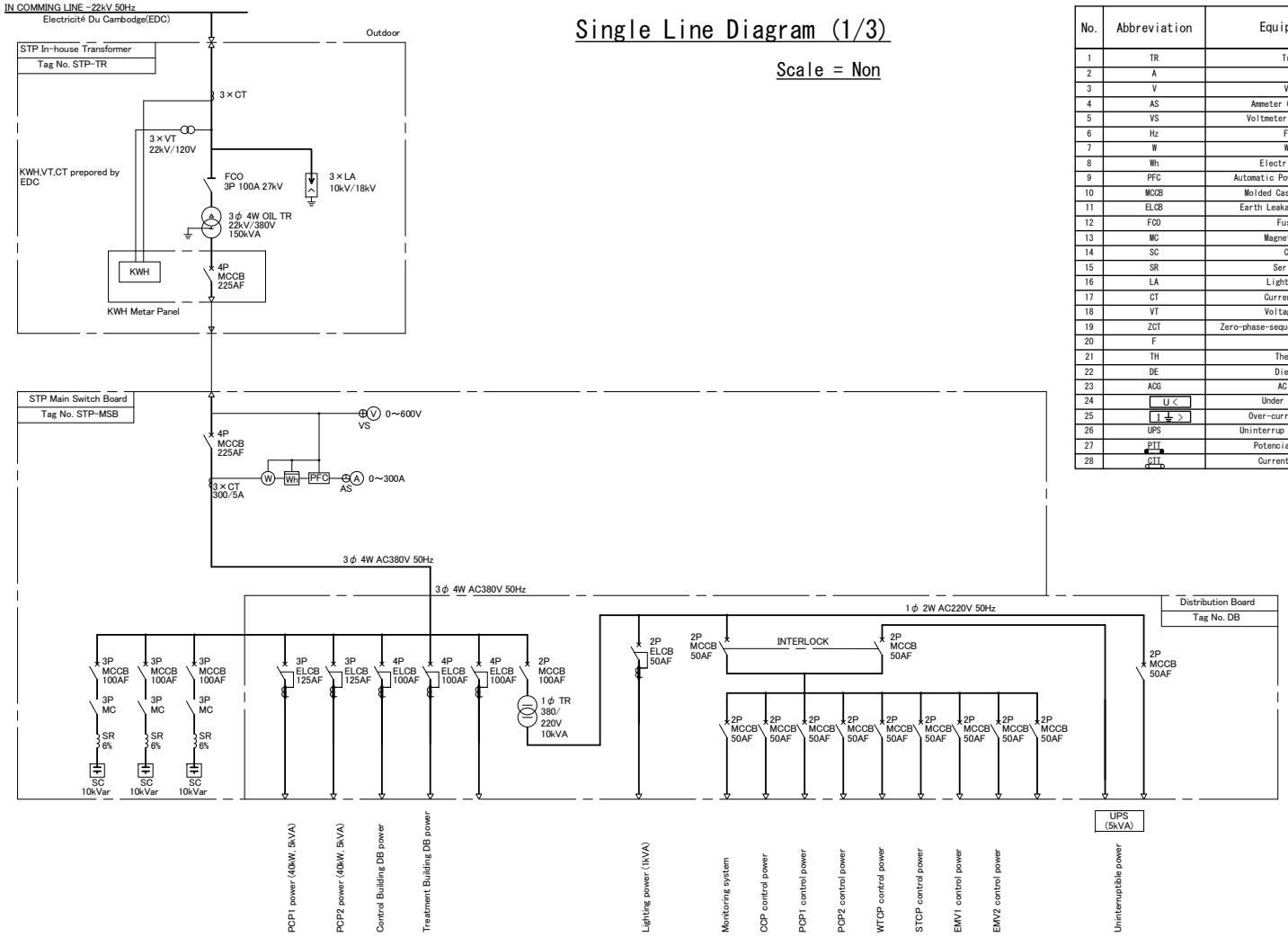
Plan of Biogas Digester and Settler

Scale = 1:70

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-020	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Sludge Digestion Facilities(2/2)

Single Line Diagram (1/3)

Scale = Non

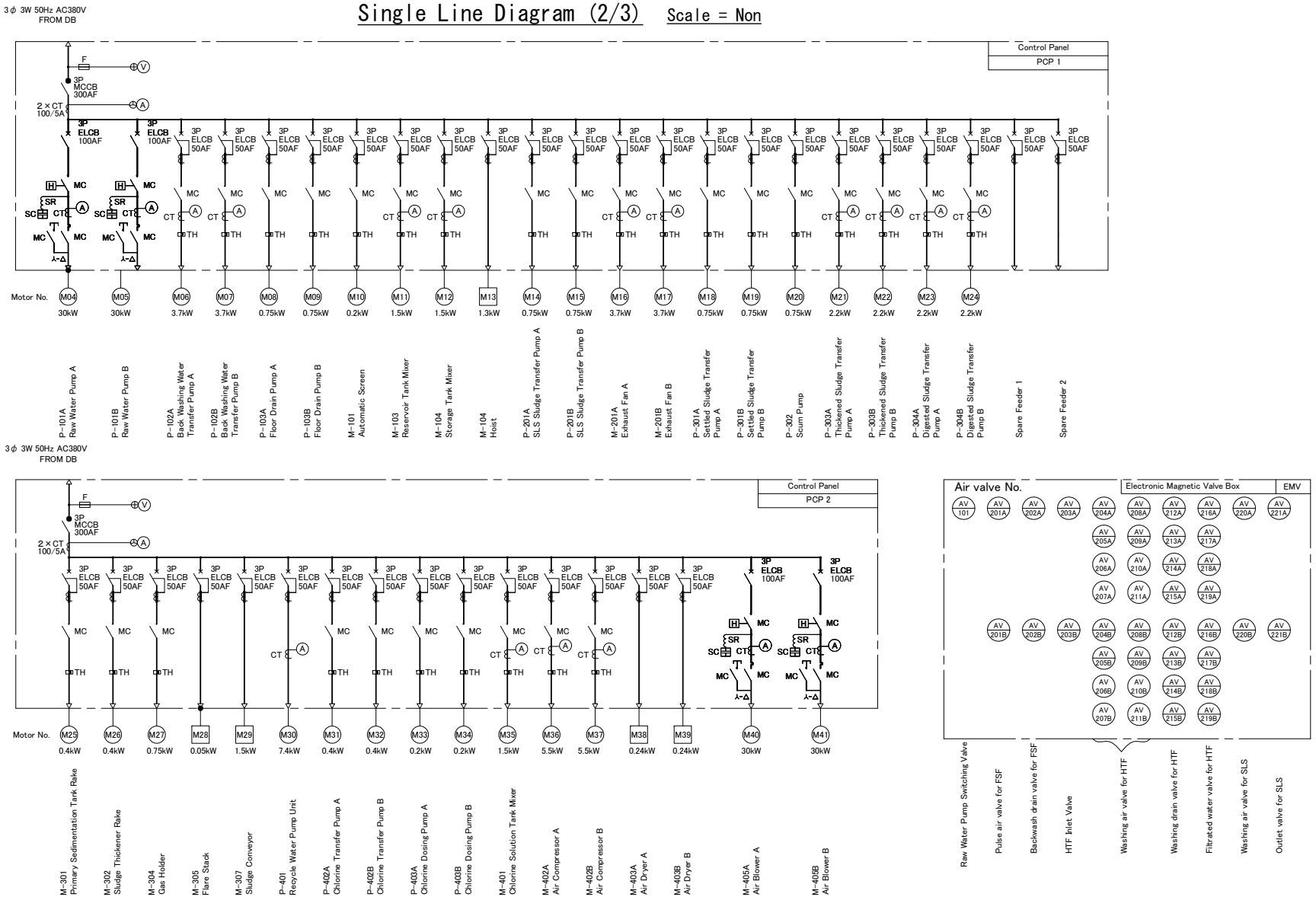


No.	Abbreviation	Equipment Name
1	TR	Transfomer
2	A	Ammeter
3	V	Voltmeter
4	AS	Ammeter Changeover Swich
5	VS	Voltmeter Changeover Swich
6	Hz	Frequency
7	W	Wattmeter
8	Wh	Electric energymeter
9	PFC	Automatic Power factor Regulator
10	MCCB	Molded Case Circuit Breaker
11	ELCB	Earth Leakage Circuit Breaker
12	FCO	Fuse Cut Out
13	MC	Magnetic Contactor
14	SC	Condenser
15	SR	Series reactor
16	LA	Lighting Arrestor
17	CT	Current Transfomer
18	VT	Voltage Transfomer
19	ZCT	Zero-phase-sequence Current Transfomer
20	F	Fuse
21	TH	Thermal Relay
22	DE	Diesel Engine
23	ACG	AC generator
24	U<	Under Voltage relay
25	I>	Over-current ground relay
26	UPS	Uninterrup tible Power System
27	PTT	Potencial Test Terminal
28	CTT	Current Test Terminal

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-001	MECHANICAL AND ELECTRICAL WORK Single Line Diagram for Sewage Treatment Plant (1/2)

Single Line Diagram (2/3)

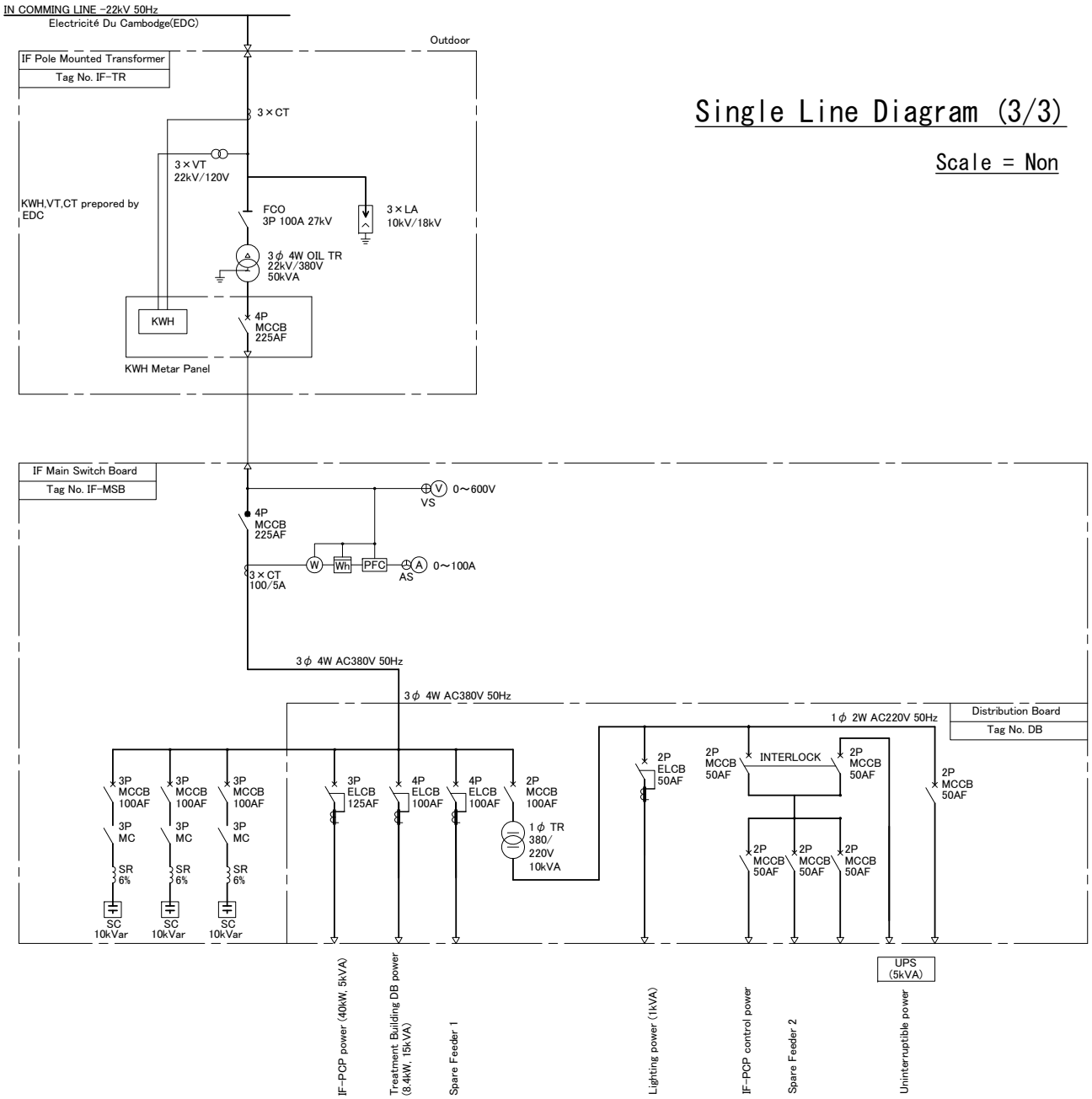
Scale = Non

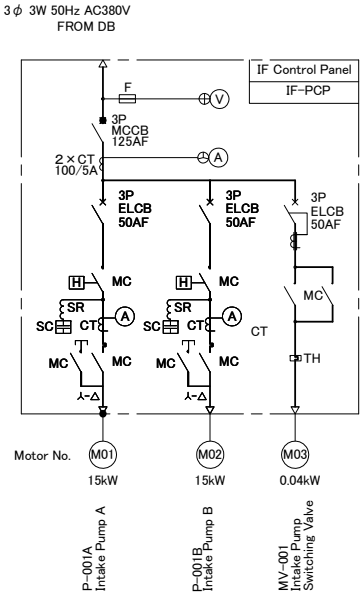


THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-002	MECHANICAL AND ELECTRICAL WORK Single Line Diagram for Sewage Treatment Plant (2/2)

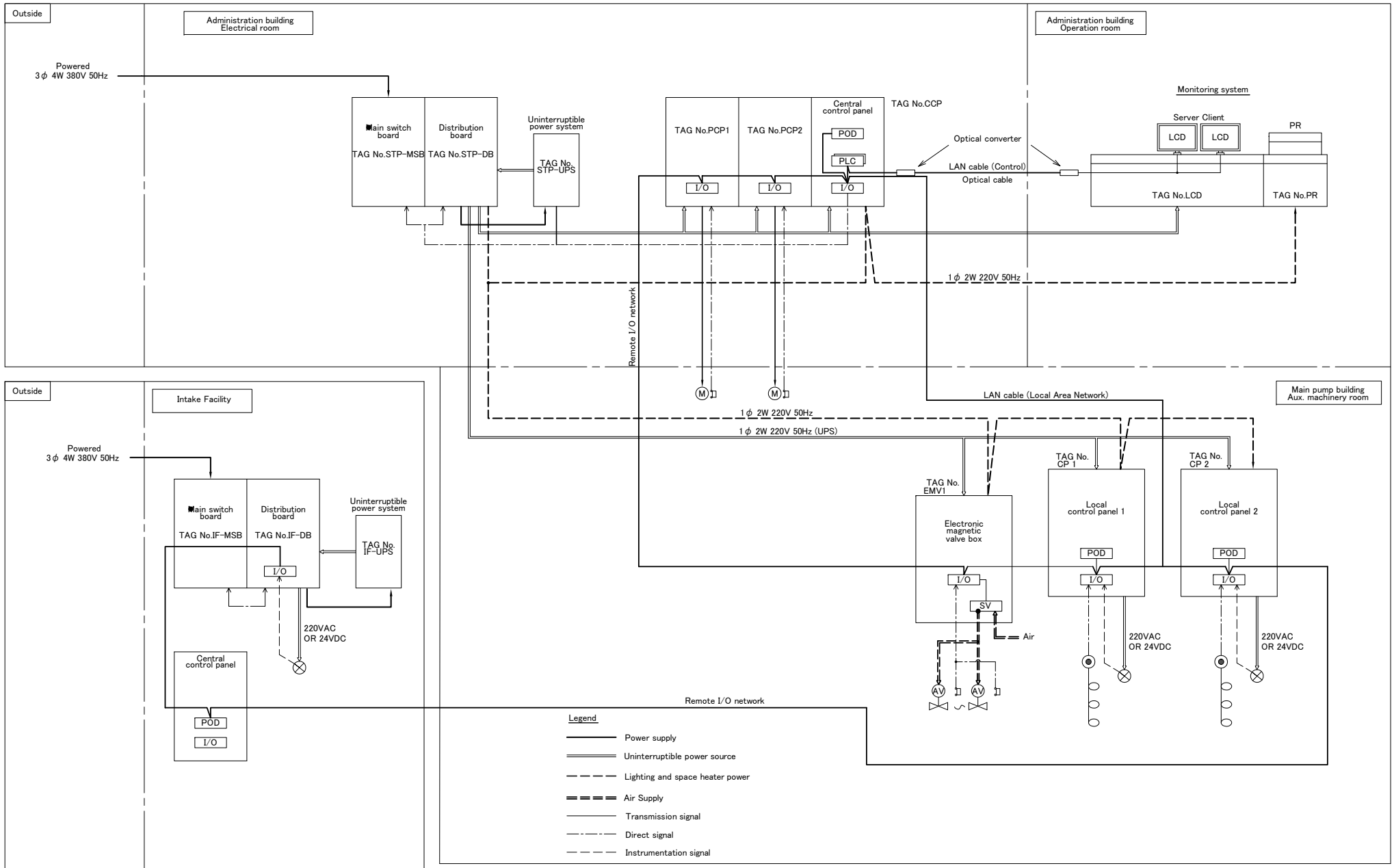
Single Line Diagram (3/3)

Scale = Non





THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-003	MECHANICAL AND ELECTRICAL WORK Single Line Diagram for Interception Facility



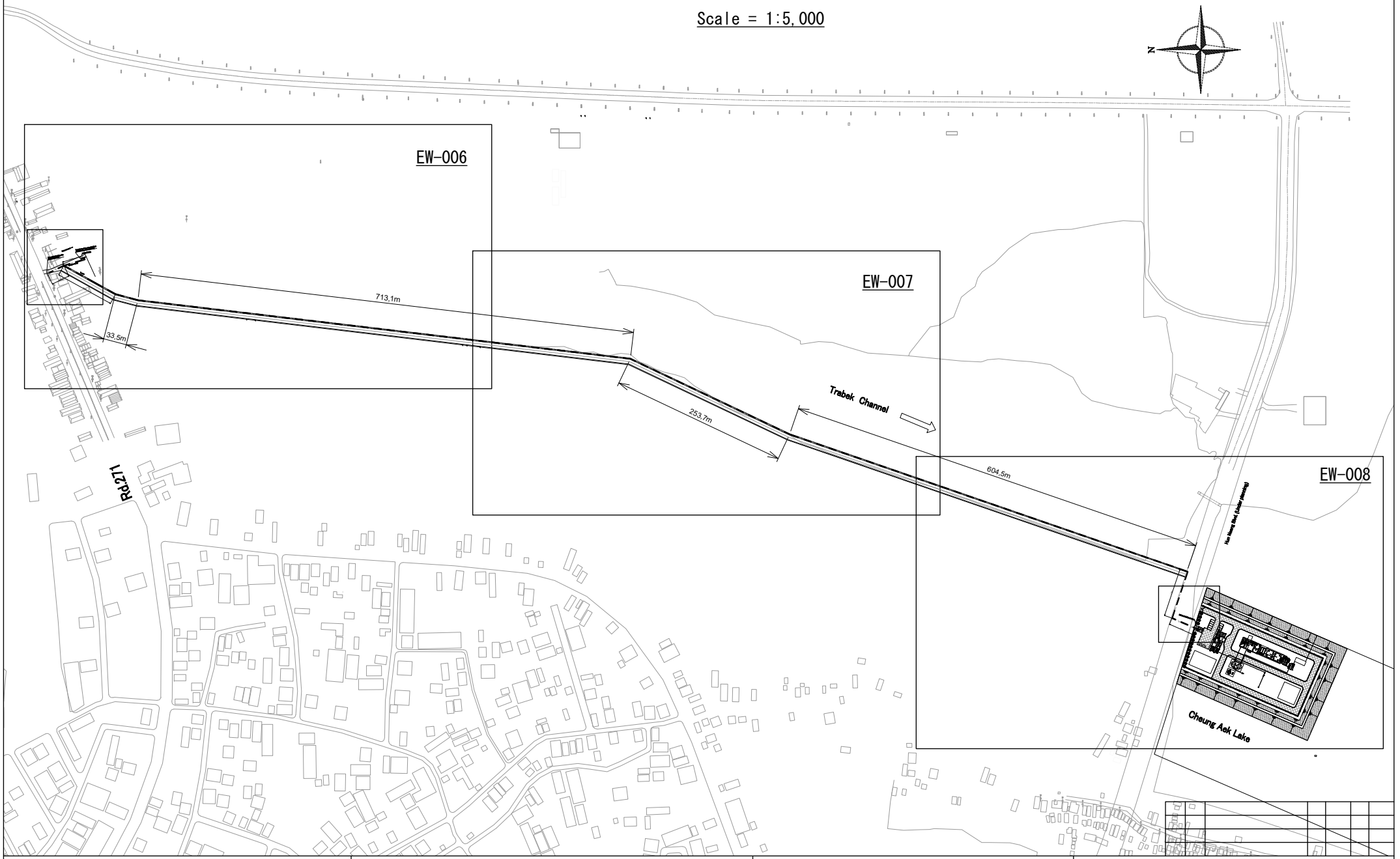
System Configuration

Scale = Non

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-004	MECHANICAL AND ELECTRICAL WORK System Configuration

Cabling Layout (all) for Power Supply

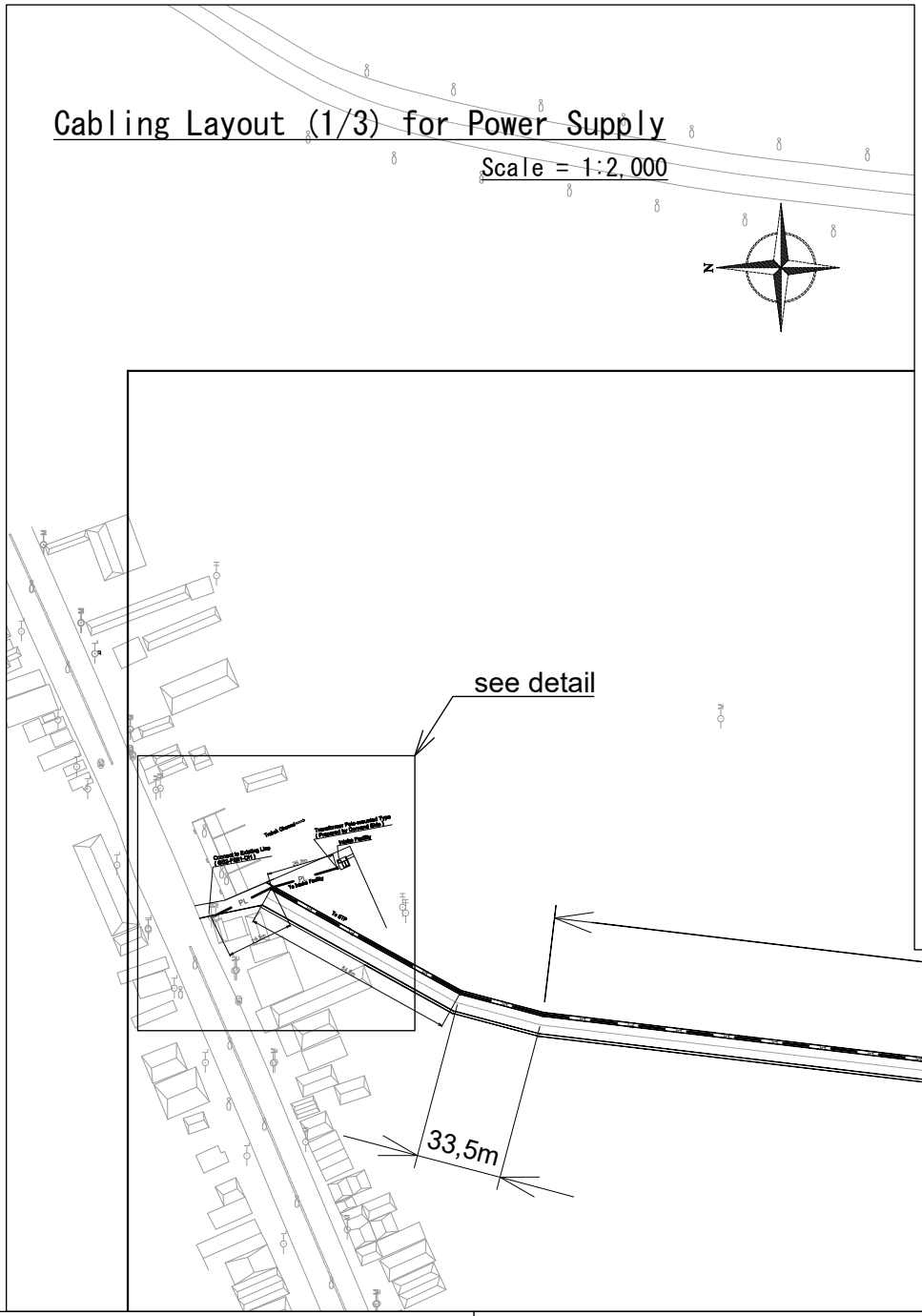
Scale = 1:5,000



THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-005	MECHANICAL AND ELECTRICAL WORK Cabling Layout for Power Supply (1/4)

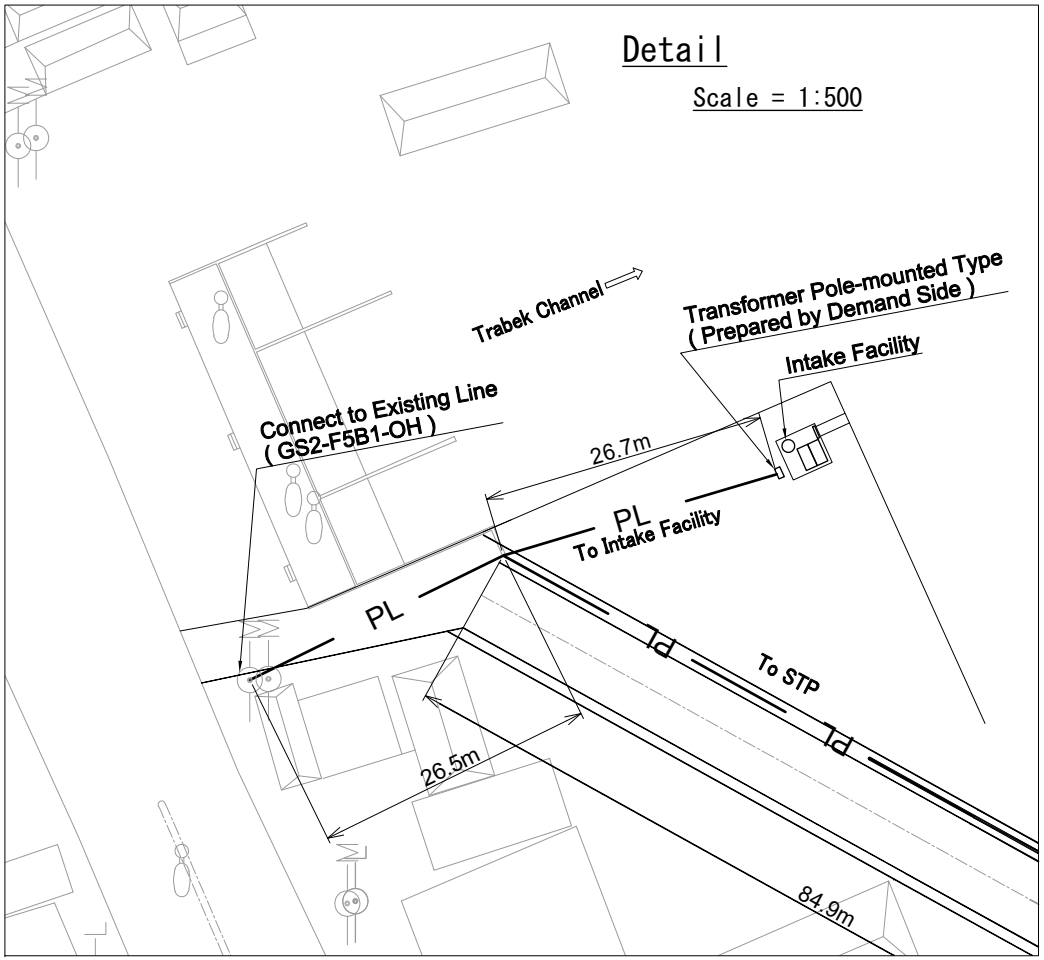
Cabling Layout (1/3) for Power Supply

Scale = 1:2,000



Detail

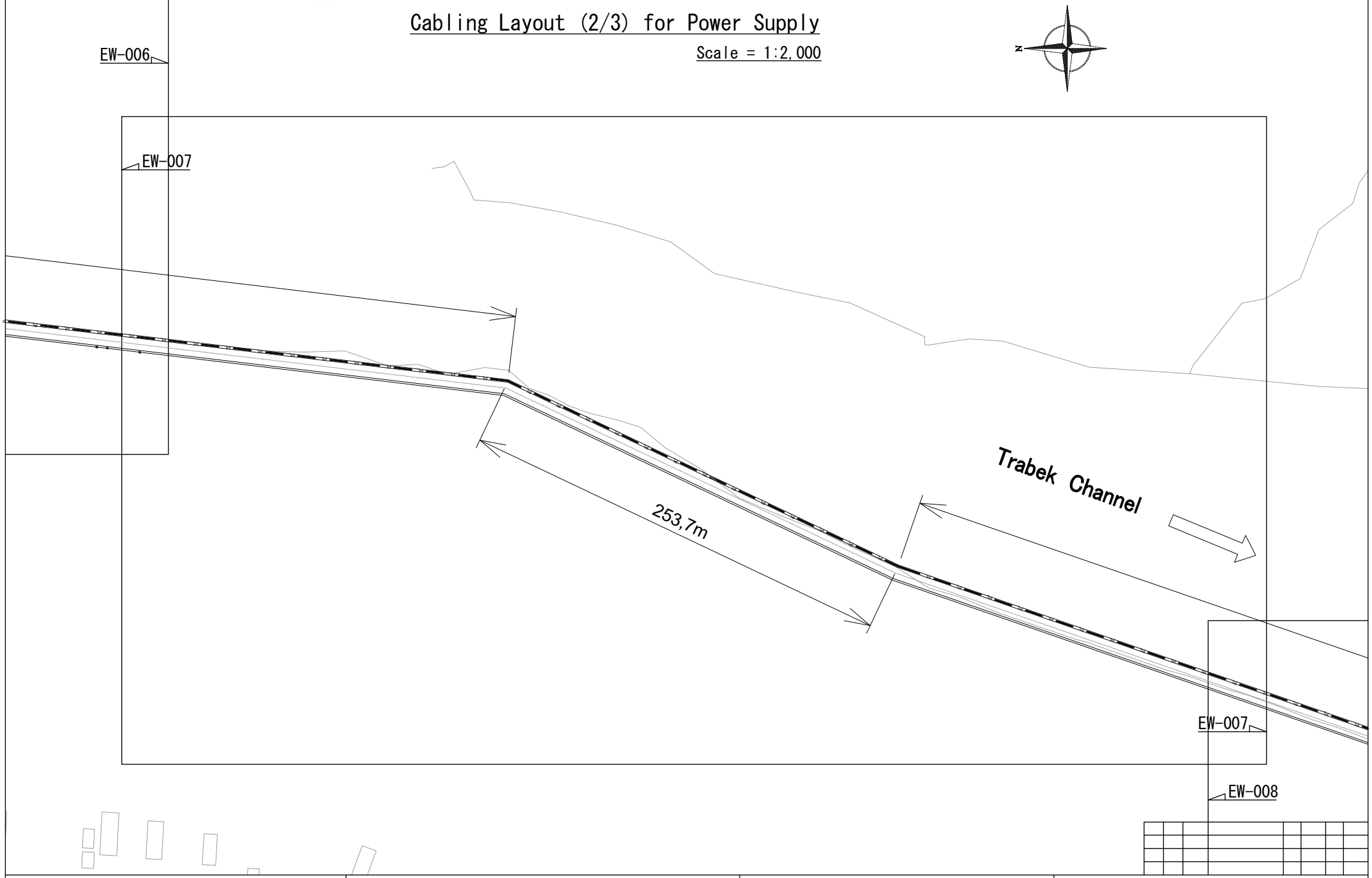
Scale = 1:500



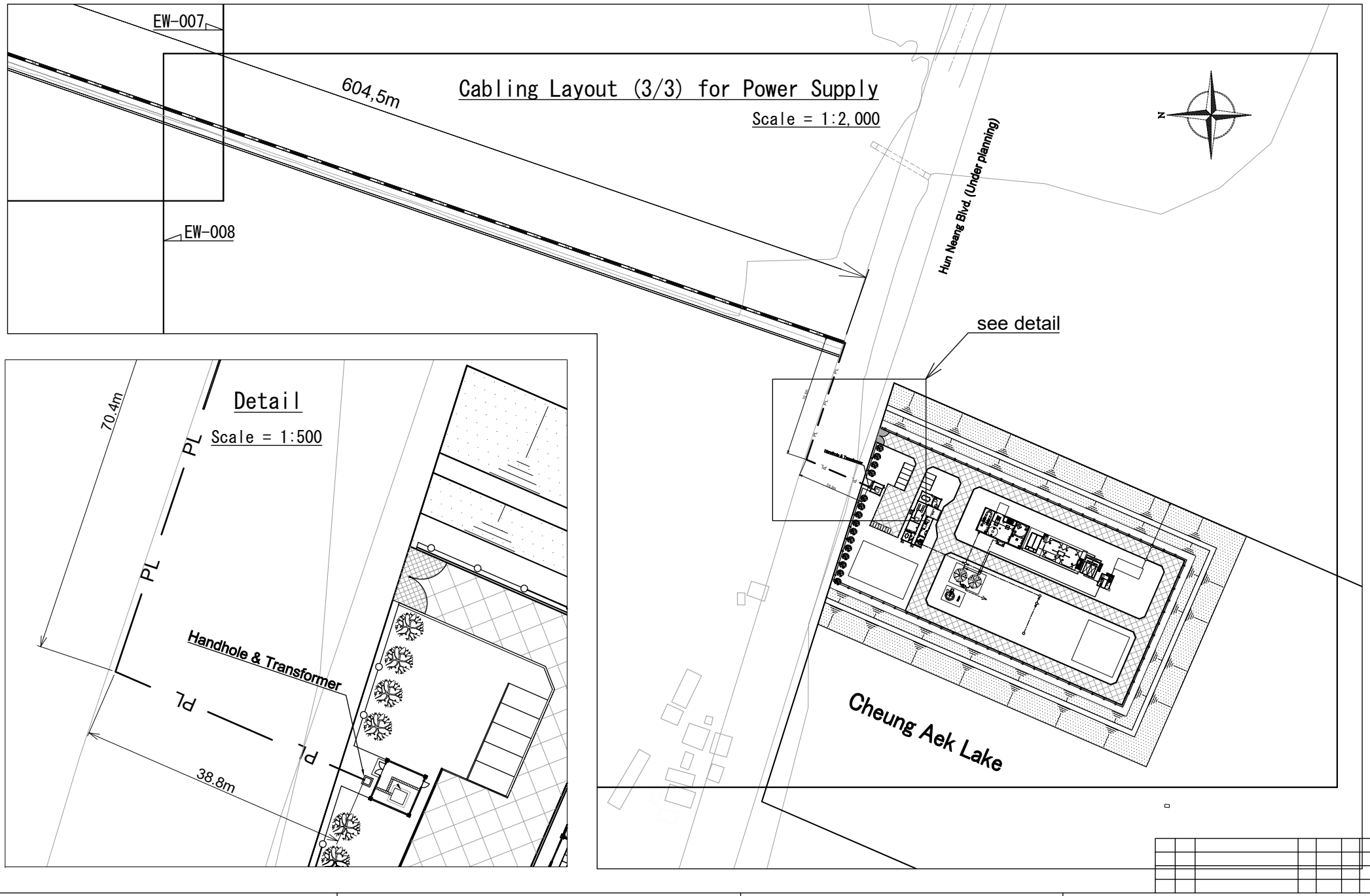
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-006	MECHANICAL AND ELECTRICAL WORK Cabling Layout for Power Supply (2/4)

Cabling Layout (2/3) for Power Supply

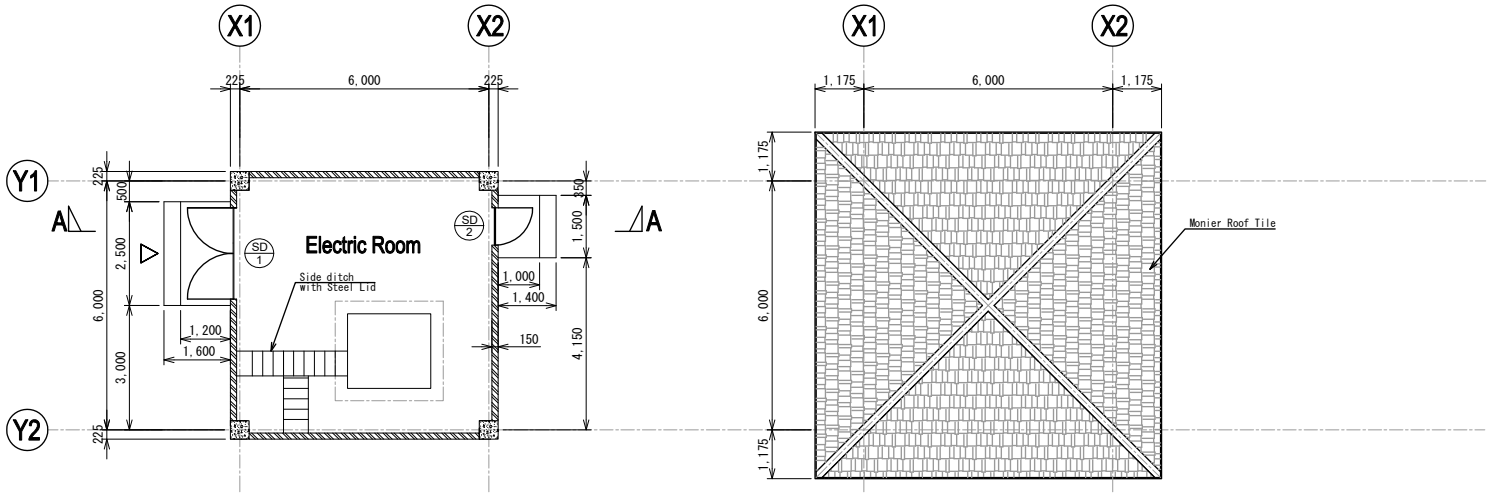
Scale = 1:2,000



THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-007	MECHANICAL AND ELECTRICAL WORK Cabling Layout for Power Supply (3/4)

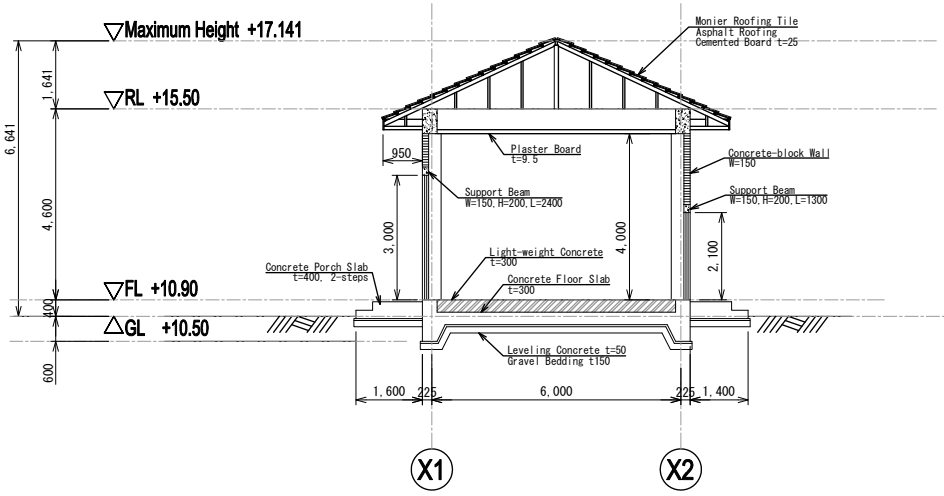


THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-008	MECHANICAL AND ELECTRICAL WORK Cabling Layout for Power Supply (4/4)

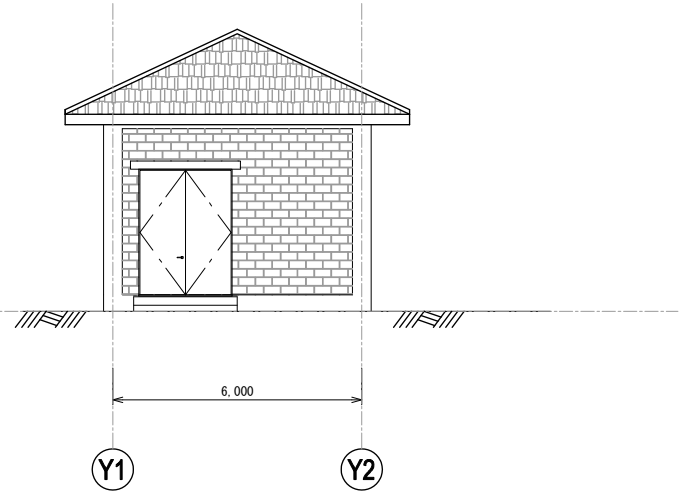


Plan

Roofing Plan



Section A-A



Front Elevation

Detail of Transformer House

Scale = 1:125

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	TH-001	MECHANICAL AND ELECTRICAL WORK Transformer House Plan and Section & Elevation

EXTERIOR FINISH SCHEDULE

	TRANSFORMER HOUSE	
ROOF		
WALL		
BASEBOARD		
DOORS & WINDOWS		

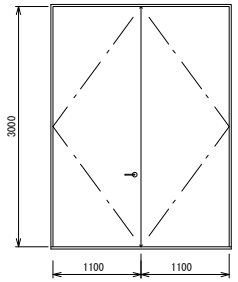
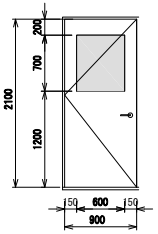
BUILDING OUTLINE

	CHLORINE SOLUTION TANK HOUSE	
THE OTHER		
FLOOR AREA	36.00m²	
USE	TRANSFORMER ROOM	
STRUCTURE	CONCRETE BLOCK STRUCTURE	
SCOPE	ONE-STORY BUILDING	
HEIGHT	5,000mm (Ridge Level from GL)	

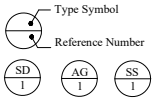
INTERIOR FINISH SCHEDULE

	ROOM NAME	FLOOR LEVEL	FLOOR	BASEBOARD	WALL	CEILING	CEILING HEIGHT (mm)	REMARKS
TRANSFORMER HOUSE	TRANSFORMER ROOM	±0	Concrete steel trowel finish	Cement plaster t20 H150	Concrete mortar t20 AEP on concrete block wall t150	Plaster Board t=9.5	4000	

CHLORINATION TANK HOUSE

KEY NUMBER / TYPE & QUANTITY	SD 1	Steel Double Swinging Door	1	SD 2	Steel Single Swinging Door	1
ELEVATION						
LOCATION	Main Entrance			Sub Entrance		
FRAME ; MATERIAL & FINISH	Steel S.O.P.			Steel S.O.P.		
THRESHOLD or SILL	SUS			SUS		
DOOR WINDOW & LOUVER — MATERIAL & FINISH	Steel S.O.P.			Steel S.O.P.		
DOOR WINDOW & LOUVER — THICKNESS	40 mm			40 mm		
DOOR WINDOW & LOUVER — GLASS & SCREEN	TP 5mm			TP 5mm		
HARDWARE						
REMARKS						

NOTES or REVISIONS :



SYMBOL LEGEND

WD	:	Wooden Door
WWL	:	Wooden Window Louver
AWL	:	Aluminum Window Louver
AW	:	Aluminum Window
AD	:	Aluminum Door
SD	:	Steel Door
SG	:	Steel Louver
AG	:	Aluminum Louver

FINISH LEGEND

C.W.P.	:	Clear Wood Preservative
S.O.P.	:	Ready-mixed Synthetic Resin Paint
A.E.P.	:	Acrylic Resin Emulsion Paint
S.V	:	Oil Stain Varnish

THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	TH-002	MECHANICAL AND ELECTRICAL WORK Transformer House Finish Schedule and Door & Window List