添付資料－2

ミ　ニ　ッ　ツ　(1)

〃　(2)

〃　(3)

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ミ ニ ッ ツ (1)

MINUTES OF DISCUSSION
ON
the Sewerage Construction and Rehabilitation Project
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request of the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a preliminary study on the Sewerage Construction and Rehabilitation Project (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the People's Republic of Bangladesh the study team headed by Mr. Yasuo NISHIGUCHI, Deputy Director, Sewerage Planning Division, Sewerage and Purification Department, Ministry of Construction (hereinafter referred to as "the Team") from June 1 to 13, 1987.

The team had a series of discussion on the Project with the officials concerned of the Government of the People's Republic of Bangladesh headed by Mr. S.A.N.M. Wahed, Chief Engineer, DWASA and conducted a field survey in the relevant areas to the project.

As a result of the study, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the project.

Dhaka, June 11, 1987

Yasuo Nishiguchi

Mr. Yasuo NISHIGUCHI
Team Leader
Preliminary Study Team
Japan International
Cooperation Agency.

M.R.BRIG. CHOWDHURY KHALEQUZZAMAN
(Retd.)
CHAIRMAN
DHAKA WATER SUPPLY AND SEWERAGE AUTHORITY.

ATTACHMENT:

1. The objective of the Project is to rehabilitate sewage lift stations and Narinda Sewerage Pumping stations, and to improve the existing treatment facilities at Pagla to upgrade the discharged water quality.

2. The site of the Project is located in the city of Dhaka, capital of the People's Republic of Bangladesh. (Site map is atached as Annex I)

3. The Project Components requested by the Bangladesh side are as follows:

   a) Rehabilitation of the existing lift stations and related facilities including rehabilitation of sewer.

   b) Rehabilitation of Narinda central Pumping stations (old and new)

   c) Rehabilitation of Pagla outfall system.

   d) Improvement of the existing sewage treatment plant at Pagla.

4. Water Supply and Sewerage Authority (DWASA) is resoonsible for the administration of the project.

5. The Bangladesh side has understood Japanese Grant Aid System explained by the Team.

6. Japanese Government will send a Basic Design Study Team at an earlier date in order to collect further information and data and to make the Basic Design in consultation with Dhaka WASA, when this project is regarded as practicable through the report of the preliminary Study.

7. The Bangladesh side shall provide all necessary assistance, information and data relating to the project when the Basic Design Study Team visits the People's Republic of Bangladesh.

ミ ニ ッ ツ (2)

MINUTES OF DISCUSSION
ON
THE SEWERAGE CONSTRUCTION AND REHABILITATION PROJECT FOR DHAKA WASA
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request made by the Government of the People's Republic of Bangladesh for the Sewerage Construction and Rehabilitation Project (hereinafter referred to as 'the Project') the Government of Japan has sent, through the Japan International Cooperation Agency (hereinafter referred to as 'JICA') which is an official agency implementing the technical cooperation of the Government of Japan, the team headed by Mr. Shinji Omori, to conduct the survey for 28 days from September 3 to 30, 1987.

The team carried out a field survey, held a series of discussions and exchanged views with the authorities concerned of the Government of the People's Republic of Bangladesh.

Both parties have agreed to recommend to their respective Governments and the Authorities concerned to examine the attachment herewith towards the realization of the project.

Dhaka, September 10, 1987.

Shinji Omori
Shinji Omori
Team Leader
Basic Design Study Team
Japan International
Cooperation Agency.

Brig.Chowdhury Khalequzzaman
(Retd.)
Chairman
Dhaka Water Supply and
Sewerage Authority.

ATTACHMENT

1. The Japanese side explained the inception report of the Basic Design Study and the Bangladesh side understood it with certain observations as conveyed to the Japanese Team. The Scope of the work to be covered is shown in Annex-I.

2. Both parties confirmed the objective of the project with regard to the Sewerage Construction and Rehabilitation, the Project site, the executing body and the project components as mentioned in the articles a,b,c and d of the Minutes of Discussions of the Preliminary Study Team signed on the 11th June, 1987.

3. The team will convey to the Government of Japan the request of the Government of the People's Republic of Bangladesh that the former takes necessary measures to cooperate by implementing the project within the scope of Japanese economic cooperation programme in grant form.

4. With regard to the improvement of the existing Pagla Sewerage treatment plant, the Team is to compare and contrast the following alternatives:
   (1) Primary S.T. and expansion of the Ponds.
   (2) Trickling Filter (Including P.S.T)
   (3) Aerated Lagoon.
   (4) Others.

5. The Government of Bangladesh will take necessary measures as listed in Annex-II on condition that grant assistance by the Government of Japan is extended to the Project.

S.O.

ANNEX-I

The scope of the work to be covered is as follows:

1) The study will be implemented as an urgent improvement plan of the existing sewerage system of Dhaka city, in which existing reference data on the long term plan will be put in order to more accurately define the purposes of this project.

2) The study and evaluation of the capacity of the existing sewer pipelines and sewage treatment facilities will be performed. However, the rehabilitation and expansion of the trunk sewer and branch sewer are excluded from the subject of this plan except trunk sewers related to Hazaribagh L.S. and Narinda P.S. and few other places where urgently necessary for recovering the function of the existing trunk sewer.

3) The lift stations and pumping stations facilities will be surveyed for the operation and functioning conditions of the existing facilities, and rehabilitation of the pumps, pumping stations and improvement of the accessory equipment will be implemented as required.

4) The sewage treatment facility will be examined both in terms of quality and quantity to be treated. The planned quantity of sewage to be treated will be determined taking into consideration the result of this study and that of evaluation of the existing sewage quantity and the maximum conveyance capacity of sewer piping from Narinda and Shamibag upto Pagla.

S.O.

(more)

5) The discharge piping of treated water from the Pagla treatment facility to Burhi Ganga River will be examined whether or not the piping has a capacity sufficient for discharging the quantity of treated water as well as resistance against pressure of the highest flood water level of the river at the Pagla treatment facilities. If no, improvement of the piping will be performed.

6) The effect of use and the appropriate capacity of the equipment will be investigated on the cleaning equipment of sewer piping including sludge carrying facilities. The professional training will be provided.

7) From among the above mentioned improvement plans, as stated in items 1,2,3,4,5 & 6, the feasible plans to be addressed to the basic design will be selected taking into consideration the results of the study and evaluation of urgencies and total project cost including operation and maintenance cost.

ANNEX-II

Following arrangements will be required to be taken by the Government of Bangladesh.

1. To provide necessary data as per as possible for smooth completion of the study.

2. To provide facilities for distribution of electricity, water supply, drainage, telephone lines and other incidental facilities to the project site.

3. To ensure prompt unloading, tax exemption as applicable, customs clearance at ports of disembarkation in Bangladesh of the products purchased under the grant.

4. To exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in Bangladesh with respect to the supply of the products and services under the verified contracts. In this regard the existing Govt.'s (The Government of Bangladesh) rule will be followed.

5. To accord Japanese nationals, whose services may be required in connection with the supply of the products and the services under the varified contracts, with such facilities which may be necessary for their entry into Bangladesh and stay therein for the performance of their work.

6. To maintain and use properly and effectively the facilities constructed and equipment purchased under the grant.

7. To undertake incidental civil works such as gardening, fencing, gates, guard house and extorior lighting.

S.O.

ミ ニ ッ ツ (3)

MINUTES OF DISCUSSION
ON
THE BASIC DESIGN SURVEY WORKS FOR DETAILED DESIGN DRAWING OF THE SEWERAGE CONSTRUCTION & REHABILITATION PROJECT FOR DHAKA WASA
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request made by the Government of the People's Republic of Bangladesh for the Sewerage Construction and Rehabilitation Project therinafter referred to as the Project's the Government of Japan has sent, through the Japan International Cooperation Agency thereinafter referred to as 'JICA' which is an official agency implementing the technical cooperation of the Government of Japan, the team headed by Mr. Shinji Omori, to conduct the survey for 28 days from September 3 to 30, 1987.

The team carreid out a field survey, held a series of discussions and exchanged views with the authorities concerned of the Government of the People's Republic of Bangladesh.

Both parties have agreed to recommend to their respective Governments and the Authorities concerned to examine the attachment herewith towards the realization of the project.

Dhaka, September 30, 1987

Kenji Hori
Project Manager and
Sewerage facilities Planning
Basic Design Survey Team
Japan International Co-operation Agency.

Brig. Chowdhury Khalequzzaman (Retd.)
Chairman
Dhaka Water Supply and Sewerage Authority.

ATTACHMENT

1. Collected Data

(1) The existing latest long-term development plan on water supply and Sewerage systems in Dhaka is detailed in the Feasibility Report dated April 24, 1991 prepared by RMP and J.M. Montogomery.

(2) The unit of quantity of water which is being used in the several datas, including the capacity of pumps marked on the same is to be understood as IMGD or igpm, i.e. imperial gallon.

Therefore, the "US gpm" indicated in Figure 5-4, page 5-23, out of the said Feasibility Report should be read into "igpm".

2. The preferential facilities to be addressed to the basic design study are as follows:

(1) Pumps and other accessories of the lift stations and Central pumping station.

The detail of the facilities to be covered is shown in Annex 1.

(2) Reconstruction of the sump-wells including bar screens and inlet sewer at the new Narinda P.S.

(3) Replacement of the sewer pipe line (Discharging side) leading to the lift pump at the Hazaribag L.S.

The sewer should be provided with a pressure pipe line inorder to enable the sewage to flow by natural force to the next lift station.

The existing sewer for the same distance replaced into pressure pipe line should be used for sewage collection pipe line covering Hazaribag L.S. Industrial West Water, however is not required.

(4) Improvements on the existing Pagla STP

(a) Case-1 that is the treatment process of PST and expansion of the existing ponds out of the comparing alternative plans which are shown in Annex 2, is to be selected as the feasibility treatment method for Pagla STP because of the most low operation and maintenance cost. The stabilization ponds should be limited inside WASA land for the basic design study.

(b) Total sewge treatment capacity of Pagla (Pagla STP) is to be provided with approximately 40 IMGD (183.000 M3/day) based on the grant request from the Bangladesh side.

(c) The capacity of Pagla STP to be constructed by this basic design study, however, should be planned based on the study of the conveyance capacity of the existing trunk sewer pipe line between junctions of sewers coming from Narinda and Swaminbag, and Pagla without any another additional pressure to be given to the existing 54" brick sewer line, i.e. approximately 25 IMGD (120.000^3 /day).

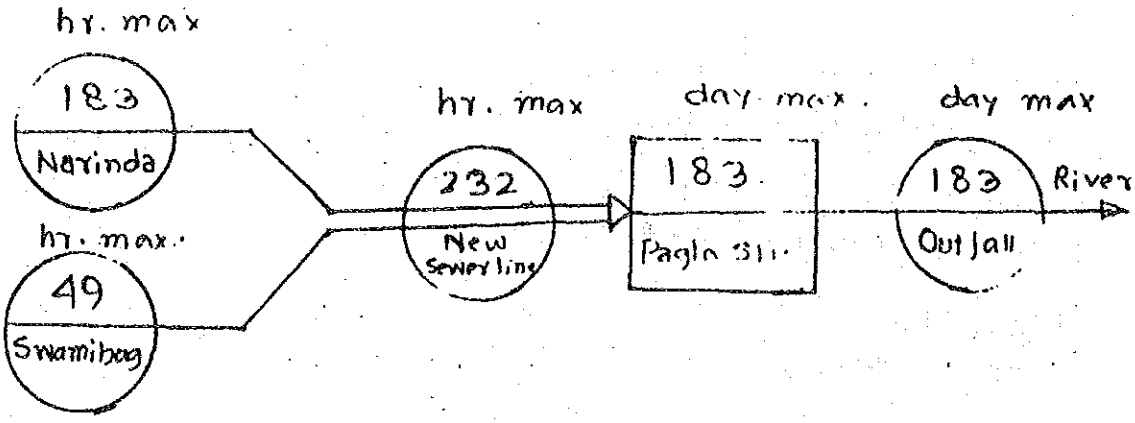
(d) The capacity of major facilities in terms of the total planning and this basic design study should be provided as follows:-

DESIGN CONDITION

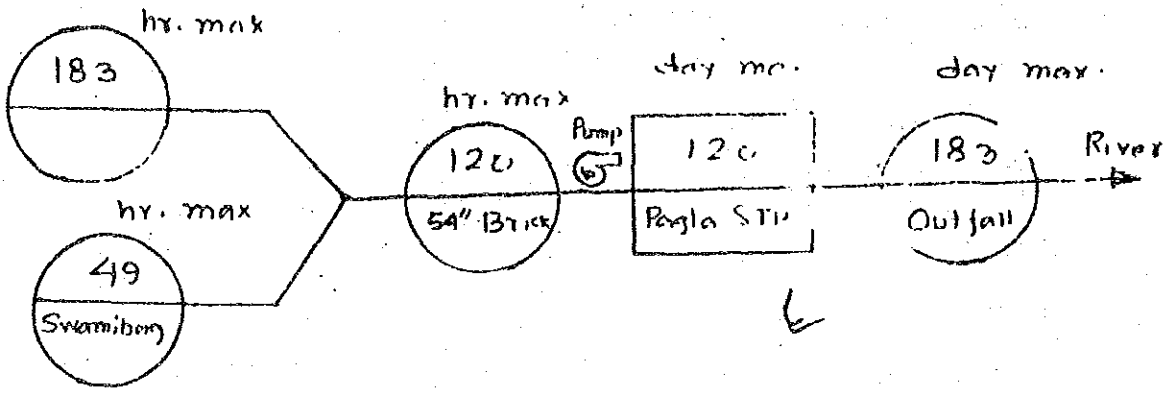
	TOTAL PLANNING	BASIC DESIGN	ESISTING
NEW NARINDA P.S. (Total pump cap.)	hr max. 183.000 m3/D	hr max. 183.000 m3/D	hr max 183.000 m3/I
SWAMINBAG L.S. (Total pump cap.)	hr max. 49.000 m3/D	hr max. 49.000 m3/D	hr max 49.000 m3/D
SEWER LINE (54"Brick Sewer)	hr max 232.000 m3/D	hr. max 120.000 m3/D	hr max 120.000 m3/D
PAGLA S.T.P.	day max. 183.000 m3/D	day max. 120.000 m3/D	day max. 37.000 m3/D
PAGLA OUT FALL	day max 183.000 m3/D	day max. 183.000 m3/D	day max. 183.000 m3/D

DESIGN CAPACITY OF MAJOR FACILITIES IN TERMS OF TOTAL PLANNING AND BASIC DESIGN STUDY

TOTAL PLANNING



BASIC DESIGN STUDY



(5) Construction of the discharge piping of treated water from the Pagla STP to Burhi Ganga River.

a) The discharge pipe should be limited till the existing gatemanhole which is located inside the road or bank of the river, which means that the existing pipe crossing the road or bank of the river, and the last manhole distributing treated water continue to function.

b) The site to be used for installation of the pipe should be provided by the Bangladesh side.

(6) The cleaning equipment of sewer piping:

1) High pressure sewer cleaner x 5 Nos. with spare hoses

2) Vacuume Sewage cleaning truck x 5 Nos.

3) 4 ton capacity sludge carrying pick-up x 5 Nos.

4) Bucket machine x 5 Units.

5) Pipe cleaning tool x 5 Units.

6) Sludged de-watering pump petrol/diesel driven alongwith hose pipe x 1 Unit.

3. The following should be inserted in the basic design study based on the minutes of discussion of the basic design team signed on September 10, 1987

1) About 75m of 42" dia m.s. discharge piping infront of old Narinda Sewage pump station needs be urgently replaced.

2) About 150 metre length of 24" dia R.C.C. sewer between Asadgate and Tejgaon Sewage lift stations is in bad condition and replacement of the same is urgently necessary.

3) About 100m length of 24" dia R.C.C. sewer between Gulshan and Tejgaon lift station needs be replaced immediately.

4) About 200m of 36" & 48" dia equivalent brick sewer from Tejgaon to Swaminbag lift stations needs be rehabilitated immediately.

The item No. 2, 3 & 4 could not be shown to the Consultants as the sewers in question are under water.

4. From among the above mentioned improvement plans, the feasible plans to be addressed to the basic design will be selected taking into consideration to results of the study and evaluation of urgencies and total project cost including operation and maintenance cost.

ANNEX I

A>B>C : Priority for to be replaced or reconstructed.

Item / Name of L/S	(a) Pump	(b) Vacume pump	(c) Sump pump	(d) Inlet Gate	(e) Screen	(f) Panel	(g) Generator	(h) Transformer	(i) Pipe and valves
Nawabganj (1964)	A (S)	-	-	A	A	A	-	-	A
Azimpur (1956)	B (V)	-	A	A	A	A	-	-	B
Medical Cal.C (1968)	(V)	A	A	A	A	A	-	-	C
Hazaribag (1978)	A (S)	-	-	A	A	A	-	A	A
New Market (1967)	C (V)	A	A	A	A	A	-	-	A
Nagbazar (1956)	B (S)	-	-	A	A	A	-	-	B
G&T (1956)	C (V)	-	A	A	A	A		-	C
Asad Gate (1978)	C (V)	A	A	A	A	A	good	-	A
Tejgaon (1977)	C (V)	A	A	A	A	A		good	A
Bashaboo (1976)	C (V)	A	A	A	A	A	-	good	A
Swaminbag (1978)	C (V)	A	A	A	A	A	-	good	A
Faridabad (1968)	A (S)	-	-	A	A	A	-	-	A
Narinda (old) (1923)	A	A	A	A	A	A	-	A	A
Narinda (New) (1978)	good	A	A	A	A	A	good	A	C

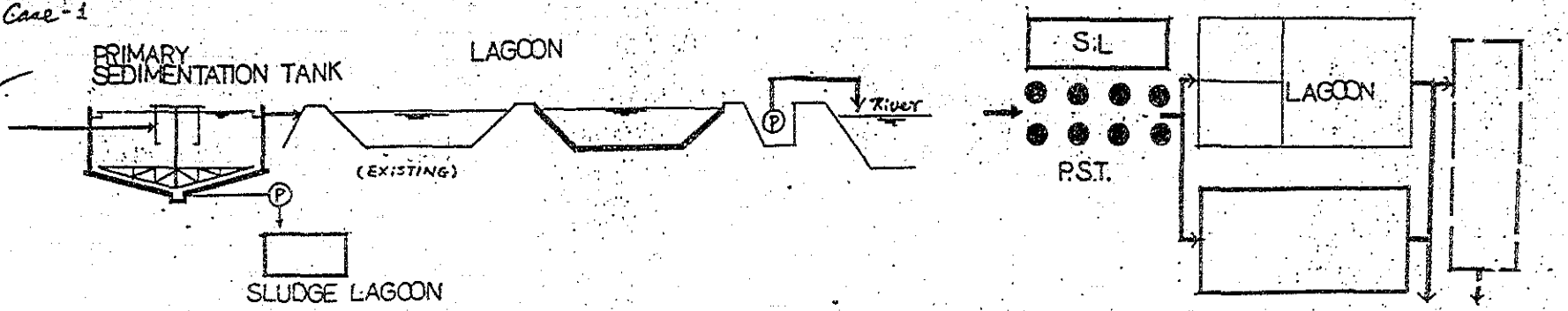
Item Name	(j) Delivery Tank	(k) Delivery Pipe line	(l) Repair of Structure	(m) Movable Sumersible pump	(n) W.Level Indicator
Nawabganj	C	C	A	C	A
Azimpur	C	C	A	A	A
Medical Call	C	A	C	A	A
Hazaribag	A	A	A	A	A
New Market	C	C	C	A	A
Nagbazar	good	good	A	A	A
P&T	C	C	A	A	A
Asad Gate	C	C	C	A	A
Tejgaon	C	C	A	A	A
Bashaboo	C	C	A	A	A
Swaminbag	C	C	C	A	A
Faridabad	C	A	C	C	A
Narinda (old)	-	-	A	A	A
Narinda(new)	-	-	A	A	A

Annex-2

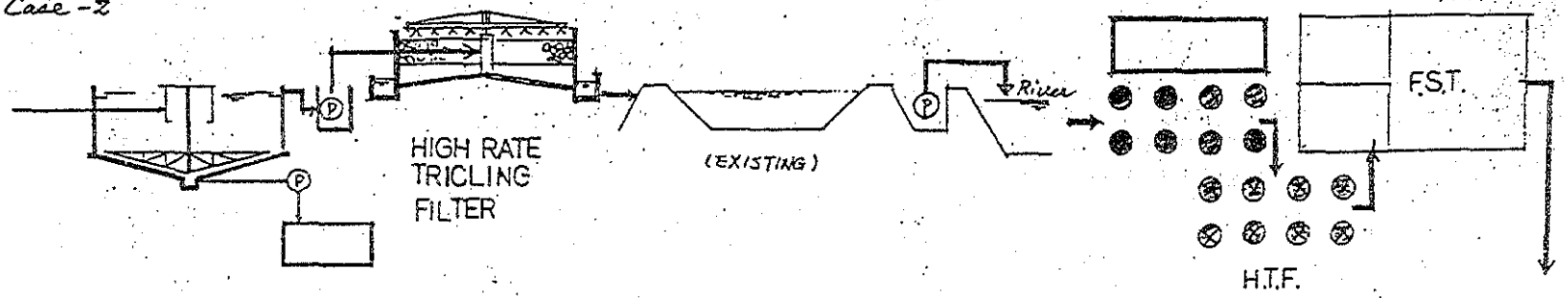
Note: ⊔ line indicates that the facilities are provided by the project.

Comparison Alternative Proces for Pagla sewage Treatment Plant

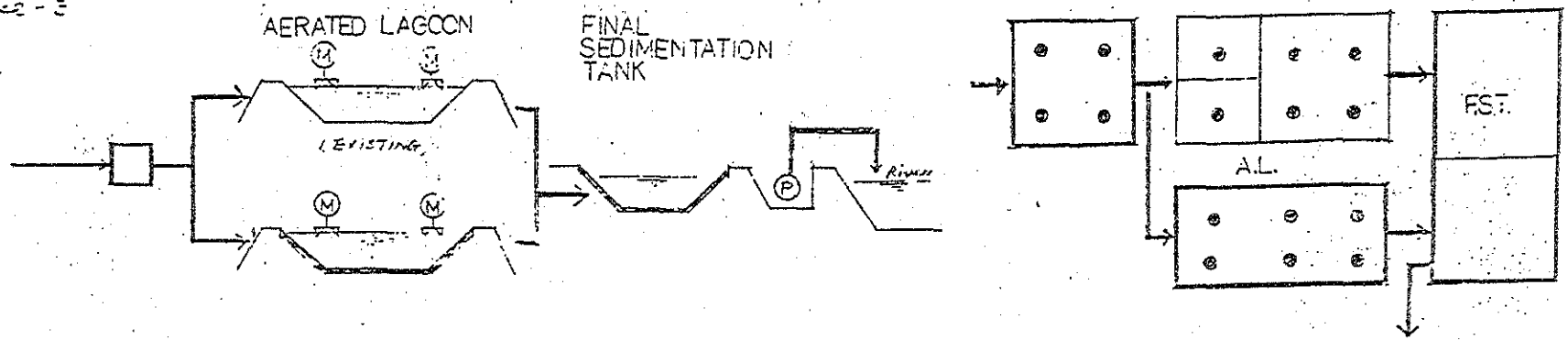
Case-1



Case-2



Case-3

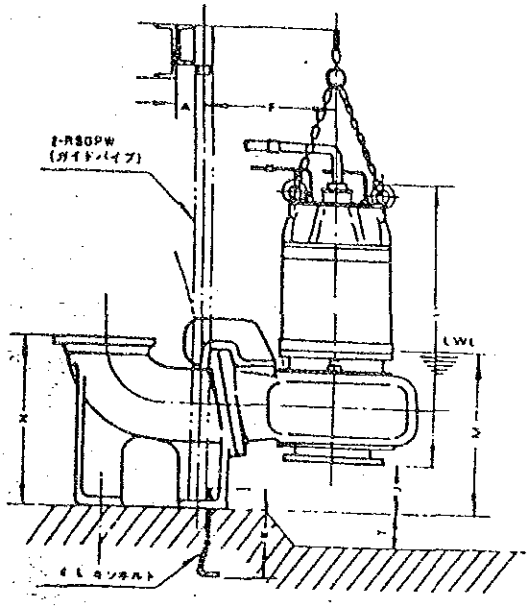


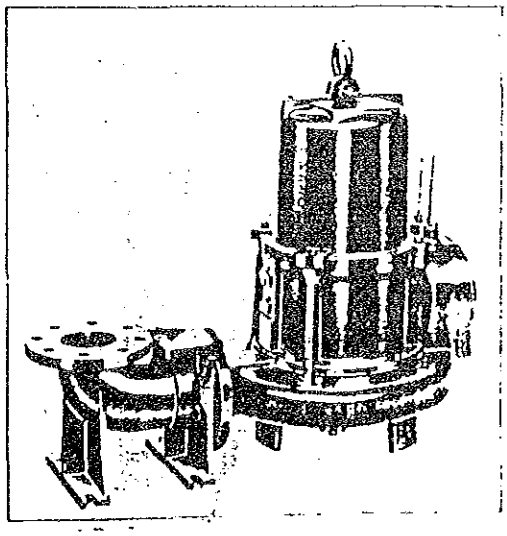
日本上下水道設計株式会社

Annex-2 Comparison Table for Alternatives

Case / Item	Case.1 Primary S.T. and Lagoon	Case.2 Primary S.T. and Trickling Filter	Case.3 Facultative Aerated Lagoon	Remarks
1. Design Basis				
Daily Flow	120.000 m^3/d (Approx. 40 MGD)	Same as Case.1	Same as Case.1	
Water Quality (Approx.)	BOD(mg/l) SS(mg/l) Influent 250 200 Effluent 50 60			
2. Facilities				
	① Primary Sedimentation Tank ϕ29m × 3m^H × 8 Tanks	① Primary Sedimentation Tank ϕ29m × 3m^H × 8 Tanks	① Facultative Aerated Lagoon Rt = 4 days (Exist) 329,100 m^2 × 1.5m^H (Expansion) 156,000 m^2 × 1.5m^H	
	② Sludge Collector ϕ29m × 1.5 KW × 8 sets	② Sludge Collector ϕ29m × 1.5KW × 8 sets	② Surface Aerator 22 KW × 60 sets	
	③ Raw Sludge Pump ϕ100mm × 1.1 m^3/m × 5m^H × 3.7KW × 8 sets	③ Raw Sludge Pump ϕ100 × 1.1 m^3/m × 5m^H × 3.7KW × 8 sets	③ Sedimentation Pond Rt = 1 days 90,000 m^2 × 2 m^H	
	④ Lagoon Rt = 6 days (Exist) 329,100 m^2 × 1.5 m^H (Expansion) 390,900 m^2 × 1.5 m^H	④ Lift Pump (Existing Out-fall pump) 1000 gpm × 20HP(15KW) × 2 sets 2,500 gpm × 30HP(22KW) × 2 sets 7,000 gpm × 75HP(55KW) × 3 sets		
	⑤ Sludge Lagoon 80,000 m^2 × 2.0 m^H	⑤ Trickling Filter ϕ34 m × 2 m^H × 8 Tanks		
		⑥ Lagoon Rt = 2.7 days (Approx.) (Exist) 329,100 m^2 × 1.5 m^H		
		⑦ Sludge Lagoon 80,000 m^2 × 2.0 m^H		
	⑥ Out-Fall Pump ϕ400 × 25 m^3/m × 55 KW × 6 sets (1 set stand-by)	⑧ Out-Fall Pump ϕ400 × 25 m^3/m × 55 KW × 6 Sets (1 set stand-by)	④ Out-Fall Pump ϕ400 × 25 m^3/m × 55 KW × 6 Sets (1 set stand-by)	* Out-Fall pump shall be operated in a rainy season and not operated dry season
3. Total Power Consumption (Approx.)	Dry Season 873.7 KWh/D Rainy Season 1653.7 KWh/D	Dry Season 1,139.3 KWh/D Rainy Season 10,519.3 KWh/D	Dry Season 26,100 KWh/D Rainy Season 31,380 KWh/D	
4. Power Charge (Approx.)	Dry Season M1,107.4 TK/6mon. Rainy Season 2,137,099 TK/6mon. Total 2,278,206 TK/year	Dry Season 1,942,645 TK/6mon. Rainy Season 3,938,495 TK/6mon. Total 5,881,150 TK/year	Dry Season 9,865,800 TK/6mon. Rainy Season 11,861,640 TK/6mon. Total 21,727,440 TK/...	

Annex - 3 Submergible Pump.





ミ ニ ッ ツ (4)

MINUTES OF DISCUSSION

ON

THE DRAFT FINAL REPORT OF THE BASIC DESIGN STUDY

ON

THE SEWERAGE CONSTRUCTION AND REHABILITATION PROJECT

FOR DHAKA CITY

IN

THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request of the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a basic design study on the Sewerage Construction and Rehabilitation Project for Dhaka city and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Bangladesh the study team from September 3 to 30 , 1987.

As a result of the study, JICA prepared a Draft Final Report on the Study and dispatched a mission, headed by Mr. Yasuo Nishiguchi, Deputy Director, Sewerage Planning Division, Sewerage and Purification Department, Ministry of Construction, to explain and discuss it from January 6 to 16, 1988.

Both parties had a series of discussions on the Report and have agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Dhaka, March 21 ,1988

NORIO MATSUZAWA
Resident Representative
Japan International Cooperation Agency

BRIG. CHOWDHURY KHALEQUZZAMAN (Retd)
Chairman
Dhaka Water Supply and Sewerage Authority

ATTACHMENT ONE

Major points of understanding are as follows:

1. The Bangladesh side agreed in principle to the basic design proposed in the draft final report to be incorporated in the basic design study report.

2. Ten (10) copies of final reports in English for basic design on the project will be submitted to the Government of the People's Republic of Bangladesh in March, 1988.

3. The Bangladesh side has understood the system of Japan's Grant Aid Programme and confirmed the arrangements to be taken by the Government of the Poeple's Republic of Bangladesh for the realization of the project as agreed upon in the " Minutes of Discussion " dated September 10,1987.

4. The site to be used temporarily by the construction contractors for construction of the facilities shown below should be provided by Bangladesh side.

   (1) The site for installation of the out fall pipe from Pagla S.T.P. to the end gate manhole located at inside the river bank.

   (2) The site for installation of trunk sewer for new Narinda pumping station and other places also.

ATTACHMENT TWO

1. Eight (8) fixed generators (50 KVA) and two (2) movable generators (50 KVA) will be provided in the project for standby use in case of power failure.

2. For flow measuring, two (2) to three (3) ultrasonic flowmeters will be provided in the project.

3. One (1) standby submersible pump each for Hazaribag, Nawabaganj, Faridabad and Old Narinda pumping stations of which pumps are to be replaced in the project, will be provided.

   As for other pumping stations, it is considered there is a standby pump already installed in each station.

4. Spare parts consumed for two (2) to five (5) years for the supplied equipment, pumps, machineries etc. will be provided in the project.

5. An administrative building in Pagla S.T.P. will be two (2) storied instead of one (1) storied.

6. To keep provision for overcoming the difference 6' of level between sump well and inlet manhole in the New Market L.S. should be included.

7. Discharge pipe of Faridabad Station will be replaced only between the Station and Haricharan Roy Road, and Katherpool syphon.

8. Two (2) 375 KVA diesel generators for Pagla S.T.P. as backup in case of a power failure, have already been included in the project.

添付資料－3

維持，管理費用比較

（120,000㎥／日）

代替案の比較（1／2）　　Q＝120,000㎥／分（今回計画）

項目＼代替案	Case. 1 最初沈殿池＋通性ラグーン				Case. 2 最初沈殿池＋高速散水沪床				Case. 3 エアレーテッド通性ラグーン				備考
(1) 維持管理費													
1）電力費													
a）使用電力量	機器名	台数(予)	kw	計算	機器名	台数(予)	kw	計算	機器名	台数(予)	kw	計算	
	揚水ポンプ	3(1)	45	2×45×24×0.8 ＝1,728	揚水ポンプ	3(1)	90	2×90×24×0.8 ＝3,456	エアレーター	26	22	酸素必要量から求める。 120,000×(200-50) ×10^{-3}×1.0×1/1.8 ＝10,000	*1 放流河川の年間の水位変動を考慮し，運転率0.7とした。
	汚泥掻寄機	4	2.2	4×2.2×24×0.8 ＝169	汚泥掻寄機	4	2.2	4×2.2×24×0.8 ＝169					
	生汚泥ポンプ	5(1)	7.5	4×7.5×2.5×0.8 ＝60	生汚泥ポンプ	5(1)	7.5	4×7.5×2.5×0.8 ＝60	塩素注入ポンプ	2(1)	2.2	1×2.2×24×0.8 ＝43	
	塩素注入ポンプ	2(1)	2.2	1×2.2×24×0.8 ＝43	塩素注入ポンプ	2(1)	2.2	1×2.2×24×0.8 ＝43					
	その他			≒100	その他			≒200	その他			≒50	
	小計			2,100 kw／日	小計			3,928 kw／日	小計			10,093 kw／日	
	放流ポンプ	7	(273)	273×24×0.8×0.7 *1 ×$\frac{120}{183}$＝2,406	放流ポンプ	7	(273)	273×24×0.8×0.7 *1 ×$\frac{120}{183}$＝2,406	放流ポンプ	7	(273)	273×24×0.8×0.7 *1 ×$\frac{120}{183}$＝2,406	
	計			4,506 kw／日	計			6,334 kw／日	計			12,499 kw／日	
	年間使用電力量 乾期（約5ヶ月）（放流ポンプ運転不要） 2,100 kw／日×30×5＝315,000 kw 雨期（約7ヶ月）（放流ポンプ運転要） 4,506 kw／日×30×7＝946,260 kw 計　1,261,260 kwH／年				乾期 3,928 kw／日×30×5＝589,200 kw 雨期 6,334 kw／日×30×7＝1,330,140 kw 計　1,919,340 kwH／年				乾期 10,093 kw／日×30×5＝1,513,950 kw 雨期 12,499 kw／日×30×7＝2,624,790 kw 計　4,138,740 kwH／年				
b）電力費	1,261,260 kwH／年×2.1 TK／kwH ＝2,648,646 TK／年 （100%）				1,919,340 kwH／年×2.1 TK／kwH ＝4,030,614 TK／年 （152%）				4,138,740 kwH／年×2.1 TK／kwH ＝8,691,354 TK／year （328%）				電力料金はPDBのTarif(1987.8)による。2.1 TK／kwH

代 替 案 の 比 較 （2/2）

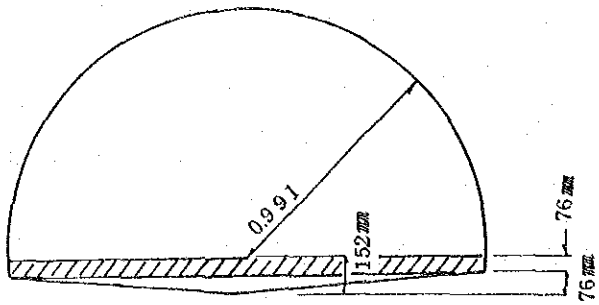
項目＼代替案	Case. 1 最初沈殿池＋通性ラグーン	Case. 2 最初沈殿池＋高速散水沪床	Case. 3 エアレーテッド通性ラグーン	備考
2）薬品費				
a）消毒用塩素剤	注入率　3 mg/ℓ 1日当り使用量 120,000 m³/日×3 mg/ℓ×10⁻³ ＝ 360 kg/日			
	年間使用量 360 kg/日×365日＝131,400 kg/年	同　左	同　左	
	年間薬品費 131,400 kg/年×8.5 TK/kg＝ 1,116,900 TK/年			薬品単価はWASAの購入単価
3）人件費				
	場　長　1人×48,000TK/年＝48,000 技術員　2人×36,000TK/年＝72,000 運転員　6人×12,000TK/年＝72,000	場　長　1人×48,000TK/年＝48,000 技術員　2人×36,000TK/年＝72,000 運転員　8人×12,000TK/年＝96,000	場　長　1人×48,000TK/年＝48,000 技術員　2人×36,000TK/年＝72,000 運転員　8人×12,000TK/年＝96,000	運転に要する人員であり，作業員は含んでいない。
	計　192,000 TK/年	計　216,000 TK/年	計　216,000 TK/年	
4）補修費その他	200,000 TK/年	200,000 TK/年	200,000 TK/年	軽微な補修，部品交換を対象として一律計上
5）維持管理費合計				
電力費	2,648,646	4,030,614	8,691,354	
薬品費	1,116,900	1,116,900	1,116,900	
人件費	192,000	216,000	216,000	
補修費その他	200,000	200,000	200,000	
計	4,157,546 TK/年	5,563,514 TK/年	10,224,254 TK/年	

添付資料－4

幹線管きょ能力の評価

(i) ＪUNCTIDNマンホール～PAGLA処理場間
（合流）
a）等流計算（管勾配＝動水勾配のとき）

口径＝54″相当（1.37m相当）のレンガアーチ管（下図）



勾配Ｉ＝0.00045（モントゴメリーのレポートによる。）

面積Ａ＝$0.991^2\times\pi\times\frac{1}{2}$
$+0.991\times2\times0.076$
$+0.991\times2\times0.076\times\frac{1}{2}$
$=1.77\,m^2$

潤辺Ｐ＝$0.991\times2\times\pi\times\frac{1}{2}$
$+0.076\times2+2\times\sqrt{0.991^2+0.076^2}=5.25\,m$

粗度係数ｎ＝0.015（レンガアーチ管）

径深＝Ａ／Ｐ＝1.77／5.25＝0.337　　$R^{2/3}=0.484\,m$

Ｉ＝0.00045　　$\therefore I^{1/2}=0.0212$

$\therefore V=\frac{1}{0.015}\times0.484\times0.0212=0.684\ m/sec$

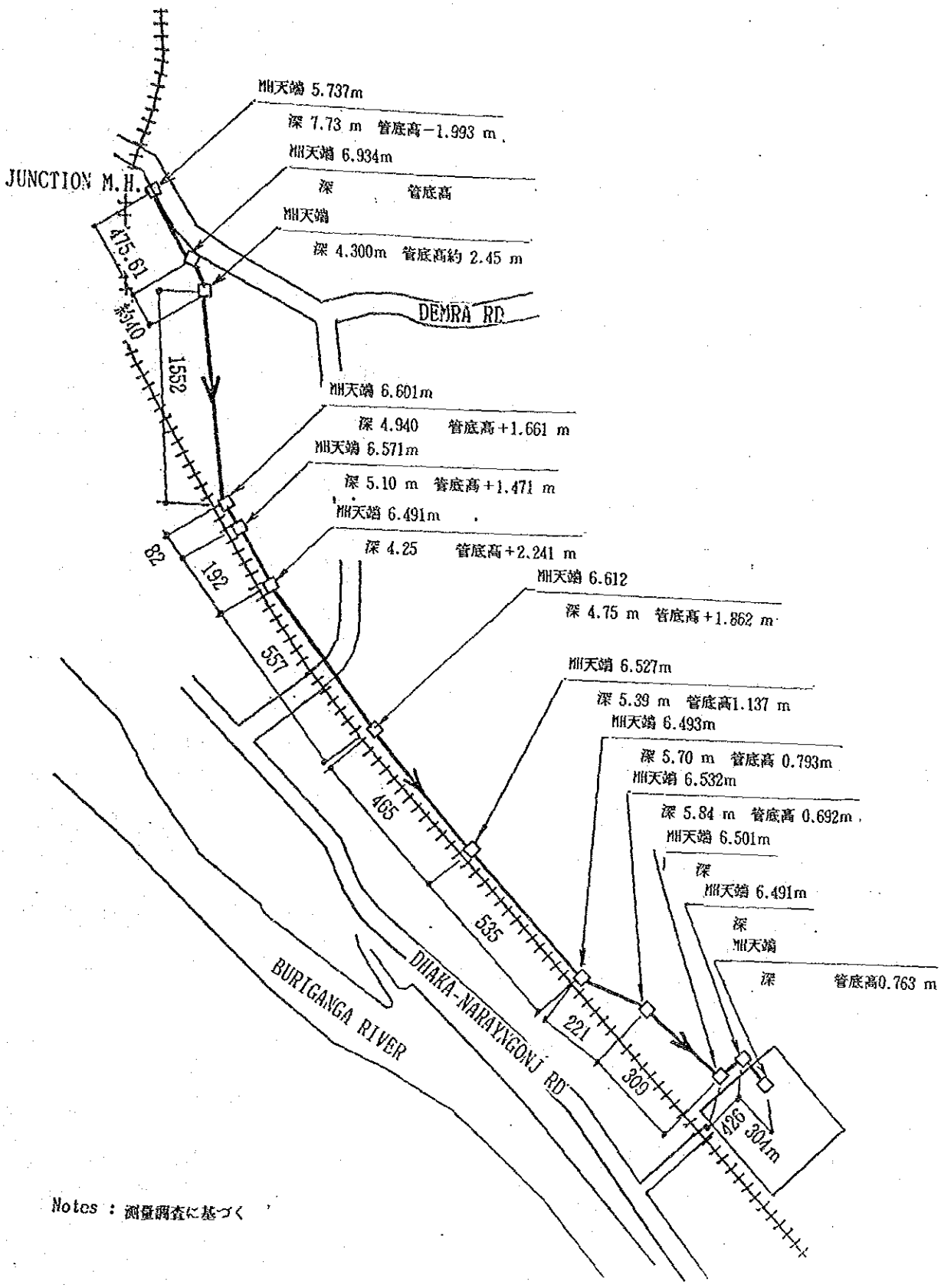
Ｑ＝$1.77\times0.684=1.21\ m^3/sec=104,602\ m^3/sec$

b）圧力管の場合で検討

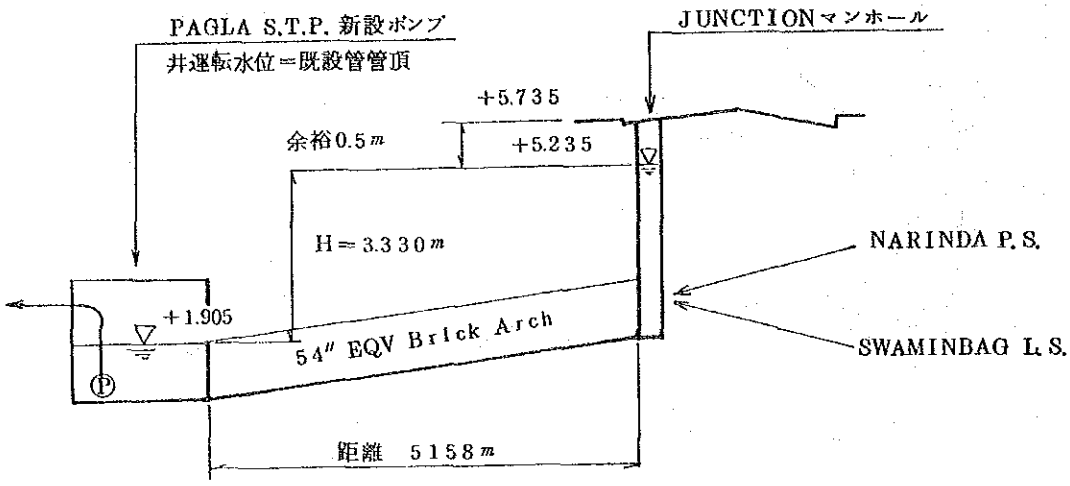
ＪUNCTIONマンホール～PAGLA間の位置関係は図Ａ４－１に示す通りである。計（合流）
算の仮定条件を次の図の様に考える。

ＪUNCTIONマンホール水位；地盤高より0.5m下りとする。（＋5.235m）

処理場運転水位；既設54″レンガアーチ管の管頂とする。（＋1.905m）



図Ａ４－１　Pagla 処理場流入幹線



前述のとおり，A＝1.77㎡，P＝5.25m，n＝0.015，R＝0.337

（$R^{2/3}$＝0.484）

$$I = \frac{3.330}{5,158} = 0.000646 \quad (I^{1/2} = 0.0254)$$

$$V = \frac{1}{0.015} \times 0.484 \times 0.0254 = 0.820\ m/sec$$

$$Q = 1.77 \times 0.820 = 1.45\ m^3/sec = 125,280\ m^3/day \rightarrow 120,000\ m^3/day$$

よって，PAGLA S.T.P.までの輸送能力は120,000㎥／day と考えるのが妥当である。処理場の改良計画も当面の建設計画は120,000㎥／day でおさえるのが先行投資が少なく妥当と判断される。

c）JUNCTIONマンホール～PAGLA処理場間の幹線能力を120,000㎥／day としたときのJUNCTIONマンホールの水位

$$h_f = \frac{V^2 \cdot n^2}{R^{4/3}} \times \ell = \frac{(\frac{1.39}{1.77})^2 \times 0.015^2}{(0.484)^2} \times 5,158 = 3.055\ m$$

JUNCTIONマンホールの水位＝1.905＋3.055＝4.960 m

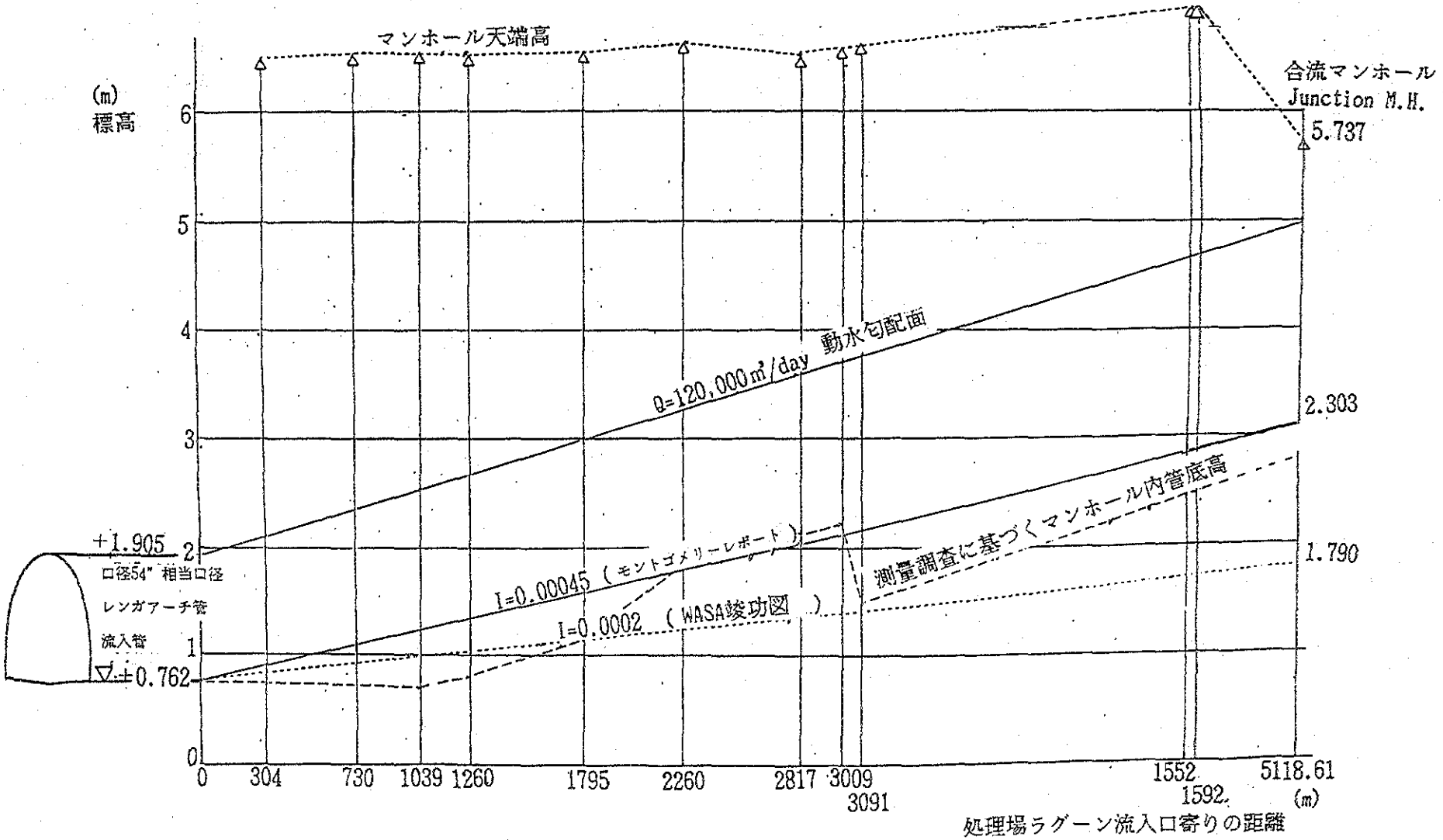


図 A 4 － 2　Pagla 処理場流入幹線縦断図

上記の結果（Q＝１２０,０００㎥／dayの場合）を断面図に表わすと，図Ａ４－２のとおりとなる。５４″ＥＱＶレンガアーチ管にかかる圧力は管頂部で約2.0 t／㎡，管底部で約3.0 t／㎡である。

(ii) NARINDA P.S.～JUNCTIONマンホール

この管は圧力管で設計されている。竣功図はなく詳細は不明である。

口径＝３６″相当（0.９１４m相当）レンガアーチ管（下図）

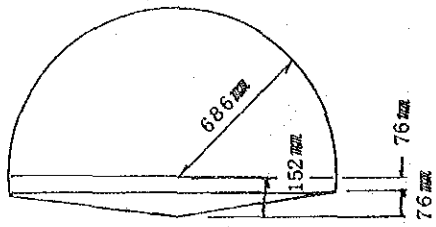
$$A = 0.686^2 \times \pi \times \frac{1}{2} + 0.686 \times 2 \times (0.152 \times \frac{1}{2}) + 0.686 \times 2 \times 0.076 \times \frac{1}{2}$$

$$= 0.896\ m^2$$

$$P = 0.686 \times 2 \times \pi \times \frac{1}{2} + 0.152 \times 2 \times \frac{1}{2} + 2 \times \sqrt{0.686^2 + 0.076^2}$$

$$= 3.69\ m$$

$$n = 0.015$$



NARINDA P.S.の地盤高を＋6.１５m，JUNCTIONマンホールまでの距離を５００m，JUNCTIONマンホールの水位を＋4.９６０mとする。

$$I = \frac{(6.15 - 4.96)}{500} = 0.00238 \quad (I^{1/2} = 0.0488)$$

$$R = \frac{A}{P} = \frac{0.896}{3.69} = 0.243\ m \quad (R^{2/3} = 0.389)$$

$$Q = A \cdot V = 0.896 \times 1.27 = 1.14\ m/sec = 98{,}000\ m^3/day$$

(iii) SWAMINBAG L.S. 吐出側幹線能力

口径＝４８″相当（1.２２m相当）レンガアーチ管（下図）

$$A = 0.801^2 \times \pi \times \frac{1}{2} + 0.801 \times 2 \times (0.152 \times \frac{1}{2}) + 0.801 \times 2 \times 0.076 \times \frac{1}{2}$$

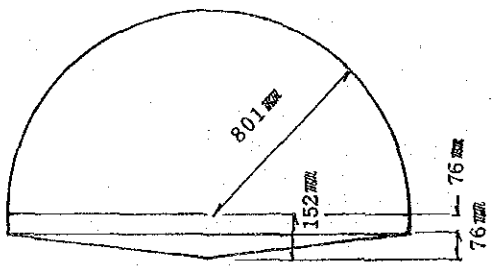
$$= 1.19\ m^2$$

$$P = 0.801 \times 2 \times \pi \times \frac{1}{2} + 0.152 + 2 \times \frac{1}{2} + 2 \times \sqrt{0.801^2 + 0.076^2}$$

$$= 4.28\ m$$

$$n = 0.015$$

$$I = \frac{(7.625 - 4.983)}{450} = 0.00587 \quad (I^{1/2} = 0.0766)$$



$$R = \frac{1.19}{4.24} = 0.202 \quad (R^{2/3} = 0.345)$$

$$V = \frac{1}{0.015} \times 0.345 \times 0.0766 = 1.76 \ m/sec$$

$$Q = A \cdot V = 1.19 \times 1.76 = 2.09 \ m^3/sec = 180,956 \ m^3/day$$

(IV) BASHABOO L.S. 吐出側幹線能力

口径＝48″相当（1.22m相当）レンガアーチ管　A＝1.19㎡，　勾配は0，圧力管として設計されている。

動水勾配を求める条件として，

上流側　　BASHABOO L.S. 地盤高－0.50m＝＋5.237

SWAMINBAG L.S.流入管管頂　　＝＋2.200

$$I = \frac{5.237 - 2.200}{2,740} = 0.00111 \qquad I^{1/2} = 0.0333$$

$$R = 0.278 \qquad (R^{2/1} = 0.426)$$

$$V = \frac{1}{0.015} \times 0.426 \times 0.0333 = 0.946 \ m/sec$$

$$Q = A \cdot V = 1.19 \times 0.826 = 0.983 \ m^3/sec = 84,900 \ m^3/day$$

(V) TEJGAON L.S. 吐出側幹線能力

口径＝36″相当（0.914m相当）レンガマーチ管

$$I = 0.00048 \quad (I^{1/2} = 0.0219)$$

$$A = 0.896 \ m^2, \quad P = 3.69 \ m, \quad n = 0.015,$$

$$R = 0.243 \ m \qquad (R^{2/3} = 0.389)$$

$$V = \frac{1}{0.015} \times 0.389 \times 0.0219 = 0.568 \ m/sec$$

$$Q = 0.896 \times 0.568 = 0.509 \ m^3/sec = 43.978 \ m^3/day$$

(VI) ASADGATE L.S. 吐出側幹線能力

口径＝18″＝0.457m

$$I = 0.016 \quad (I^{1/2} = 0.04)$$

$$A = 0.457^2 \times \pi \times \frac{1}{4} = 0.164 \ m^2$$

$$P = 0.457 \times \pi = 1.44 \ m$$

$$n = 0.013$$

$$R = \frac{A}{P} = \frac{0.164}{1.44} = 0.114 \ m \quad (R^{2/3} = 0.235)$$

$$V = \frac{1}{0.013} \times 0.235 \times 0.04 = 0.723 \ m/sec$$

$Q = 0.164 \times 0.723 = 0.119\ m^3/sec = 10,282\ m^3/day$

(vii) P & T L.S. 吐出側幹線能力

口径＝36″相当（0.914 m 相当）レンガアーチ管

$I = 0.0026$　（$I^{1/2} = 0.0510$）

$A = 0.896\ m^2$,　$P = 3.69\ m$,　$n = 0.015$

$R = 0.243\ m$　（$R^{2/3} = 0.389$）

$$V = \frac{1}{0.015} \times 0.389 \times 0.051 = 1.32\ m/sec$$

$Q = 0.896 \times 1.32 = 1.18\ m^3/sec = 101,952\ m^3/day$

(viii) MOGHBAZAR L.S. 吐出側幹線能力

口径＝24″＝0.610 m

勾配は測量結果による。

$I = 0.00856$　（$I^{1/2} = 0.0925$）

$$A = 0.610^2 \times \pi \times \frac{1}{4} = 0.292\ m^2$$

$P = 0.610 \times \pi = 1.92\ m$

$n = 0.013$

$$R = \frac{A}{P} = \frac{0.292}{1.92} = 0.152 \quad (R^{2/3} = 0.285)$$

$$V = \frac{1}{0.013} \times 0.285 \times 0.0925 = 2.03\ m/sec$$

$Q = 0.292 \times 2.03 = 0.593\ m^3/sec = 51,235\ m^3/day$

(ix) NEWMARKET L.S. 吐出側幹線能力

吐出側の口径については資料によって18″，24″，36″と異なっており，測量調査においてもマンホールを明けることが出来ず，確認できなかった。

ここの流下能力は，流出管の能力と等しいとみる。即ち，竣功図からHAZARIBAG L.S. の吐出側管と同能力とする。

$Q = 0.213\ m^3/sec$（計算は後記）

(x) HAZARIBAG L.S. 吐出側幹線能力

口径＝24″＝0.610 m

$I = 0.0011$　（$I^{1/2} = 0.0332$）

$A = 0.152\ m$,　$P = 1.92\ m$,　$n = 0.013$

$R = 0.152\ m$　（$R^{2/3} = 0.285$）

$$V = \frac{1}{0.013} \times 0.285 \times 0.0332 = 0.728\ m/sec$$

$Q = 0.292 \times 0.728 = 0.213\ m^3/sec = 18,403\ m^3/day$

(XI) MEDICALCOLLEGE L.S. 吐出側幹線能力

口径＝12″＝0.305 m

勾配については竣功図およびその他の資料がなく，吐出側のマンホールも開かない構造になっていたため流入管の測量結果から求めたものと同能力とする。

$I = 0.0807$ $(I^{1/2} = 0.284)$

$A = 0.0731\ m^2$, $P = 0.958\ m$, $n = 0.013$

$R = 0.0763$ $(R^{2/3} = 0.180)$

$$V = \frac{1}{0.013} \times 0.180 \times 0.284 = 3.93\ m/sec$$

$$Q = 0.0731 \times 3.93 = 0.287\ m^3/sec = 24,797\ m^3/day$$

(XII) AZIMPUR L.S. 吐出側幹線能力

口径＝12″＝0.305 m

勾配は測量の結果により，

$I = 0.0042$ $(I^{1/2} = 0.0648)$

$A = 0.0731\ m^2$, $P = 0.958\ m$, $n = 0.013$

$R = 0.0763\ m$ $(R^{2/3} = 0.180)$

$$V = \frac{1}{0.013} \times 0.180 \times 0.0648 = 0.897\ m/sec$$

$$Q = 0.0731 \times 0.897 = 0.0656\ m^3/sec = 5,668\ m^3/day$$

(XIII) NAWABGANJ L.S. 吐出側幹線能力

口径＝12″＝0.305 m

勾配は測量結果による。

$I = 0.0127$ $(I^{1/2} = 0.113)$

$A = 0.0731\ m^2$, $P = 0.958\ m$, $n = 0.013$

$R = 0.0763$ $(R^{2/3} = 0.180)$

$$V = \frac{1}{0.013} \times 0.180 \times 0.113 = 1.56\ m/sec$$

$$Q = 0.0731 \times 1.56 = 0.0991\ m^3/sec = 8,562\ m^3/day$$

(XIV) FARIDABAD L.S.

口径は収集した資料によって異なるが，12″＝0.305 m とする。

勾配は測量結果による。

$I = 0.0101$ $(I^{1/2} = 0.100)$

$A = 0.0731\ m^2$, $P = 0.958\ m$, $n = 0.013$

$R = 0.0763\ m$ $(R^{2/3} = 0.180)$

$$V = \frac{1}{0.013} \times 0.180 \times 0.100 = 1.38\ m/sec$$

$$Q = 0.0731 \times 1.38 = 0.1011\ m^3/sec = 8,726\ m^3/day$$

上記の計算は主に満管流量（動水勾配線と管頂勾配線がほぼ一致する場合）という条件の計算値であり，もし下流側中継ポンプ場が長時間停止していたり，下流側中継ポンプ場のポンプ井の運転水位が高いレベルで運転する場合には，幹線の流下能力を発揮できないので，この場合には管渠能力は上記計算を下まわる。

添付資料－5

中継ポンプ場ポンプ吐出量測定結果

ポンプ吐出量実測結果

これは，既設ポンプ配管に超音波センサーを取り付け計測したものであるが，今回調査期間PAGLA S.T.P. までの幹線が破壊されていたこと，洪水のためPAGLA S.T.PのL.S.のポンプを起動できなかったこと，センサーを取付ける配管スペースの無かったポンプ場が多かったこと等，計測可能なポンプが限ぎられた。また次表で設計揚水量よりも実測値が大きいところは長期間ポンプが停止中であったため，ポンプ井水位が高く設計よりも低揚程であったためである。

ポンプ吐出量実測結果

施設名	設計ポンプ能力 GPM / (m³/m)	測定結果 m³/m	備考
Narinda P.S.	#5 2,500 / (11.37)	18.355	#5 only－running '87. 9. 13
	#5 2,500 / (11.37)	18.165	#5, #6－both running '87. 9. 13
	#6 1,000 / (4.55)	9.320	#6 only－running '87. 9. 13
Swaminbag L.S.	#2 1,500 / (6.82)	8.509	#2 only－running '87. 9. 19
Medical Colledge L.S.	#1 500 / (2.27)	3.096	Dia of derivery pipe—6″ '87. 9. 19
	#2 500 / (2.27)	2.042	Dia of derivery pipe—4″ '87. 9. 19
P&T L.S.	#1 1,500 / (6.82)	7.012	#1 only－running '87. 9. 12

添付資料－6

水　質　調　査　結　果

表－1　BOD_5 at 20℃ for Pagla Sewerage Treatment Plant and Buriganga River.

Period	Influent	Effluent	Upstream of discharge point at Buriganga river.	Downstream (直下流)
In last Wet season (1986. 10. 7)	250	86	2.8	19.0
In last dry season (1986. 12. 2)	210	76	2.2	17.0

('87年6月9日収受)

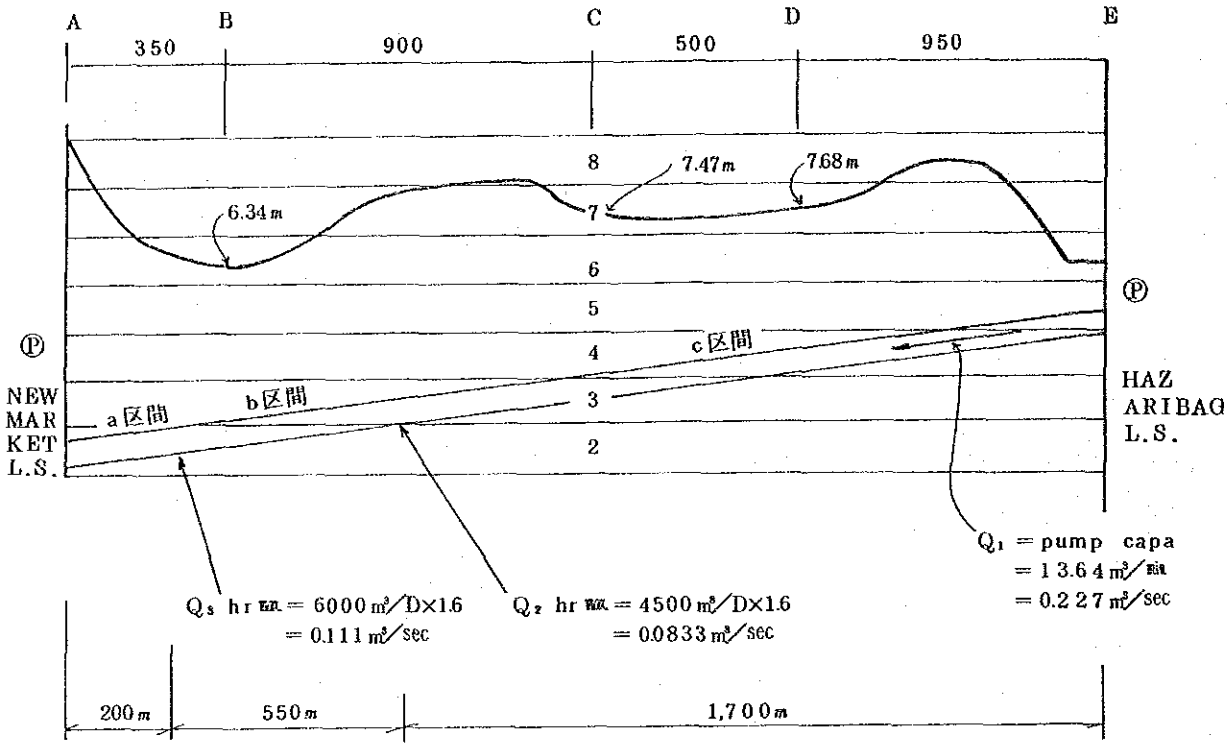
表－2　Anaerobic Ponda Eiiluent Qualitiea

Locatfon	pH	Temperature (℃)	Transparency (cm)	BOD5 (mg/ℓ)	Colour	SS (mg/ℓ)	Date
№1 Lagoon	7.2		2 — 3	104	Slightly darkgrey	328	Feb. 27/1985
№3 Lagoon	7.2		5 — 6	118	〃	31	〃
№2 〃	7.2	27.5	2.0	56	Light pink	111	Mar. 3/1985
№3 〃	7.2	27.5	5.0	76.5	Light green	39	〃

添 付 資 料 － 7

Hazaribag L.S. ～ Newmarket L.S. 間の管渠の損失水頭

バザリーバーグ L.S.～ニューマーケット L.S. 間の損失計算



a 区間　摩擦損失

$L = 200\ m$，　24″ DIA $= 610\ mm$，　$Q = Q_1 + Q_2 + Q_3 = 0.421\ m^3/sec$

$A = 0.292\ m^2$，　$P = 1.92\ m$，　$R = 0.152\ m$，　$n = 0.013$

$$V = \frac{0.421}{0.292} = 1.44\ m/sec$$

マニングの式

$$h_f = \frac{U^2 \cdot n^2}{R^{4/3}} \cdot \ell = \frac{1.44^2 \times 0.013^2}{0.152^{4/3}} \times 200 = \frac{2.07 \times 0.000169}{0.0811} \times 200 = 0.862\ m$$

b 区間　摩擦損失

$L = 550\ m$，　24″ DIA $= 610\ mm$，　$Q = Q_1 + Q_2 = 0.310\ m^3/sec$

$A = 0.292\ m^2$，　$P = 1.92\ m$，　$R = 0.152\ m$，　$n = 0.013$

$$V = \frac{0.310}{0.292} = 1.06\ m/sec$$

マニングの式

$$h_f = \frac{1.06^2 \times 0.000169}{0.0811} \times 550 = 1,288\ m$$

C区間　摩擦損失

$L = 1{,}700\ m$，　24″ DIA $= 610\ mm$，　$Q = Q_1 = 0.227\ m^3/sec$

$A = 0.292\ m^2$，　$P = 1.92\ m$，　$R = 0.152\ m$，　$n = 0.013$

$$V = \frac{0.227}{0.292} = 0.777\ m/sec$$

マニングの式

$$h_f = \frac{0.777^2 \times 0.000169}{0.0811} \times 1{,}700 = 2.139\ m$$

ニュー・マーケットL.S.の運転水位をポンプ機械室フロア（＋5,540）の1 m下がりとすると，

運転水位（A点）$= +5.540 - 1.000 = +4.540\ m$

B　点　$= +4.540 + 0.862 + 1.288 \times \frac{350-200}{550} = +5.75\ m$

C　点　$= +4.540 + 0.862 + 1.288 + 2.139 \times \frac{900+350-550-200}{1700} = +7.32\ m$

D　点　$= +4.540 + 0.862 + 1.288 + 2.139 \times \frac{500+900+350-550-200}{1700} = +7.95\ m$

この水位を図と対比するとわかるように，C点の水位はGLよりわずかに低く，D点で完全にGLより吹き出している。

この事より，DHAKA・WASA　の要望している様に，緊急対策としてハザリーバーグL.S.より1,500 m の区間の送水管を圧送管に切り替えるとともに，この区管の既設管をハザリーバーグL.S.の流入管に接続し，途中区間の管の破損の可能性についても対処しえるものとする。

なお，この改造の完了後も，他のL.S.と同様であるが，下流側L.S.（この場合，ニュー・マーケットL.S.）の断続運転による揚水方法を改め，ポンプ井の水位を下げた連続運転を行なわなければ，マンホールからの吹出しや管渠能力の効率的利用は望めないことを管理者は認識すべきである。