［　資　　料　］

1. 調査団員・氏名

(1) 現地調査 （第一次現地調査期間：2018 年 5 月 7 日～7 月 8 日）

氏 名	担 当	所 属	現地調査期間
伊藤 民平	総括	JICA 地球環境部環境管理第一チーム 課長	5 月 22 日～ 5 月 26 日
柏村 正允	計画管理	JICA 地球環境部環境管理第一チーム	5 月 22 日～ 5 月 26 日
下河内 仁	業務主任/下水道計画 1/下水処理施設(土木)計画 1・設計	建設技研インターナショナル	5 月 7 日～ 7 月 8 日
花房 政英	副業務主任/下水道計画 2	日本工営	5 月 21 日～ 6 月 2 日
長谷川 善宣	下水処理施設(土木)計画 2	建設技研インターナショナル	6 月 3 日～ 6 月 9 日
松下 剛	土質/地盤造成/自然条件調査	建設技研インターナショナル	5 月 10 日～ 6 月 17 日
朝倉 徹	施工計画/積算	建設技研インターナショナル	5 月 27 日～ 6 月 17 日
谷島 誠	財務計画	建設技研インターナショナル	6 月 11 日～ 6 月 30 日

(2) 現地調査 （第二次現地調査期間：2018 年 8 月 7 日～10 月 7 日）

氏 名	担 当	所 属	現地調査期間
下河内 仁	業務主任/下水道計画 1/下水処理施設(土木)計画 1・設計	建設技研インターナショナル	8 月 22 日～ 10 月 7 日
高村 斎弘	管路施設(土木)計画・設計	日本工営	8 月 20 日～ 9 月 8 日
竹田 久人	下水処理施設(機械・電気)計画・設計	建設技研インターナショナル	8 月 7 日～ 8 月 31 日
松下 剛	土質/地盤造成/自然条件調査	建設技研インターナショナル	8 月 28 日～ 9 月 23 日
朝倉 徹	施工計画/積算	建設技研インターナショナル	8 月 11 日～ 9 月 1 日
平野 哲	運営・維持管理計画	北九州市上下水道局	8 月 13 日～ 8 月 26 日
谷本 晋一郎	環境社会配慮	日本工営	8 月 21 日～ 9 月 16 日

(3) 概略設計概要現地説明時　（現地調査期間：2019 年 5 月 15 日～5 月 25 日）

氏 名	担 当	所 属	現地調査期間
伊藤　民平	総括	JICA 地球環境部環境管理第一チーム　課長	5 月 20 日～ 5 月 24 日
柏村　正允	計画管理	JICA 地球環境部環境管理第一チーム	5 月 20 日～ 5 月 25 日
下河内　仁	業務主任/下水道計画 1/下水処理施設(土木)計画 1・設計	建設技研インターナショナル	5 月 15 日～ 5 月 25 日
花房　政英	副業務主任/下水道計画 2	日本工営	5 月 19 日～ 5 月 25 日
朝倉　徹	施工計画/積算	建設技研インターナショナル	5 月 15 日～ 5 月 25 日

2. 調査行程

【第一次現地調査期間】

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		●									

【第二次現地調査期間】

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

【概略設計概要現地説明時】

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. 関係者（面会者）リスト

現地調査期間中に表敬・打合せを行ったカンボジア国関係者のリストを以下に示す。

氏　名　(敬称略)	役　職	所　属
プノンペン都庁（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
プノンペン都公共事業運輸局（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
プノンペン都公共事業運輸局排水ポンプ場・下水処理場室（Drainage Pumping Station and Sewage Treatment Plant Office : DSO/DPWT）		
Dourng Chansarath	Deputy Cheif	DSO
Chhorng Vantha	Deputy Cheif	DSO
Men Sokkhen	Deputy Cheif	DSO
プノンペン都土地管理・都市計画・建設局（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
プノンペン都環境局（Department of Environment : DOE/PPCC）		
Keo Chanarith	Director	DOE/PPCC
Khuon Dara	Deputy Director	DOE/PPCC
プノンペン都行政区		
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
カンボジア公共事業運輸省（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
カンボジア土地管理・都市計画・建設省（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
カンボジア環境省（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

プノンペン水道公社（Phnom Penh Water Supply Authority : PPWSA）

Samreth Sovithiea	Deputy General Director	
Chea Satephoat	Director	Planning and Project Department

在カンボジア日本国大使館（Embassy of Japan in Cambodia）

Atsushi Hirose	Second Secretary	Embassy of Japan

カンボジア電力公社（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

カンボジア地雷対策センター（Cambodian Mine Action Center）

Oum Phumro	Deputy Director General	

JICA　カンボジア事務所（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. 討議議事録(M/D)

4.1 討議議事録(M/D)(2018年5月25日)

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 民平

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.

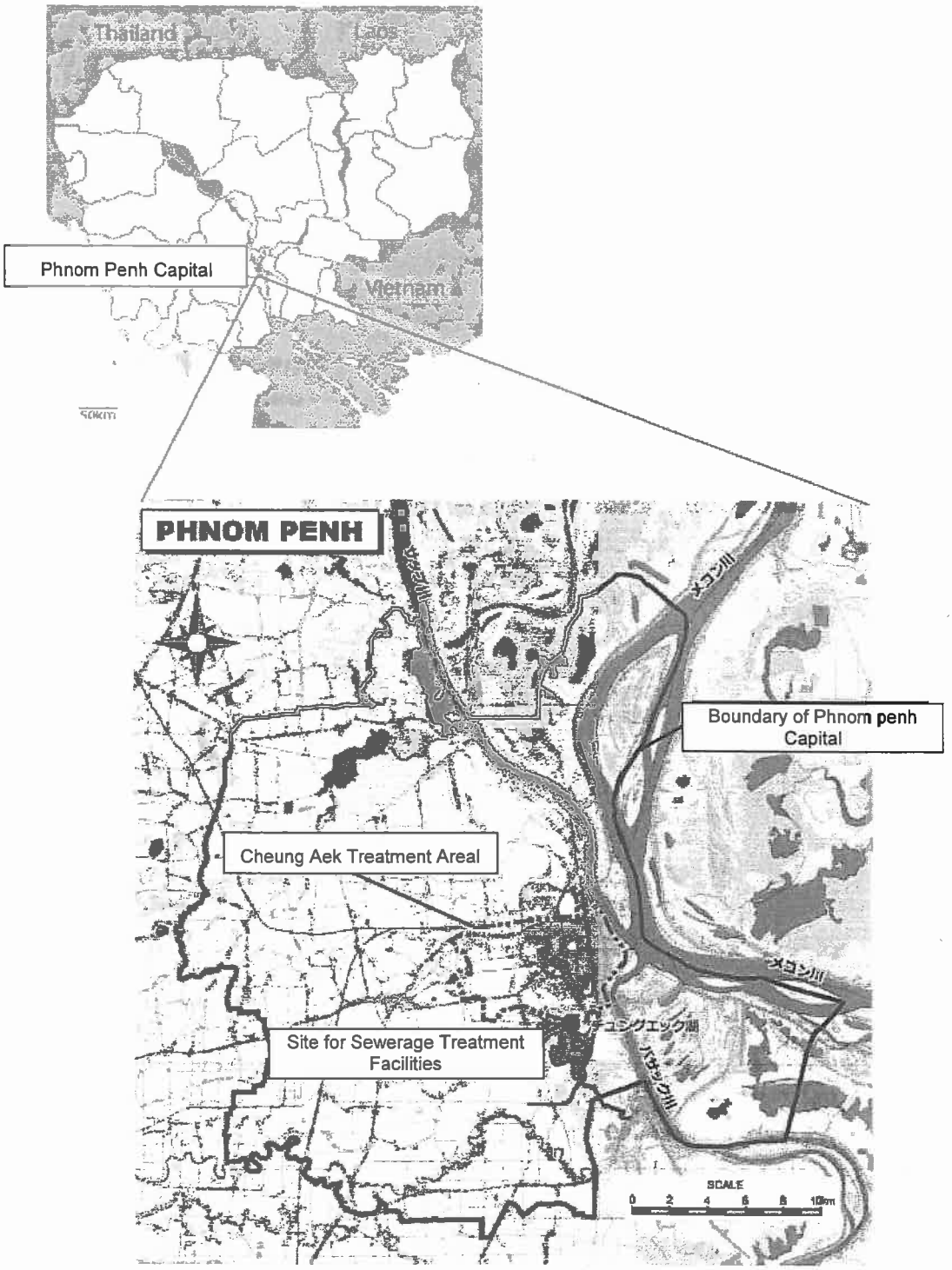
11-5. Monitoring during the implementation

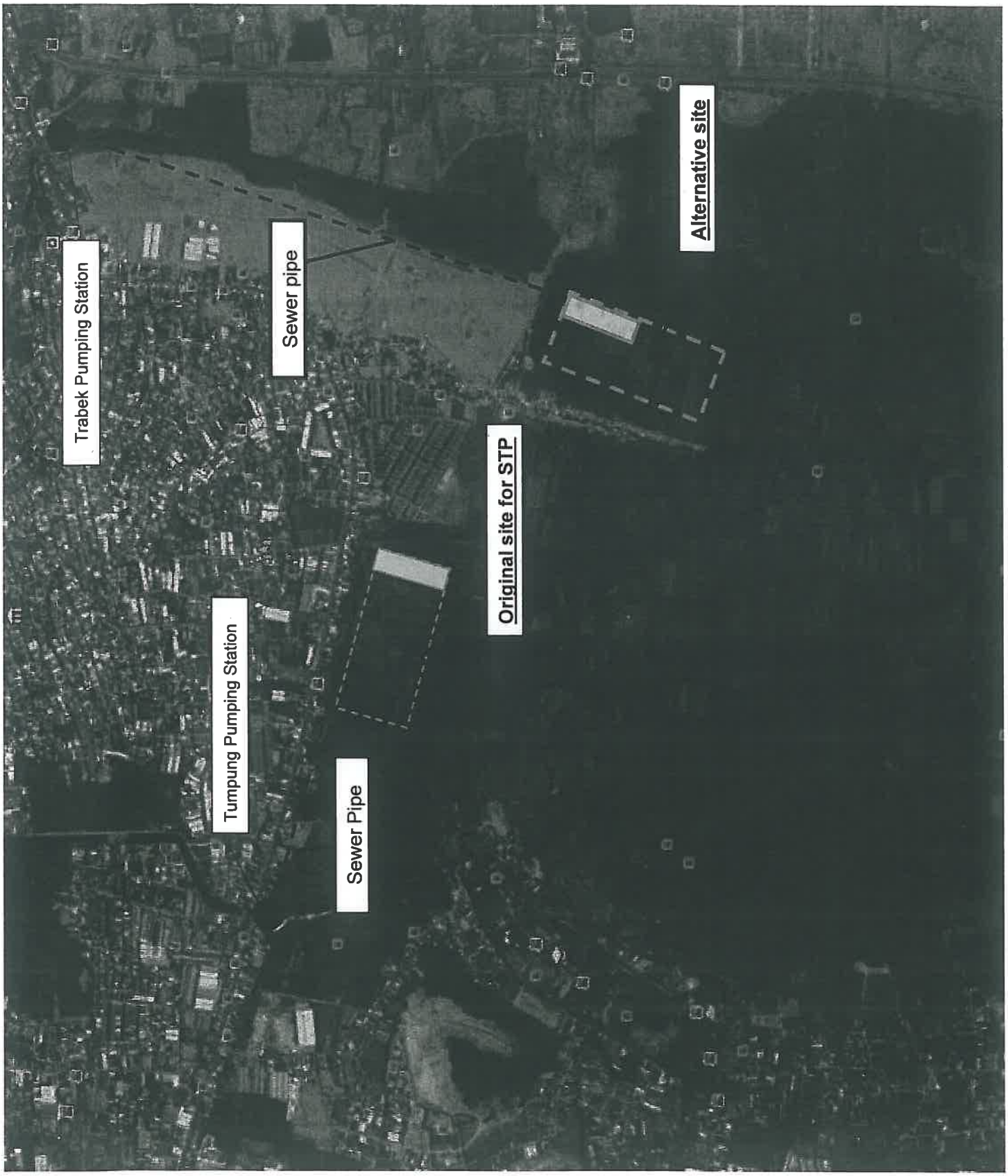
PPCA and DPWT agreed to monitor the Project every three (3) months during the implementation by using the Project Monitoring Report form as attached in Annex 8

11-6. Confidentiality of the Project

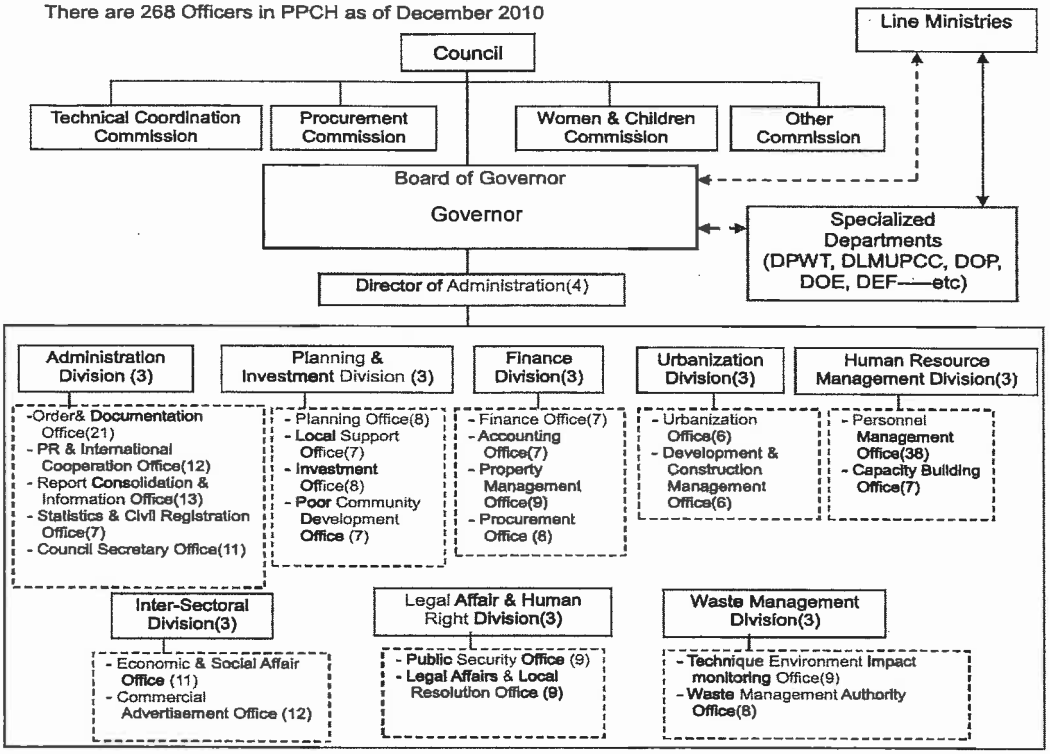
The Team explained that the Preparatory Survey Report to be prepared at the end of the survey would be disclosed to the public in Japan. However, the Team also explained that a confidential part which might affect bidding process such as cost estimation should be kept undisclosed until the bidding has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

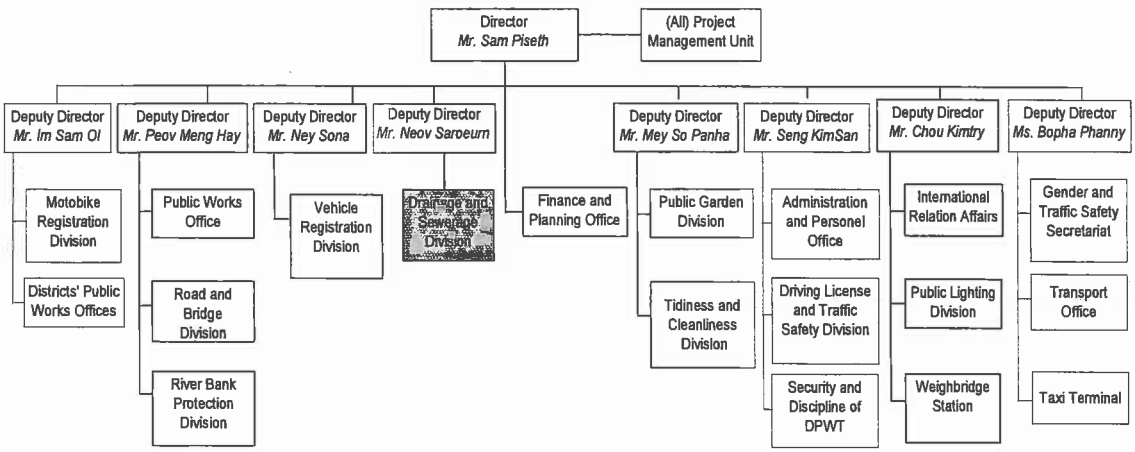

Thailand
Laos
Vietnam
Phnom Penh Capital
PHNOM PENH
Boundary of Phnom penh Capital
Cheung Aek Treatment Areal
Site for Sewerage Treatment Facilities
SCALE


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.

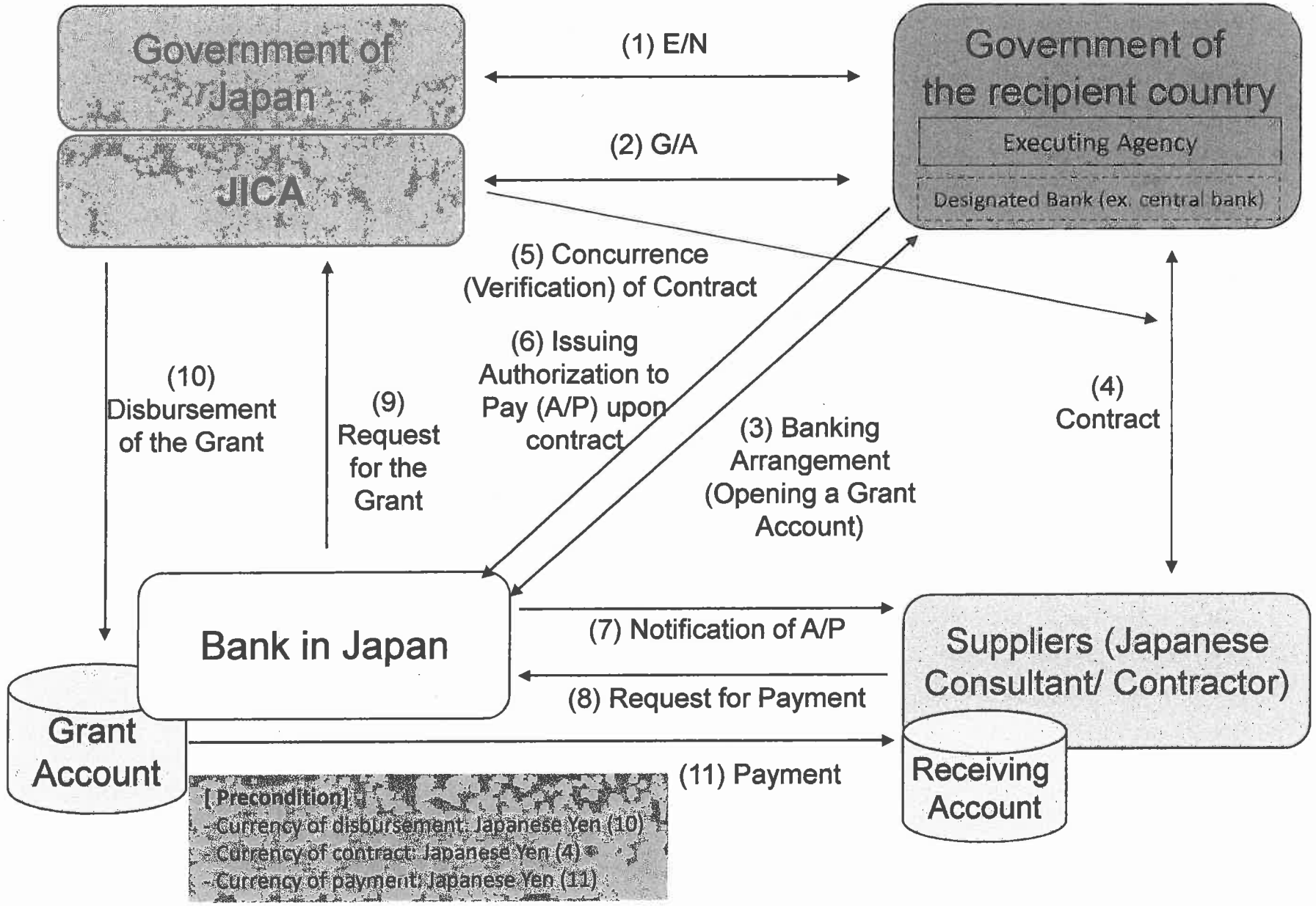
3) Proper Use

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 ●月 20●5	2nd ●月 20●5	3rd ●月 20●5	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 討議議事録(M/D) (2019年5月23日)

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.

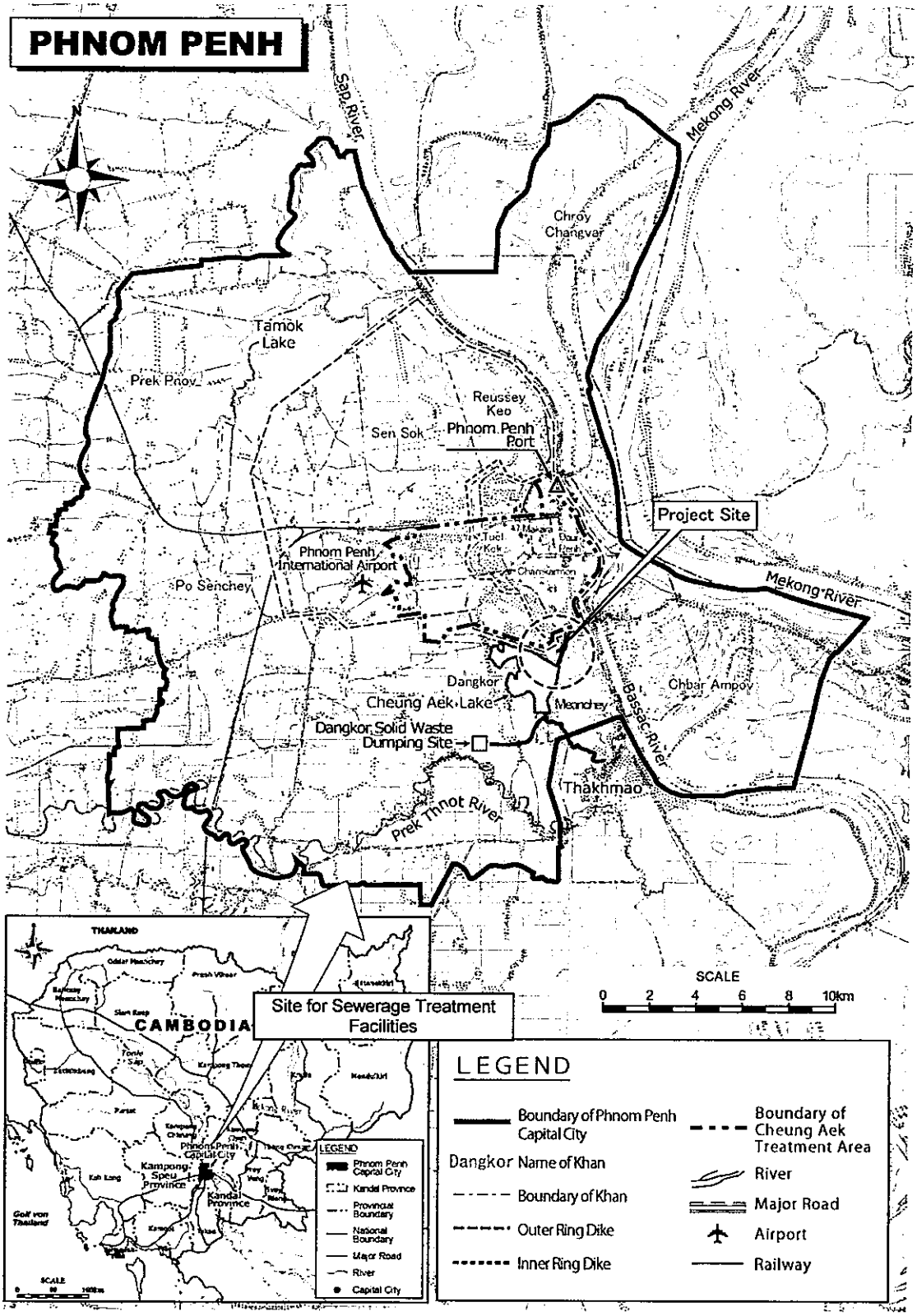
Both sides agreed to study the future expansion of STP continuously under the mutual cooperation.

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.

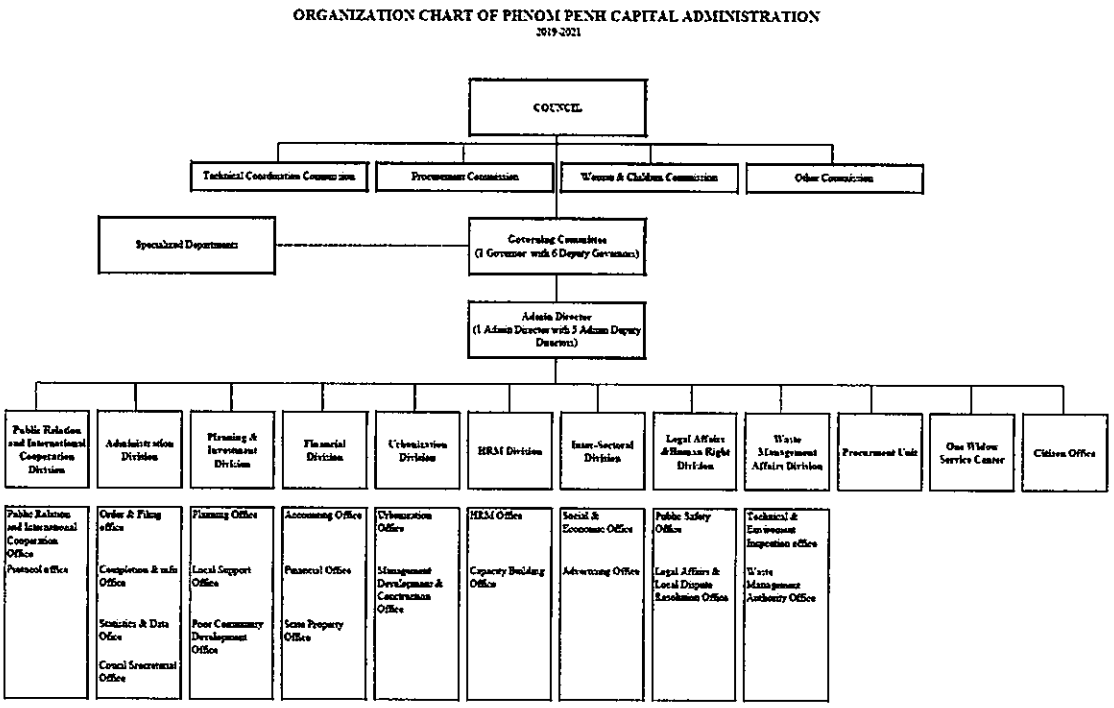
Both sides confirmed the importance of collaboration between the Project and the technical cooperation project considering difference with Soft Component of the Project.

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

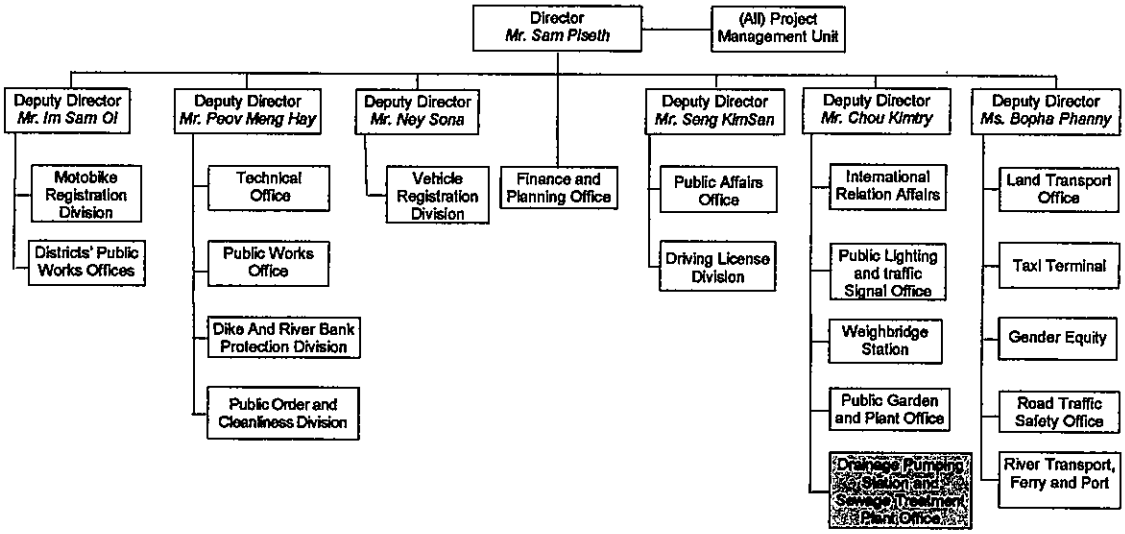

PHNOM PENH
Sap River
Mekong River
Chroy Changvar
Tamok Lake
Prek Pnov
Reussey Keo
Sen Sok
Phnom Penh Port
Project Site
Phnom Penh International Airport
Po Senchey
Mekong River
Dangkor
Cheung Aek Lake
Meanchey
Chbar Ampov
Bassac River
Dangkor Solid Waste Dumping Site
Thakhmao
Prek Thnot River
THAILAND
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



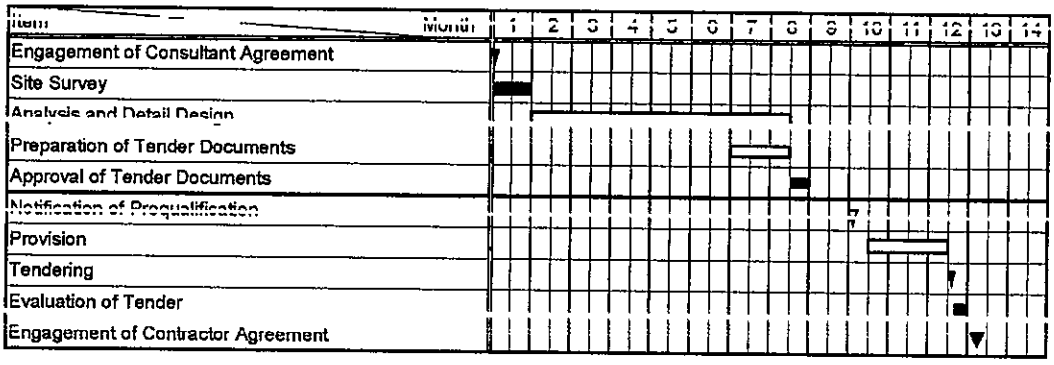
Organization Chart of DPWT



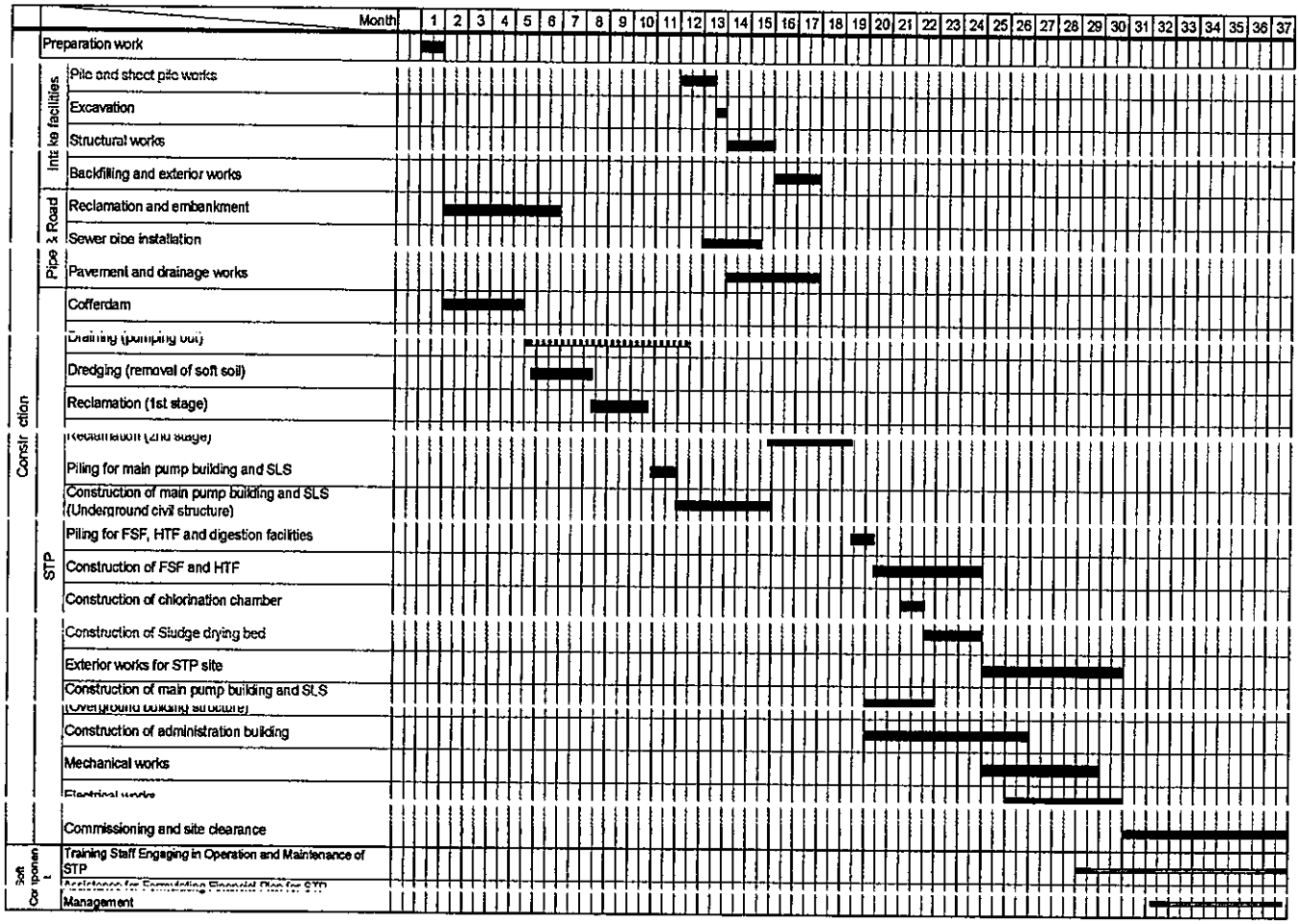
Annex 3

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

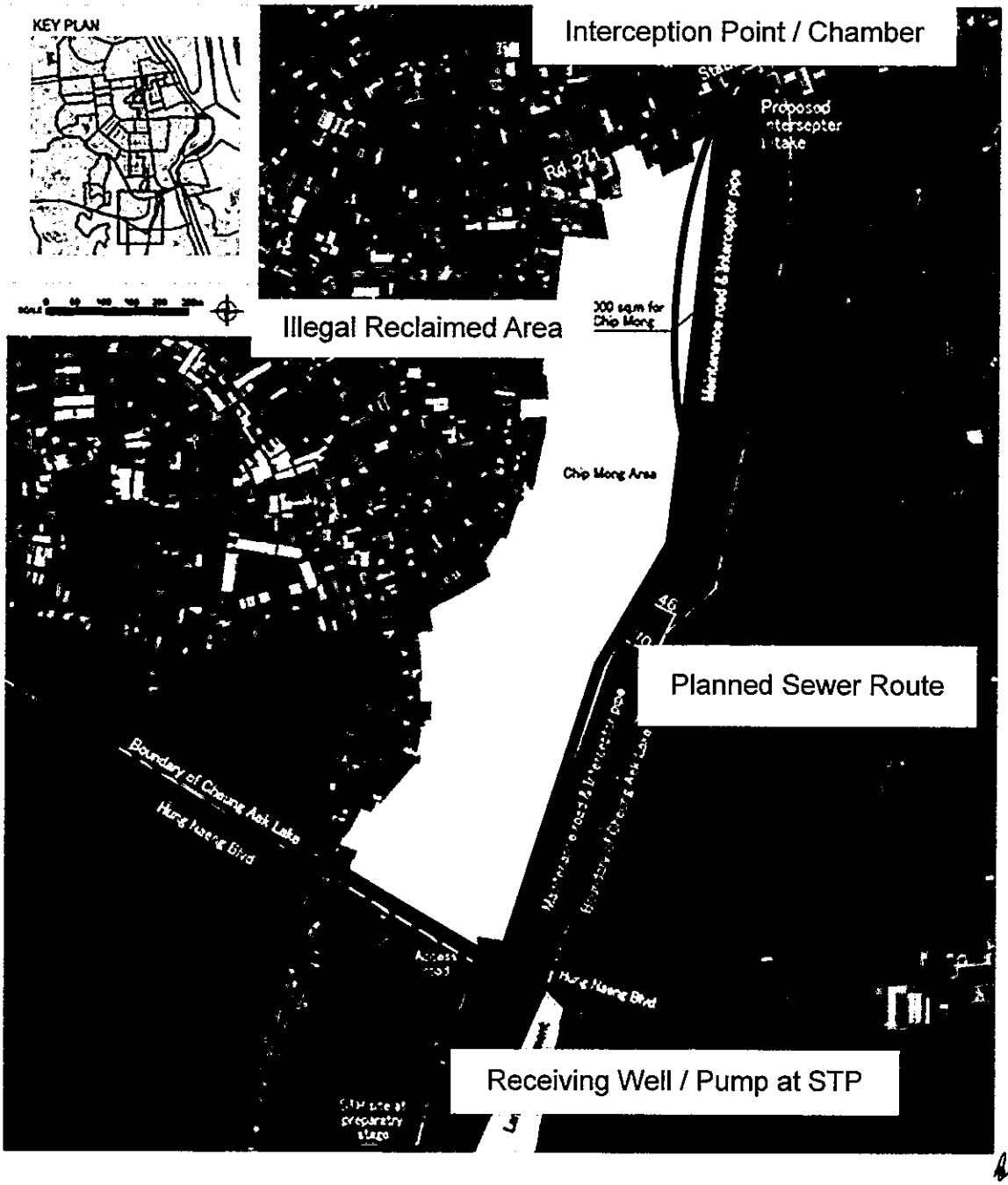
-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent 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
Illegal Reclaimed Area
Chip Mong Area
Planned Sewer Route
Receiving Well / Pump at STP
Boundary of Cheung Ash Lake
Hung Tseng Bird

5. ソフトコンポーネント計画書

目　　次

1. ソフトコンポーネントを計画する背景

1.1. プロジェクトの背景

プノンペン都では、急速な人口増加(約 100 万人: 1998 年から 169 万人：2013 年政府推計)と都市化により汚水量が増大しているが、下水道施設は未整備のため、汚水は腐敗槽から排水路を通って湖沼・湿地帯で自然浄化される仕組みとなっている。然しながら、腐敗槽は適切な維持管理がなされず、汚水が不完全な処理のまま放流されているのが実態である。また近年、開発事業に伴う湖沼・湿地帯の埋立てが進み、自然浄化機能が低下している。特に、本事業対象地域の汚水が放流される Cheung Aek 湖は、面積が 2003 年から 2015 年にかけて大きく減少し、汚水による水質悪化が著しい。また、同湖に接続する排水路では、そこに流れ込む汚水からの悪臭、雨季の排水不良による冠水により、環境衛生面でも悪影響を及ぼしている。

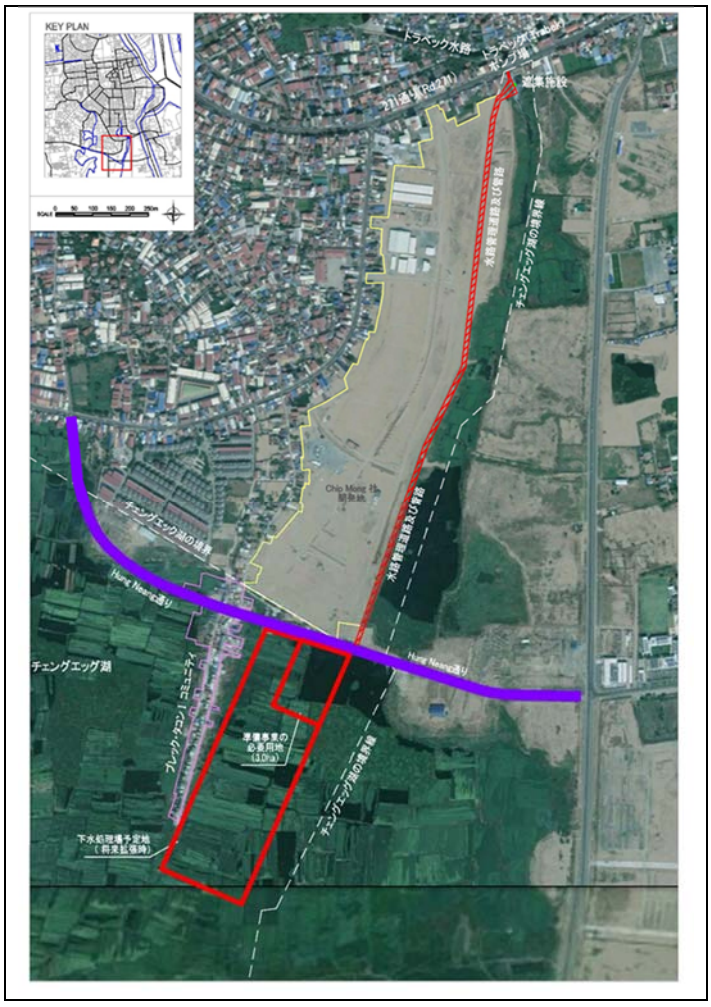


図 1.1　本プロジェクトの対象エリア

このような状況に対して、2014 年から 2016 年にかけて実施された「プノンペン都下水・排水改善プロジェクト」の中で策定されたマスタープランにおいては、都内で最も市街化が進み、水環境の悪化が最も著しい Cheung Aek 湖流域を含む「Cheung Aek 処理区」をオフサイト処理区域(下水道による集合処理区域)として設定した上で、さらに、カンボジア政府側の実施体制も含めた事業実施能力、カンボジア政府側のニーズ等を勘案し、短期(～2020 年)、中期(2021～30 年)、長期(2031～40 年)の 3 段階に分け当処理区の段階的整備計画を立案した。

プノンペン下水道整備計画準備調査は同整備計画の「短期」の計画における下水処理場、下水管渠(導水管)等を整備するものである。

1.2. 上位目標とプロジェクト目標

1.2.1. 上位目標

当該セクターの上位計画(上位目標)としては、国家レベルのものと都レベルのものがある。以下、各々について記述する。

(1) 国家戦略的開発計画(National Strategic Development Plan: NSDP)

カンボジア国政府は国家開発計画の基盤となる国家戦略として、グッドガバナンス(汚職撲滅、法制・司法改革、行財政改革、兵員削減の 4 戦略)の確立を最優先戦略とし、「①農業分野の強化」「②インフラの復興と建設」「③民間セクター開発と雇用創出」「④能力構築と人材開発」を最重要開発課題とする四辺形戦略(Rectangular Strategy) を掲げている。

カンボジア国政府は四辺形戦略に基づく開発計画として、国家戦略的開発計画 NSDP 2009～2013 を策定、2010 年 6 月に発表した。本開発計画では、下水・排水セクターに係る開発方針として、特に、国道沿いに位置するプノンペン都を含む大都市において、下水・排水施設の整備と維持を重点項目として位置付けている。また、NSDP 2014～2018 においても、NSDP 2009～2013 に引き続き、国道沿いに位置するプノンペン都を含む大都市において、下水・排水施設の整備と維持を重点項目として位置付けている。

(2) プノンペン都都市開発戦略(City Development Strategy: CDS)

プノンペン都は、上記の国家レベルの開発計画を踏まえた上で、2015 年を目標年とする都市開発戦略(City Development Strategy：CDS)を 2005 年に策定している。CDS では、今後のプノンペン都の発展と市民生活の向上を目的とした開発計画構想における 5 つの重点分野として「①土地利用と住宅」、「②環境と天然資源」、「③社会資本整備と交通」、「④社会福祉」、「⑤経済発展」を挙げている。これらの重点項目下にそれぞれ目標として、重点分野②の下に「水質汚濁の防止」及び「下水処理の促進」が、重点分野③の下に「排水システムの改善」が位置付けられている。

(3) プノンペン都都市開発計画(White Book on Development and Planning of Phnom Penh)

プノンペン都は、CDS に基づき、フランス政府及びパリ市の支援により、2020 年を目標年としたプノンペン都の総合都市開発計画を 2007 年に策定した。その後、その目標年次を 2035 年に延伸し、王令により設立された土地管理都市計画国家委員会による可決を経て、2015 年 12 月 23 日付けの政令(Sub-decree)の発出により承認された。

本計画では、プノンペン都の一極集中を防ぐための郊外の開発と都市圏の拡大、住宅・土地開発における官民連携の促進、景観・環境都市としてのアイデンティティの確立等の計画が提案されている。下水・排水分野の整備方針について、下水処理場を Cheung Aek Lake へ設置する提案をしている。

1.2.2. プロジェクト目標

プノンペン都「Cheung Aek 処理区」に下水道施設を整備することにより、Cheung Aek 湖に流入する汚濁負荷量の削減を図り、もっと当該地域の水・衛生環境保全もしくは改善を目標とする。

1.3. プロジェクトの概要

プロジェクトの概要は、次表のとおりである。

表 1.1　　協議議事録(M/D)に基づく相手国からの要請内容

コンポーネント	詳細内容
下水処理場 (遮集施設を含む)	- 規模：5,000 m^3/日 - 処理方式：前ろ過散水ろ床法 (PTF: Pre-treated Trickling Filtration)
アクセス道路 /下水管渠(導水管)の整備	- 約 2.0 km(口径 500 mm)

注) ただし、下水管渠については、その後、技術的検討の結果、口径 300 mm で圧送管にて整備することとした。

1.4. ソフトコンポーネントの必要性

プノンペン都において、下水処理場を用いた汚水対策を実施するのは初めての経験であり、下水処理場の運転・維持管理経験を有する職員はいないことから、本プロジェクトで建設する下水処理場の持続的かつ効率的に運営されることを担保するため、本プロジェクトの実施を機に、それらの職員の養成、能力強化を実施する必要がある。ソフトコンポーネントは、「運転・維持管理能力強化」及び「財務計画策定支援」の 2 分野に大別して実施する。

【下水処理場の運転・維持管理能力強化】

プノンペン都では下水処理場の運転・維持管理に携わった経験がないため、下水処理施設の運転・維持管理の各作業について技術移転するとともに、下水処理場運営の全般を管理できる能力の強化が必要である。

運転・維持管理作業の技術移転としては、具体的には、各施設(汚水処理施設、汚泥処理施設、管理棟、遮集施設)の点検・運転管理、汚泥処分、水質管理等の能力開発を行う。また、下水道事業運営全般の管理能力強化については、汚水処理・汚泥処理の原理や仕組みといった基礎知識、及び運営体制の構築や人材管理について指導する。こうした活動により DSO 職員が自立して下水処理場の運転・維持管理を行い、総合的な下水道事業の運営能力の育成を図ることが出来る。

【下水処理場運営に係る財務計画策定支援】

下水処理場は、電気代、薬品代、汚泥処分費用、設備の修繕/更新等、様々な費用が定常的にかかる施設であり、それらを賄う資金が確保されていない場合は、下水処理場の運転の継続が不可能となる。下水処理場の運転・維持管理費用を正確に把握し、それらを的確に調達するための、予算及び支出管理に係る技術移転を行う。合わせて移転された技術を元に上部組織に対する予算協議を実行できるよう、財務面に関する知見の蓄積

及び能力強化を行う。

下水処理場の運転・維持管理に必要な業務全体の概要、及びソフトコンポーネントの対象業務を、図 1.2 に示す。

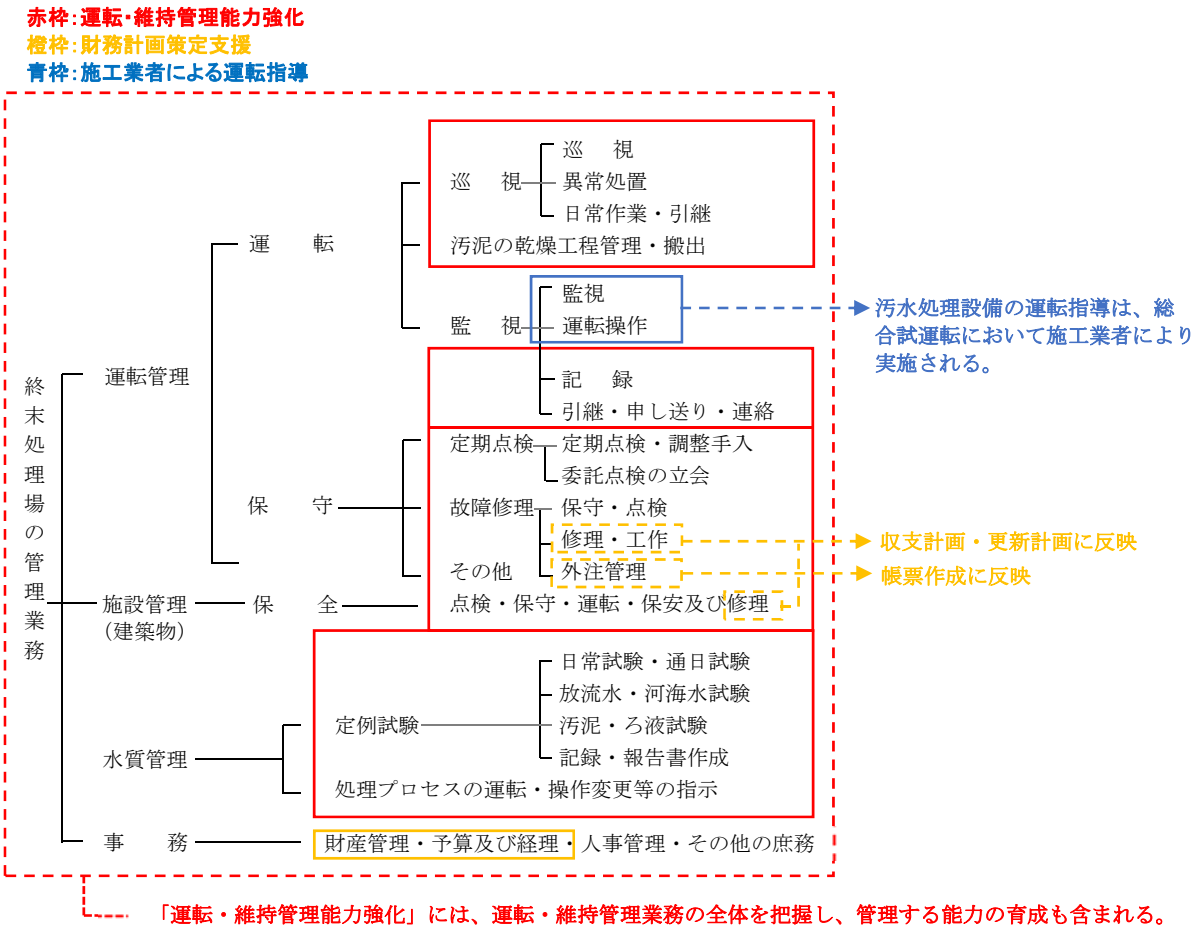


図 1.2　下水処理場の運転・維持管理に必要な業務全体と、ソフトコンポーネントの対象

1.5.　ソフトコンポーネントの実施対象者

1.5.1. 下水処理場の運転・維持管理能力強化

本プロジェクトで建設する下水処理場の運転・維持管理は、プノンペン都公共事業運輸局(Department of Public Works and Transport : DPWT)排水ポンプ場・下水処理場室(Drainage Pumping Station and Sewage Treatment Plant Office : DSO)が担当する。DSO の組織図を、職員数(正規職員数及び契約職員数の内訳)とともに添付資料(C)に示す。Sewarage Treatment Plant Team には 2 名の正規職員が所属しているが、現在、プノンペン都において下水処理場は稼働していないことから、その 2 名は既設のポンプ場及び排水路の維持管理並びに湖沼の管理に従事している。

このため、必要なスタッフはソフトコンポーネント開始前までに DPWT もしくは DSO により確保されている必要がある。本プロジェクトで建設する下水処理場の運転・維持管理に必要なスタッフの一覧を添付資料(d)に示す。このうち、技術移転及び能力開発を必要とする対象者は、管理責任者、機械/電気技術者及び水質管理技術者の計 4 名とする。

1.5.2. 下水処理場運営に係る財務計画策定支援

財務計画策定支援のソフトコンポーネント対象者は、DPWT の予算を管理する部局である Finance and Planning Office の職員 1 名と、DSO の Administration and Personnel Section の職員 1 名とし、財務計画策定に係る技術移転を行う。本プロジェクトにおいては、財務管理について適切な予算管理及び支出管理に必要とされる基礎的な知識・技術の習得を目指すものとする(公営企業会計に係る高度な知識・技術の移転は含めないものとする)。

主として、DSO の Administration and Personnel Section 職員に対しては、日常的な帳簿の管理や運転・維持管理経費の把握・分析に関する能力育成を、DPWT の Finance and Planning Office 職員に対しては、予算計画の立案及び予算協議に関する能力育成を図るものとする。

2. ソフトコンポーネントの目標

DPWT 及び DSO による継続的な下水処理場の運転・維持管理及び財務計画の策定支援により、将来的に達成されるべき状態は以下のとおりである。

- 下水処理場が毎年継続して持続的に運転・維持管理され、その汚水処理機能が発揮される。
- 下水処理場を毎年継続して持続的に運転・維持管理するための財務的な基盤が構築される。

3. ソフトコンポーネントの成果

3.1. 下水処理場の運転・維持管理能力強化

DSO の職員を対象にしたソフトコンポーネント実施により、対象者が下水処理場を計画的かつ持続的に運転・維持管理できるよう育成する。ソフトコンポーネント完了時に期待される効果は以下のとおりである。

- DSO が、汚水処理/汚泥処理・処分/水質管理を始めとする下水処理場の運転・維持管理技術・知見を習熟し、かつ処理場全般の運営に必要な管理能力を身につけることで、ソフトコンポーネント終了後も、自らが運転・維持管理計画を立案し、その計画に基づく運転・維持管理を実施できるようになる。

3.2. 下水処理場運営に係る財務計画策定支援

DSO の職員及び DPWT の Finance and Planning Office 職員を対象にしたソフトコンポーネント実施により、対象者が下水処理場運営に係る財務計画を策定できるよう育成される。ソフトコンポーネント完了時に期待される効果は以下のとおりである。

- DSO が、持続的な下水処理場の運転・維持管理を行うため必要な収支の把握・記録を含めた財務管理の知見・能力を習熟し、運転・維持管理に係る収支報告書を策定できるようになる。また設備更新費を分析して財務計画に反映し、下水処理場の継続的な運転・維持管理を実施できるようになる。

4. 成果達成度の確認方法

ソフトコンポーネント終了時前に、上記成果の達成度を確認する方法として次表の項目が挙げられる。

表 4.1　　成果達成度の確認方法

項目	確認事項	確認方法
下水処理場の運転・維持管理能力強化	下水道事業の管理者として必要な水質管理及び汚泥処分項目等を含む、下水処理場の運転・維持管理能力が確立されているか。	● 下水処理場の施設点検、汚泥処分、水質管理の各マニュアル及び維持管理計画案が作成されている。また各マニュアル及び同計画案に基づき、汚泥処理、水質管理、管理項目について習熟度テストを実施。
	汚水処理の仕組みと原理を理解した上で施設の運転操作に習熟し、通常運転で想定されるトラブルに対し自ら解決にあたる能力が確立されているか。	● 汚水処理に関する基礎知識及び処理設備の操作について習熟度テストを実施。 ● (施工業者が行う)各機器の一般的な操作に加えて、水質条件の違いやトラブル発生時等種々のケースに応じた運転操作や、水質分析結果/汚泥性状等の運転操作へのフィードバックも含めた、「運転管理マニュアル(最終版)」が作成されている。なお、「運転管理マニュアル(最終版)は施工業者が作成する「運転管理マニュアル」に上記の点を加えたものとする。
	下水処理場の運転・維持管理を継続的に行われるための組織体制が確立されているか。	● 添付資料(d)に示す人員体制が構築されていることを確認する。
下水処理場運営に係る財務計画策定支援	下水処理場の財務管理にあたり基本となる会計帳票の作成・運用能力が確立されているか。	● 下水処理場会計帳票フォーマットが作成されている。 ● 帳票入力に係る習熟度テストを実施。
	下水処理場の収支計画及び更新計画にかかる各種書類が作成され、同書類等を元に予算計画について説明ができるか。	● 下水処理場年次収支計画書及び更新予算計画書が作成されている。 ● 予算計画が DSO 職員の手により DPWT の予算関連部局に説明される(協議資料により確認)。

5. ソフトコンポーネントの活動(投入計画)

DSO に日本のコンサルタント 2 名(運転・維持管理能力強化及び財務計画策定支援)を派遣する。運転・維持管理能力強化担当のコンサルタントは、計画的かつ持続的な下水処理場

の運転・維持管理に関する能力強化を行う。一方、財務計画策定支援担当のコンサルタントは、運転・維持管理能力強化担当と協力して、下水処理場の財務計画に関する支援を行う。

5.1. 下水処理場の運転・維持管理強化

日本人コンサルタント(運転・維持管理能力強化)を 1 名派遣する。当コンサルタントは、下水処理場の運転・維持管理に精通し、対象者である Sewarage Treatment Plant Team の管理責任者、機械/電気技術者及び水質管理技術者に対して技術移転を行うことができる高度な知識・技術を有する必要がある。また、左記知識・技術に加えて DSO の作業監理を含む運転・維持管理全体を総括できる人材である必要がある。

また、日本人コンサルタント(運転・維持管理能力強化)は、汚水処理の原理や仕組みについて教育を行った上で、汚泥処分や水質管理も含めた広範な維持管理活動について技術移転を行う。技術移転成果を踏まえ DSO と十分協議を重ねた上で、安全管理と環境配慮を考慮した下水処理場の維持管理計画(年間･月間)の策定支援を行い、同計画に基づく継続的な運転・維持管理が行われるような組織体制が構築されているか確認する。また、運転・維持管理活動により得られた情報(水質分析結果や汚泥性状の変化など)の運転操作へのフィードバックを含めた、運転管理マニュアル(最終版)を作成する。

5.2. 下水処理場運営に係る財務計画策定支援

日本人コンサルタント(財務計画策定支援)を 1 名派遣する。財務計画策定支援のコンサルタントは、本無償資金協力事業によって建設される下水処理場を円滑かつ持続的に運転・維持管理するために必要な財務計画策定に係る支援を行うことが可能な、専門的知識・技術を有する人材が必要である。

また、日本人コンサルタント(財務計画策定支援)は、DSO の Administration and Personnel Section 職員に対し、下水処理場会計帳票フォーマットの作成を指導するとともに下水処理場の運転に必要な日常的なコストについて把握・分析する能力の育成を図る。また DPWT の Finance and Planning Office 職員に対しては、年次収支計画書(案)及び設備更新計画(案)の立案について指導を行う。同時に、下水処理場の運転・維持管理作業を計画的に毎年継続して実施できるよう、プノンペン都に対する予算の割当てと執行の働きかけを支援する。但し、持続的な下水処理場の運営には互いに各々の業務内容を把握しておく必要があるため、原則として全日程 2 名(DSO の Administration and Personnel Section 職員、DPWT の Finance and Planning Office 職員)ともに対象とする。

5.3. ソフトコンポーネントの投入計画

上記の支援に係る作業の詳細内容は下記のとおりであり、必要とする期間は、「運転・維持管理能力強化」に 2.53 人月、「財務計画策定支援」に 1.34 人月の合計 3.87 人月とする。

(1) 下水処理場の運転・維持管理能力強化：2.53 人月

以下の作業方針に基づき、現地に 3 回派遣し定期的な能力強化を行う。さらに、事

業完了時にはソフトコンポーネントの総括を行う。派遣期間を通じて作業監理を行い、現地着任時と帰国前には JICA カンボジア事務所に報告するものとする。

主な作業方針

- 第 1 期：DSO を含む DPWT 関係者と事業の全体計画について説明・協議を行う。下水処理場の原理や仕組み等の基礎知識について講義を行った上で、建設中の施設を巡りながら講義内容と実施設の関係性について説明し、本施設に対する理解度を深める。また、運転・維持管理の作業内容/分担リストの作成方針を指導した上で、DSO 職員が作成する作業内容/分担リスト案をベースに必要な組織体制が構築されているかどうか確認し、人員配置が不十分であれば運転開始までに配置を完了させる方策について関係機関と協議を行う。

- 第 2 期：実負荷をかけて試運転中の施設を利用しながら(施工業者が行う一般的な機器の操作指導以外の)運転・維持管理作業に係る実地技術移転を行う。技術移転内容は水質管理、汚泥処分等の専門事項の他、日誌・日報の付け方、場内巡視や作業員管理なども含まれる。これらの技術移転成果を踏まえ維持管理計画(案)を DSO 職員の手により作成する。その他に各機器納入メーカーの個別の操作マニュアルに加えて、水質条件が異なる汚水の流入、放流水質の基準超過や汚泥性状の異常等への対応も含めた「運転管理マニュアル(最終版(案))」を作成し、供用開始後に DSO 職員が自立して運転を実施できるよう準備する。

- 第 3 期：供用開始後、約半年に渡る運転・維持管理の実施状況をレビューし課題を分析したうえで、DSO 職員とともに課題解決の方策を図る。また、(第 2 期は雨季に実施されるため)初めての乾期における運転状況についてデータを収集し、気候条件に応じた運転方法に対する理解を深め、「維持管理計画」及び「運転管理マニュアル(最終版)」を完成させる。

以下に、「運転・維持管理能力強化」要員の現地活動詳細計画を示す。

「運転・維持管理能力強化」要員の現地活動日程の詳細計画（1/2）

日	曜日	第1期	第2期	第3期
1	日	移動:日本からカンボジア		
2	月	・DPWT本部およびDSO管理職とソフトコンポーネントの計画内容を説明・協議(第1期)、2期目以降は各活動内容の説明・協議 ・JICAカンボジアへ着任報告、活動内容説明		
3	火	・配布資料準備（日程表、簡易テキスト、業者との協議レジュメ等） ・DSO職員にソフトコンポーネントの実施事項を説明	配布資料準備（実地作業実施のチェックリスト、業者との協議レジュメ等）、DSO職員に活動内容と目標を説明	配布資料準備（データ分析フォーム・比較資料、協議レジュメ等）、DSO職員に活動内容と目標を説明
4	水	汚水処理の仕組みおよび維持管理の基礎（原理・目的）に係る講義	維持管理の作業項目/分担に係る実地指導（巡視、日報／日誌、人材管理等）	乾期における運転での水質データ採取、分析準備
5	木	下水処理場の維持管理項目/内容/分担リストの作成指導	維持管理の作業項目/分担に係る実地指導（汚水処理の仕組み、維持管理の原理・目的）	第2期以降6か月間の運転データ（汚泥発生量・電力消費）整理・分析
6	金	DSO職員で作成した維持管理に掛かるリスト案を確認、理解が十分でない箇所のフォローアップ	同上	第2期以降6か月間の維持管理状況のDSO職員へのヒアリング、データ分析
7	土	休日		
8	日	休日		
9	月	リスト案に基づき、維持管理に必要な体制・人材が確保されているかDSO職員とともにレビュー	維持管理の作業項目/分担に係る実地指導（水質管理：採水作業、サンプル取扱い等）	汚泥処分に関する再指導（立上げ初期の第2期とは汚泥量/性状が大幅に異なる可能性がある）
10	火	不十分な人材があれば、第2期の実施までに配置する方策を協議	維持管理の作業項目/分担に係る実地指導（水質管理：室内分析、外部委託項目の確認・委託先訪問）	同上
11	水	施工業者を交え、第2期の活動日程と総合試運転の工程について協議・調整	維持管理の作業項目/分担に係る実地指導（汚泥処分：処分先の管轄機関訪問、手続き確認）	前週の分析を踏まえ、DSO職員と共に継続的な維持管理における課題を抽出、解決方針を検討
12	木	建設中の施設を巡りながら汚水処理設備の原理・操作概念を説明し、汚水処理施設の運転に対する理解度を深める。	維持管理の作業項目/分担に係る実地指導（汚泥処分：投入作業の実践、乾燥管理・搬出作業の確認・技術移転）	上記に基づき、解決に向けてのアクションを実施（例：汚泥処分先との協議、水質分析の外部委託機関との協議等）
13	金	建設中の施設を巡りながら水質試験の採取箇所・方法、汚泥処分の流れを説明し、維持管理作業に対する理解度を深める。	維持管理の実地指導に関する習熟度テスト実施	
14	土	休日		

「運転・維持管理能力強化」要員の現地活動日程の詳細計画（2/2）

日	曜日	第1期	第2期	第3期
15	日	休日		
16	月	汚水処理の運転内容、および維持管理作業の内容について理解が十分でない箇所のフォローアップ	様々な運転ケースを想定し、DSO職員の手でトラブルシューティングの実践	乾期における水質分析結果を回収し、運転操作へのフィードバック方案を最終化
17	火	DPWT本部およびDSO管理職への活動報告、必要スタッフの確実な確保についてフォローアップ	上記ケーススタディ結果等より業者作成のマニュアルでカバーされない各種ノウハウを整理し、運転管理マニュアル（案）を作成	水質の違いに応じた運転・維持管理に対する習熟度テスト実施、理解が十分でない箇所のフォローアップ
18	水	指導内容（基礎知識、体制と分担、維持管理の実施準備）の分析および第2期活動への課題整理	運転実施能力について習熟度テストの実施、理解が十分でない箇所の抽出	上記結果を踏まえ、運転管理マニュアル（最終版）を作成
19	木	JICAカンボジア事務所へ報告、移動：カンボジア発	総合試運転での汚泥発生量、電力消費等の実績について、維持管理計画立案のために整理・分析	保守作業、簡易な修理における現地調達材料を整理、ベンダーへヒアリング
20	金	日本着	下水処理場の運転維持管理の計画立案に係る技術移転	上記の流通状況確認結果を踏まえ、調達先・仕様を整理
21	土	-	休日	休日
22	日	-	休日	休日
23	月	-	下水処理場の運転維持管理の計画立案に係る技術移転	DSO職員による維持管理計画の最終化を支援
24	火	-	「財務計画策定支援」担当へ経費に関わる事項（運転・維持管理における作業項目、試運転における電力消費、汚泥処分費等）について引き継ぎ	運転管理マニュアル（最終版）および維持管理計画の製本、関係部署への配布・説明、データ管理・更新体制の確認
25	水	-	DSO職員が作成した維持管理計画案を確認、理解が十分でない箇所のフォローアップ	ソフトコンポーネント実施報告書作成
26	木	-	DPWT本部およびDSO管理職への報告・協議、技術移転内容の分析および第3期活動への課題整理	・報告書作成続き ・DPWT本部およびDSO管理職への報告・協議
27	金	-	JICAカンボジア事務所へ報告、移動：カンボジア発	JICAカンボジア事務所へ報告、移動：カンボジア発
28	土	-	日本着	日本着

(2) 下水処理場運営に係る財務計画策定支援：1.34 人月

以下の作業方針に基づき、現地に 2 回派遣する。

主な作業方針

- 第 1 期：運転・維持管理における財務計画策定の重要性に係る講義・指導、会計帳票・収支計算書の作成指導を行う。実負荷による試運転実績(汚泥発生量、電力使用量)に基づく運転コストを整理分析し、収支計算書に反映する。
- 第 2 期：(第 1 期が雨季における運転であることに鑑み)乾期における運転にて汚泥処理費用や電力費用の増減を評価し、収支計算書にフィードバックする。会計帳票への入力が正しく継続的に行われているかどうか確認し、理解が不十分だと思われる箇所についてフォローアップを行う。また設備更新費を含めた下水処理場の維持管理及び更新計画の作成指導を行う。加えて、運転・維持管理計画の成果に基づき設定した必要予算について、プノンペン都に対する継続的な予算の割当てと執行の適切な働きかけ方について知見を移転する。

以下に、「財務計画策定支援」要員の現地活動詳細計画を示す。

「財務計画策定支援」要員の現地活動日程の詳細計画

日	曜日	第1期	第2期
1	日	移動:日本からカンボジア	
2	月	・DPWT本部およびDSO管理職とソフトコンポーネントの計画内容を説明・協議(第1期)、2期目は各活動内容の説明・協議 ・JICAカンボジアへ着任報告、活動内容説明	
3	火	・ソフコン対象者2名に対して活動内容と目標の説明 ・「下水処理場運転維持管理」担当より経費に関わる事項（運転維持管理計画における作業項目、試運転における電力消費、汚泥処分費等）について引き継ぎ	・ソフコン対象者2名に対して活動内容と目標の説明および第1期指導内容の復習・確認 ・「下水処理場運転維持管理」担当より乾期の運転状況（水質の変化による各経費への影響や、維持管理項目の変更）等について引き継ぎ
4	水	下水処理場運営の財務計画の基礎に係る指導	会計帳票への記入内容の分析・レビュー、理解が十分でない箇所のフォローアップ
5	木	財務計画の基礎に係る指導の続き、理解度確認・不明点のフォローアップ	乾期の運転結果に基づくコスト実績の整理・分析
6	金	下水処理場会計帳票フォーマットの作成指導	上記分析に基づいた年次収支計算書の修正
7	土	休日	
8	日	休日	
9	月	DSO職員で作成した帳票フォーマットを確認、フォローアップ	下水処理場年次収支計画書の最終化支援
10	火	下水処理場年次収支計算書作成指導	下水処理場更新計画の立案指導
11	水	DPWT職員で作成した年次収支計算書を確認、フォローアップ	DPWT職員で作成した下水処理場更新計画を確認、最終化支援
12	木	総合試運転におけるコスト実績の整理・分析について指導	同上
13	金	上記分析に基づいた年次収支計算書の修正について指導	活動結果整理分析（習熟度テストの実施を含む）
14	土	休日	
15	日	休日	
16	月	習熟度テストの実施、理解が不十分と思われる箇所のフォローアップ	ソフコン対象者2名による、プノンペン都に対する維持管理計画の説明・予算協議の実施支援
17	火	収支計算書に基づき、今後想定される維持管理費用の見込みについてDPWT本部およびDSO管理職へ報告・協議	・前日の協議結果を踏まえ、今後の予算協議実施に向けたフィードバック ・報告書作成
18	水	前日の協議結果に基づき、ソフコン対象者2名とともに収支計算書の見直しの必要性について検討。	報告書作成続き
19	木	・活動結果分析および次回活動への課題整理 ・JICAカンボジア事務所へ報告、移動：カンボジア発	・DPWT本部およびDSO管理職への報告 ・JICAカンボジア事務所へ報告、移動：カンボジア発
20	金	日本着	日本着
21	土	-	-
22	日	-	-

次表に投入計画をまとめる。

担当	月数									人/月	
	1	2	3	4	5	6	7	8	9	現地	国内
運転・維持管理能力強化	0.67		0.93						0.93	2.53	0.00
財務計画策定支援				0.67					0.67	1.34	0.00
合計										3.87	0.00

図 5-1　　ソフトコンポーネントの投入計画

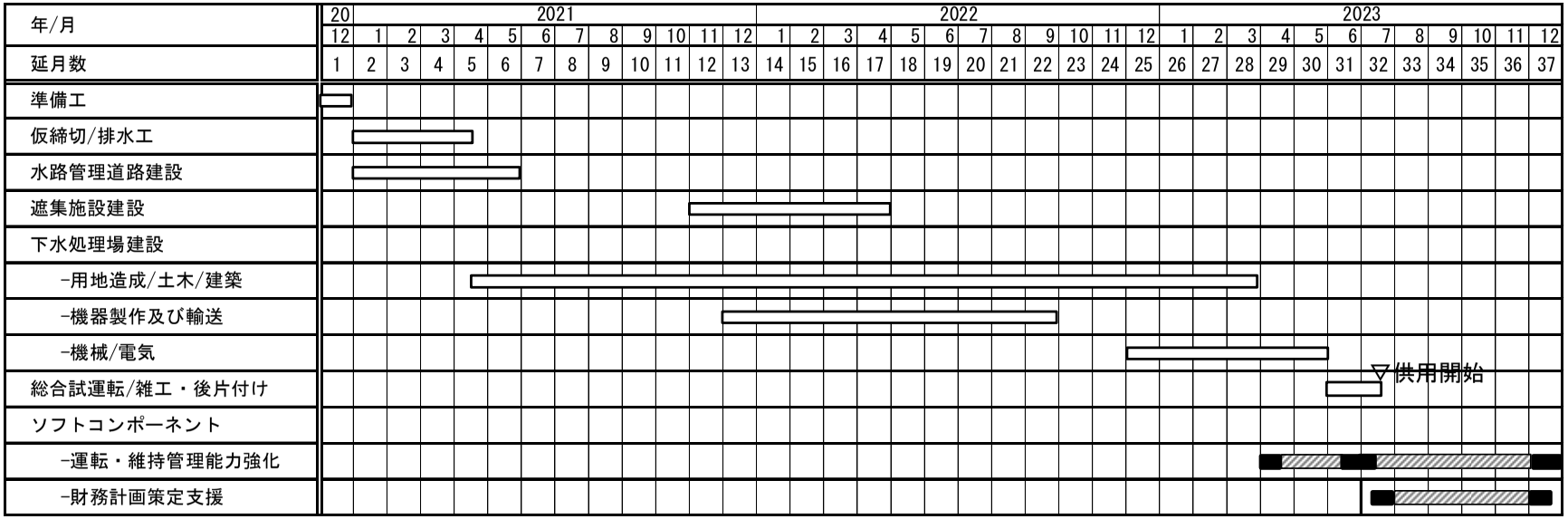
6. ソフトコンポーネントの実施リソースの調達方法

ソフトコンポーネント実施リソースは、以下の理由により本邦コンサルタントによる直接支援型で行う。

- プノンペン都では、下水処理場を用いた汚水対策は初めての試みであり、都市の排水施設を系統立てて管理する経験に乏しく、計画的・長期的視野に立って計画立案や運営管理能力の強化策を講じる人材に欠ける。
- 計画に基づき作業の進捗を厳しく管理できる技術者が不足している。
- 建設される下水処理場にて導入される水処理方式(前ろ過散水ろ床法)は、日本独自の技術であり、本技術に係る知見及び経験が必要とされる。

7. ソフトコンポーネントの実施工程

ソフトコンポーネントの全体実施工程の案は以下のとおりである。



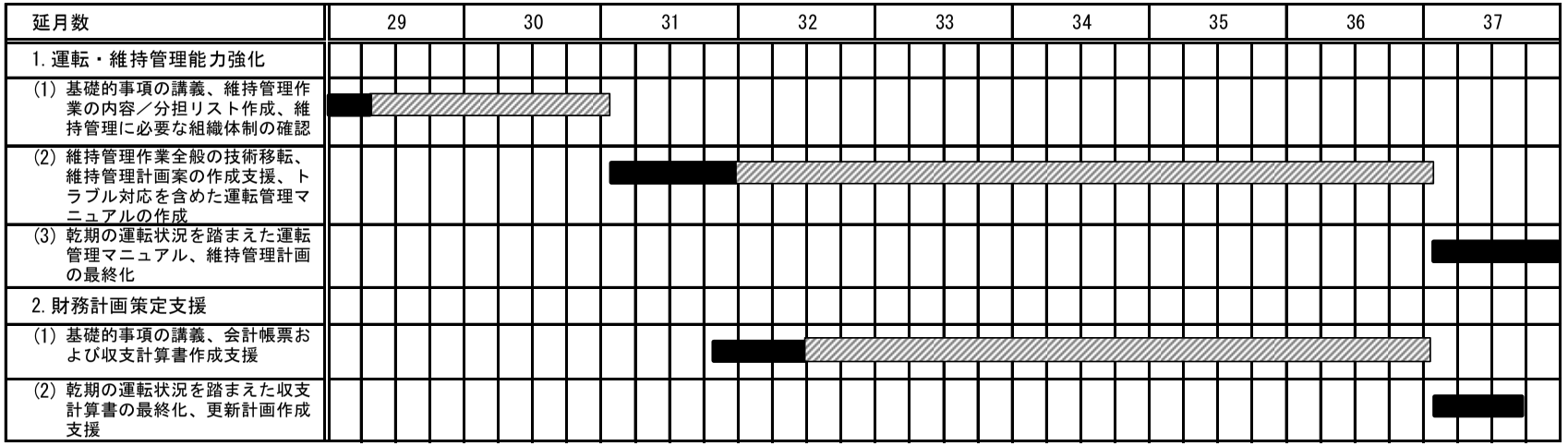


図 7.1　ソフトコンポーネント実施工程案

8. ソフトコンポーネントの成果品

ソフトコンポーネント業務の成果品は以下に示すとおりである。

- 維持管理計画(施設点検・水質管理・汚泥処理の各作業に係るマニュアル及び各作業の月間/年間実施スケジュール、実施体制、作業分担が示されている)
- 運転管理マニュアル(最終版) (各機器の操作に加えて、水質基準の超過や汚泥性状の異常等に対する水処理プロセスへのフィードバックも含めて整理する)
- 習熟度テスト結果(基礎知識、運転操作、各維持管理作業)
- 下水処理場会計帳票フォーマット、及び入力作業の習熟度テスト結果
- 下水処理場年次収支計画書
- 下水処理場更新計画
- 下水処理場の予算確保に関する協議資料
- 上記の成果をとりまとめたソフトコンポーネント完了報告書

9. ソフトコンポーネントの概略事業費

ソフトコンポーネントの概算事業費は下表の通りである。

表 9.1　　ソフトコンポーネントの概算事業費

項目	金額(千円)
直接人件費	3,358
直接経費	3,448
間接費(諸経費、技術経費)	6,985
合　計	13,791

為替レート：1US ドル =111.84 円

10. 相手国側の責務

ソフトコンポーネントの実施に関するカンボジア側の責務は以下の通りである。

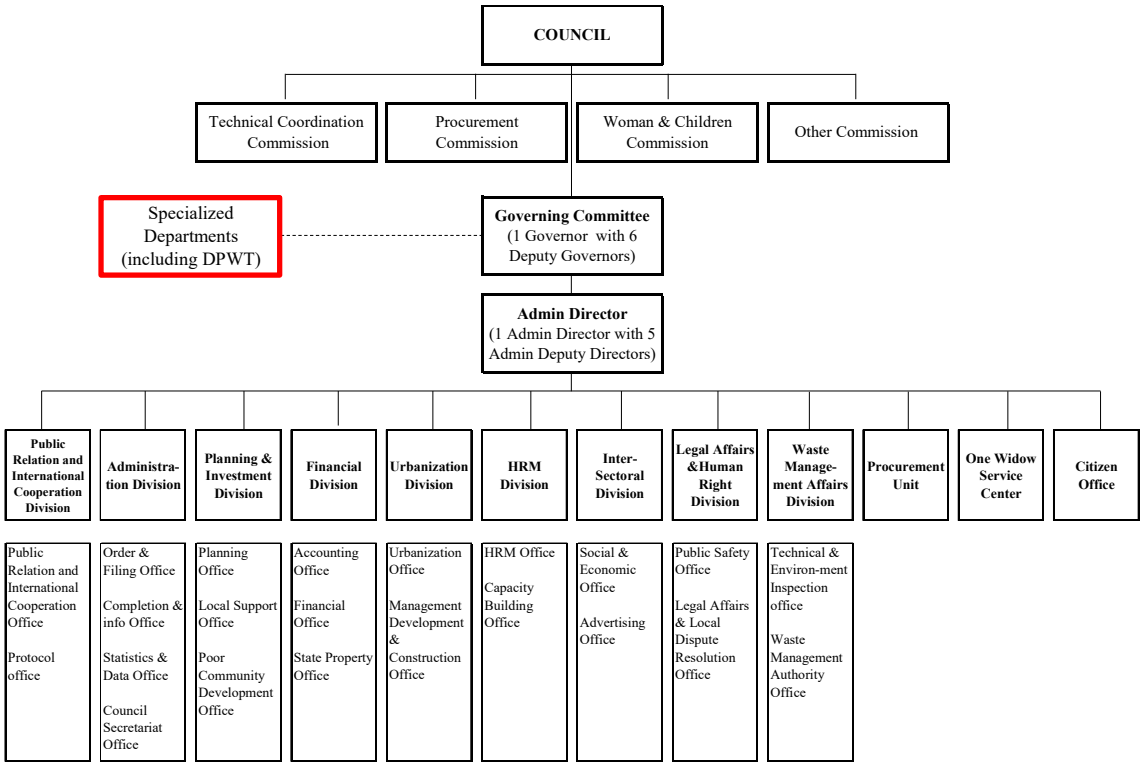
- 適切な計画立案：
  DSO はソフトコンポーネントの実施により取得した知識を利用して、妥当な下水処理場の運転・維持管理計画を継続的に立案する。また DPWT は、同 Finance and Planning Office が立案する財務計画に基づき、適切な予算割当て・執行のために協力する。
- 適切な予算の確保：
  プノンペン都は計画作業量と整合性を確保できる予算額を割当て、執行する。計画作業量と作業実績、費用実績の確認は DSO の上位機関である DPWT が行う。

- 人員配置：
  次世代を担う人材として若年層の職員を定期的、かつ継続的に雇用する。この人材には、下水処理場の運営・維持管理に携わる、土木技術者、機械/電気技術者に加えて、将来的には、下水処理場内部において水質検査を実施することも念頭に、水質管理に係る技術者も含むものとする。

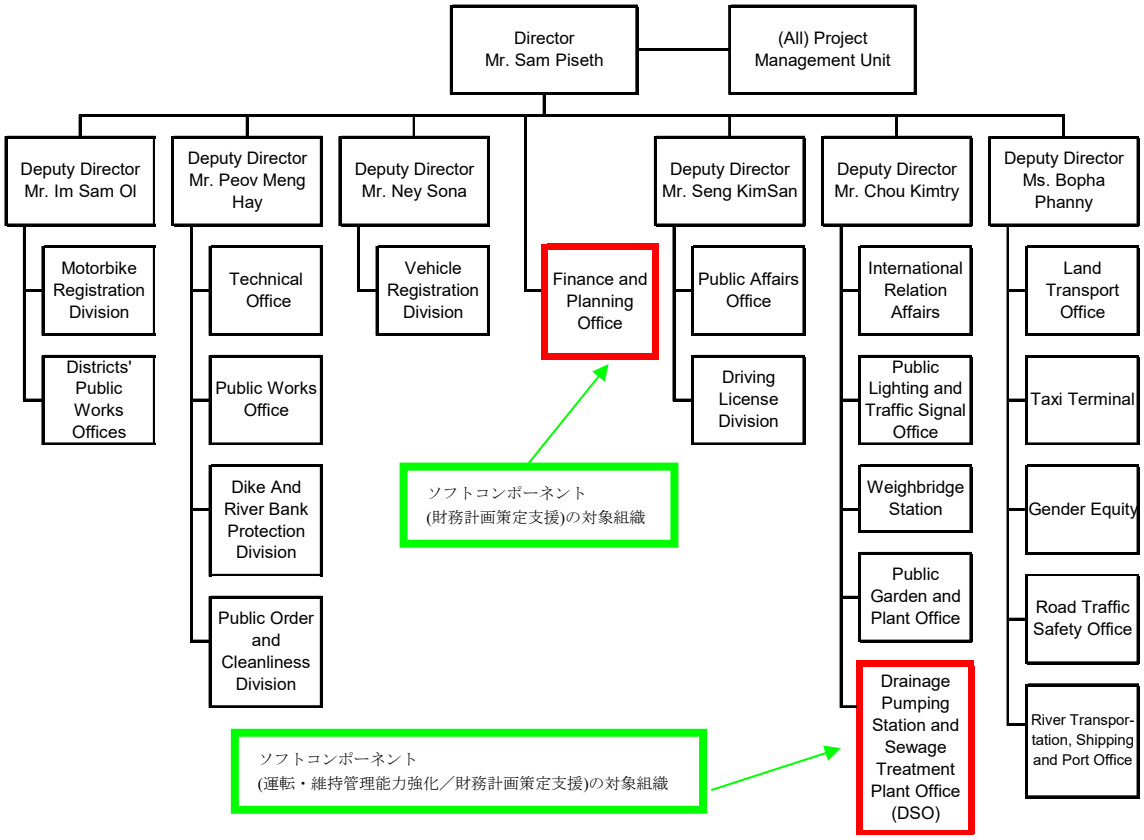
- Supervisor(Trainer)の育成及び能力強化：
  DSO の職員の異動等が生じた場合でも、確実に下水処理場の運転・維持管理に関する技能を継承できるよう、運転・維持管理作業を現場で指揮する Supervisor を育成し、その技術力を維持する。

- 継続的な活動の実施及び報告・監理体制の構築：
  ソフトコンポーネント期間の終了後も、DSO が持続的に運転・維持管理計画の立案や、活動記録の作成/更新を実施するよう、DSO から DPWT への定期的かつ自律的な作業実施報告体制、DPWT による監理体制を構築する。

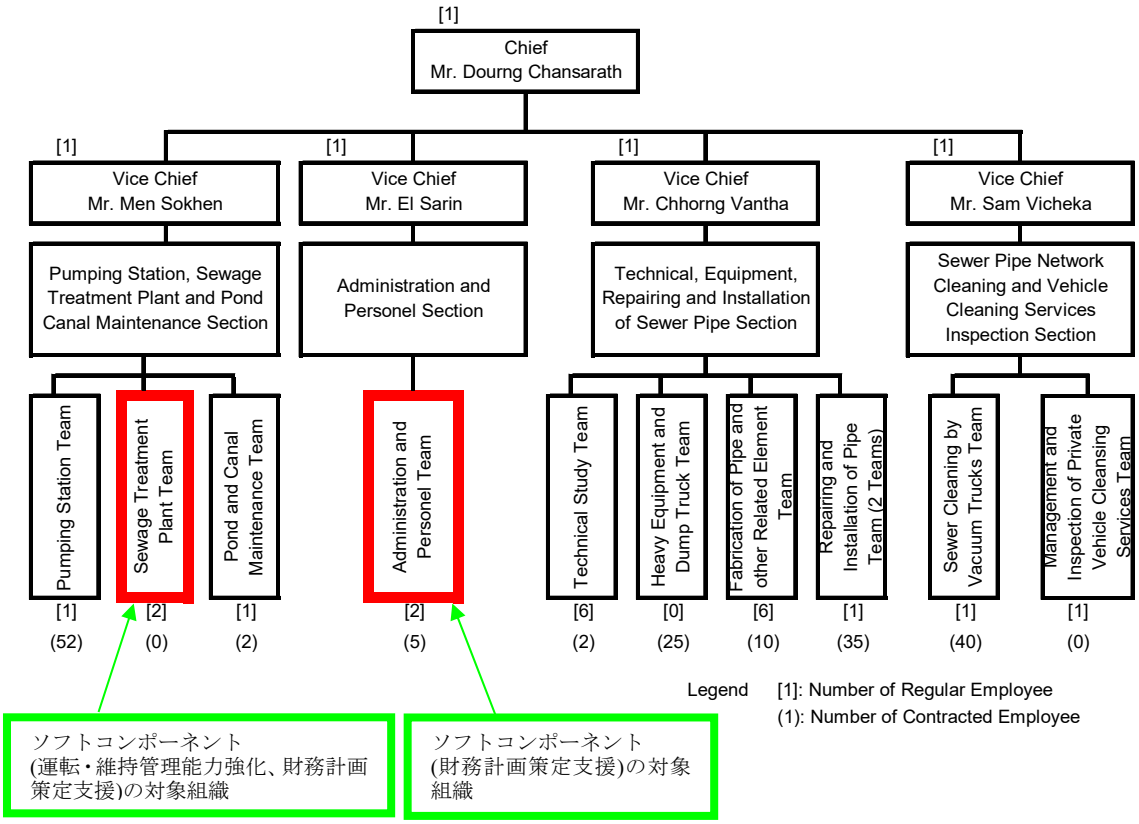
添付資料



(a) プノンペン都の組織図と DPWT の位置づけ



(b) DPWT の組織図(ソフトコンポーネント対象組織を赤枠で表示)



(c) 排水ポンプ場・下水処理場室(DSO)の組織図(ソフトコンポーネント対象組織を赤枠で表示)

職種	人数	職務
管理責任者	1	施設管理者
機械/電気技術者	2	汚水処理施設ほか機械電気設備の運転管理
水質管理技術者	1	サンプリング及び水質分析
事務員	1	庶務、広報(見学者の案内等)
作業員(水処理施設)	2	スカムの除去、施設清掃
作業員(汚泥処理施設)	4	汚泥積み込み作業、施設清掃
合計	11	

ソフトコンポーネント
(運転・維持管理能力強化)
における技術移転の対象者

(d) 本施設の維持管理に必要な Sewage Treatment Plant Team のスタッフ構成
(ソフトコンポーネント対象者を赤枠で表示)

6. 参考資料

6.1 JICA ガイドラインとカンボジアの環境関連法令の比較

項目	JICA ガイドライン(対象プロジェクトに求められる環境社会配慮)	カンボジアの環境法制度	現行プロジェクトで必要な対応
1. 基本的事項	1.影響の回避・最小化をプロジェクト計画に反映する早期からの調査・検討。 2. 経済的、財務的、制度的、社会的及び技術的分析との調和がとれた定量的、定性的な評価。 3.重大な影響については、環境影響評価報告書での代替案や緩和策の提案。 4.重大な影響については、必要に応じ、専門家等からなる委員会を設置。	環境保全及び天然資源管理法(1996)の 3 章では、以下が規定されている。 公共、民間の全ての事業ならびに活動には環境影響評価を実施しなければならない、また環境省によって承認され王国政府に提出されなければない。 環境影響評価が必要な性質、規模については別途環境省の提案する副法令において定義される。	特に大きなかい離はない。
2. 対策の検討	1.影響の回避、最小化、緩和のための複数の代替案を検討。 2.環境管理計画、モニタリング計画など適切なフォローアップの計画や体制の構築。	環境保全及び天然資源管理法(1996)、環境影響評価の手続きに関する副法令(1999)及び IEIA/EIA 報告書の策定に関する一般的なガイドラインについての規程(2009)には、代替案については特に記述されてない。 IEIA/EIA 報告書の策定に関する一般的なガイドラインについての規程(2009)附表 1 の 7 章は、予算、組織体制、実施方法とモニタリングスケジュールを環境管理計画の記述の中で含んでいる。	調査の概要については、両ポリシーにおいて類似しているが、マスタープラン及び優先プロジェクトの検討において代替案を提供する必要がある。
3. 検討する影響のスコープ	1.人間の健康と安全への影響及び自然環境への影響ならびに社会的影響を含む影響の調査・検討。 2.派生的・二次的な影響、累積的影響、不可分一体の事業の影響も含む調査・検討。	JICA ガイドラインにおいて提起されている人間の健康と安全への影響及び自然環境への影響に対する配慮についてはカンボジアの制度の中でも一般的にカバーされている。 IEIA/EIA の実施ガイドライン通達の附表 1 では、報告書に必要な情報が規定されており、それらは； 物理的資源；土壌、気象、大気質、水理 生物学的資源；森林、動物種、希少種、絶滅危惧種、渡り、生息地、生物多様性、生態系、湿地系、 社会‐経済資源；人口統計、居住地、経済的状況、土地利用、水利用、電気利用、インフラシステム、教育、公共保健、文化遺産、歴史建造物、古刹、仏塔、習慣/伝統、少数民族、先住民族、観光地 事業と不可分で派生的、2 次的、累積的な影響の評価について特に記述はない。	特に大きなかい離はない。環境調査の内容や時期等の原則的な考え方は JICA 環境ガイドラインに合致した形でカバーされているものの、SEA の適用については特にカンボジアの法令において記述がない。
4. 法令、基準、計画等との整合	1.当該国の環境社会配慮に関する法令、基準、政策、計画等の順守。 2.自然保護や文化遺産保護のために特に指定した地域の外での	保護区法(2008)において、すべての種類の公共インフラ建設のための保護区内、コアゾーンや保全ゾーンでの伐開、整地は厳重に禁止する(36 条)となっている。	特に大きなかい離はない。

項目	JICA ガイドライン(対象プロジェクトに求められる環境社会配慮)	カンボジアの環境法制度	現行プロジェクトで必要な対応
	事業実施。	これらの行為は、持続可能な利用ゾーンまたはコミュニティーゾーンに限られ環境省の依頼によりカンボジア政府の承認を受けたもののみ可能となる(36 条) また、44 条では、環境への負の影響を最小限に抑えるため、保護区域の管理目的を達成するため、環境社会影響評価が保護区域また保護区域界に隣接地における、すべての提案、開発投資に求められる。環境社会配慮影響評価の手続きは環境社会配慮影響評価関連規定の手続きの順守が求められている。	
5. 社会的合意	1.社会的に適切な方法での適切な調整。重大な影響の場合、早期の段階で情報公開の上でステークホルダーとの協議を経て、プロジェクト計画に反映。 2.社会的な弱者についての配慮。	住民参加は、IEIA/EIA 報告書の策定に関する一般的なガイドラインについての規程(2009)の附表 1 における EIA 報告書の重要項目のひとつとされている。	特に大きなかい離はない。
6. 生態系及び生物相	1.重要な自然生息地または重要な森林の著しい転換または著しい劣化の回避。 2.森林の違法伐採の回避。	生物学的特質は、IEIA/EIA 実施のためのガイドライン通達の附表 1 の 4.1.2 生物学的資源(森林;森林地域、樹種、森林型、動物種、希少種、絶滅危惧種、渡り、生息地、生物多様性、生態系、湿地)において記述されている。	特に大きなかい離はない。
7. 非自発的住民移転	1.非自発的住民移転の回避、最小化。 2.適切な時期に与えられる十分な補償及び支援。 3. 苦情に対する処理メカニズムが整備され、影響を受ける人々やコミュニティの適切な参加による住民移転計画の立案、実施、モニタリング。 4.大規模非自発的住民移転が発生する際の、影響を受ける人々が理解できる手法による住民移転計画の事前公開(世界銀行のセーフガードポリシーの OP4.12 Annex A に準拠)。	環境保護・天然資源管理に関する法律(1996)、環境影響評価の手続きに関する政令(1999)、IEIA/EIA 報告書の策定に関する一般的なガイドラインについての規程(2009)等の EIA 関連法令では特に住民移転の回避、最小化は記述されていない。しかしながら、当該国における住民移転や用地取得の手続きは強化されるために充実がはかられている。影響の最小化は一般的に公共のプロジェクト、特に国際的ドナーが資金源となる場合は考慮されている。	特に大きなかい離はない。しかしながら、カンボジアにおける居住環境は、特に土地所有/利用に関して、複雑である。
8. 先住民族	1.プロジェクトが先住民族に及ぼす影響の回避と最小化。 2.先住民族の諸権利が尊重と、十分な情報提供による自由な事前の協議を通じた合意。 3. 当該先住民族が理解できる手法による先住民族計画として先住民族のための対策(世界銀行のセーフガードポリシーの OP4.10 Annex B に準拠)。	コミュニティによる用地取得は土地法において記述されている。 また、IEIA/EIA 実施ガイドラインにおいて、先住民族の状況は“習慣/伝統、少数民族または先住民族”として IEIA/EIA 報告書の策定に関する一般的なガイドラインについての規程(2009)の Prakas (布告)、附表 1 において含まれなければならない。2018 年 2 月付副法令 No. 22 ANK/BK においても、先住民族計画について網羅されている。	特に大きなかい離はない。しかしながら、カンボジアにおける居住環境は、特に土地所有/利用に関して、複雑である。
9. モニタリング	1.事前に計画された緩和策、予測が困難であった事態の有無の適切なモニタリング。	関連法令及び IESA に参照される副法令では特にモニタリング実施や住民参加の詳細についての記述	特に大きなかい離はない。モニタリング活動のための適切な提案をす

項目	JICA ガイドライン(対象プロジェクトに求められる環境社会配慮)	カンボジアの環境法制度	現行プロジェクトで必要な対応
	2.実行可能性のあるモニタリング計画を含むプロジェクト計画策定。 3.現地ステークホルダーを配慮したモニタリング手続き。 4.ステークホルダーの十分な参加による公開での協議・検討機会を通じた問題解決。	はない。しかし、2018 年 2 月付副法令 No. 22 ANK/BK において、住民移転計画の実施におけるモニタリング(内部及び外部)手続きが示されている。 モニタリング計画は、IEIA/EIA 報告書の策定に関する一般的なガイドラインについての規程(2009)の附表 1 において環境管理計画に含まれるべき事項となっている。 *注:* ESIA 報告は、影響を受ける世帯、資産、森林を含む本プロジェクトの住民移転計画から、住民移転政策及び苦情処理を除外したものである。	る。

6.2 公聴会の結果

No	ステークホルダー	コメント	*提案*	解決策
1	プノンペン都	● このプロジェクトは、日本の技術を使ってプノンペン都 Chueng Aek 湖の環境改善、や福祉増進が可能である。また、シェムリアップやシアヌークビルと異なり、プノンペンには下水処理場がない。 ● 総事業費は、 35-38 百万 USD 程度になろう。 ● 用地は、国有地であり、副法令 124, 2008 年に規定されている 520 ha の Cheung Aek 湖内である。都は、現在、19 ha の移管手続きを進めている。 ● 移管手続きを進めているところであるが、都はもし、土地所有者からの苦情がでれば解決する予定である。この解決は都の責務であり、その経験も有している。 ● 都は、環境社会配慮調査チームに調査許可を出した。	● *土壌侵食がないようコンクリートブロックでかためる。* ● *この処理システムは、医療で使用される抗生物質にも対処すべき。* ● *本プロジェクトは、2019 年 7 月には開始されるだろう。* ● *この湖は、副法令上は国有地である。したがい、その所有は違法となる。* ● *JICA ガイドラインに従い、速やかに建設を開始すべき。国家的にも関心が高い。* ● *水環境を改善し、水因性疾病を減らすことに貢献してほしい。*	● *JICA プロジェクトでは、築堤を行い、のり面のすべりを防止する芝を植える、コンクリートブロックで固める等の防護対策を行う予定。* ● *本プロジェクトは、日本の最新技術を使用しているので、有害物質も除去してくれるものと考えられる。* ● *本プロジェクトを極力早期に完成し、早く市民に開放すべき。* ● *都は、土地収用の問題を財務省と連携して解決する。* ● *EIA チームは注意深くかつ、計画どおりに調査を終わらせる。* ● *本プロジェクトは、カンボジア国の基準に従い施設を建設し、カンボジアの水質基準に従い処理を行う。*
2	関連機関	● 13 部局と 2 課で 100%本プロジェクトをサポートする。なぜなら、本プロジェクトは、都の発展に不可欠であり、下水処理場を用いた初の環境改善プロジェクトだからである。 ● 本プロジェクトは、特にサイト周辺の人々にとって便益のあるものである。 ● 都中心部及びその郊外ごみ収集は、CINTRI によって実施されている(週に 2 回)。ごみ収集車が故障すると、ごみ収集サービスに支障がでる(ごみが収集されず溜まる等)。 ● DOE は、本プロジェクトの実施で開水路が減り、人々が本プロジェクトをサポートすることを希望する。 ● パブリックアナウンスメントにより、都民がこのプロジェクトを理解することを望む。都民は、清	● *調査は適切に実施し、結果を開示することを希望する。* ● *建設工事の出来る限り早期の実施を望む。* ● *プロジェクトオーナーは、カンボジアにおける汚水処理技術関する人材育成を実施すべきである* ● *本プロジェクトでは、5000m3/日分の処理施設が建設されるが、これは、全体計画の 2%である。よって、早期の全施設建設をすべきである。* ● *将来、解決困難な問題を避けるため拡張エリアの用地も確保すべきである。* ● *開水路を蓋掛けすべきである。* ● *将来的な拡張のために、更なる用地取得を行わないでほしい。* ● *就業時間は月曜から金曜で 1 日 8 時間とすべきである。* ● *工事中に事故が起こったら、コントラクターが補償すべきである。*	● *EIA チームは、全ての利害関係者の、本プロジェクトに対する十分な理解を得るべく十分な調査をすべきである。* ● *プロジェクトオーナーは、極力プロジェクトの早期実現をはかり、市民に開放する予定である。* ● *本プロジェクトは、プロジェクトの持続性を担保するためのカンボジア人職員の訓練を含んでいる。* ● *都は、JICA と共同でプノンペン都を包括するマスタープランを策定した。しかし、予算不足が問題であり、処理場建設のための予算確保を試みる。* ● *政府は、2018 年 12 月 13 日付副法令 No 168 において、Cheung Aek 湖 の 19.0736 ha を本プロジェクトと将来的な拡張のために準備した。* ● *本プロジェクトは、処理場まで暗渠にて汚水管を埋設する計画である。*

No	ステークホルダー	コメント	*提案*	解決策
		潔で開水路がなくなることを望んでいる。 ● 本プロジェクトは汚泥処理も含んだ優れたものである。現在、どの業者もそのような処理をしていない。 ● 本プロジェクトは水質をよりよい状況に変えていく。 ● 本プロジェクトは、サイト周辺の生物多様性、魚類、人間、動物に便益を与える。 ● 本プロジェクトは、水資源への負の影響を軽減する。 ● 本プロジェクトは、下水処理場を建設する良いプロジェクトである。下水処理場の建設は都としても環境面での初めてのプロジェクトである。 ● 関係局は、本プロジェクトを円滑に実施するために全ての利害関係者と協力する。 ● Cheung Aek 湖と Trabek 湖エリアは、まだシステムに登録されていない。 ● 本プロジェクトは、深刻な影響を与えない。国有地を取得した場合も、本プロジェクトは国家プロジェクトであるため、問題はない。 ● 本プロジェクトは街の評判の向上に寄与する。 ● JICA による金銭的及び先進的技術のサポートを受ける事はカンボジアにとって誇るべき事である。 ● 本プロジェクトが水源に与える影響はない。建設が安全で適切である限り、想定されるのは利点のみである。 ● 本プロジェクト地域は、MOWRAM の下の副法令 124, 2008 年に規定されている 520 ha である。 ● 都における JICA のプロジェクトはすべて品質が高いものである事を感謝する。 ● 下水処理が基準を満たしている場合、街の景観を	● *作業者に不満があったり、雇用者が作業者を気に入らない場合、コントラクターまたは雇用者は、問題を確認するために合法的に当局に報告する。* ● *作業条件規定に記載されている作業の基準に従わなければならない。* ● *作業者は18 歳以上にしてほしい。* ● *適切な契約を結んでほしい。* ● *公休日や残業時間に作業することによる抗議活動を防いでほしい。* ● *コントラクターは、法律に従い、建設が始まる際には、労働職業訓練局に、作業者を登録してほしい。当省の契約(長期及び短期の)に従い、問題を解決してほしい。* ● *身体障がい者を差別しないでほしい。可能なら、彼らに適した仕事を提供してほしい。* ● *プロジェクトオーナーは、将来的に建設及び計画が行われるプロジェクト地域の政令の責任がある省と協議すべきである。* ● *すべての衛星都市は、排水及び下水道システムを備えるべきである。* ● *Flat,及びBorey は、小規模な処理システムを備えるべきである。* ● *新しい街には近代的なビルがあるが、排水及び下水道システムは古いままである。これからビルを建設するときには、街の景観や環境への影響を減らす為に、下水処理システムも併せて近代化してほしい。* ● *市民生活や生態系を向上させるためにシステムを拡張してほしい。* ● *政府、水や衛生に関連する省庁は、JICA のような共に本分野に取り組むパートナーを見つけるように努力してほしい。* ● *JICA 及びプロジェクト・パートナーは、職員や学生に技能訓練をしてほしい。* ● *都は、固液廃棄物の管理を向上させ、環境及び観光分野を強化してほしい。*	● *都とミンチェー区は、副法令 No 123 に規定された 520 ha への侵害を防止する。* ● *都と JICA は、カンボジアの労働法その他手続きを順守する。* ● *都と JICA は、カンボジアの労働法を順守する。とりわけ、労働・職業訓練省による労働関係規則や基準を順守する。* ● *本プロジェクトでは、障がい者を差別せず、適切な仕事に従事できるようにする。* ● *政府は、2018 年12 月13 日付副法令 No 168 、Cheung Aek 湖の 19.0736 ha を本プロジェクト及び将来の拡張用地として位置づける。* ● *都はMOE と協力し、下水処理管理に邁進し、 近郊都市、工場、過剰な汚水を排出する事業所等に下水処理場を設置させ、汚濁を削減する。* ● *都は、JICA と協力しマスタープランを策定したが、資金不足。* ● *本プロジェクトは、施設の維持管理技能を強化する訓練を行う。* ● *都は、MOE と協力し、プノンペン都が美しい観光都市になるように、廃棄物の管理に取り組む。* ● *都は、学生向け学習プログラムの開催を提案する。* ● *本プロジェクトは、人々への影響について検討する計画があり、これはカンボジア政府の責任の下に行われる。* ● *政府及び都は、プノンペン及びカンボジアの全地域の人々のための医療センターの建設に取り組んでいる。* ● *プノンペン都は、JICA と協力して、下水処理プロジェクトのマスタープランを作成した。しかし、資金不足であり、建設を行う資金の調達に取り組む予定である。* ● *プノンペン都及びJICA は、安全基準を遵守し、*

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		向上させ、観光客の集客に役立つ。 ● 本プロジェクトは、本地域の潜在指数を向上させ、その他の地域のモデルとなる。衛生的な都市による競争により、より良い地域となる。 ● 本プロジェクトは、街の景観に影響を与えない。 ● 本プロジェクトは、金銭的にも技術的にも将来的な目標となる。 ● 本プロジェクトは、健康及び生態における多くの影響を軽減する。 ● 本プロジェクトは、技術者や作業者に仕事を提供し、移住による人々の流出を減らす。 ● 本プロジェクトにおける処理容量は、Cheung Aek 湖に流入する都の全下水排出量より少ないため、この不均衡が懸念される。しかし、これがパイロットプロジェクトであることを考慮すると問題ではない。 ● 都において、特に Mean Chey 区 では、水系の疫病及び肺病は 2%、マラリアは 0.001%である。 ● 以前は、5 年サイクルで多くの伝染病が発生している。 ● 王政府は、ビタミンやワクチン、駆虫のような医療行為を 1 年に 2 度(6 ヶ月に 1 度)行う政策を策定し、罹患率が大きく減少した。 ● 全体的に、排水システムのようなインフラの整備が不十分である。多くの病気はインフラ不足によって発生している。 ● JICA による技術的、資金的なカンボジアへの支援のおかげで、本プロジェクトは形成された。本プロジェクトは、水利用や汚水処理に関する意識を高める上で、非常に重要である。 ● 本プロジェクトは、農業に対しても良い影響を与える。なぜなら、処理水は、農業や農業的な水利用に負の影響を与えない	● *都は、処理場完成後は、観光客や学生が本処理場を見学できるようにしてほしい。* ● *本プロジェクトが貧困世帯に影響を与えるなら、十分な補償と生活再建を行ってほしい。* ● *このエリアでは、概ね700家族に1 箇所相当で、健康センターがある。衛星都市でも、同様な割合で健康センターを設置すべき。* ● *可能なら、都及び政府は、病院にも下水処理場を設置してほしい。カンボジアの病院には、このような処理施設がないため。* ● *都は、下水処理場の建設中、特に女性の健康をケアしてほしい。* ● *不慮の事故に備えて、建設現場に看護師を待機させてほしい。* ● *女性や子供専用のトイレを設置してほしい。* ● *男女平等として、同一労働には同一の賃金を提供してほしい。* ● *幼い子供がいたり、妊娠をしている女性労働者には、自身の健康や子供の世話の為に早退する権利を与えてほしい。* ● *女性に仕事を与えてほしい。* ● *女性や子供に対するケアを行ってほしい。* ● *騒音、悪臭、塵埃による人々への影響を防止する。* ● *良質な仮設住宅を供給してほしい。* ● *都は、都民に対して本プロジェクトに関する情報を広く知らせてほしい。* ● *関係機関と協力し、影響を受ける人々への解決策を見つけてほしい。* ● *処理水が放流地点周辺の洪水を起こさないよう、十分に調査してほしい。* ● *Trabek ポンプ場への変圧器の設置は、EDC 基準と整合しておらず、維持管理、修繕が困難である。処理場への電気機器の設置は、EDC 基準に従い、EDC から必要な承認を得る。*	*プロジェクトスタッフの仮設住居施設の基準を守る。* ● *JICA 調査チームは、薬品箱を用意し、不慮の事故が追った場合に備えて、近隣の病院を協力してプロジェクトをバックアップする。* ● *本プロジェクトは、スタッフの数に従い、男女別のトイレを用意する。* ● *本プロジェクトは男女平等を尊重し、同一労働、同一賃金を提供する。* ● *プロジェクトでは、女性の権利を尊重し、育児しやすい環境を整える。* ● *都及びJICA は、本プロジェクトにおける環境及び社会的影響を注視する。* ● *都と JICA は、安全基準を尊重し仮設住居プロジェクトスタッフに対する高い安全を目指す。* ● *ESIA 調査チームを通じて、プロジェクトに関する情報は、公聴会等で共有されている。* ● *MEF と都は、法的に市民への影響を軽減すべきである。* ● *JICA は洪水防御施設の計画建設を実施してきた。本プロジェクトも、周辺環境に好影響を与える。* ● *本プロジェクトはカンボジア基準に則り EDC と共同して工事を実施する。* ● *ライセンスを持った登録業者を施工業者として選ぶ。*

No	ステークホルダー	コメント	*提案*	解決策
		上、水質汚濁を改善し、水に触れる農民に害を及ぼさないからである。 ● 本プロジェクトは、漁業には影響を与えない。なぜなら、漁場やキノボリウオ、雷魚、シルバーグラミー、スリースポットグラミー等の限られた魚の繁殖を保護する保護区域がないからである。 ● 本下水処理場は非常に良い。日本が直接、調査をしているし、我々に多数コンタクトしてくれている。 ● 日当たりの水道使用量は一人当たり 120-150 L である。現在、水道供給量は 500,000m^3/日であり 2024 年には、1,000,000m^3/日まで増加する。 ● 本処理場では、ニロート浄水場からの水を使用することになる。ニロート浄水場は、Hun Neang 道路から約 3 キロ離れた Trabek ポンプ場下の 1,400 mm の導水管を備えている。 ● 水道料金の 10% が確実に都に入るようにすべきである。 ● 本プロジェクトはすばらしい。調査団員も何度か協議のために EDC に訪れてくれた。 ● EDC は、中圧か低圧の電気を本プロジェクトに供給可能である。 ● 受電方法は 2 種類ある。一つは、既設の Trabek ポンプ場から引き込むケース、2 つ目は、プロジェクトサイト近傍の EDC ケーブルから直接引き込むケースである。 ● 本プロジェクトは、使用料に応じて電力料金を支払うことになる。 ● プロジェクトサイト内の不発弾については、現時点で、調査がなされていないため、その情報はない。また、されていたとしても、省レベルでは可能でも局レベルでその情報を得るのは難しい。	● *都と JICA は、建設時には再度、EDC と電力の供給に関して協議をしてほしい。* ● *都と JICA は、施工業者に対して、許可を受けた業者から土砂を購入するように指導する。また、そのような業者を探すため、関係機関と協力する。*	

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		● 埋立てのための土砂は、川やその他の土取り場から調達することになる。 ● 本プロジェクトの成功を祈念する。		
3	関係機関 (Khan、Sangkat、Village)	● ミンチェー区は、100%のサポートを行う。また 町や村とともに,本プロジェクトは、発展に必要であり、健康(水因性疾病の減少)や福祉の増進に役立つからである。 ● 本プロジェクトは、ミンチェー区の誇りである。なぜなら、下水処理場の建設は都内で初の試みであるからである。ただし、公正な補償は必要である。 ● 環境改善プロジェクトは、経済的なポテンシャルも上げることになる。 ● プロジェクトエリア内の関係機関(区, sangkat)は、土地所有者の名前を把握していない。なぜなら、土地の売買は、所有者が独自で実施しているからである。プロジェクトサイトの西では、Oknha Louk Hour 氏が土地を所有し、コンクリート壁を構築し樹を植えている。 ● 本プロジェクトは、水因性疾病の減少に貢献する。 ● 下水は、作物をダメにし、品質を下げる。本プロジェクト完成時には、水質が改善される。それは、作物の品質を上げ、売値を上げることにつながる。 ● 本プロジェクトは、水因性疾病の罹患率を下げ、人々をより健康にする。関係機関は、本プロジェエクと協力する ● ミンチェー区の人々も本プロジェクトを支援する。 ● Cheung Aek 湖に流れ込む汚水は、人々の健康に悪影響を及ぼす。臭気もひどい。	● *関係機関は、本プロジェクトのために、土地利用に係る紛争を解決する必要がある。しかし、その影響は軽微である。* ● *都は、影響を受ける人々に適切な支援を与えてほしい。* ● *Chak Angre Krom 町の人々への影響を最小にしてほしい。* ● *プロジェクトは、良質なものとし、適切な技術基準に従ってほしい。* ● *Cheung Aek 湖へ流入する全ての汚水を処理できる処理場とすべき。* ● *プロジェクト実施により、悪臭が減少する。*	● *都と JICA は、全てのレベルの関係機関と協力し、プロジェクトを円滑に実施するための諸問題を解決する。* ● *MEF と都は、法的に市民への影響を軽減すべきである。* ● *都はテクニカルアドバイザーを JICA から派遣してもらい、計画や施工監理に従事させ、日本の基準に則りプロジェクトを管理する。* ● *都は下水プロジェクトのマスタープランを JICA と作成した。しかし、資金が不足しており、資金源を見つけることが必要。*
4	影響世帯（作物及び近隣居住）	● 作物への影響は、6 世帯全世帯にインタビューした。下水処理場は都市の発展のために必要であり	● *人々の作物栽培への影響を回避することを希望する。*	● *MEF と都は、影響住民へ法に基づく補償をする。* ● *都は、日本の基準に基づく、計画及び施工監理を*

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		最新技術が必要。環境負荷の削減を希望する。 ● 本プロジェクトが影響住民に対して補償しないことが懸念される。 ● 本プロジェクトにより湖の環境がより良いものになることを希望する。 ● Cheung Aek 湖に流入する汚水は、現在でも、Prek Takung 1 村の住民に悪影響を及ぼしている。特に子供が沐浴をするため。 ● 本プロジェクトが、水生植物を栽培している人々が汚水により病気になることが減ることを希望する。 ● 本プロジェクトが、水質改善に寄与し、湖でとれる魚の数が増えることを望む。現在、湖でとれる魚の質は良くない。 ● 洪水が、本プロジェクトサイト周辺の人々や動物、家屋が洪水被害を受けることが懸念される。	● *作物への影響等を受ける住民へ、直接補償をしてほしい。* ● *施設建設後も、十分なモニタリングと施設の維持を希望する。*	*実施できる人材を起用する。*

6.3 JICA 環境ガイドラインとカンボジア国の土地の取得と住民移転に関するシステムの制度比較分析

No	JICA ガイドライン/ WB OP 4.12	カンボジアの法制度	比較	本プロジェクトにおける対策
1	非自発的住民移転及び生活手段の損失は、可能ならば回避し、実行可能な代案を調査する。	「開発事業における住民移転実施手続きに係る通達, No. 006 MEF, 2016」によると、住民移転回避の可能性は、フィージビリティ調査において調査される。	違いは無い。	JICA ガイドライン及び WB OP 4.12 に従い、プロジェクト設計において、土地の取得や住民移転は回避もしくは緩和するよう考慮しなければならない。
2	非自発的に住民移転を行わなければならなかった人々及び生活手段を妨げられ、失った人々は、再び標準的な生活、収入の機会及びプロジェクト前の生産基準を取り戻すために、十分に補償及び補助されなければならない。	上記の通達(Circular)は、影響を最小化することを示しているが、実際の手順は記載されていない。公有地のコンセッションは示されているが、土地の範囲や使用には、不十分である。	大きな違いは無いが、実際の手順が不明である。	ICA ガイドライン及び WB OP 4.12 に従い、プロジェクト設計において、土地の取得及び住民移転の緩和または回避を行わなければならない。補助は少なくともプロジェクト前を基準とした生活を取り戻すことができるように提供されなければならない。
3	非自発的に住民移転を行わなければならなかった人々及び生活手段を妨げられ、失った人々は、再び標準的な生活、収入の機会及びプロジェクト前の生産基準を取り戻すために、十分に補償及び補助されなければならない。	「通達 No.2 公有地の違法占拠 2007」によると、違法状態の土地所有者は、補償を受ける資格は無いが、実際の状況を基にして、生活を行う適正な規模の土地を取得することにより、優遇措置を受ける事ができる。しかし、実際の手順は示されていない。	違いは無いが、実際の手順が不明である。	ICA ガイドライン及び WB OP 4.12 に従い、補助はプロジェクト前のレベルの生活を取り戻すことができるように提供されなければならない。
4	補償は、可能な限り完全な代替補償を提供する事を原則とする。	「用地取得法」の article 2 には、住民移転の前に公平で適切な代替補償を確実に提供する事が示されている。	損失の完全な補償を確実にする実際の代替補償の見積方法がない。	ICA ガイドライン及び WB OP 4.12 に従い、 可能な限り完全代替補償を提供する。
5	補償及びその他の補助は、移転の前に提供する。	「土地収用法 2010」によると、収用委員会が事前に不動産の所有者に補償を行い、公平に支払いを行った場合にのみ、不動産の所有権の収用が可能である。	違いは無い。	ICA ガイドライン及び WB OP 4.12 に従い、事前にカンボジア側による補償及び補助の提供が奨励される。
6	大規模な住民移転を伴うプロジェクトは、住民移転計画を作成し、公表されなければならない。住民移転計画には、「世界銀行セーフガードポリシー, OP 4.12, Annex A」に記載の要素を含める事が望ましい。	SOPs には、情報開示手順が示されている。ARAP で調査された項目が JICA の要件を満たさない可能性もある。(例えば、全面的な人口調査及び補償額の計算など)	大きな違いは無いが、実際の手順が不明である。	ICA ガイドライン及び WB OP 4.12 に従い、カンボジア側で情報を公開し、JICA のホームページが開示手段として使用されることが推奨される。
7	住民移転計画の作成において、影響を受ける人々及びそのコミュニティに、事前に十分な情報を提供してから、意見聴取の場を設定しなければならない。意見聴取協議の	IRC は、プロジェクト詳細や住民移転政策等を開示する関係機関を集めた説明会を開催する責任があることが示されている。また 「用地取得法」には、意見聴取会を	大きな違いは無いが、実際の手順が不明である。	ICA ガイドライン及び WB OP 4.12 に従い、 意見聴取会が開かれる。参加者の選定の際には、社会的側面や組織に関する特別な配慮が行われる。

No	JICA ガイドライン/ WB OP 4.12	カンボジアの法制度	比較	本プロジェクトにおける対策
	際には、影響を受ける人々が理解できる形、方法、言語で説明を行わなければならない。	行う事が示されている。		
8	住民移転計画の計画、実施、及びモニタリングにおいて、影響を受ける人々の適切な参加を促さなければならない。	「Social Land Concessions に係る副法令, 2003」において、 コミューンの議会が計画作成を主導し、住民参加を促すことが示されている。しかし住民参加は、法的に定められてはいない。	住民参加は任意である。	ICA ガイドライン及び WB OP 4.12 に従い、 参加が促される。
9	影響を受ける人々及びコミュニティの適切及びアクセス可能な苦情申し立ての仕組みを作らなければならない。	「用地取得法」には、苦情処理委員会の設立が記載されている。しかし、苦情処理の仕組みの実際の手順は確立されていない。	大きな違いは無いが、実際の手順が不明である。	ICA ガイドライン及び WB OP 4.12 に従い、カンボジア側に苦情処理の仕組みを設置するように促される。

6.4　モニタリングフォーム案
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	pH:6.5-8.5 TSS:<15 DO:>5 COD:<5 TN:<1 TP<0.1 Pb:<0.01 As:<0.01	

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			Pb:<0.01 As:<0.01 Cd:<0.001 Hg:<0.0005 (mg/l) Total Coliform:< 1000 (MPN/100 ml)	Cd:<0.003 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					

Environmental Resource	Monitoring Item	Result	Baseline	Standard (MOE)	Standard (Japan)	Remarks
	wildlife 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)	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:<	

Environmental Resource	Monitoring Item	Result	Baseline	Standard (MOE)	Standard (Japan)	Remarks
	- Monitoring on solid-liquid waste management - Monitoring the filter system cleaning			Total Coliform:< 1000 (MPN/100 ml)	50 (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 用地取得･住民移転

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 環境チェックリスト

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　プロジェクトに関連する水質基準及び排水基準

(1) 水質基準及び排水基準

カンボジア国では、水質汚濁の防止を目的とした「Sub-decree on Water Pollution Control, 1999(水質汚濁防止に関する政令)」が、1999 年 4 月 6 日に制定されている。本政令は、廃水(液体廃棄物)、有害廃液の定義、分類、水質環境基準、排水基準、排出者の責任、モニタリング、許認可、査察、罰則などを定めている。

同政令で定められている水質環境基準として「生物多様性保全」のため、河川、湖沼(貯留池)及び海域における水質環境基準が設定されている(**表-1**)。また同政令では「公衆衛生管理(public health protection)」のため、公共水域での水質環境基準が 25 項目(パラメーター)で定義されている(**表-2**)。

表-1　水質環境基準(生物多様性保全)

	No	項目	単位	基準値
1. 河川	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. 湖沼及び貯留池	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. 沿岸域	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

出所：Sub-decree on Water Pollution Control, Annex4 :Water Quality Standard in public water areas for bio-diversity conservation.

表-2　水質環境基準(公衆衛生管理)

No	項目	基準値 (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
14	Hexachloroethylene	< 0.05

No	項目	基準値 (µg/l)
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

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

排水基準に関しては、同政令では(Annex 2 として)「公共水域もしくは下水への汚染源の排出基準(Effluent standard for pollution sources discharging wastewater to public water areas or sewer)が規定されている(**表-3**)。この基準では「保護公共水域」への基準が設定されているが、現在のところ、プノンペン都では、保護地区が指定されていないため、工場を含むすべての排水について「公共水域及び下水への排出」基準が公共水域への放流点で適用される。

表-3　公共水域への排水基準

No	項目	単位	基準値	
			保護公共水域への排出	公共水域及び下水管へ排出
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

No	項目	単位	基準値	
			保護公共水域への排出	公共水域及び下水管へ排出
35	DO	mg/l	>2.0	>1.0
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

注：保護公共水域(Protected public water area)は、「保護地区」への排水排出であるが、現在カンボジアでは保護地区として指定されている地区はないため、すべての排水は「公共水域及び下水へ排出」基準が適用されている。

出所：Sub-decree on Water Pollution Control、Annex 2, Effluent standard for pollution sources discharging wastewater to public water areas or sewer.

(2) 雨水排水及び汚水処理システムの管理に関する政令(Sub-Decree)

本政令は、2017 年 11 月 25 日付けで発効した雨水排水及び汚水処理の管理に関する最新の政令である。本政令には、1) 関連省庁(MPWT、MOE 及び MOI)及び地方自治体の雨水排水及び汚水処理管理に係る所掌、2) 雨水排水及び汚水処理の管理方法 3) 雨水排水及び汚水処理サービスを提供する関連官庁及び自治体の責務、4) モニタリング及び査察 5) 罰則等が定められている。

また、本政令では、商業ビル、民間住宅開発地区、リゾート施設、娯楽施設等からの排水基準を、**表-4** のように定めている。

表-4　商業ビル、民間住宅開発地区、リゾート施設、娯楽施設等からの排水基準

No.	項目	単位	許容値	
			集中型下水処理場に通じる汚水排除システムに接続している場合	公共用水域または集中型下水処理場に通じていない汚水排除システムに直接放流する場合
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

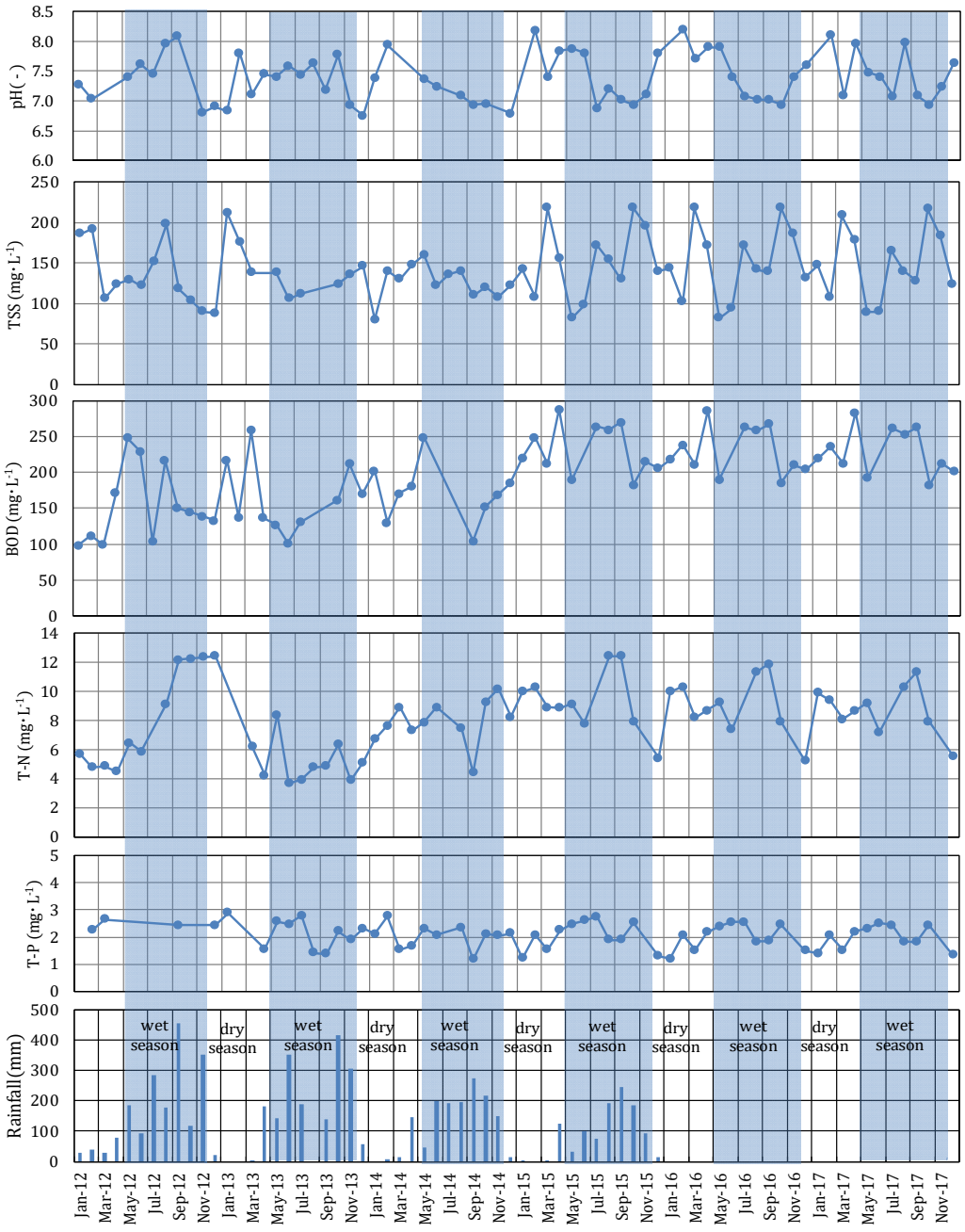
出所: Sub-decree on the Management of Drainage and Wastewater Treatment System (Table of Annex 1 and Annex 2)

6.7　水質に関する考察

1.　流入水質に関する考察

1.1 MOE による水質分析結果

MOE は 2012 年 1 月から 2017 年 12 月の期間において Trabek ポンプ場周辺より採水した汚水の分析業務を実施している。採水地点が本プロジェクトの取水地点に近いため、この分析結果は STP の設計に利用可能であると考えられる。分析データは季節に関係なく大きく変動しており、また変動の理由が明確でないことから、誤差を最小とするためにデータを Smirnov-Grubbs 検定を用いて統計的に検討を行った。図 **1-1** に検定後の水質分析データを示し、また**表 1-1** にその概要をまとめる。



出所: MOE 提供データに基づき調査団作成

図 1-1 Trabek ポンプ場周辺の汚水性状(Smirnov-Grubbs 検定後)

表 1-1 分析結果のまとめ(Smirnov-Grubbs 検定後)

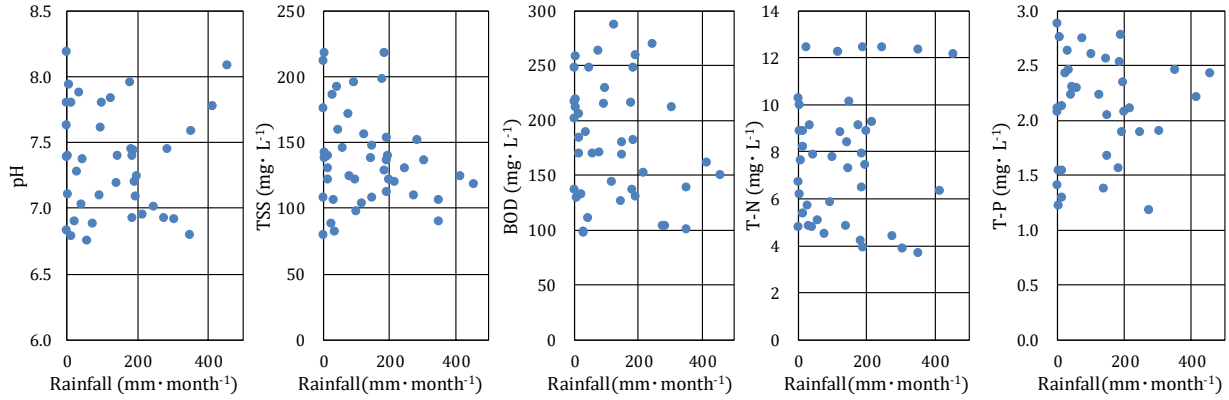
	pH (-)	TSS (mg･L^{-1})	BOD (mg･L^{-1})	T-N (mg･L^{-1})	T-P (mg･L^{-1})
Average	7.39	142	197	8.1	2.1
Median	7.40	138	205	8.2	2.1
Maximum	8.20	218	288	12.4	2.9
Minimum	6.75	80	98	3.7	1.2
Standard Deviation	0.41	38.4	53	2.5	0.5

出所: MOE 提供データに基づき調査団作成

期間中採水された試料の pH、全浮遊物質 (TSS)、生物化学的酸素要求量(BOD)、全窒素(T-N)及び全リン(T-P)の単純平均はそれぞれ 7.39、142mg/L、 197mg/L、8.1mg/L 及び 2.1mg/L であった。

1.2 乾季と雨季の差

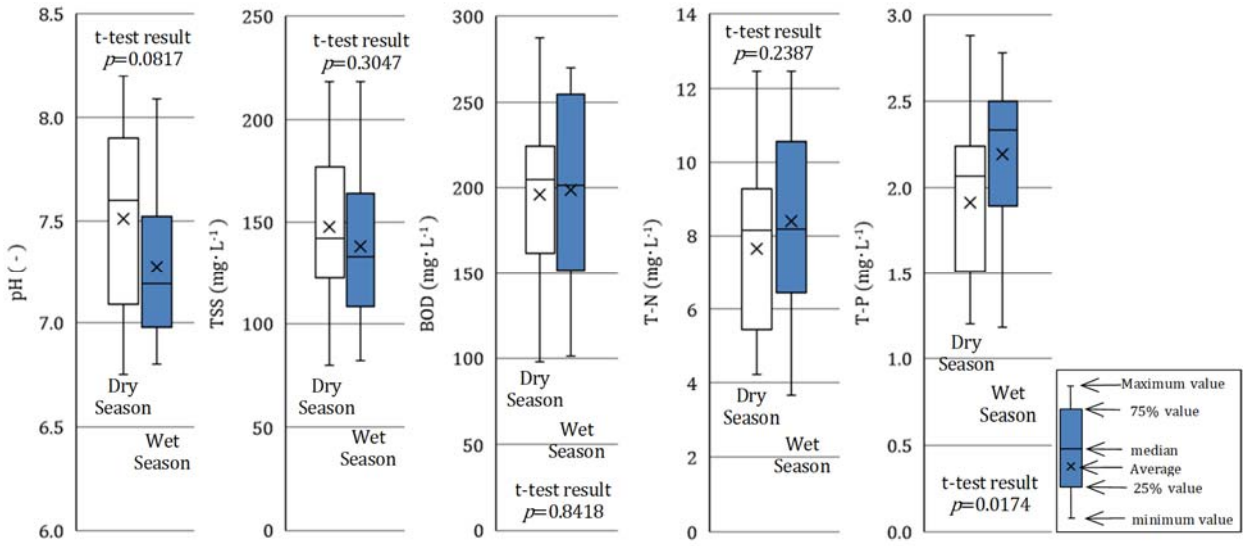
カンボジアの気候は 12 月から 4 月にかけての乾季と 5 月から 11 月にかけての雨季と 2 つに分けられる。本プロジェクトで処理される汚水は雨水と合流したものであることから、降雨量が直接汚水性状に影響すると考えられる。先に示した**図 1-1** には 2012 年から 2015 年にかけての降雨量のデータを併せて示しており、乾季と雨季を色で区分している。**図 1-2** は月間の降雨量と汚水の性状の関係を示しているが、この図から降雨量との明確な関係は認められない。



出所: 調査団

図 1-2 降雨量と汚水性状の関係

そのため、乾季と雨季の汚水性状の違いがあるかどうかを確認するために統計的な検定を試みた。 **図 1-3** に 2012 年から 2017 年にかけてのデータを乾季及び雨季に区分し、作成した箱ひげ図を示す。ここで乾季は 12 月から 4 月とし、残りの期間を雨季とした。*T* 検定によって得られた *p* 値を同図に併せて示す。一般に *p* 値＞0.05 の場合は、両者の平均値に差は認められないとされるが、これに基づけば、T-P のみが乾季と雨季において平均値に差があると判断される。このような結果となるひとつの理由として採水が降雨中に行われておらず、雨水は早く流れてしまうため、採水時には雨水の影響が既に小さくなっていたことが考えられる。



出所: 調査団

図 1-3 乾季と雨季の水質比較

1.3 本調査における水質分析結果

MOE より提供されたデータの精度を確認するために、2018 年 8 月 22 日に Trabek ポンプ場において汚水の採水を行った。ポンプが稼働している際にポンプ場の上流側及び下流側において計 4 箇所より採水した。**図 1-4** に採水箇所を示し、**表 1-2** にその分析結果を示す。T-BOD は 115 ～ 180mg/L の間で変動し、その平均は 149mg/L であった。TSS の平均値は 54.5mg/L であり、MOE 提供のデータより大幅に小さな値であった。T-N 及び T-P の平均はそれぞれ 30.3mg/L 及び 1.38mg/L であった。

出所: Google Earth Pro®

図 1-4 採水地点

写真 1-1 Trabek ポンプ場における採水作業

表 1-2 水質分析結果の概要

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^{-1})	115	180	155	145	149 (115-180)
S-BOD (mg･L^{-1})	63.0	61.0	65.0	59.0	62.0 (59.0-65.0)
TSS (mg･L^{-1})	62.0	42.0	46.0	68.0	54.5 (42.0-68.0)
T-N (mg･L^{-1})	29.4	32.2	30.1	29.5	30.3 (29.4-32.2)
NH_4^+-N (mg･L^{-1})	11.2	14.0	12.6	11.8	12.4 (11.2-14.0)
T-P (mg･L^{-1})	1.43	1.34	1.35	1.40	1.38 (1.34-1.43)

採水日: 2018 年 8 月 22 日
出所: 調査団

1.4 STP 設計のための流入汚水性状

M/P における流入汚水の BOD は各セグメント(生活系、商工業系)からの排出汚濁負荷より 195mg/L に、また TSS は BOD×105%の値と定めている。**表 1-1** に示す BOD 平均値は M/P に示される値と極めて近いことから 195mg/L を設計値として採用する。**表 1-1** に示す TSS は M/P の値よりも小さいが、保守的な観点から、高い値、即ち 205mg/L を設計値とする。pH は 7.5 に設定する。**表 1-3** に STP 設計のために設定した汚水性状を示す。計画されている STP は PTF 法であり、基本的に窒素及びリンの除去は考慮されないことから、最終放流水の T-N 及び T-P の基準値は定めていない。よって流入汚水中のこれら指標についても同様に設定しないものとする。

表 1-3 STP 設計に供する汚水性状

	pH (-)	TSS (mg･ L^{-1})	BOD (mg･ L^{-1})
Adopted Value for STP Design	7.5	205	195

出所) JICA 調査団

2. PTF 法による窒素及びリンの除去の限界

PTF 導入ガイドライン[1]では PTF は計画放流水質が BOD で 10mg/L を超え 15mg/L 以下の区分である下水処理場に適用され、窒素・リン除去を目的とする高度処理施設に単独で適用することはできないとしている。一方、ベトナムのダナン市において実施された PTF のパイロット試験結果[2]は、一部の窒素及びリンは除去されたことを示している。**表 2-1** にパイロット試験結果の平均値を示す。パイロット試験結果を示す報告書には有機態窒素(Org-N)は示されていないが、全窒素(T-N) より硝酸態窒素(NO_3^--N) 及び亜硝酸態窒素(NO_2^--N)を差し引いたものを Org-N としている。

表 2-1 各プロセスにおける水質分析結果平均値

	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)]

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

流入汚水中の T-N の平均値は 19.4mg/L、最終放流水、即ち SLS 処理水中の T-N は 8.2mg/L であり、除去率は 57.7%であった。リンの場合、流入 4.4mg/L、流出 0.7mg/L、除去率は 84.1%であった。

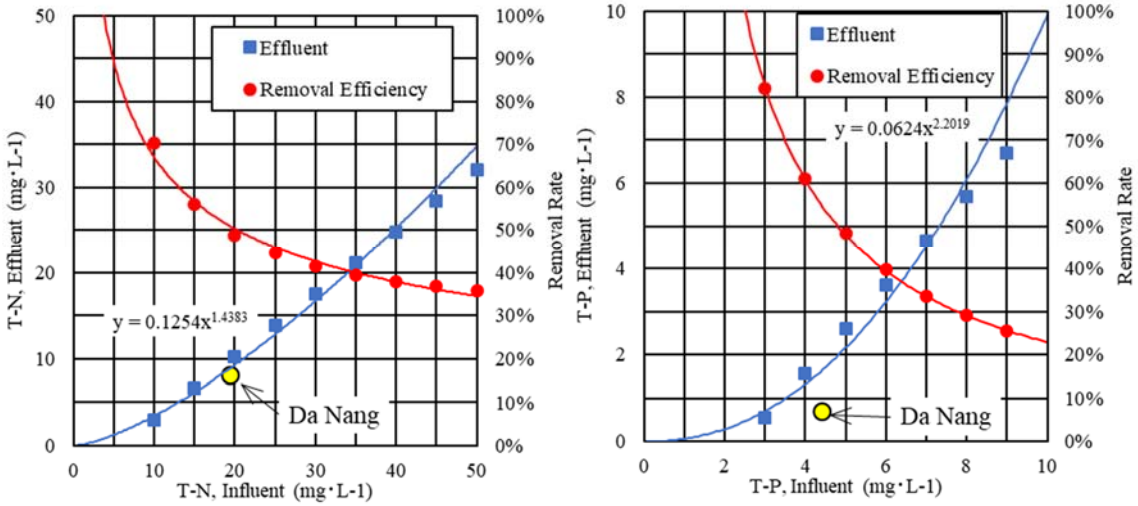
本プロジェクトでは流入汚水中の窒素及びリンの濃度は定めていないが、取水施設近傍より採水した汚水の T-N 及び T-P の分析結果は、**表 1-1** 及び**表 1-2** に示すようにダナン市のケースよりも大幅に高い値となっている。

さらに、プノンペンの STP は、汚泥の最終処分量及び温室効果ガスの排出を最小化するために汚泥消化プロセスを備える計画である。嫌気性消化プロセスにおける生物分解によって、有機物は低分子化され、有機物中の窒素及びリンはアンモニア態窒素(NH_4^+-N)及びリン酸態リン(PO_4^{3-}-P)に分解され、消化液中に溶解する。固液分離された消化液(返流水)は汚水処理設備に返送される。よって、嫌気性消化プロセスは汚水処理プロセスに影響を及ぼし、最終放流水中の窒素及びリンの濃度が高くなる可能性があると言われている。この点を考慮し、T-N 及び T-P がどの程度削減可能かを明確にするためシミュレーションを行った。**図 2-1** にシミュレーション結果として、流入汚水及び処理水中の T-N、T-P 及びそれぞれの除去率を示す。T-N 及び T-P の除去率は流入汚水濃度に依存し、流入汚水濃度が高くなれば除去率は低くなる。例えば、流入汚水中の T-N が 20mg/L の場合、処理水濃度は 9.8mg/L であり除去率は 49%であるが、流入汚水濃度が 40mg/L になれば処

[1] 国土交通省国土技術政策総合研究所, B-DASH プロジェクト No.12 無曝気循環式水処理技術導入ガイドライン(案), ISSN1346-7238, No.951 (平成 29 年 2 月).

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

理水濃度は 25mg/L となり除去率は 38%に低下する。ダナン市の流入汚水濃度 19.4mg/L において比較すると、シミュレーションの結果はダナン市の場合よりも約 0.8mg/L 高くなっている。また流入汚水中の T-P が 4.4mg/L において比較すると、結果はダナン市よりも 1.0mg/L 高くなっている。これらの差は汚泥消化の影響によるものと考えられる。



出所: 調査団

図 2-1 最終放流水の T-N 及び T-P 想定値及び除去率

3. 本プロジェクトにおいて提案した処理システムを仮定した場合の放流水質予測値

前項で議論した、最終放流水の T-N 及び T-P 想定値及び除去率と MOE 及び本調査内で実施した水質分析結果をもとに、本プロジェクトにおいて提案した処理システムを仮定した場合の放流水質の予測値を次表にまとめる。

表 3-1 本プロジェクトにおいて提案した処理システムを仮定した場合の放流水質予測値

	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)

出所: 調査団

6.8　　汚泥処理方式の比較検討(詳細資料)

1.　施設建設費(CAPEX)

表 1.1 に各ケースの施設建設費(CAPEX)の試算結果を示す。ケース 2 が最も高額になる。

表 1.1　汚泥処理システムの施設建設費(CAPEX)

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

出所：調査団

2.　維持管理費(OPEX)

各ケースの維持管理費(OPEX)の試算結果を**表 2.1** に示す。結果には人件費、汚泥搬送費、施設のメンテナンス費用を含むが、汚泥の最終処分費は含んでいない。土木建築設備、機械配管設備及び電気計装設備のそれぞれのメンテナンスコストは、施設建設費(CAPEX)のそれぞれ、1%、3%及び 2%と設定した。ケース 1 及び 2 は脱水にポリマを消費するため、また機械脱水機の運転に熟練した運転員が必要になるため、ケース 3 及び 4 と比較して極めて高額となる。

表 2.1　汚泥処理システムの維持管理費(OPEX)

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	

出所：調査団

3. 温室効果ガス(GHGs)発生量比較

汚泥処理システムの比較のため、温室効果ガス(GHGs)は一つの指標として検討されるべきである。GHGs は汚泥処理及び処分の各ステージにおいて発生する。汚泥脱水、消化または乾燥のための電力消費により二酸化炭素(CO_2)が発生する。脱水汚泥または乾燥汚泥を最終処分場まで搬送する際に、搬送車両は燃料を消費し、それに伴い CO_2、メタン(CH_4)及び一酸化二窒素(N_2O)を発生する。また汚泥中の生分解性物質は最終処分場において分解され、CH_4 を発生する。汚泥の処理及び処分を通じて排出される GHGs の総量は以下の式で計算される。

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

ここで、

$GHGs_{Total}$ ： 温室効果ガス排出総量(kg-CO_{2Eq}/year)
$GHGs_{Electricity}$ ： 電力消費による温室効果ガス排出量(kg-CO_{2Eq}/year)
$GHGs_{Fuel}$ ： 汚泥搬送車両の燃料消費による温室効果ガス排出量(kg-CO_{2Eq}/year)
$GHGs_{Disposal}$ ： 汚泥処分による温室効果ガス発生量(kg-CO_{2Eq}/year)

3.1 電力消費による温室効果ガス排出量

電力消費に伴い発生するGHGsは以下の式により求められる。

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

ここで、

EF_{Grid}: 排出係数(625.7 kg-CO_{2Eq}/MWh*)

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

EC_{Grid}: 電力消費量(MWh/year)

表3.1に電力消費によるGHGs排出量を示す。GHGs 排出量は電力消費量に比例するため、汚泥消化を有する汚泥処理システムは消化槽の撹拌機の電力消費により、多くのGHGsを排出する。

表 3.1 電力消費による温室効果ガス排出量

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

出所：調査団

3.2 汚泥搬送車両の燃料消費による温室効果ガス排出量

自動車燃料の消費によってCO_2のみならず、CH_4及びN_2Oも発生する。CH_4及びN_2OのCO_2への換算係数(地球温暖化係数)はそれぞれ25及び 298であることから、汚泥搬送車両の燃料消費によるGHGs 排出量は以下の式より求められる。

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

ここで、

EF_{CO2}: 燃料消費による二酸化炭素排出係数 (74,100 kg-CO_2/TJ*)

EF_{CH4}: 燃料消費によるメタン排出係数 (3.9 kg-CH_4/TJ*)

EF_{N2O}: 燃料消費による一酸化二窒素排出係数(3.9 kg-N_2O/TJ*)

$Fuel_{Diesel}$: ディーゼル燃料消費量(= 燃料消費量×ディーゼル燃料の低位発熱 量: 37.7MJ/L)

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

汚泥搬送車両の燃料消費によるGHGs排出量を**表3.2**に示す。GHGs排出量は最終処分される汚泥量に比例する。消化後に汚泥を乾燥させることが汚泥処分量を最小化できる方式であり、GHGs排出量を最小化できる最善の方式である。

表 3.2　汚泥搬送車両の燃料消費による温室効果ガス排出量

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

出所：調査団

3.3 汚泥処分による温室効果ガス排出量

最終処分場において、処分された汚泥はCH_4を発生する。特定の年に処分される汚泥のCH_4生成ポテンシャルは、その後数十年間にわたって徐々に低下する。

CH_4排出を試算する式は“2006 IPCC Guideline for National Greenhouse Gas Inventories, Vol.5 Waste, Chapter 3 Solid Waste Disposal”によって与えられている。対象とする期間を通じて発生するCH_4排出量は、最終処分場に処分される汚泥の量と組成、及び現場での管理状況に応じて計算される。

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

ここで、

$DDOC_m$: 分解可能な有機炭素量(Gg/year)

W: 処分汚泥量(Gg/year)

DOC : y年次の分解可能な有機炭素の割合(Gg-Carbon/Gg-Sludge)

DOC_f: 分解可能なDOCの割合(=0.5*)

MCF: メタン変換係数(=0.8*、適正な管理が行われず、高さ>5m and/or 高水位の場合)

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

$$DDOC_{m\ decompT} = DDOC_{maT-1} \cdot (1 - e^{-k}) \quad (5)$$

ここで、

$DDOC_{m\ decompT}$: T年における分解された$DDOC_m$ (Gg)

$DDOC_{maT-1}$: 最終年T-1における累積$DDOC_m$ (Gg)

T: 対象期間 (=20years)

K: 反応定数 (0.4 year^{-1*})

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

$$CH_{4\ generated\ T} = DDOC_{m\ decompT} \cdot F \cdot \frac{16}{} \quad (6)$$

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

ここで、

$CH_{4\ generated\ T}$: メタン発生量 (Gg)

$DDOC_{m\ decompT}$: T年における分解されたDDOC$_m$ (Gg)

F: 発生ガス中のメタン含有率 (=0.5*)

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

表3.3に20年間における汚泥処分によるGHGs排出量を示す。表中の$GHGs_{Disposal}$ は20年間の発生量を年平均値として示している。汚泥消化を有する汚泥処理システムのGHGs排出量は、STP内で既に消化が行われ安定化しているため、汚泥消化を有さないシステムよりも小さくなる。

表 3.3　汚泥処分による温室効果ガス排出量

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

出所：調査団

3.4　温室効果ガス排出総量

上記より GHGsの排出総量は**表3.4**に示すとおりとなる。汚泥消化後に乾燥を行うことが4つの汚泥処理方式の中でGHGs排出量を最小化できる方式である。

表 3.4　汚泥処理及び処分における温室効果ガス排出総量

(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

出所：調査団

6.9 容量計算書

1. 設計条件

(1) 計画流入下水量 (一日最大)　　5,000 m^3/day

(2) 計画流入水質

	晴天時		雨天時	
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.設計

2.1. 沈砂池

(1) 設計条件

- 水面積負荷:　　1,800 m^3/m^2/day
- 池数:　　2 (　1　常時　　1　予備)

(2) 設計計算

- 必要池面積

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

沈砂池

形状寸法:　3.0 m x 1.0 m x 0.5 m H(水深)

- 水面積:　3.0 m^3/m^2/day
- 水面積負荷:　1,667 m^3/m^2/day

2.2. 自動除塵機

(1) 設計条件

- 基数:　1 常時
- 池幅:　1.0 m

(2) 設計

自動除塵機

幅 1,000mm x 高 2,000mm x 目幅 15mm x 0.025kW x 1基 (常時使用)

2.3. スクリーン

(1) 設計条件

- 基数: 1 予備
- 池幅: 1.0 m

(2) 設計

スクリーン 幅 1,000mm x 高 2,000mm x 目幅 15mm x 1基（予備）

2.4. 調整槽

(1) 設計条件

- 設計流量:

	Dry Season	Rainy Season
流入水量	5,000 m^3/day	5,000 m^3/day
HTFからのオーバーフロー水量	284.5 m^3/day	285.4 m^3/day
沈殿池からの分離液水量	1,119.6 m^3/day	570.5 m^3/day
消化タンクからの分離液水量	35.7 m^3/day	11.5 m^3/day
汚泥乾燥床からの分離液水量	8.8 m^3/day	2.8 m^3/day
計	6,448.6 m^3/day	5,870.2 m^3/day

- 設計水量採用値: 6,448.6 m^3/day
- 槽数: 1
- 滞留時間: 0.5 hours

(2) 設計計算

- タンク容量:

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

調整槽 形状寸法: 5.5 m x 7.0 m x 3.5 m H(水深) 容量: 135 m^3

2.5. 調整槽攪拌機

(1) 設計条件

- 水槽容量: 135 m^3
- 攪拌方式: 水中攪拌機
- 攪拌能力: 1.0 m^3/m^3/hour
- 攪拌機数: 1

(2) 設計計算

- 攪拌機の必要能力:

135 m^3 x 1.0 m^3/m^3/hour / 60 / 1 基 2.3 m^3/min

調整槽攪拌機 仕様: 2.6 m^3/min x φ 250 mm x 1.5 kW x 1 基

2.6. 揚水ポンプ設備

(1) 設計条件

- 流入水量: 6,448.6 m^3/day
- ポンプ台数: 2 (1 常時 1 予備）

(2) 設計計算

- ポンプの揚水量:

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

揚水ポンプ設備
揚水量: 5.1 m^3/min x 17 mH x φ 250 mm x 30 kW x 2 台

2.7. 分水槽 1

(1) 設計条件

- 流入ポンプの揚水量: 6,448.6 m^3/day(晴天時) 5,870.2 m^3/day(雨天時)
- 採用揚水量: 6,448.6 m^3/day
- 分水槽の数: 1 水路
- 滞留時間: 1 min

(2) 設計計算

- 分水槽の容量:

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

分水槽
形状寸法: 1.0 m x 3.9 m x 1.7 m H(水深)
容量: 6.63 m^3

2.8. 前段ろ過施設 (FSF)

(1) 設計条件

- 槽数: 2
- 水量負荷と水質濃度:

流量と水質 (晴天時)

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
流入水量	5,000.0	195	975.0	130	650.0	205	1,025.0
HTFオーバーフロー水量	284.5	116	33.0	98	27.9	50	14.2
沈殿池分離液量	1,119.6	122	136.2	85	94.8	212	237.1
消化タンク分離液量	35.7	541	19.3	500	17.9	1,528	54.6
乾燥床分離液量	8.8	529	4.7	500	4.4	1,114	9.8
計	6,448.6	181	1,168.2	123	795.0	208	1,340.7

流量と水質 (雨天時)

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
流入水量	5,000.0	100	500.0	70	350.0	90	450.0
HTFオーバーフロー水	285.4	71	20.3	54	15.4	50	14.3
沈殿池分離液量	570.5	67	38.0	41	23.1	114	65.1
消化タンク分離液量	11.5	590	6.8	500	5.8	1,522	17.5
乾燥床分離液量	2.8	562	1.6	500	1.4	1,107	3.1
計	5,870.2	97	566.7	67	395.7	94	550.0

設計条件の整理

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
計 (晴天時)	6,448.6	181	1,168.2	123	795.3	208	1,340.6
計 (雨天時)	5,885.2	96	566.9	67	395.7	93	549.9

- 採用流量: 6,448.6 m^3/day
- 水面積負荷: 150 m^3/m^2/day
- ろ床の高さ: 0.6 m
- ろ過後のTSS: 50 mg/l
- FSFのP-BOD除去率: 0.9143 x (TSS除去率) (%)

(P-BOD) = (T-BOD) - (S-BOD)

- FSFのS-BOD 除去率: 20 %
- 逆洗の頻度: TSS 濃度 x 水面積負荷 / 0.83

(2) 設計計算

- 水面積:

6,448.6 m^3/day / 150 m^3/m^2/day / 2 槽 = 22 m^2/槽

前段ろ過施設 (FSF)

形状寸法: 3 m x 8 m x 0.6 m H(ろ床高) x 2 槽

ろ床表面積: 24.2 m^2/槽 採用: 24 m^2/槽

水面積負荷: 134 m^3/m^2/day(晴天時)

122 m^3/m^2/day(雨天時)

- TSS と BOD 除去

TSS

晴天時

除去量: 208 mg/l - 50 mg/l = 158 mg/l

除去率: (208 mg/l - 50 mg/l) / 208 mg/l = 76.0 %

雨天時

除去量: 93 mg/l - 50 mg/l = 43 mg/l

除去率: (93 mg/l - 50 mg/l) / 93 mg/l = 46.2 %

S-BOD

晴天時

除去量: 123 mg/l x 20 %= 25 mg/l

除去率: 123 mg/l - 25 mg/l = 98 mg/l

雨天時

除去量: 67 mg/l x 20 %= 13 mg/l

除去率: 67 mg/l - 13 mg/l = 54 mg/l

P-BOD

晴天時

除去量: (181 mg/l - 123 mg/l) x 76.0 X 0.9143 %= 40 mg/l

除去率: 181 mg/l - 123 mg/l - 40 mg/l = 18 mg/l

雨天時

除去量: (96 mg/l - 67 mg/l) x 46.2 X 0.9143 %= 12 mg/l

除去率: 96 mg/l - 67 mg/l - 12 mg/l = 17 mg/l

T-BOD

晴天時

除去量: 25 mg/l + 40 mg/l = 65 mg/l

除去率: 181 mg/l - 65 mg/l = 116 mg/l

雨天時

除去量: 13 mg/l + 12 mg/l = 25 mg/l

除去率: 96 mg/l - 25 mg/l = 71 mg/l

- 一回当たりの逆洗水量

24.2 m^2 /槽 x 1.2 mH = 29 m^3/槽/回

- 逆洗回数

晴天時: 208 mg/l x 134 $m^3/m^2/day$ / 2 槽 x 0.83kg/m^2/day /1,000
= 17 回/day/槽

雨天時: 93 mg/l x 122 $m^3/m^2/day$ / 2 槽 x 0.83kg/m^2/day /1,000
= 7 回/day/槽

- 一日当たりの逆洗水量

晴天時: 29 m^3/槽/回 x 2 槽 x 17 回/day/槽 = 986.0 m^3/day

雨天時: 29 m^3/槽/回 x 2 槽 x 7 回/day/槽 = 406.0 m^3/day

- 流入水の水量と水質

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	5,462.6	116	633.7	98	535.3	50	273.1
雨天時	5,479.2	71	389.0	54	295.9	50	274.0

- 逆洗水の水量と水質

	逆洗水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	986.0	278	274.5	98	96.6	1,083	1,067.5
雨天時	406.0	192	78.1	54	21.9	680	275.9

2.9. 分水槽 2

(1) 設計条件

- 流入ポンプの揚水量: 5,462.6 m^3/day(晴天時) 5,479.2 m^3/day(雨天時)
- 採用揚水量: 5,479.2 m^3/day
- 水路数: 1 水路
- 滞留時間: 0.5 min

(2) 設計計算

- 分水槽の容量:

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

分水槽 2
形状寸法: 1.6 m x 2 m x 0.65 m H(水深)
容量: 2.08 m^3

2.10. 散水担体ろ床 (HTF)

(1) 設計条件

- 槽数: 2 槽
- 室数: 4 /槽 (8 合計室数)
- BOD 負荷: 1.6 kg-BOD/m^3/day (*A*)
- ろ床の高: 2.5 m (*B*)
- HTFからの排出TSS: 6.2335 X Ln(*A*) + 22.233
- HTFからの排出S-BOD: (0.7538 x Ln(*A*) +2.6562) x (9.87715 x $B^{-0.92}$) / 4.25
- HTFからの排出P-BOD: 0.9143 x (排水のTSS)
- 逆洗の頻度: 毎回 8 days
- 浸漬時間: 10 hours/回
- ろ床の空隙率: 90%

(2) 設計計算

- HTFの流入水量と水質

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	5,462.6	116	633.7	98	535.3	50	273.1
雨天時	5,479.2	71	389.0	54	295.9	50	274.0

- HTFの容量:

BOD負荷より:

晴天時 633.7 kg/day / 1.6 kg/m^3/day / 2 組 = 199 m^3/槽
199 m^3/槽 / 2.5 m = 80 m^2/槽

雨天時 389.0 kg/day / 1.6 kg/m^3/day / 2 組 = 122 m^3/槽
122 m^3/槽 / 2.5 m = 49 m^2/槽

採用水面積 80 m^2/槽

散水担体ろ床 (HTF)
形状寸法: 正八角形 φ 10.0 m x 辺長 4.142 m x 2.5 m H(ろ床高) x 2 槽
容量: 205 m^3, HTFの水面積負荷: 82 m^2/槽
水面積負荷: 16.7 m^3/m^2/day(晴天時) 16.8 m^3/m^2/day(雨天時)
BOD 負荷: 1.6 kg-BOD/m^3/day(晴天時) 1 kg-BOD/m^3/day(雨天時)

- 排水のTSS

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

-排水のP-BOD

0.9143 x 26 mg/l = 24 mg/l

-排水のS-BOD

(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

安全をみた排水のS-BOD 10 mg/l

-排水のT-BOD

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

- オーバーフロー水量

晴天時:

5,462.6 m^3/day / 2 槽 / 4 室/槽 x 10 hours/24 = 285 m^3/day

雨天時:

5,479.2 m^3/day / 2 槽 / 4 室/槽 x 10 hours/24 = 285 m^3/day

- 一室当たりの排水量

π/4 x (Dia. 10.0 m)^2 x 2.5 mH / 4 室/槽 = 49.1 m^3/回/室

- 一日当たりの排水量

49.1 m^3/回/室 x 4 室/槽 x 2 槽 / 8 days = 49.1 m^3/day

- HTFからのオーバーフロー水量と水質

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	284.5	116	33.0	98	27.9	50	14.2
雨天時	285.4	71	20.3	54	15.4	50	14.3

- HTFからの排水量と水質

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	5,129.0	34	174.4	10	51.3	26	133.4
雨天時	5,144.7	34	174.9	10	51.4	26	133.8

- HTFの一回当たり排水量と水質

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/event)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	49.1	34	1.7	10	0.5	26	1.3
雨天時	49.1	34	1.7	10	0.5	26	1.3

2.11. 分水槽 3

(1) 設計条件

- 流入ポンプの揚水量: 5,129.0 m^3/day(晴天時) 5,144.7 m^3/day(雨天時)
- 採用揚水量: 5,144.7 m^3/day
- 水路数: 1 水路
- 滞留時間: 1 min

(2) 設計計算

- 分水槽の容量:

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

分水槽 3			
形状寸法:	3.9 m x	1.1 m x	1.3 m H(水深)
容量:	5.58 m^3		

2.12. 最終ろ過施設(SLS)

(1) 設計条件

- 槽数: 2 槽
- 採用流量: 5,144.7 m^3/day
- 水面積負荷: 150 m^3/m^2/day at Filtering Part
- ろ床の高さ: 0.7 m
- SLSでのTSS 除去率: 0.2549 x (SLSへの流入TSS濃度) +78.088 (%)
- SLSから排出されるP-BOD: 1.4008 x (SLSからの排出TSS濃度) (mg/l)
- SLSでのS-BOD除去率 : 除去不能
- 沈殿汚泥の濃度: 5,000 mg/l
- TSSの沈殿回収率: 0.8
- 洗浄頻度: 常時 3 kg-TSS/m^2
- 逆洗時間: 30 min

(2) 設計計算

- ろ床の水面積:

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

最終ろ過施設(SLS)			
形状寸法:	4.0 m x	5.0 m x	0.7 m H(ろ床高)
ろ床の水面積:	20.0 m^2/槽		
ろ床の水面積負荷:			129 m^3/m^2/day(晴天時)
			129 m^3/m^2/day(雨天時)

- TSS 除去率: 0.2549 x 26 mg/l +78.088 = 84.7 %
安全をみたTSS除去率 60 %
- 排水のTSS: 26 mg/l x (1 - 60 %) = 11.0 mg/l
晴天時 4,999.0 m^3/day x 11.0 mg/l / 1000 = 55.0 kg/day
雨天時 5,014.7 m^3/day x 11.0 mg/l / 1000 = 55.2 kg/day
-排水のP-BOD : 1.4008 x 11.0 mg/l = 16.0 mg/l
-排水のS-BOD : 10 mg/l
-排水のT-BOD :
16.0 mg/l + 10.0 mg/l = 26.0 mg/l
- 洗浄頻度
晴天時 24 hours/day /(133 kg/day / 2 槽 / 20.0 m^2/槽 / 3 kg-TSS/m^2)
= 常時 22 hours/槽
雨天時 24 hours/day /(134 kg/day / 2 槽 / 20.0 m^2/槽 / 3 kg-TSS/m^2)
= 常時 22 hours/Tank
- 沈殿汚泥量 (晴天時)
晴天時 (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
雨天時 (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
- ろ過前TSS量 (晴天時)
晴天時 133.4 kg/day - 55.0 kg/day- 62.7 kg/day = 15.7 kg/day
雨天時 133.8 kg/day - 55.2 kg/day- 62.9 kg/day = 15.7 kg/day
-洗浄排水量
晴天時
129 m^3/m^2/day x 20.0 m^2/槽 x 30 min/回 / 1,440 = 53.8 m^3/槽/回
53.8 m^3/槽/回 x 24 / 22 x 2 Tanks = 117.4 m^3/day
雨天時
129 m^3/m^2/day x 20.0 m^3/槽 x 30 min/回 / 1,440 = 53.8 m^3/槽/回
53.8 m^3/槽/回 x 24 / 22 x 2 槽 117.4 m^3/day

- SLSからの排水量及び水質

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	4,999.0	26.0	130.0	10.0	50.0	11.0	55.0
雨天時	5,014.7	26.0	130.4	10.0	50.1	11.0	55.2

- SLSからの沈殿汚泥量と濃度 (一日平均)

	汚泥量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	12.6	2,817	35.5	10	0.1	5,000	62.7
雨天時	12.6	2,825	35.6	10	0.1	5,000	63.0

- SLSからの洗浄水量及び濃度 (一日平均)

	洗浄水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	117.4	76	8.9	10	1.2	134	15.7
雨天時	117.4	76	8.9	10	1.2	134	15.7

2.13. 塩素混和池

(1) 設計条件

- 流入水量:
- 採用流入水量: 5,014.7 m^3/day
- 槽数: 1 槽
- 滞留時間: 15 min

(2) 設計計算

- 槽容量:

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

塩素混和池					
形状寸法:	2.0 m x	16.2 m x	2.0 m H(水深)		
必要容量:	58.3 m^3	容量:	64.8 m^3		

2.14. 塩素注入ポンプ

(1) 設計条件

- 塩素注入率: 3 mg/l
- 有効塩素率.: 70%
- 塩素溶液濃度: 12%
- ポンプ台数: 2 (1 常用 1 予備)

(2) 設計計算

- 必要塩素量:

晴天時:

4,999.0 m3/day x 3 mg/l = 15 kg/day
15 kg/day / 70% = 21.5 kg/day (固形分)
15 kg/day / 12% = 125 L/day (溶液)

雨天時:

5,014.7 m3/day x 3 mg/l = 15.1 kg/day
15.1 kg/day / 70% = 21.6 kg/day (固形分)
15.1 kg/day / 12% = 126 L/day (溶液)

採用値 126 L/day

- ポンプ能力:

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

塩素注入ポンプ							
ポンプ仕様:	0.4 L/min x	0.3	Mpa x	0.2	kW x	2	台

2.15. 塩素溶解タンク

(1) 設計条件

- 塩素消費量: 126 L/day
- タンク数: 1 基
- 貯留日数: 10 day

(2) 設計計算

- 必要タンク容量:

126 L/day x 10 day / 1 タンク /1000= 1.26 m^3/タンク

塩素溶解タンク					
形状寸法:	径	1.2 m x	1.5 m H x	1	基
Capacity:	1.6 m^3/基 x	1	基		

2.16.洗浄排水貯留設備

(1) 設計条件

- 槽数: 1 槽
- 滞留時間: 2 hours
- 流入水量

	晴天時	雨天時
FSFからの逆洗水	986.0 m^3/day	406.0 m^3/day
SLSからの逆洗水	117.4 m^3/day	117.4 m^3/day
HTFからの排水	49.1 m^3/day	49.1 m^3/day
STからの上澄水	62.0 m^3/day	24.1 m^3/day
計	1,214.5 m^3/day	596.6 m^3/day

- 採用水量: 1,214.5 m^3/day

(2) 設計計算

- 槽容量:

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

洗浄排水貯留槽			
形状寸法:	5.5 m x	7 m x	3 m H(水深)
容量:	116 m^3		

2.17. 洗浄排水貯留槽攪拌機

(1) 設計条件

- 槽容量: 116 m^3
- 攪拌方式: 水中攪拌機
- 攪拌強度: 1.0 m^3/m^3/hour
- 攪拌機台数: 1 基

(2) 設計計算

- 攪拌機能力:

116 m^3 x 1.0 m^3/m^3/hour / 60 / 1 基 2 m^3/min

洗浄排水貯留槽攪拌機					
攪拌機仕様:	2.2 m^3/min x	φ 250 mm x	1.5 kW x	1 基	

2.18. 洗浄排水移送ポンプ

(1) 設計条件

- 洗浄排水量: 1,214.5 m^3/day
- ポンプ台数: 2 (1 常用 1 予備)

(2) 設計計算

- ポンプ揚水量:

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

洗浄排水移送ポンプ									
仕様:	1.1 m^3/min x	6	mH x φ	125x100 mm x	3.7	kW x	2	台	

2.19. 一次濃縮槽

(1) 設計条件

- 流入水量・水質

晴天時

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
FSFからの逆洗水	986.0	278	274.5	98.00	96.6	1,083	1,067.5
SLSからの逆洗水	49.1	34	1.7	10	0.5	26	1.3
HTFからの排水	117.4	76	8.9	10	1.2	134	15.7
STからの上澄水	62.0	400	24.8	76	4.6	1,631	101.1
計	1,214.5	255	309.8	85	102.9	976	1,185.6

雨天時

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
FSFからの逆洗水	406.0	192	78.0	54	21.9	680	276.1
SLSからの逆洗水	49.1	34	1.7	10	0.5	26	1.3
HTFからの排水	117.4	76	8.9	10	1.2	134	15.7
STからの上澄水	24.1	424	10.2	31	0.6	1,340	32.3
計	596.6	166	98.8	41	24.2	545	325.4

- 採用流入水量: 1,214.5 m^3/day
- 水面積負荷: 35 m^3/m^2/day
- 沈殿汚泥の濃度: 10,000 mg/l
- TSS 沈殿回収率: 0.8
- P-BOD 除去率: 0.8
- S-BOD 除去率: 0
- 槽数: 1 槽
- 有効水深: 3 m

(2) 設計計算

- 所要水面積:

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

一次濃縮槽
形状寸法: 内径 7.0 m x 3.0 m H
水面積: 38.4 m^2 滞留時間: 2.3 hours
水面積負荷: 31.6 m^3/m^2/day

- 沈殿汚泥 TSS 量

晴天時 1,185.6 kg/day x 0.8 = 948.5 kg/day
雨天時 325.4 kg/day x 0.8 = 260.3 kg/day

- 沈殿汚泥量

晴天時 948.5 kg/day / 10,000 mg/l /1000 = 94.9 m^3/day
雨天時 260.3 kg/day / 10,000 mg/l /1000 = 26.1 m^3/day

- 上澄水の TSS 量

晴天時 1,185.6 kg/day - 948.5 kg/day = 237.1 kg/day
雨天時 325.4 kg/day - 260.3 kg/day = 65.1 kg/day

- 上澄水量

晴天時 1,214.5 m^3/day - 94.9 m^3/day = 1119.6 m^3/day
雨天時 596.6 m^3/day - 26.1 m^3/day = 570.5 m^3/day

- 沈殿汚泥量・濃度

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	94.9	1,829.8	173.7	85.0	8.1	10,000	948.5
雨天時	26.1	2,328.9	60.8	41.0	1.1	10,000	260.3

- 上澄水量と濃度

	流入水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	1,119.6	121.6	136.2	85.0	94.8	211.8	237.1
雨天時	570.5	66.7	38.0	41.0	23.1	114.1	65.1

2.20. 沈殿汚泥移送ポンプ

(1) 設計条件

- 汚泥量: 94.9 m^3/day
- ポンプ台数: 2 (1 常用 1 予備)

(2) 設計計算

- ポンプ揚水量:

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

沈殿汚泥移送ポンプ
仕様: 0.2 m^3/min x 6 mH x φ 50 mm x 0.75 kW x 2 台

2.21. 重力濃縮槽

(1) 設計条件

- 固形物負荷: 60 kg/m^2/day
- 水面積負荷: 20 m^3/m^2/day
- 水深: 4 m
- 槽数: 1 槽
- 回収率: 90%
- 濃縮汚泥濃度.: 20,000 mg/l
- 流入汚泥量・濃度

晴天時

	汚泥量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
PST 濃縮汚泥	94.9	1,830	173.7	85	8.1	10,000	948.5
SLS 沈殿汚泥	12.6	2,817	35.5	10	0.1	5,000	62.7
計	107.5	1,946	209.2	76	8.2	9,407	1,011.2

雨天時

	汚泥量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
PST 濃縮汚泥	26.1	2,329	60.8	41	1.1	10,000	260.3
SLS 沈殿汚泥	12.6	2,825	35.6	10	0.1	5,000	63.0
計	38.7	2,491	96.4	31	1.2	8,354	323.3

- 採用汚泥量: 107.5 m^3/day
- 採用 TSS量: 1,011.2 kg/day

(2) 設計計算

- 必要水面積:

固形物負荷より

1,011.2 kg/day / 60 kg/m^2/day / 1 槽 16.9 m^2

水面積負荷より

107.5 m^3/day / 20 m^3/m^2/day / 1 槽 6.0 m^2

採用水面積 16.9 m^2

重力濃縮槽					
形状寸法:	径	5.5 m x	4.0 m H		
水面積:	23.7 m^2	滞留時間:	21.2 hours		
固形物負荷:	42.7 kg/m^2/day	水面積負荷:	4.54 m^3/m^2/day		

- 濃縮汚泥量

晴天時 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

雨天時 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

- 上澄水

晴天時 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

雨天時 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

- 濃縮汚泥量・濃度 (一日平均)

	汚泥量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	45.5	4,052	184.4	76	3.5	20,000	910.1
雨天時	14.6	5,902	86.2	31	0.5	20,000	291.0

- 上澄水量・濃度 (一日平均)

	上澄水量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	62.0	400	24.8	76	4.6	1,631	101.1
雨天時	24.1	424	10.2	31	0.6	1,340	32.3

2.22. 重力濃縮汚泥移送ポンプ

(1) 設計条件

- 濃縮汚泥量: 45.5 m^3/day
- ポンプ台数: 2 (1 常用 1 予備)

(2) 設計計算

- ポンプ揚水量:

45.5 m^3/day /24/60 / 1 台 0.04 m^3/min

重力濃縮汚泥移送ポンプ											
仕様:	0.1 m^3/min x	18	mH x φ	50x40	mm x	2.2	kW x	2	台		

2.23. 汚泥消化タンク

(1) 設計条件

- 濃縮汚泥量: 45.5 m^3/day
- TSS容積負荷: 4 kg-TSS/m^3/day
- 重力濃縮汚泥量: 910.1 kg-TSS/day
- 滞留時間 (HRT): 20 days (消化 + 沈殿)
- TSS除去率: 40%
- BOD除去率: 80%
- メタンガス発生率: 0.3 m^3_N-CH_4/kg-TSS Removed
- 消化ガス化率 60 $\%^V/_V$
- 消化汚泥濃度.: 50,000 mg/l
- 汚泥回収率: 90%

(2) 設計計算

- 一次消化タンク・二次消化タンクの必要容積:

  45.5 m^3/day x 20 days = 910 m^3

- 一次消化タンクの必要容量:

  910.1 kg-TSS/day 4 kg-TSS/m^3/day = 228 m^3

一次消化タンク							
形状寸法: 径	7.5 m x	11.0 m H (水深)					
タンク容量	485.9 m^2	TSS 容積負荷:	1.87	kg-TSS/m^3/day	HRT	10.6	days
二次消化タンク							
形状寸法: 径	7.5 m x	10.0 m H (水深)					
タンク容量	441.7 m^2				HRT	9.7	days
タンク容量計	927.6 m^3	HRT 計	20.3	m^3			

- 消化汚泥固形物量

  晴天時 910.1 kg/day x (1 - 40%)= 546.1 kg/day

  雨天時 291.0 kg/day x (1 - 40%)= 174.6 kg/day

- 消化汚泥量

  晴天時 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

  雨天時 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

- 分離液量

  晴天時 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

  雨天時 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

- 消化汚泥BOD量

晴天時　184.4 kg/day x (1 - 80%)= 36.9 kg/day
雨天時　86.2 kg/day x (1 - 80%)= 17.2 kg/day

- 消化汚泥量・濃度

	汚泥量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	9.8	1,792	17.6	500	4.9	50,000	491.5
雨天時	3.1	3,371	10.4	500	1.6	50,000	157.1

- 分離液量・濃度

	分離液量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	35.7	541	19.3	500	17.9	1,528	54.6
雨天時	11.5	590	6.8	500	5.8	1,522	17.5

- メタンガス発生量

晴天時　910.1 kg/day x 40% x 0.3 m^3_N-CH_4/kg = 109.2 m^3_N-CH_4/day
雨天時　291.0 kg/day x 40% x 0.3 m^3_N-CH_4/kg = 34.9 m^3_N-CH_4/day

- 消化ガス発生量

晴天時　109.2 m^3_N-CH_4/day / 60 $\%^v/_v$X = 182.0 m^3_N-Biogas/day
雨天時　34.9 m^3_N-CH_4/day / 60 $\%^v/_v$X = 58.2 m^3_N-Biogas/day

2.24. 消化汚泥移送ポンプ

(1) 設計条件

- 消化汚泥量: 9.8 m^3/day
- 汚泥移送時間: 23 hours/day, 7 days/week
- 汚泥引き抜き時間: 1 hours/day, 5 days/week
- 汚泥返送率: 200% （供給に対して）
- ポンプ台数: 2 (1 常用 1 予備)

(2) 設計計算

- 返送汚泥量に対して:

9.8 m^3/day x 200% x 7 / 7 x 24/ 23 / 60 / 1 台 0.35 m^3/min

- 除去汚泥量に対して:

9.8 m^3/day / 1 hours/day x 7 / 5 / 60 / 1 台 0.23 m^3/min

- 採用ポンプ揚水量 0.35 m^3/min

消化汚泥移送ポンプ
仕様: 0.4 m^3/min x 18 mH x φ 80 x 65 mm x 5.5 kW x 2 台

2.25. ガスホルダ

(1) 設計条件

- ガス発生量: 182.0 m^3_N/day
- 貯留時間: 2 hours
- 温度: 35 °C
- 圧力: 2 kPa

(2) 設計計算

- 消化ガス量(実際):

182.0 m^3_N/day x (273.15 + 35) / 273.15 x (101.325 + 2) / 101.325 = 209 m^3/day

- 必要貯留量:

209.4 m^3/day x 2 / 24 = 17 m^3

ガスホルダ		
タンク容量:	20.0	m^2
貯留時間	2.3	hours

2.26. 余剰ガス燃焼装置

(1) 設計条件

- 発生ガス量: 209.4 m^3/day
- 燃焼回数: 3 回/day

(2) 設計計算

- 燃焼装置の所要能力:

209.4 m^3/day / 24 x 3 回 26 m^3/hour

余剰ガス燃焼装置		
焼却能力:	30.0	m^3/hour
焼却時間	7.0	hours/day

2.27. 汚泥乾燥床

(1) 設計条件

- 発生汚泥量: 9.8 m^3/day
- 発生汚泥濃度: 50,000 mg/l
- 運転時間: 1 hours/day, 5 days/week

- 乾燥汚泥の含水率: 50%
- 回収率: 98%
- 乾燥時間: 20 days
- 乾燥床数: 20 床
- 乾燥床内の汚泥高: 0.3 m

(2) 設計計算

- 乾燥汚泥量:

晴天時	491.5 kg/day x	98% kg/day =	481.7 kg-DB/day
	481.7 kg/day / (1-	50%) =	963 kg-WB/day
雨天時	157.1 kg/day x	98% kg/day =	154.0 kg-DB/day
	154.0 kg/day / (1-	50%) =	308 kg-WB/day

- 乾燥床の表面積

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

汚泥乾燥床			
形状寸法	8 m x	5 m x	0.3 m H (汚泥深さ)
乾燥床の面積:	40 m^2 x	20 床	

- 浸出液量

晴天時

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

雨天時

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

- 浸出液量・濃度 (一日平均)

	浸出液量	T-BOD		S-BOD		TSS	
	(m^3/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)	(mg/l)	(kg/day)
晴天時	8.8	529	4.7	500	4.4	1,114	9.8
雨天時	2.8	562	1.6	500	1.4	1,107	3.1

2.28. コンプレッサー

(1) 設計条件

- FSFの通気速度 : 1.0 m/min
- FSFの水表面積 : 24.0 m^2/Tank
- 空気弁作動のための要件: 0.1 m^3/min
- 空気圧縮機の台数: 2 (1 常用 1 予備)

(2) 設計計算

- 所要圧縮空気量:

24.0 m^2/槽 x 1.0 m/min + 0.1 m^3_N/min = 24.1 m^3_N/min

空気圧縮機
仕様: 500.0 L_N/min x 0.8 MPa x 5.5 kW x 2 台

2.29. 送風ファン

(1) 設計条件

- HTFの通気速度 : 1.5 m/min
- SLSの通気速度 : 0.4 m/min
- HTFの表面積 : 82.0 m^2/槽
- 室数: 4 /槽
- SLSの表面積 : 20.0 m^2/槽
- 送風機台数: 2 (1 常時 1 予備)

(2) 設計計算

- HTFの所要空気量:

82.0 m^2/槽 / 4 室 1.5 m/min = 30.8 m^3_N/min

- SLSの所要空気量:

20.0 m^2/槽 / 0.4 m/min = 8.0 m^3_N/min

- 採用必要空気量: 30.8 m^3_N/min

送風機
仕様: 32.7 m^3_N/min x 3,000 mmH_2O x 30 kW x 2 台

2.30. ブロワー

(1) 設計条件

- HTF 流入量 : 5,479.2 m^3/day
- 下水 1 m^3当たりの必要空気量 6 m^3_N-Air / m^3-下水
- HTFの槽数: 2 槽
- HTFの送気量: 32.7 m^3_N/min/series
- 所要排気量: 110% （送気量に対して）
- 台数: 2 台

(2) 設計計算

- 必要換気量:

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

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

- 排風量:

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

ブロワー
仕様: 36.1 m^3_N/min x 3.0 kPa x 3.7 kW x 2 台

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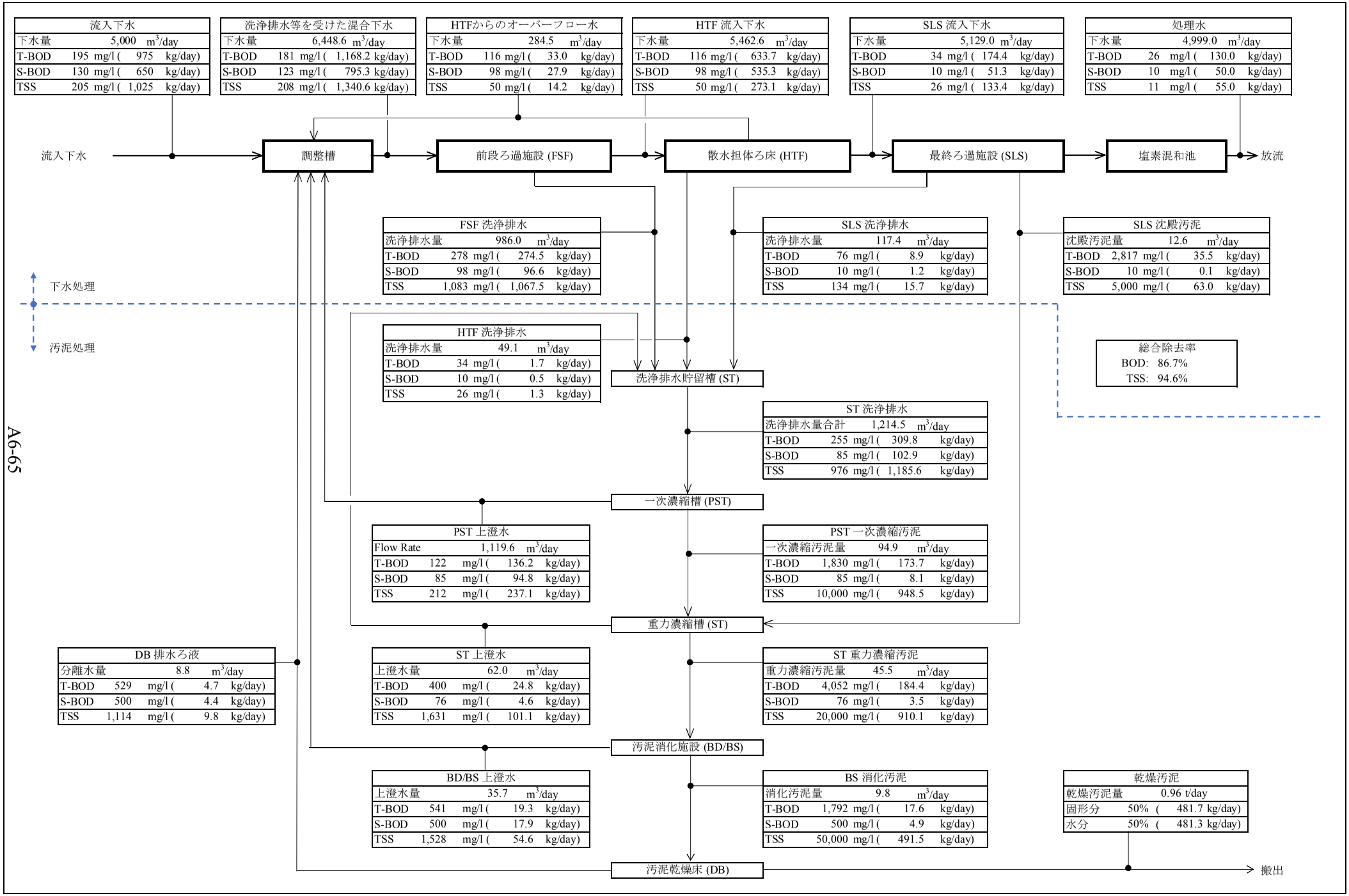
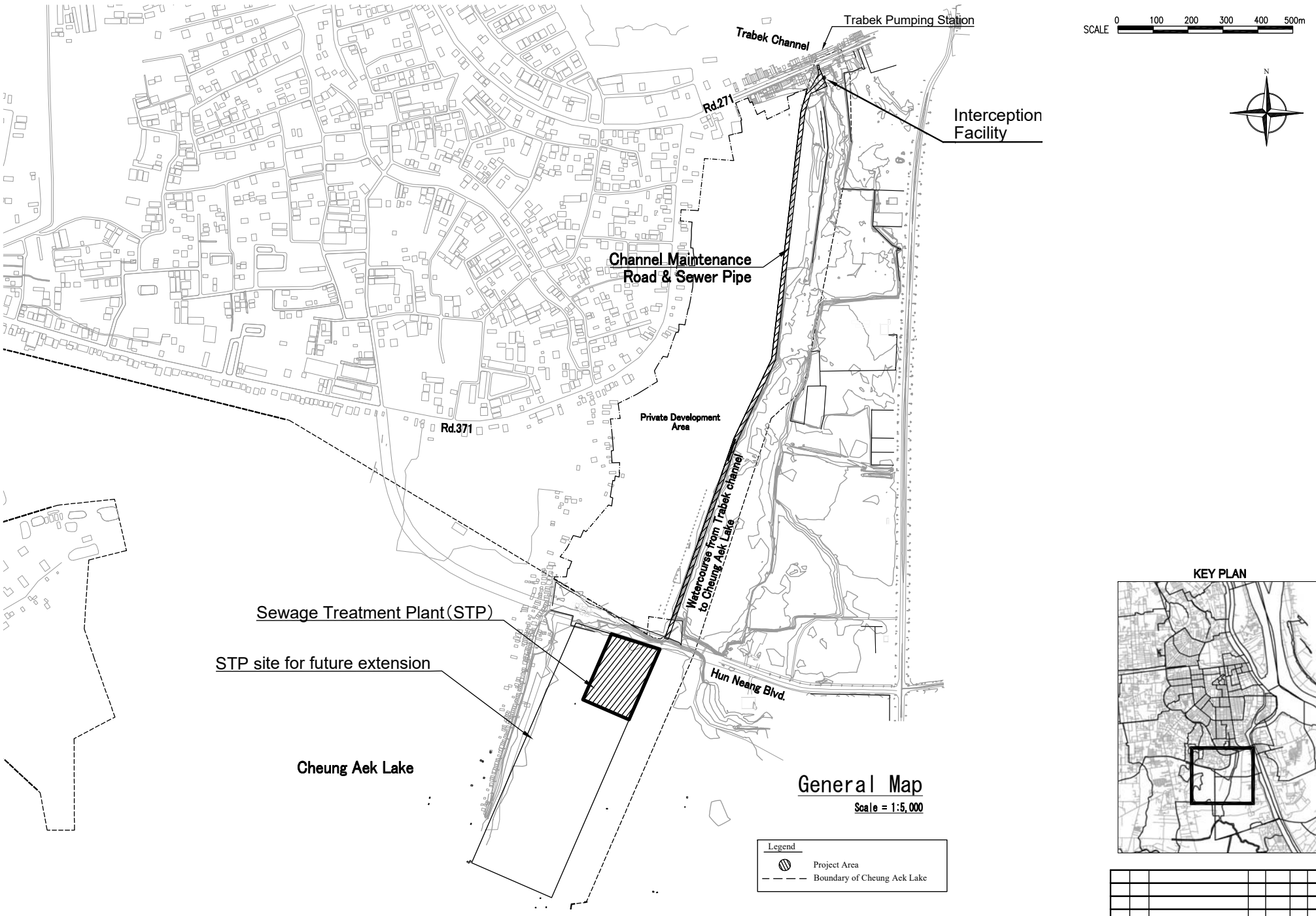

流入下水
下水量 5,000 m3/day
T-BOD 195 mg/l (975 kg/day)
S-BOD 130 mg/l (650 kg/day)
TSS 205 mg/l (1,025 kg/day)
洗浄排水等を受けた混合下水
下水量 6,448.6 m3/day
T-BOD 181 mg/l (1,168.2 kg/day)
S-BOD 123 mg/l (795.3 kg/day)
TSS 208 mg/l (1,340.6 kg/day)
HTFからのオーバーフロー水
下水量 284.5 m3/day
T-BOD 116 mg/l (33.0 kg/day)
S-BOD 98 mg/l (27.9 kg/day)
TSS 50 mg/l (14.2 kg/day)
HTF 流入下水
下水量 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)
SLS 流入下水
下水量 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)
処理水
下水量 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)
流入下水
調整槽
前段ろ過施設 (FSF)
散水担体ろ床 (HTF)
最終ろ過施設 (SLS)
塩素混和池
放流
FSF 洗浄排水
洗浄排水量 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)
SLS 洗浄排水
洗浄排水量 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)
SLS 沈殿汚泥
沈殿汚泥量 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)
下水処理
汚泥処理
HTF 洗浄排水
洗浄排水量 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)
洗浄排水貯留槽 (ST)
総合除去率
BOD: 86.7%
TSS: 94.6%
ST 洗浄排水
洗浄排水量合計 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)
一次濃縮槽 (PST)
PST 上澄水
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)
PST 一次濃縮汚泥
一次濃縮汚泥量 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)
重力濃縮槽 (ST)
DB 排水ろ液
分離水量 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)
ST 上澄水
上澄水量 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)
ST 重力濃縮汚泥
重力濃縮汚泥量 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)
汚泥消化施設 (BD/BS)
BD/BS 上澄水
上澄水量 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)
BS 消化汚泥
消化汚泥量 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)
乾燥汚泥
乾燥汚泥量 0.96 t/day
固形分 50% (481.7 kg/day)
水分 50% (481.3 kg/day)
汚泥乾燥床 (DB)
搬出

［ 別　添 ］概略設計図

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

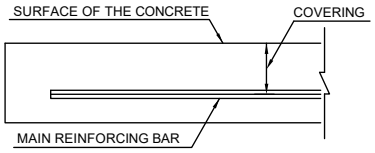
3.1 CLASSIFICATION OF CONCRETE IS AS SHOWN BELOW :

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.

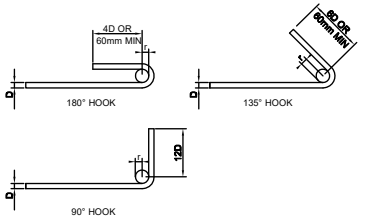
3.7 CLEAR DISTANCE BETWEEN PARALLEL BARS EXCEPT IN COLUMNS AND BETWEEN MULTIPLE LAYERS, SHALL BE NOT LESS THAN 4/3 TIMES MAXIMUM SIZE OF COARSE AGGREGATE.

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.

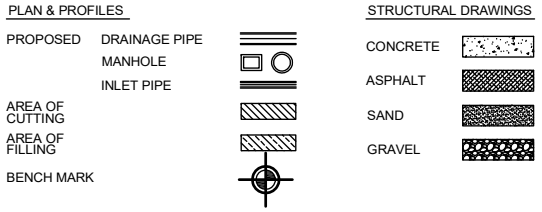
5. OTHERS

ABBREVIATIONS

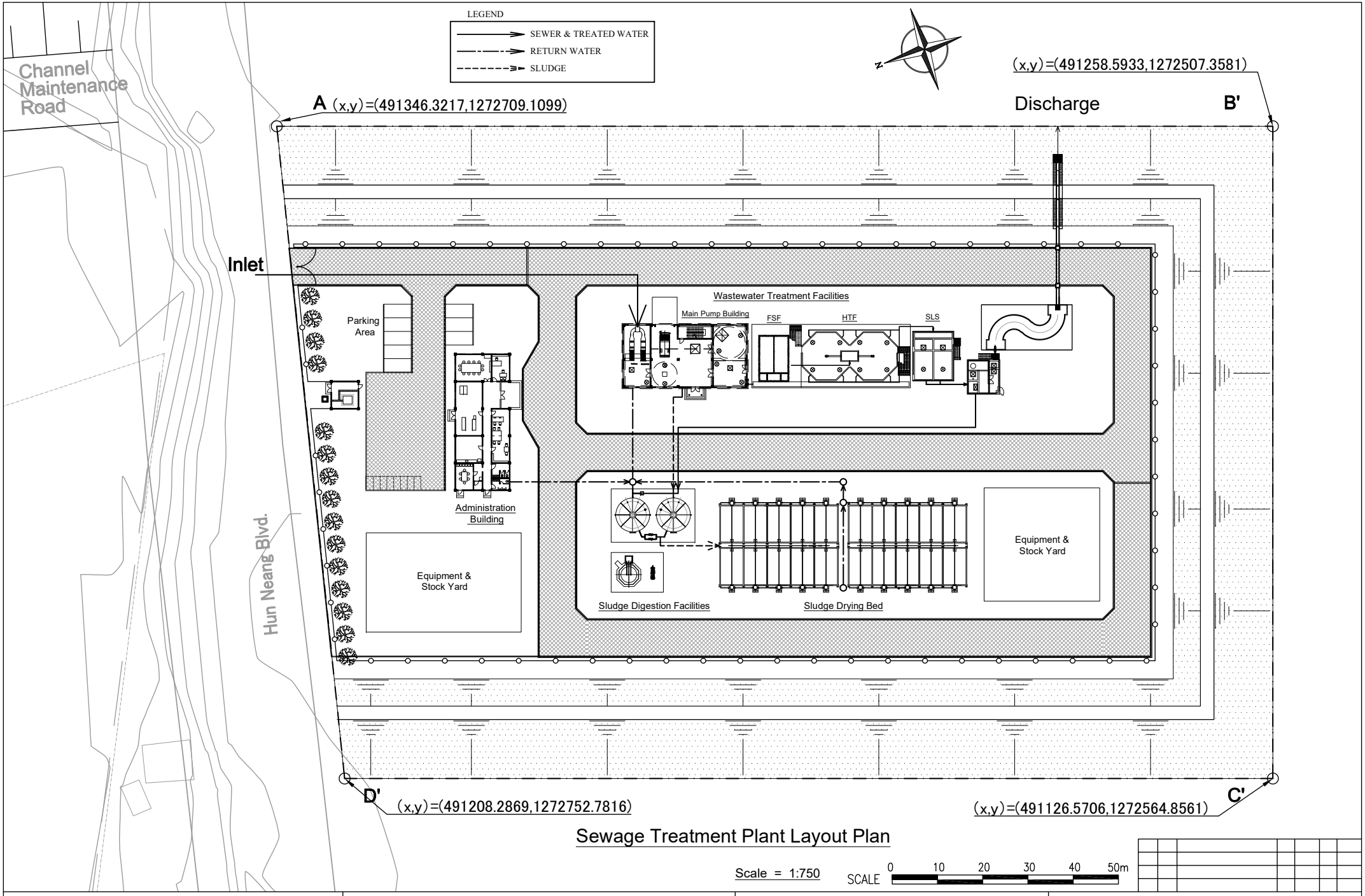
-GENERAL-

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

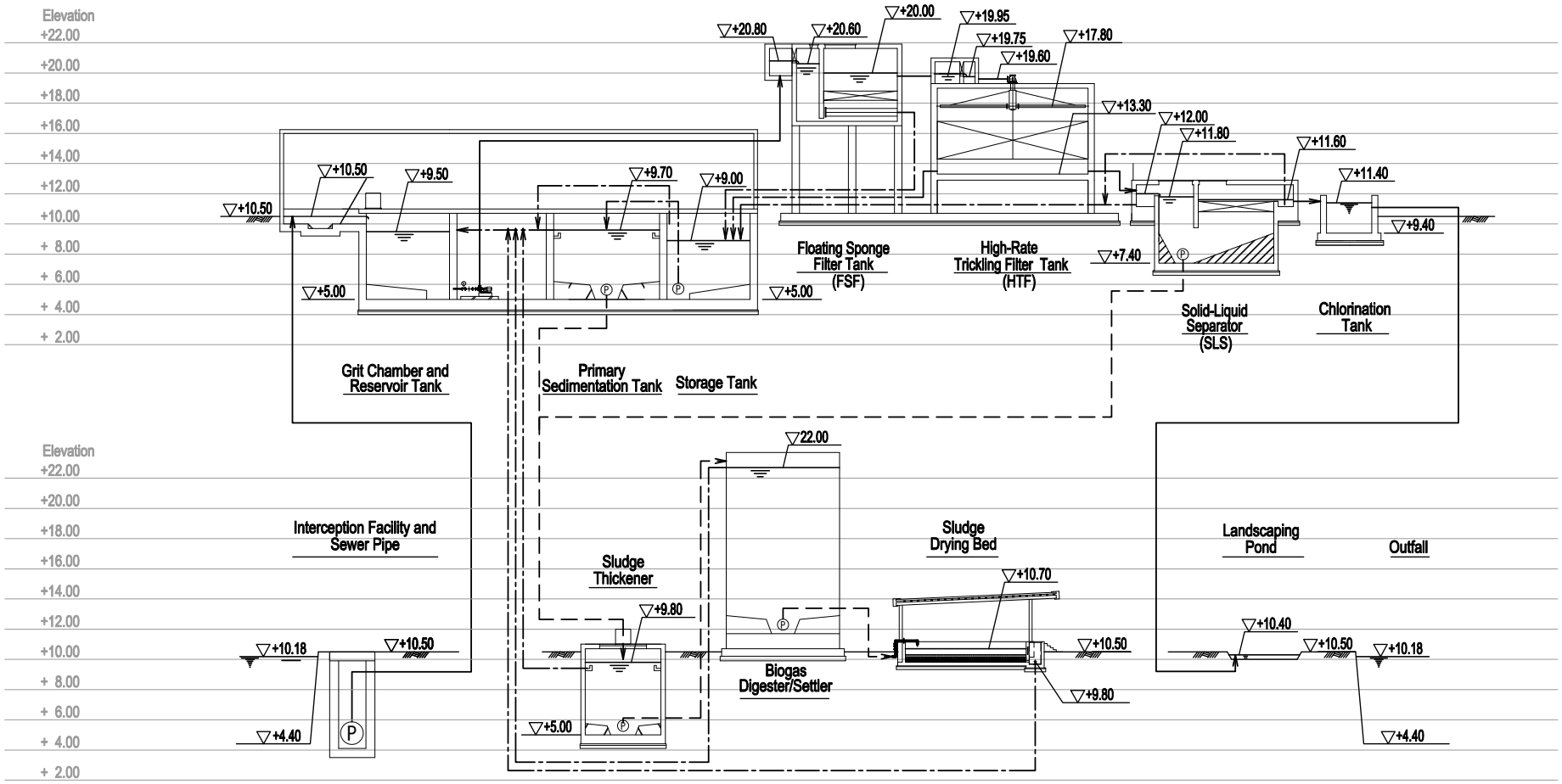


Sewage Treatment Plant Layout Plan

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

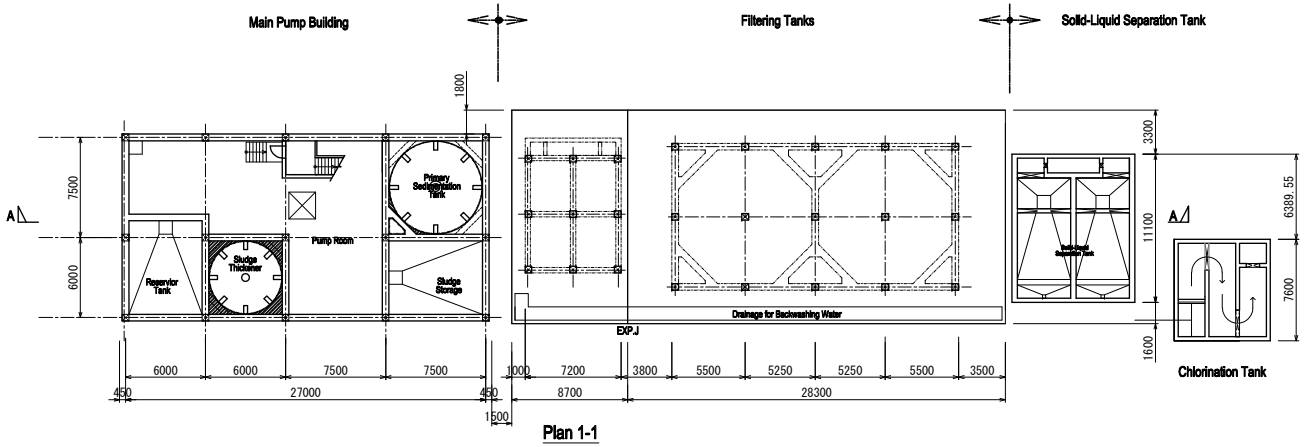


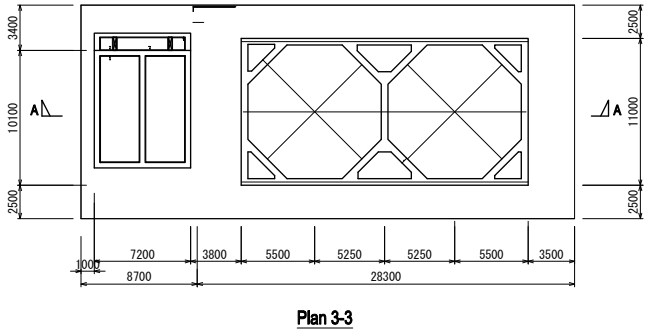
Sewage Treatment Plant Hydraulic Profile

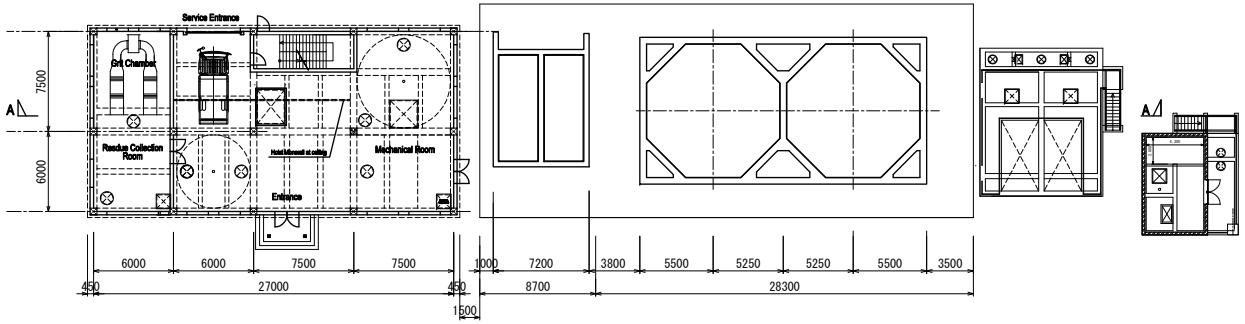
V-Scale = 1:150

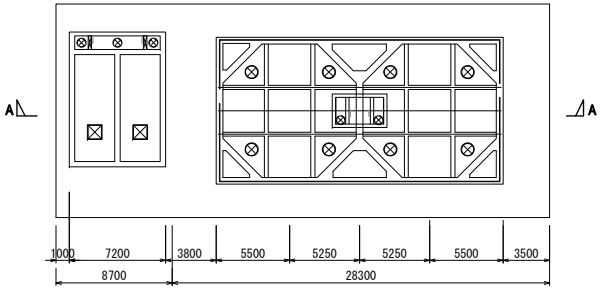
H-Scale = Non

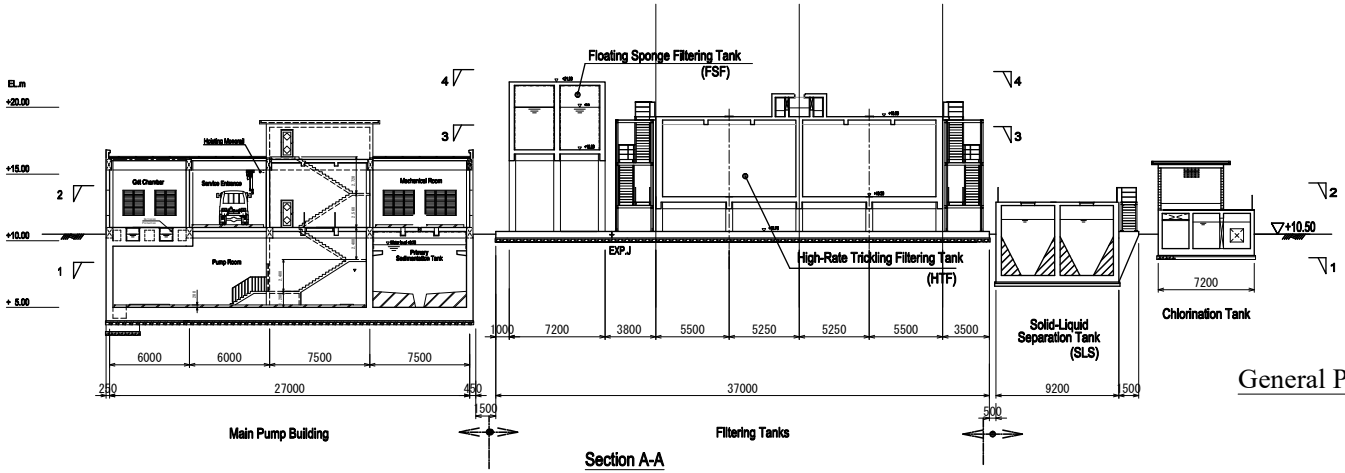
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-GN-002	SEWAGE TREATMENT PLANT Hydraulic Profile









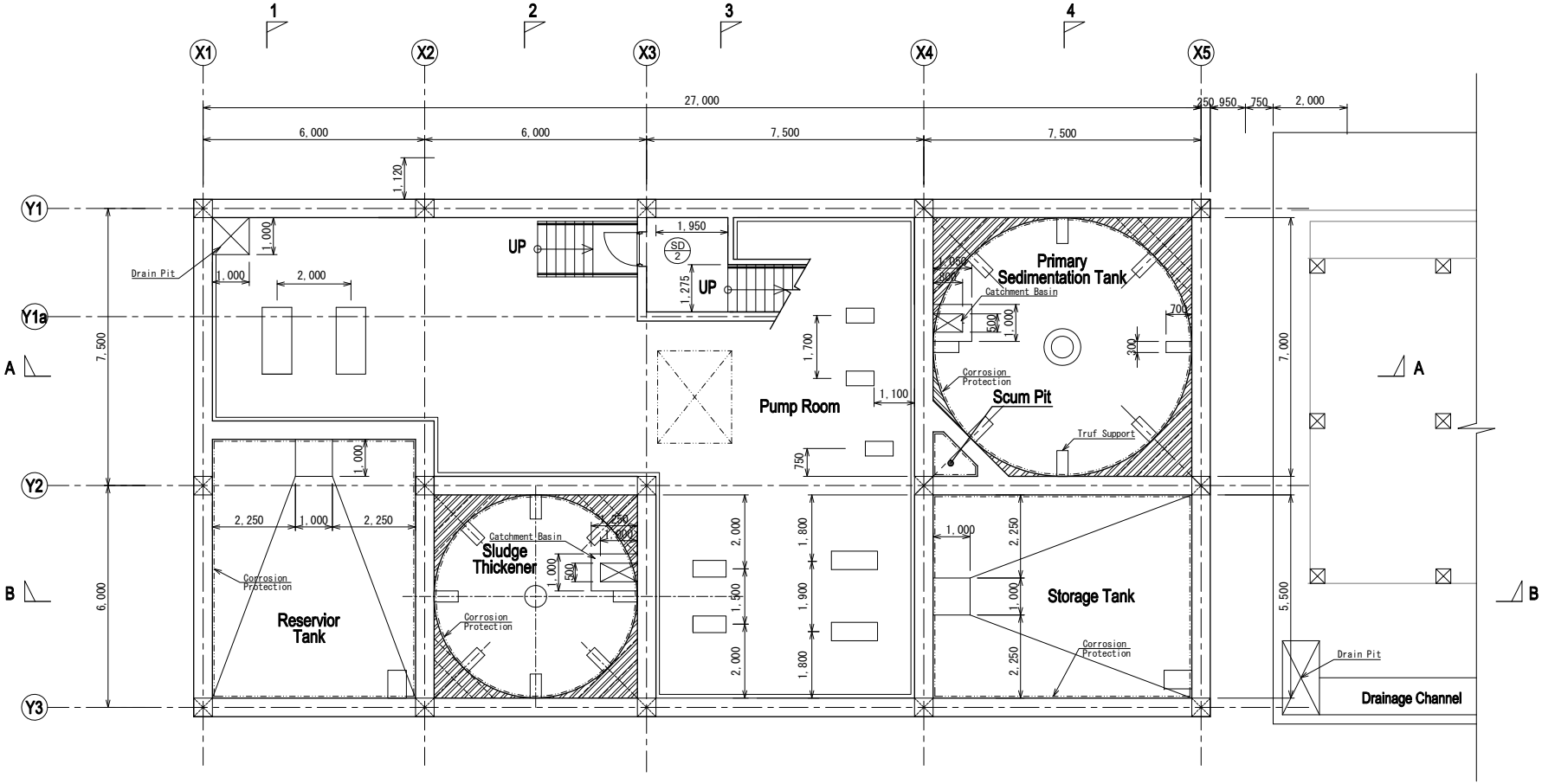


LEGEND

SEWER & TREATED WATER
BACK WASHING WATER
SLUDGE

General Plan & Cross Section of Wastewater Treatment Facilities

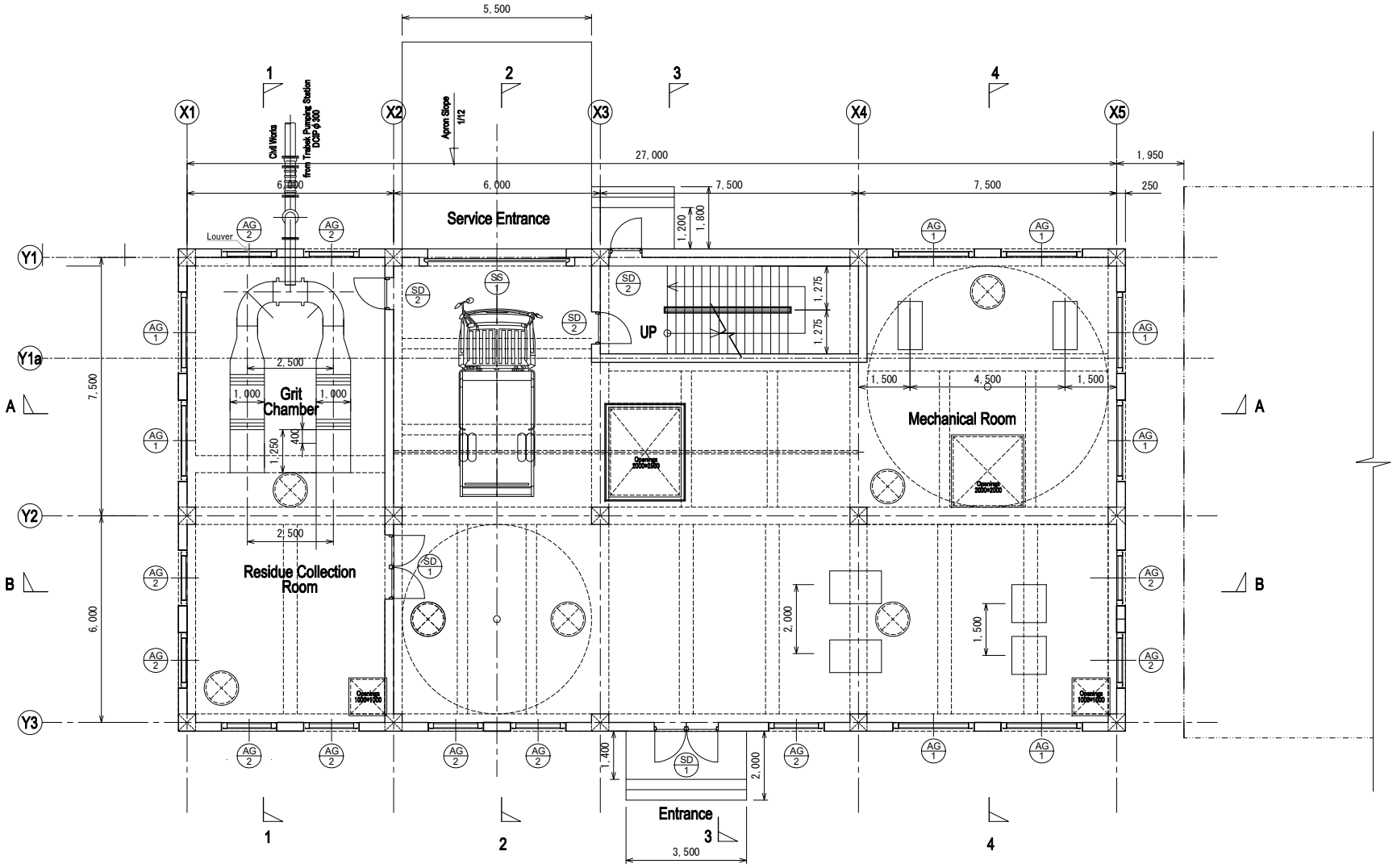
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP- GN-003	SEWAGE TREATMENT PLANT General Layout of Wastewater Treatment Facilities



Basement Floor (BF) PLAN

Scale = 1:125

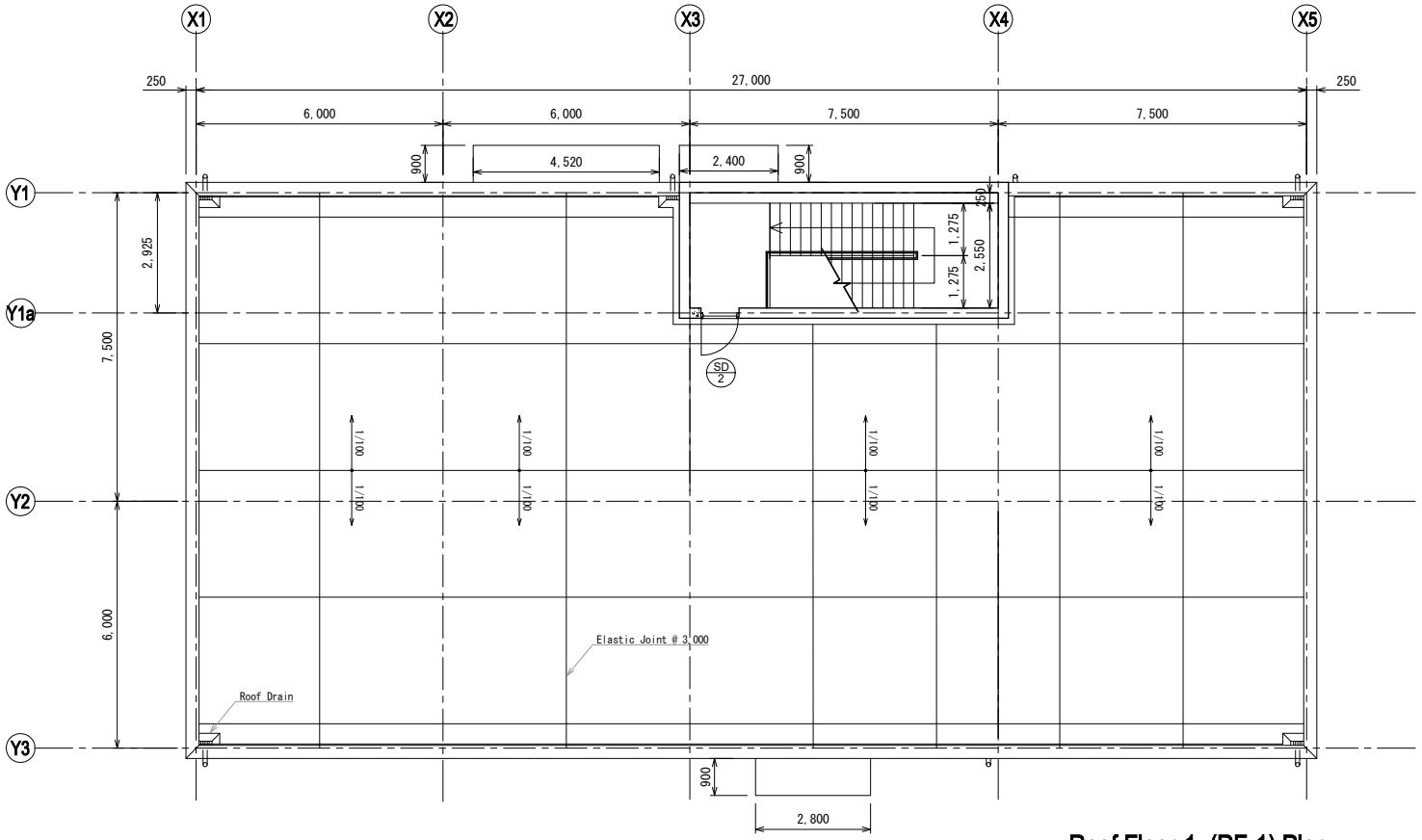
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-001	SEWAGE TREATMENT PLANT Main Pump Building Plan (1/3)



Ground Floor (GF) PLAN

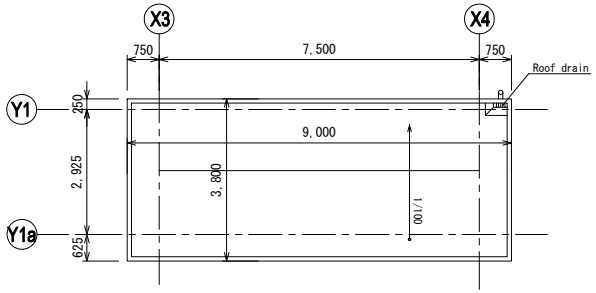
Scale = 1:125

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

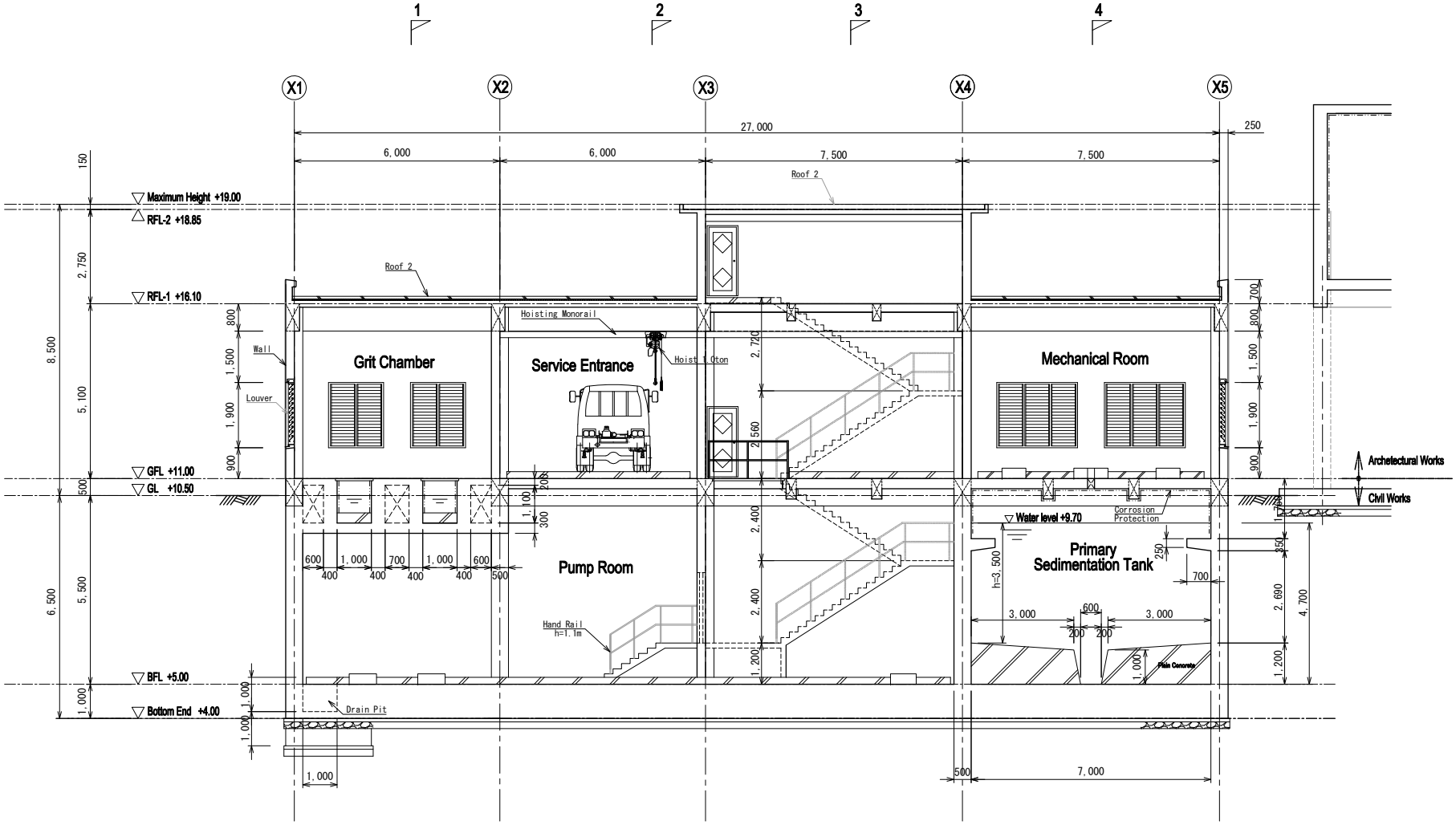
Scale = 1:125



Roof Floor - 2 (RF-2) Plan

Scale = 1:125

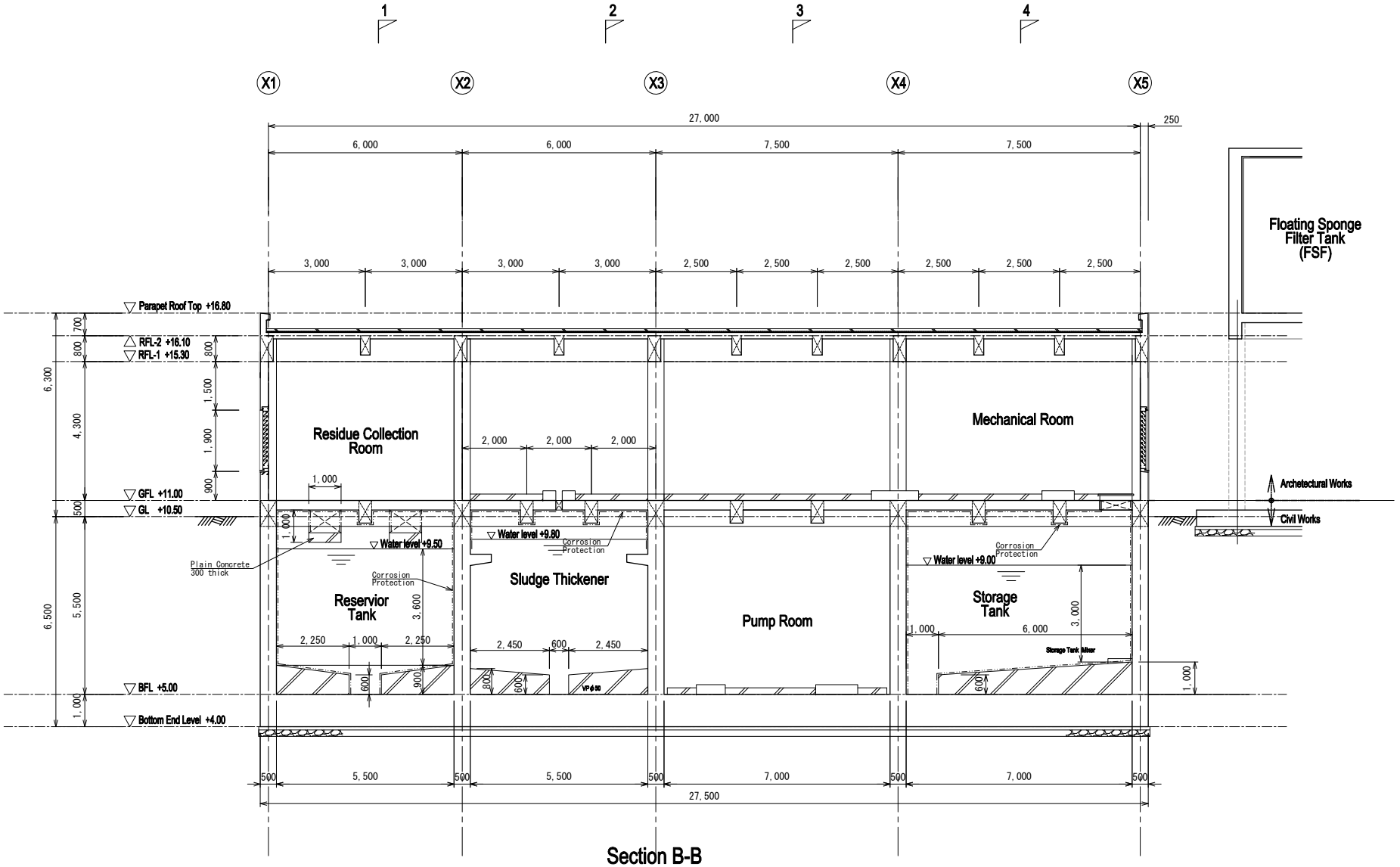
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-003	SEWAGE TREATMENT PLANT Main Pump Building Plan(3/3)



Section A-A

Scale = 1:125

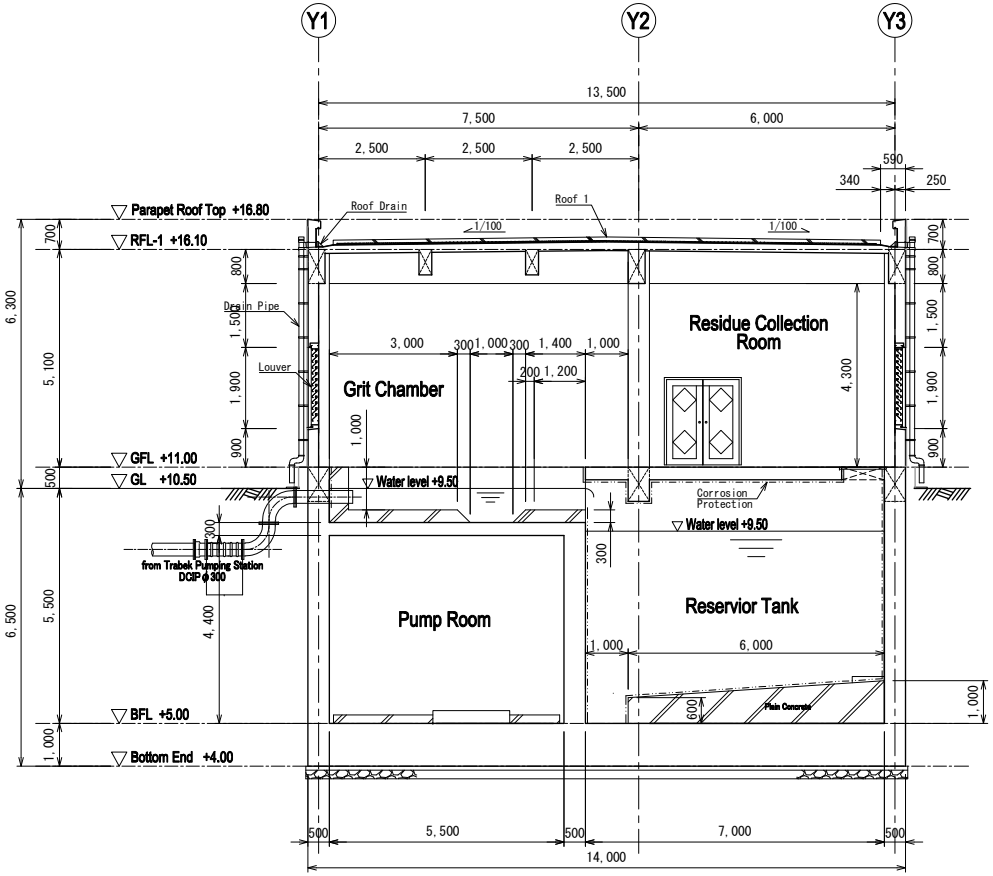
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-004	SEWAGE TREATMENT PLANT Main Pump Building Section (1/4)



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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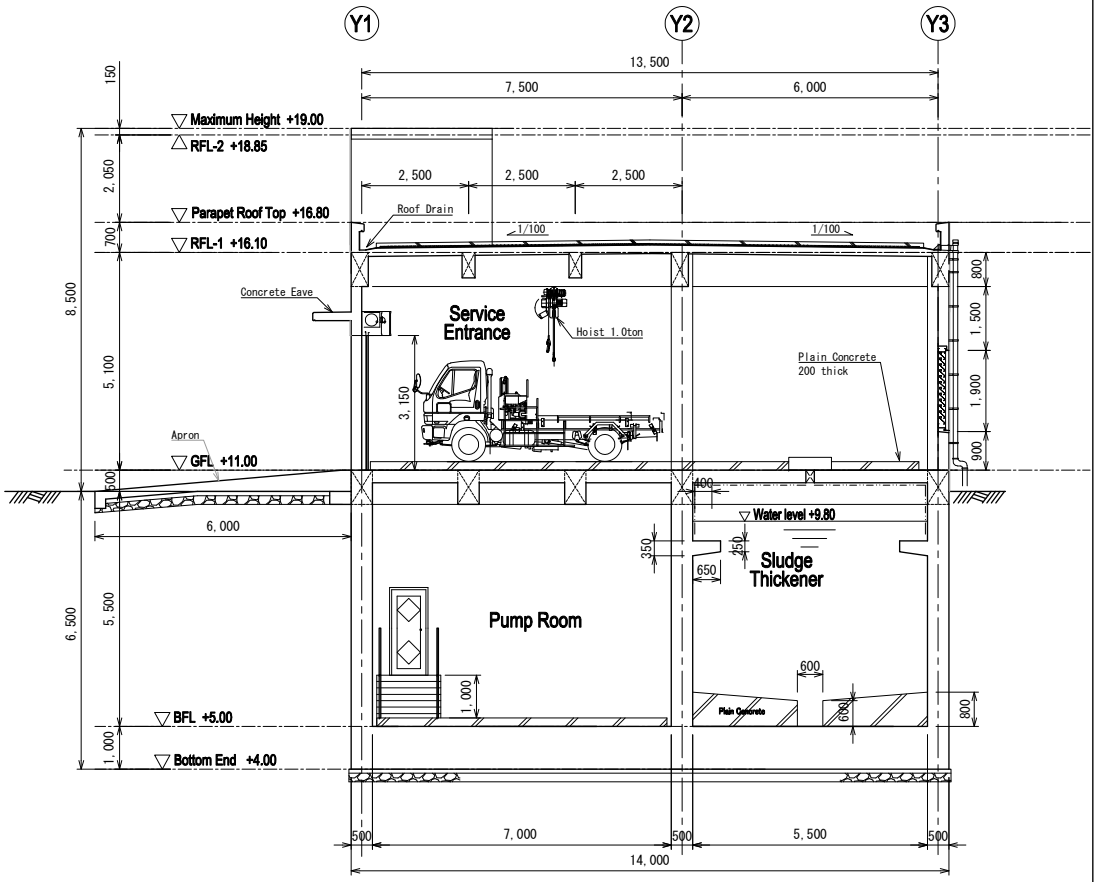
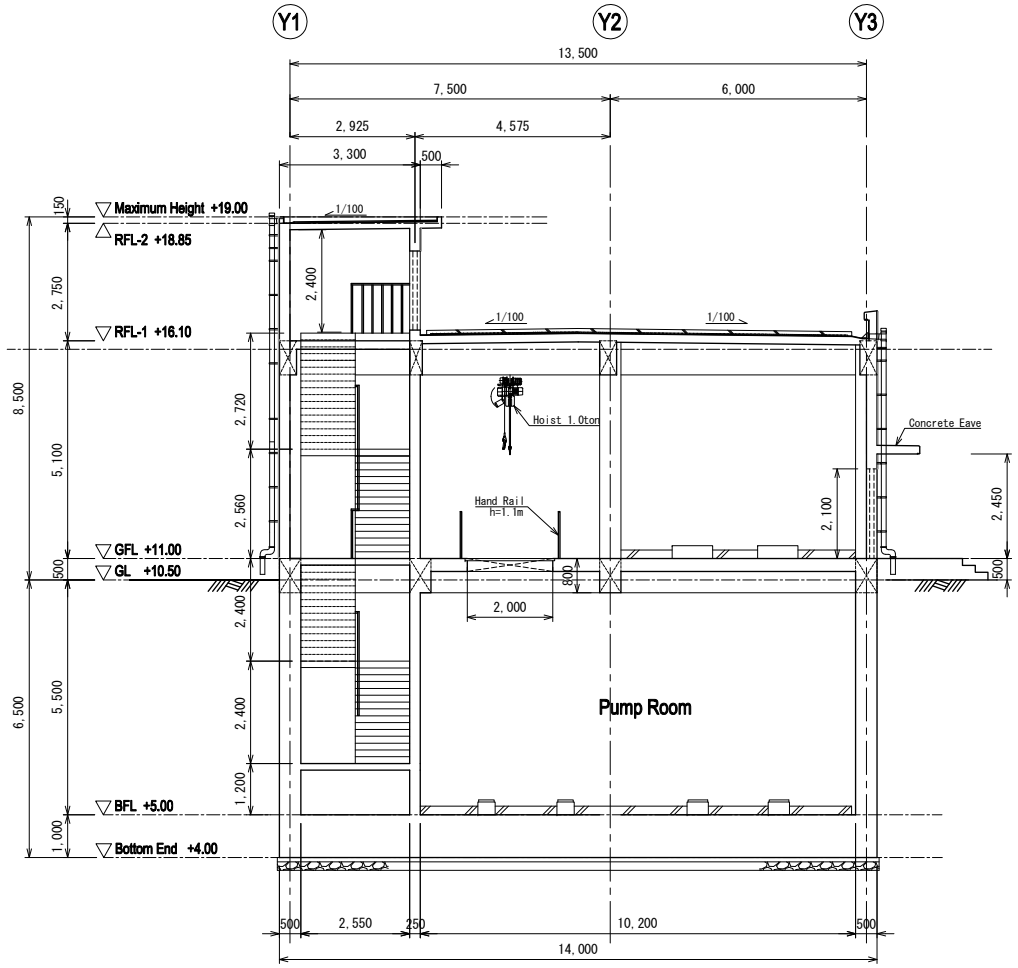


Section 2-2

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

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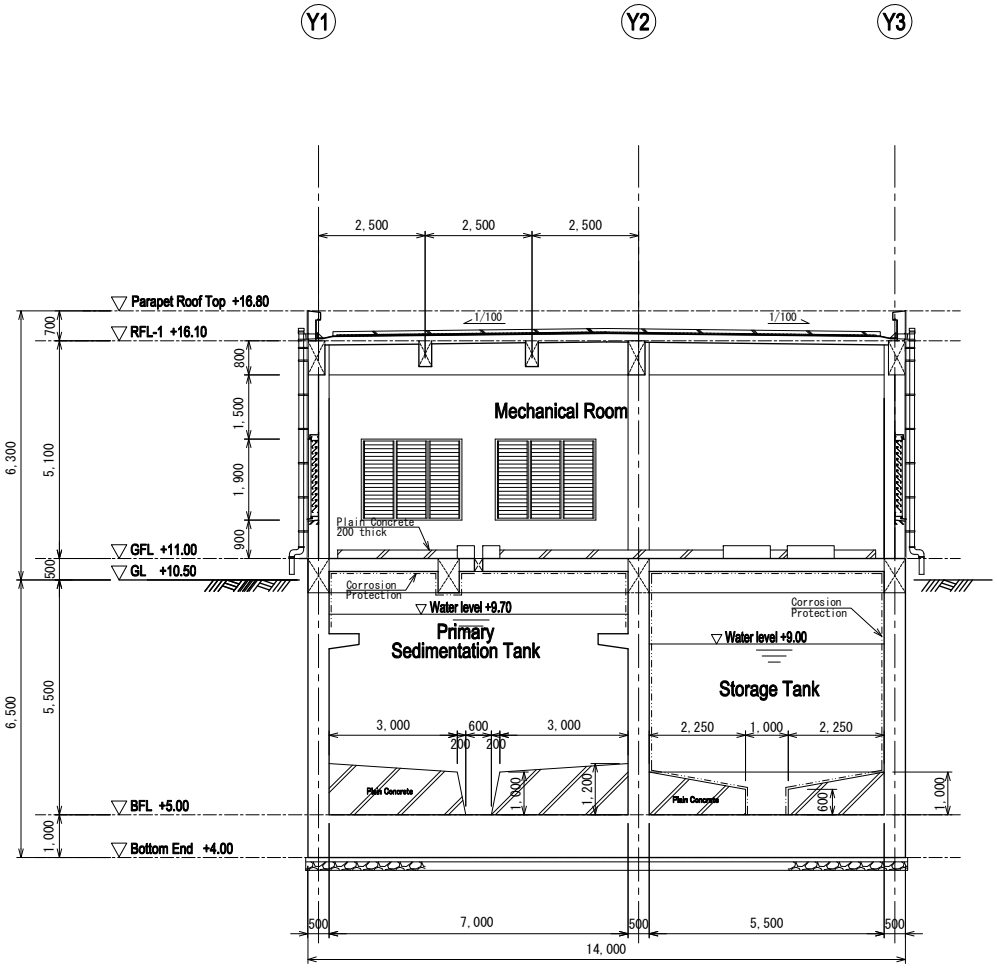
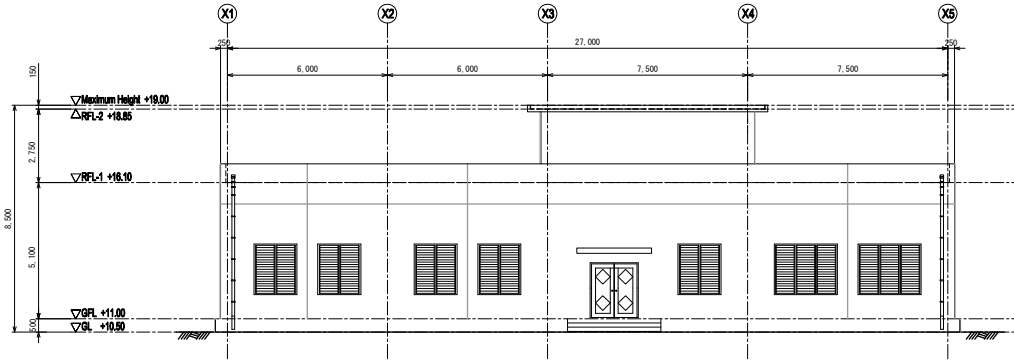


Section 4-4

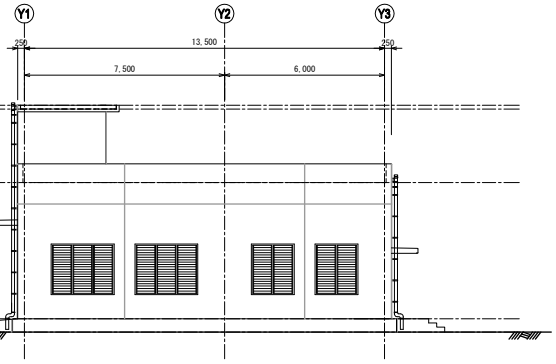
Scale = 1:125

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)



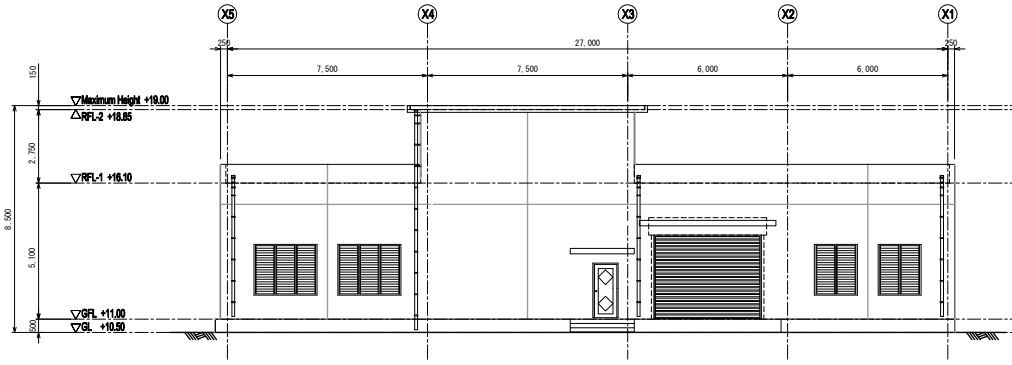
Elevation Front View

Scale = 1:200



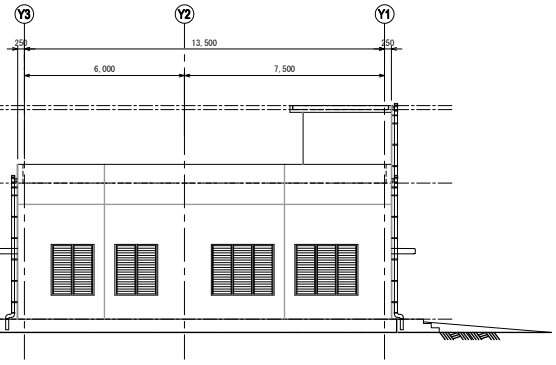
Elevation Left View

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

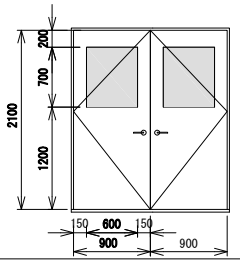
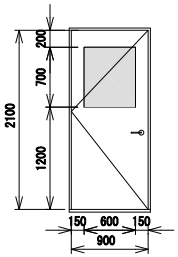
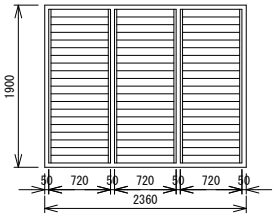
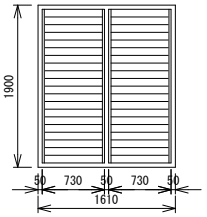
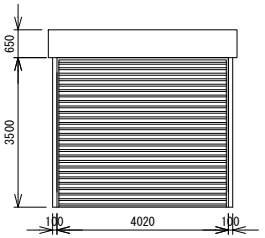
	MAIN PUMP BUILDING	CHLORINE SOLUTION TANK HOUSE
FLOOR AREA	364.50m²	34.78m²
USE	MECHANICAL ROOM, RESIDUE COLLECTION ROOM	CHLORINE SOLUTION TANK ROOM
STRUCTURE	REINFORCE CONCRETE STRUCTURE	CONCRETE BLOCK STRUCTURE
SCOPE	ONE-STORY BUILDING	ONE-STORY BUILDING
HEIGHT	8,500mm (from GROUND LEVEL) 8,000mm (from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

INTERIOR FINISH SCHEDULE

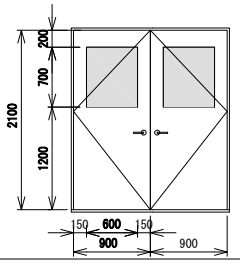
	ROOM NAME	FLOOR LEVEL	FLOOR	BASEBOARD	WALL	CEILING	CEILING HEIGHT (mm)	REMARKS
MAIN PUMP BUILDING	MECHANICAL ROOM	±0	Concrete steel trowel finish W/Epoxy resin coating Light-weight concrete t300	Concrete mortar t200 AEP H300	Fair-faced concrete AEP	Fair-faced concrete AEP	5,000	Side ditch with steel 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

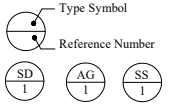
MAIN PUMP BUILDING

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 :



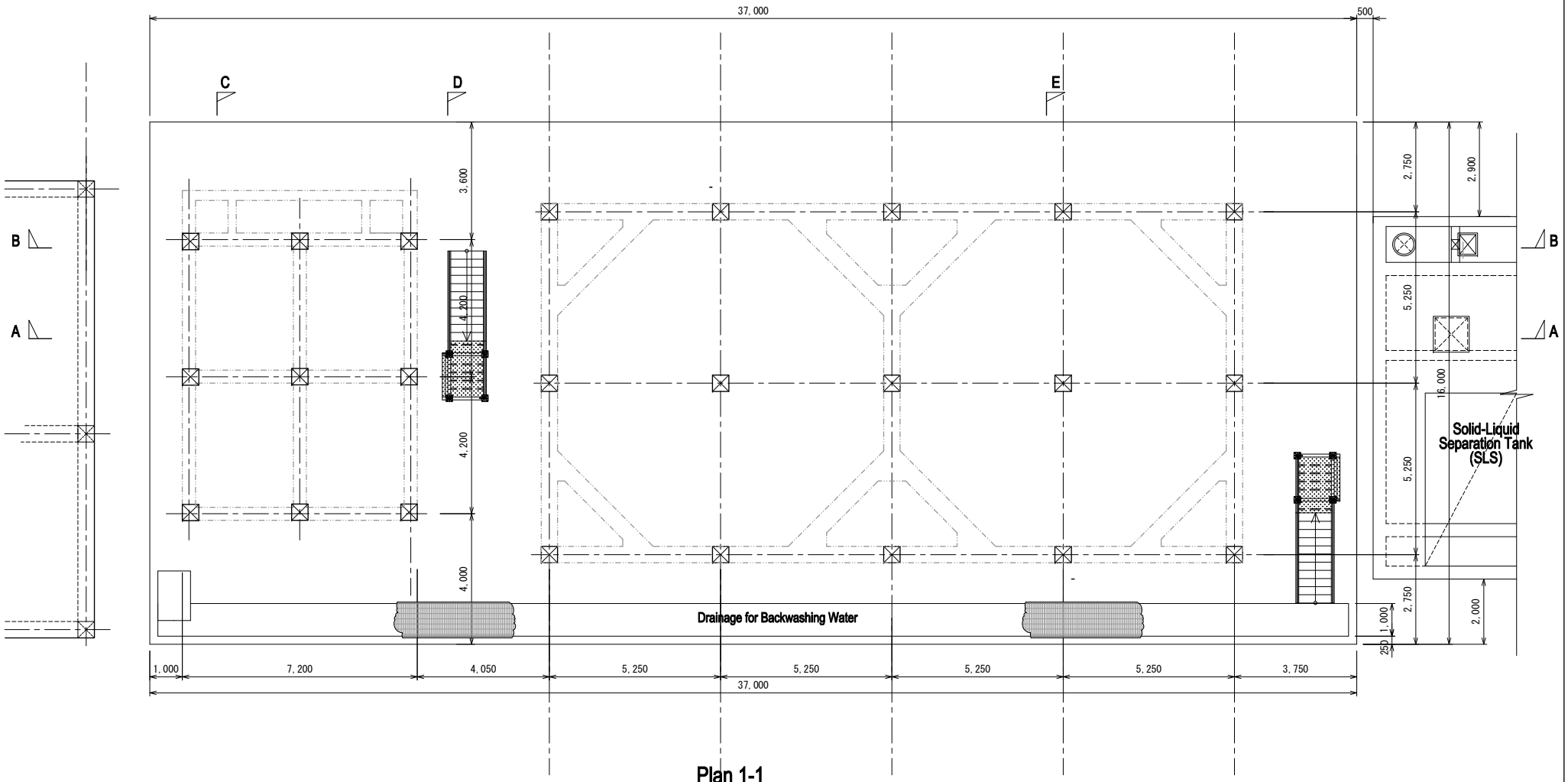
SYMBOL LEGEND

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

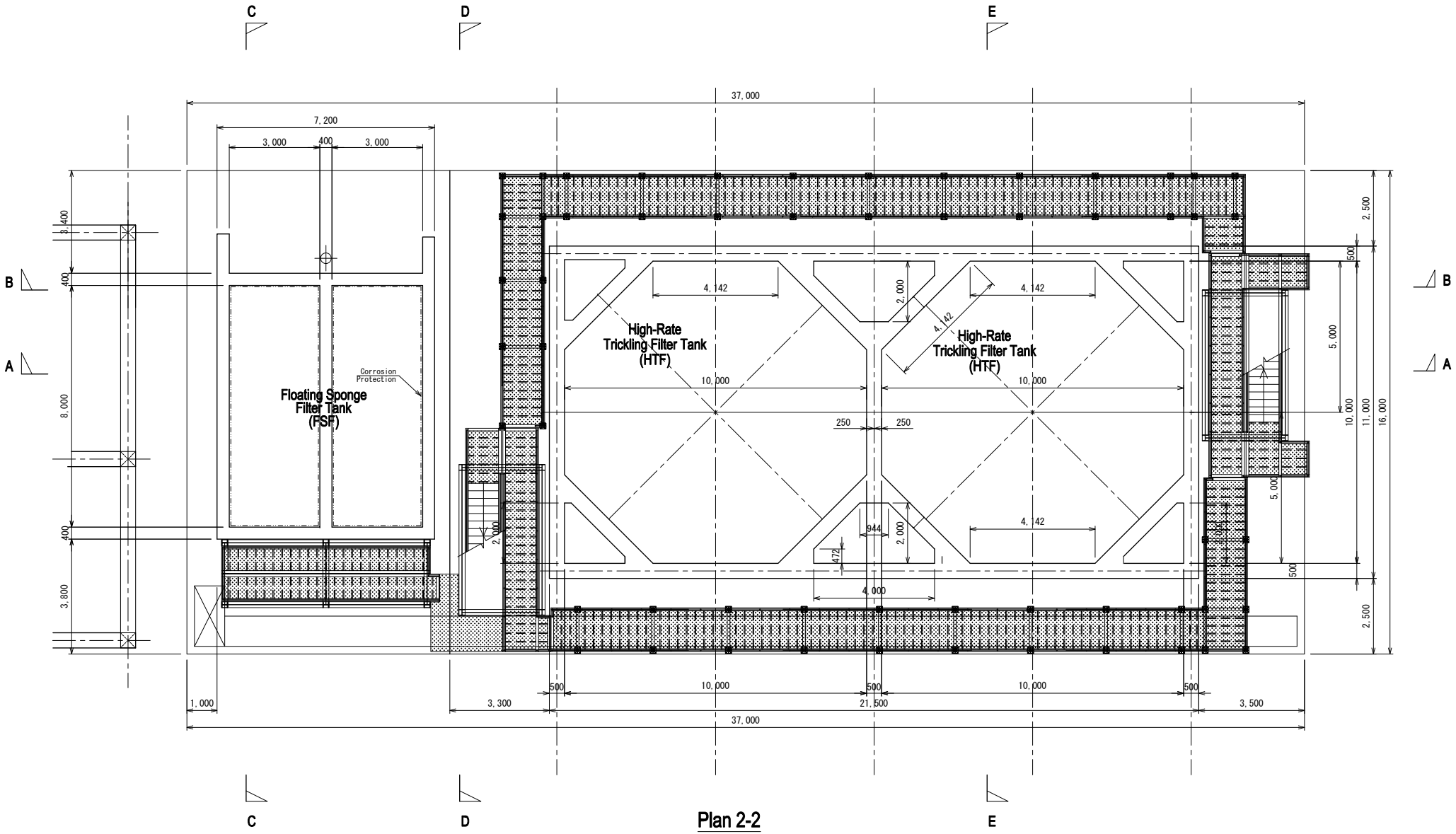
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-MB-010	SEWAGE TREATMENT PLANT Main Pump Building Door & Window List



Plan 1-1

Scale = 1:125

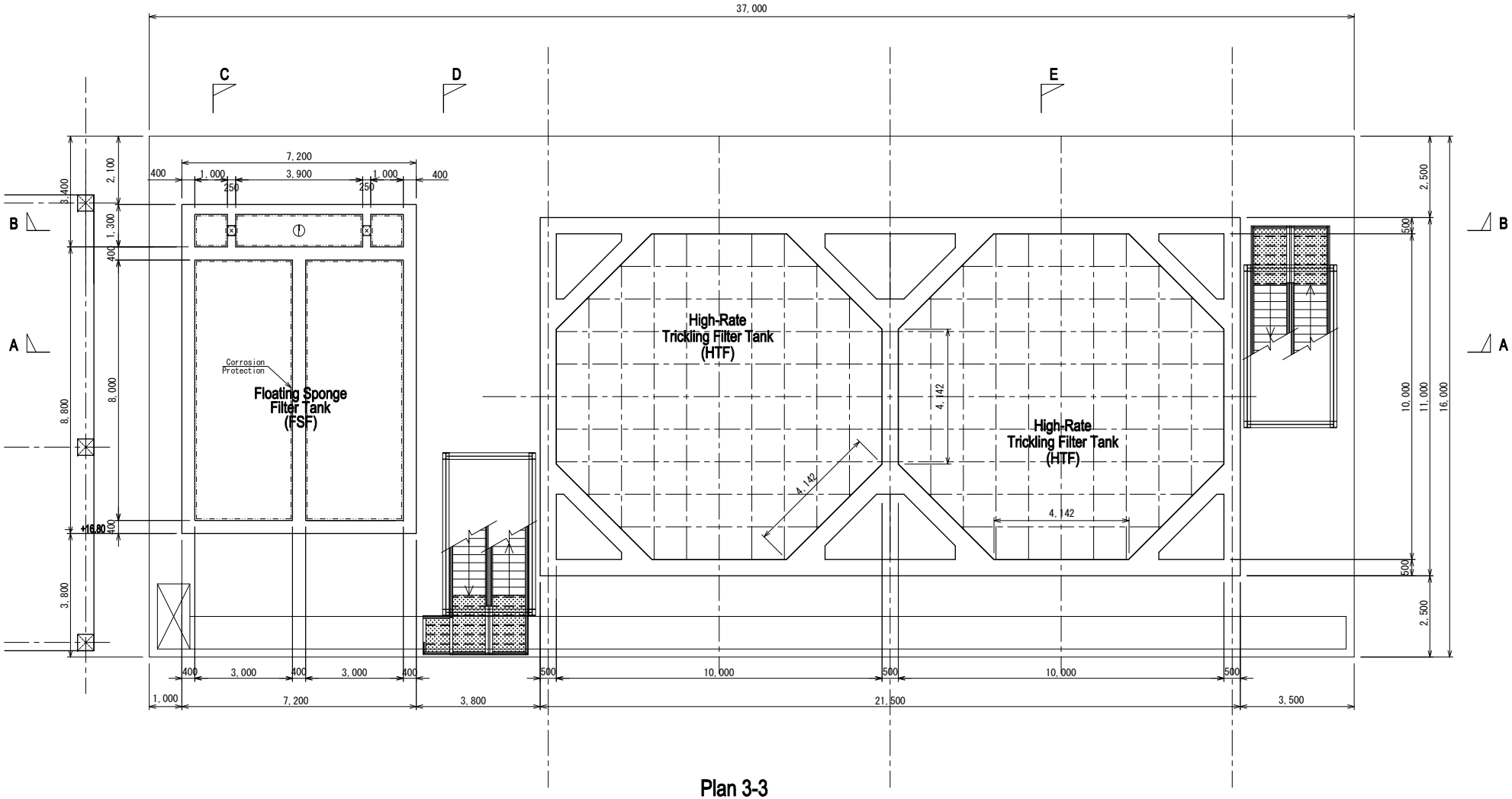
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-001	SEWAGE TREATMENT PLANT Filtering Tank Plan (1/4)



Plan 2-2

Scale = 1:125

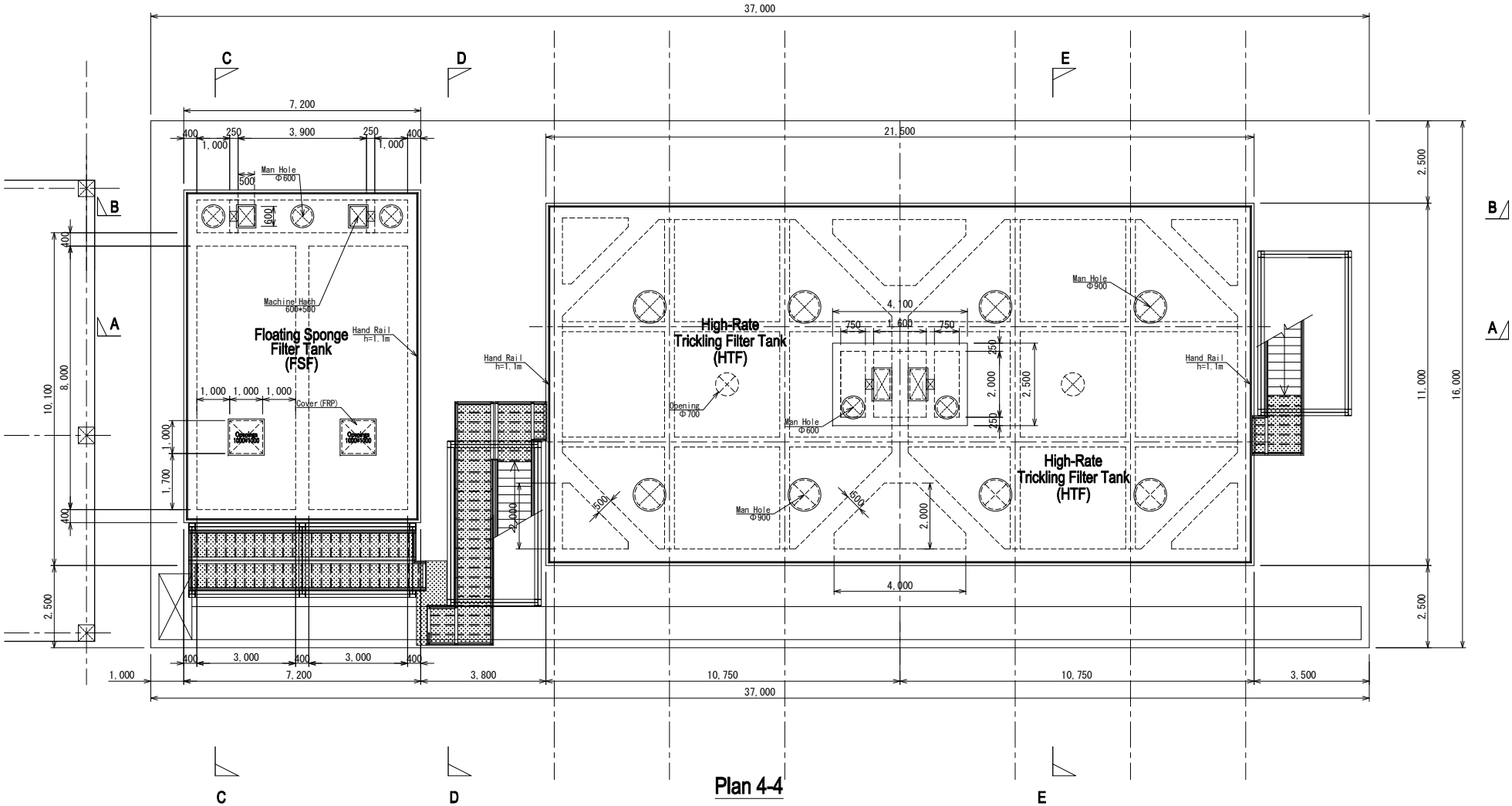
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-002	SEWAGE TREATMENT PLANT Filtering Tank Plan (2/4)



Plan 3-3

Scale = 1:125

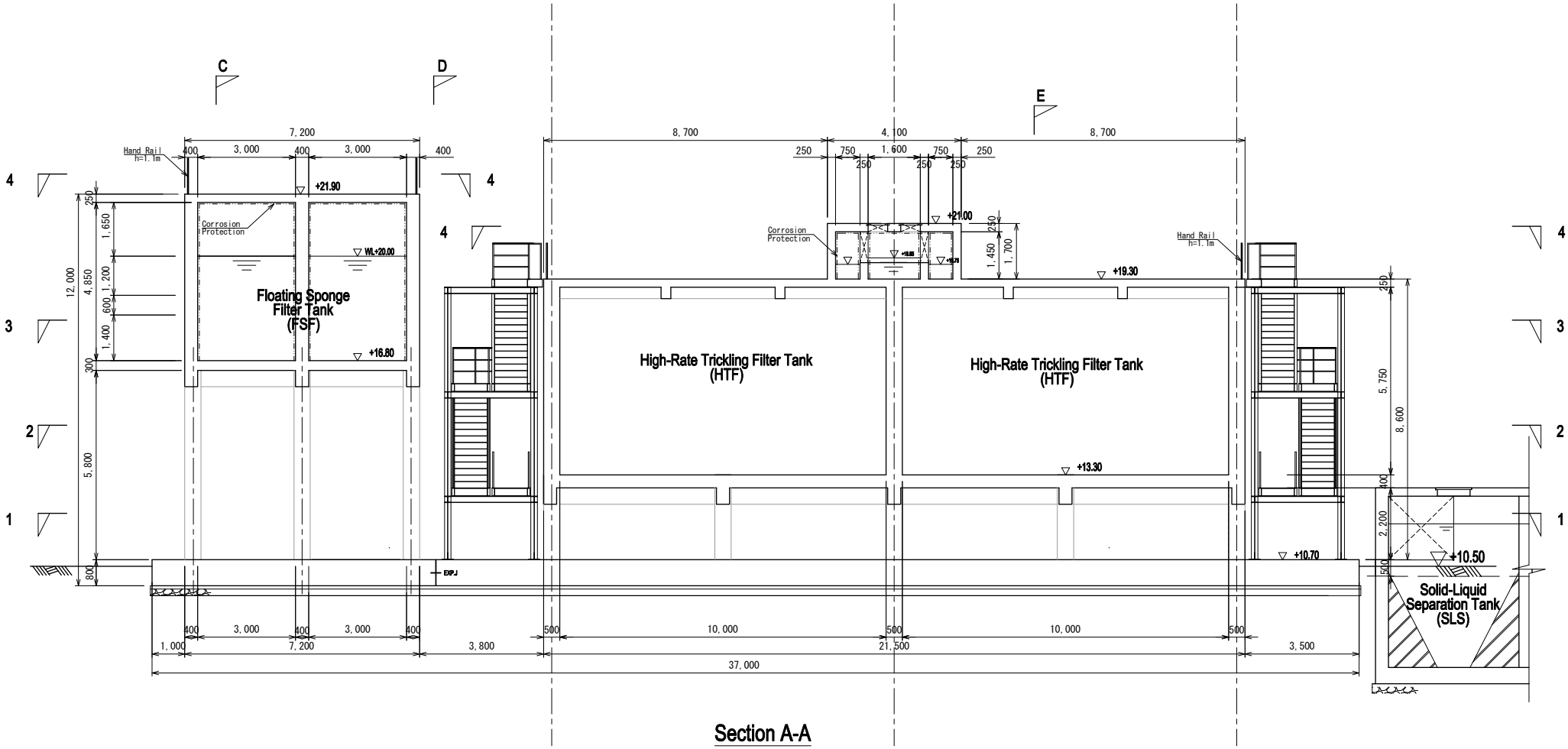
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-003	SEWAGE TREATMENT PLANT Filtering Tank Plan (3/4)



Plan 4-4

Scale = 1:125

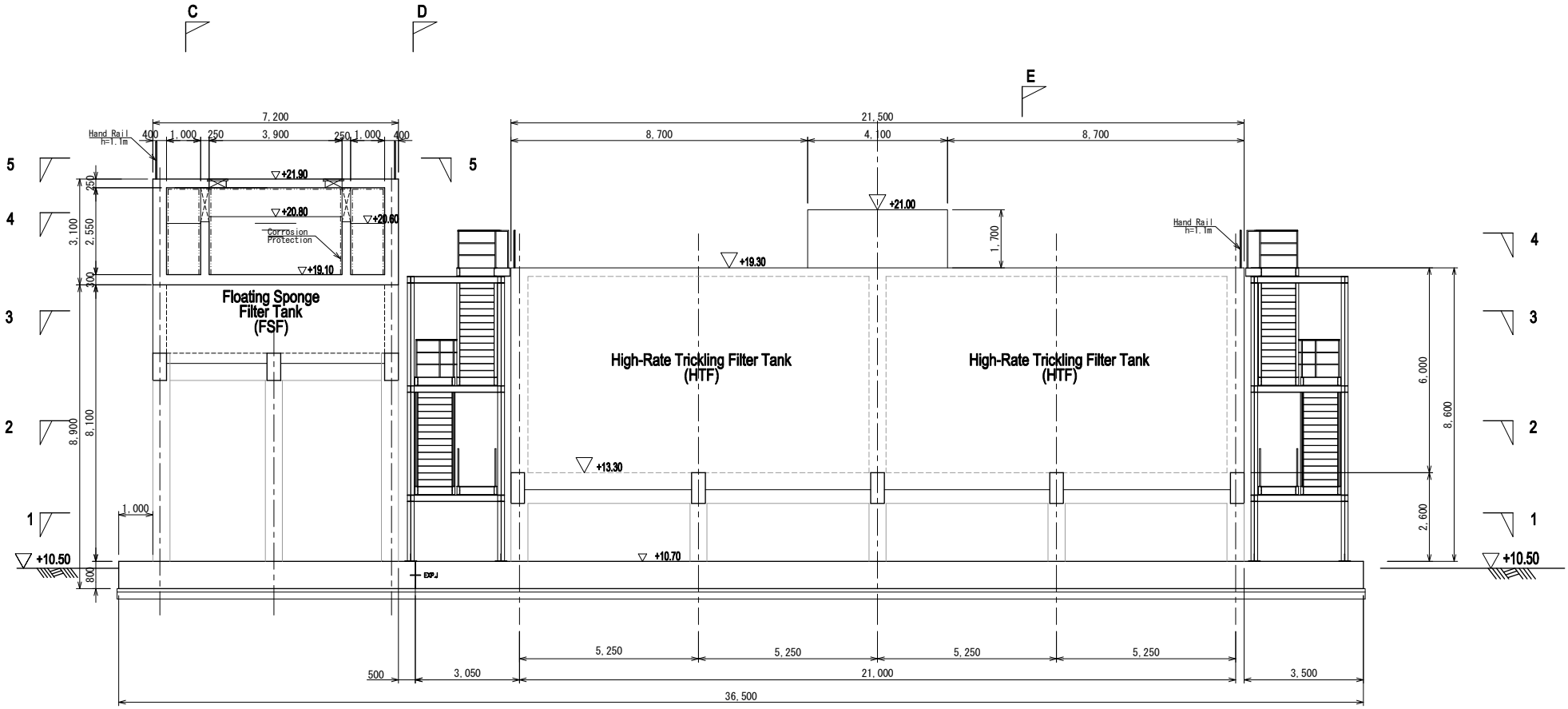
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-004	SEWAGE TREATMENT PLANT Filtering Tank Plan (4/4)



Section A-A

Scale = 1:125

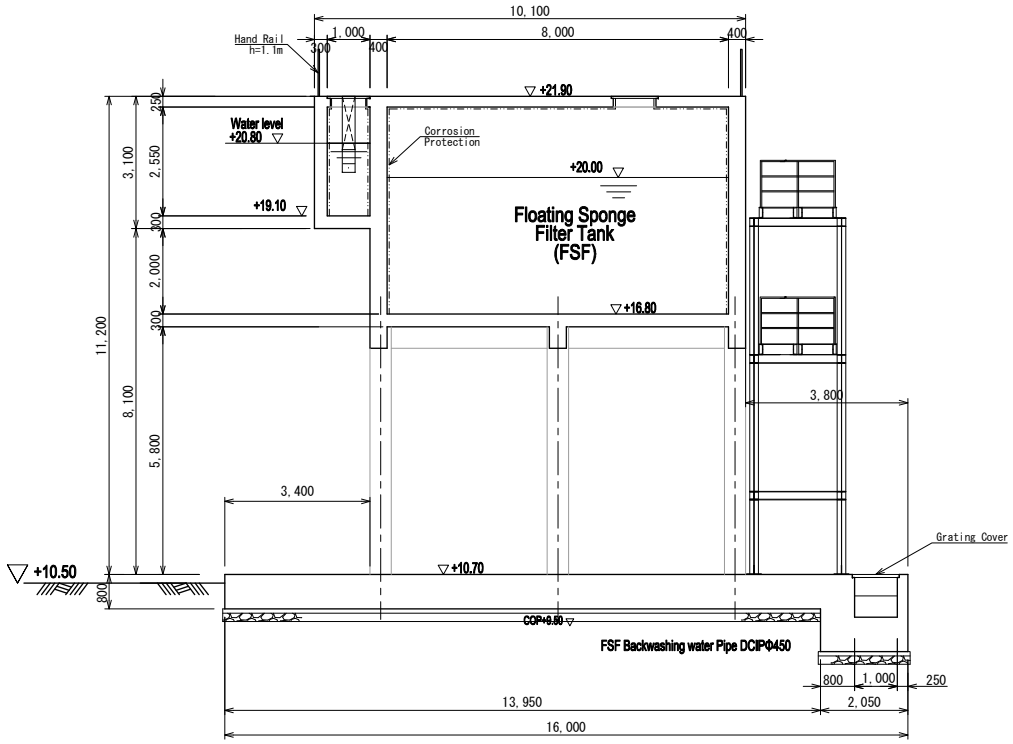
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-005	SEWAGE TREATMENT PLANT Filtering Tank Section (1/4)



Section B-B

Scale = 1:125

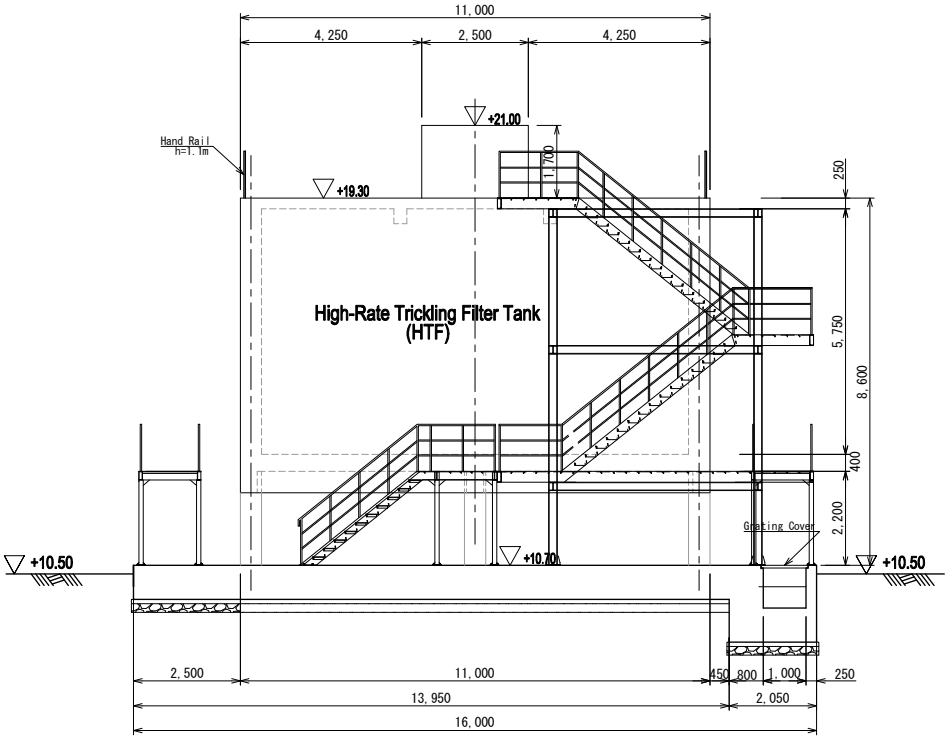
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-HT-006	SEWAGE TREATMENT PLANT Filtering Tank Section (2/4)



Section C-C

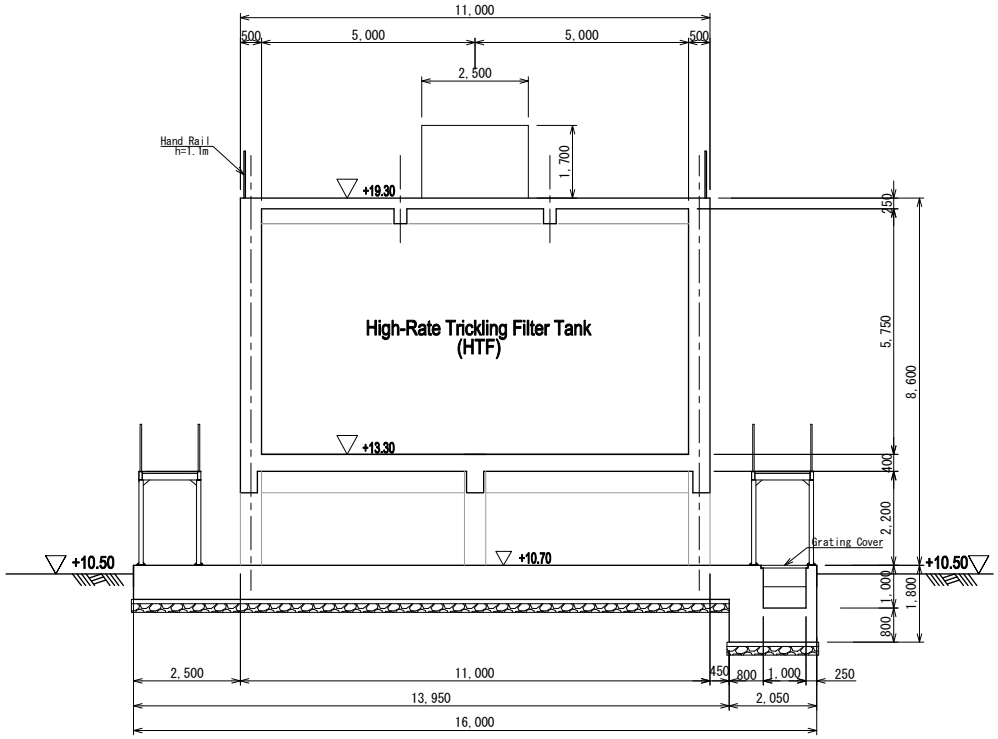
Scale = 1:125

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

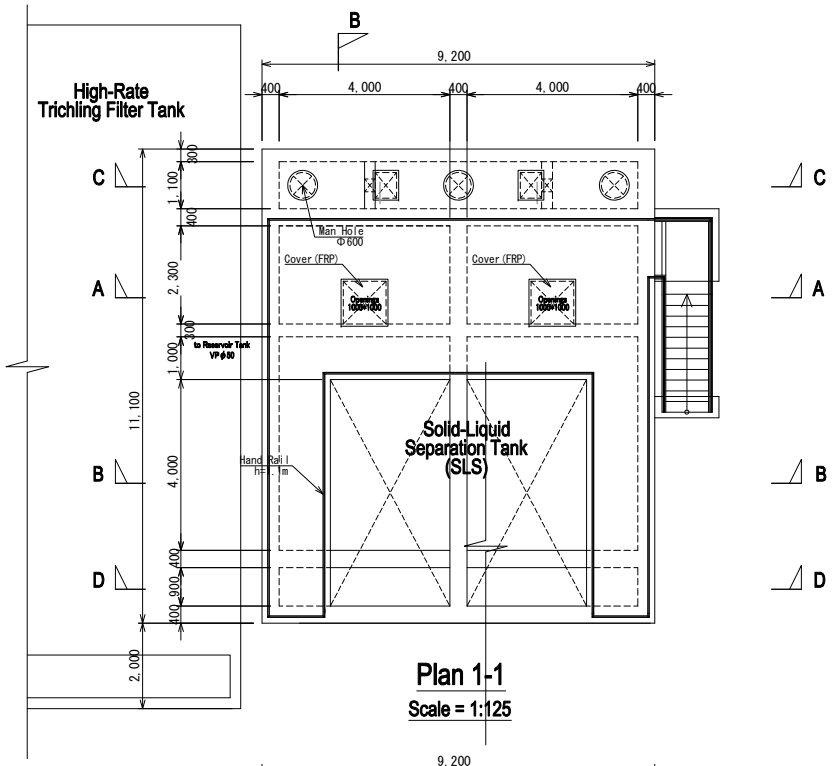
Scale = 1:125



Section E-E

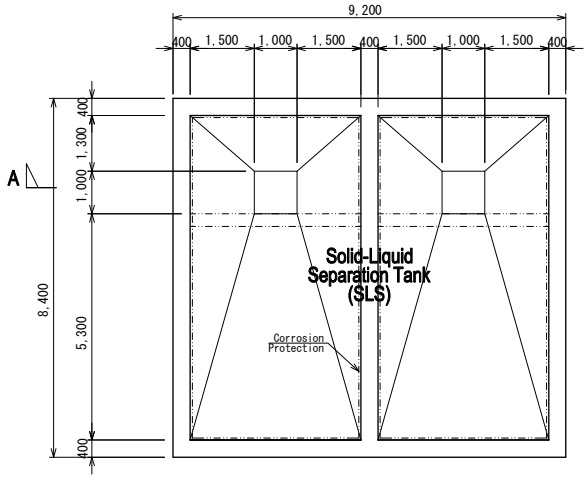
Scale = 1:125

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)



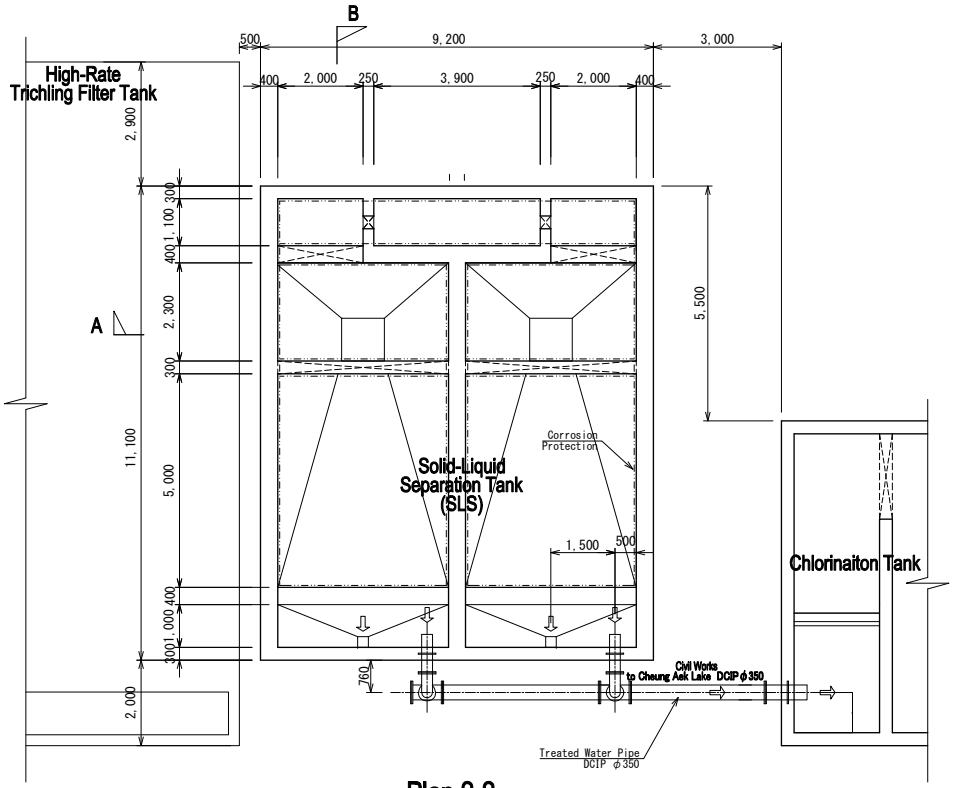
Plan 1-1

Scale = 1:125



Plan 3-3

Scale = 1:125



Plan 2-2

Scale = 1:125

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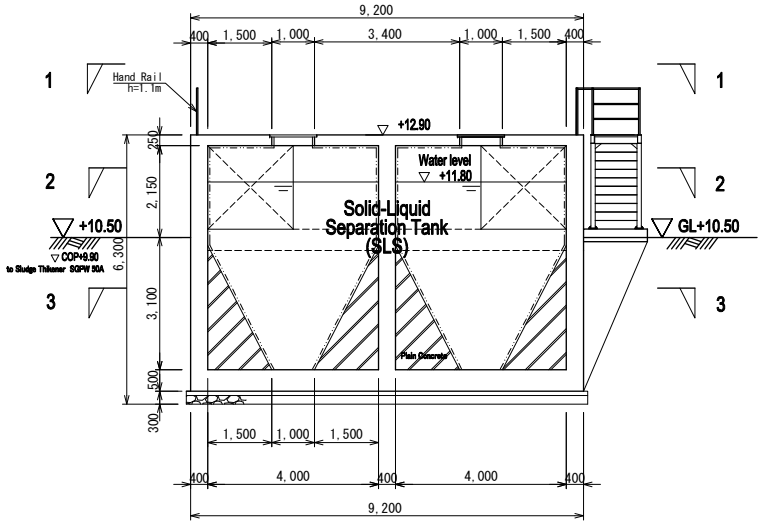
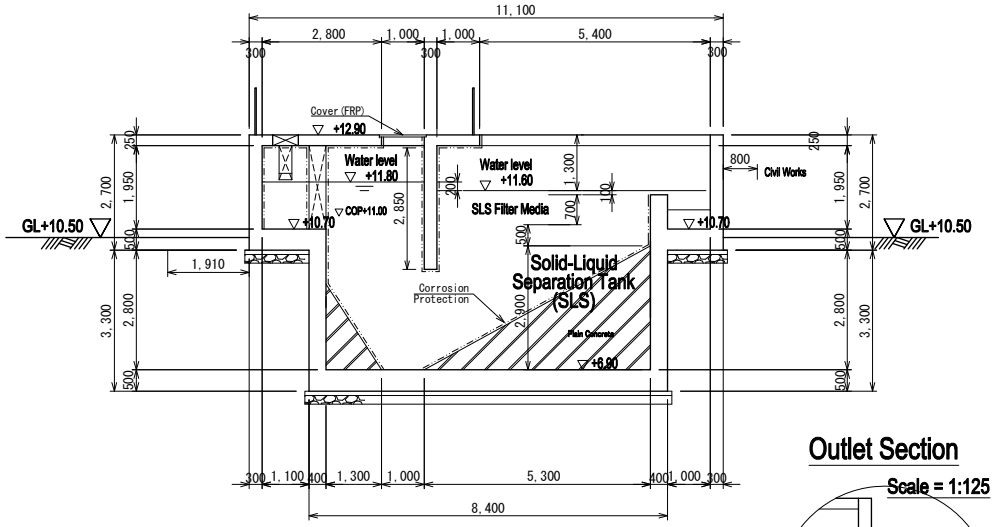
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-SL-001	SEWAGE TREATMENT PLANT Solid-Liquid Separation Tank Plan



Section A-A

Scale = 1:125

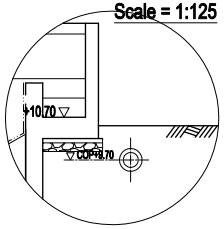


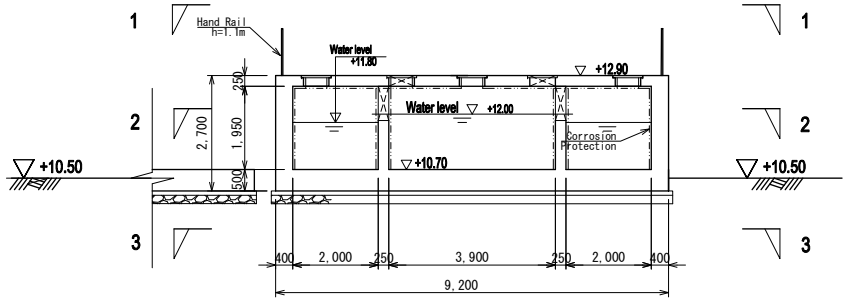
Section B-B

Scale = 1:125

Outlet Section

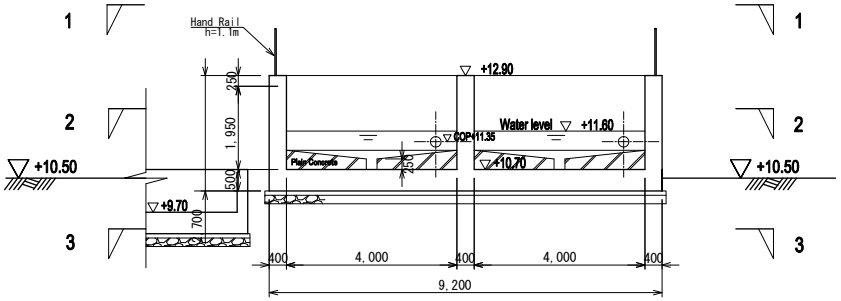
Scale = 1:125





Section C-C

Scale = 1:125



Section D-D

Scale = 1:125

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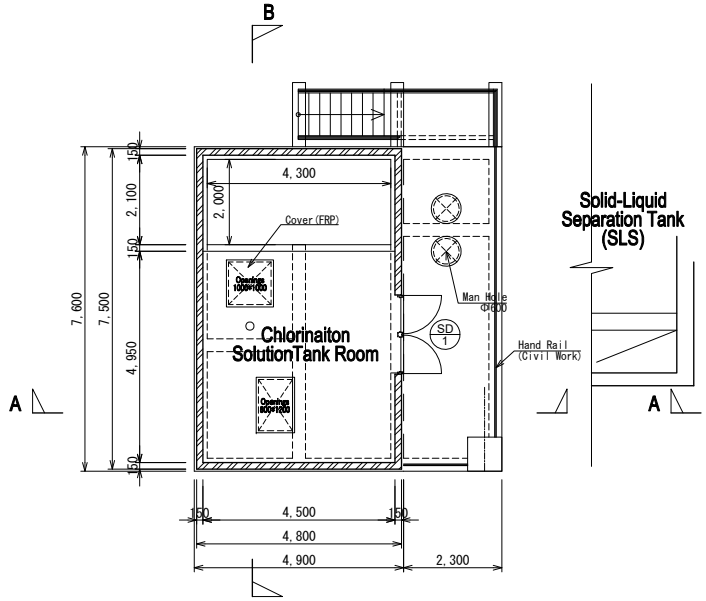
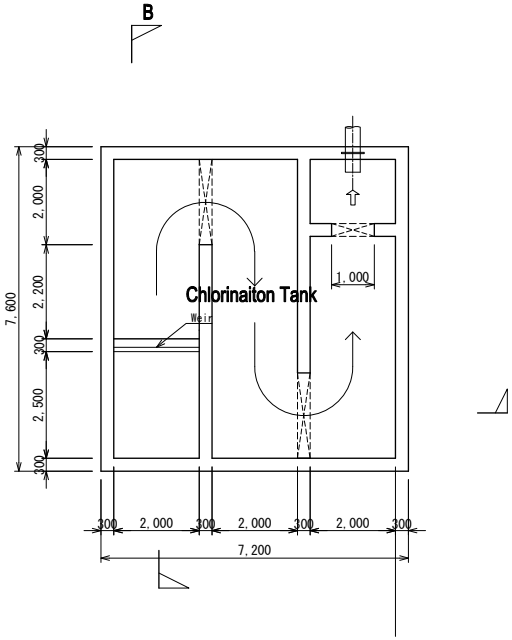
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-SL-002	SEWAGE TREATMENT PLANT Solid-Liquid Separation Tank Section



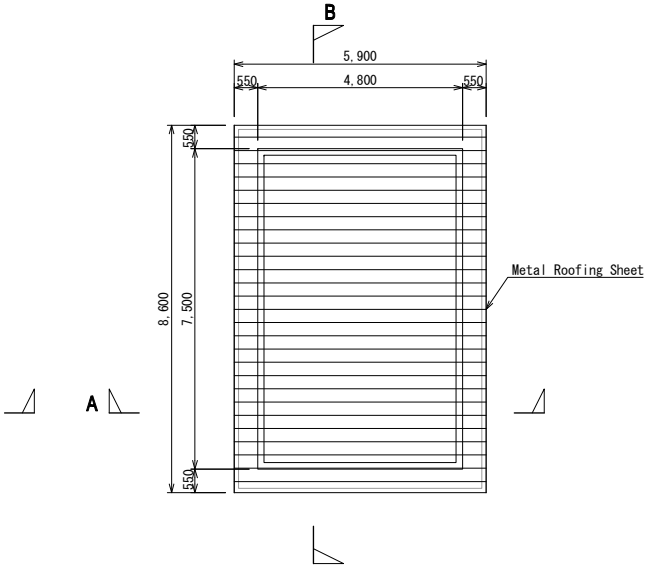
Plan 1-1

Scale = 1:125



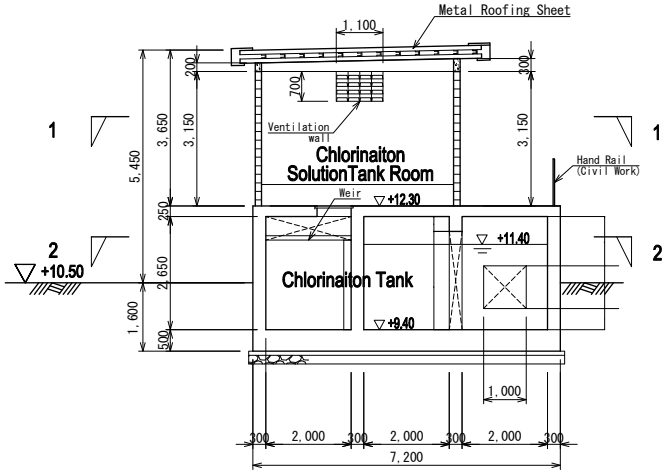
Plan 2-2

Scale = 1:125



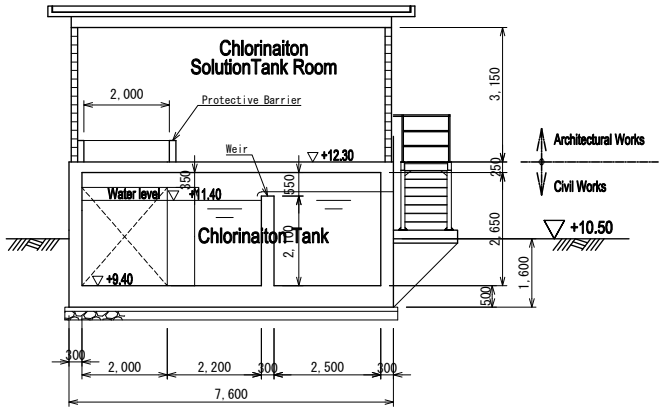
Roof Plan

Scale = 1:125



Section A-A

Scale = 1:125

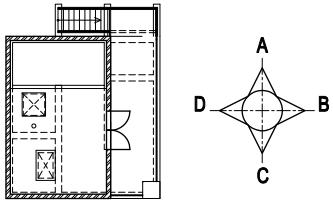


Section B-B

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

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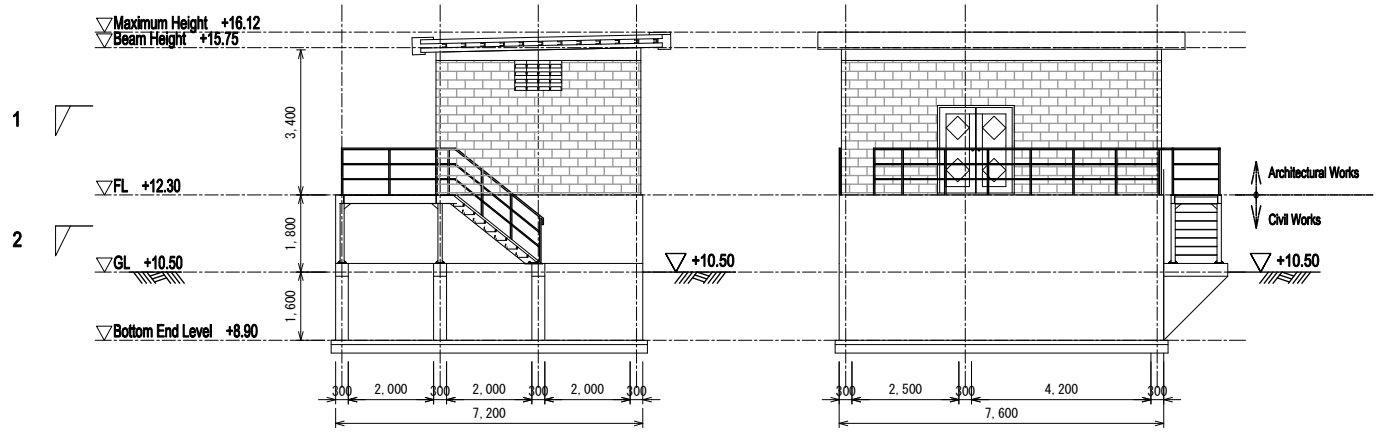
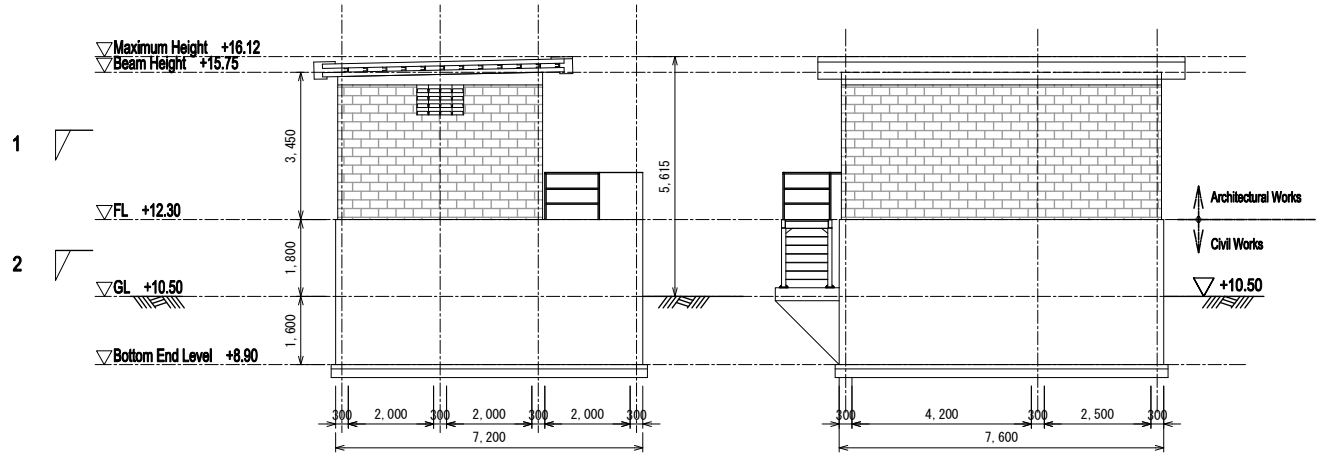


Elevation "A" View

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		

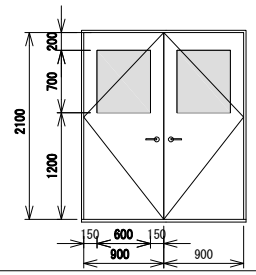
BUILDING OUTLINE

	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 :

Type Symbol
Reference Number

SD 1 AG 1 SS 1

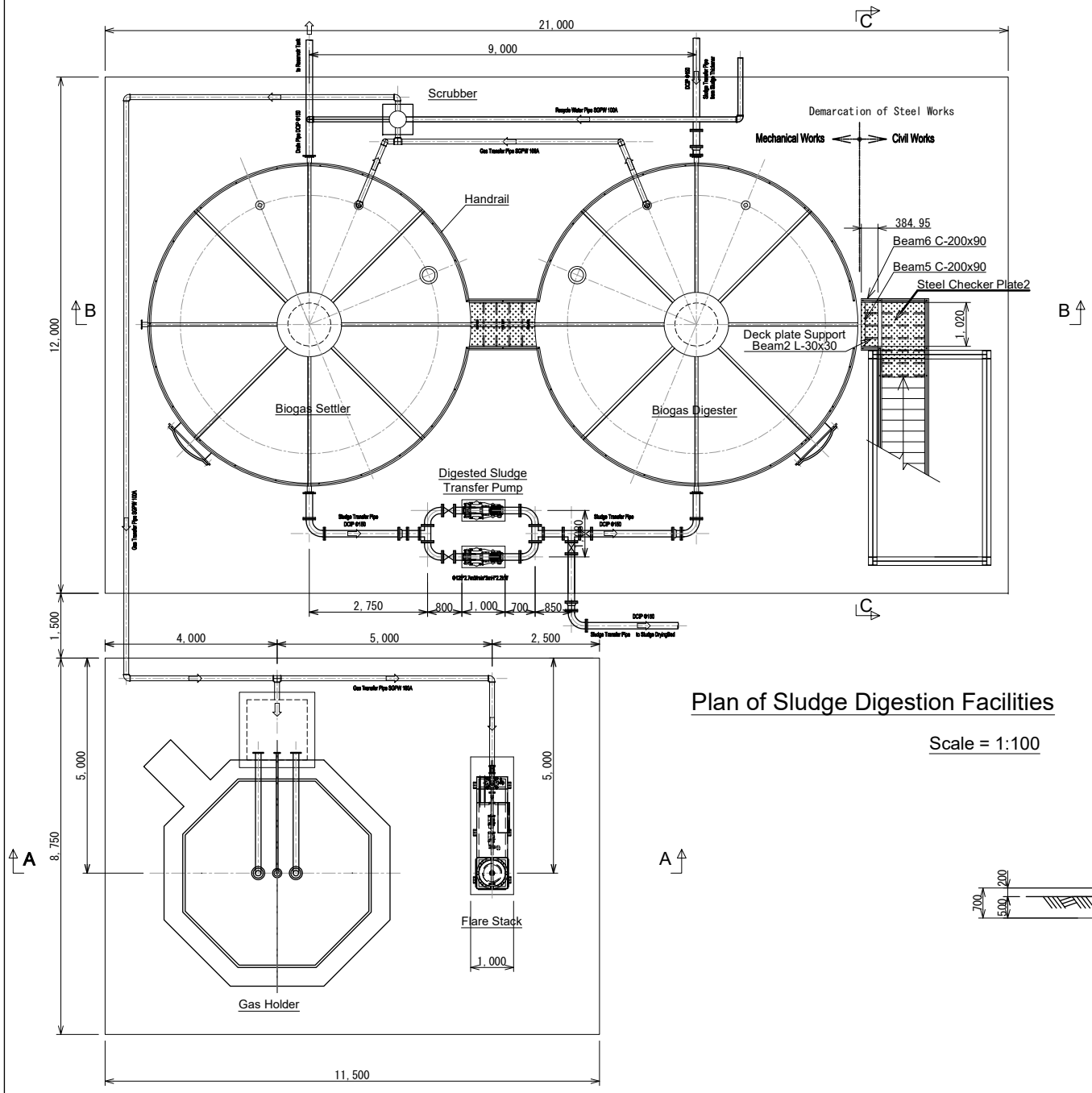
SYMBOL LEGEND

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

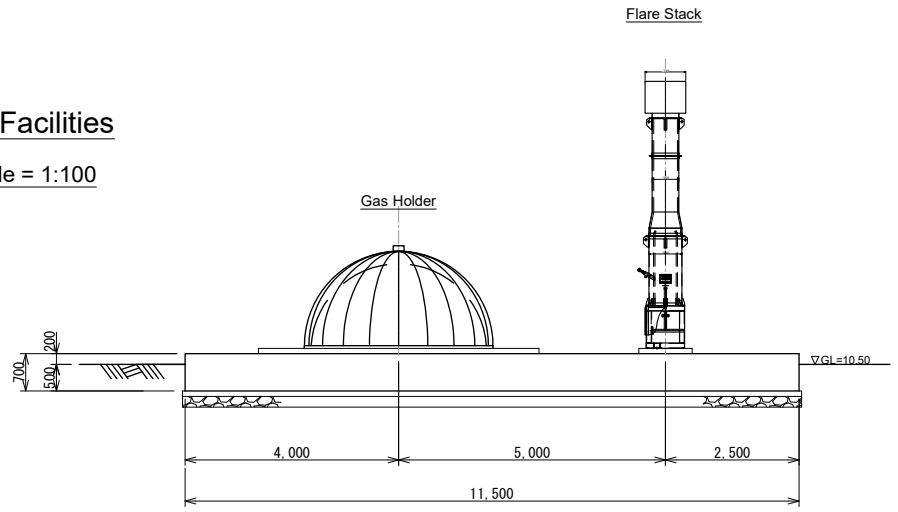
C.W.P.	:	Clear Wood Preservative
S.O.P.	:	Ready-mixed Synthetic Resin Paint
A.E.P.	:	Acrylic Resin Emulsion Paint
S.V	:	Oil Stain Varnish

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

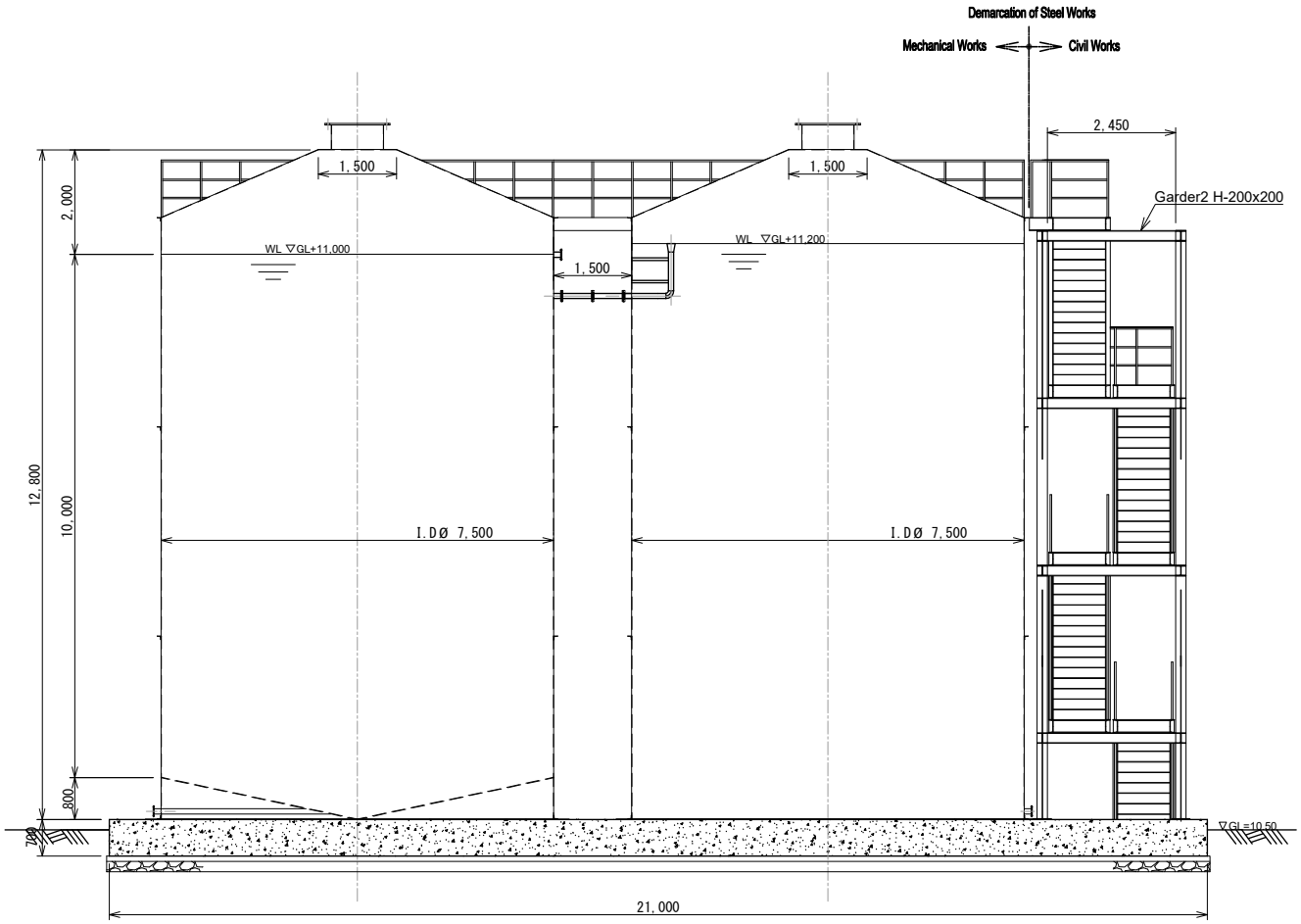
Scale = 1:100



Section A-A

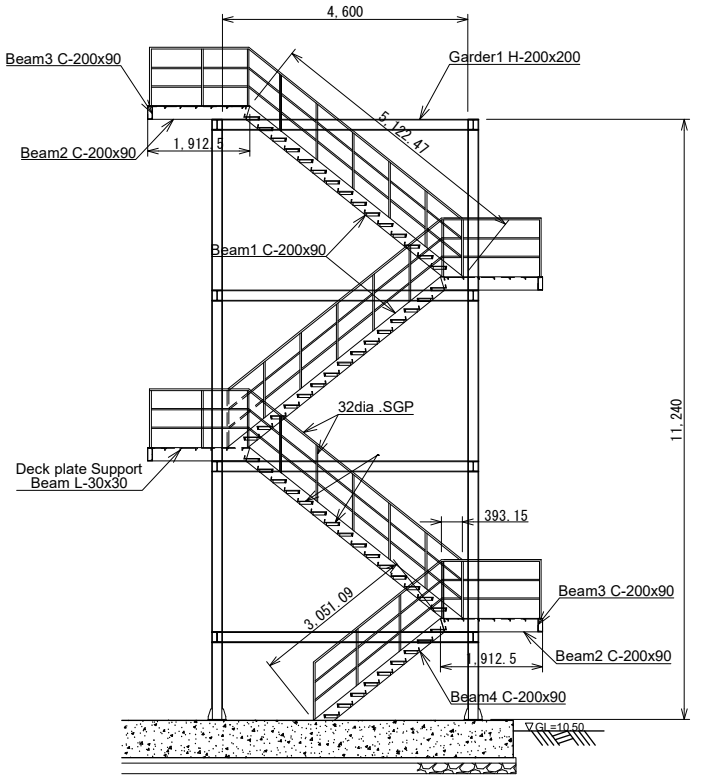
Scale = 1:100

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)

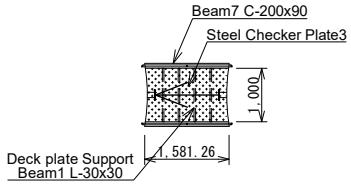


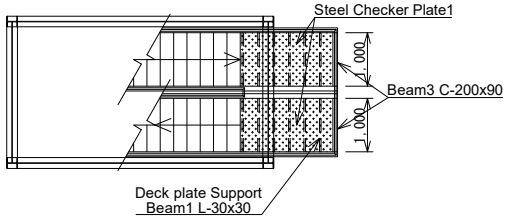
Section B-B

Scale = 1:100



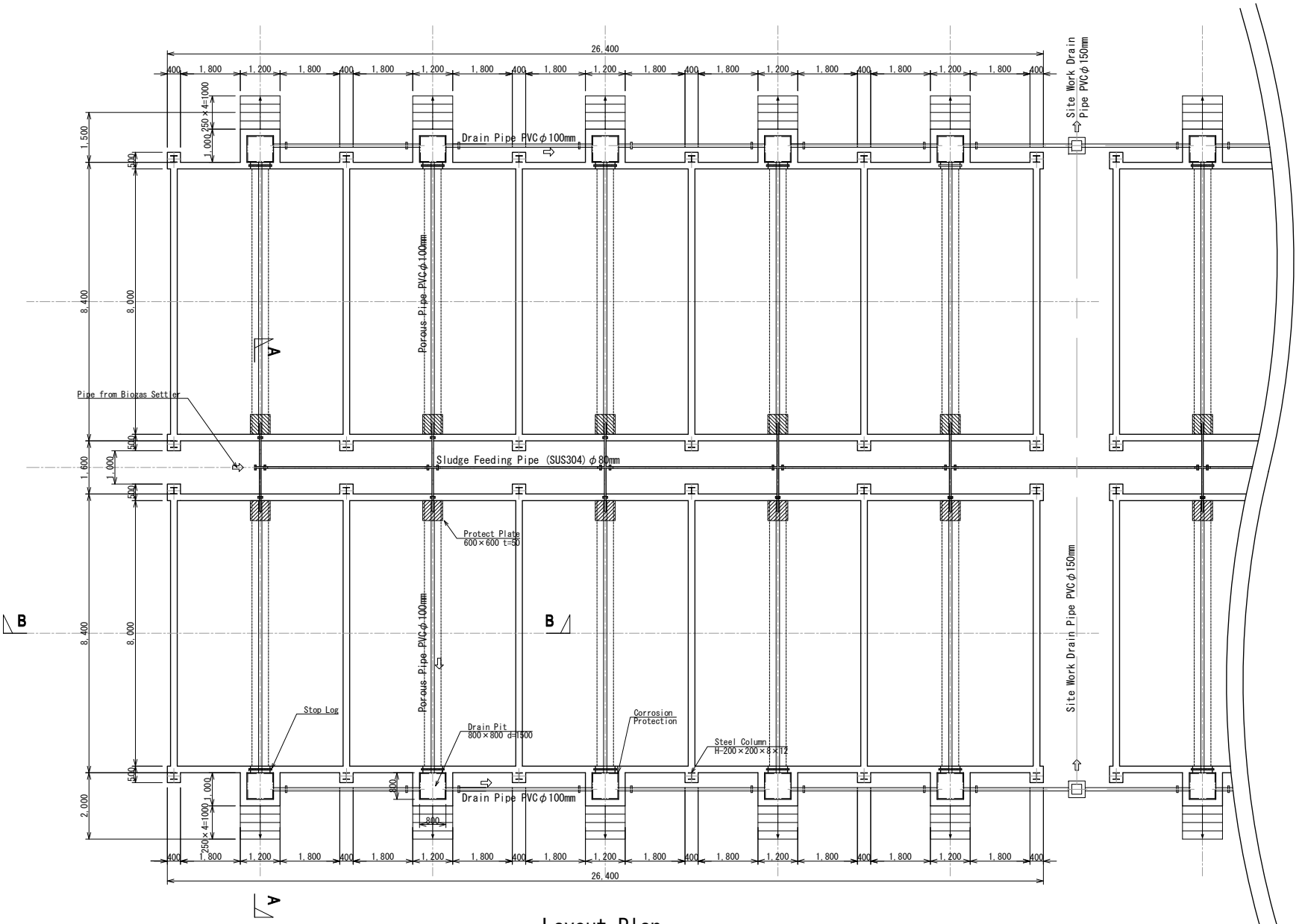
Section C-C





Detail Plan of Steel Walkway Scale = 1:100

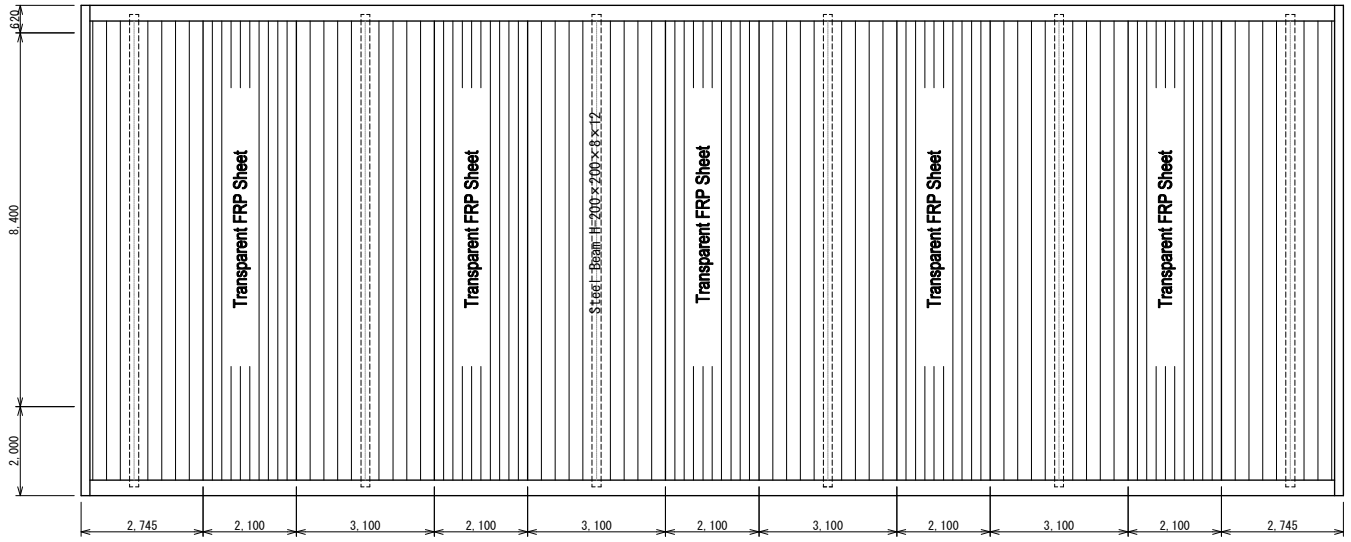
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-SD-002	SEWAGE TREATMENT PLANT Sludge Digestion Facilities Plan & Section (2/2)



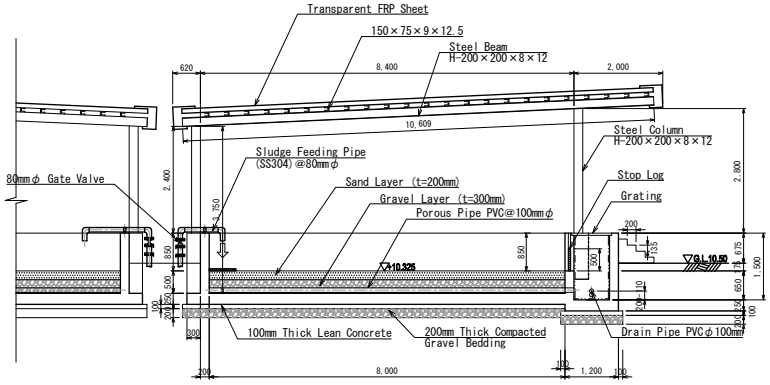
Layout Plan

Scale = 1:120

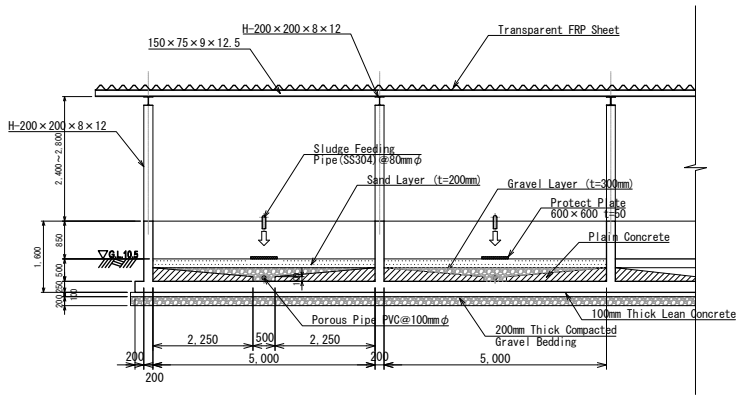
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-DB-001	SEWAGE TREATMENT PLANT Sludge Drying Bedd Plan



Roofing Plan



Section A-A

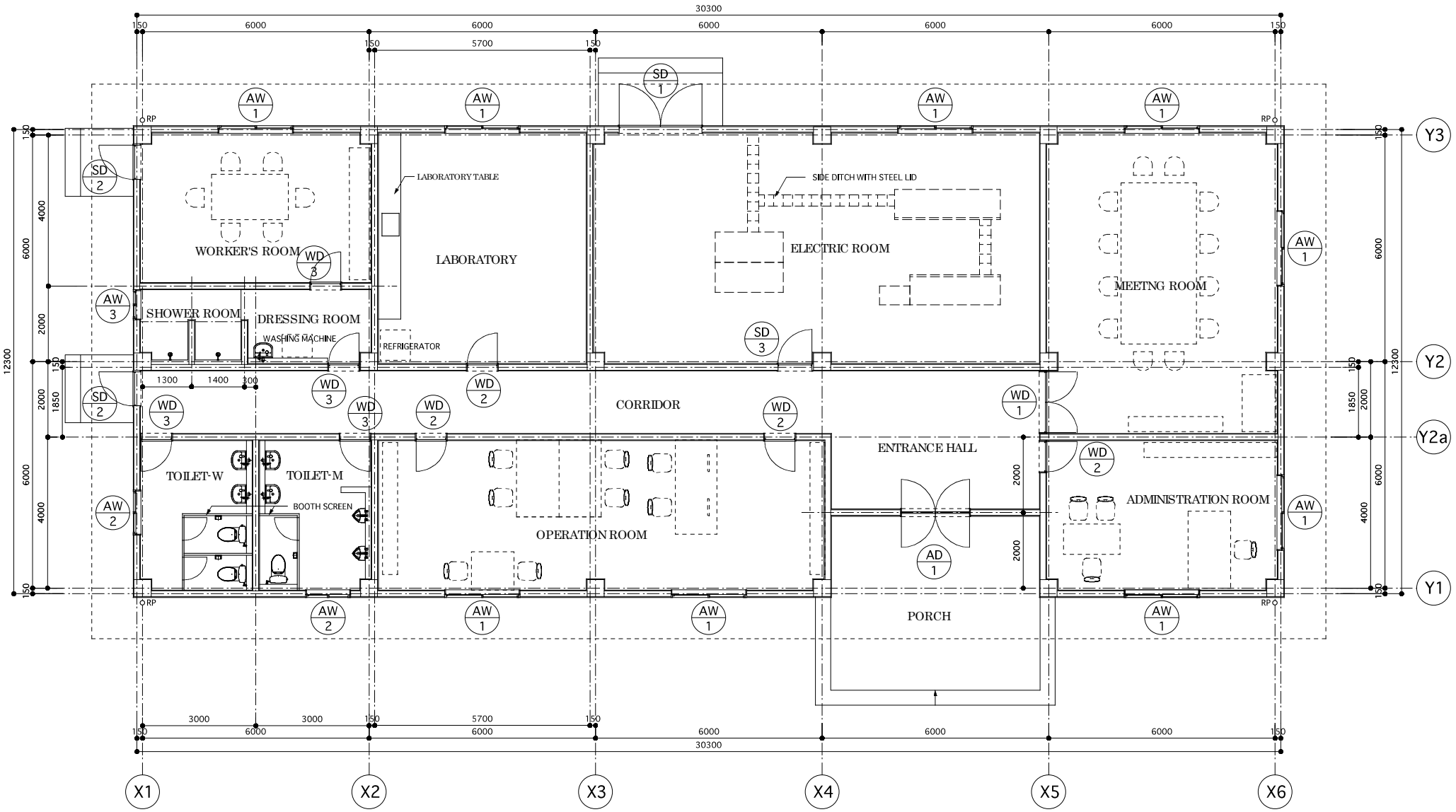


Section B-B

Sludge Drying Bed Plan & Sections

Scale = 1:120

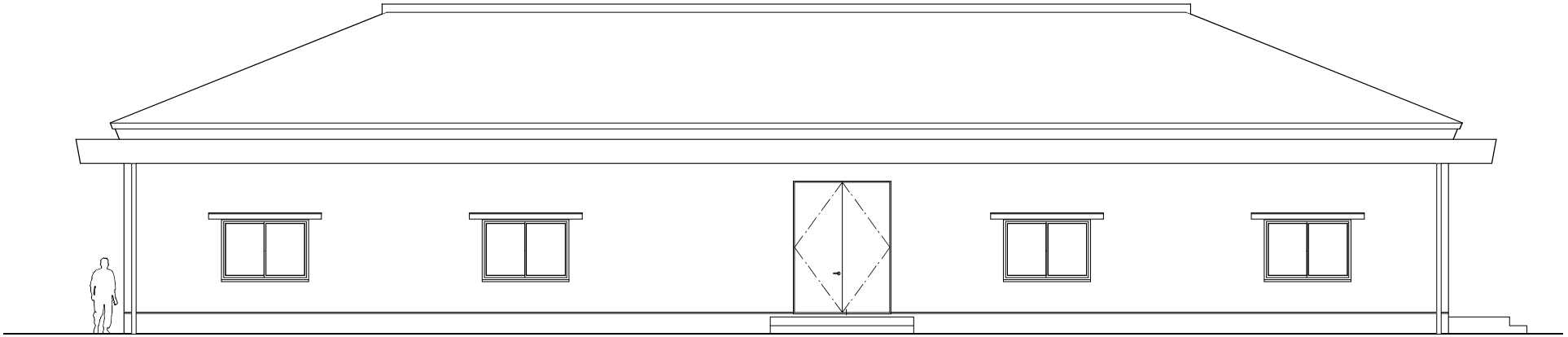
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-DB-002	SEWAGE TREATMENT PLANT Sludge Drying Bedd Plan & Section



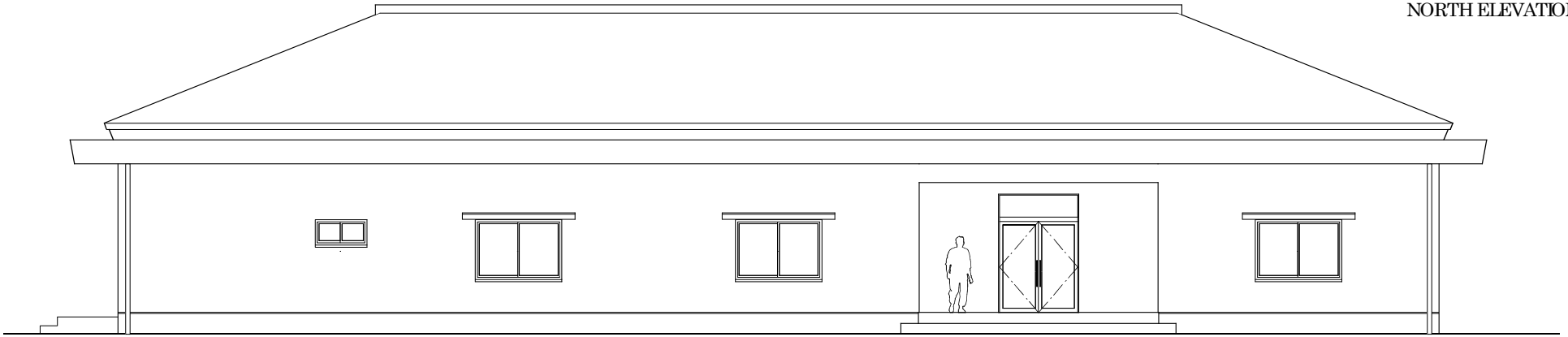
FLOOR PLAN

SCALE 1:100

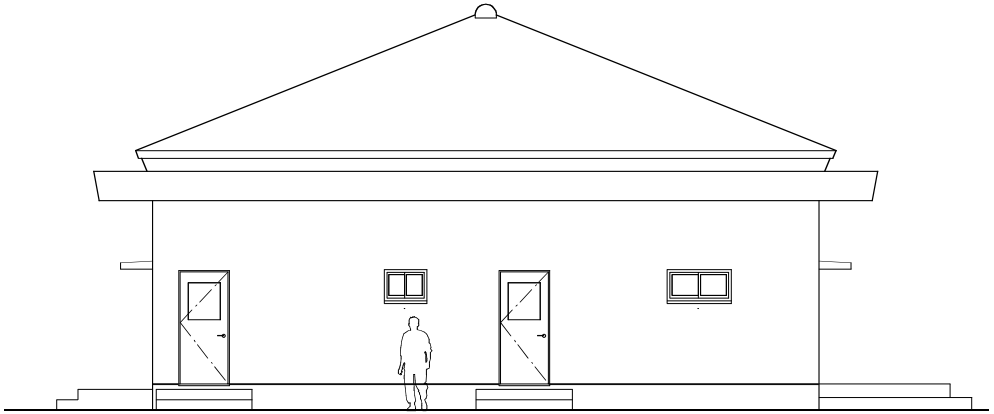
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-AB-001	SEWAGE TREATMENT PLANT Administration Building Floor Plan



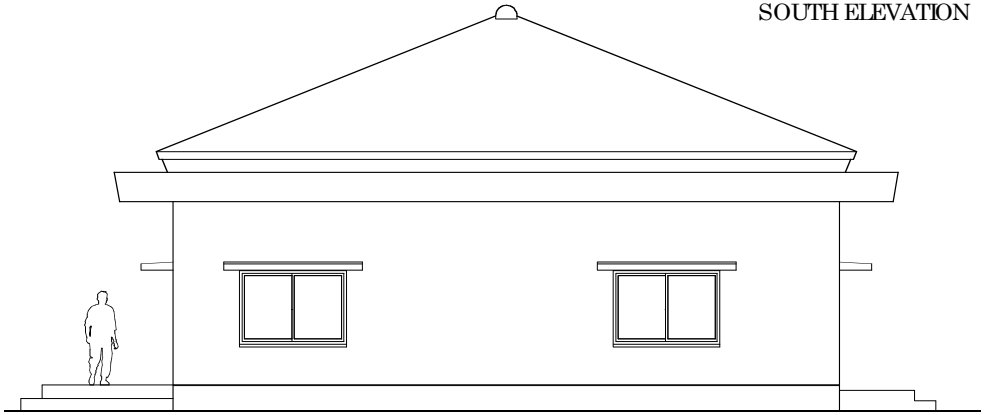
NORTH ELEVATION



SOUTH ELEVATION



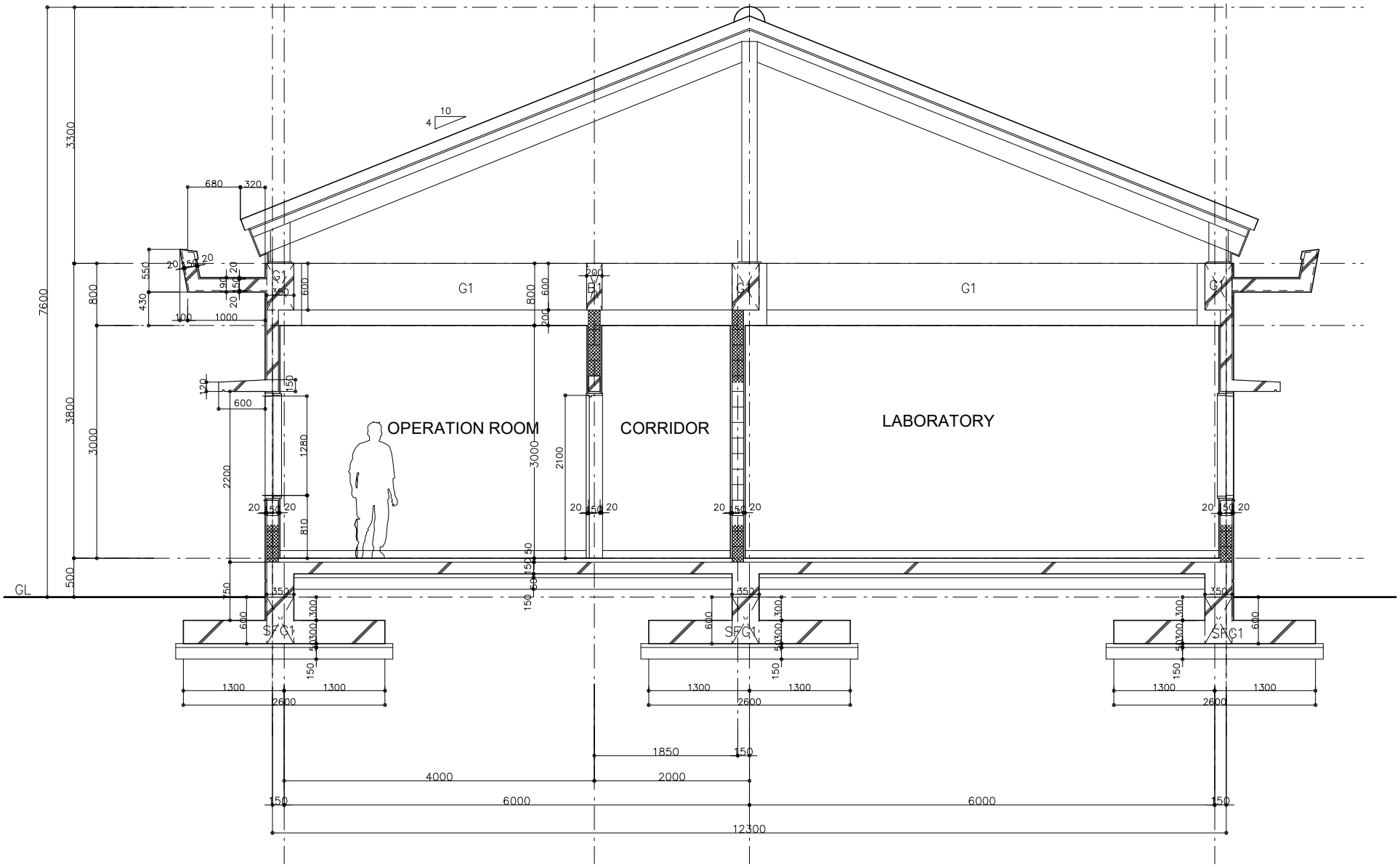
WEST ELEVATION



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

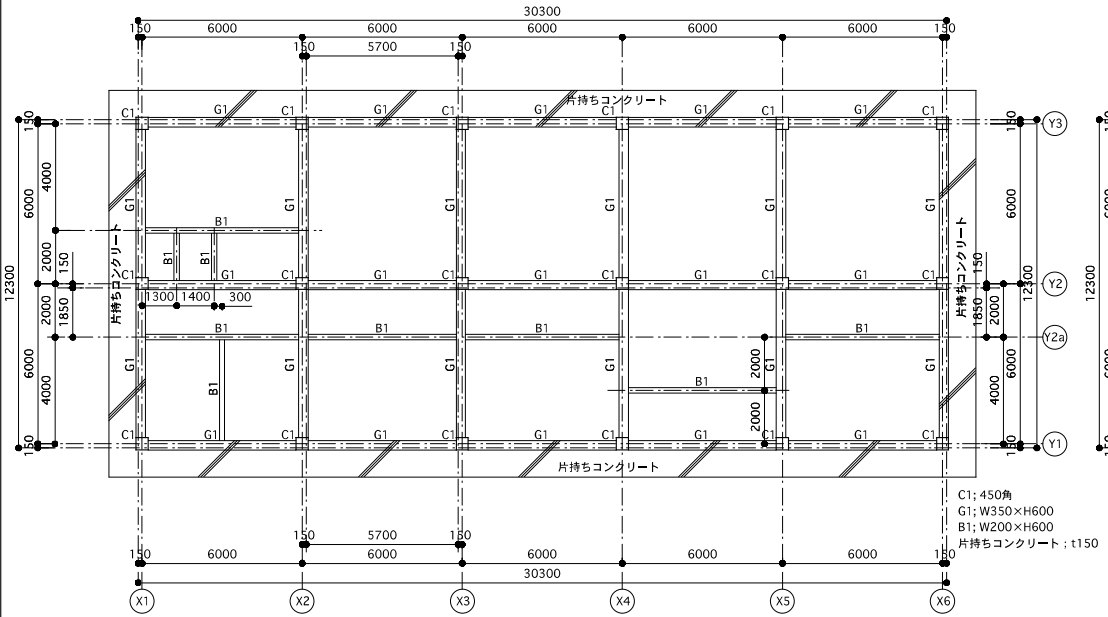
	ROOM NAME	FLOOR LEVEL	FLOOR	BASEBOARD	WALL	CEILING	CEILING HIGHT (mm)	REMARKS
ADMINISTRATION BUILDING	ADMINISTRATION ROOM	±0	Ceramic tile 300×300 on cement mortar	Ceramic tile H100	Cement mortar t20 AEP on concrete block t150	Plaster board t9.5 AEP /LGS	3000	
	OPERATION ROOM	±0	Ceramic tile 300×300 on 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

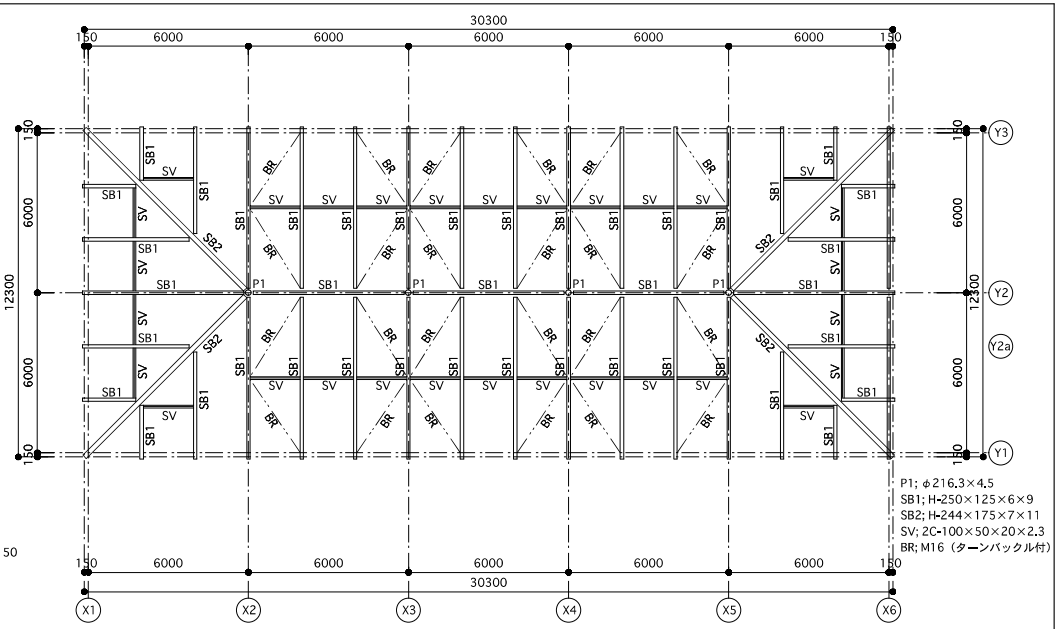
CTI ENGINEERING INTERNATIONAL CO., LTD.
NIPPON KOEI CO.,LTD.
WATER AND SEWER BUREAU,CITY OF KITAKYUSHU

STP-AB-004

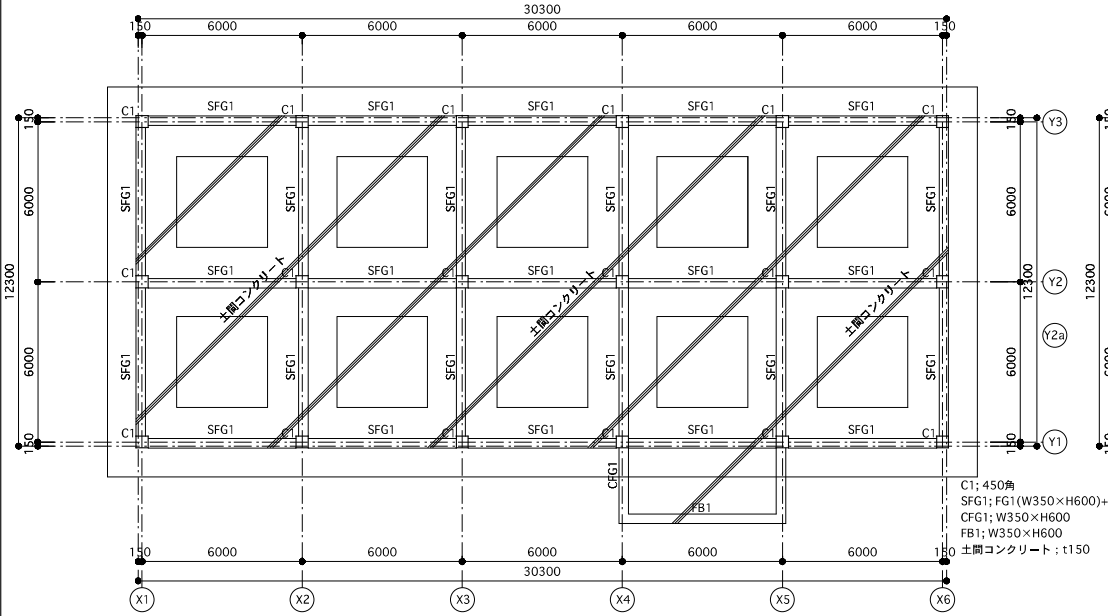
SEWAGE TREATMENT PLANT
Administration Building Finish Schedule



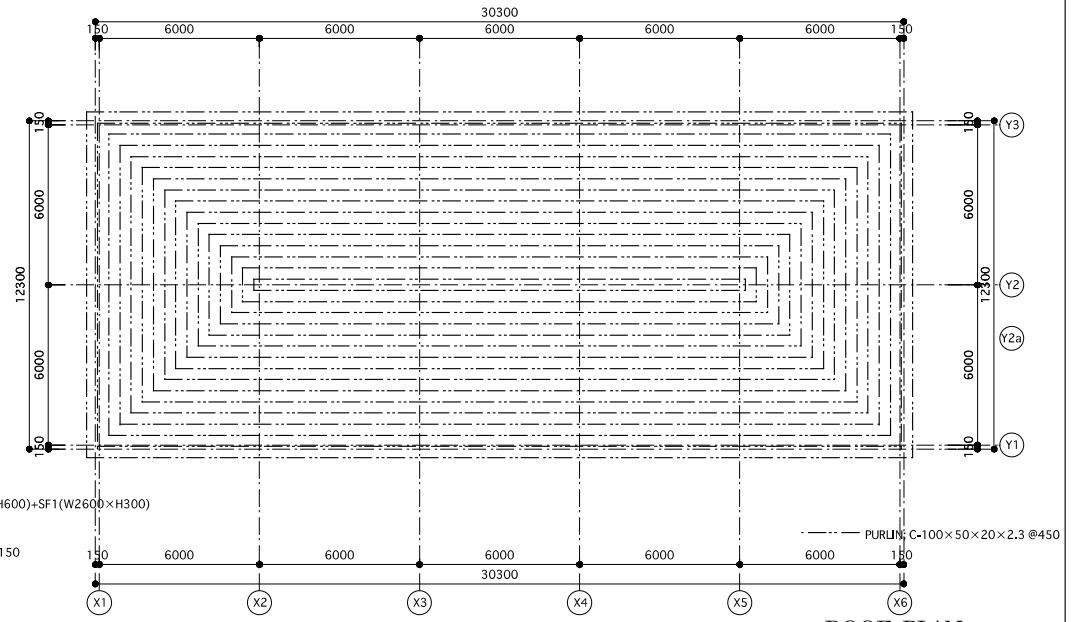
BEAM PLAN



ROOF FLAMING PLAN



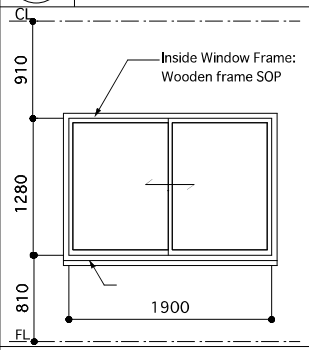
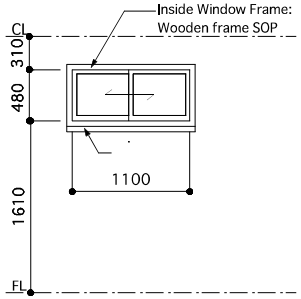
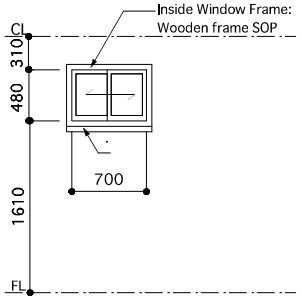
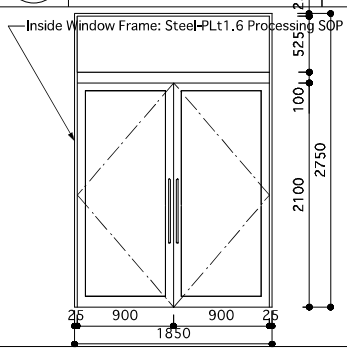
FOUNDATION PLAN

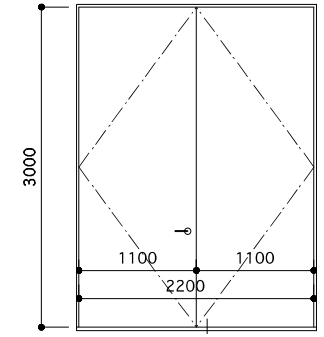
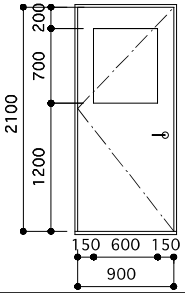
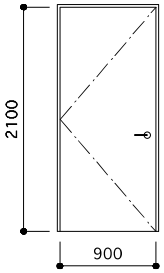


ROOF PLAN

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
DOOR, WINDOW & LOUVER — THICKNESS	6mm	5mm	5mm	6mm
DOOR, WINDOW & LOUVER — 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.
DOOR, WINDOW & LOUVER — THICKNESS	50 mm	40 mm	40 mm
DOOR, WINDOW & LOUVER — 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

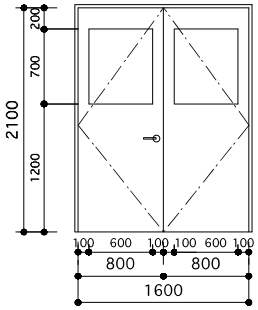
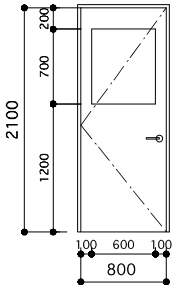
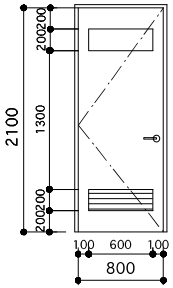
SCALE 1:50

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

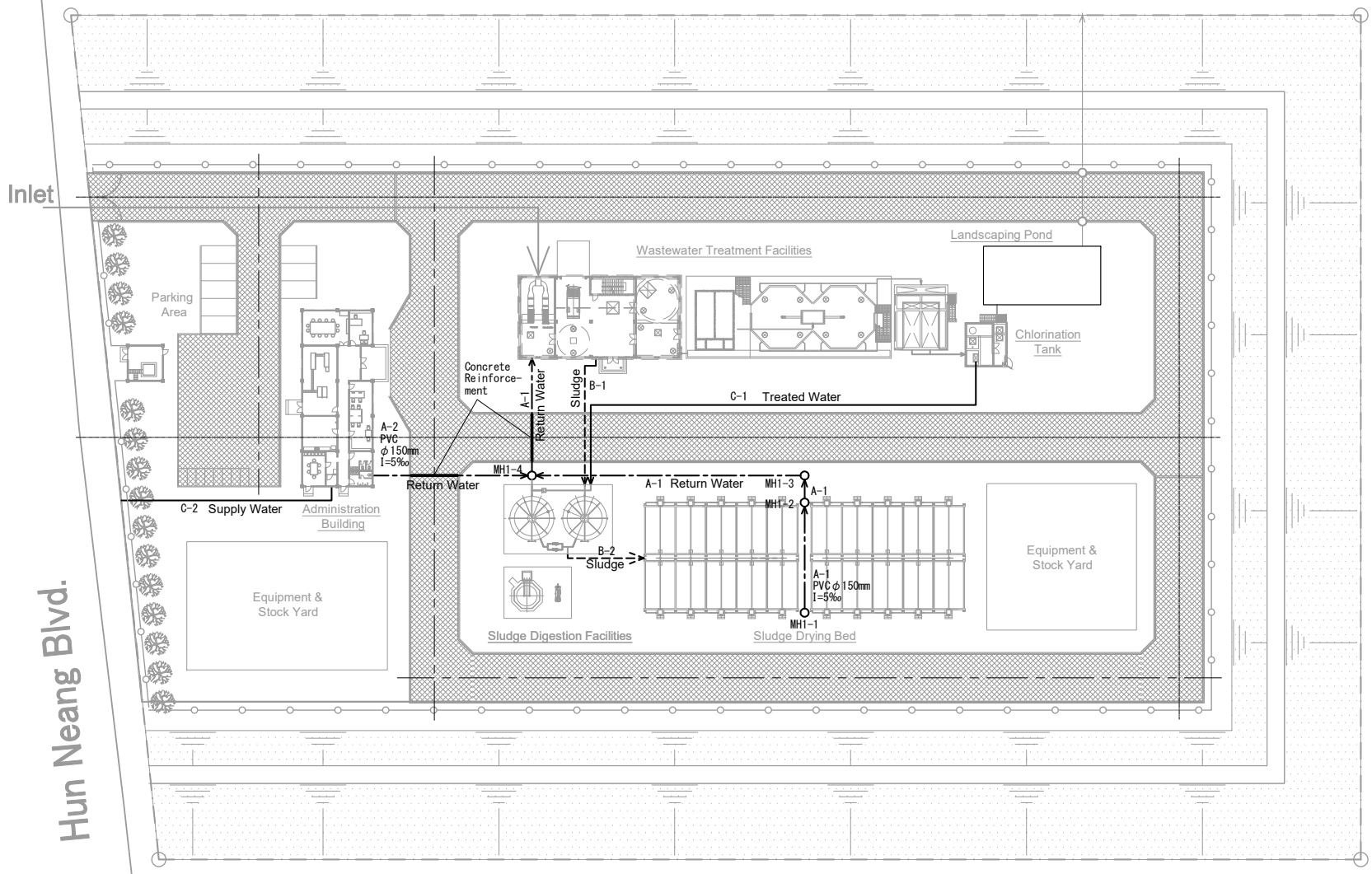
OTHER ABBREVIATION

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

List of Outdoor Pipline

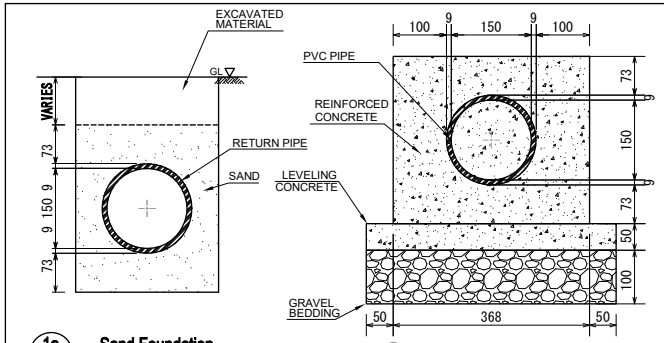
No	Usage	Flow Type	Material / Dia.	Length(m) / Length under pavement
A-1	Return Water	Gravity	PVC / φ150mm	89.906 / 8.569
A-2	Seweage	Gravity	PVC / φ150mm	27.073 / 8.724
B-1	Sludge	Pressure	PVC / φ40mm	23.476 / 8.569
B-2	Sludge	Pressure	PVC / φ65mm	13.742
C-1	Treated Water	Pressure	PVC / φ50mm	86.610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

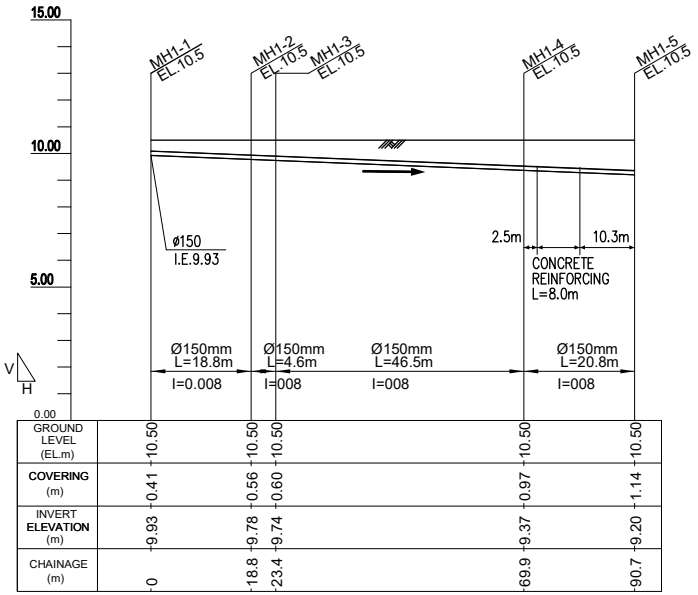


1a Sand Foundation

1b Concrete Protection (under pavement)

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

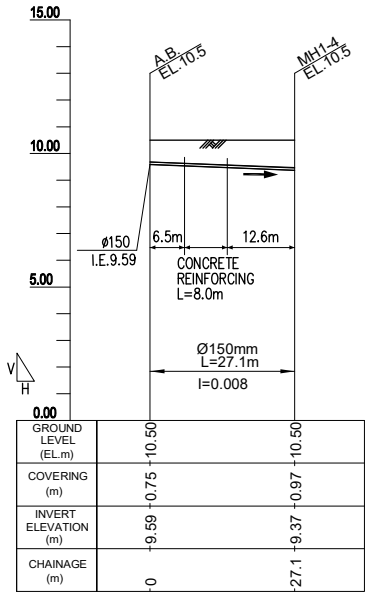
Scale 1:20



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)

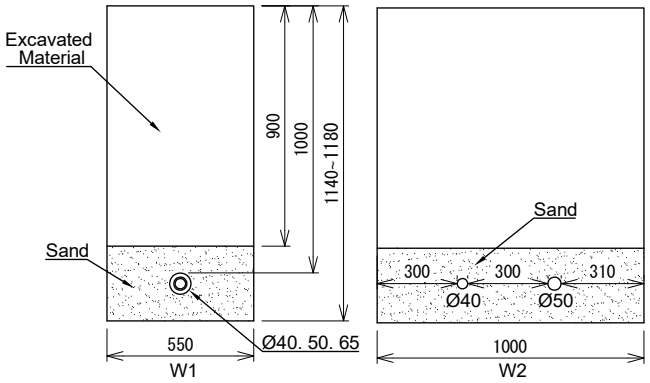
H-Scale 1:1,000 V-Scale 1:200



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

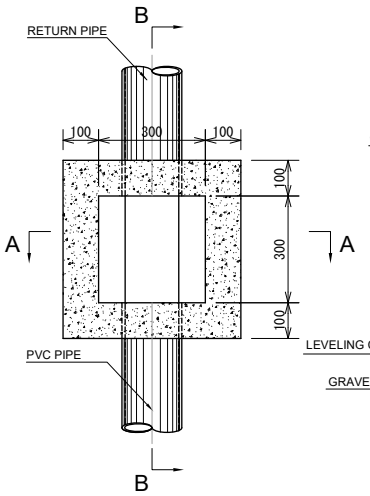


2a Section Type 1

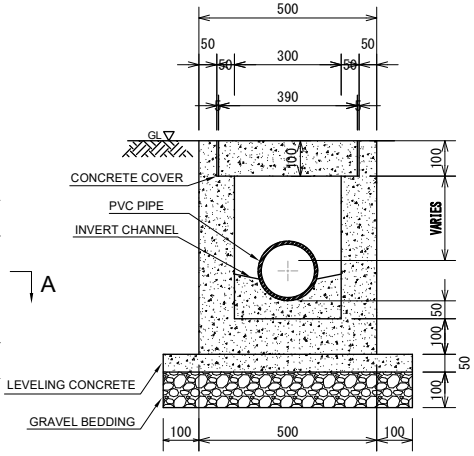
2b Section Type 2

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

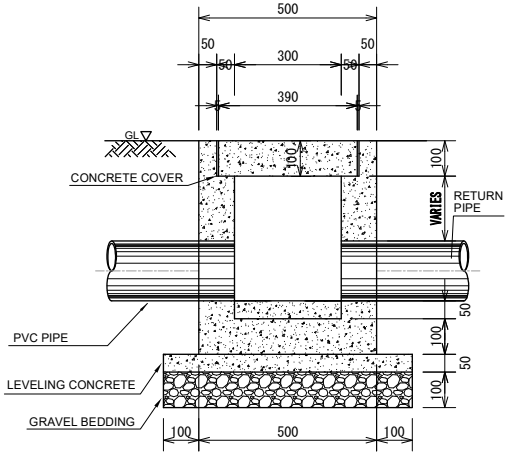
Scale 1:20



3a Plan of Manhole



3b Section A-A



3c Section B-B

3 Sections of Manhole

Scale 1:15

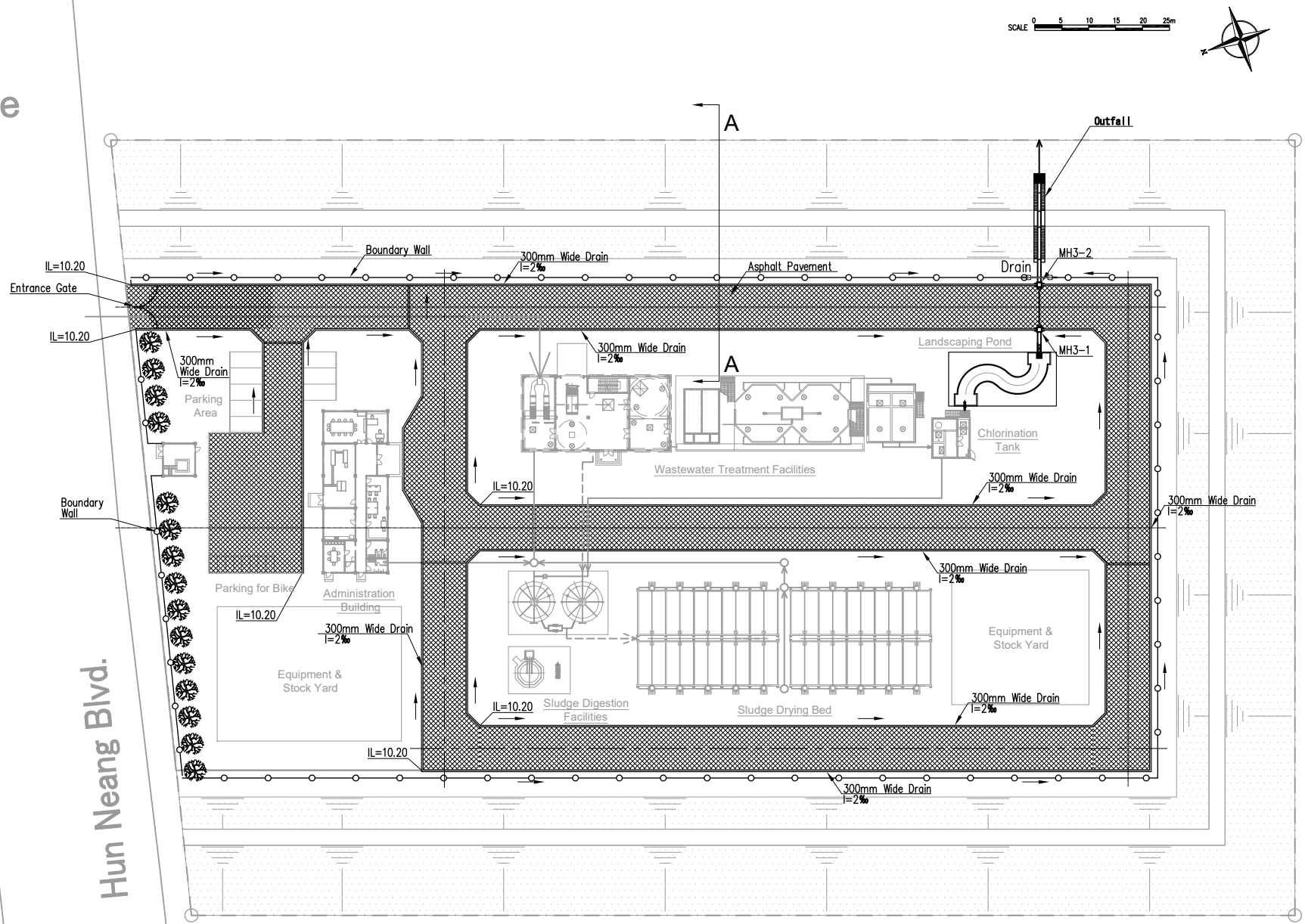
SCALE A (1:1,000) 0 10 20 30 40 50m

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

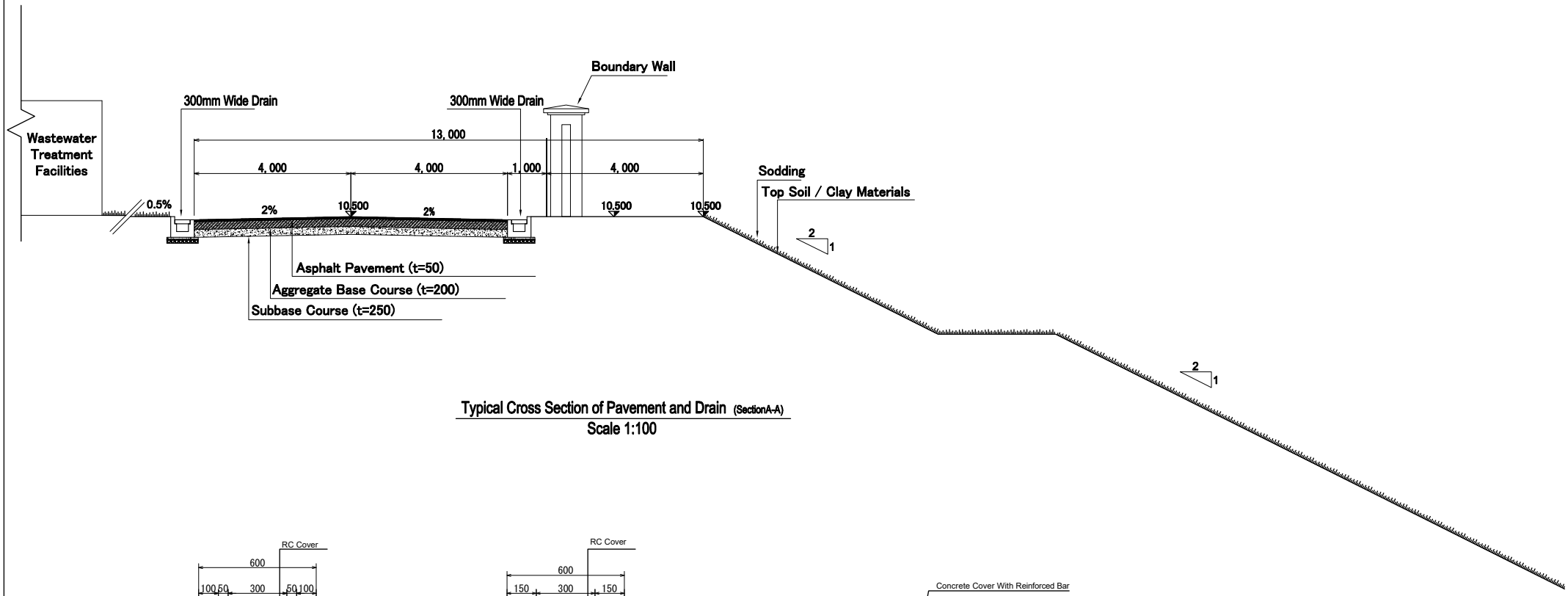
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-002	SEWAGE TREATMENT PLANT Profile and Detail of Yard Piping



Layout of Pavement, Drainage, Gate & Wall

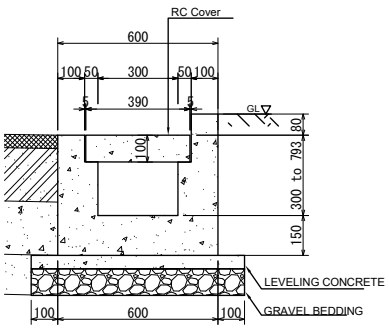
Scale = 1:750

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

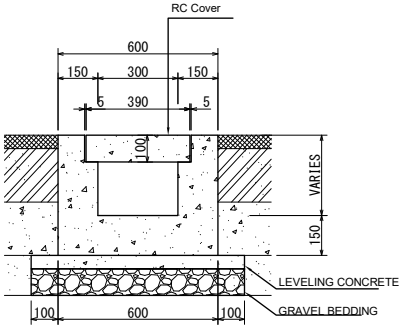


Typical Cross Section of Pavement and Drain (SectionA-A)

Scale 1:100

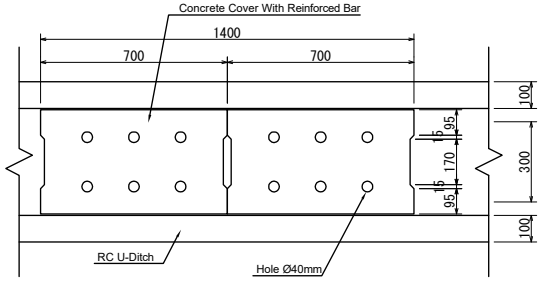


1a 300 Wide Drain



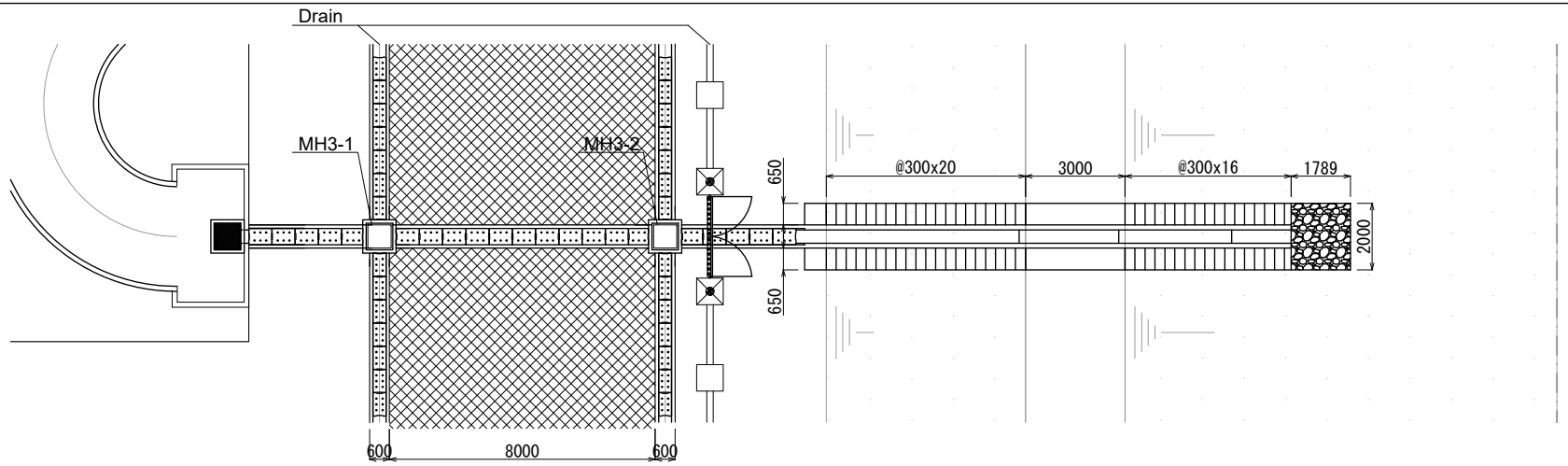
1b 300 Wide Drain (Road Cross Section)

1 Sections of Drain
Scale 1:20



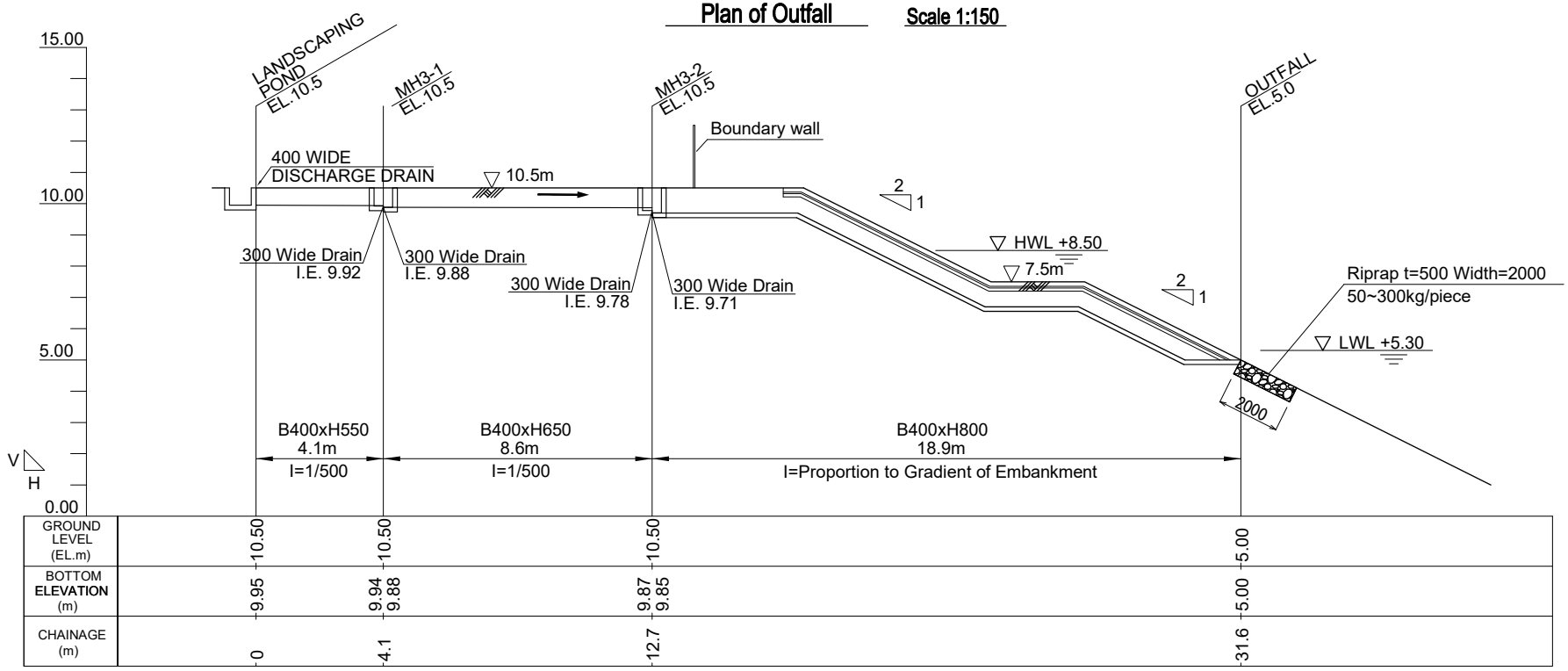
1c Concrete Cover

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



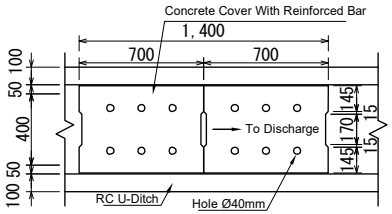
GROUND LEVEL (EL.m)	10.50	10.50	10.50		5.00
BOTTOM ELEVATION (m)	9.95	9.94 / 9.88	9.87 / 9.85		5.00
CHAINAGE (m)	0	4.1	12.7		31.6

Profile of Outfall

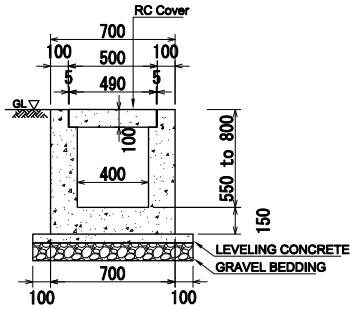
Scale(V=H) 1:150

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)

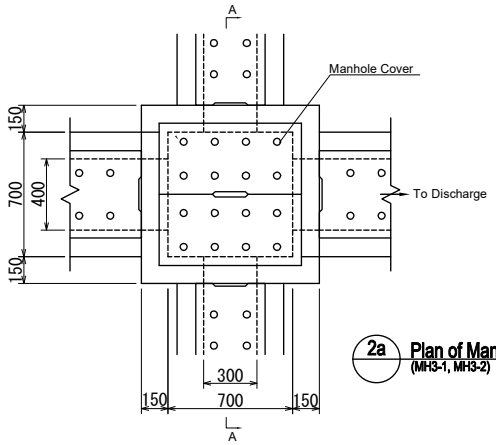


1b Concrete Cover

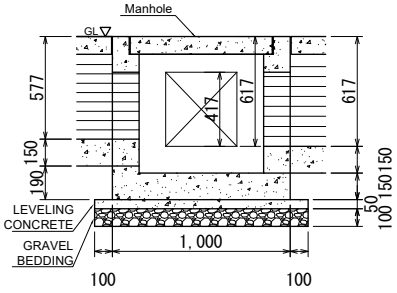


1a Typical 400 Wide Discharge Drain (Depth 550-633) With Cover

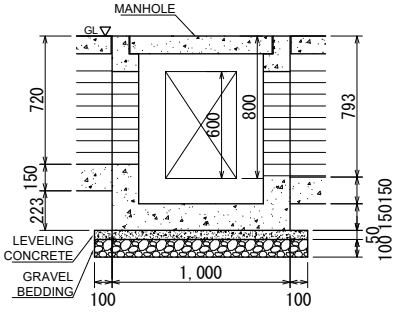
1 Sections of Discharge Drain
Scale 1:30



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

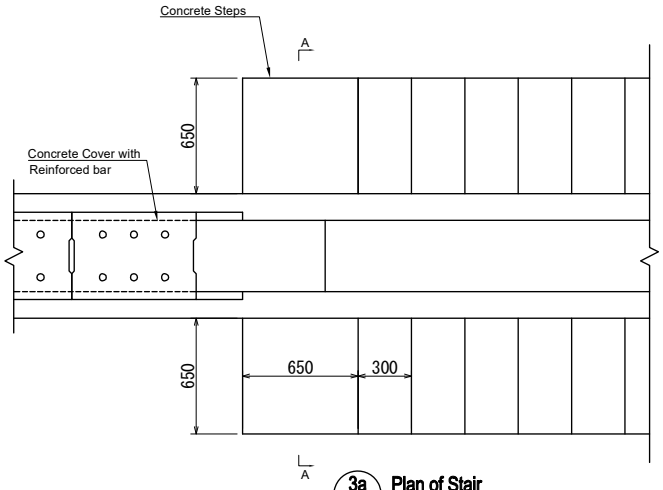


2b Section A-A (MH3-1)

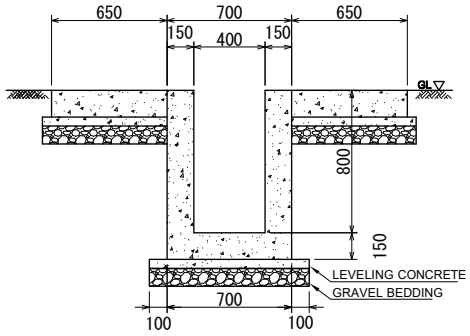


2c Section A-A (MH3-2)

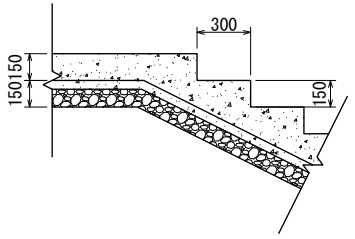
2 Sections of Discharge Manhole
Scale 1:30



3a Plan of Stair



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

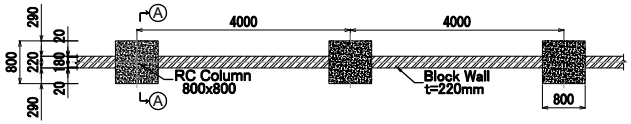


3c Section A-A

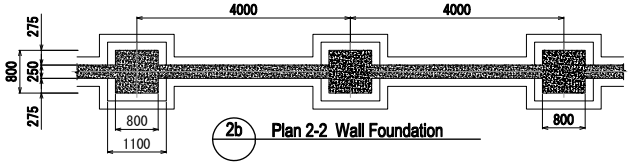
3 Sections of Discharge Stair & Drain
Scale 1:30

SCALE A (1:150) 0 0.5 1.0

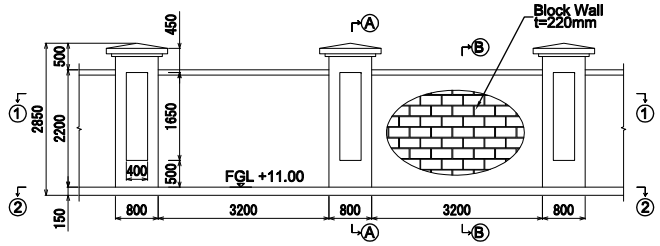
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU
STP-LS-006	SEWAGE TREATMENT PLANT Detail of Outfall (2/2)



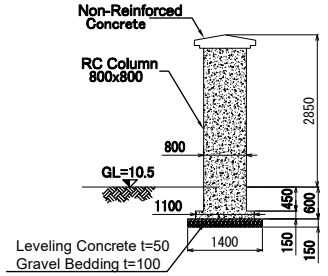
2a Plan 1-1 Column and Wall



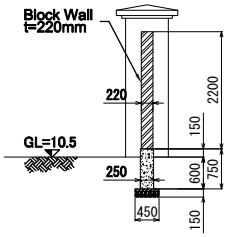
2b Plan 2-2 Wall Foundation



2c Front Elevation

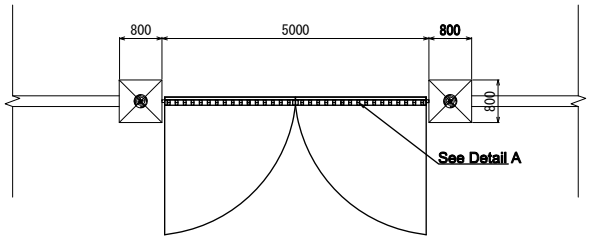


2d Section A-A

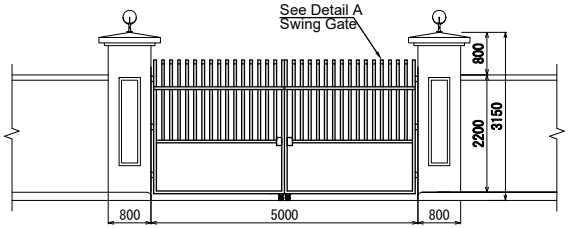


2e Section B-B

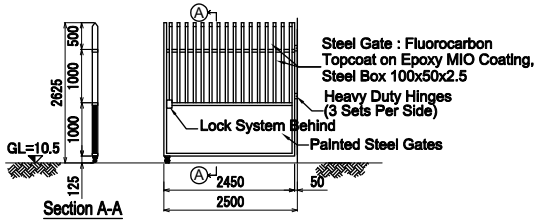
2 Detail of Boudary Wall
Scale 1:100



1a Plan



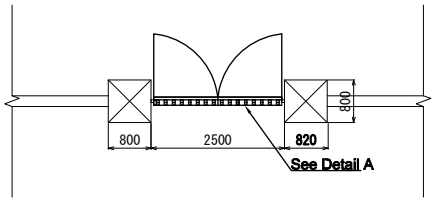
1b Front Elevation



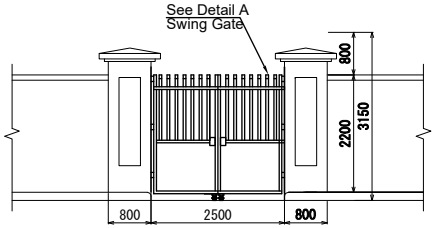
Section A-A

1c Detail A

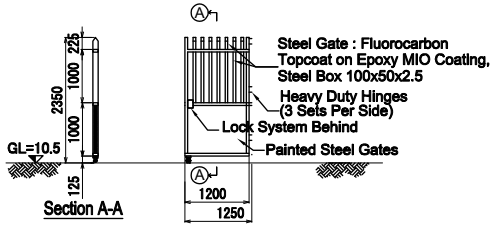
1 Detail of Main Entrance Gate
Scale 1:100



1a Plan



1b Front Elevation



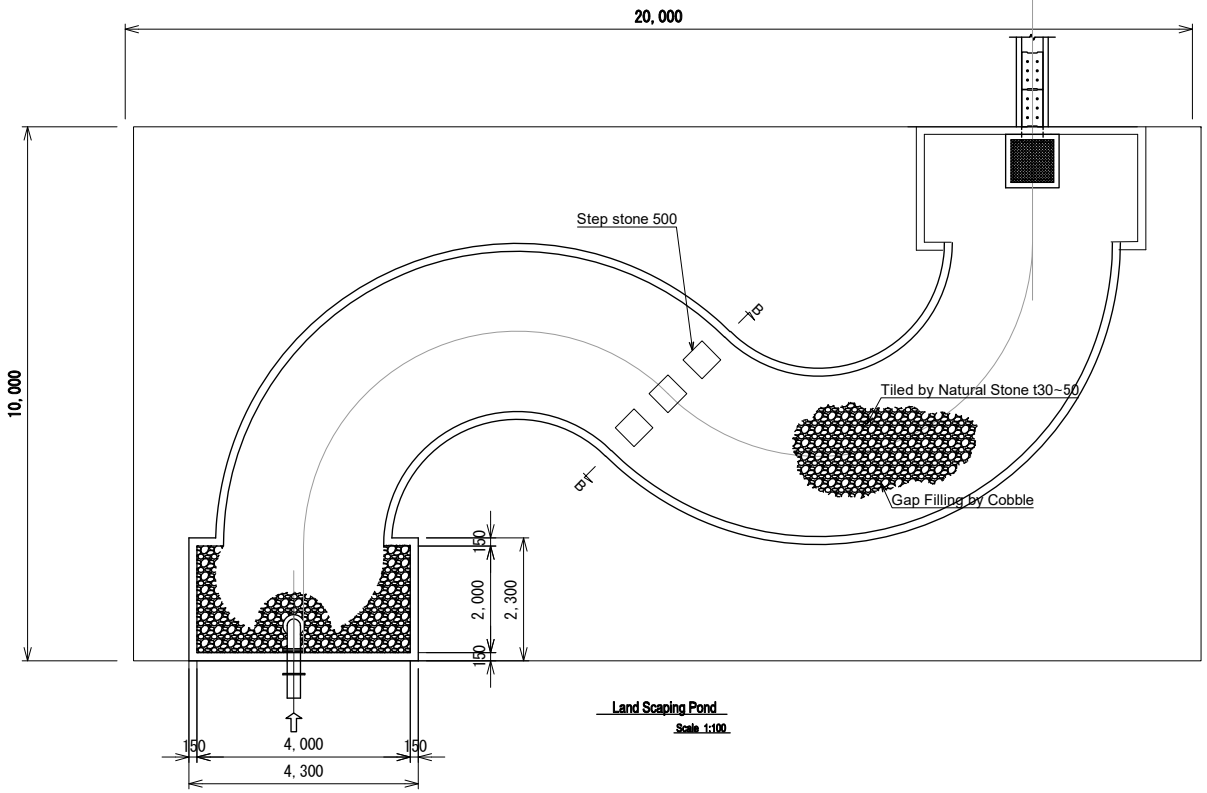
Section A-A

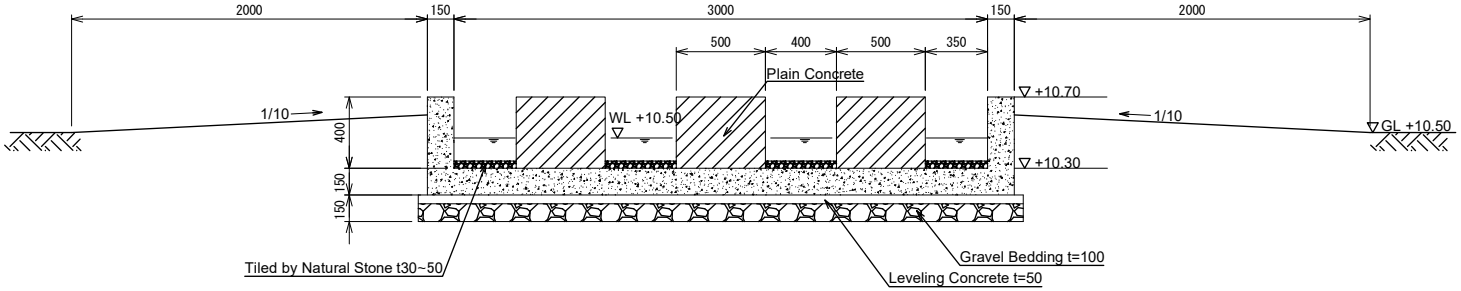
1c Detail A

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





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

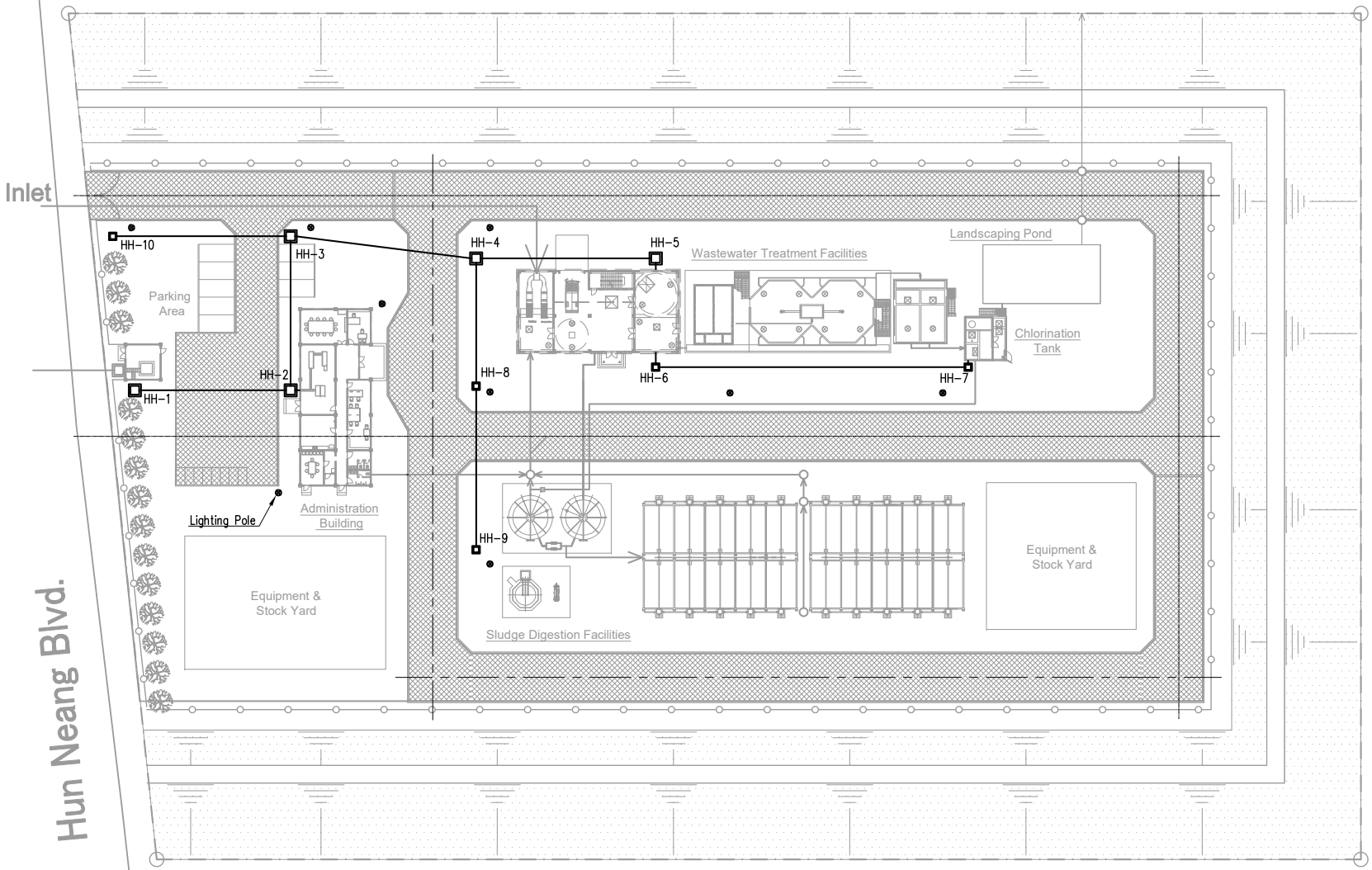
Route No	Origine ~ Destination	Length (m) / under pavement	High Voltage	Low Voltage	Signaling
A	HH-1 ~ HH-2	19.463 / 17.612	200 x 1		40 x 1
B	HH-2 ~ HH-3	27.148	200 x 1	150 x 1	40 x 1
C	HH-2 ~ HH-4	30.308 / 8.667		150 x 1	40 x 1
D	HH-4 ~ HH-5	29.069		150 x 1	40 x 1
E	HH-5 ~ HH-6	17.319		150 x 1	40 x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

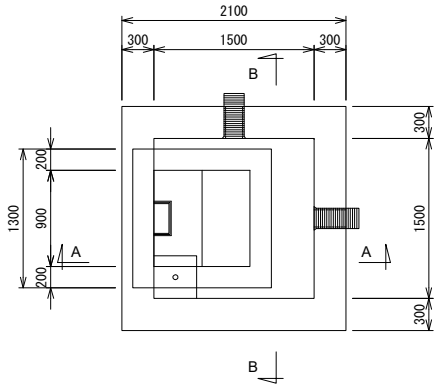
No	Handhole Type
HH-1 ~ HH-5	Type A
HH-6 ~ HH-10	Type B



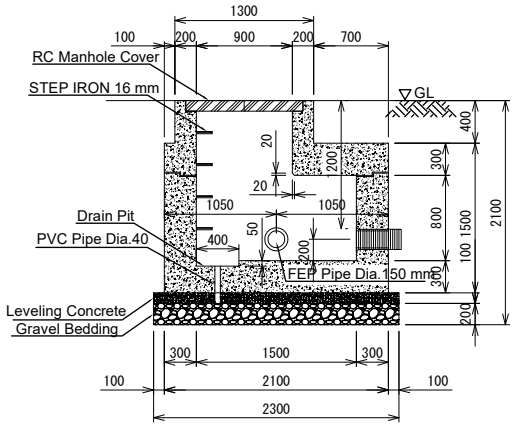
Layout of Yard Cabling

Scale = 1:750

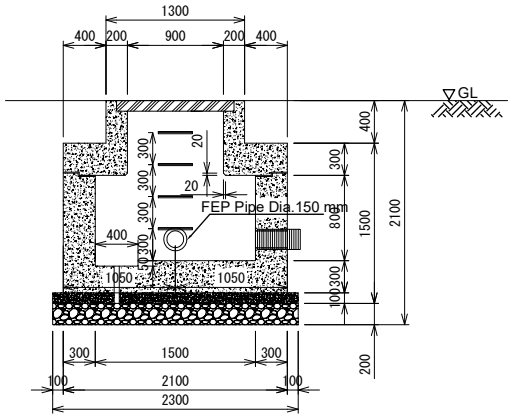
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LS-009	SEWAGE TREATMENT PLANT Layout of Yard Cabling & Lighting



1a Plan

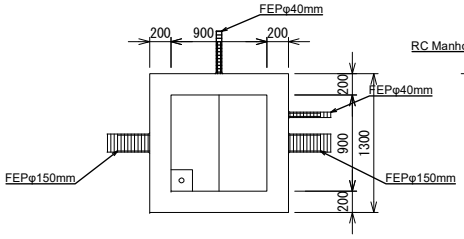


1b Section A-A

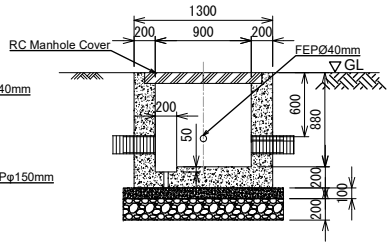


1c Section B-B

1 Electrical Manhole Type-A (1500x1500)

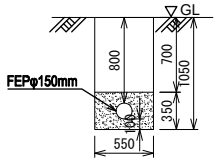


2a Plan

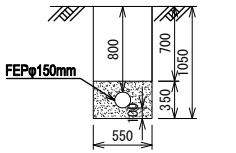


2b Section A-A

2 Electrical Manhole Type-B (900x900)

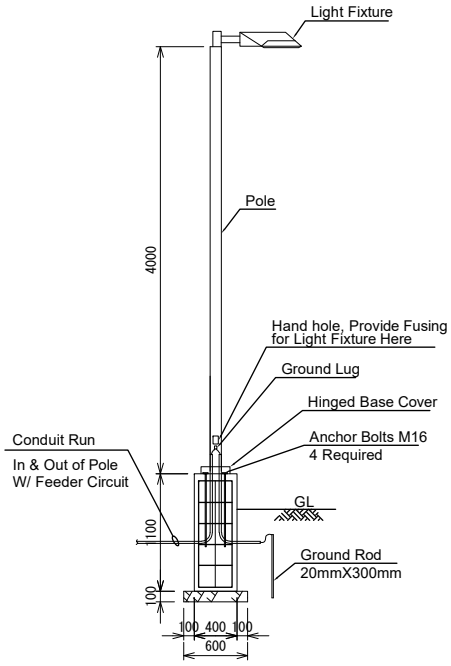


3a Section Type A



3b Section Type B

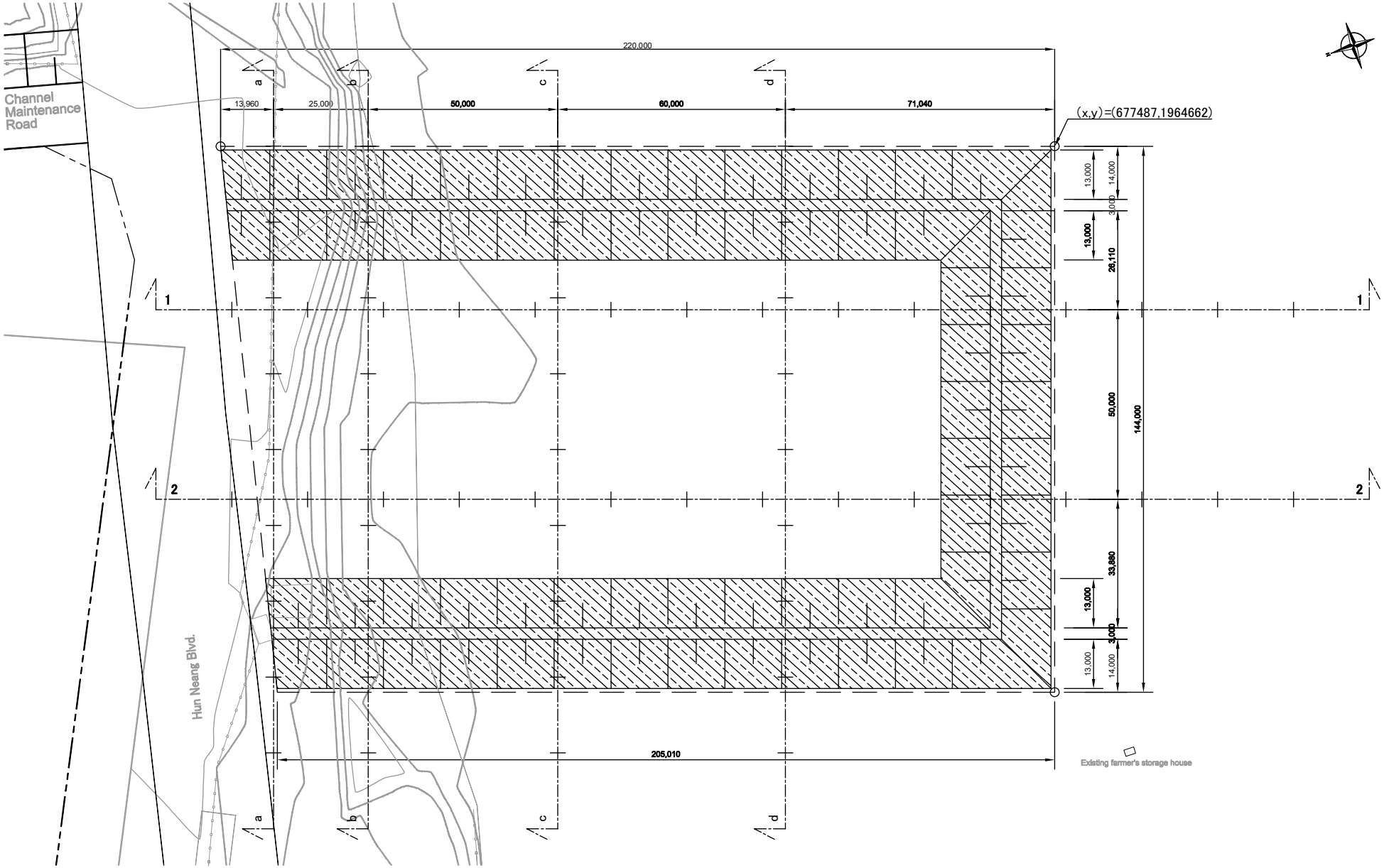
3 Typical Section of Trench Excavation for Electrical Cable



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

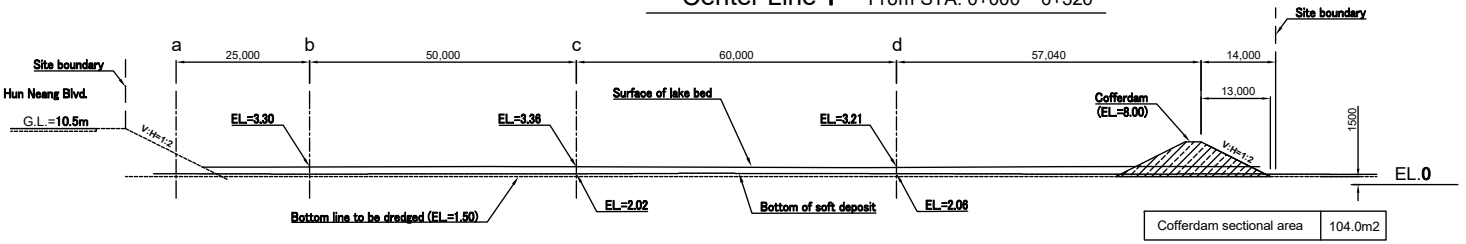


Layout Plan of Cofferdam

Scale = 1:1000

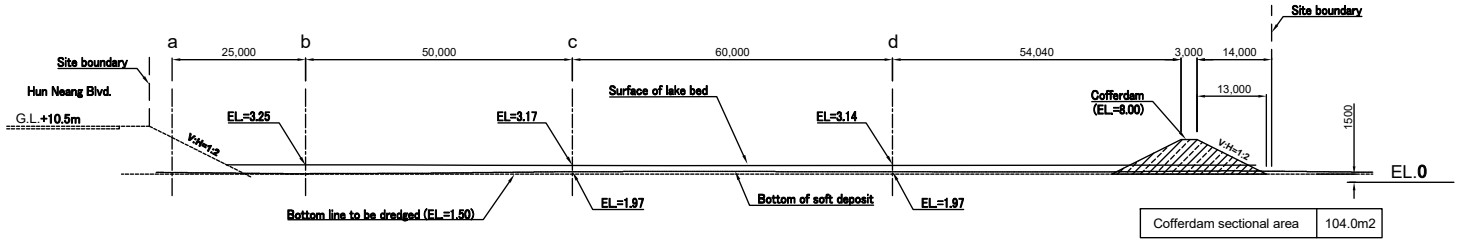
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-001	SEWAGE TREATMENT PLANT Layout Plan of Cofferdam

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

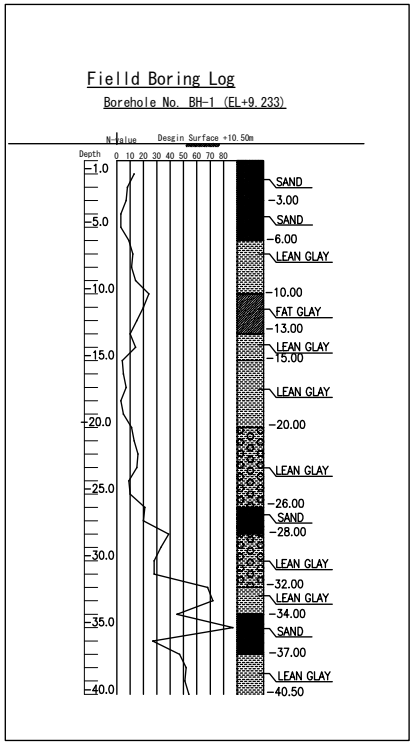


Cofferdam sectional area	104.0m2

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



Cofferdam sectional area	104.0m2



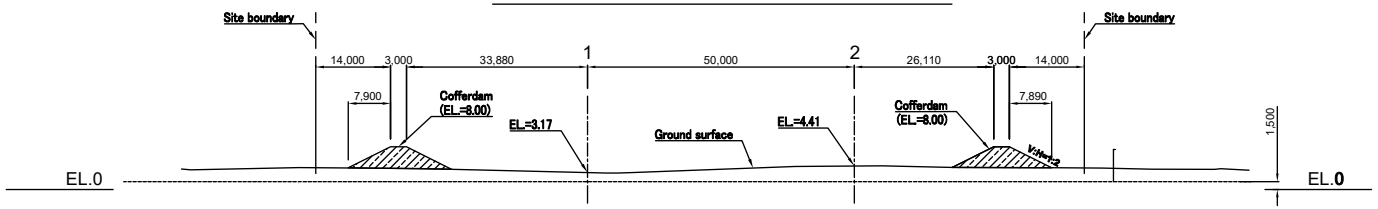
Section of Cofferdam (1/2)

Scale = 1:1000

SCALE 0 10 20 30 40 50m

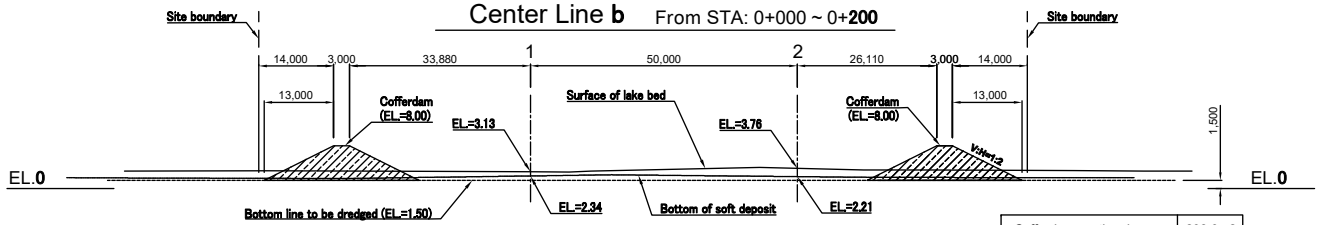
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-002	SEWAGE TREATMENT PLANT Section of Cofferdam (1/2)

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



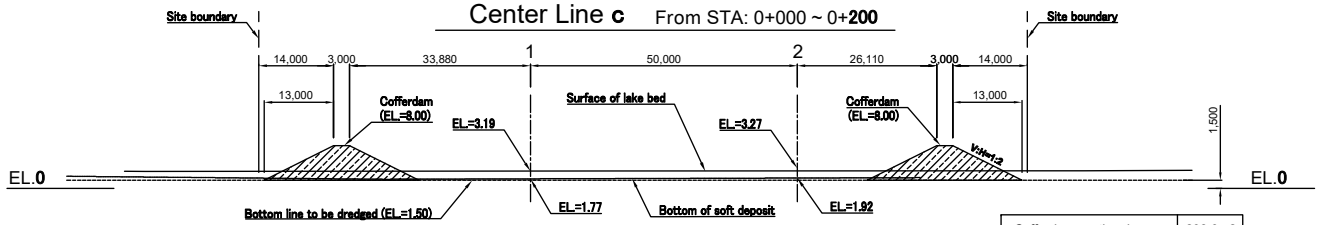
Cofferdam sectional area	87.6m2

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



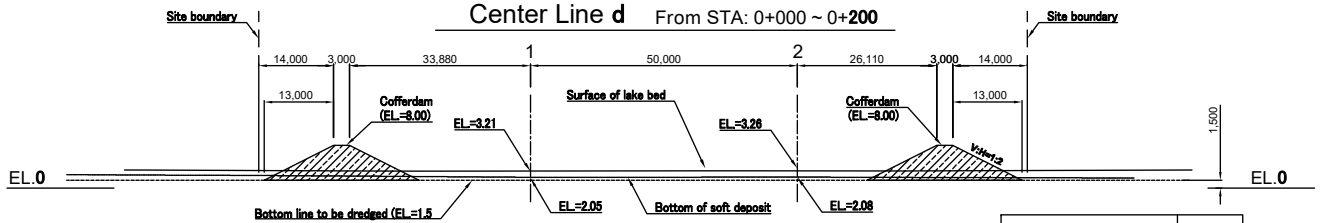
Cofferdam sectional area	208.0m2

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



Cofferdam sectional area	208.0m2

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



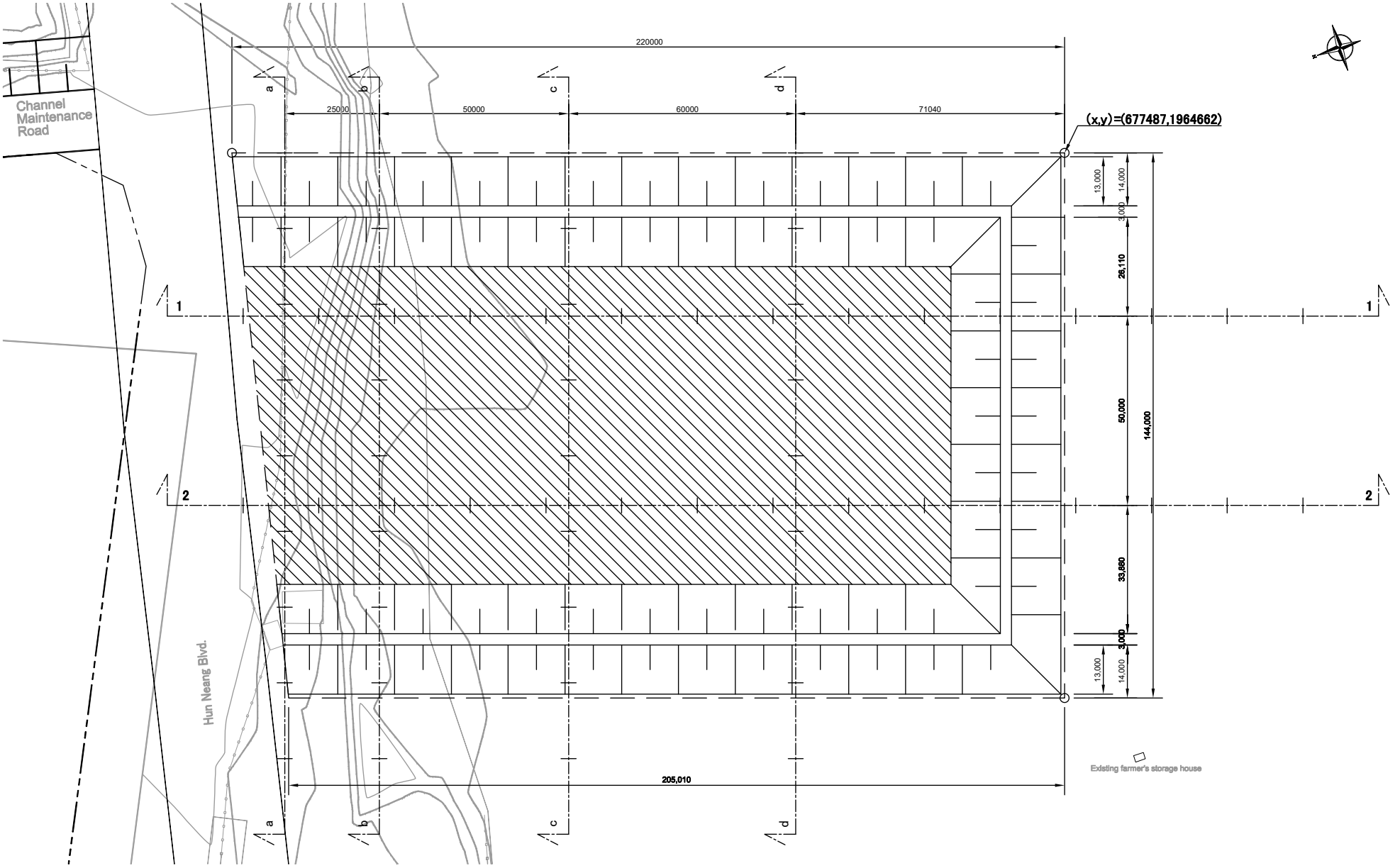
Cofferdam sectional area	208.0m2

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

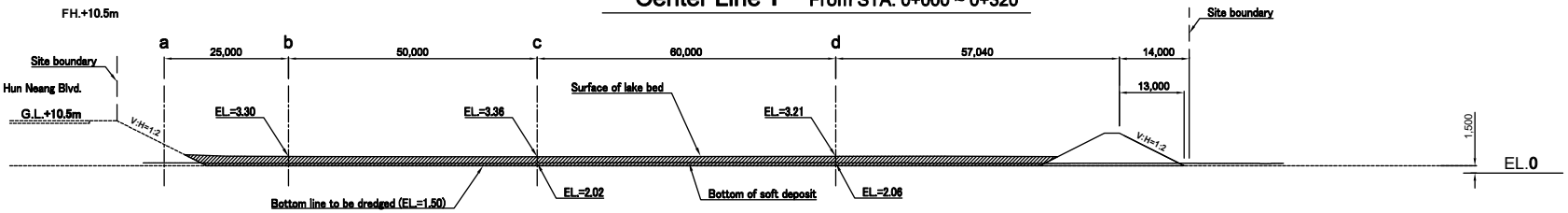
Scale = 1:1000

Legend

Site boundary
Lake boundary
Dredging area

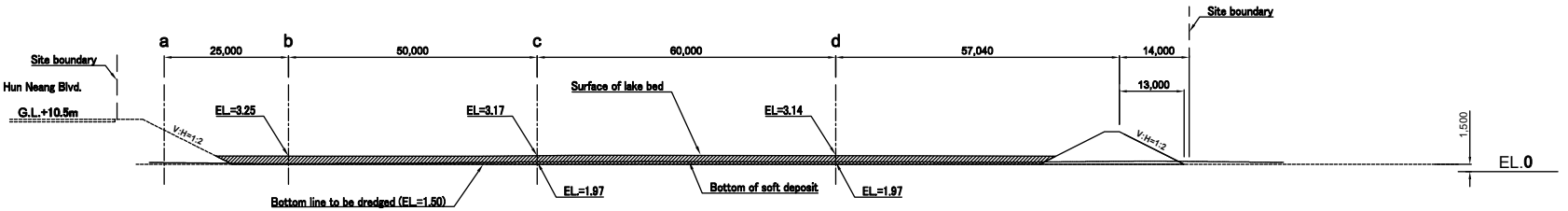
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-004	SEWAGE TREATMENT PLANT Layout Plan of Dredging

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



Dredging sectional area	313m2

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



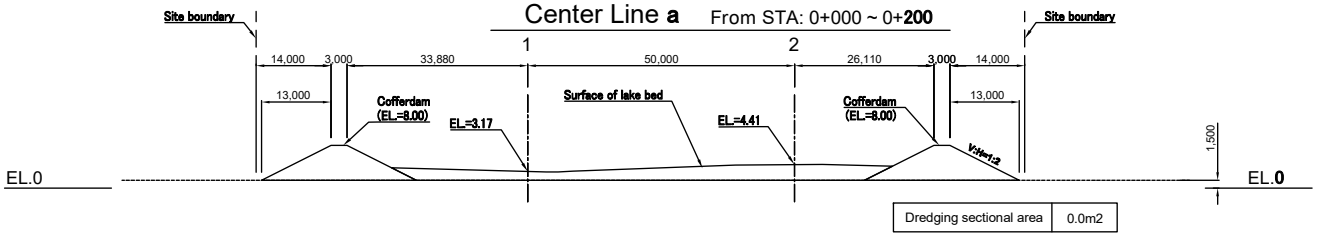
Dredging sectional area	278.5m2

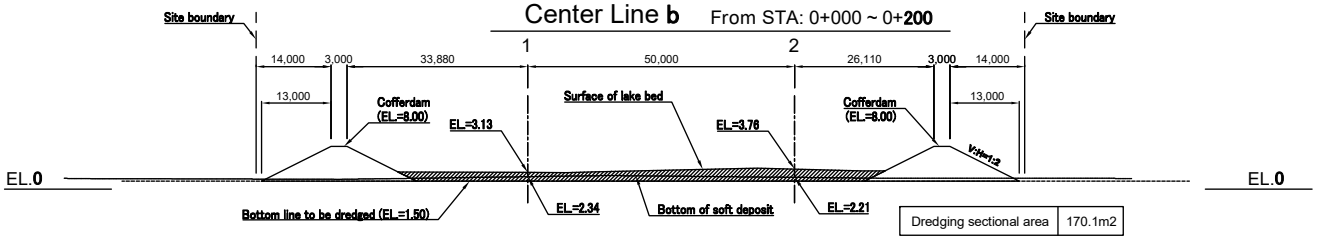
Section of Dredging (1/2)

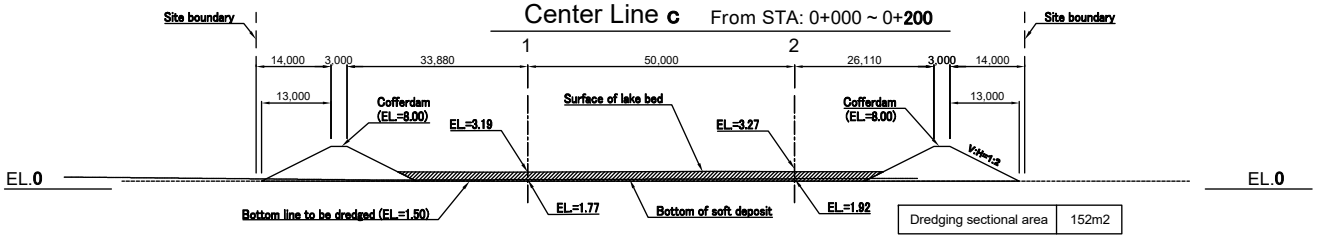
Scale = 1:1000

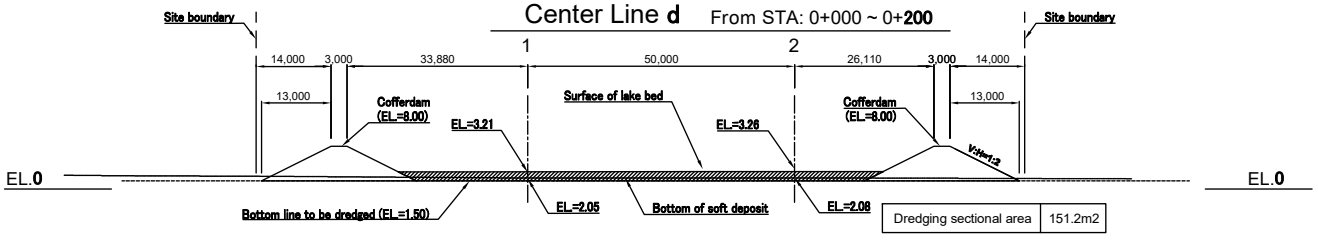
SCALE 0 10 20 30 40 50m

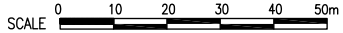
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-005	SEWAGE TREATMENT PLANT Section of Dredging (1/2)







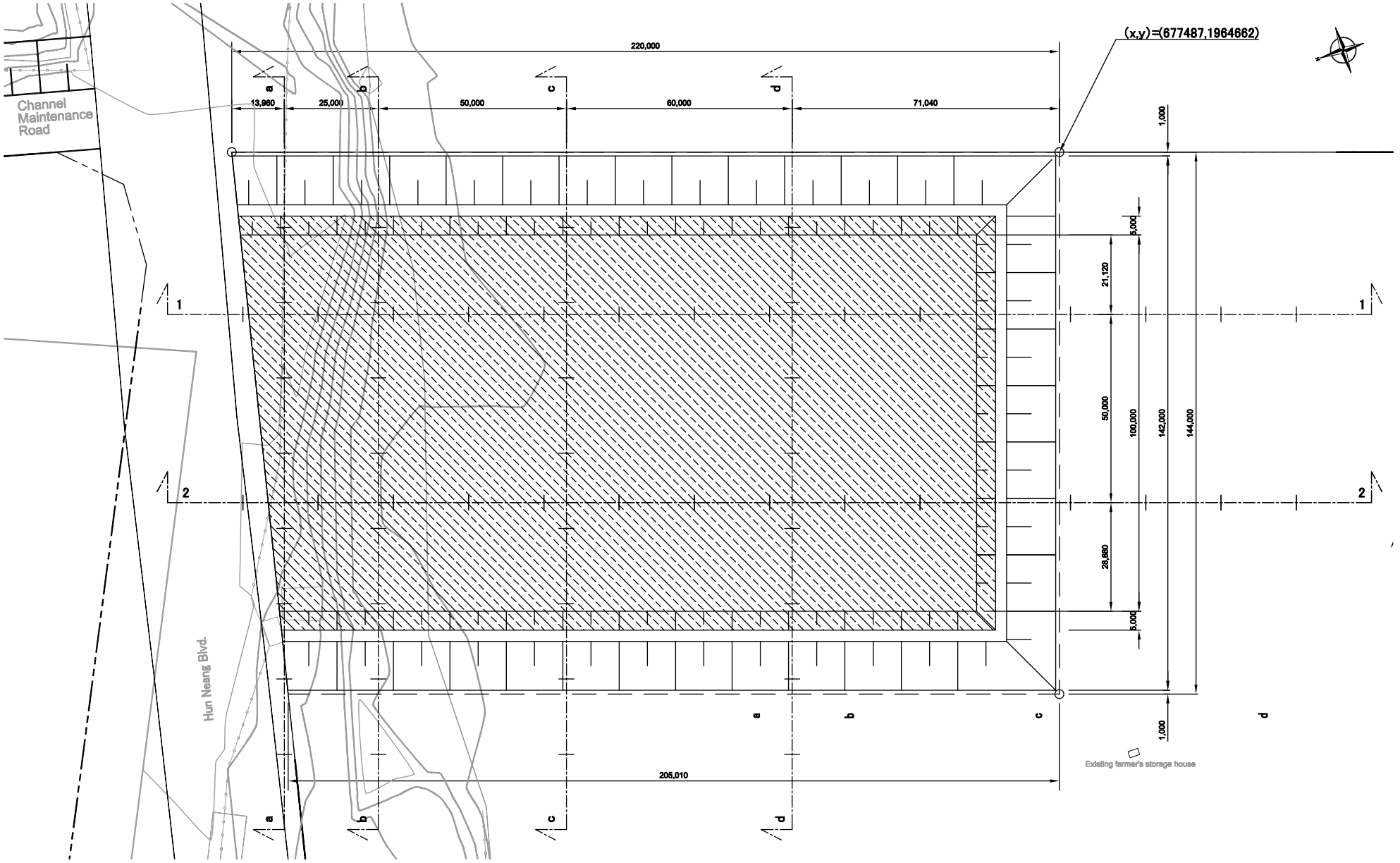




Section of Dredging (2/2)

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

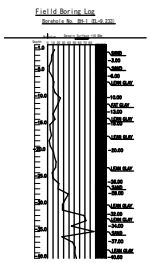
Filling area

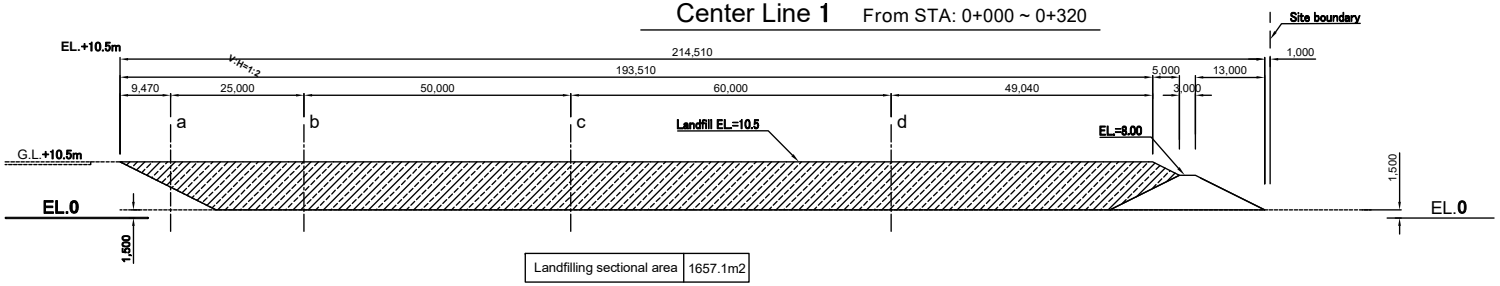
Lake boundary

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

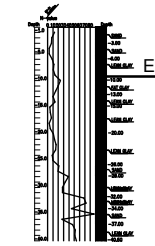
Center Line 1 From STA: 0+000 ~ 0+320

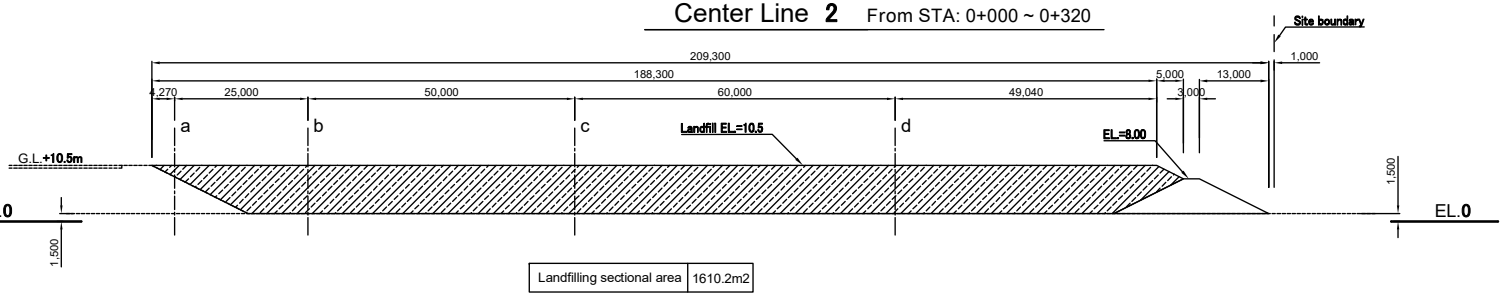




Landfilling sectional area	1657.1m2

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





Landfilling sectional area	1610.2m2

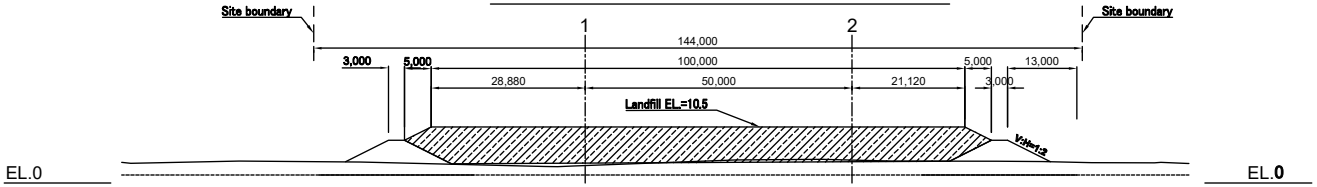
Section of Landfill (1/2)

Scale = 1:1000

SCALE 0 10 20 30 40 50m

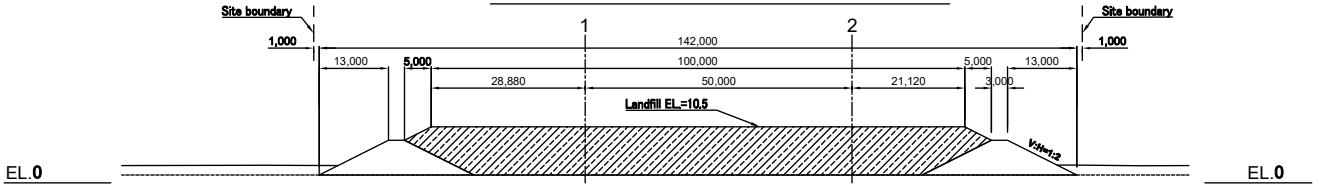
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	STP-LF-008	SEWAGE TREATMENT PLANT Section of Landfill (1/2)

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



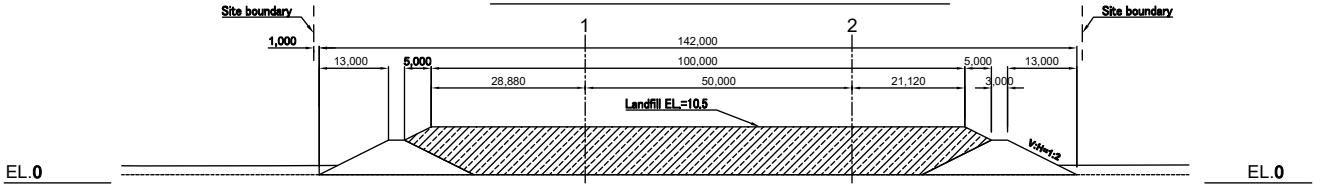
Landfilling sectional area	686.3m2

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



Landfilling sectional area	893.0m2

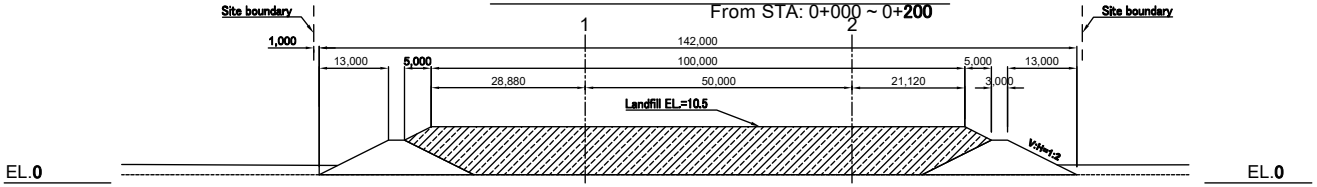
Center Line **c** From STA: 0+000 ~ 0+**200**



Landfilling sectional area	893.0m2

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

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



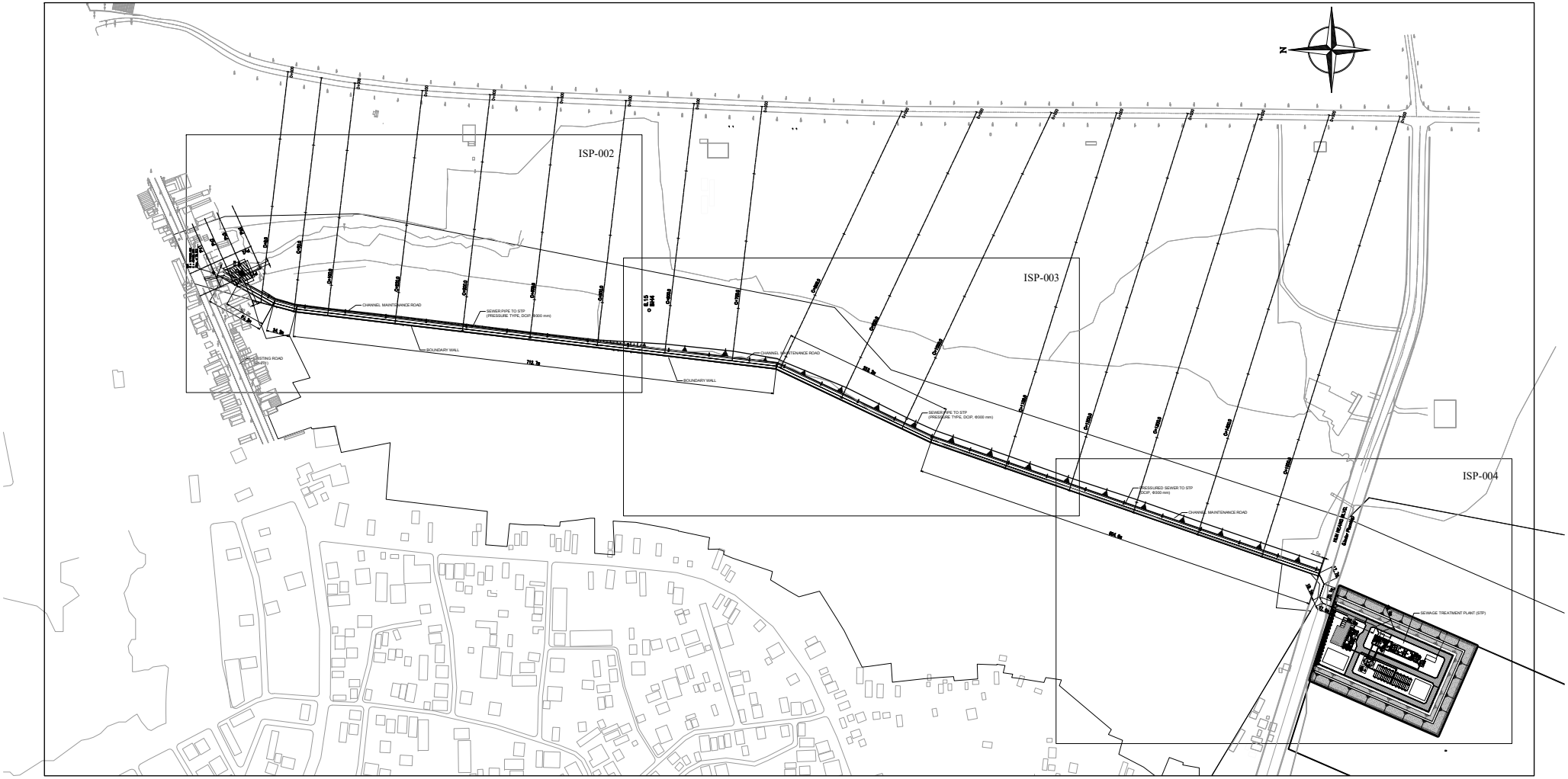
Landfilling sectional area	893.0m2

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)



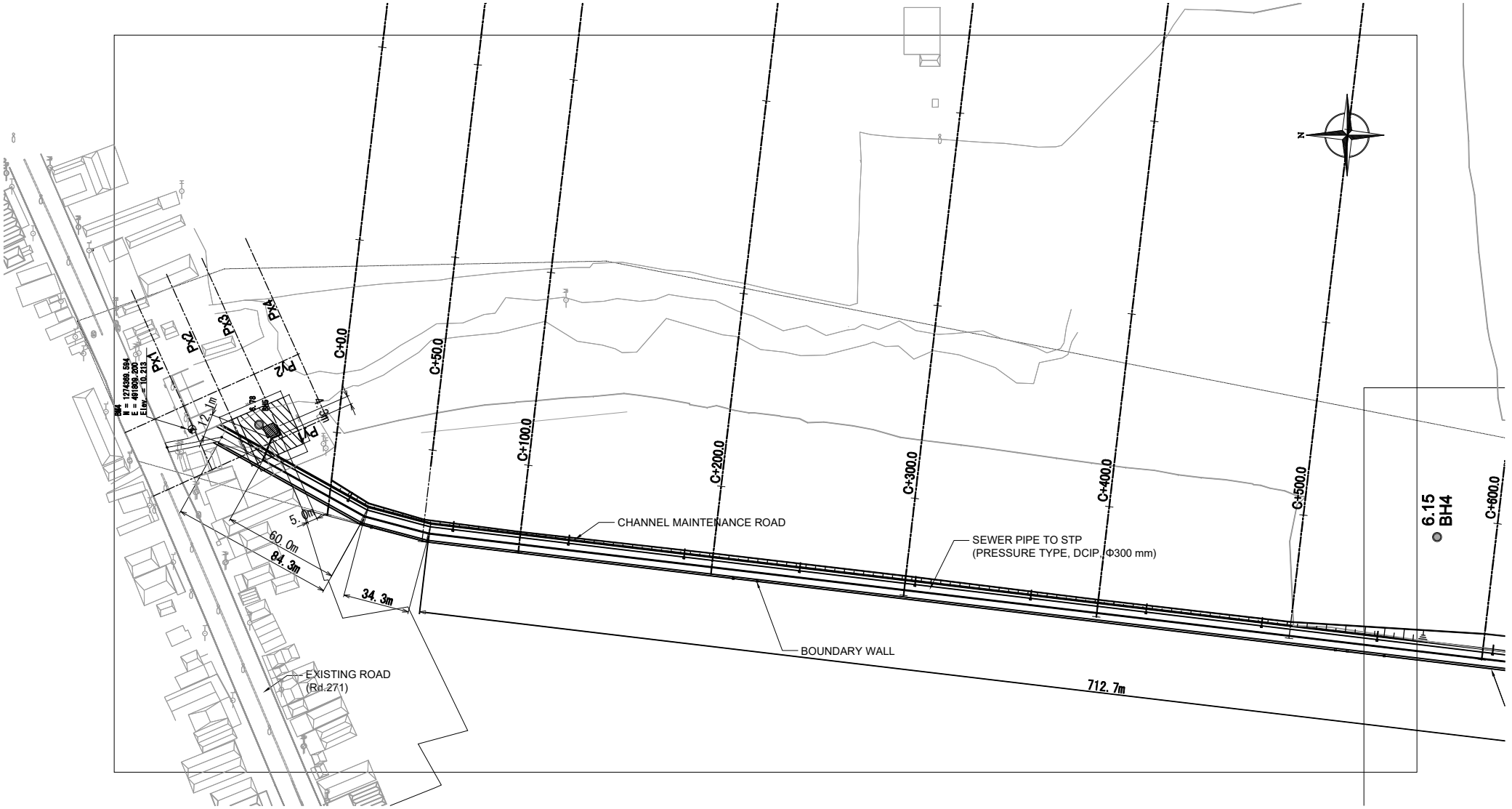
Intake & Sewer Pipe

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)

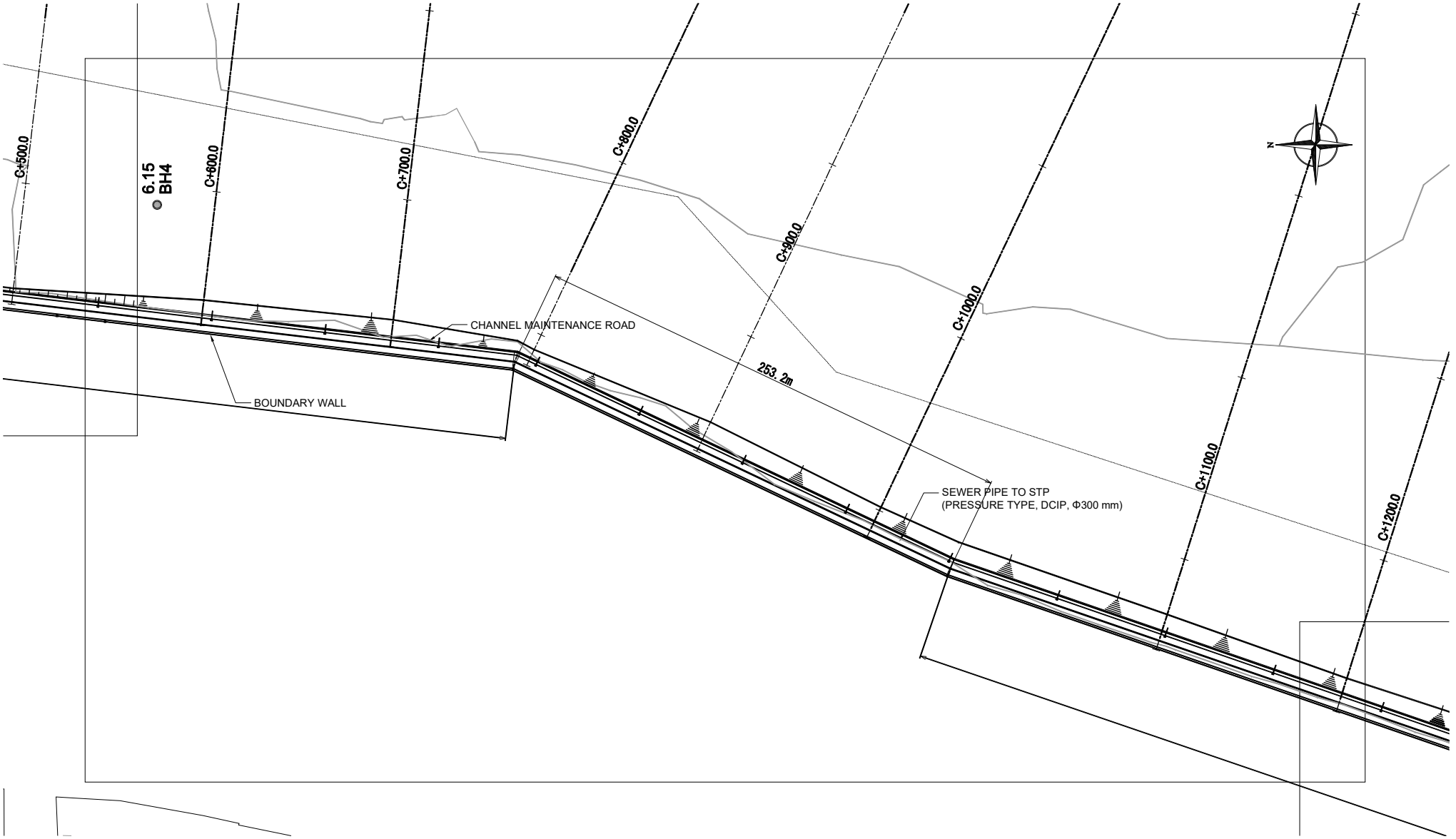


Interception Facility & Sewer Pipe

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)

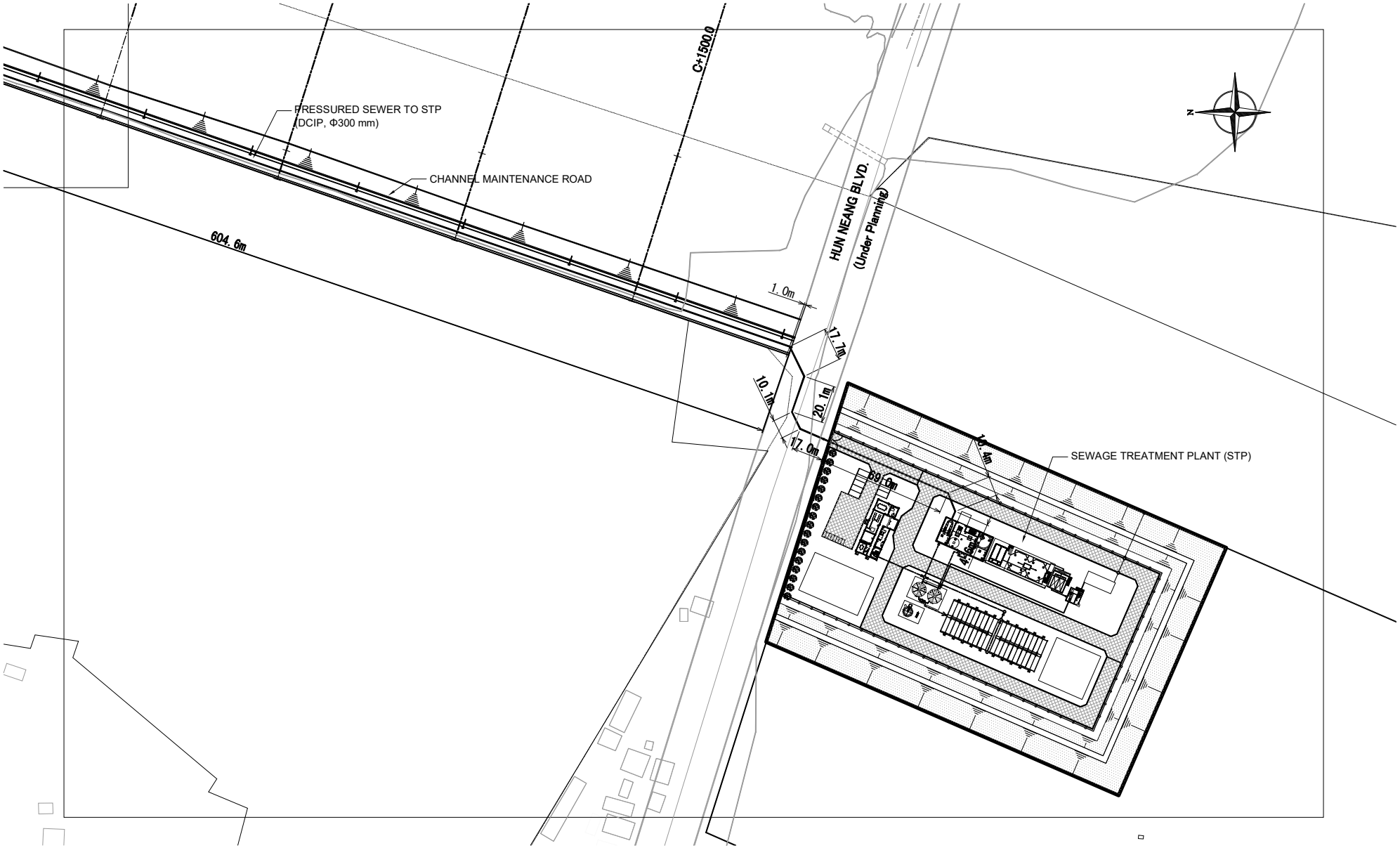


Interception Facility & Sewer Pipe

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

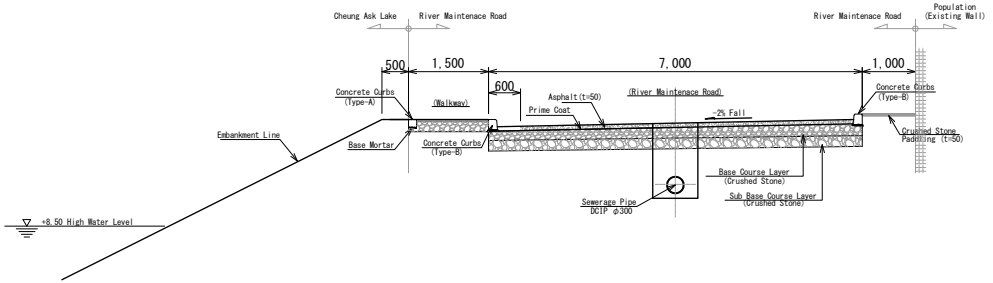
Layout Plan (3/3)

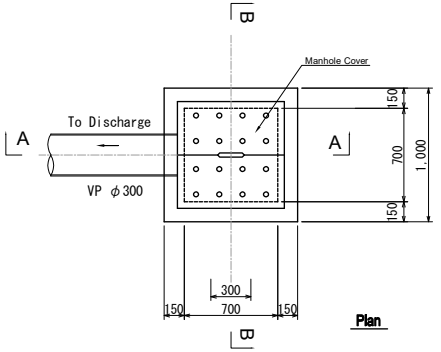
Scale = 1 : 2,000

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

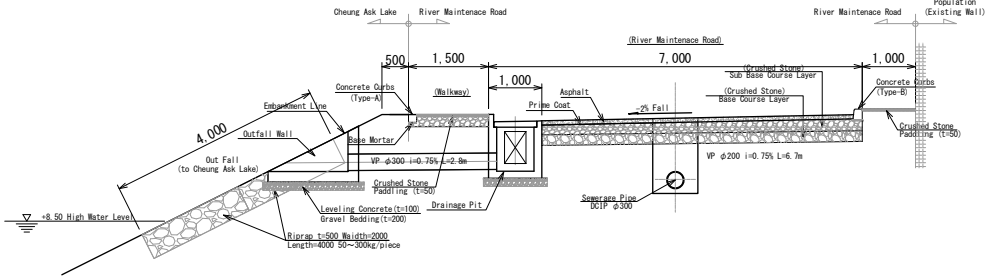


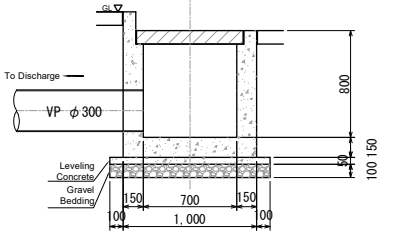


Plan

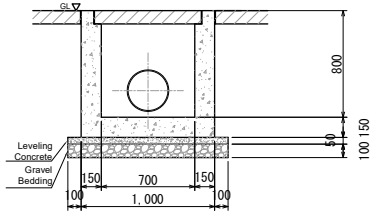
B-B Section (Out Fall)

Scale A 1:100





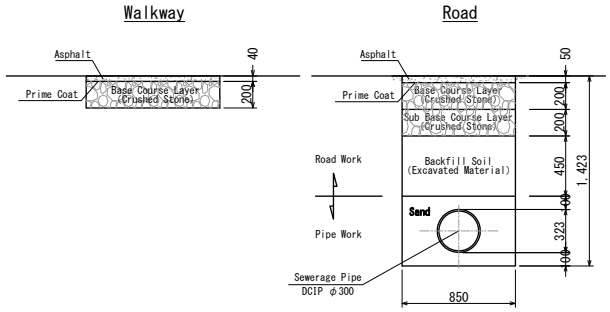
Section A-A

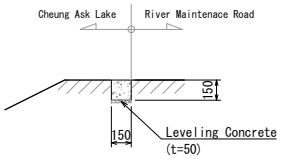


Section B-B

Pavement Structure

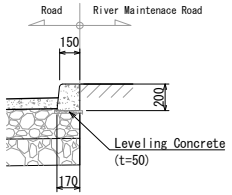
(Scale:B 1:40)





Concrete Curbs (Type-A) Section

Scale 1:40



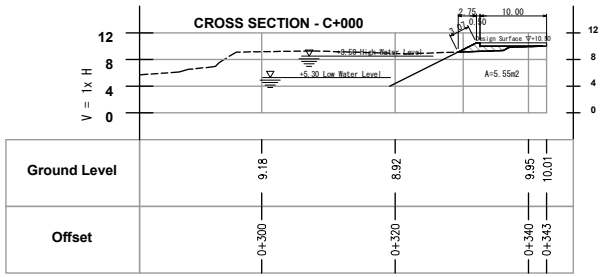
Concrete Curbs (Type-B) Section

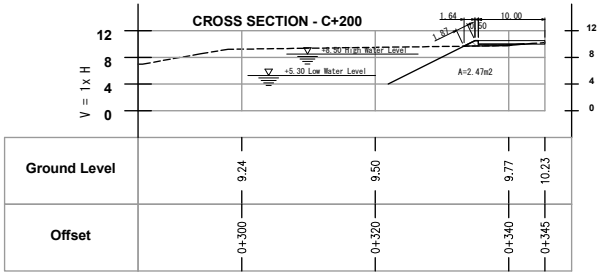
Scale 1:40

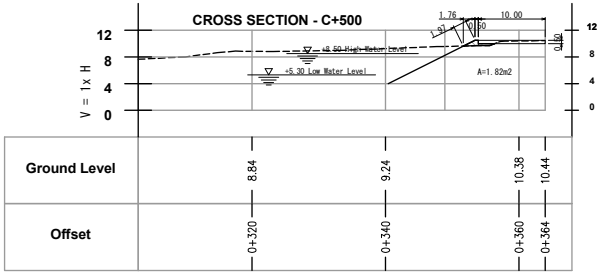
Drainage Pit

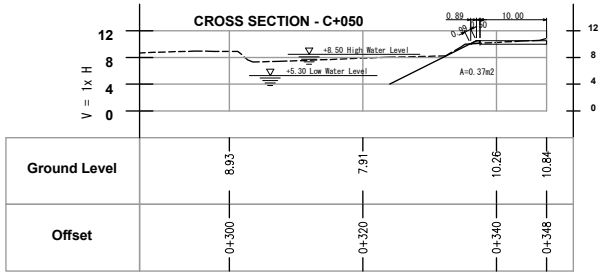
Scale 1:40

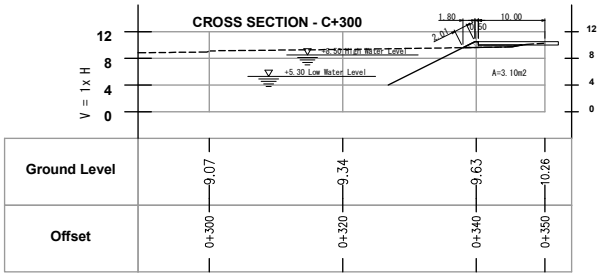
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-005	INTERCEPTION FACILITY & SEWER PIPE Channel Maintenance Road Detail

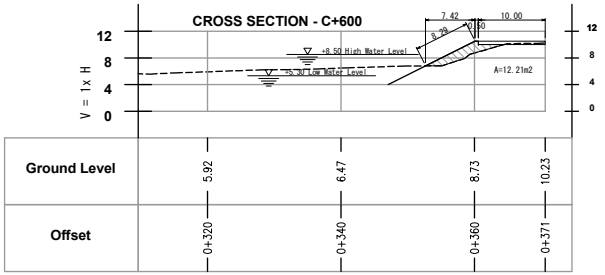


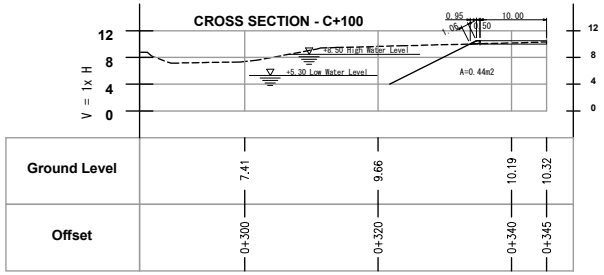


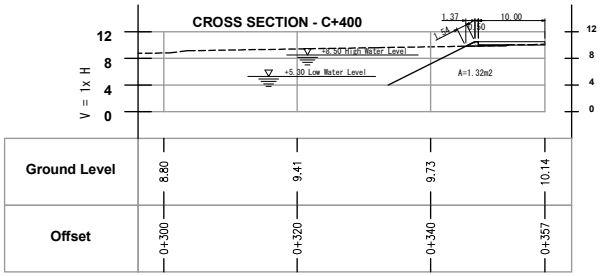


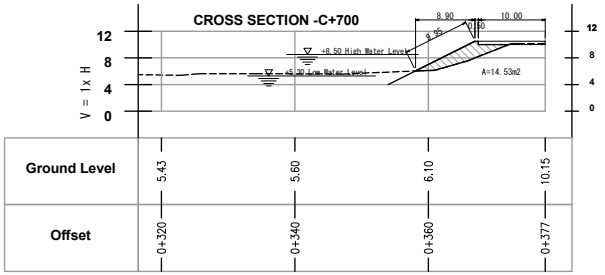








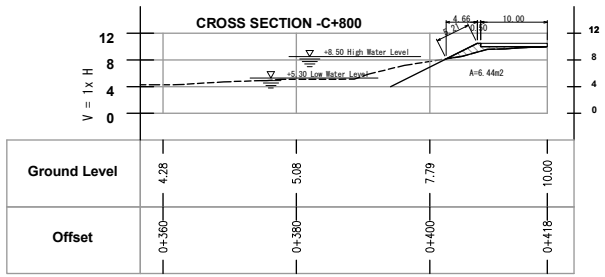


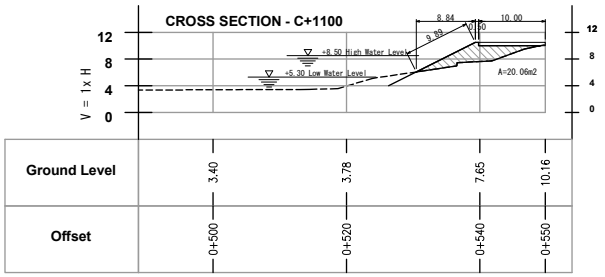


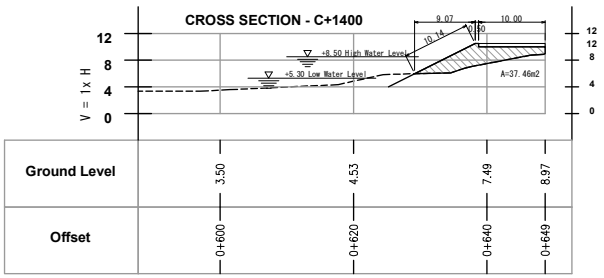
Channel Maintenance Road

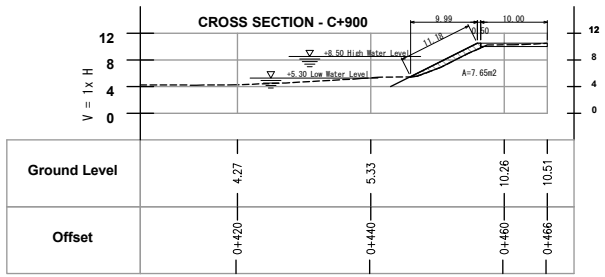
Section(1/2) Scale 1:800

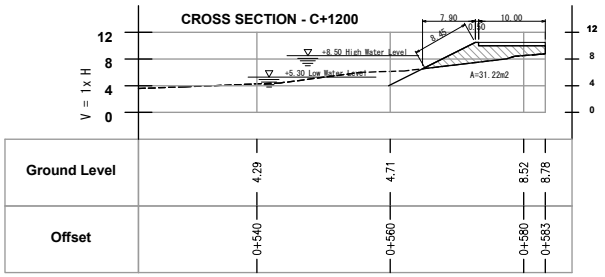
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-006	INTERCEPTION FACILITY & SEWER PIPE Channel Maintenance Road Section (1/2)

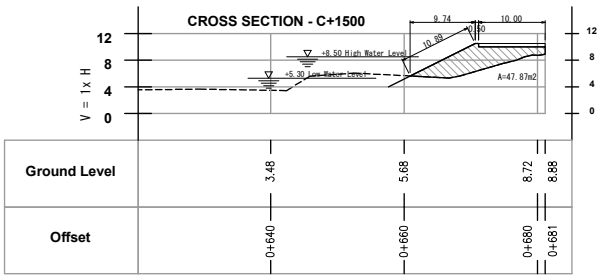


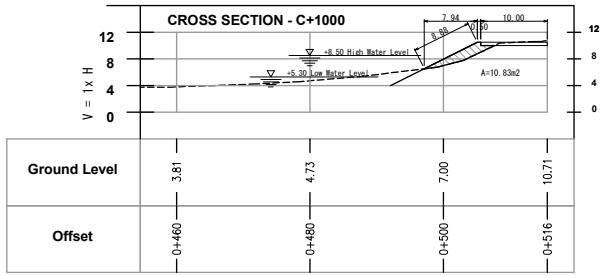


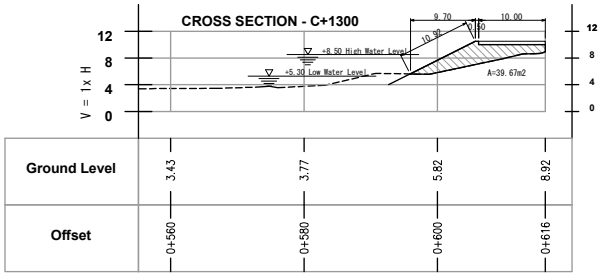












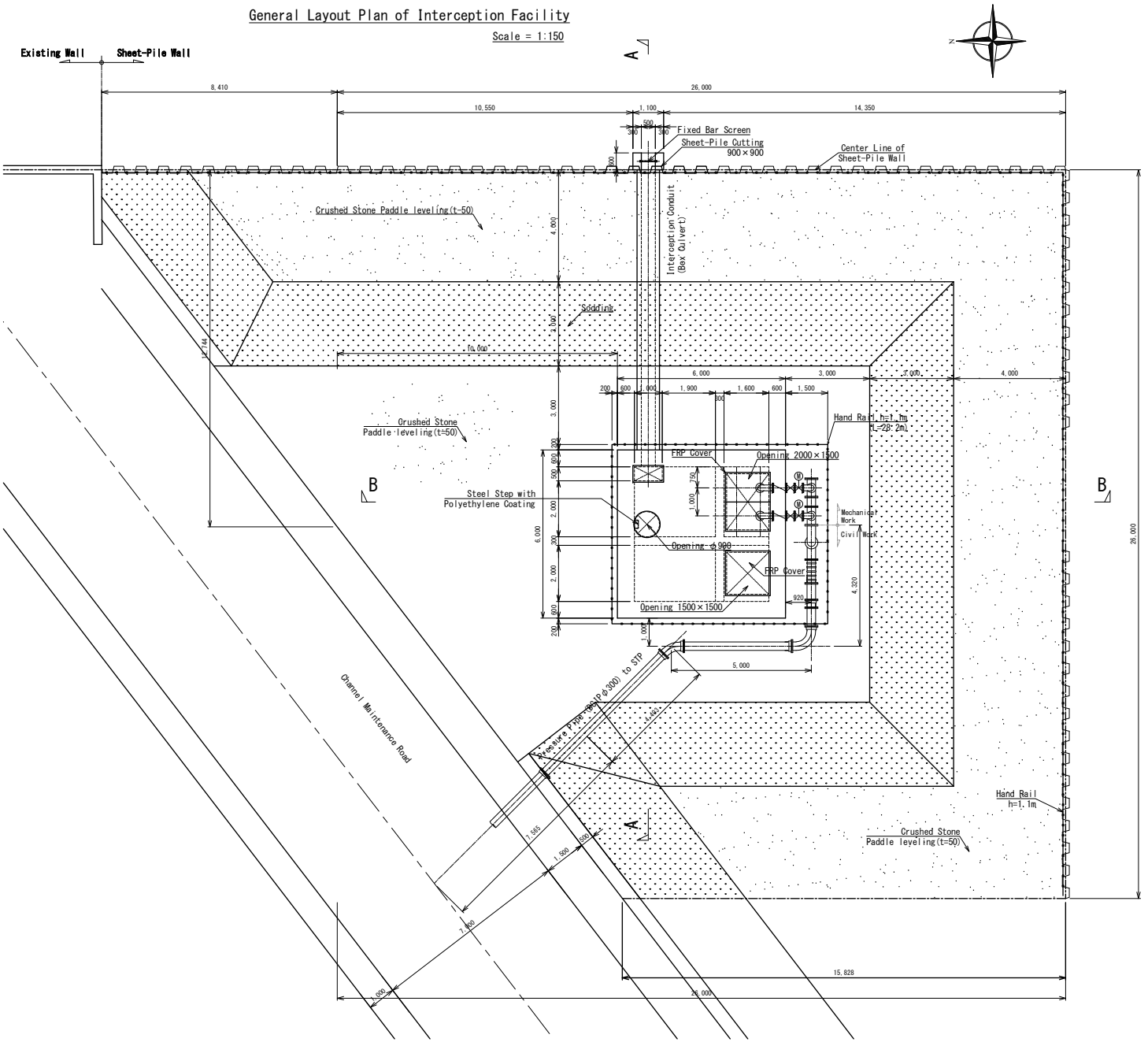
Channel Maintenance Road

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)

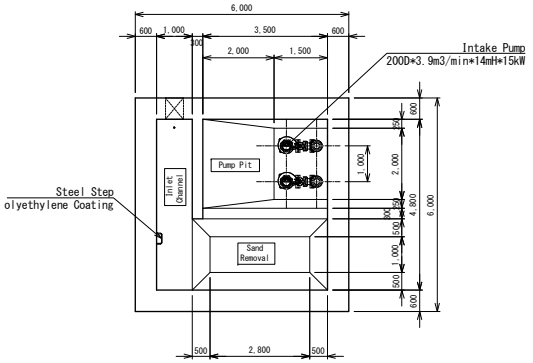
General Layout Plan of Interception Facility

Scale = 1:150



Bottom Plan at+3.5m

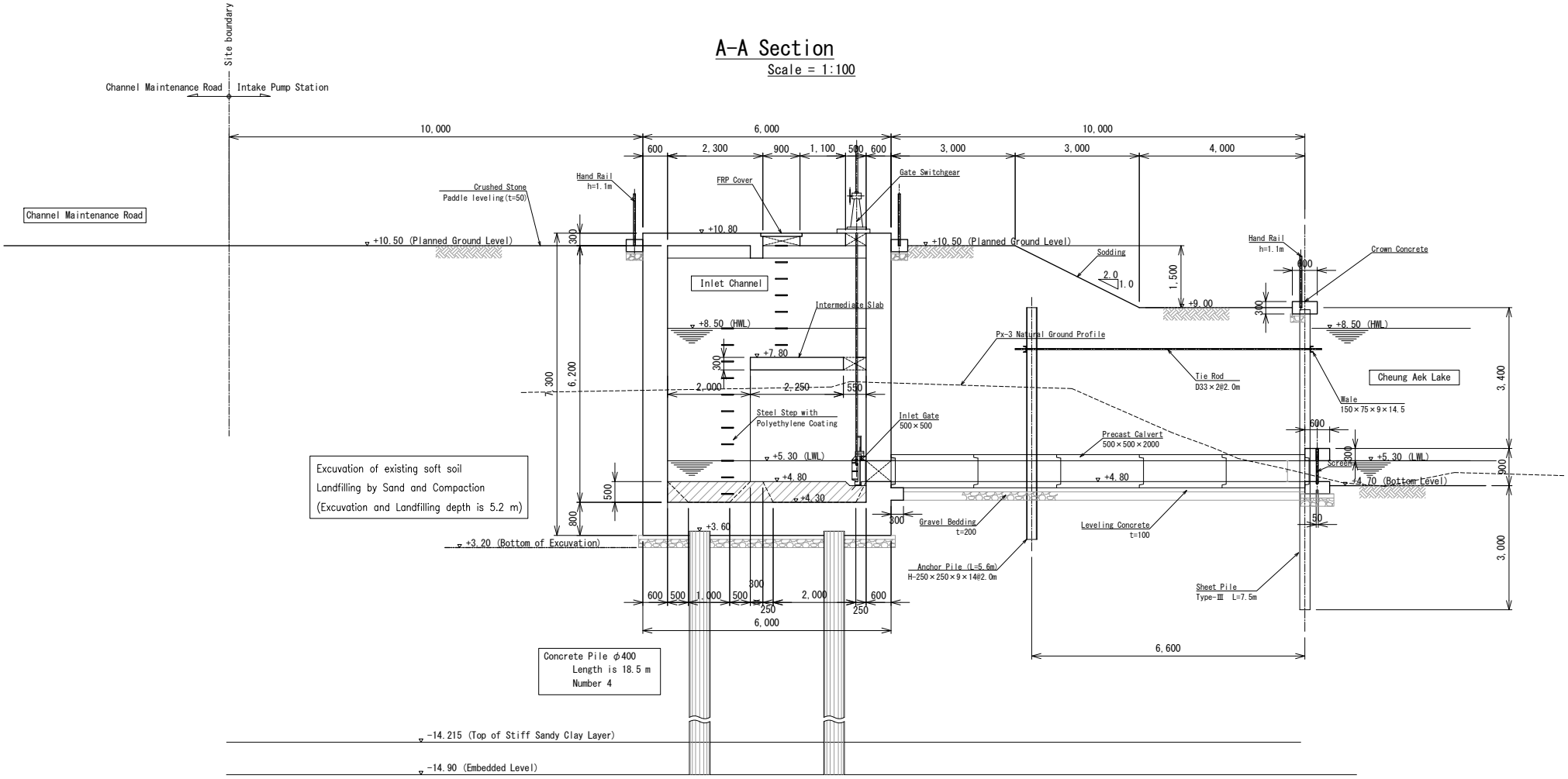
Scale = 1:150



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



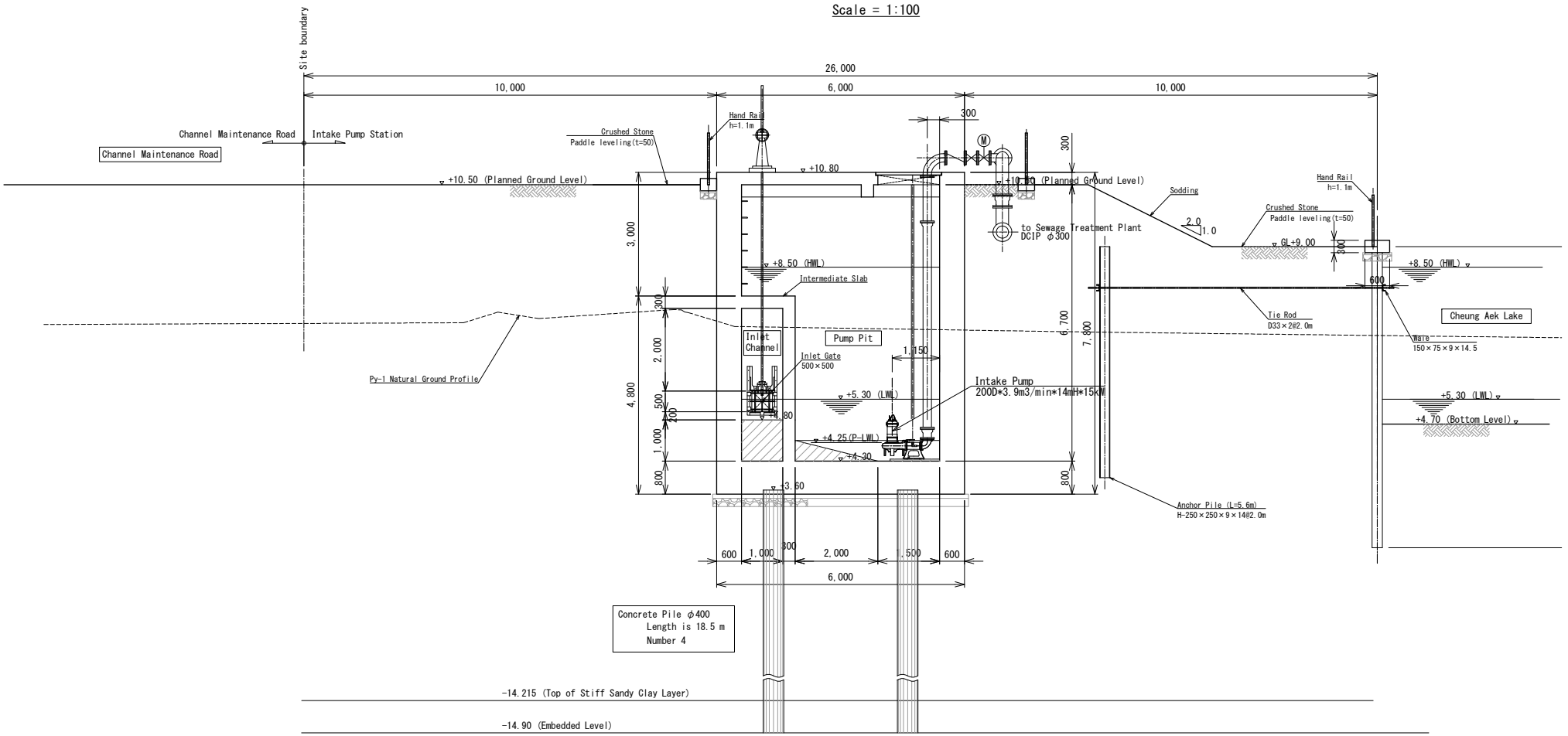
Interception Facility

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

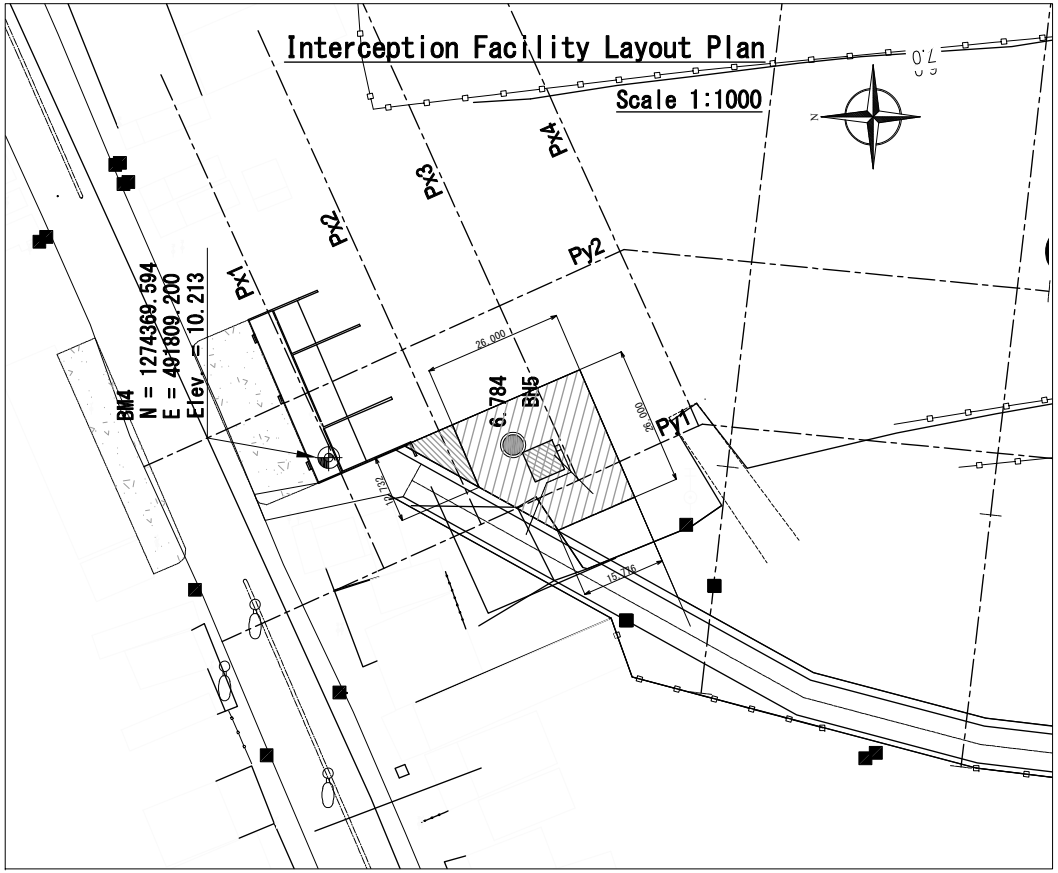
Scale = 1:100



Interception Facility

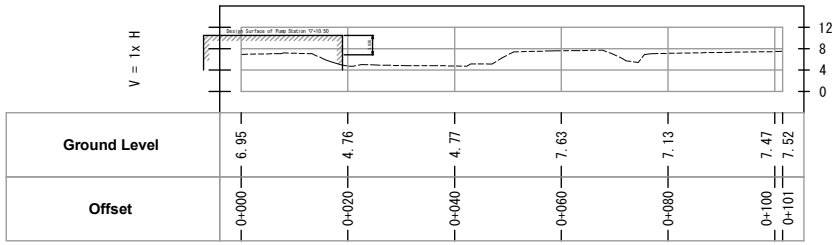
Section (2/2) Scale = 1 : 100

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)



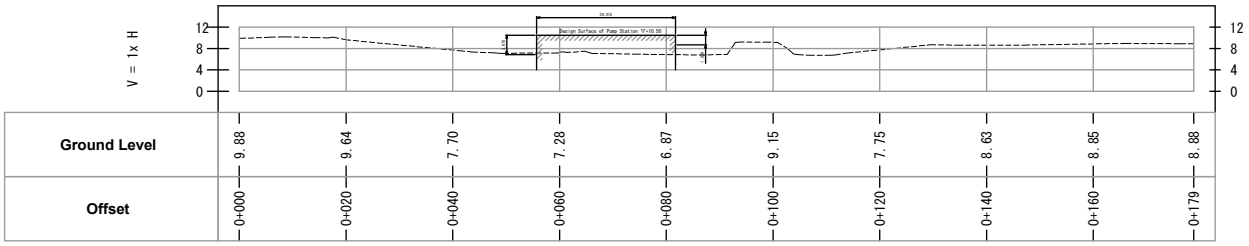
CROSS SECTION - PX3

From **STA: 0+000 ~ 0+101**



CROSS SECTION - PY1

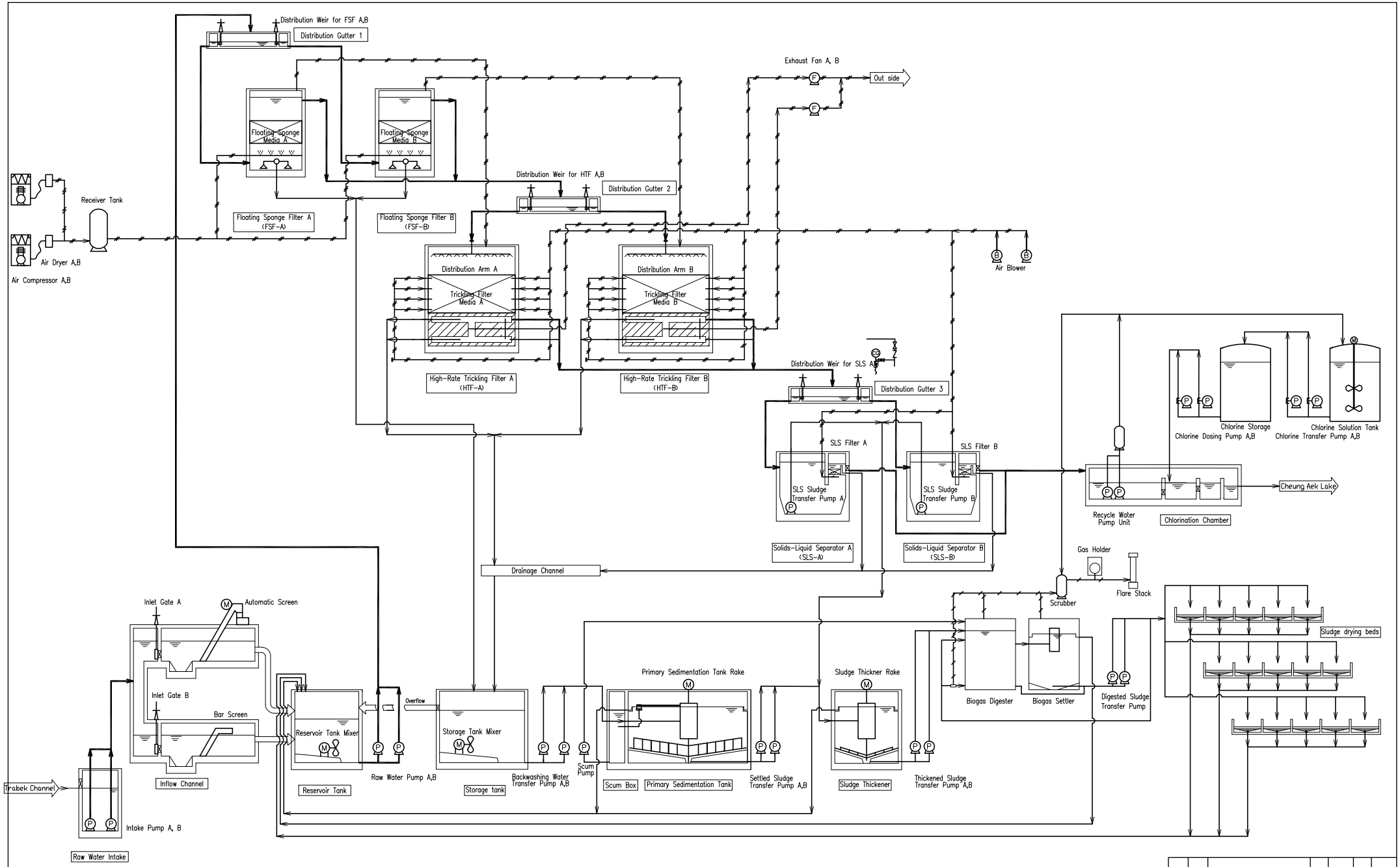
From **STA: 0+000 ~ 0+179**



Interception Facility Section

Scale = 1:1000

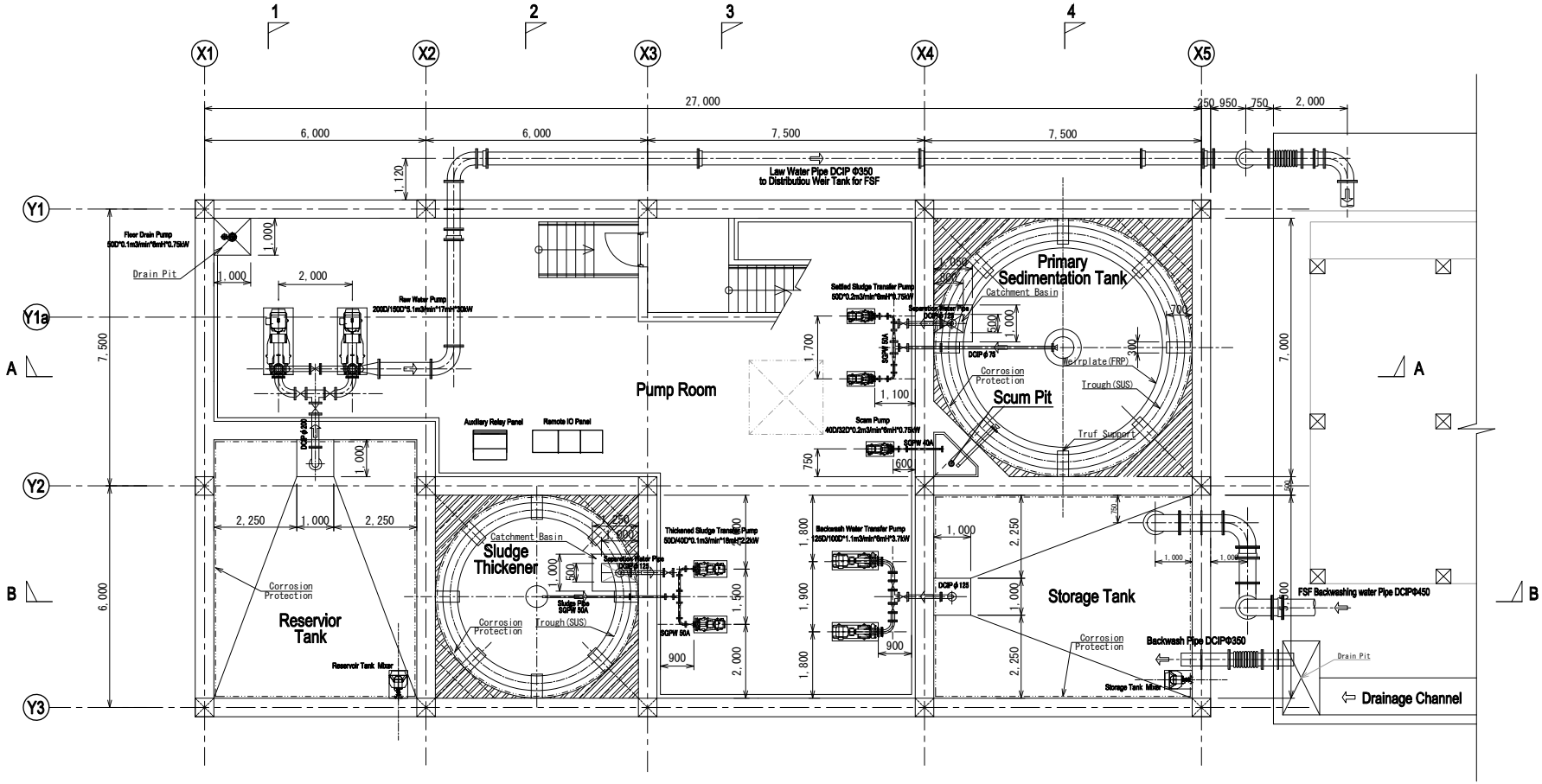
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	ISP-011	INTERCEPTION FACILITY & SEWER PIPE Layout Plan & Sections of Interception Facility



General Flow Diagram

Scale = Non

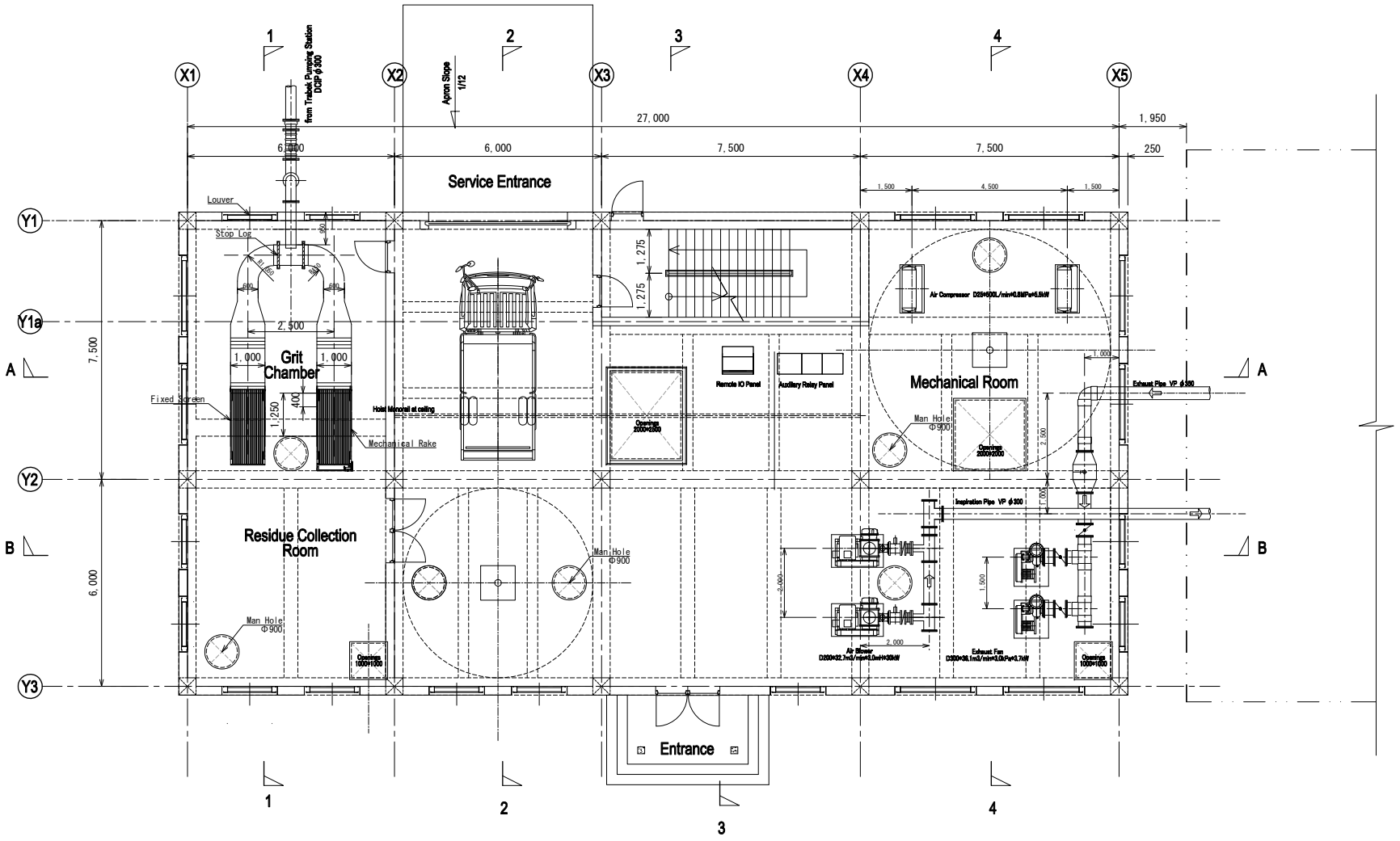
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-001	MECHANICAL AND ELECTRICAL WORK General Flow Diagram



Basement Floor (BF) PLAN

Scale=1:125

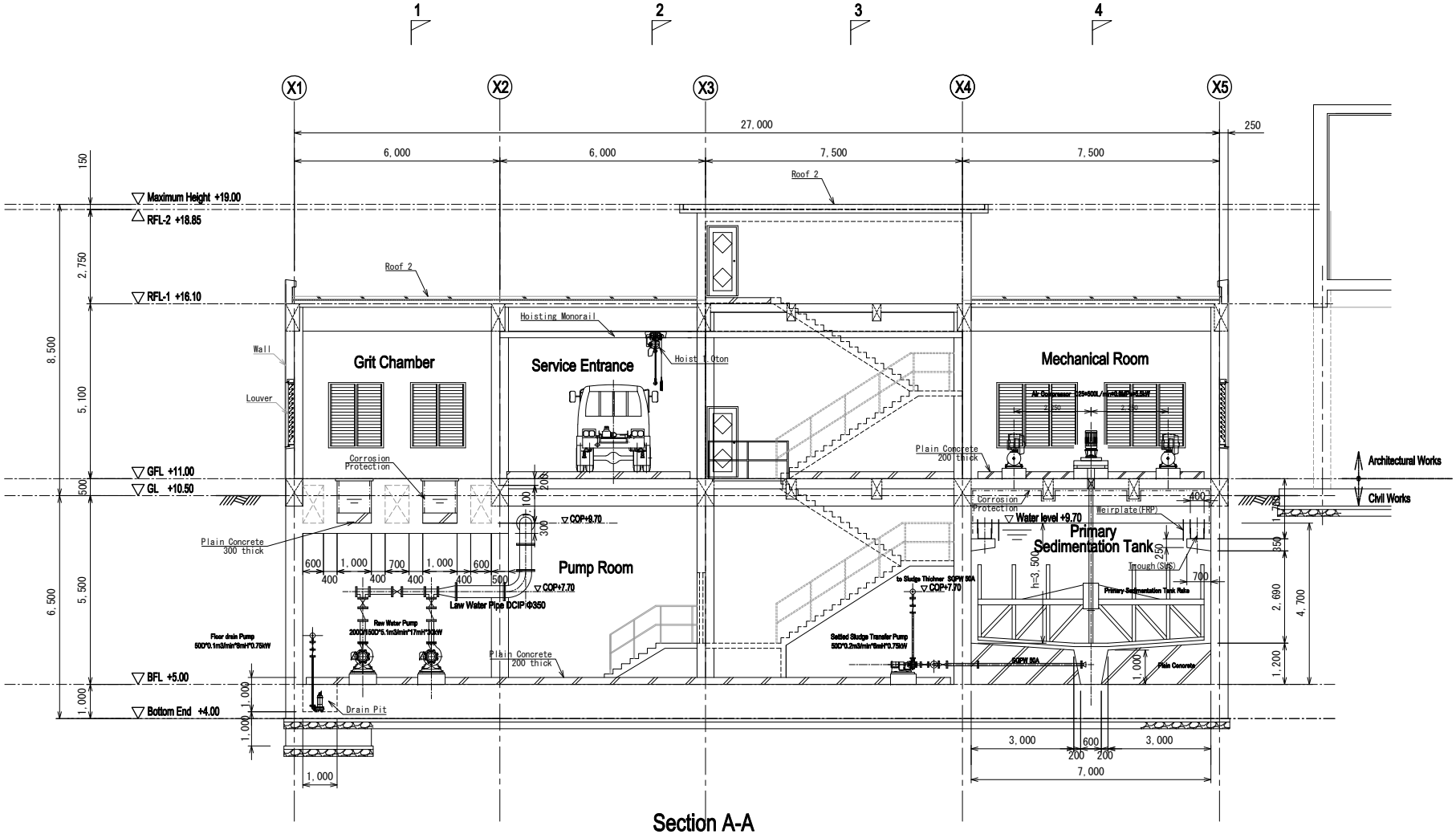
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-002	MECHANICAL AND ELECTRICAL WORK Mecahnical Equipment Layout for Main Pump Building (1/2)



Ground Floor (GF) PLAN

Scale=1:125

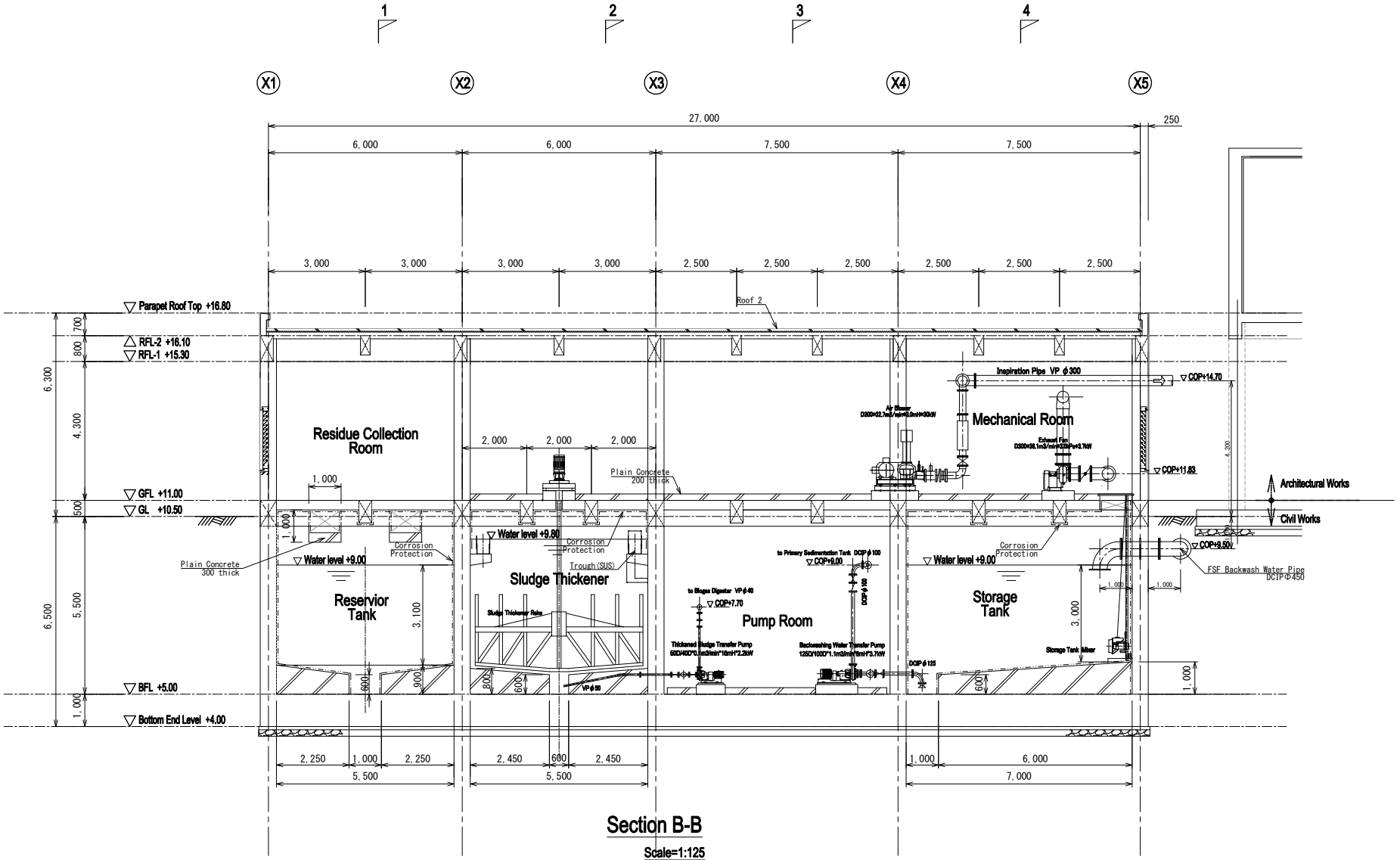
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-003	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout Plan for Main Pump Building (2/2)



Section A-A

Scale=1:125

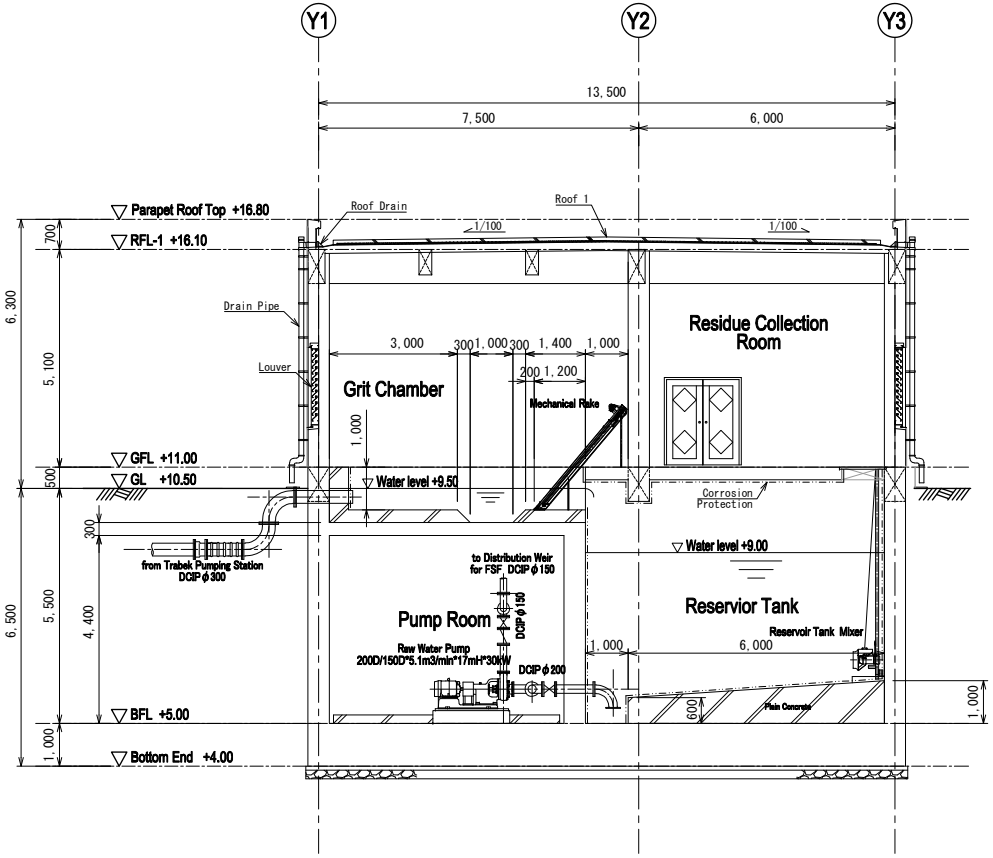
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-004	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Main Pump Building (1/4)



Section B-B

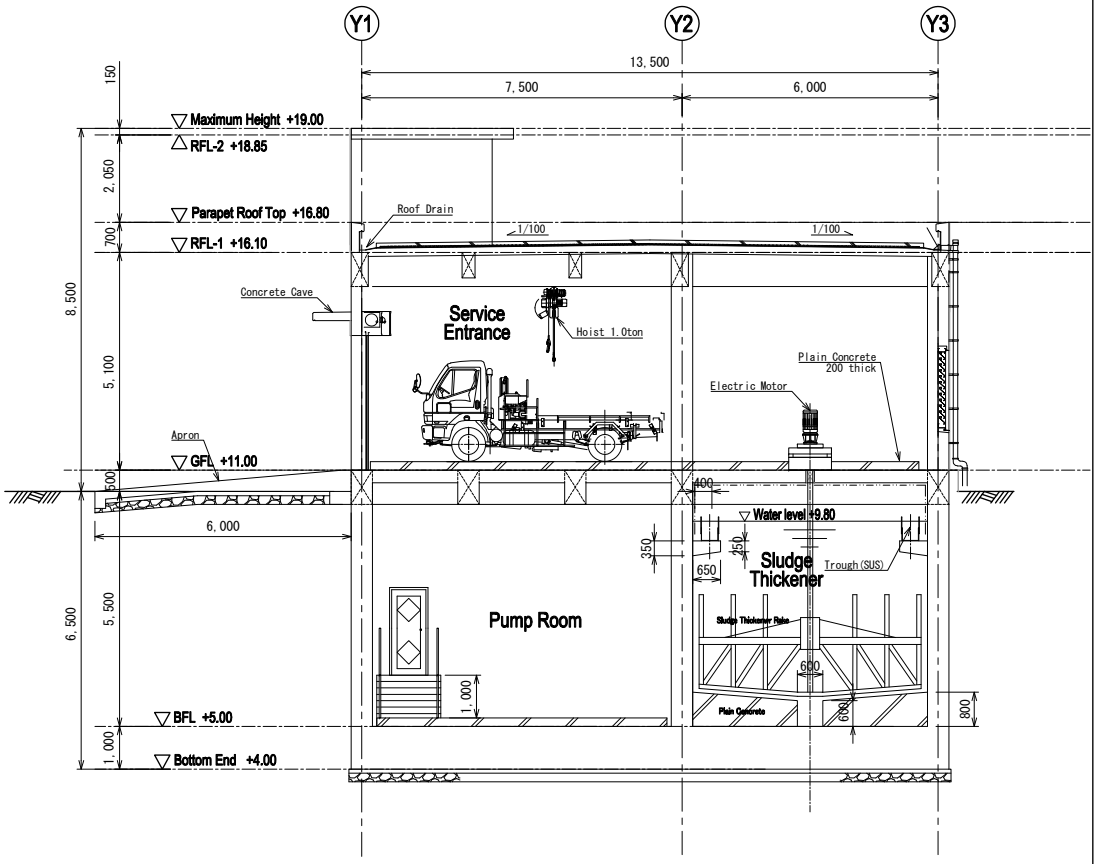
Scale=1:125

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

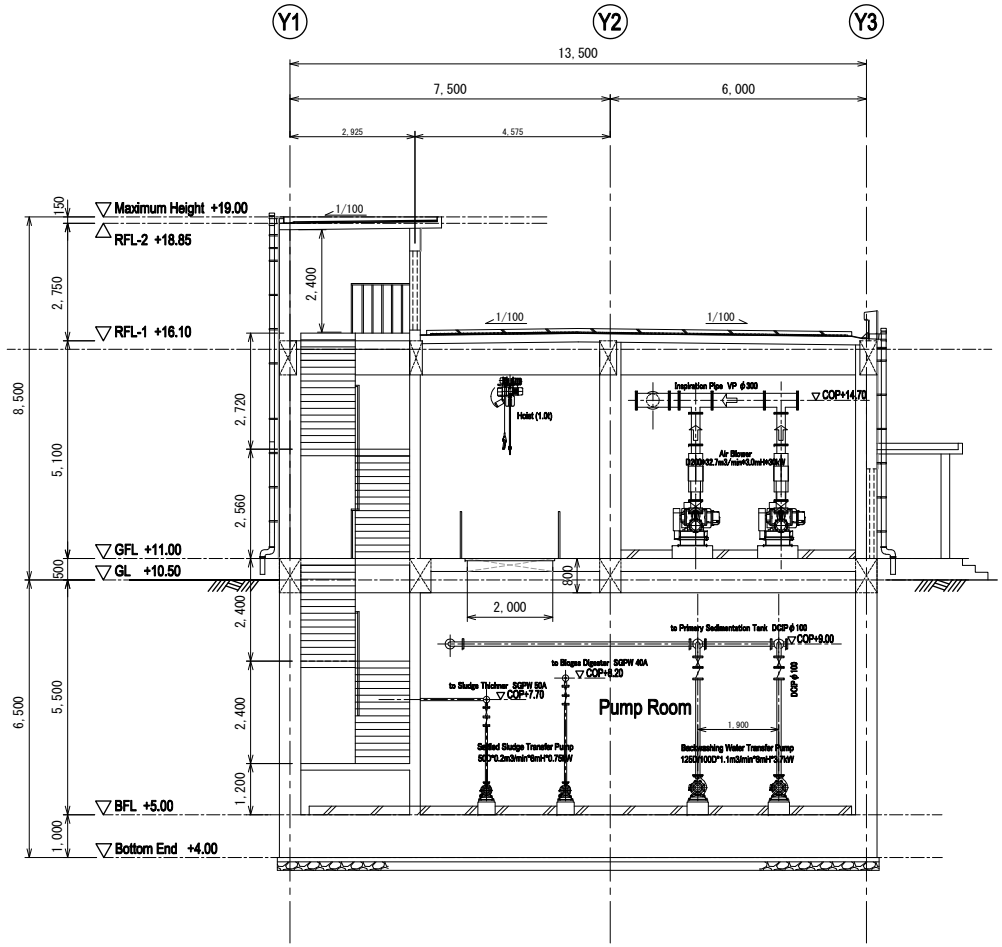
Scale=1:125



Section 2-2

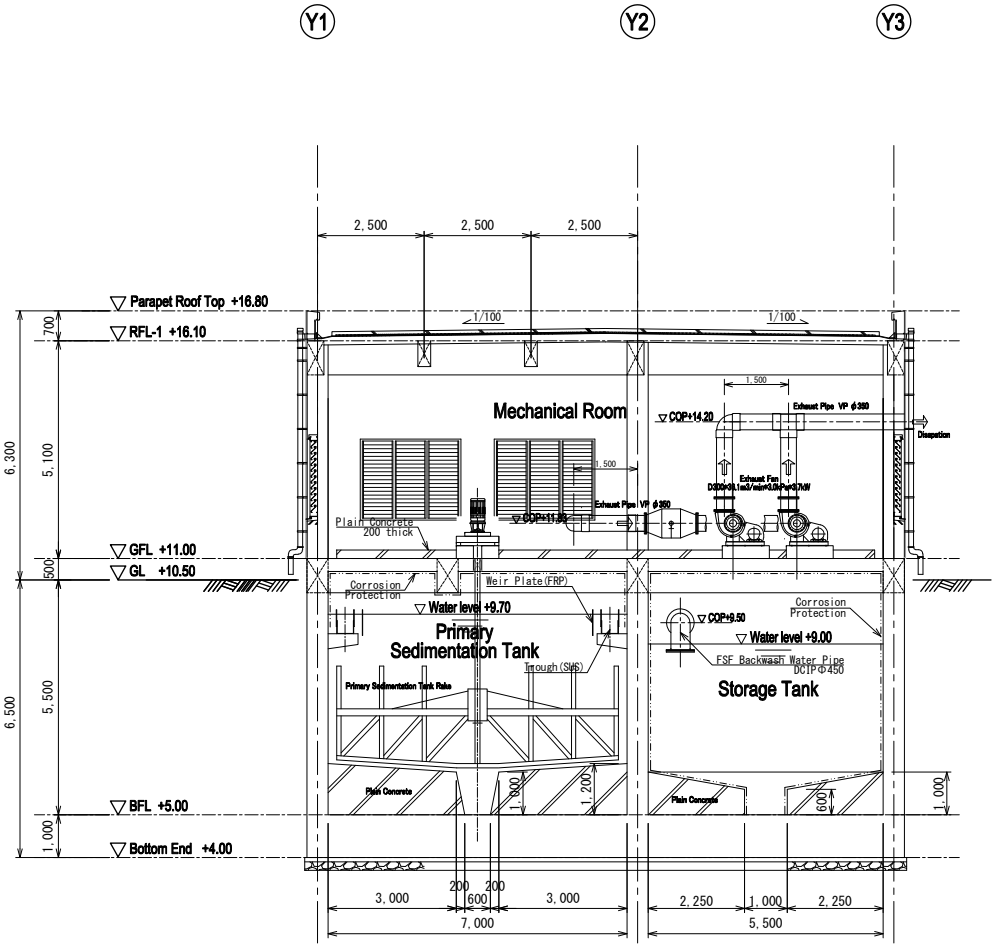
Scale=1:125

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

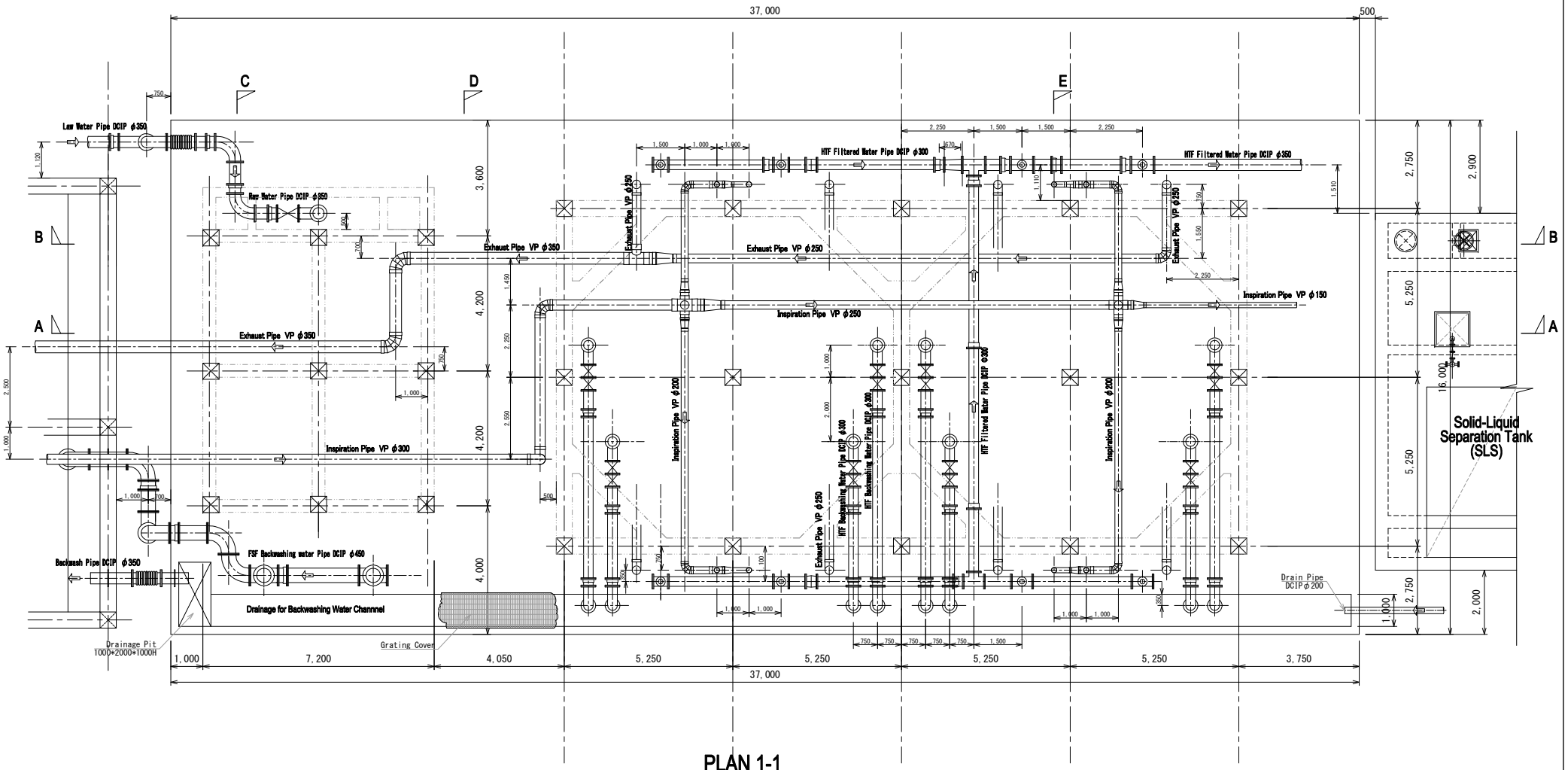
Scale=1:125



Section 4-4

Scale=1:125

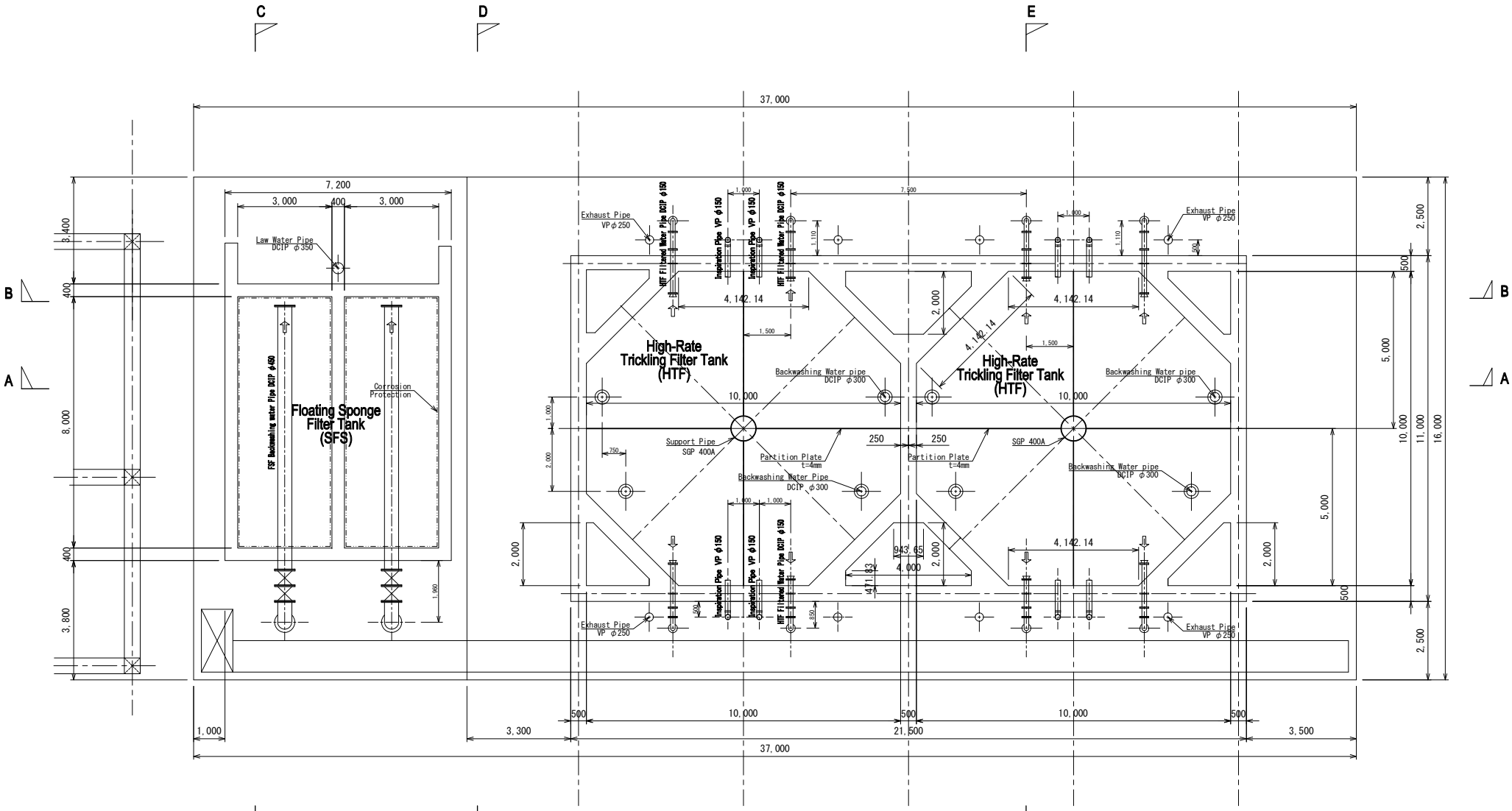
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-007	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Main Pump Building (4/4)



PLAN 1-1

Scale=1:125

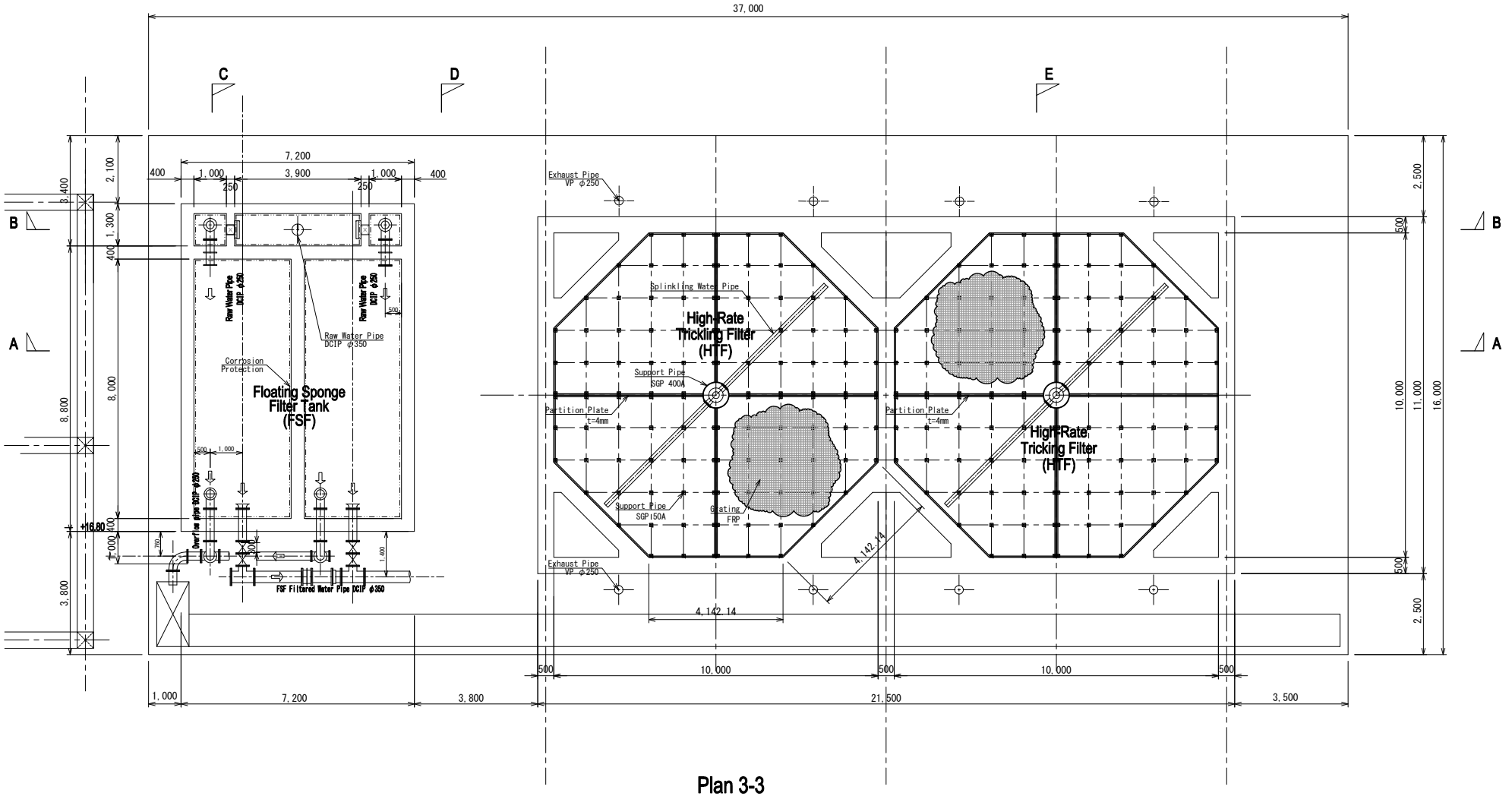
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-008	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Filtering Tank (1/4)



PLAN 2-2

Scale=1:125

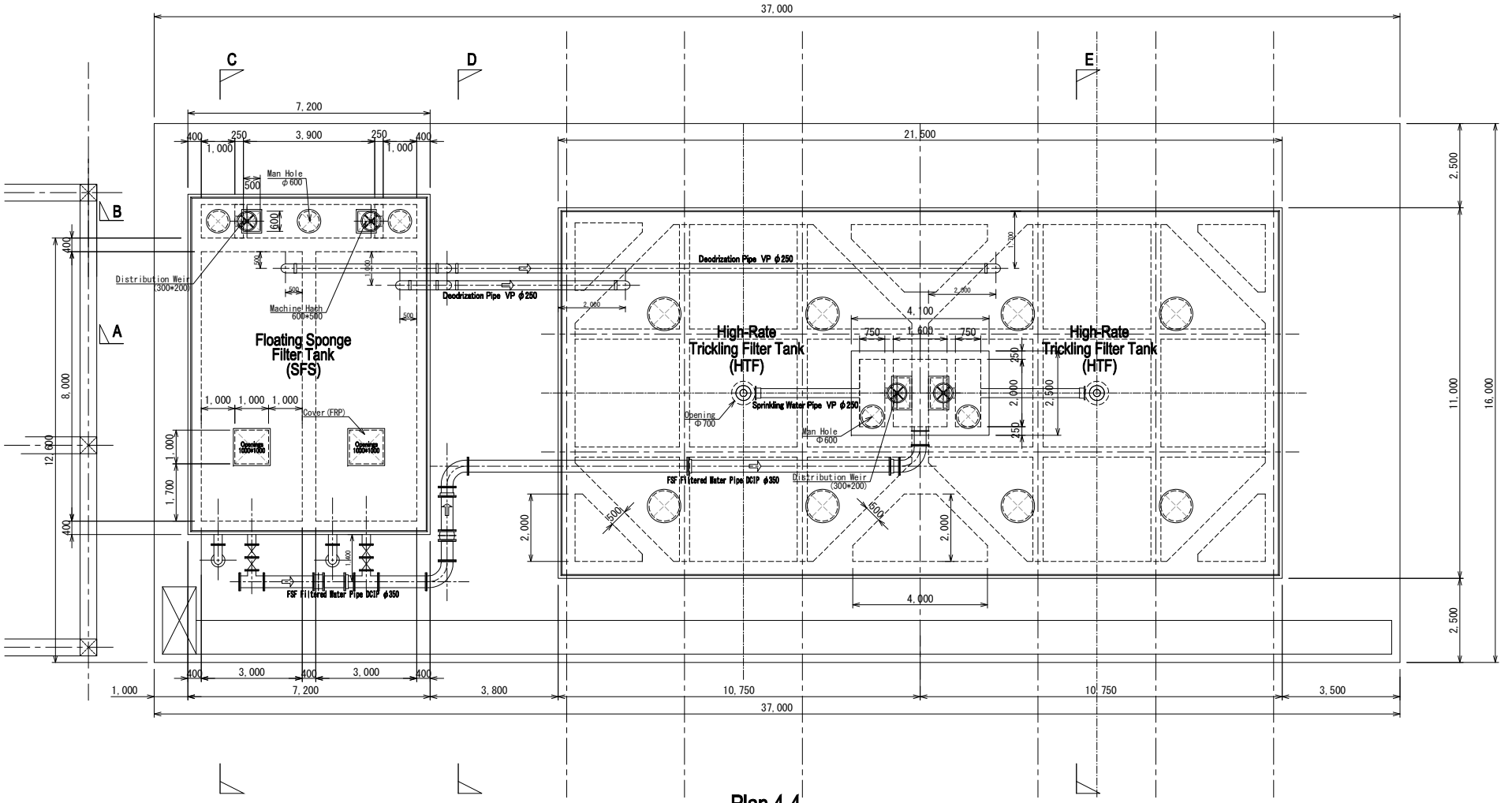
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-009	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Filtering Tank (2/4)



Plan 3-3

Scale=1:125

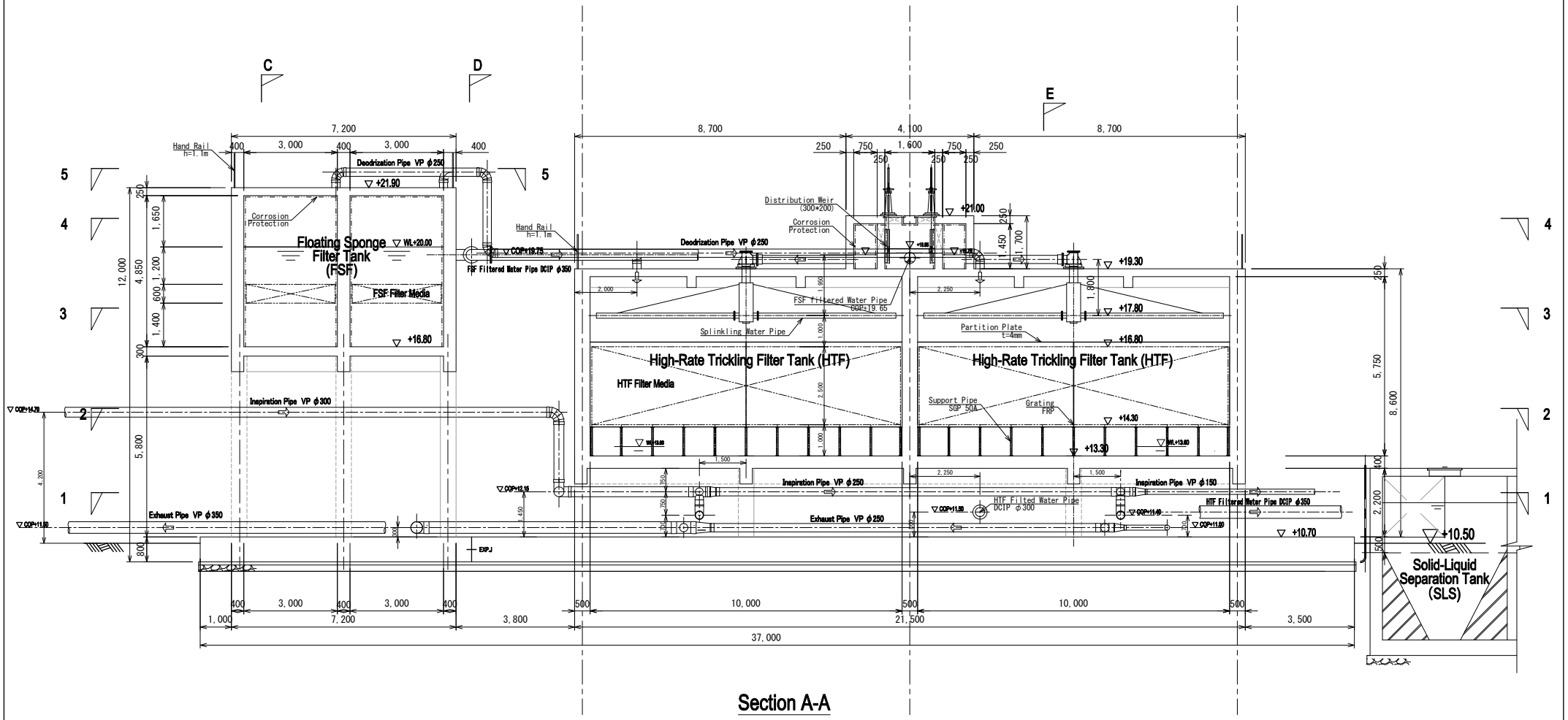
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-010	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Filtering Tank (3/4)



Plan 4-4

Scale=1:125

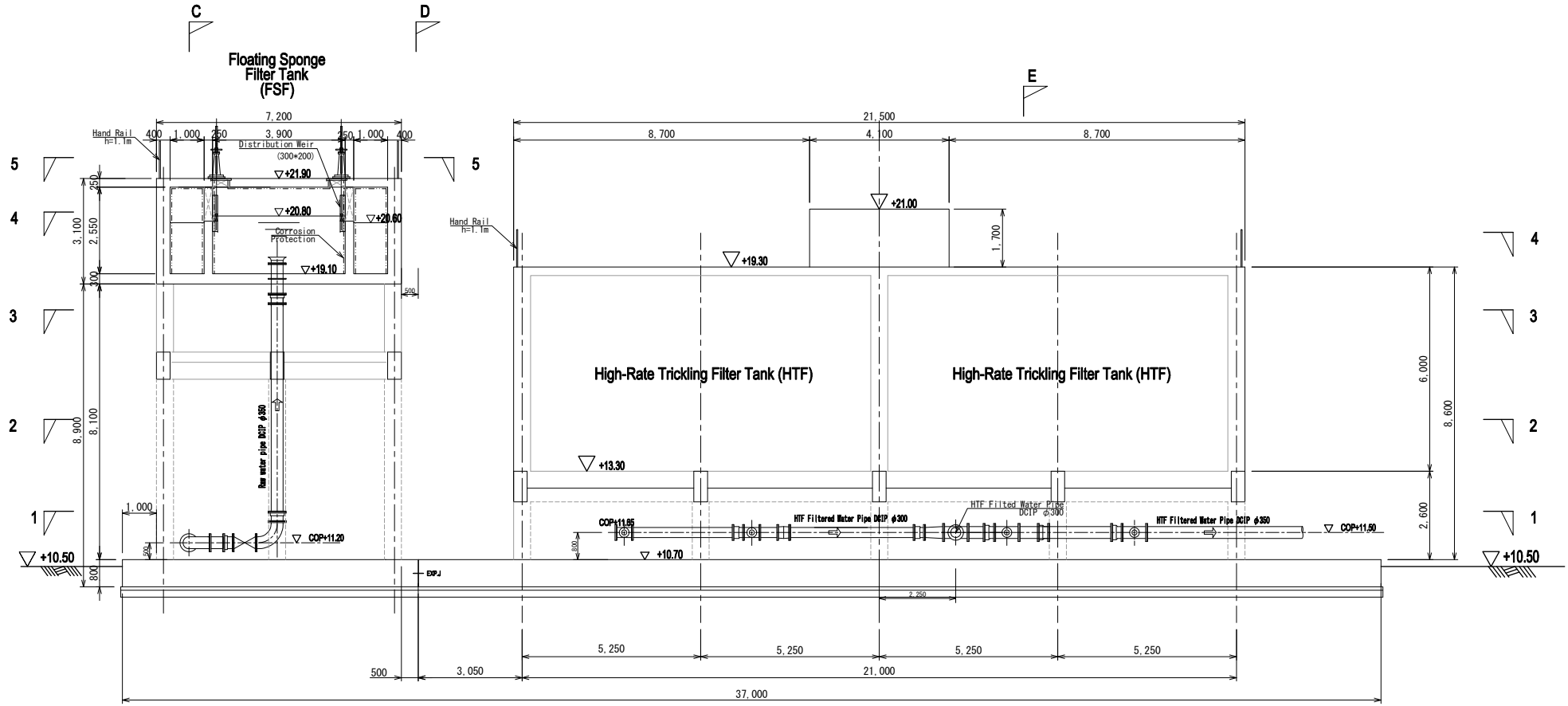
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-011	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Layout for Filtering Tank (4/4)



Section A-A

Scale=1:125

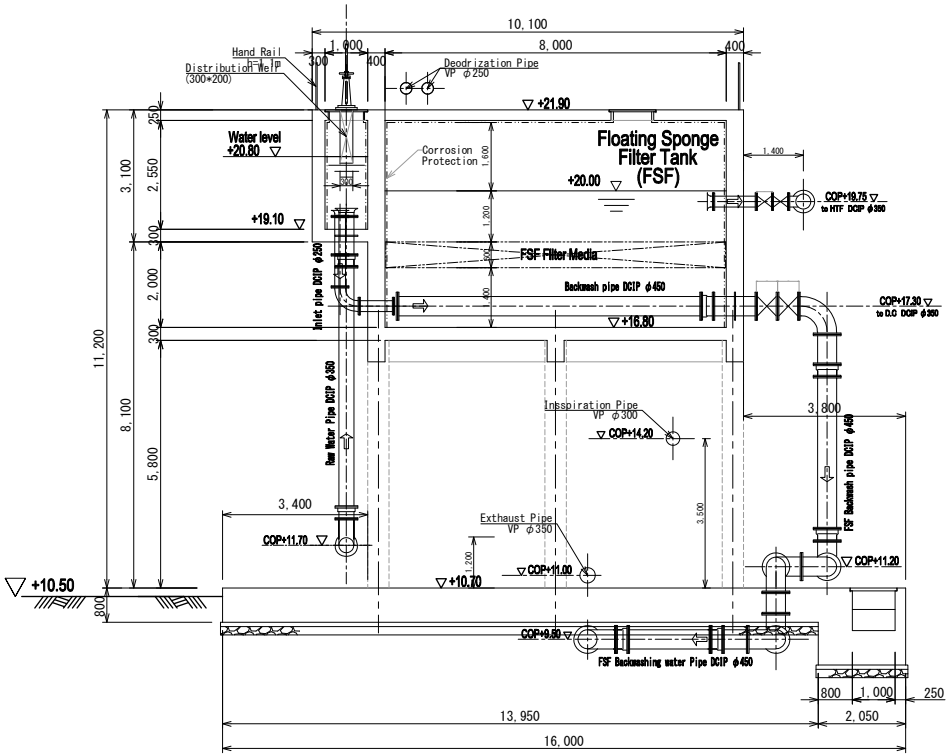
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-012	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Filtering Tank (1/4)



Section B-B

Scale=1:125

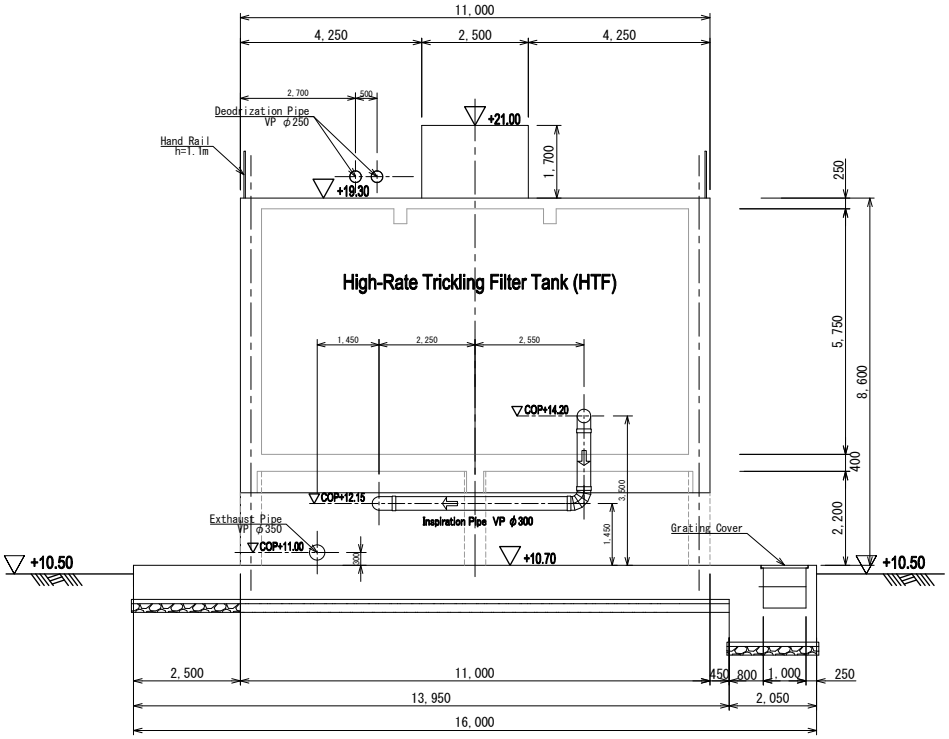
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	MW-013	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Filtering Tank (2/4)



Section C-C

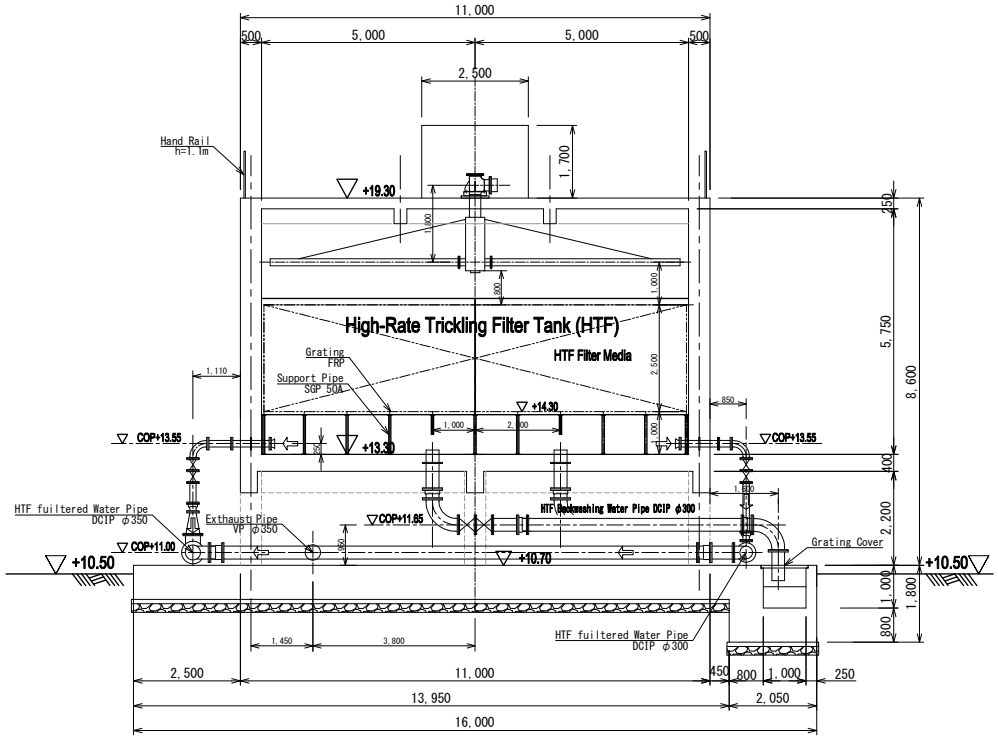
Scale=1:125

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

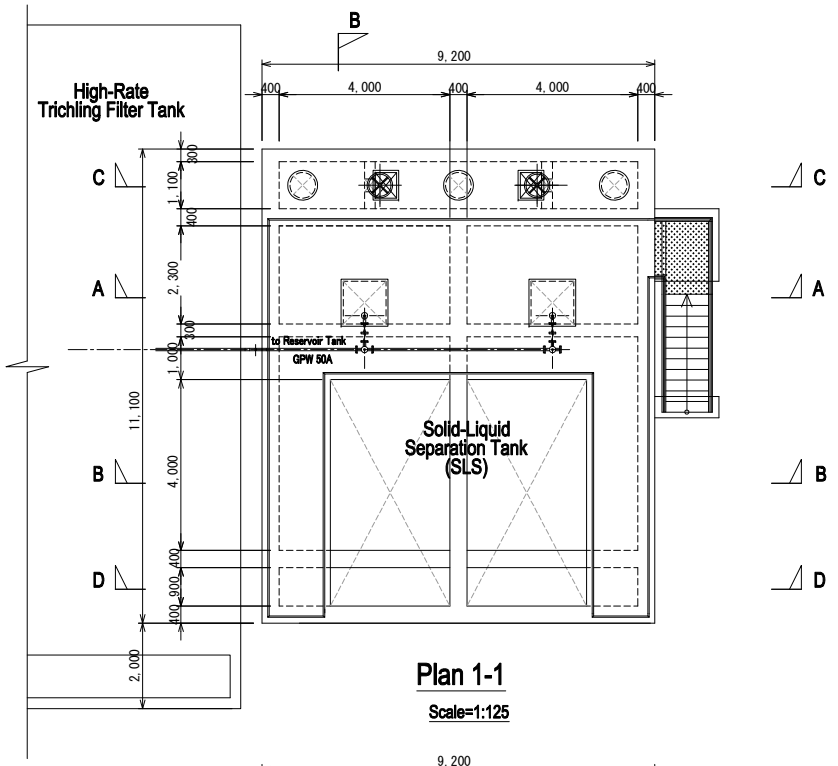
Scale=1:125



Section E-E

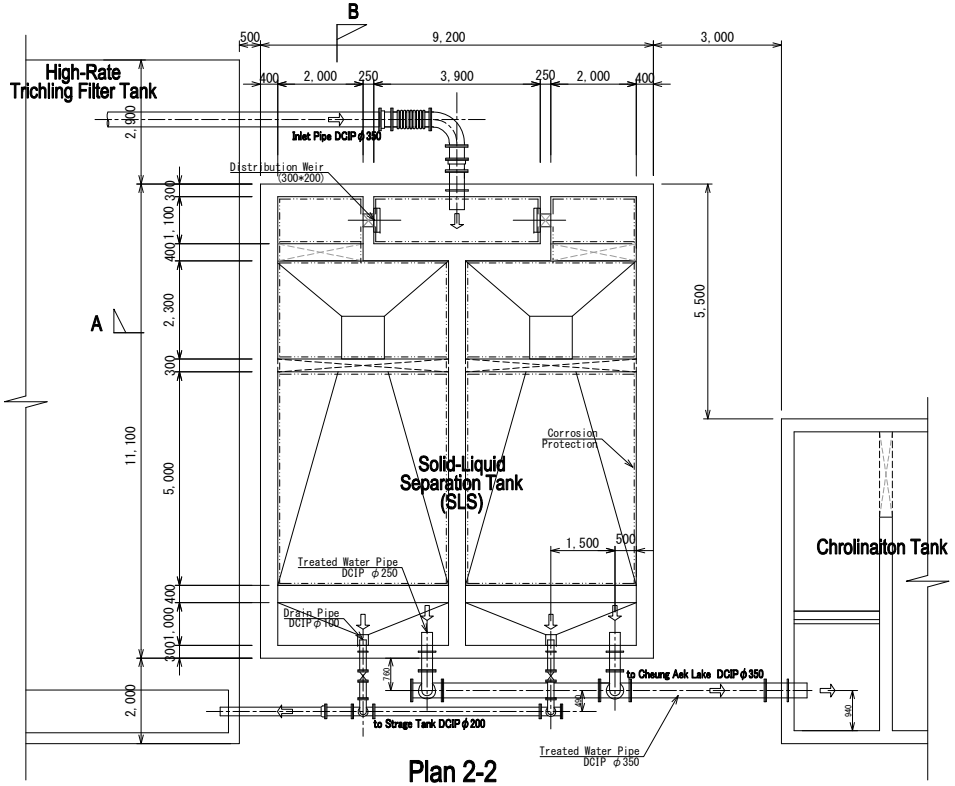
Scale=1:125

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)



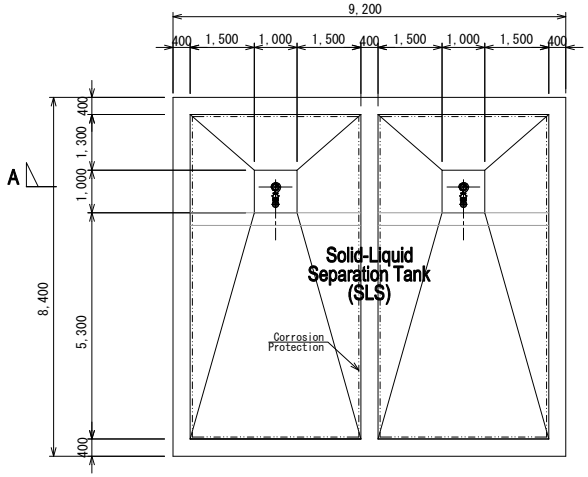
Plan 1-1

Scale=1:125



Plan 2-2

Scale=1:125

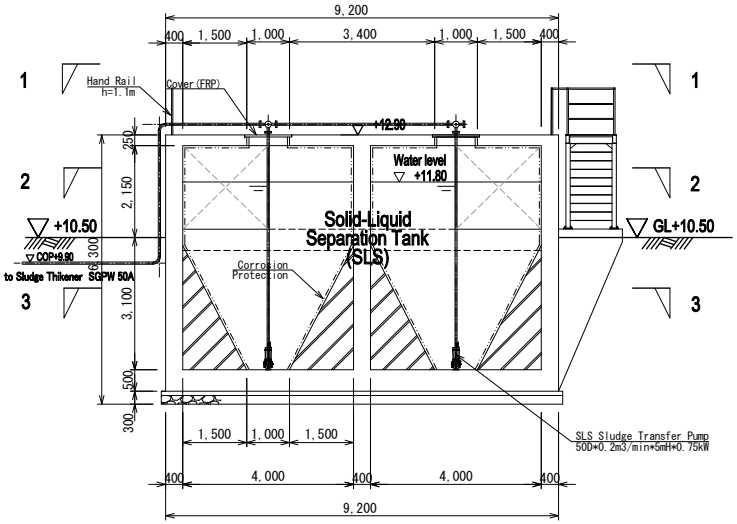


Plan 3-3

Scale=1:125

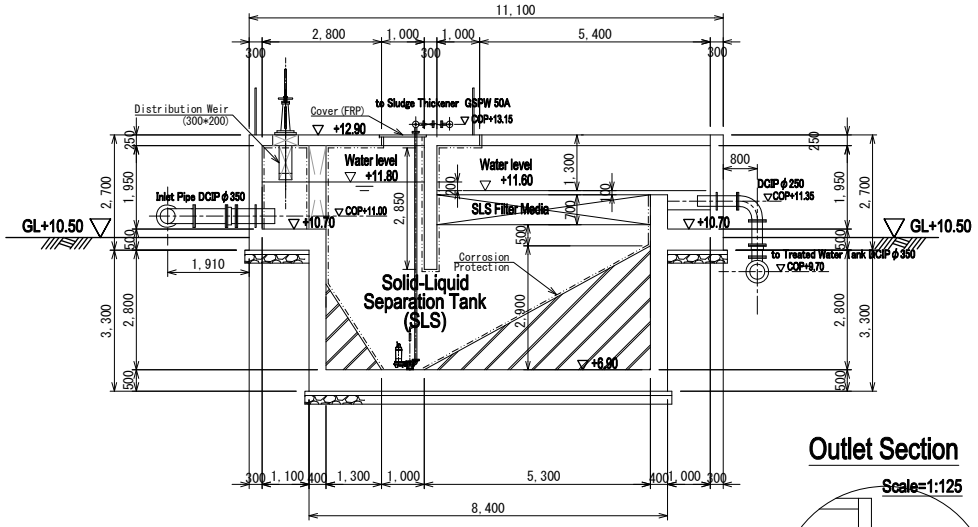
SCALE 0 1.0 2.0 3.0 4.0 5.0m

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

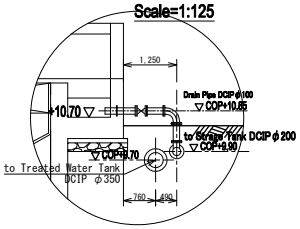


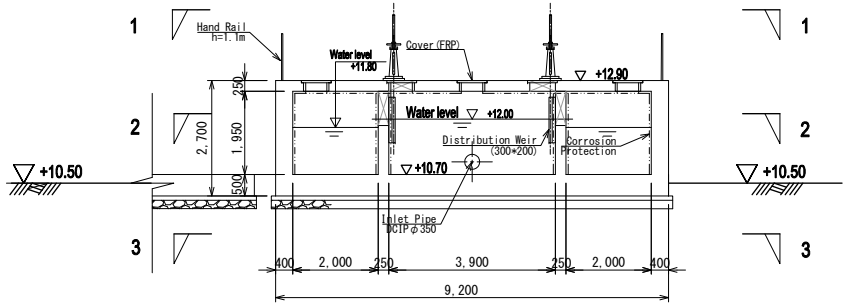
Section B-B

Scale=1:125

Outlet Section

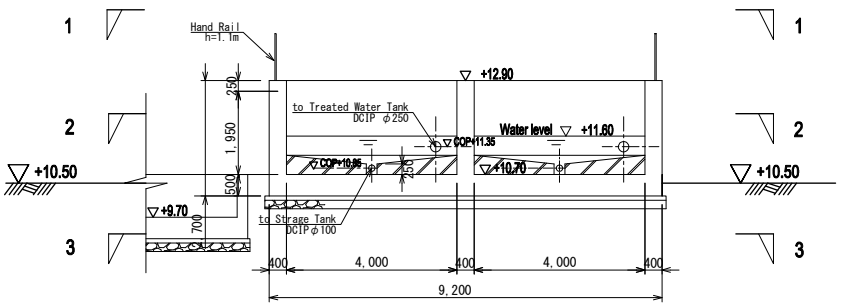
Scale=1:125





Section C-C

Scale=1:125

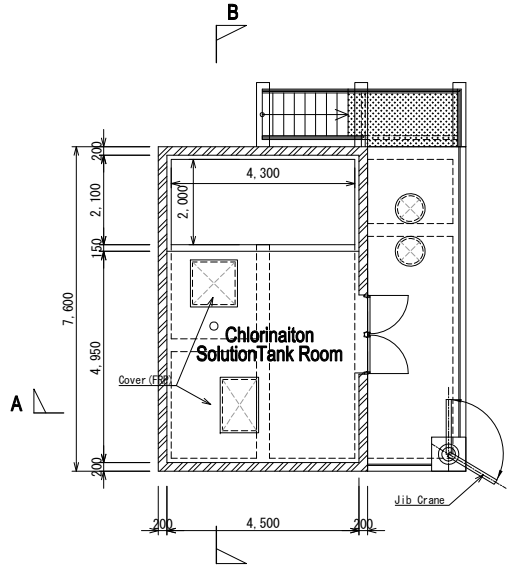


Section D-D

Scale=1:125

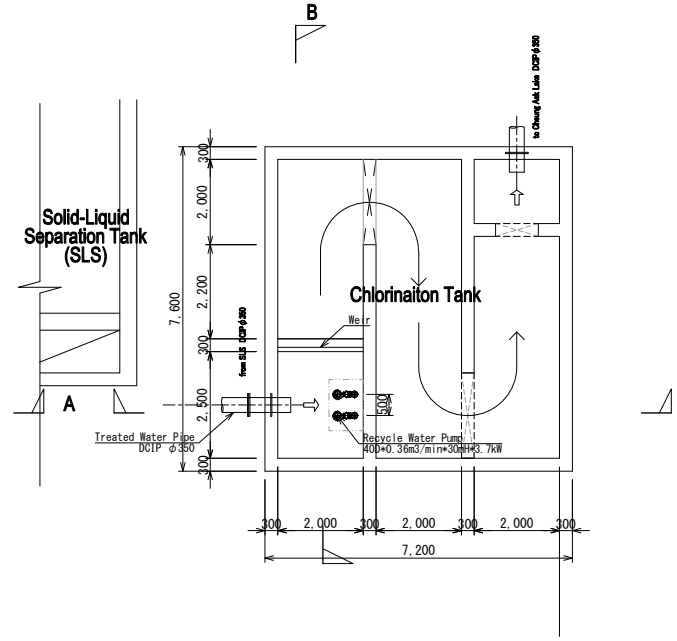
SCALE 0 1.0 2.0 3.0 4.0 5.0m

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	MW-017	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Section Layout for Solid-Liquid Separation Tank



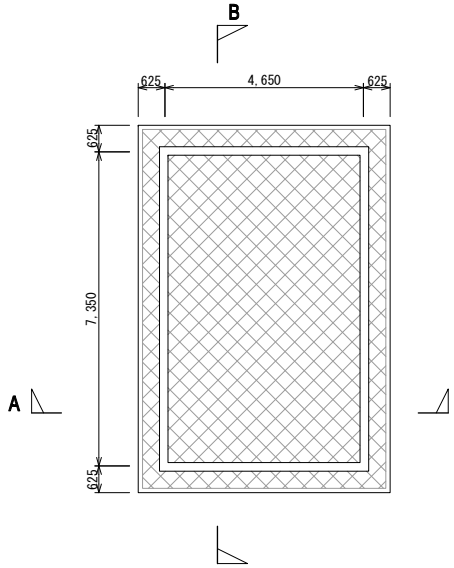
Plan 1-1

Scale=1:125



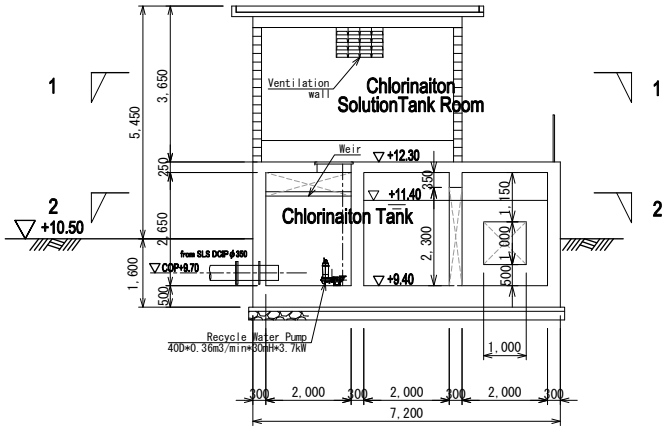
Plan 2-2

Scale=1:125



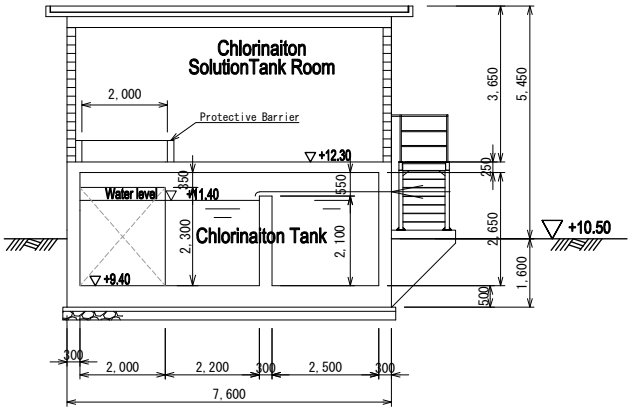
Roof Plan

Scale=1:125



Section A-A

Scale=1:125

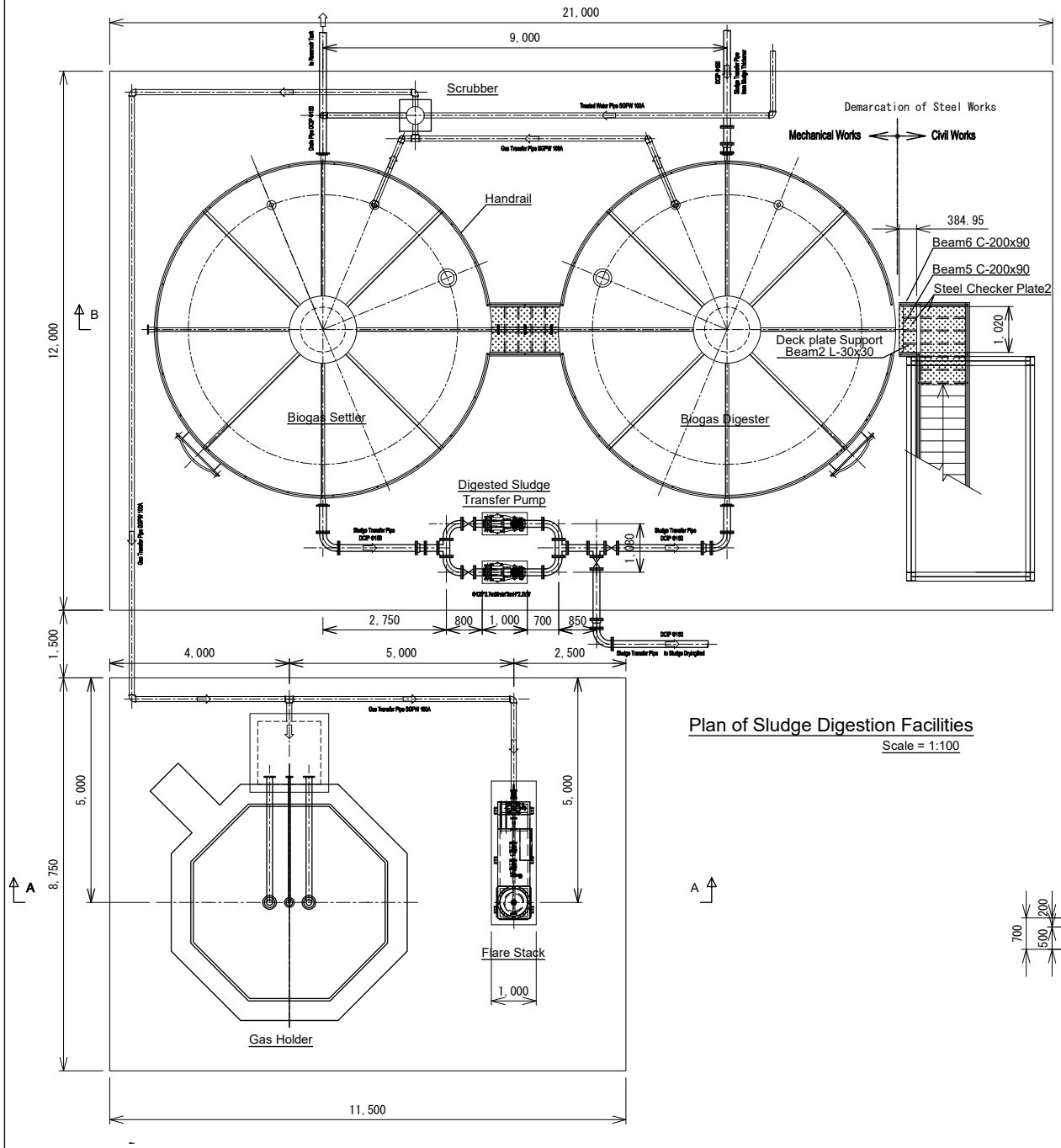


Section B-B

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	MW-018	MECHANICAL AND ELECTRICAL WORK Mechanical Equipment Plan & Section for Chlorination Tank

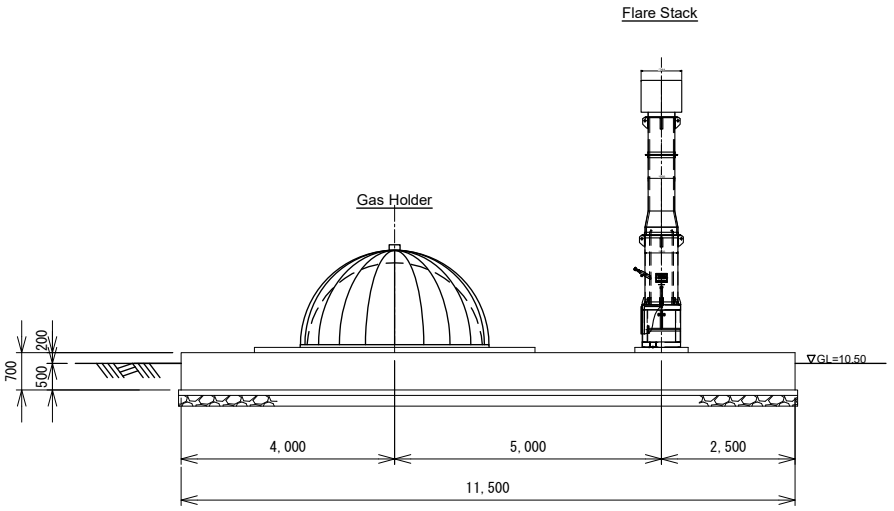


LEGEND

- TREATED WATER
- SEWER & RETURN WATER
- SLUDGE
- BIOGAS

Plan of Sludge Digestion Facilities

Scale = 1:100



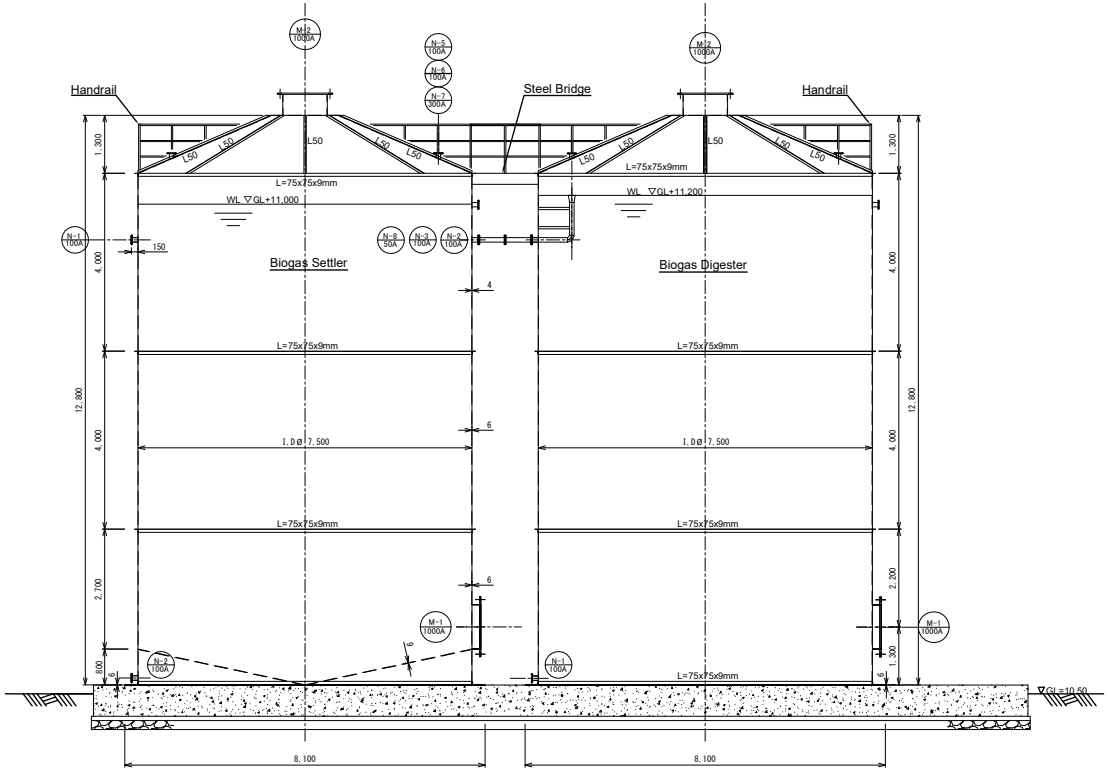
Section A-A

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

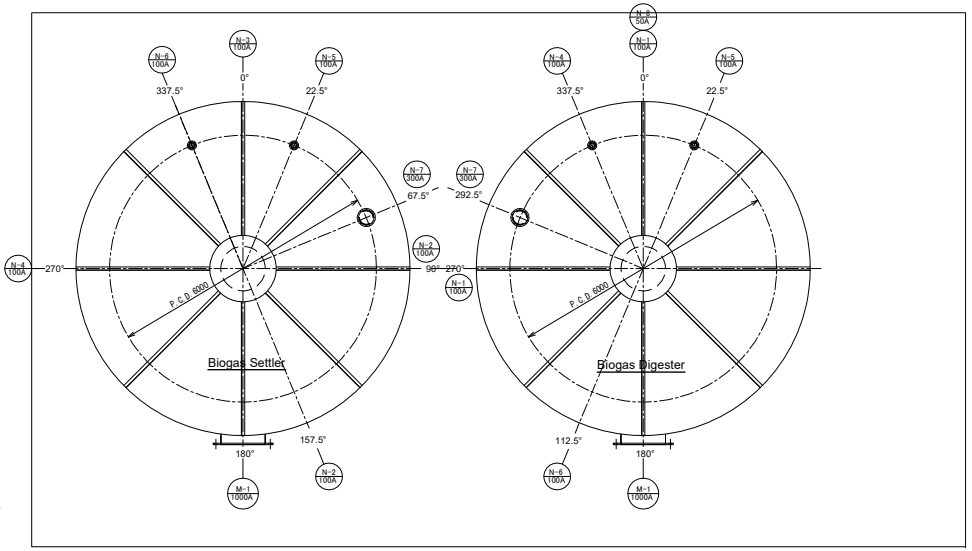


Elevation of Biogas Digester and Settler

Scale = 1:70

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



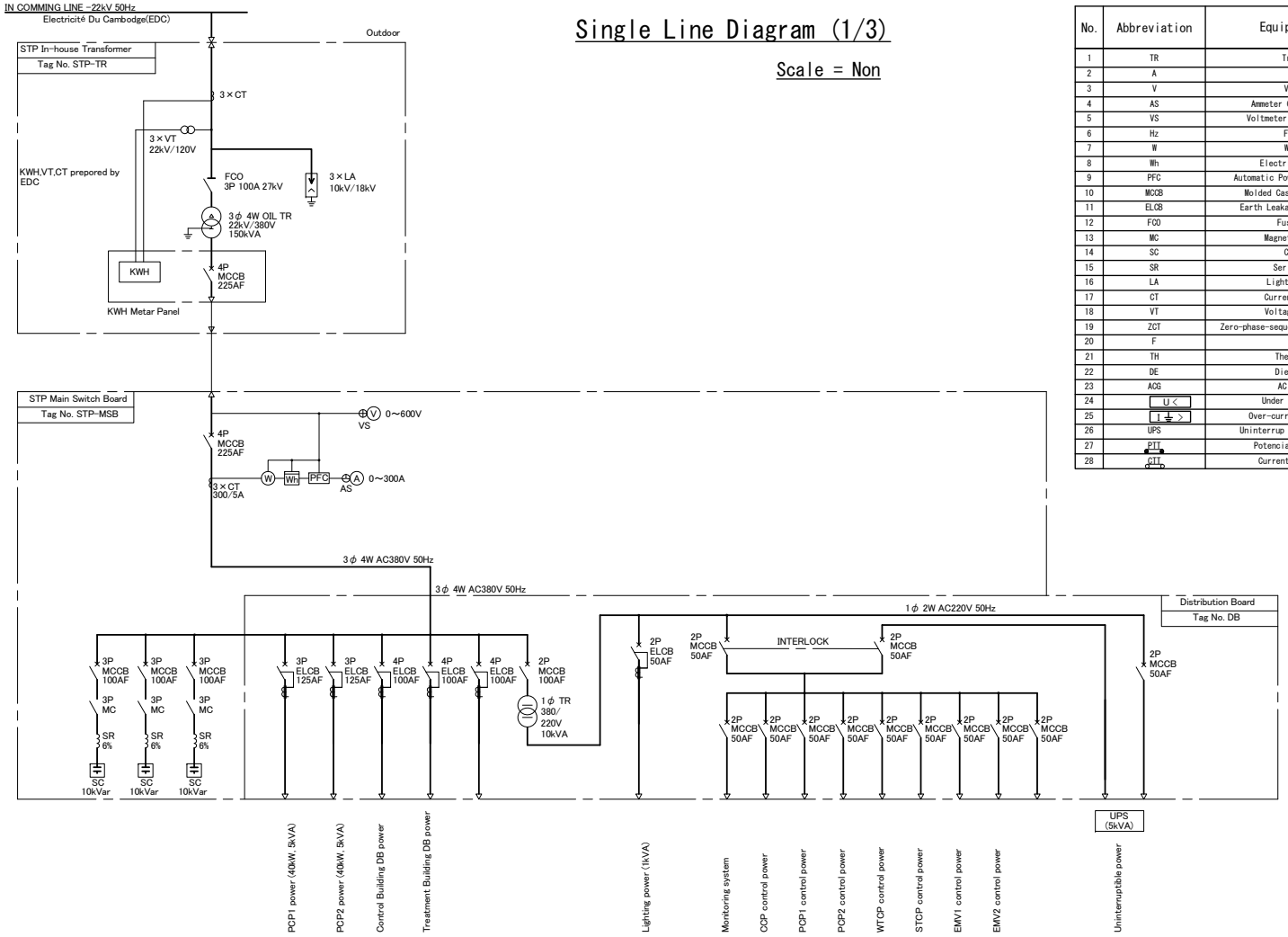
Plan of Biogas Digester and Settler

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

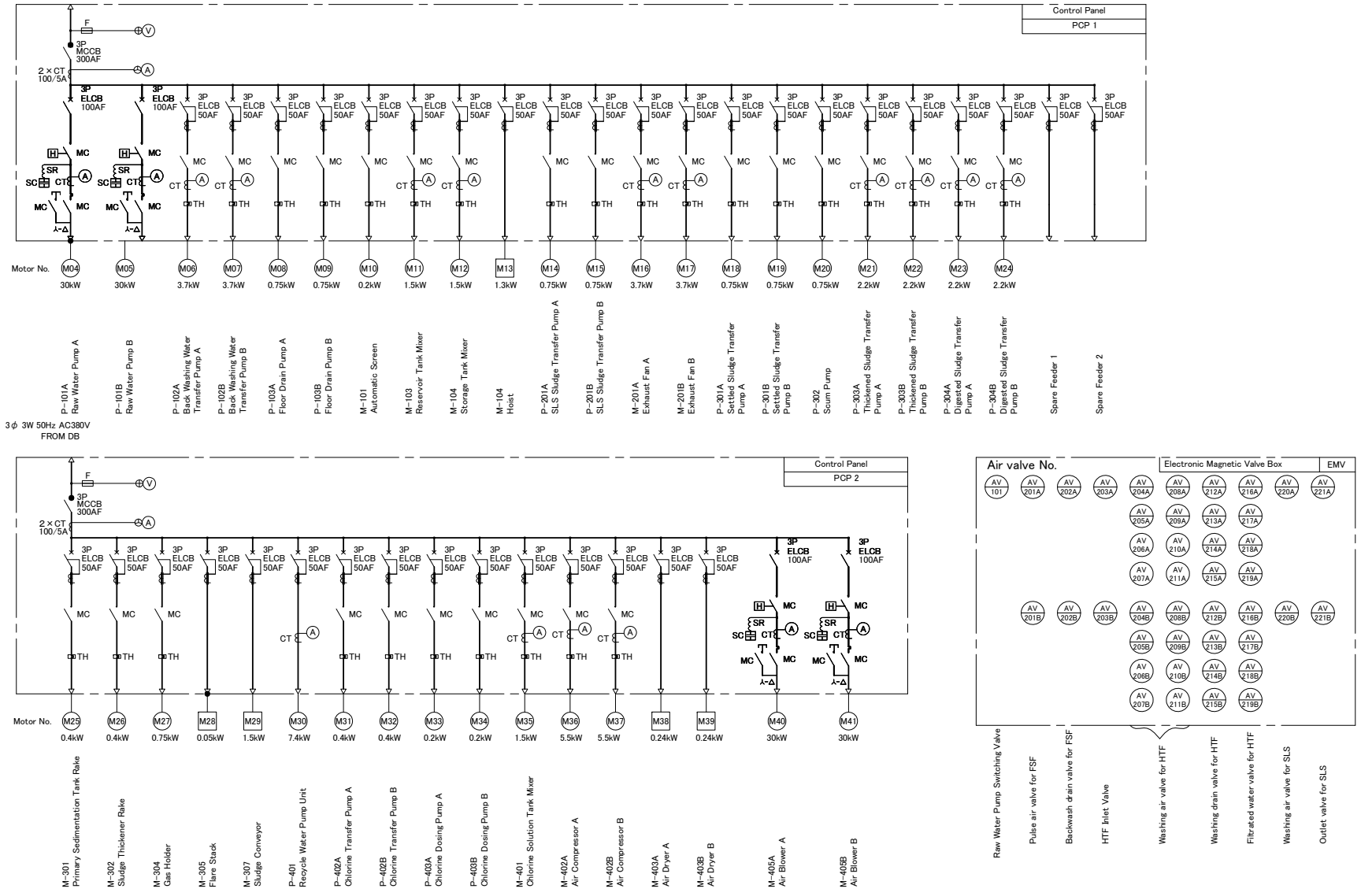


No.	Abbreviation	Equipment Name
1	TR	Transfomer
2	A	Ammeter
3	V	Voltmeter
4	AS	Ammeter Changeover Swich
5	VS	Voltmeter Changeover Swich
6	Hz	Frequency
7	W	Wattmeter
8	Wh	Electric energymeter
9	PFC	Automatic Power factor Regulator
10	MCCB	Molded Case Circuit Breaker
11	ELCB	Earth Leakage Circuit Breaker
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)

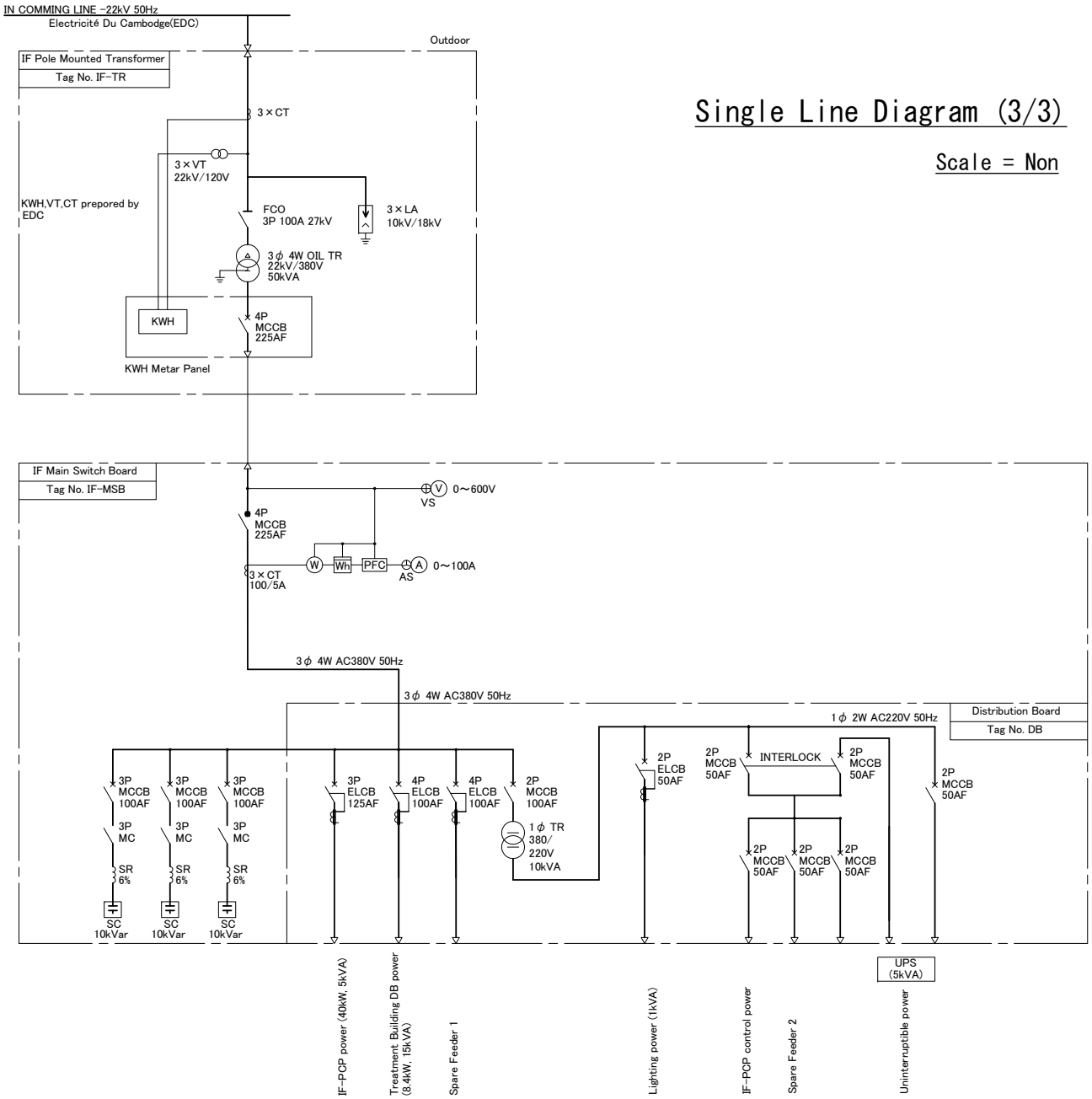
Scale = Non

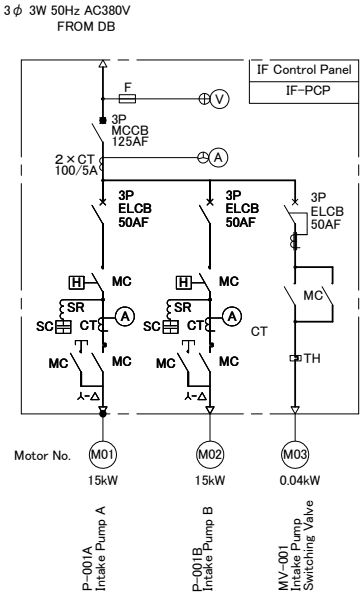


THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-002	MECHANICAL AND ELECTRICAL WORK Single Line Diagram for Sewage Treatment Plant (2/2)

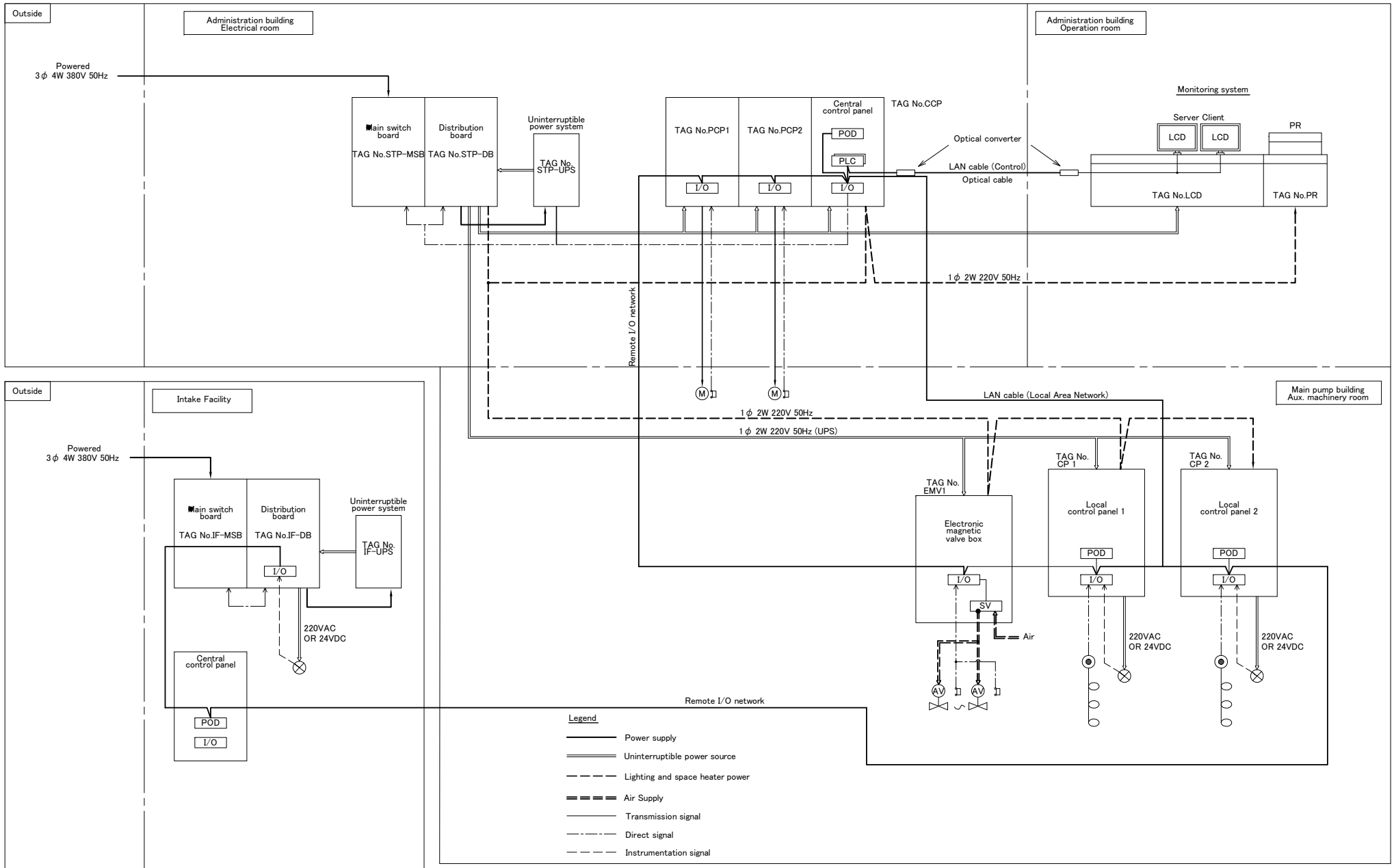
Single Line Diagram (3/3)

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



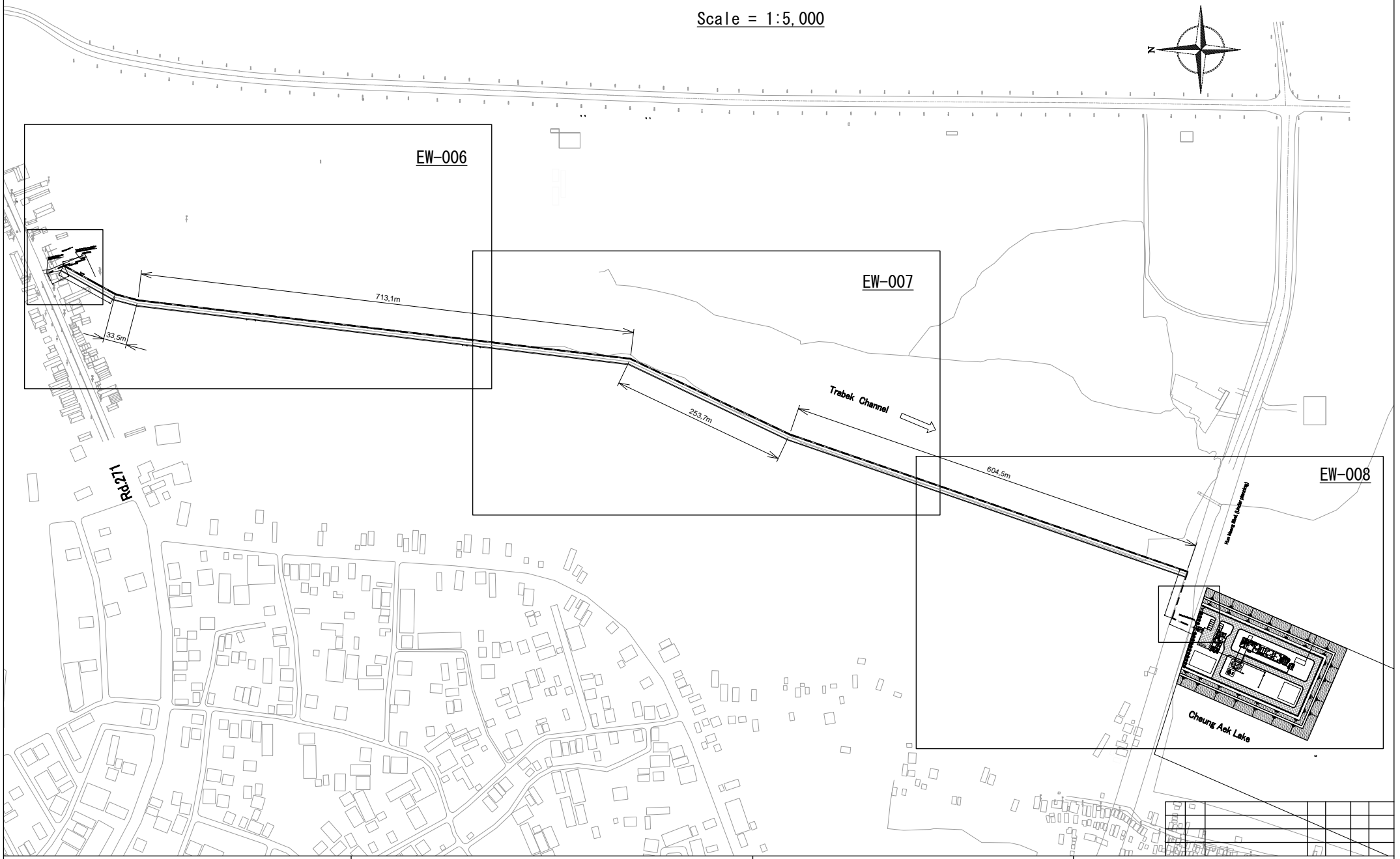
System Configuration

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

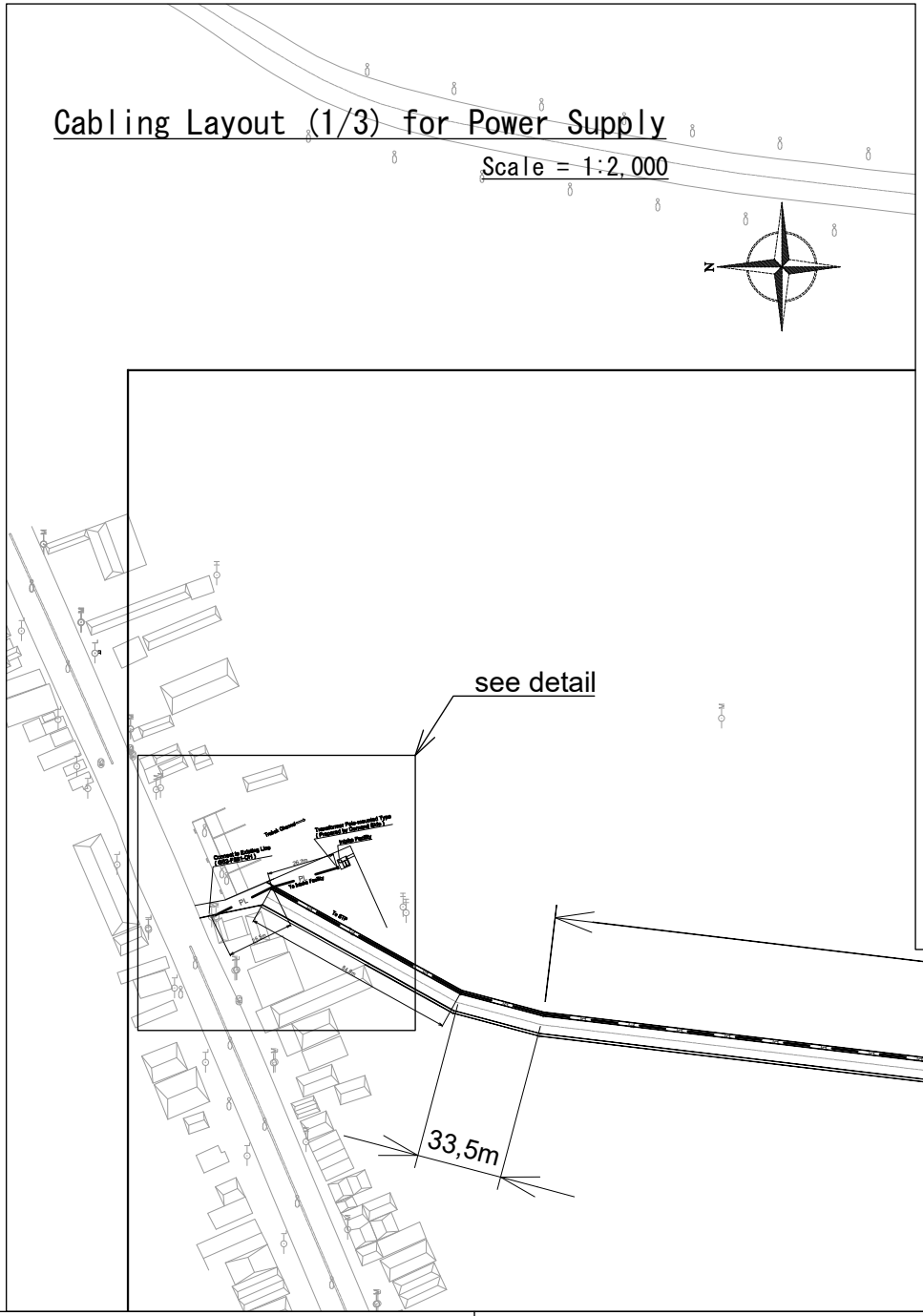
Scale = 1:5,000



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)

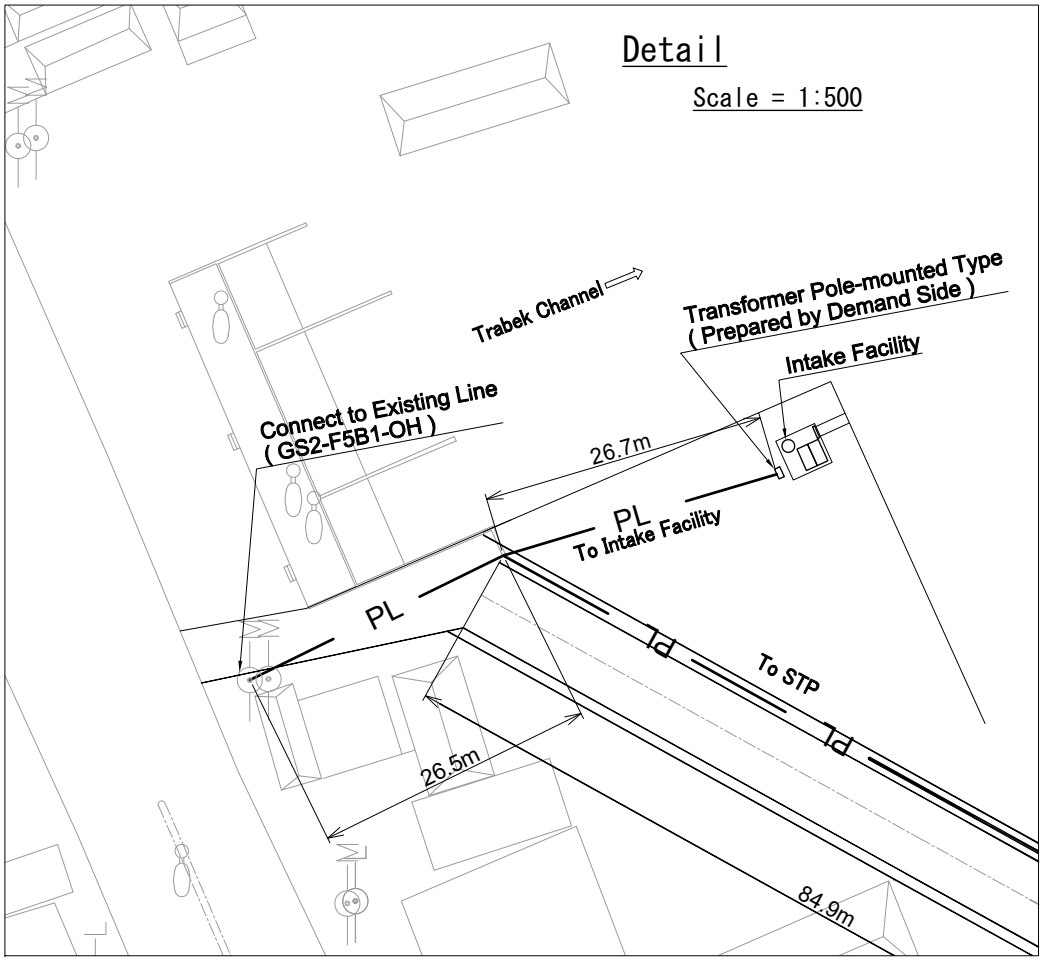
Cabling Layout (1/3) for Power Supply

Scale = 1:2,000



Detail

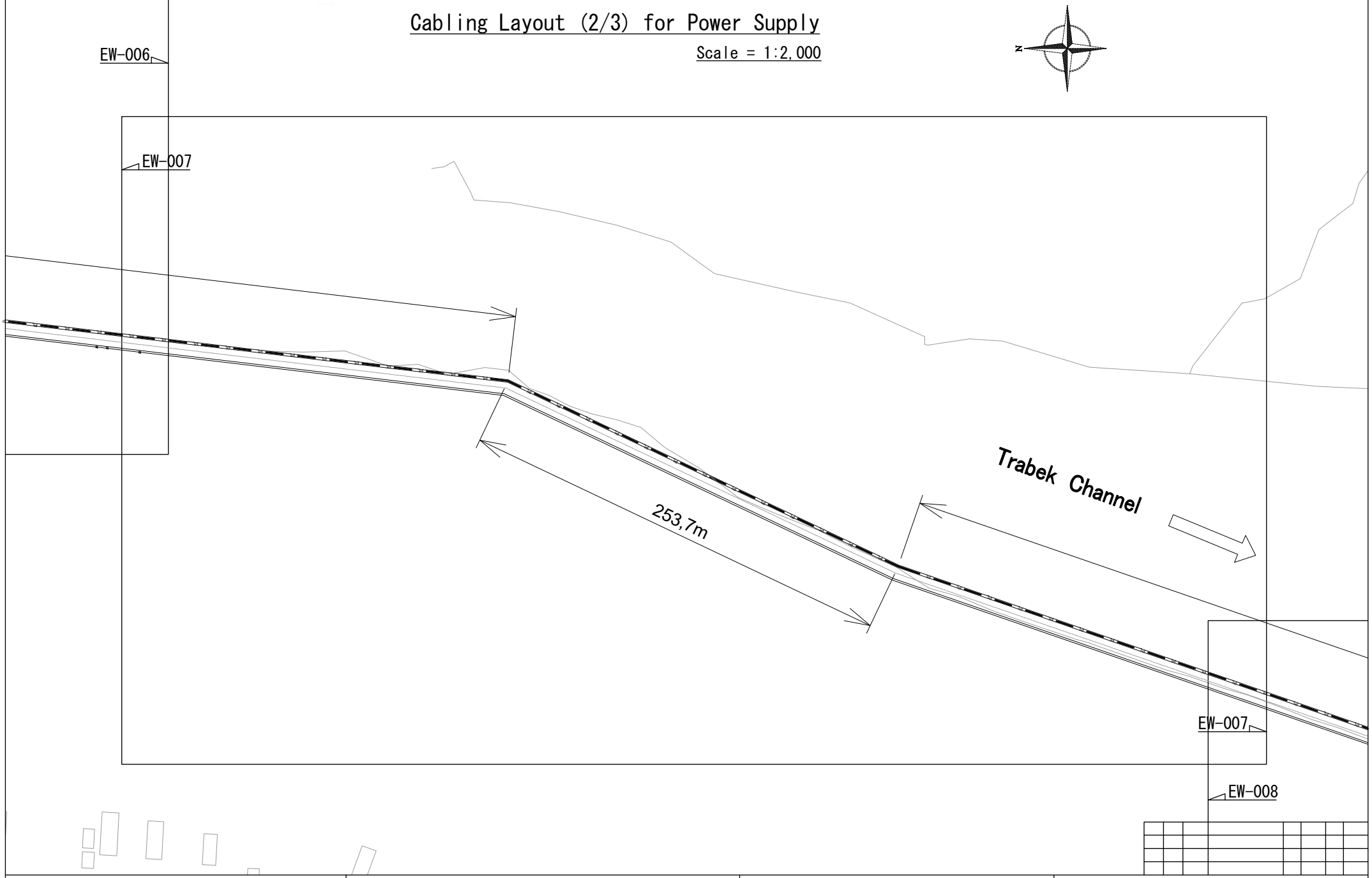
Scale = 1:500



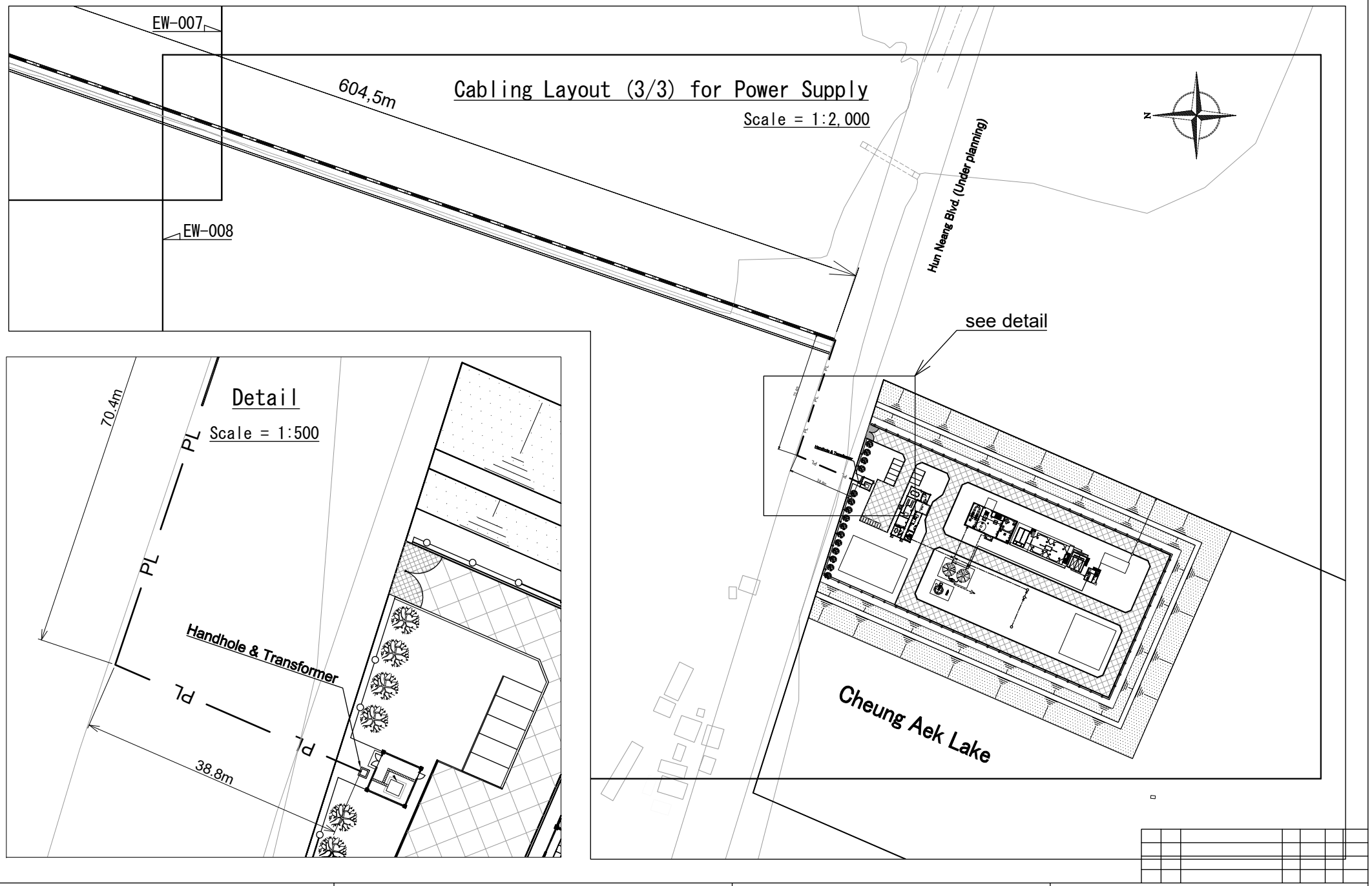
THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-006	MECHANICAL AND ELECTRICAL WORK Cabling Layout for Power Supply (2/4)

Cabling Layout (2/3) for Power Supply

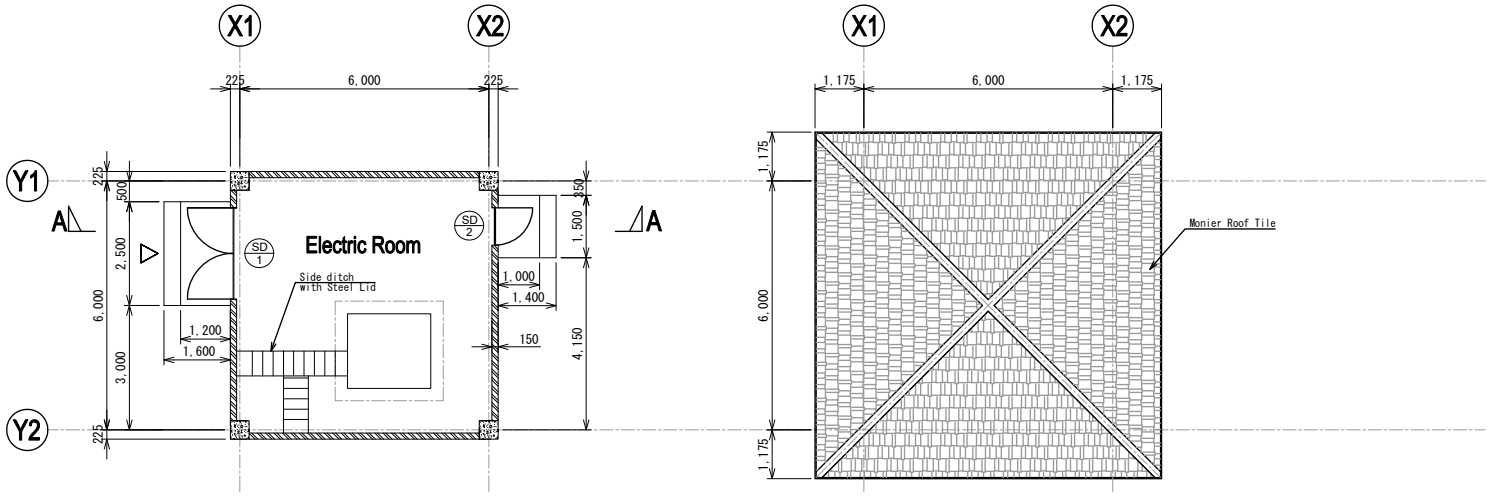
Scale = 1:2,000



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)

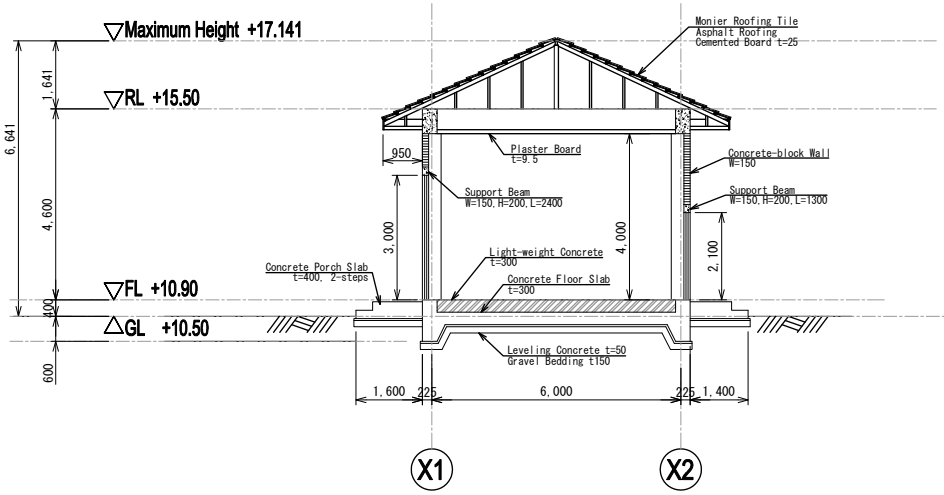


THE PREPARATORY SURVEY ON THE PROJECT FOR SEWERAGE SYSTEM DEVELOPMENT IN THE PHNOM PENH CAPITAL CITY	CTI ENGINEERING INTERNATIONAL CO., LTD. NIPPON KOEI CO.,LTD. WATER AND SEWER BUREAU,CITY OF KITAKYUSHU	EW-008	MECHANICAL AND ELECTRICAL WORK Cabling Layout for Power Supply (4/4)

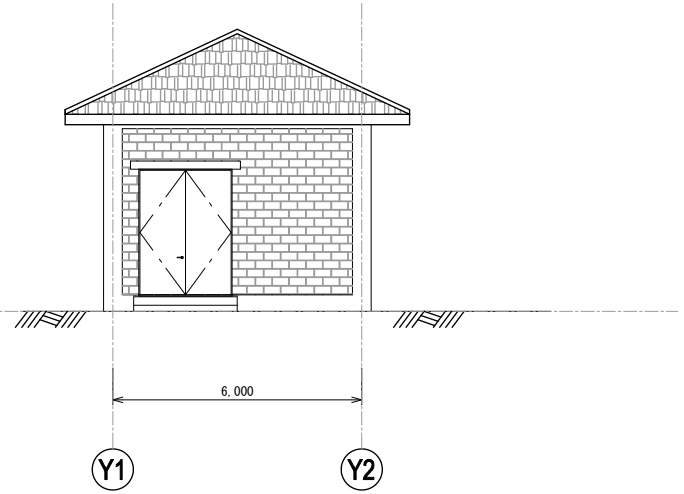


Plan

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		

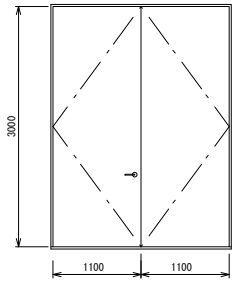
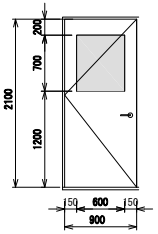
BUILDING OUTLINE

	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)	

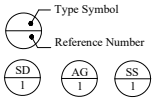
INTERIOR FINISH SCHEDULE

	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