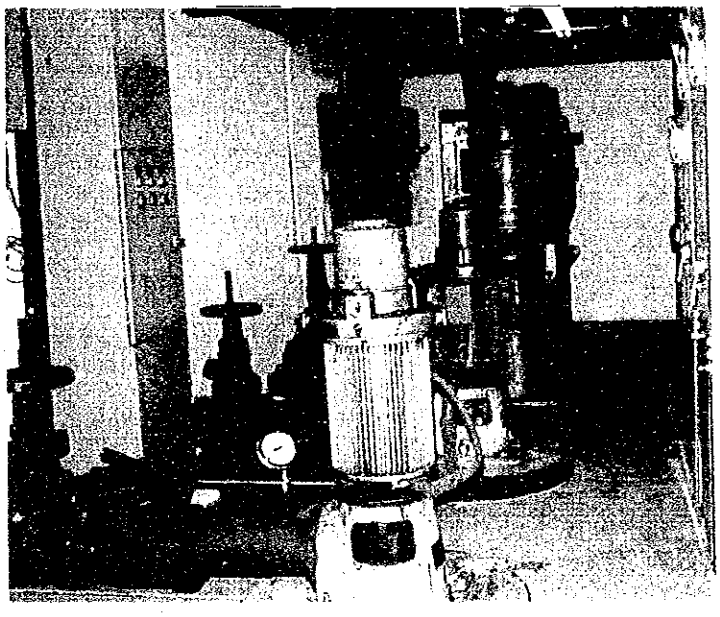
APPENDIX V

CONSTRUCTION SITE PICTURE

PAVED ROAD

UNPAVED ROAD (LATERITE)

CAUSEWAY (AT LOW TIDE)



EXISTING WATER TRANSFER PUMPS

APPENDIX VI

COUNTRY DATA

COUNTRY DATA

1. Basic Indices

(1) The Republic of Palau

Capital	: Koror

(2) Land area and population

Land area	: 492 km2
Population	: 13,772 (as of 1986)
Population density	: 28 persons / km2
Overall average populaton growth rate	: 0.7 % / year (average)

(3) Political system

President : Ngiratkel Etpison

Parliamentary democracy by separation of three powers of administration, legislation and judicature.

The bicameral system (Senators : 14, Delegates : 16)

(4) Religion : Christianity (Catholic)

(5) Languages: Palau's language, English

(6) Ethnic Composition : Micronesian

(7) Education: Illiterates are 30 to 35 % of all Palau's people.
Primary and high school are compulsory.

(8) Currency : U.S. Dollers

(9) Climate

Anual average rainfall	: 3,800 mm
Dry season	: February to April, October to December
Rain season	: May to September

(10) Geography: Palau Islands are composed with more than 200 islands, and much more rolling hills and few flat areas. Soil is mainly formed with laterite which is weathered basalt.

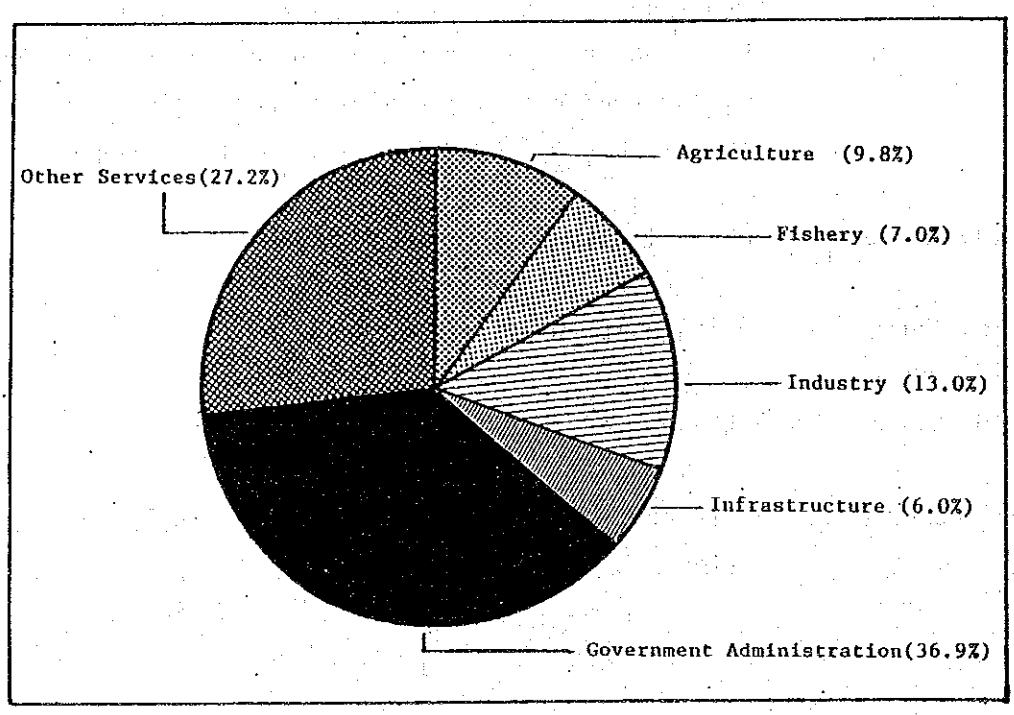
(11) Longitude and Latitude

Longitude	: 130° 30'
Latitude	: 7° 30'

2. Socio-Economic Indices

(1) Gross Domestic Product (1983) : $ 31.46 million

(2) Sectoral Shares Gross Domestic Product (1983)



(3) Gross Domestic Product per capita : $ 2,345

(4) Inflation rate

Consumers' price rate

Year	1979	1980	1981	1982	1983
1978=100	107.90	114.05	-	-	136.86

(5) Treasury balance of the Government of Palau (1985)

Revenue : $ 5,591 thousand

Expenditure :$ 24,254 thousand

U.S. Financial assistance have been applied for excess of expenditure.

(6) Balance of international trade (1984)

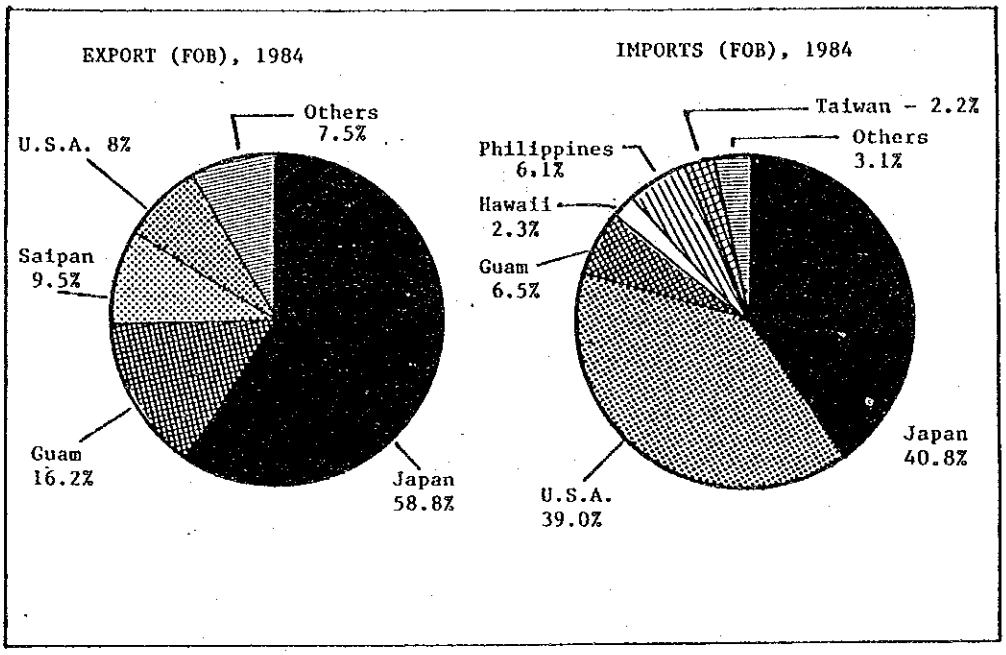
Exports : $ 464 thousand

Imports :$ 26,019 thousand

(7) Sector of exports and imports (1984)

Exports (%)		Imports (%)	
Fish	(31.6)	Food	(18.6)
Trochus shell	(37.3)	Beverage and Tabacco	(9.2)
Scrap Metal	(1.3)	Crude Material	(2.5)
Wooden Handicraft	(29.8)	Mineral Fuel, Lubricant	(9.3)
		Animal & Vegetable Oils	(0.4)
		Chemicals & Related Goods	(3.3)
		Manufactured Goods	(26.4)
		Machinary & Transport Epuipments	(22.8)
		Others	(7.5)

(8) Directions of overseas trade (1984)



3. Others

(1) National holidays

New Year Day	January, 1
Youth Day	March, 15
Senior Citizens Day	May, 5
Constitutional Day	July, 9
Labor Day	September, 4
United Nations Day	October, 24
Thanksgiving Day	November, 23
Christmas Day	December, 25

(2) Working hours : From 8:00 a.m. to 4:30 p.m.

APPENDIX VII

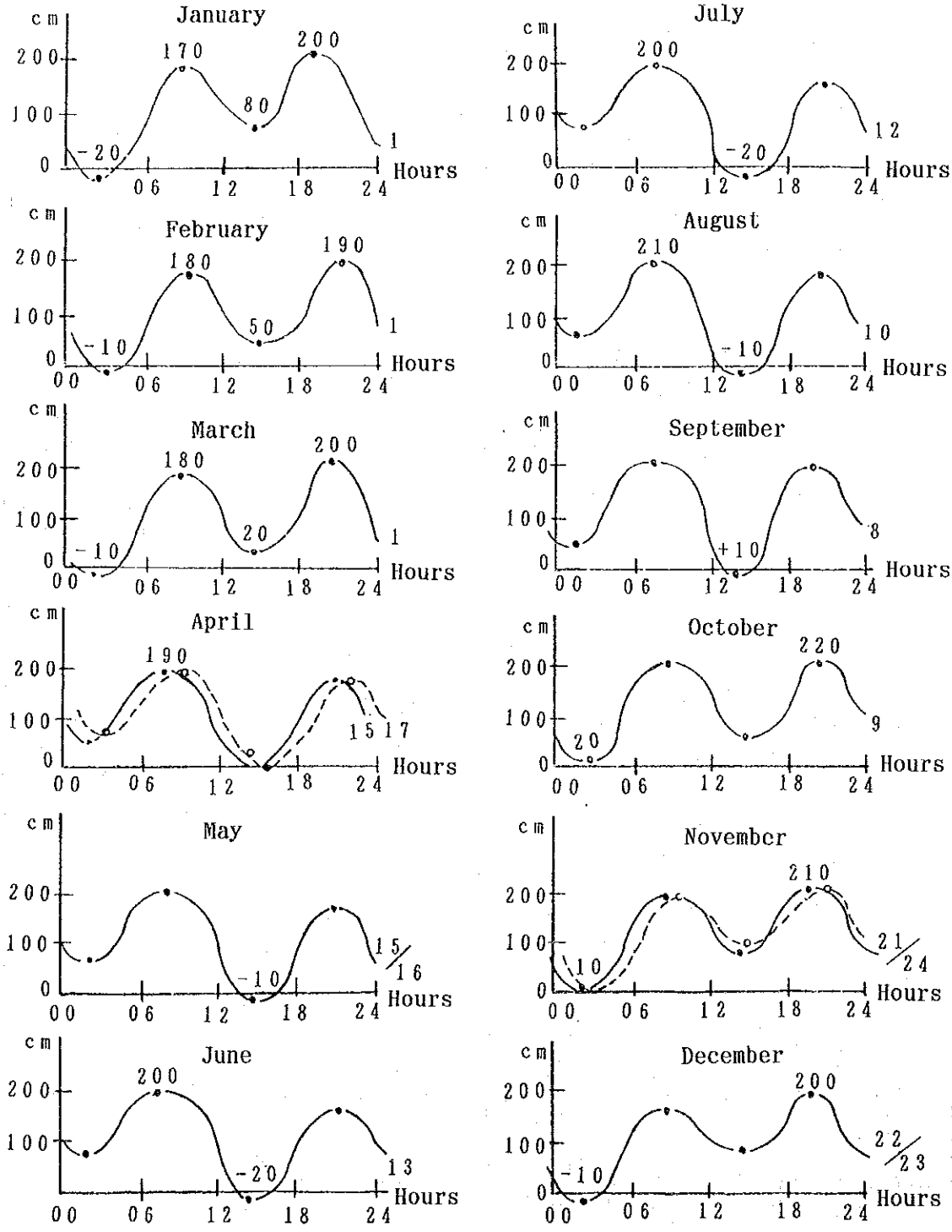
METEOROLOGICAL, MARINE AND METEOROLOGICAL DATA

Climatic Condition (Koror):1984

Month	Temparature (° F)					Rainfall		Mean Relative Humidity	
	Average		Extreme		Monthly	Total			
	max.	min.	max.	min.	average	(inch)	Days	9:00 am	15:00pm
January	87.5	74.6	90	73	81.1	18.57	28	81	78
February	87.1	74.7	89	73	80.9	10.81	25	82	77
March	88.1	75.3	90	72	81.7	13.58	25	79	76
April	88.3	76.3	90	73	82.3	7.23	24	78	73
May	89.2	76.1	91	73	82.7	10.85	27	78	75
June	87.6	74.8	89	73	81.2	16.49	25	89	79
July	88.5	74.5	91	72	81.5	12.82	22	78	75
August	86.9	75.1	90	70	81.0	17.47	22	78	77
September	88.0	75.4	91	72	81.7	10.39	21	76	75
October	86.2	75.6	90	73	80.9	15.94	26	82	78
November	89.3	76.1	91	73	82.7	9.19	16	78	78
December	89.1	75.7	91	71	82.4	9.42	25	78	74
Total						152.76	286		
Average	88.0	75.4	90	72	81.7	12.73	24	79	76

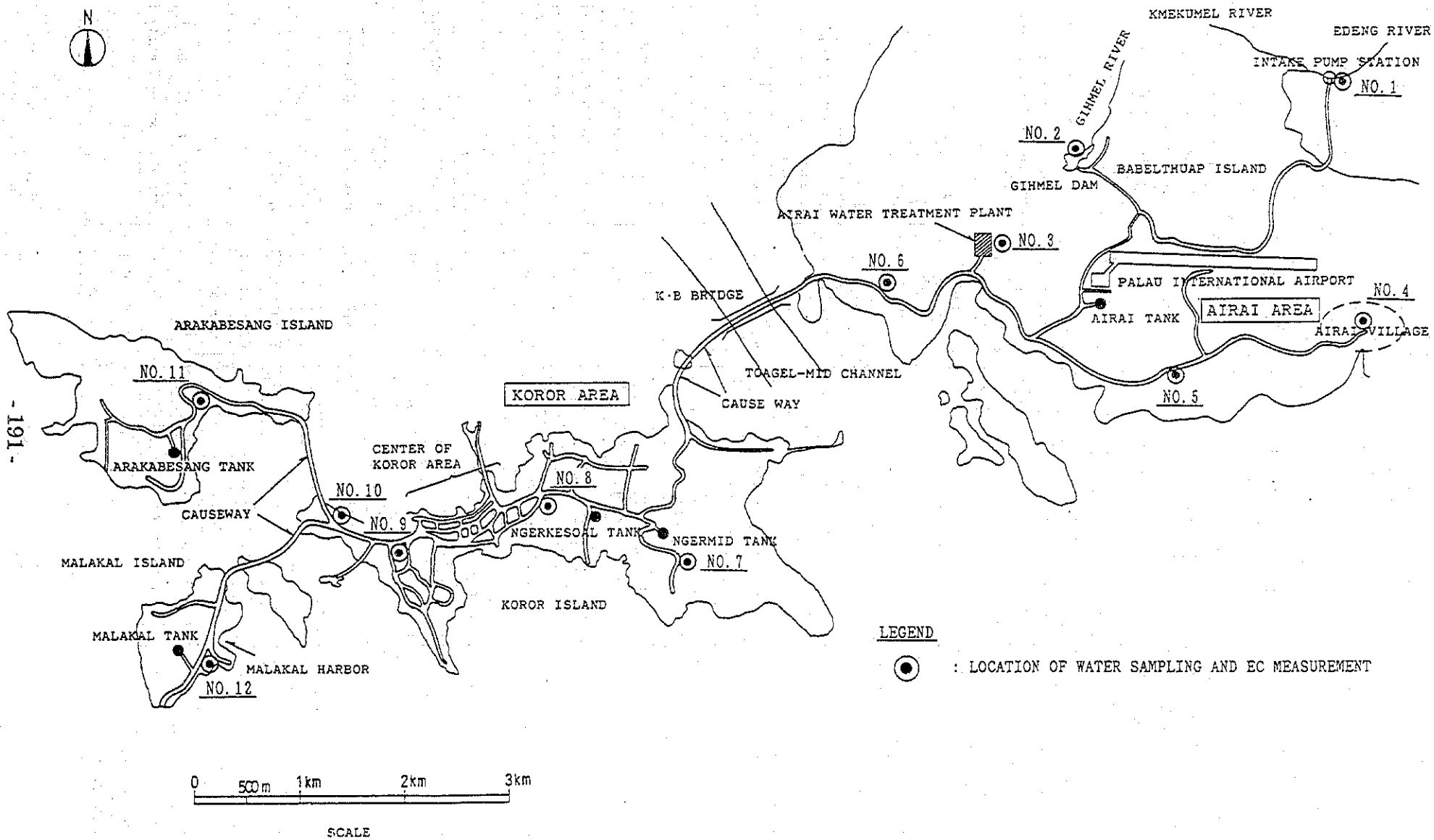
Souce : National Weather Service Office, Palau.

TIDE LEVEL AT MALAKAL HARBOR (1987)



APPENDIX VIII

RESULT OF QUALITY EXAMINATION OF WATER COLLECTED AT FIELD SURVEY



Location of samples collected for water quality test

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO.1

Sampling place ;INTAKE FACILITY
Sampling date ;22 DEC. 1990 14:30
Test date ;from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	4 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	3.7 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	270 pcs/ml	Agar bacto
Coliform group	Not detected	detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.28 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.038mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	0.02 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC・Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	28 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	138 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	10 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		26.0 ℃	
Electric Conductivity		84 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO. 2

Sampling place :GIHMEL DAM
Sampling date :22 DEC. 1990 15:00
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	5 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	7.9 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	120000 pcs/ml	Agar bacto
Coliform group	Not detected	detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.47 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	0.02 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.11 mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	< 0.01 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC・Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	28 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	126 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	30 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	10 degree	Transmittance-sedimentation
Water Temperature		31.0 ℃	
Electric Conductivity		96 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO. 3

Sampling place :TREATMENT PLANT
Sampling date :22 DEC. 1990 17:04
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	4 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	2.9 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	280 pcs/ml	Agar bacto
Coliform group	Not detected	detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.40 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.009mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	0.02 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC • Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	26 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	122 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	10 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		27.8 ℃	
Electric Conductivity		85 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO. 4

Sampling place :END OF AIRAI AREA
Sampling date :22 DEC. 1990 14:06
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	7 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	3.3 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	60 pcs/ml	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	0.06 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.34 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.022mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	< 0.01 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC・Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	27 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	124 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	6.9(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	10 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		28.8 ℃	
Electric Conductivity		92 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO.5

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Sampling place :NEAR AIRAI ELEMENTARY SCHOOL
Sampling date :22 DEC. 1990 16:50
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	6 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	2.8 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	Not detected	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid.base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.38 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.089mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	< 0.01 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC・Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	27 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	110 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	6.9(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	10 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		28.5 ℃	
Electric Conductivity		90 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO. 6

Sampling place :OSEL RESTAURANT
Sampling date :22 DEC. 1990 17:15
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	6 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	3.1 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	Not detected	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.45 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.006mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	< 0.01 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC • Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	26 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	114 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	20 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		28.0 ℃	
Electric Conductivity		87 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

Sampling place :NEAR NEGERMID TANK NO. 7
Sampling date :22 DEC. 1990 13:40
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	6 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	3.3 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	Not detected	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	0.03 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.33 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.034mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	0.02 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC • Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	27 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	112 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	20 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		29.3 ℃	
Electric Conductivity		94 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

Sampling place :NEAR MINAMI STORE NO. 8
Sampling date :22 DEC. 1990 13:55
Test date ;from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE;03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	6 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	2.5 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	Not detected	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	0.02 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.35 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	< 0.005mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	< 0.01 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC • Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	27 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	114 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	10 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		28.3 ℃	
Electric Conductivity		93 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO. 9

Sampling place :MIDTOWN GAS STATION
Sampling date :22 DEC. 1990 14:08
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	6 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	2.9 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	Not detected	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.40 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.043mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	< 0.01 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC・Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	26 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	110 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(18.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	10 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		28.1 ℃	
Electric Conductivity		93 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO. 10

Sampling place :AKIO'S GAS STATION
Sampling date :22 DEC. 1990 14:18
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	6 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	2.3 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	Not detected	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.37 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.04 mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	0.02 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC • Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	26 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	110 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	10 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		28.7 ℃	
Electric Conductivity		94 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

NO. 11

Sampling place :ARAKABESAN AREA
Sampling date :22 DEC. 1990 14:32
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE:03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	6 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	2.8 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	Not detected	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.51 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.022mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	0.02 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC・Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	26 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	110 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.3(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	20 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	10 degree	Transmittance-sedimentation
Water Temperature		31.8 ℃	
Electric Conductivity		100 μs/cm	

INSPECTION REPORT

YACHIYO Engineering Co.,Ltd.

Sampling place :NEAR MALAKAL HARBOR NO.12
Sampling date :22 DEC. 1990 14:50
Test date :from 9 JAN. 1990 to 26 DEC. 1989

Kankyo Engineering Co., Ltd.
6-20-11 SHINBASHI-MINATO-KU
TOKYO,JAPAN
PHONE;03(436)2535

Items	Limitation	Tested value	Test method
Nitrate Nitrogen & Nitrite Nitrogen	Less than or egual to 10 mg/l	< 0.1 mg/l	Cadmium.copper column reduction (Absorptiometric analysis)
Chloride ion	Less than or egual to 200 mg/l	7 mg/l	$K_2Cr_2O_4$ titration
$KMnO_4$ consumed	Less than or egual to 10 mg/l	2.2 mg/l	COD ($KMnO_4$)
Total Colonies (Bacteria)	Less than or egual to 100 pcs/ml	Not detected	Agar bacto
Coliform group	Not detected	Not detected	MPN
Cyanide ion	Not detected	Not detected	Acid base distillation decomposition pyridine -pyrazolone
Mercury	Not detected	Not detected	Atomic absorption analysis
Organophosphate	Not detected	Not detected	Gas chromatography (Absorptiometric analysis)
Copper	Less than or egual to 1.0 mg/l	< 0.01 mg/l	Atomic absorption analysis
Iron	Less than or egual to 0.3 mg/l	0.38 mg/l	Atomic absorption analysis
Manganese	Less than or egual to 0.3 mg/l	< 0.01 mg/l	Atomic absorption analysis
Zinc	Less than or egual to 1.0 mg/l	0.171mg/l	Atomic absorption analysis
Lead	Less than or egual to 0.1 mg/l	0.02 mg/l	Atomic absorption analysis
Chromium	Less than or egual to 0.05mg/l	< 0.02 mg/l	Diphenyl carbazide
Cadmium	Less than or egual to 0.01mg/l	< 0.005mg/l	Atomic absorption analysis
Arsenic	Less than or egual to 0.05mg/l	< 0.005mg/l	DDTC • Ag
Fluoride	Less than or egual to 0.8 mg/l	< 0.15 mg/l	Absorptiometric analysis
Hardness	Less than or egual to 300 mg/l	26 mg/l	EDTA
Total residue	Less than or egual to 500 mg/l	108 mg/l	Dry weight
Phenols	Less than or egual to 0.005 mg/l	< 0.005mg/l	Distillation-amine-antipyrin
Surface-active anionic	Less than or egual to 0.5 mg/l	< 0.2 mg/l	Methylene-blue
PH value	5.8 ~ 8.6	7.0(19.0 ℃)	Glass electrode
Odor	Not Abnormal	odor of Iron	
Taste	Not Abnormal	taste of Iron	
Color	Less than or egual to 5 degree	10 degree	Absorptiometric anaiysis
Turbidity	Less than or egual to 2 degree	5 degree	Transmittance-sedimentation
Water Temperature		29.0 ℃	
Electric Conductivity		94 μs/cm	

APPENDIX IX

STUDY OF WATER FACILITY IMPROVEMENT PLAN SUBMITTED DURING FIELD SURVEY

THE BASIC DESIGN STUDY
ON
THE PROJECT FOR
IMPROVEMENT OF WATER SUPPLY
IN
THE REPUBLIC OF PALAU

FIELD REPORT

DECEMBER, 1989

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

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Data of flow meter and water pressure measurement
Annex-6 Positions of previous leakage and repairing works on main pipelines.
Annex-7 Positions of PVC installation regarding water supply and distribution pipelines by US'S project.
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Annex-10 Data and informations regarding contents of US'S project in Airai and Koror area.

1. Summary of Scope for Basic Design Study

Scope of the basic design study on the project for improvement of water supply system in Airai and Koror area is summerized as follows;

(1) To perform the basic design for

a) One emergency diesel generator set(Approx. 300KVA) and one fuel oil steel tank in the intake pump station.

b) The raw water transmission line (Approx. 300 mm dia.) from the existing intake pump station to the existing Gihmel dam, the proposed route of the line is as shown on the attached Fig. 1 and Fig. 1-1.

c) The clean water transmission main line (Approx. 400mm dia.) from the existing Airai water treatment plant(WTP) to the existing Ngermid and Ngerkesoal steel tanks. The proposed route of the line is shown on the attached Fig. 1 and Fig. 2.

d) The clean water transmission main lines(Approx. 300mm dia. and 250 mm dia.) for Koror city water system. The proposed routes are shown on the attached Fig. 1 and Fig. 2.

e) The clean water transmission main line (Approx 200 mm dia.) for Airai city water system. The proposed route of the line is shown on the attached Fig. 1 and Fig. 2.

(2) To study the possibility of procurement and installation of

a) The rubber dam (Hight : 60 cm, Length : Approx. 15.2 m) to be restored on spillway of the existing Gihmel dam.

b) One set of automatic valveless gravity filter (Approx. 700 GPM) to be installed at WTP.

c) Two sets of multistage turbine pump (1050 GPM) for water transmission to replace the two existing small pumps at WTP.

(3) To study the possibility of supply of ;

a) One sand blast or high pressure water blaster machine to be used for cleaning of the existing steel tanks.

b) One 4-wheel drive vehicle (pick up) equipped with mobile communication equipment to be used for patrol of the water supply facilities.

c) One flat-bed truck equipped with a hydraulic lifting device (1ton) to be used for maintenance of the water supply system.

2. Items to be confirmed by the Government of the Republic of Palau

We would like to confirm the following basic conditions for the estimation of construction cost and construction period and the recommendation of this Grant Aid Project to JICA and the Japanese authorities concerned and so forth.

(1) Provision of the following temporary area for a construction liason office, warehouse, stockyard, etc. in Airai, Koror and Malakal area during the construction period.

In Airai area ; Approx. 5,000 m2 (Near air terminal)
In Koror area ; Approx. 6,000 m2 (Former Socio construction camp.)
In Malakal area; Approx. 6,000 m2 (Supply area and old power plant yard)

(2) Provision of the dumping yard for the disposal of surplus soil encountered in construction works.
The dumping yard shall be M-dock dumping yard.

(3) In case that the Japanese Government will supply the machines and equipment (Including sand blast or high pressure water blaster machine, 4-wheel drive vehicle and flat-bed truck, etc.), the Government of Republic of Palau shall secure the proper maintenance and effective use of the machines and eqiupment.

(4) In order to keep the construction schedule which is very tight, the Government of Republic of Palau shall permit of working for about 15 hours/day except Sunday and National holiday, if necessary.

(5) Utilization of land both five (5) feet width outside of pavement of existing roads for installation of public infrastructures.

(6) Provision of electric cabling with electric poles between nearest electric transmission line and each tank to be equipped with control valves, measurement equipment and auxiliary equipment which are necessary for level control of water tanks (5 tanks).

(7) Carrying out a leak detection and repair the existing leakage in the pipelines.

(8) To assist the Contractor in expediting the granting and issuance of visas of the Contractor's personnel including a third national.

(9) To facilitate the issuance of work permits and other permits for the Contractor and his personnel including a third national.

(10) In case that the Government of Japan will provide one unit of sand blast or high pressure water blaster machine to be used for cleaning off old paint and rust from existing steel water tanks, the Government of the Republic of Palau shall paint the tanks

(five (5) tanks) by using the machine in accordance with the construction schedule.

3. Reports submitted to the authorities concerned

3.1 Basic design conditions

3.1.1 General

(1) The target year of the project shall be 2000 year

(2) The total population of the project (including foreign residents such as Philippine)

- At present (1990) : 16,350
- At the target year (2000) : 20,600

(3) Designed water consumption

- At present : Approx. 8,300 m3/day (2.2 M gallon/day)
- At the target year(2000) : Approx. 13,300 m3/day (3.5 M gallon/day)

3.1.2 Policies for basic design

The policies for basic design on JICA proposed water supply system shall be as follows.

- To integrate with existing water supply system and US'S improvement scheme, and JICA proposed improvement project.
- To separate clean water transmission pipelines and distribution pipelines.
- To distribute water uniformly in all supply area.

- To utilize existing pipelines for distribution pipelines.
- To utilize existing steel tanks for clean water reservoirs and distribution system.
- To utilize maximum use of public lands and to minimize use of private lands.
- To utilize existing water supply pipeline (DCI) along K.B bridge for temporary water supply transmission mainline and make provision for future connection.
- To prevent rainwater from flowing into the excavated trenches during construction period.
- To minimize interruption and disturbance against traffic vehicles and pedestrians.
- To minimize construction cost.
- To minimize construction period.
- To utilize local materials, equipment, technicians and labours
- To minimize maintenance and operation cost after completion of the project.
- To apply Japanese standards, regulations and codes for design, manufacturing, installation and construction of JICA proposed water suply system except connections between existing pipelines and facilities, and JICA proposed water supply system

3.1.3 Main pipeline

(1) Routes of JICA proposed raw water transmission pipeline and clean water transmission pipeline are as shown on the attached Fig. 1 and Fig. 1-1.

(2) Connection points of JICA proposed pipelines and existing pipelines are as shown on the attached Fig. 1 and Fig. 2.

(3) Pipe diameter will be finalized in accordance with the hydraulic analysis based on the water volume of consumption at target year (2000), pipe routes, pipe elevation and existing water tank elevation, etc.

(4) Pipe material will be ductile cast iron which is made in Japan.

(5) T-shape joints (push-on type) will be used for straight pipes. Mechanical joints will be used for all fittings, valves and gates.

(6) Standard earth covering thickness of buried pipes shall be 0.7 m in the inclined area, and 0.9 m in the flat area to keep the thickness necessary for the installation of air relief valves and stop valves, etc.

(7) Ancillary equipment such as air relief valves will be provided in principle in the following rules.

a) Valves

Sluice valves shall be provided on all pipe size of JICA proposed pipelines.

b) Blow-off valves

Blow-off valves shall be provided at the selected low points such as a hollow place.

c) Air relief valves

Air relief valves shall be provided at the selected high points of JICA proposed pipeline. In case of pipe diameter 400 mm, double opening air relief valves shall be used.

3.1.4 Emergency diesel generator

Concepual plans are shown on Fig. 3 (1/2), (2/2).

(1) Number of the generator shall be one (1) set.

(2) Type of generator shall be indoor type.

(3) Capacity of generator shall be approx. 300 KVA.

(4) Voltage of electricity shall be 200 v.

(5) Cycle of electricity shall be 60 Hz.

(6) Fuel of generator shall be diesel oil.

(7) Material of fuel oil tank shall be steel.

(8) Capacity of fuel oil tank shall be approx. 3.0 m3 (approx. 800 gallons) for two (2) days continuous running.

3.1.5 Sand filter

Location of sand filter is shown on Fig. 4.

(1) Number of the sand filter shall be one(1) set.

(2) Type of filter shall be automatic valveless gravity filter.

(3) Capacity of filter shall be approx. 700 gallon per minute (GPM).

3.1.6 Water transfer pump

(1) Number of the pumps shall be two (2) sets.

(2) Type of pump shall be multistage turbine pump.

(3) Capacity of pump shall be 1050 GPM.

(4) Total head of pump shall be approx. 286 feet.

(5) Motor shall be 100 HP, 3 phase, 60 Hz.

3.2 Conceptual plan for water pipe line laying

Fig. 5. Location of section

Fig. 6. Detail of water pipe bridge near Intake

Fig. 7. Detail of water pipe line beside existing culvert at Airai

Fig. 8. Plan for water pipe line near WTP

Fig. 9. Detail of water pipe line on existing R.C. drainage pipe

Fig. 10. Water pipe line along causeway to Arakabesan Island

Fig. 11. Water pipe line along causeway to Arakabesan Island (Alternative)

Fig. 12. Water pipe line along Malakal bridge

Fig. 13. Water pipe line beside existing culvert at Malakal

Fig. 14. Typical valve cover & box

Fig. 15. Typical air valve box & blow-off

Fig. 16. Typical section of pipe crossing

Fig. 17. Valve house for steel water tanks

Fig. 18. Typical cross section of pipe in causeway

Fig. 19. Typical cross section of pipe under road

Fig. 20. Typical section of main pipe

4. Annex (Related data)

Annex-1 Data of soil investigation

We surveied the soil investigations of 21 holes along JICA proposed raw water transmission pipeline and clean water transmission pipeline on 14th, Dec. 1989 under the cooperation of GRP. The investigated soil conditions are as shown on the attached Fig. AN-1 (1/3)--(3/3).

Annex-2 Data of geographical survey in the Toagel-mid channel

We executed the geographical survey at the Toagel-mid channel on 15th, Dec. 1989 under the cooperation of GRP. The measured geographical survey is as shown on the attached Fig. AN-2 (1/3)--(3/3). The maximum depth of the toagel-mid channel is about 34 m from sea level.

Annex-3 Data of water supply pressure in Airai and Koror area

We measured the water supply pressures along the existing water supply pipeline in Airai and koror area from 4:00 PM to 8:00 PM on 15th, Dec. 1989 under the cooperation of GRP. The water pressures varies at each measuring point from 0.0 kg/cm2 (0.0 PSI) to 7.0 kg/cm2 (100 PSI). The measured water pressures are as shown on the attached Table AN-1 and Fig AN-3 (1/2), (2/2).

Annex 4 Data of tidal current velocity in the Toagel-mid channel

We surveied the velocity of tidal current in the toagel-mid channel 4 times (9:15 AM, 10:15 AM, 11:15 AM and 12:15 PM) on 15th, Dec. 1989 under the cooperation of GRP. The measured tidal current velocity are as shown on the attached Fig. AN-4. The fastest velocity measured is about 0.5 m/sec.

Annex 5 Positions of flow meters and water pressure meters

The positions of meters are as shown on the attached Fig. AN-5. Data of above meters are as shown on the attached Table AN-2.

Annex 6 Positions of previous leakage and repairing works on main pipelines

Positions of previous leakage and repairing work on main pipelines are as shown on the attached Fig. AN-6. The positions of leakage have been repaired in a few days by BPW.

Annex 7 Positions of PVC installation regarding water supply and distribution pipelines by US'S project

Positions of PVC pipes to be installed by US'S project are as shown on the attached Fig. AN-7. The existing AC pipes are never replaced by PVC pipes.

Annex 8 Data regarding number of service connections, water meters and damaged water meters

Data regarding number of service connections, water meters, damaged water meters and so on are as shown on the attached Table AN-3 and Table AN-4.

Annex 9 Data regarding back-wash water volume of sand filters

Data regarding back-wash water volume of sand filters at WTP are as shown on the attached Table AN-5.

Annex 10 Data and informations regarding contents of US'S project in Airai and Koror area

Data and informations regarding contents of US'S projects in Airai and Koror area are shown on the attached Table AN-6. However the further development projects of Airai-Koror water supply system by US AID are not planned.

Koichi L. Wong
Nationnal Planner
Republic of Palau

Masatoshi Seno
Chief of Consulting Team for
Basic Design Study, JICA

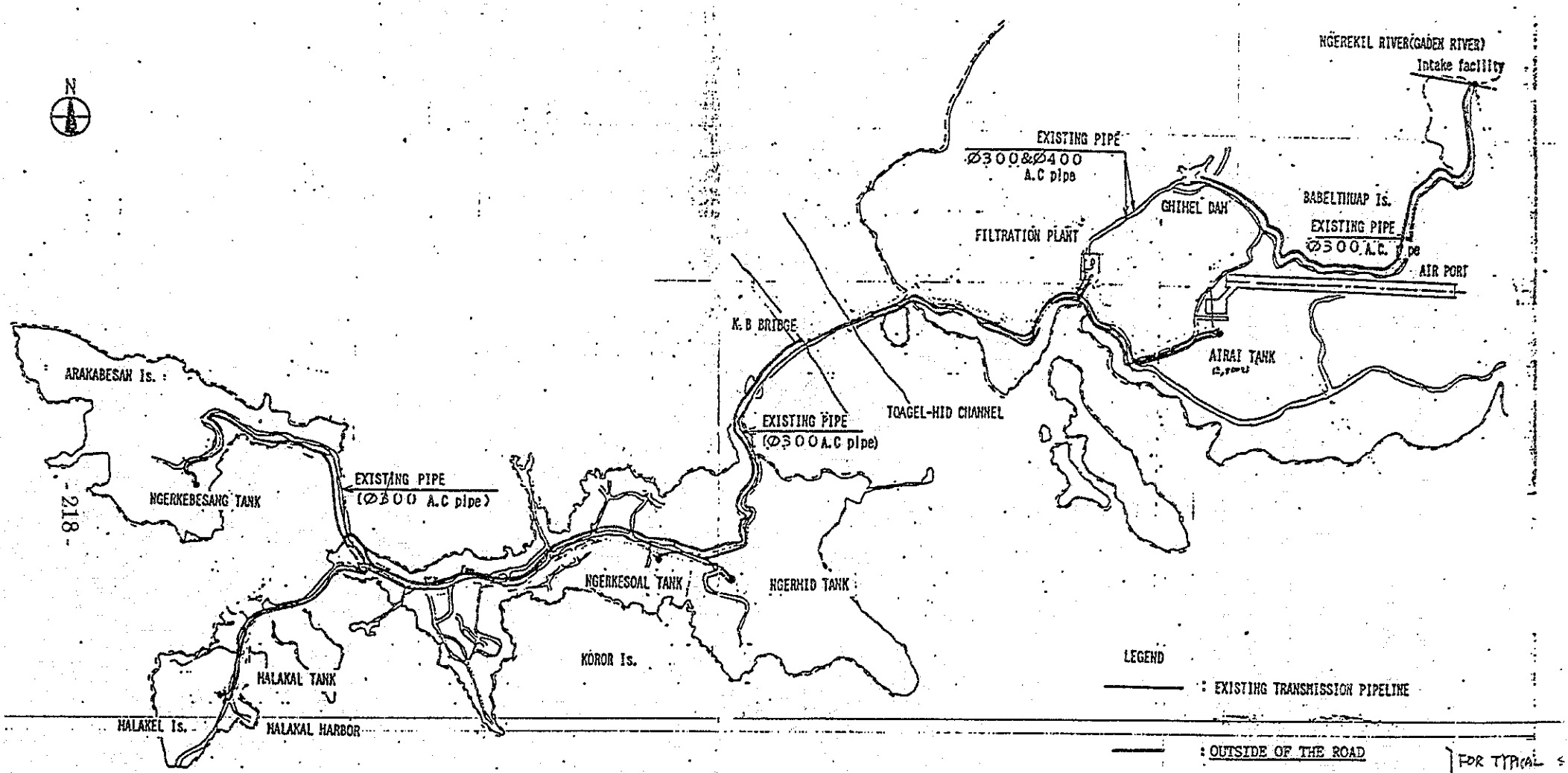


Fig. 1 CONCEPTUAL PLAN OF WATER SUPPLY ROUTE

CONCEPTUAL PLAN OF RAW WATER SUPPLY SYSTEM

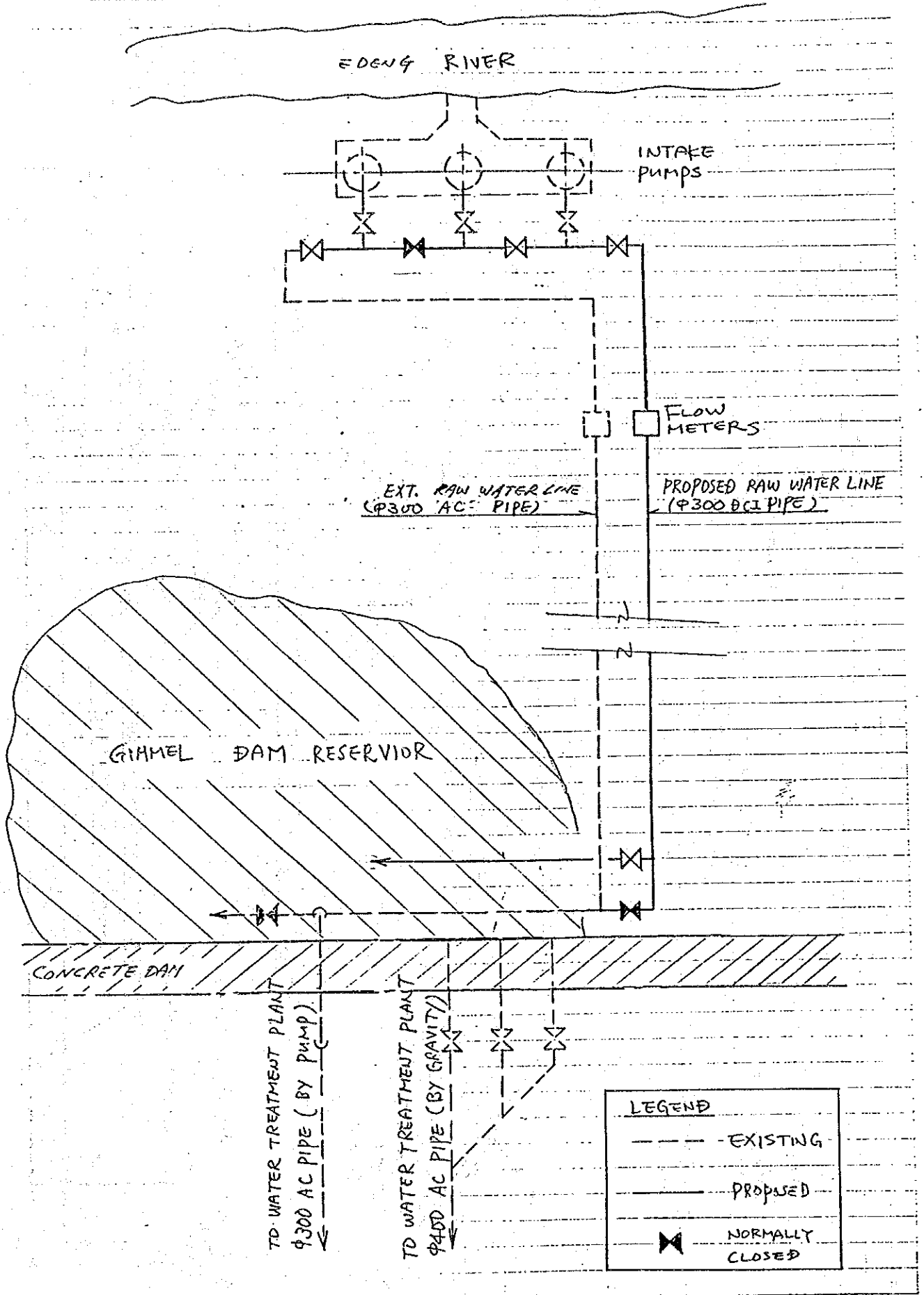


Fig. 1-1 CONCEPTUAL PLAN OF RAW WATER SUPPLY SYSTEM

M.N KLW

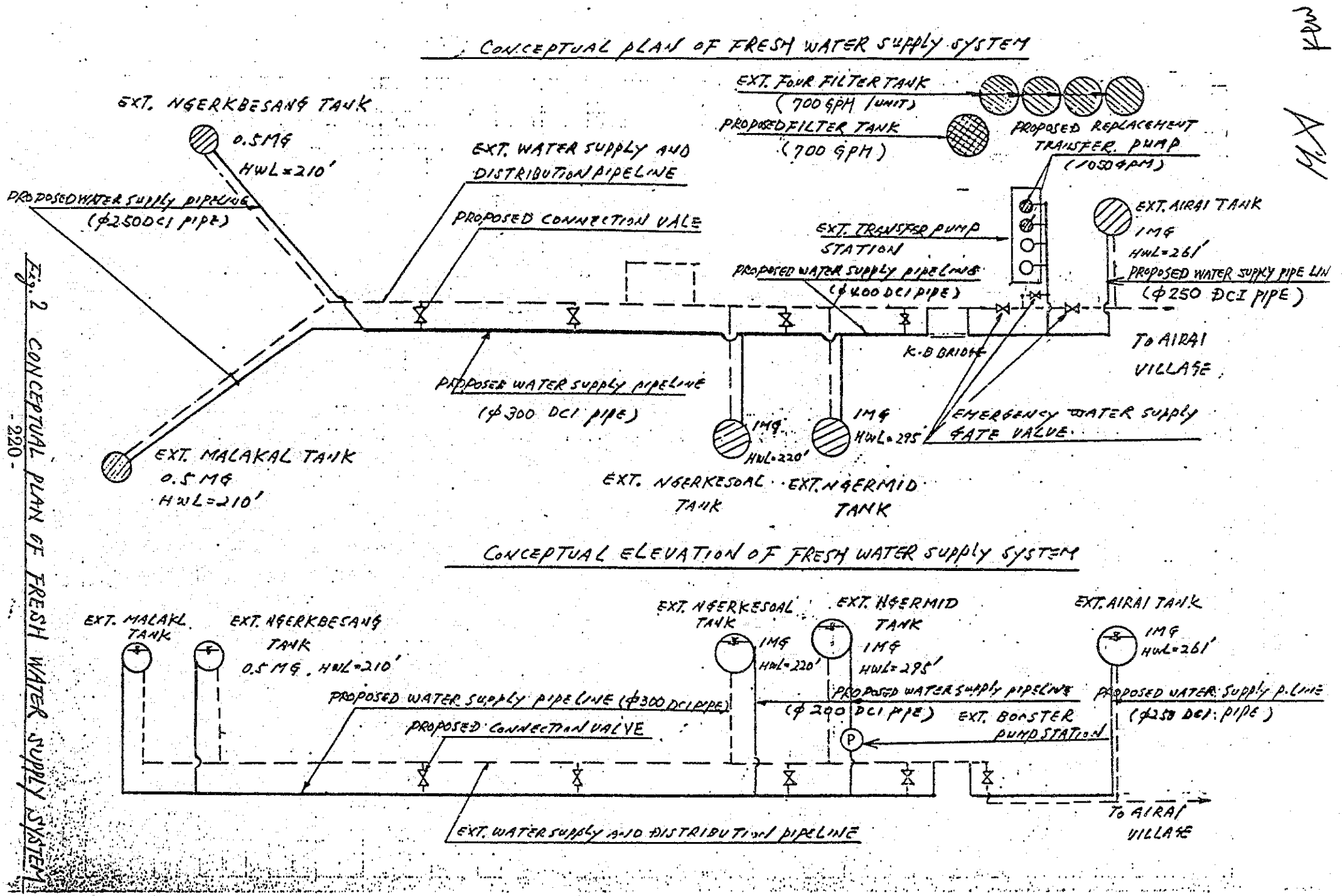


Fig. 2 CONCEPTUAL PLAN OF FRESH WATER SUPPLY SYSTEM

PLAN

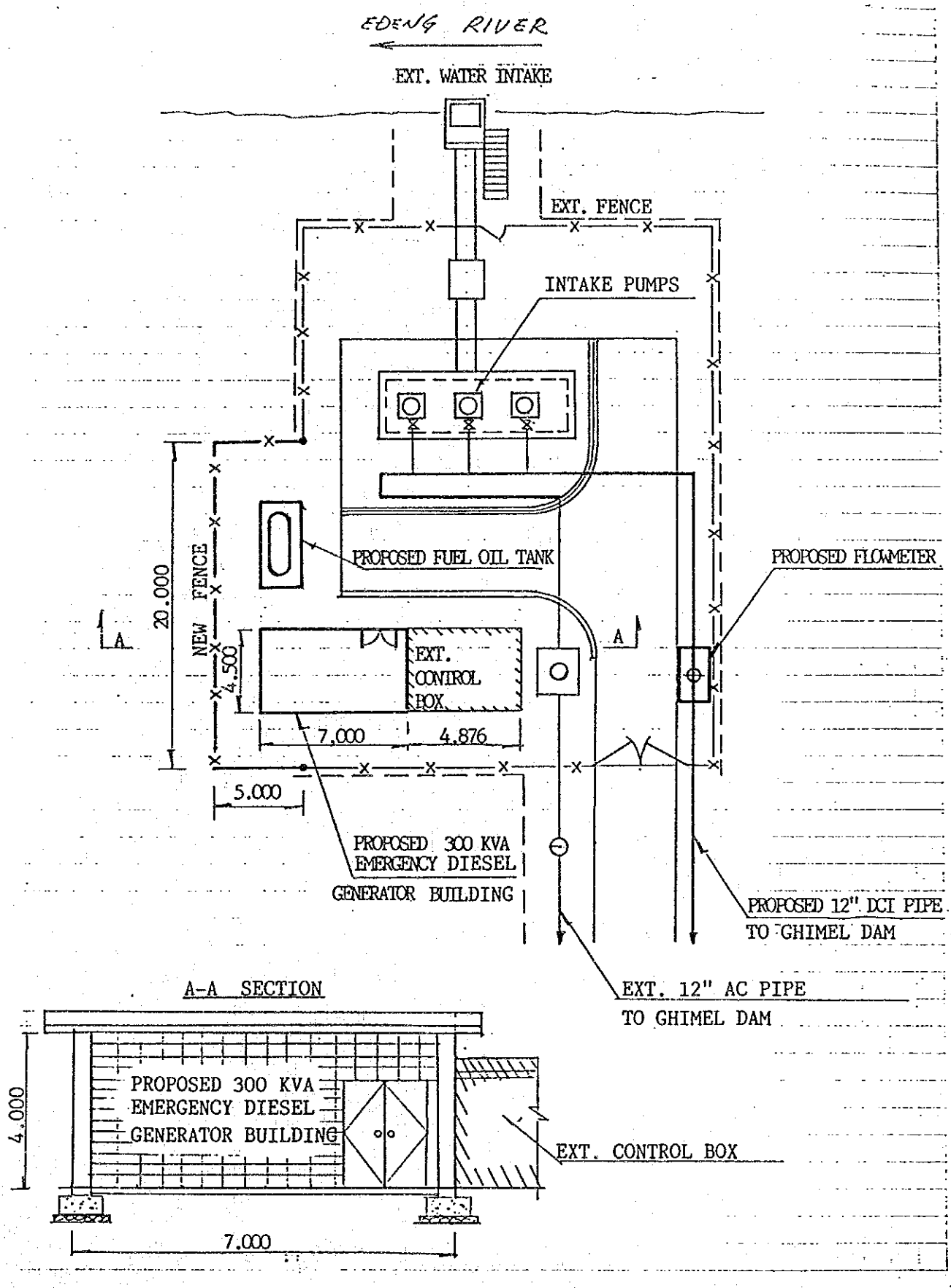
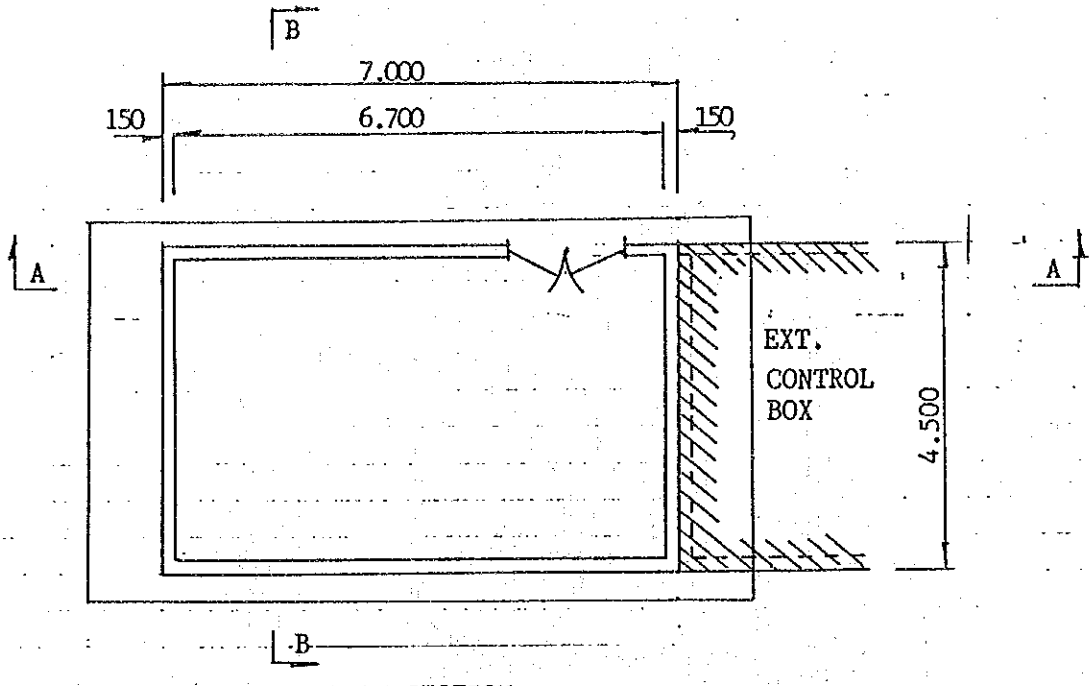


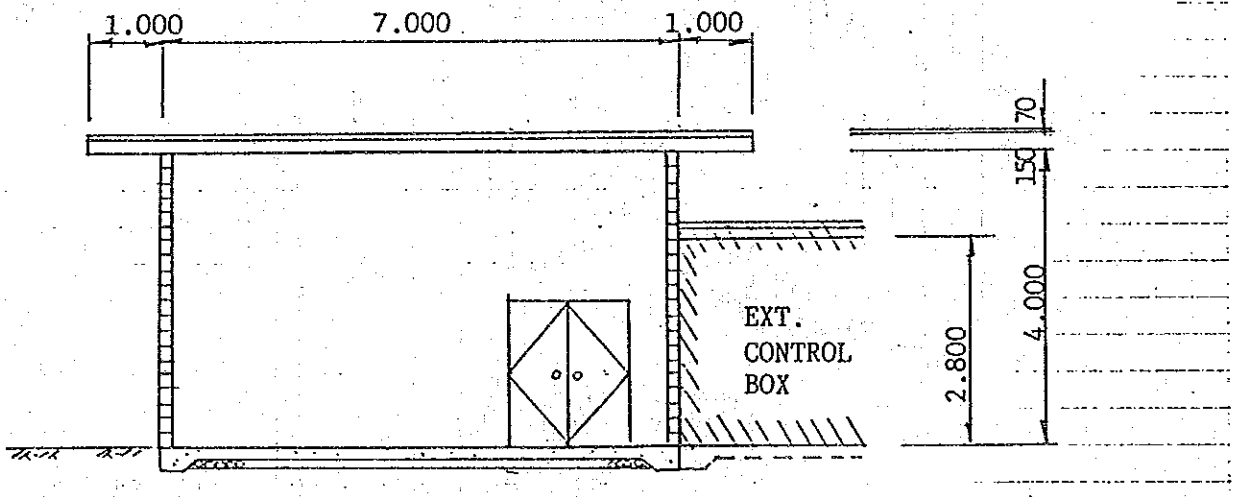
Fig. 3 (½) CONCEPTUAL PLAN FOR PROPOSED EMERGENCY DIESEL GENERATOR

EMERGENCY GENERATOR BUILDING

P L A N



A-A SECTION



B-B SECTION

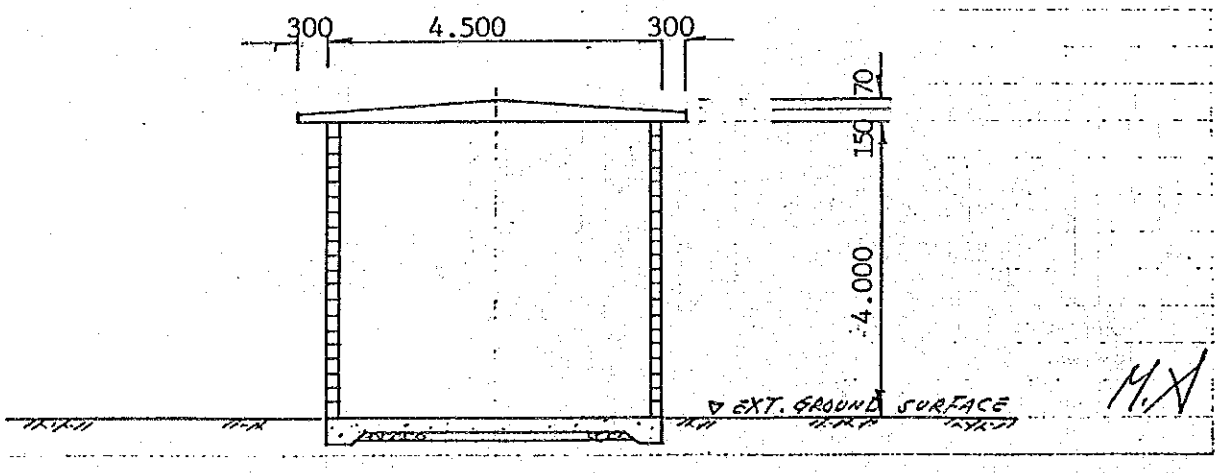


Fig. 3 (3/2) CONCEPTUAL PLAN FOR PROPOSED EMERGENCY DIESEL GENERATOR

KLW

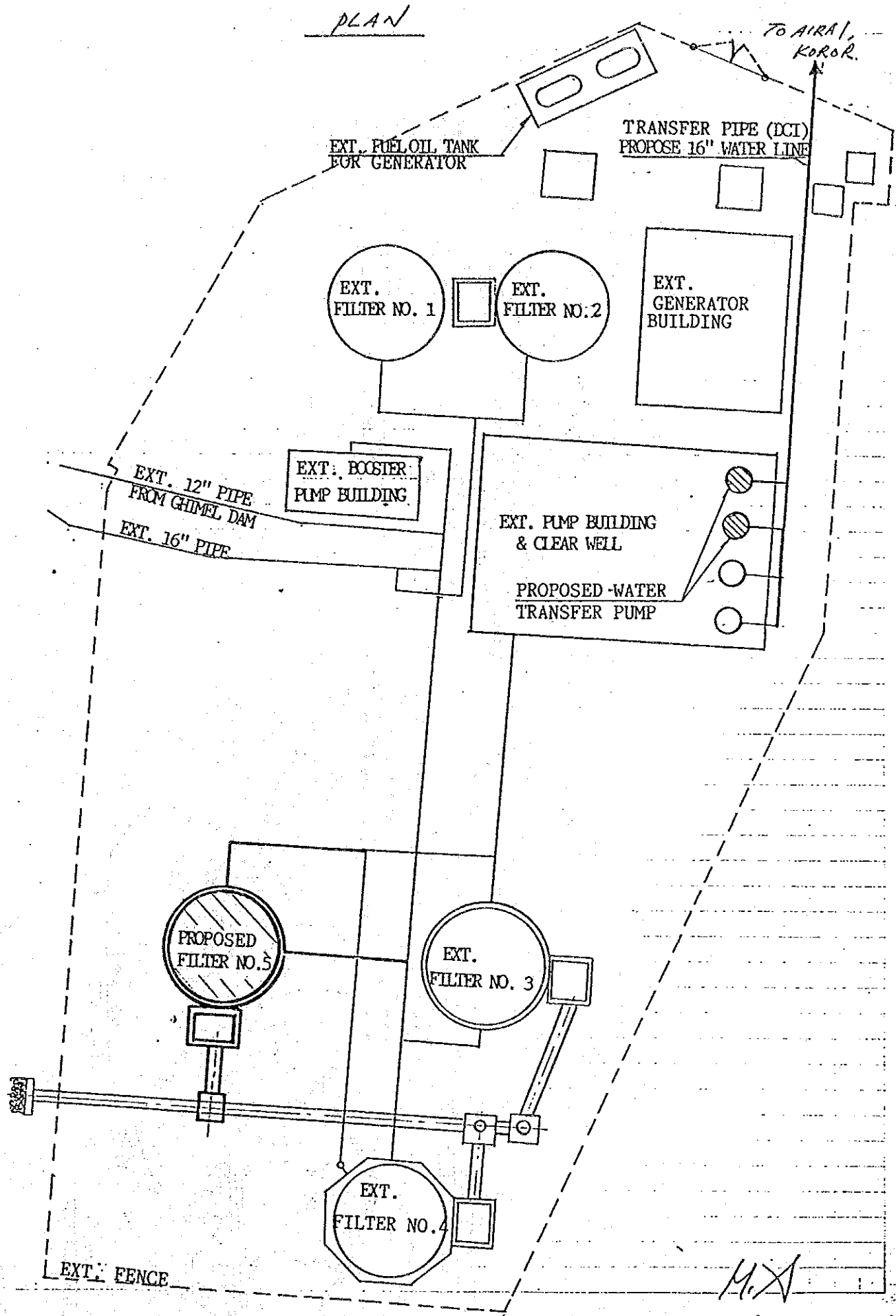


Fig 4 PLAN FOR PROPOSED FILTER NO. 5

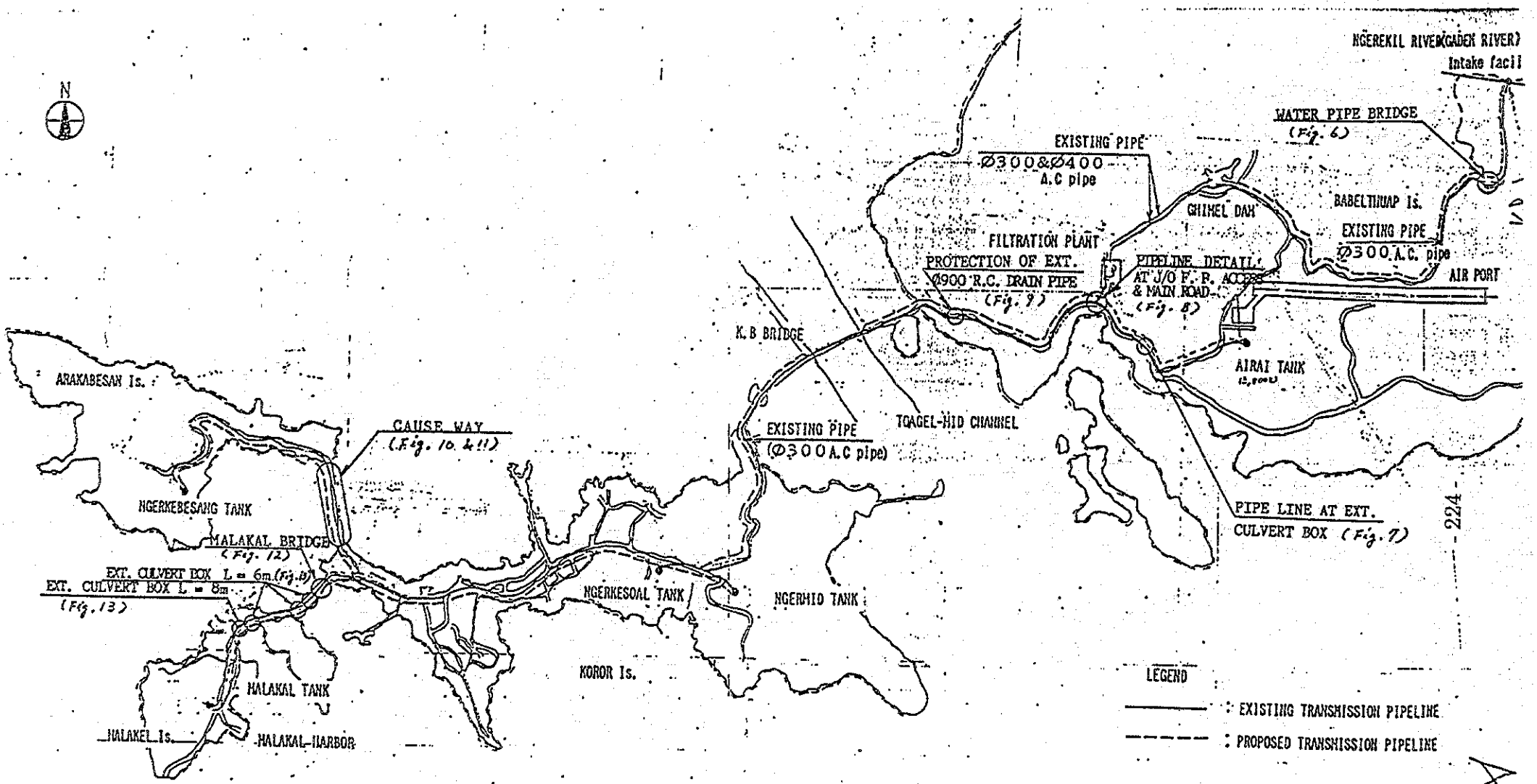
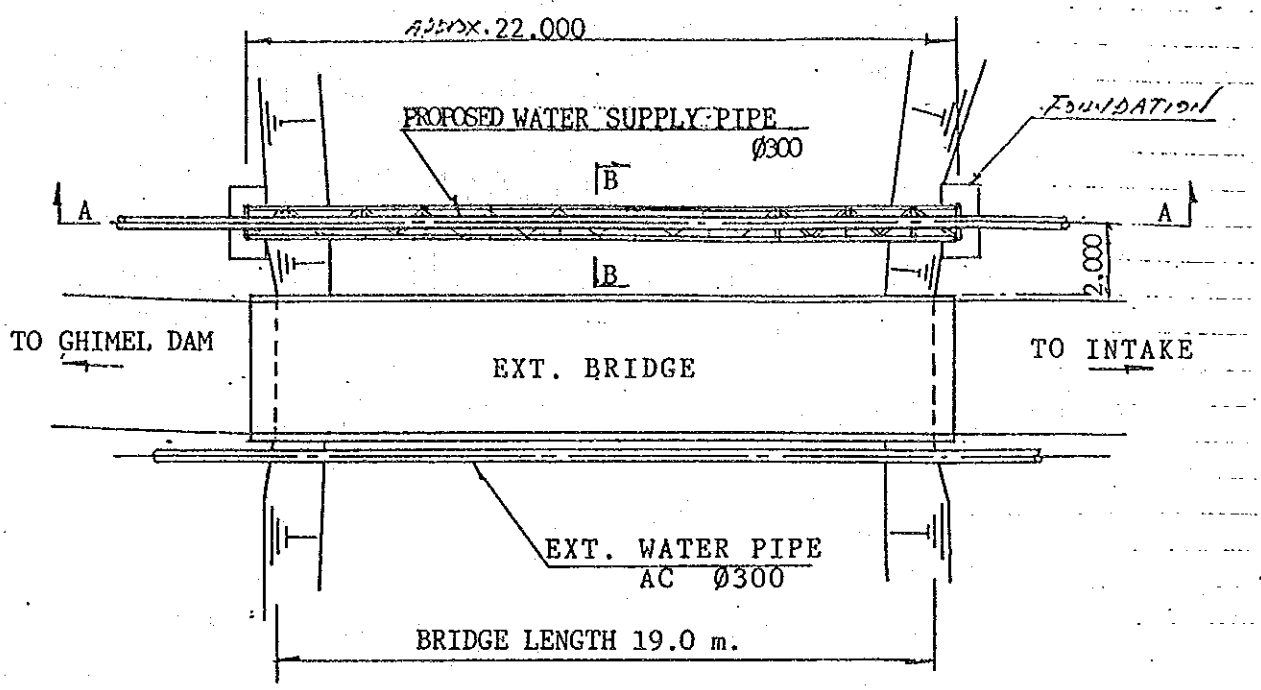


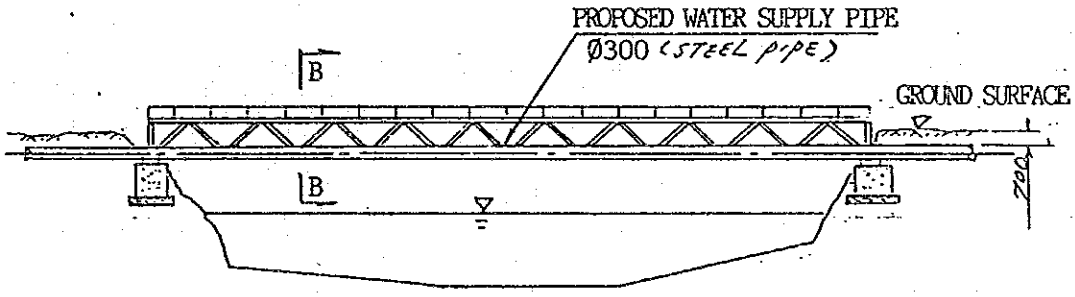
FIG.5 LOCATION OF SECTION

WATER PIPE BRIDGE

PLAN



A-A SECTION



B-B SECTION

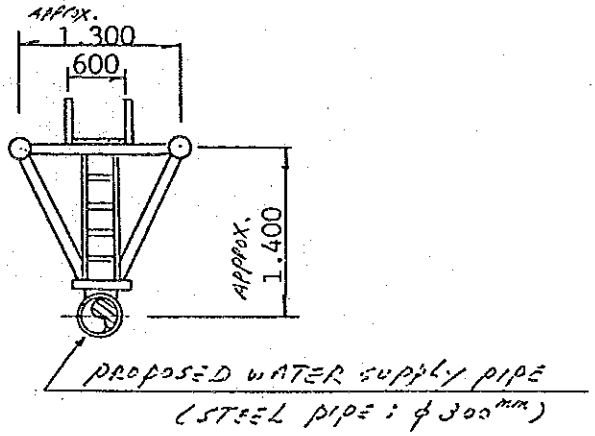
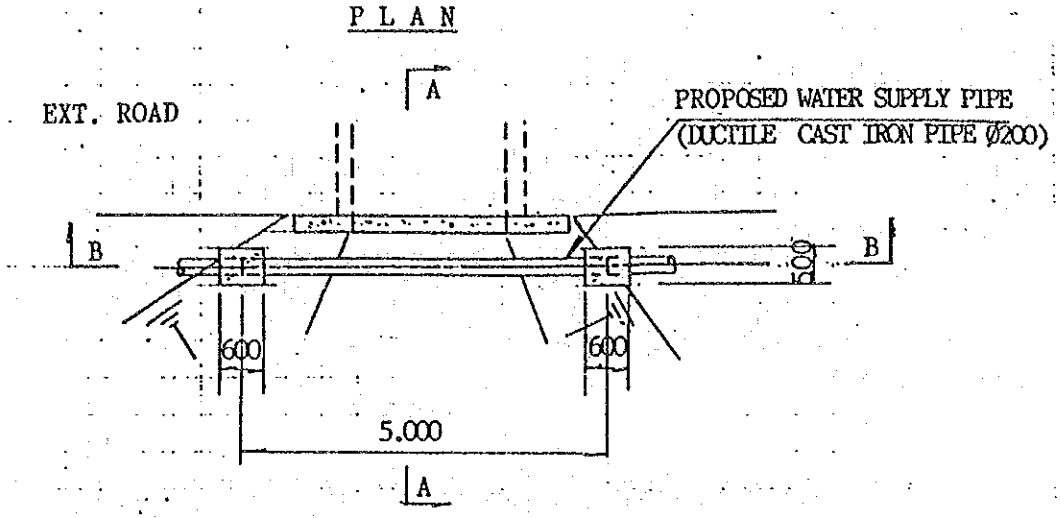
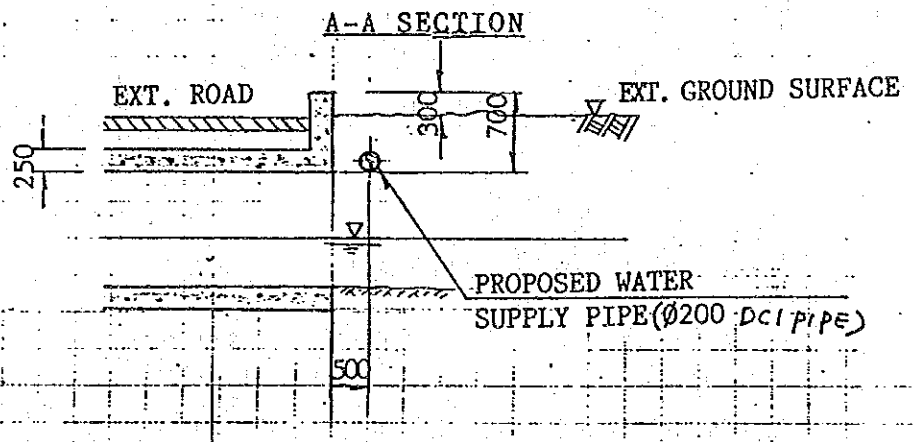


Fig. 6 DETAIL OF WATER PIPE BRIDGE NEAR INTAKE





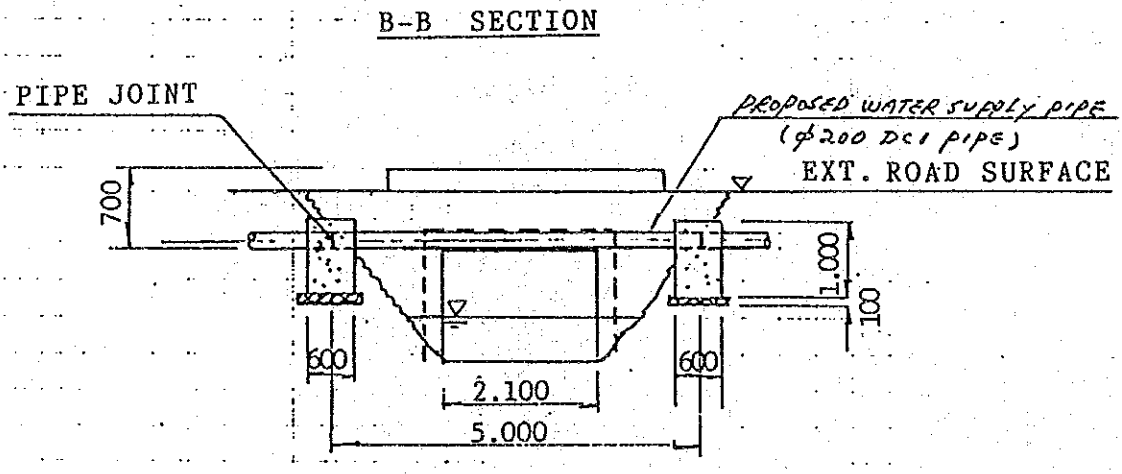
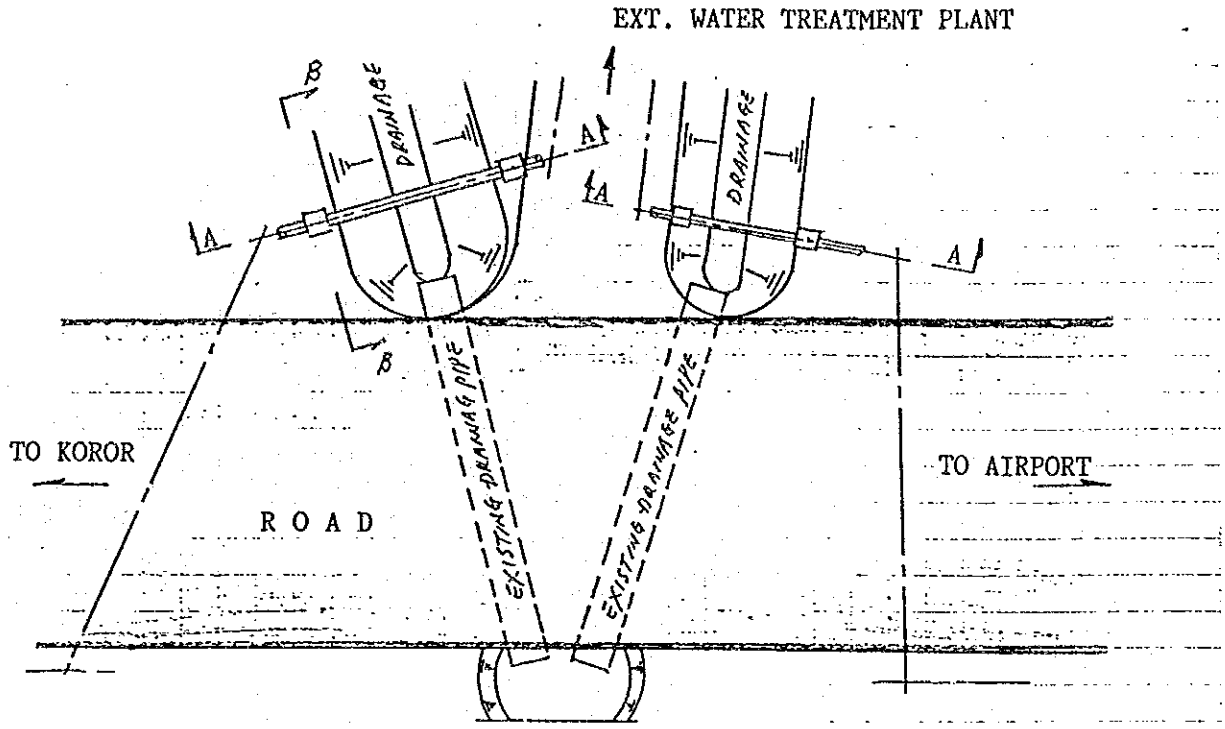


Fig.7 DETAIL OF WATER PIPE LINE BESIDE EXIST. CULVERT AT AIRAI

PLAN



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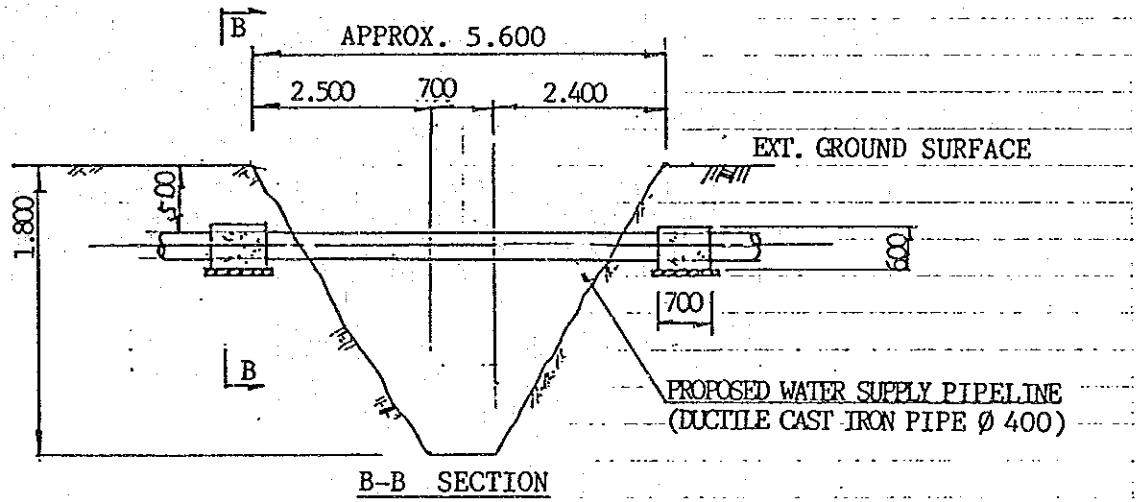

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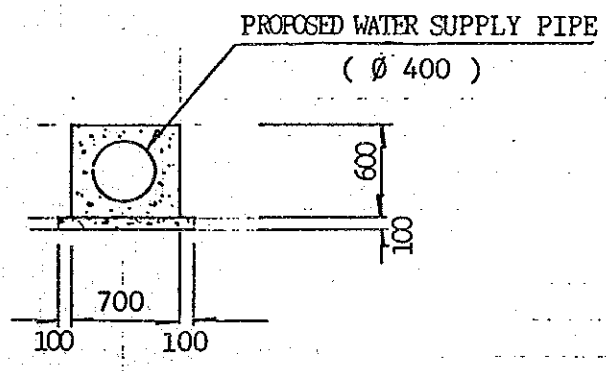


Fig. 8 PLAN FOR WATER PIPE LINE NEAR WTP.

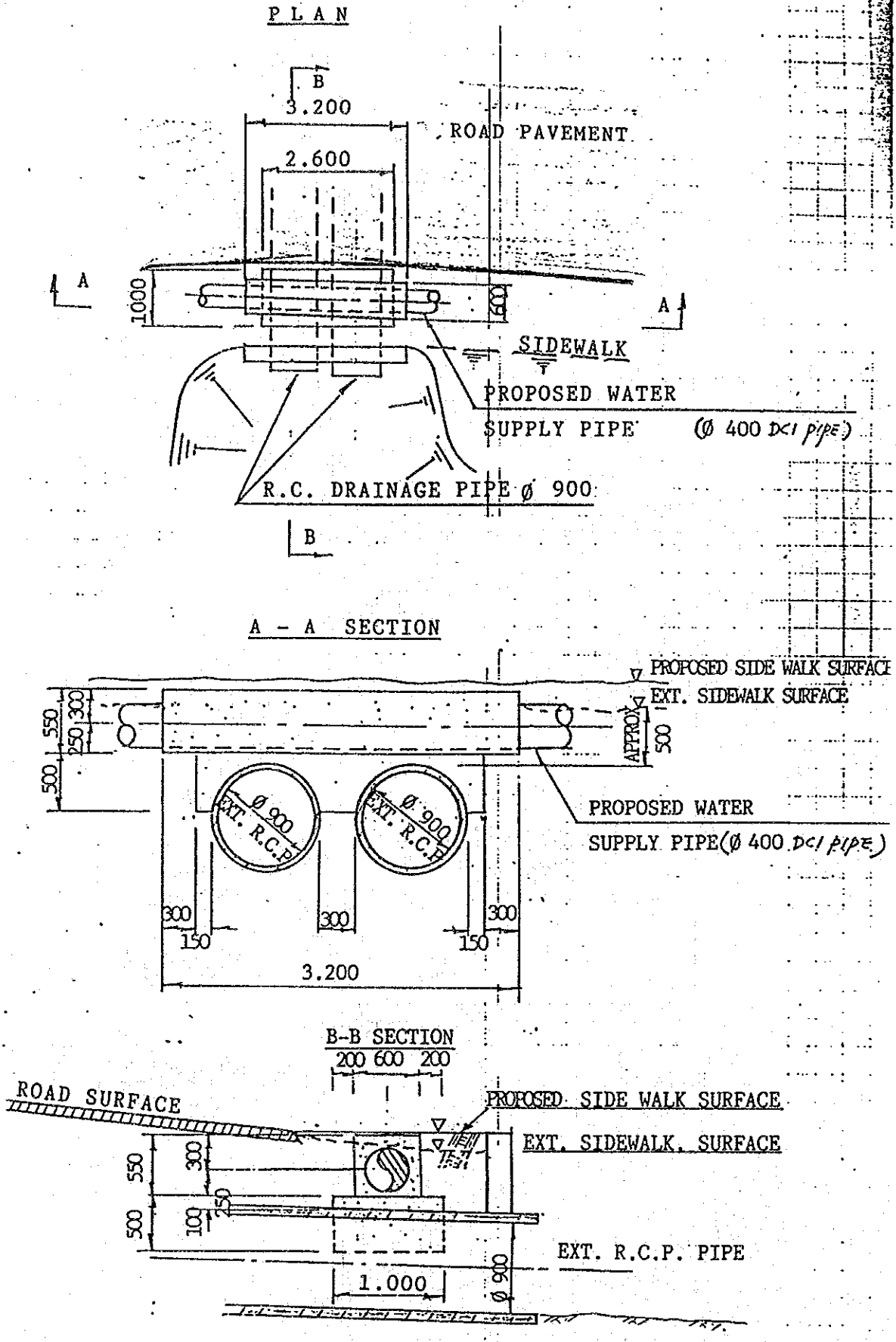
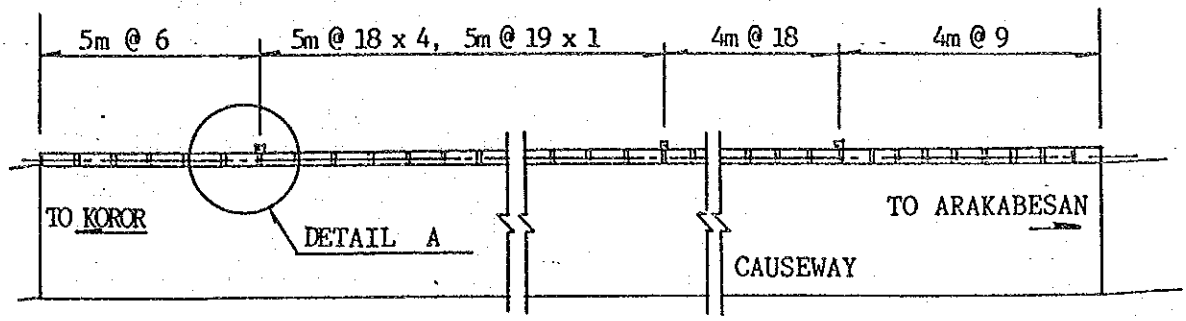
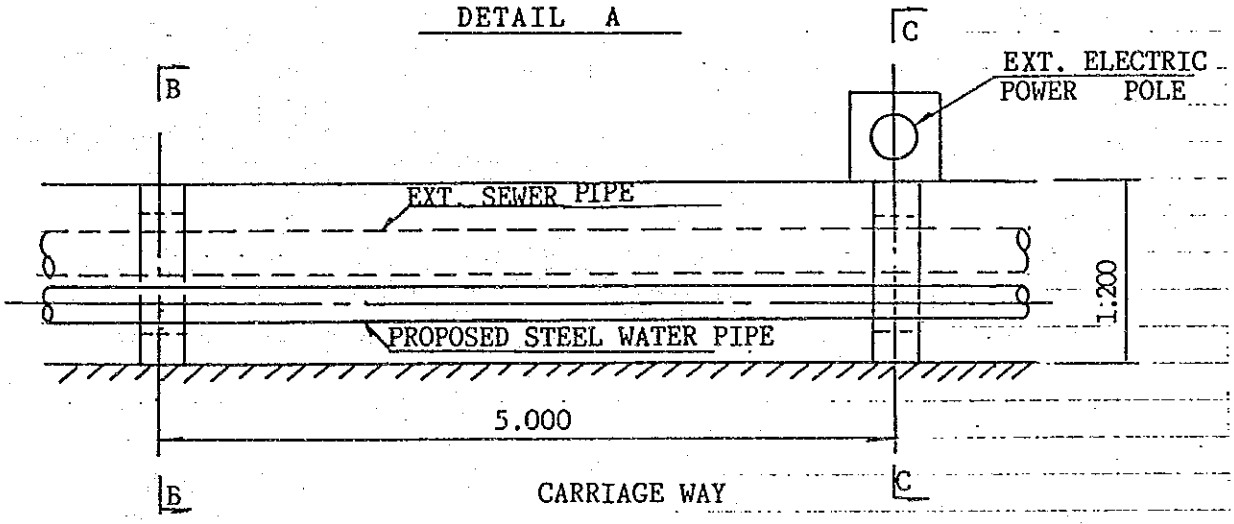


Fig. 9 DETAIL OF WATER PIPE LINE ON EXIST. RC DRAINAGE PIPE

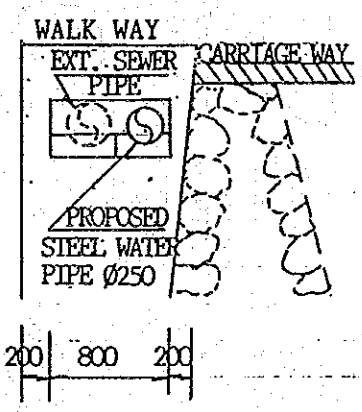
PROPOSED WATER PIPE LINE ALONG CAUSEWAY



DETAIL A



B-B SECTION



C-C SECTION

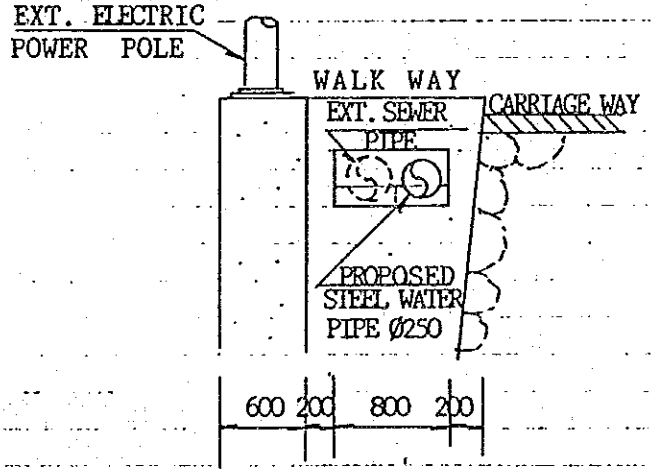
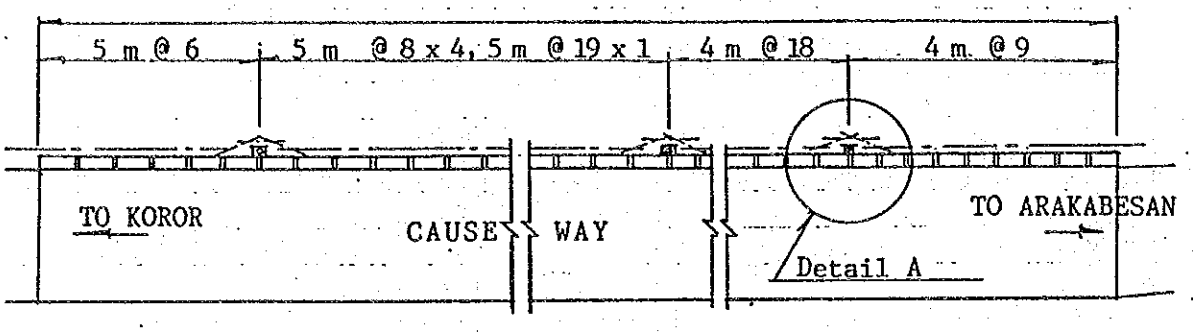
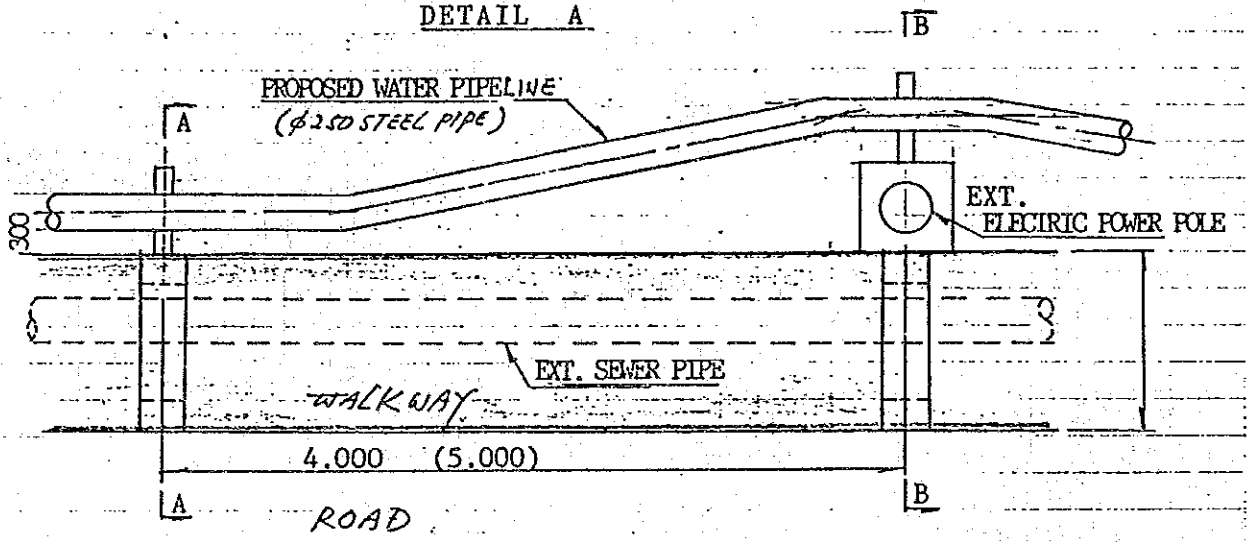


Fig.10 WATER PIPE LINE ALONG CAUSEWAY TO ARAKABESAN IS.

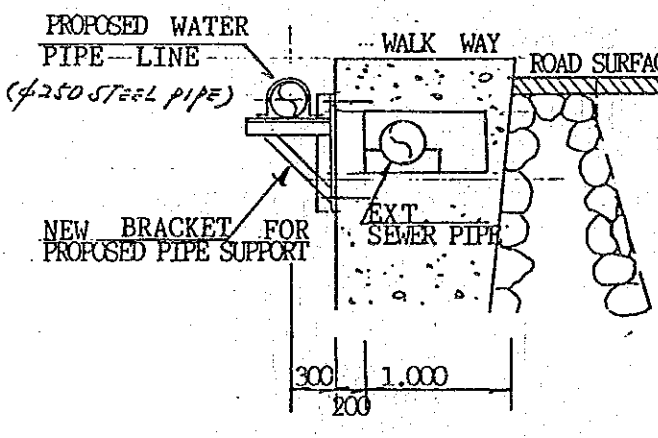
PROPOSED PIPELINE ALONG CAUSEWAY



DETAIL A



A-A SECTION



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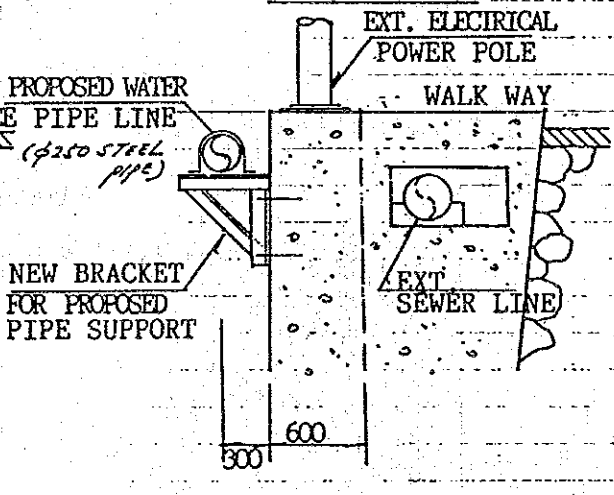


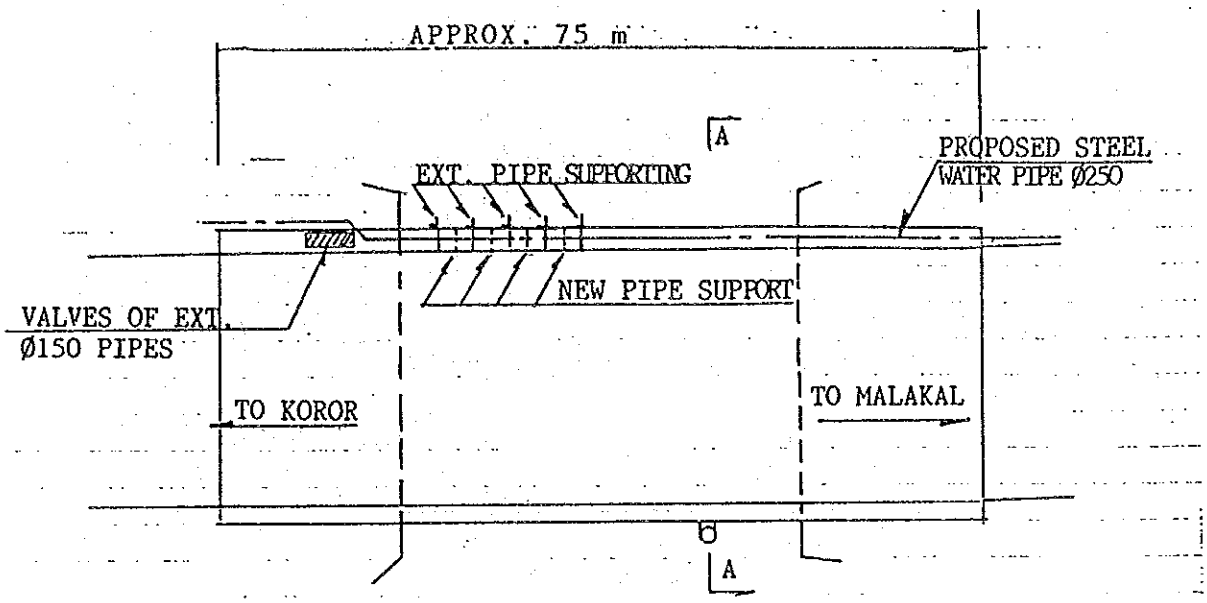
Fig. 11 WATER PIPE LINE ALONG CAUSEWAY TO ARAKABESAN IS.
(ALTERNATIVE)

M.A

KEW

MALAKAL BRIDGE WATER PIPE

P L A N



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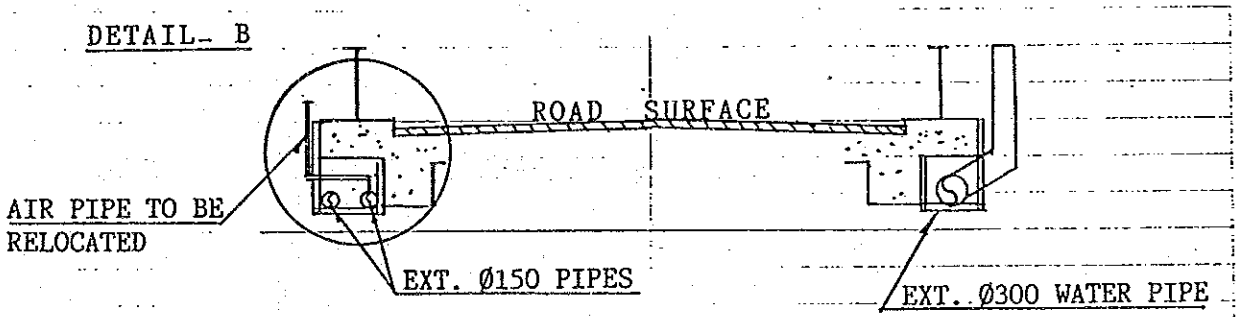


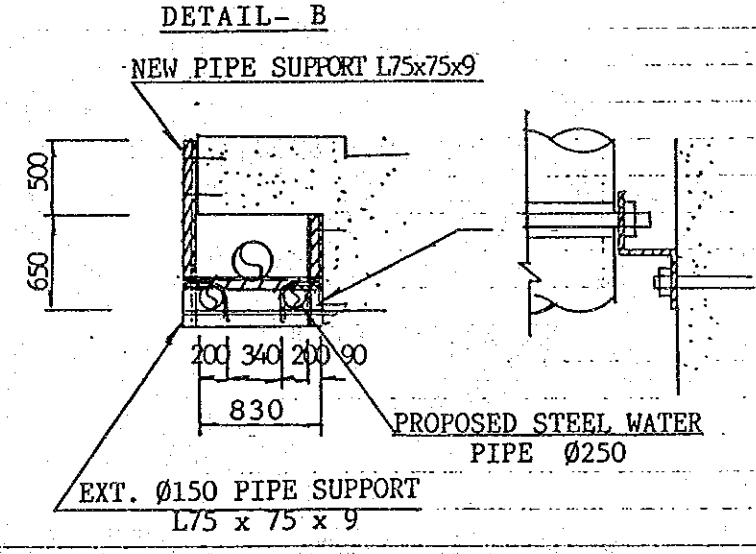


Fig.12 WATER PIPE LINE ALONG MALAKAL BRIDGE

M.A KEW

PROPOSED WATER PIPE LINE FOR CULVERT BOX AT MALAKAL

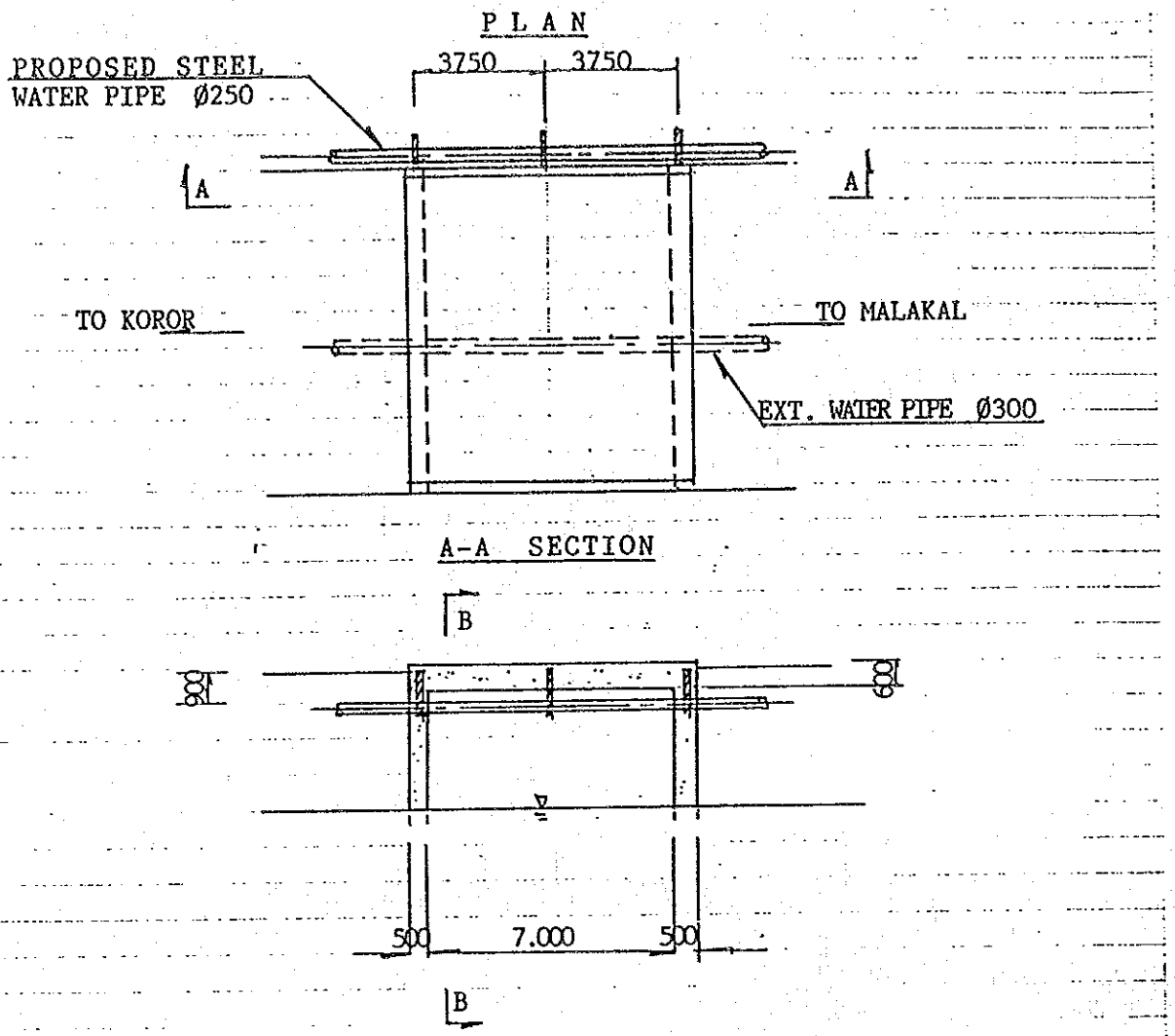
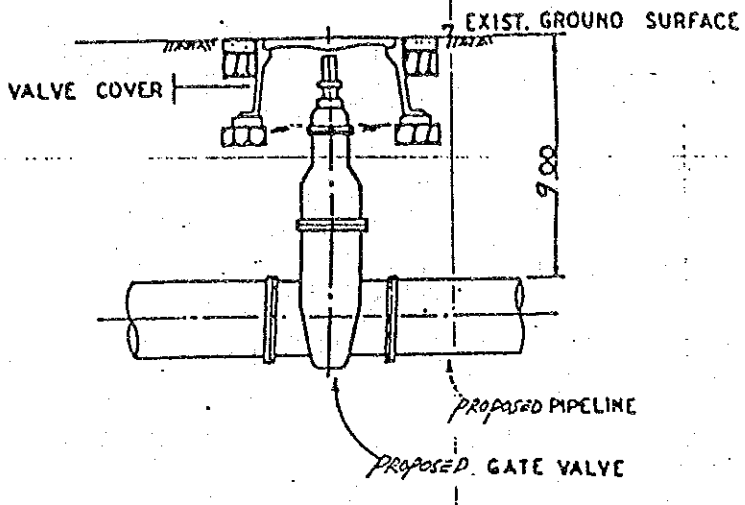
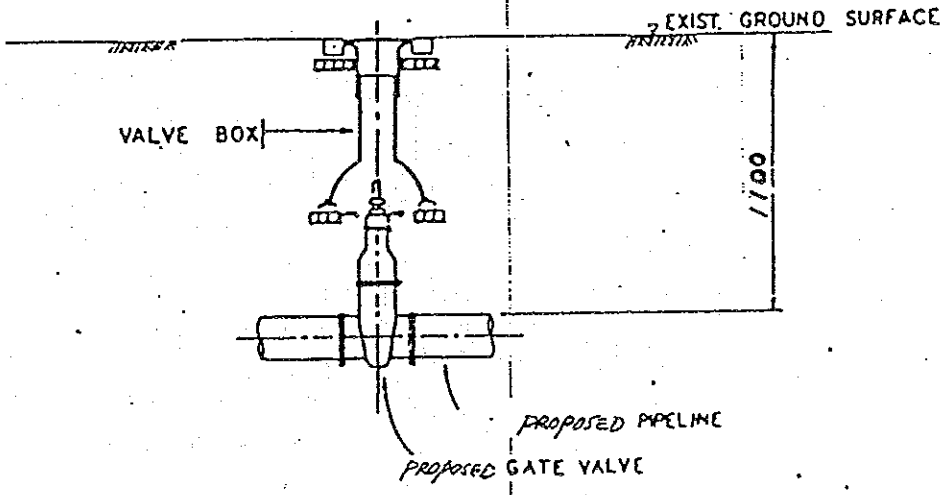


Fig. 13 WATER PIPE LINE BESIDE EXIST. CULVERT AT MALAKAL



TYP. VALVE COVER

NOT TO SCALE

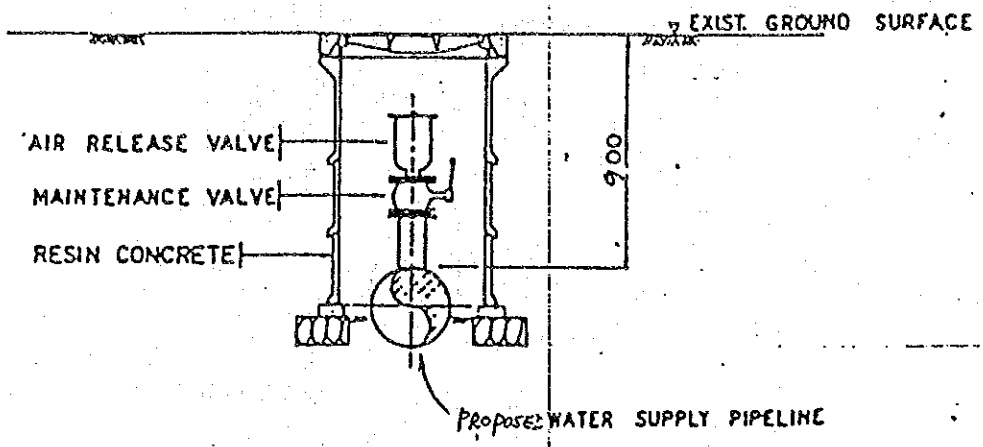


TYP. VALVE BOX FOR PROPOSED PIPELINE

NOT TO SCALE

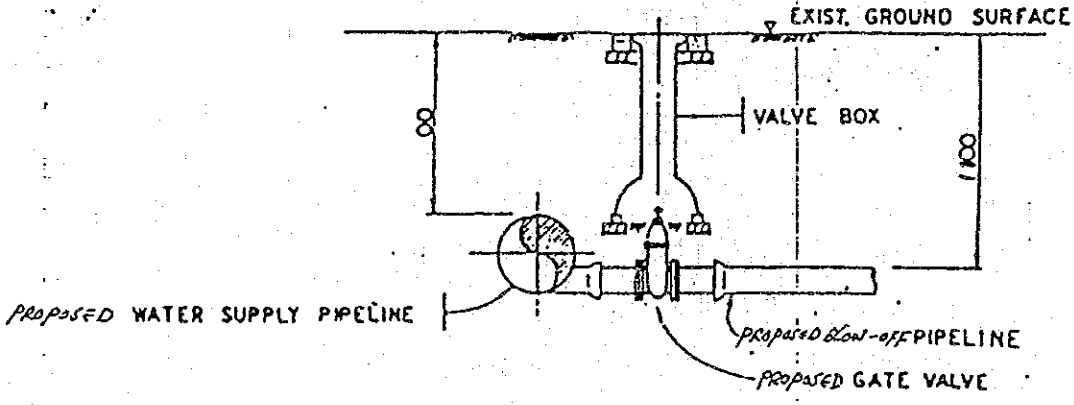
Fig. 14 TYPICAL VALVE COVER & BOX

M.N KEW



TYP. AIR VALVE BOX

NOT TO SCALE

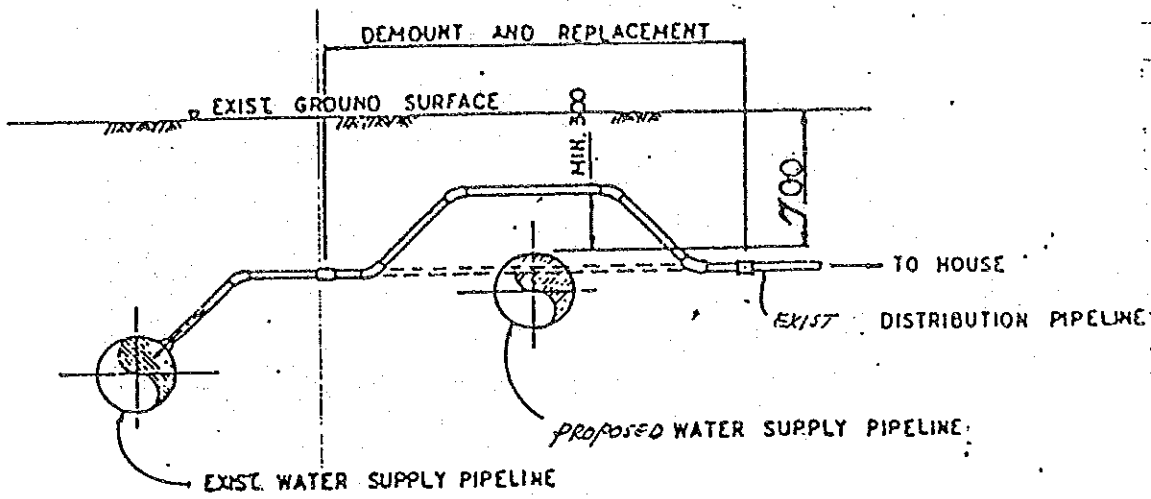


TYP. BLOW-OFF BRANCH

NOT TO SCALE

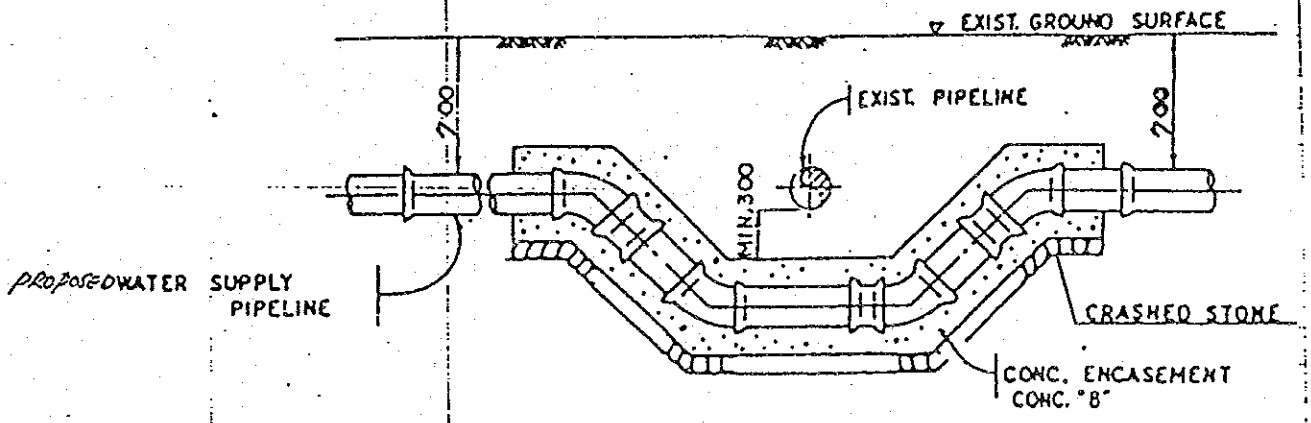
Fig. 15 TYPICAL AIR VALVE BOX & BLOW-OFF

M.A KEW



TYP. REPLACEMENT OF DISTRIBUTION PIPELINE AT PARTS CROSSING PROPOSED WATER PIPELINE

NOT TO SCALE

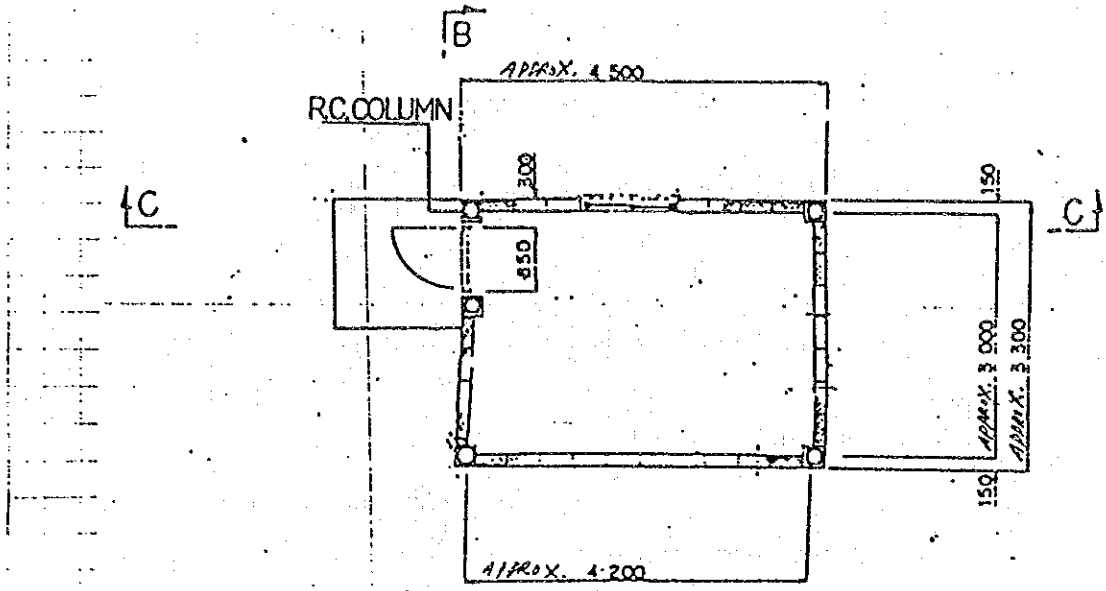


TYP. PIPE CROSSING OF EXIST. WATER MAIN PIPE

NOT TO SCALE

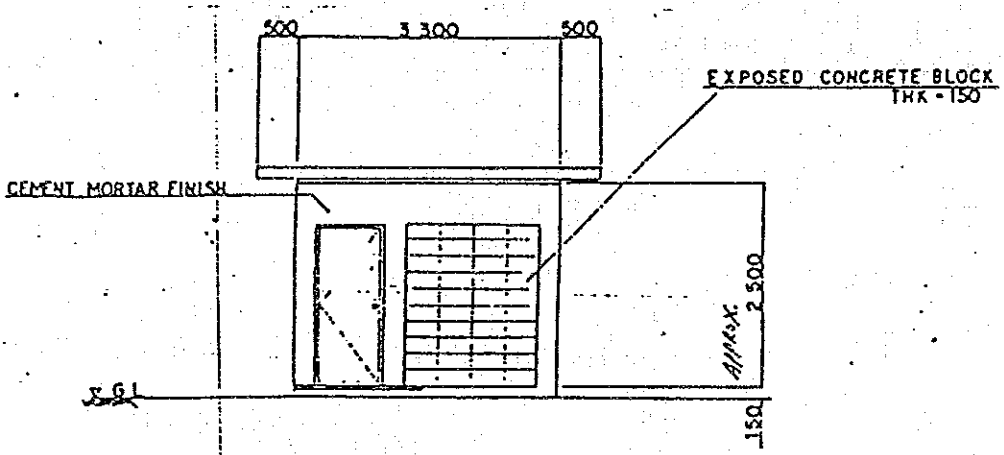
Fig. 16 TYPICAL SECTION OF PIPE CROSSING

VALVE HOUSE FOR STEEL WATER TANKS

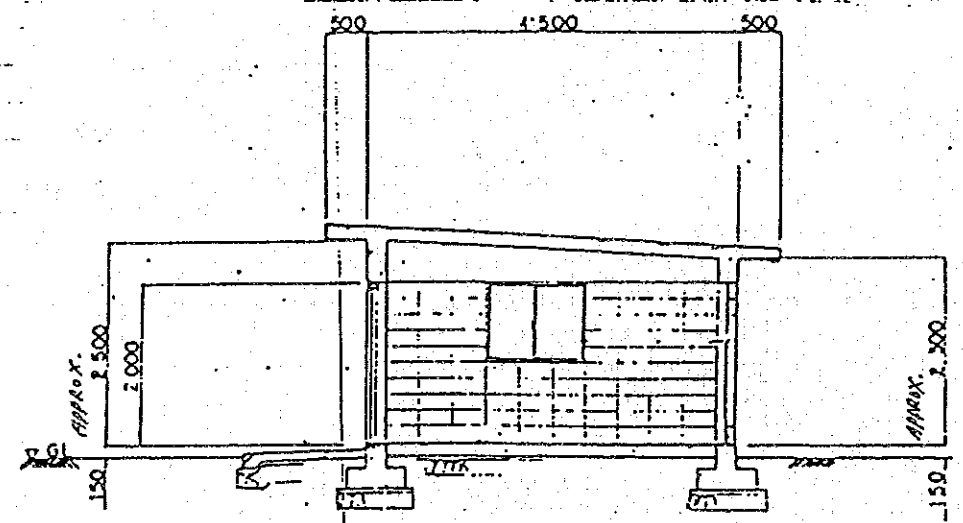


B

PLAN



ELEVATION B – B



SECTION C – C

Fig. 17 VALVE HOUSE FOR STEEL WATER TANKS

M.X

FW

TYPICAL SECTION OF EXISTING CAUSEWAY

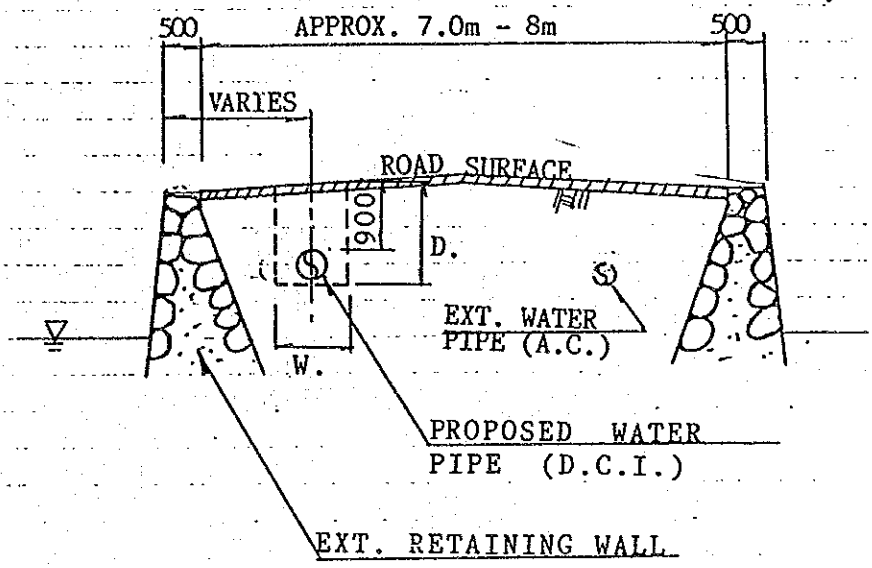
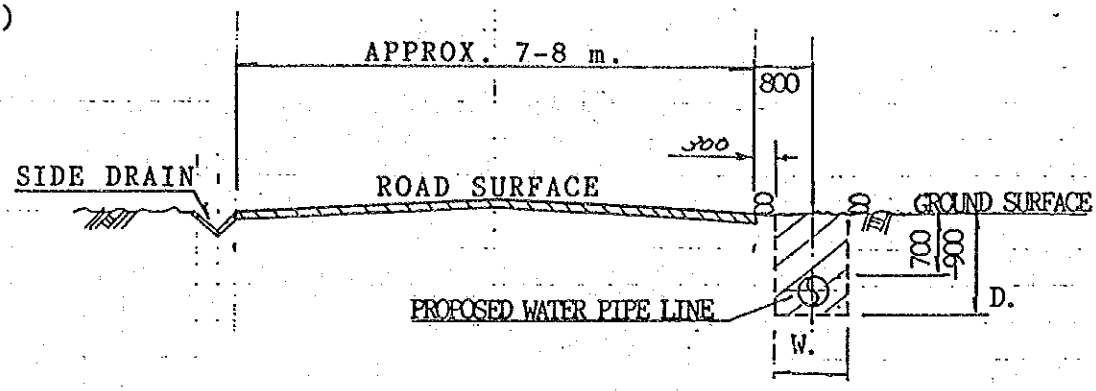


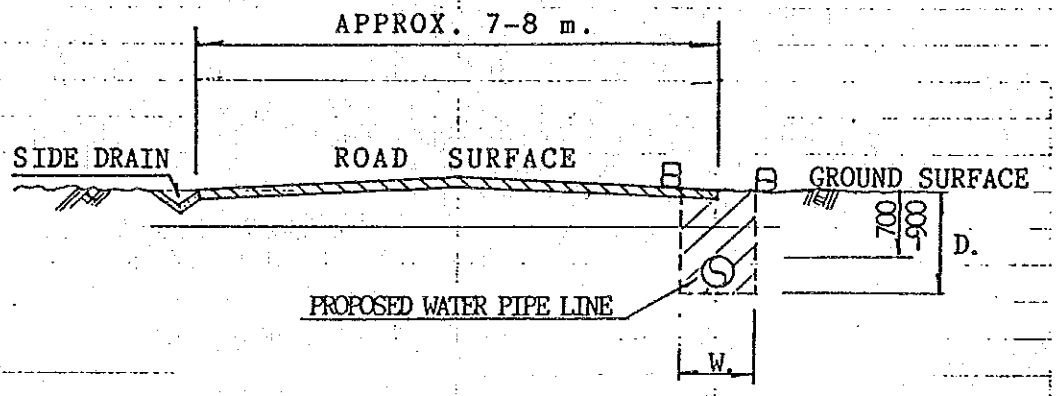
Fig.18 TYPICAL CROSS SECTION OF PIPE IN CAUSEWAY

TYPICAL CROSS SECTION OF WATER PIPELINE

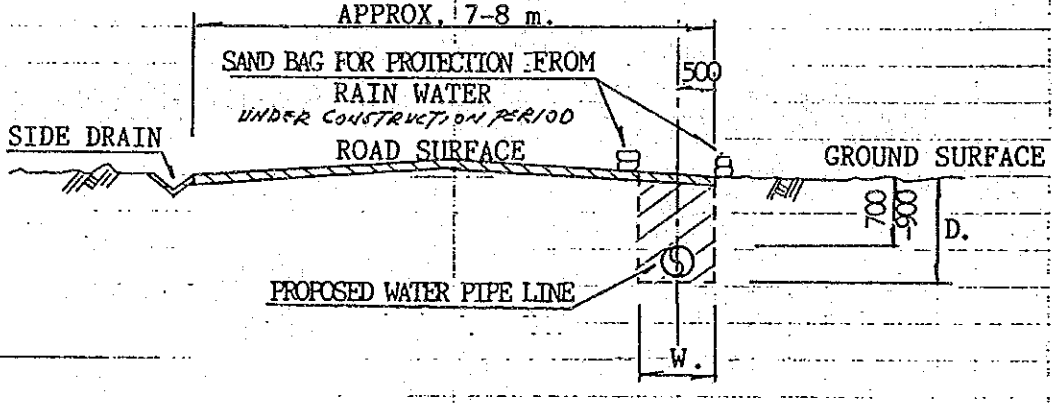
TYPE (1)



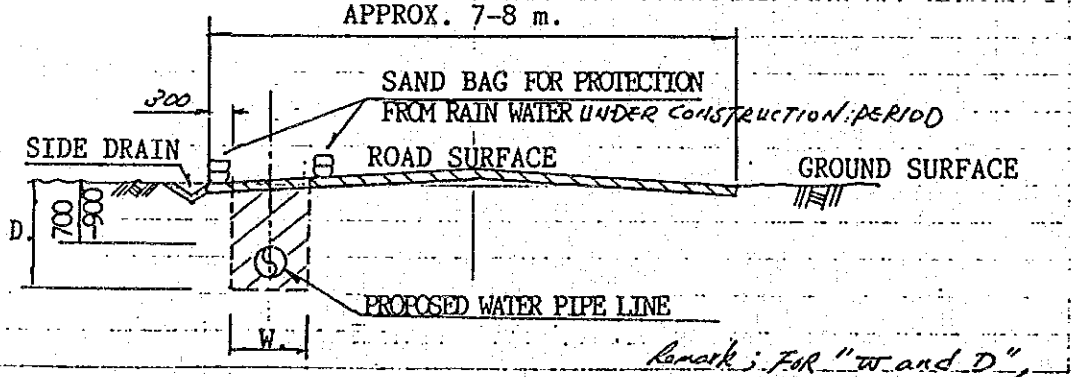
TYPE (2)



TYPE (3)



TYPE (4)

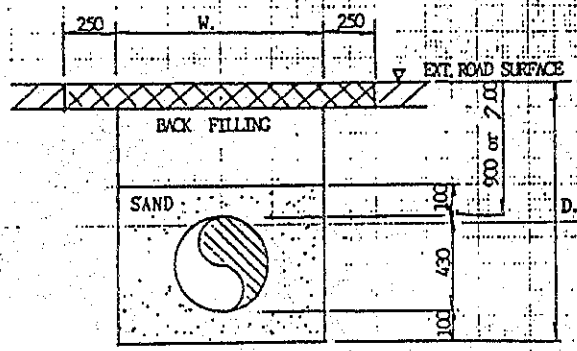


Remark; FOR "W and D",
REFER TO Fig. 20

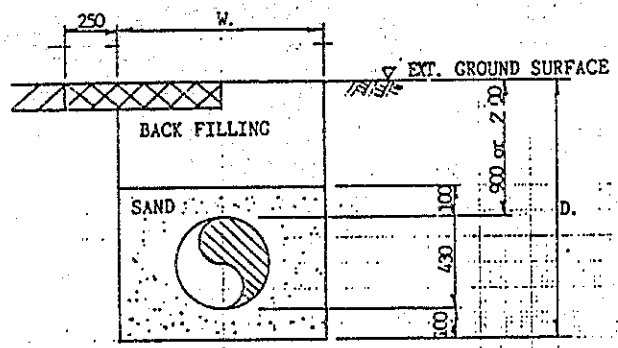
Fig. 19 TYPICAL CROSS SECTION OF PIPE UNDER ROAD

M.N Flw

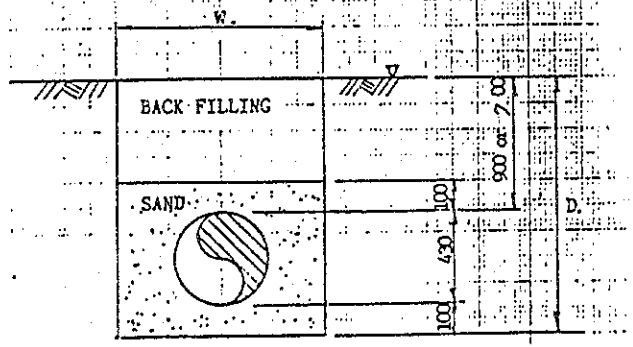
1) PAVED AREA



2) ROAD EDGE



3) UNPAVED AREA



EXCAVATION MEASURE TABLE

LOCATION	PIPE DIAMETER	400 (mm)		300 (mm)		250 (mm)		200 (mm)	
	COVER(m)	900	700	900	700	900	700	900	700
PAVED AREA	DEPTH (m)	1.43	1.23	1.33	1.13	1.28	1.08	1.22	1.02
	WIDTH (m)	1.00	1.00	0.70	0.70	0.70	0.70	0.70	0.70
ROAD EDGE	DEPTH (m)	1.43	1.23	1.33	1.13	1.28	1.08	1.22	1.02
	WIDTH (m)	1.00	1.00	0.70	0.70	0.70	0.70	0.70	0.70
UNPAVED AREA	DEPTH (m)	1.43	1.23	1.33	1.13	1.28	1.08	1.22	1.02
	WIDTH (m)	1.00	1.00	0.70	0.70	0.70	0.70	0.70	0.70

Fig. 20 TYPICAL SECTION OF MAIN PIPE
(DIAMETER OF PIPE = 400m.)

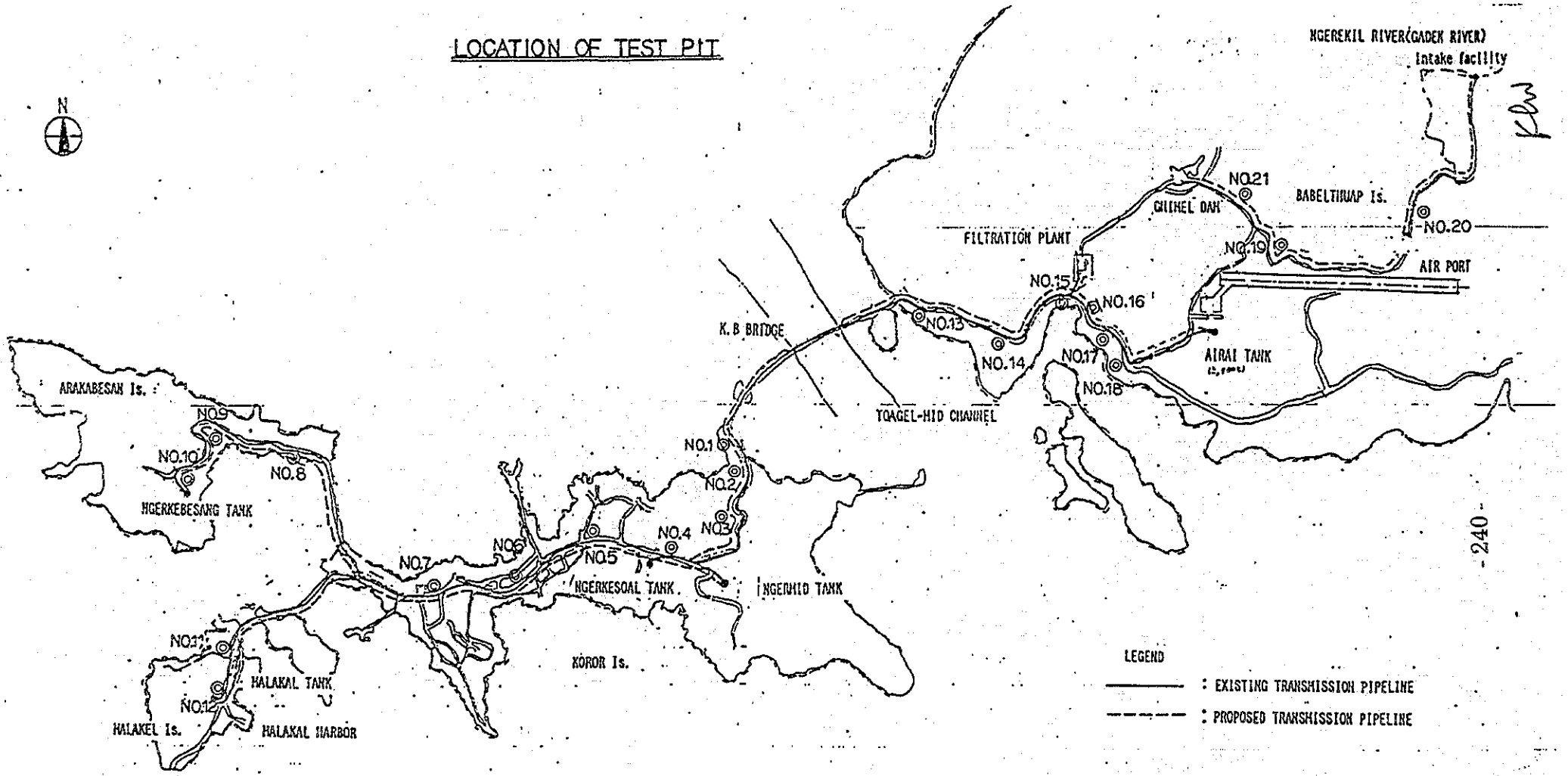


Fig. A11-1-(1/3) LOCATIONS OF TEST PIT

SOIL INVESTIGATION (1)

TEST PIT NO. 1

DEPTH	STRATUM	DESCRIPTION
0		
		SURFACE SOIL
1.0		CLAY (LATERITE) WITH COBBLE
		CORAL ROCK

TEST PIT NO. 2

DEPTH	STRATUM	DESCRIPTION
0		
		SURFACE SOIL
1.0		CLAY (LATERITE) WITH COBBLE
		CORAL ROCK

TEST PIT NO. 3

DEPTH	STRATUM	DESCRIPTION
0		
		SURFACE SOIL
1.0		CLAY (LATERITE) WITH COBBLE
2.3		CLAY (LATERITE)

TEST PIT NO. 4

DEPTH	STRATUM	DESCRIPTION
0		
1.0		DUMPED SOIL (SAND WITH GRAVEL)
2.3		CLAY (LATERITE)

TEST PIT NO. 5

DEPTH	STRATUM	DESCRIPTION
0		
1.0		CLAY (LATERITE)
2.3		

TEST PIT NO. 6

DEPTH	STRATUM	DESCRIPTION
0		
1.0		CLAY (LATERITE)
2.3		

TEST PIT NO. 7

DEPTH	STRATUM	DESCRIPTION
0		
1.0		BACKFILLED SAND WITH GRAVEL
2.3		CLAY (LATERITE)

TEST PIT NO. 8

DEPTH	STRATUM	DESCRIPTION
0		
1.0		DUMPED SOIL WITH GRAVEL
2.3		BLACK CLAY

TEST PIT NO. 9

DEPTH	STRATUM	DESCRIPTION
0		
1.0		CLAY (LATERITE)
2.3		

TEST PIT NO. 10

DEPTH	STRATUM	DESCRIPTION
0		
1.0		CLAY (LATERITE) WITH SAND
2.3		

TEST PIT NO. 11

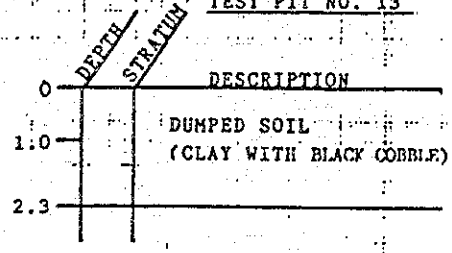
DEPTH	STRATUM	DESCRIPTION
0		
1.0		DUMPED SOIL
		CLAY (LATERITE)
2.3		▽ GROUND WATER LEVEL

TEST PIT NO. 12

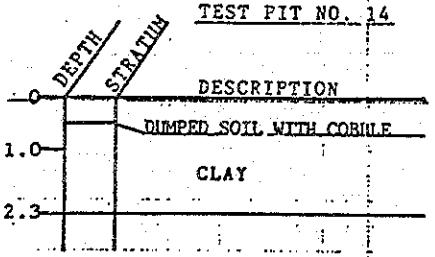
DEPTH	STRATUM	DESCRIPTION
0		
1.0		CLAY (LATERITE)
2.3		

Table AN-1-(2/2) SOIL INVESTIGATION RESULTS

TEST PIT NO. 13



TEST PIT NO. 14



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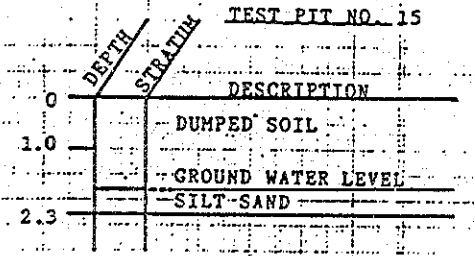
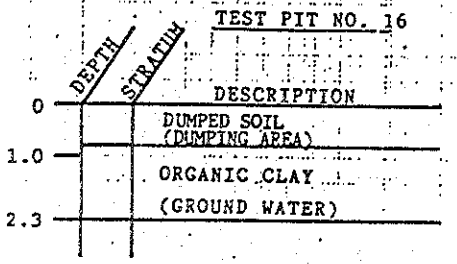


TEST PIT NO. 16



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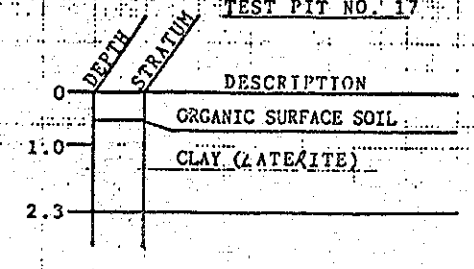
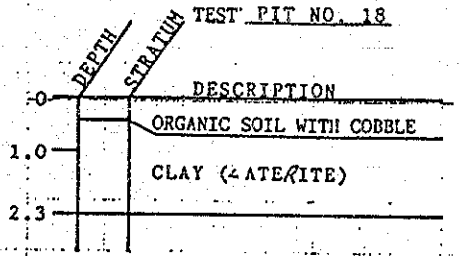
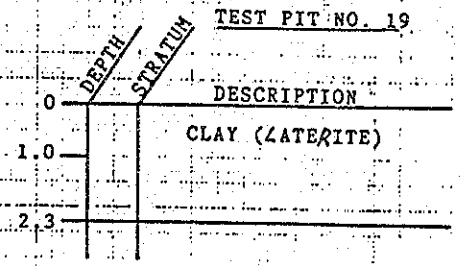


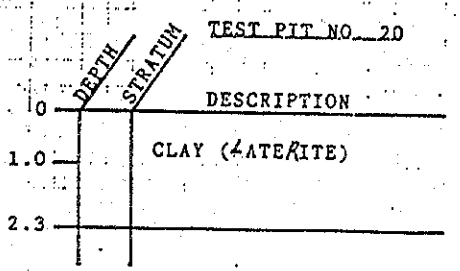
TEST PIT NO. 18



TEST PIT NO. 19



TEST PIT NO. 20



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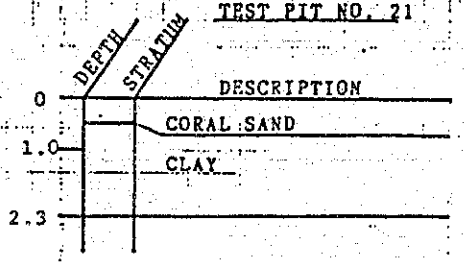
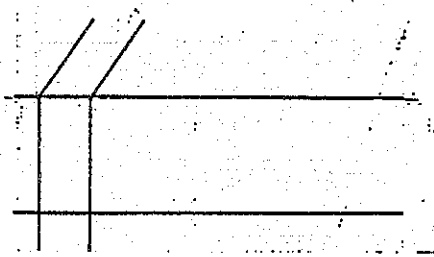
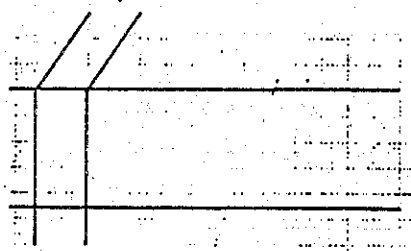






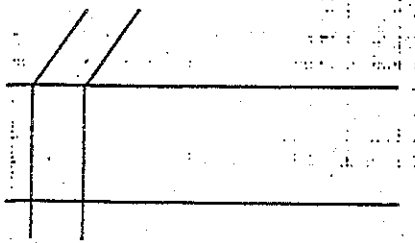


Table AN-1-13(1) SOIL INVESTIGATION RESULTS

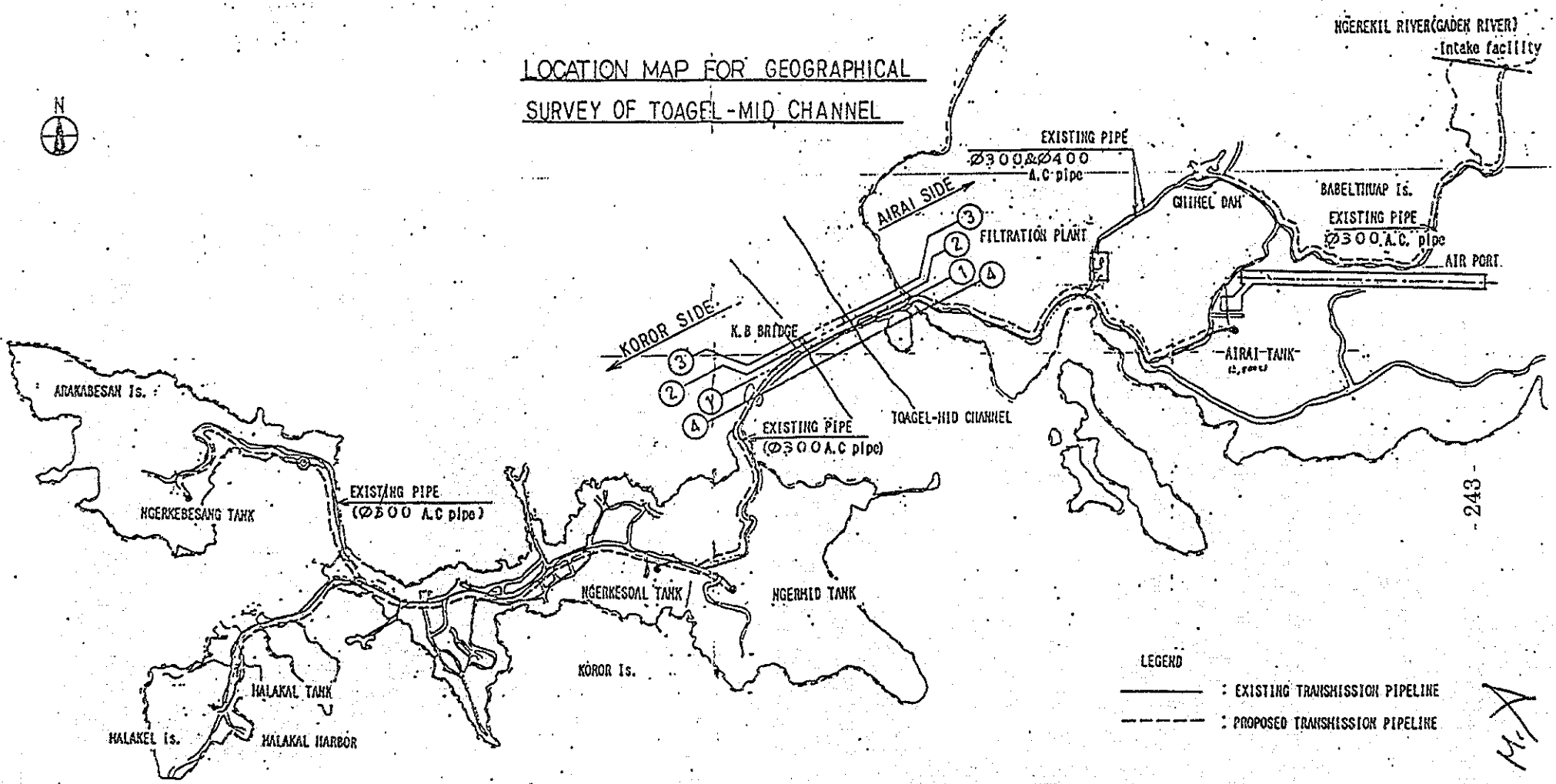
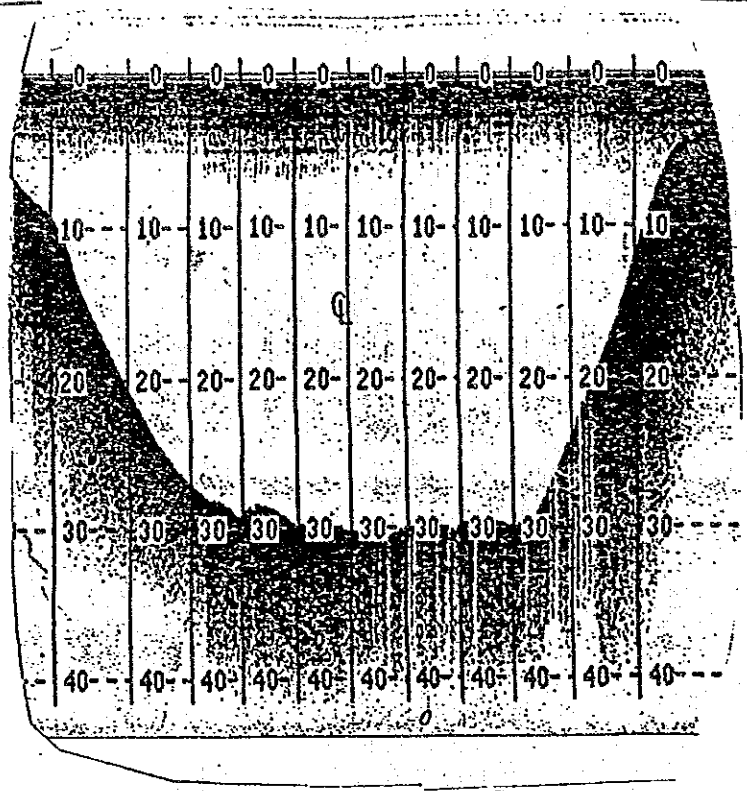


Fig: AN-2-(1/3) LOCATION OF GEOGRAPHICAL SURVEY OF TOAGEL-MID CHANNEL

AIRAI SIDE

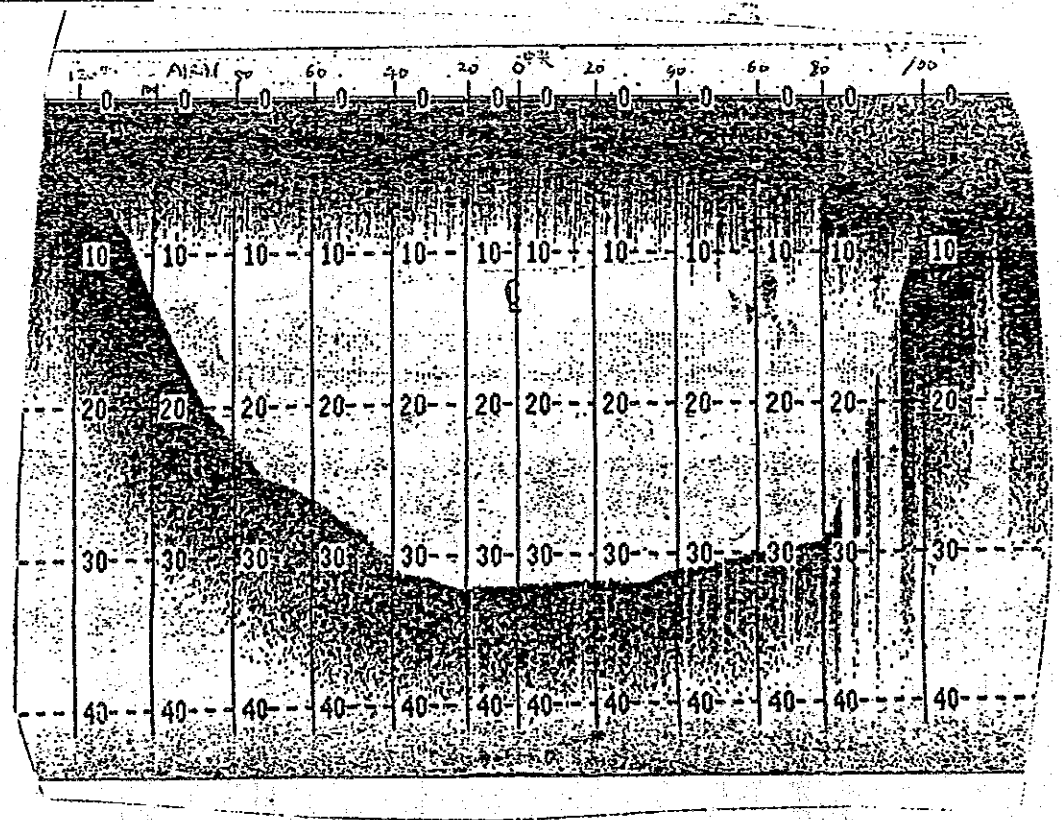
KOROR SIDE



SECTION ①-①

AIRAI SIDE

KOROR SIDE

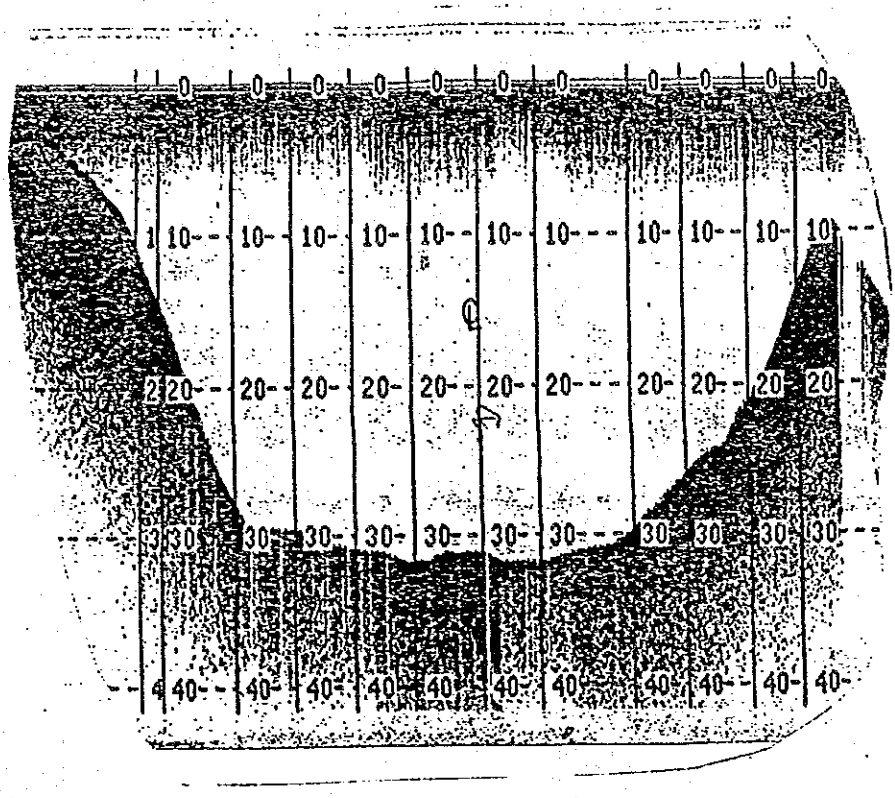


SECTION ②-②

Fig. AN-2-(2/3) GEOGRAPHICAL SURVEY RESULT

KOROR SIDE

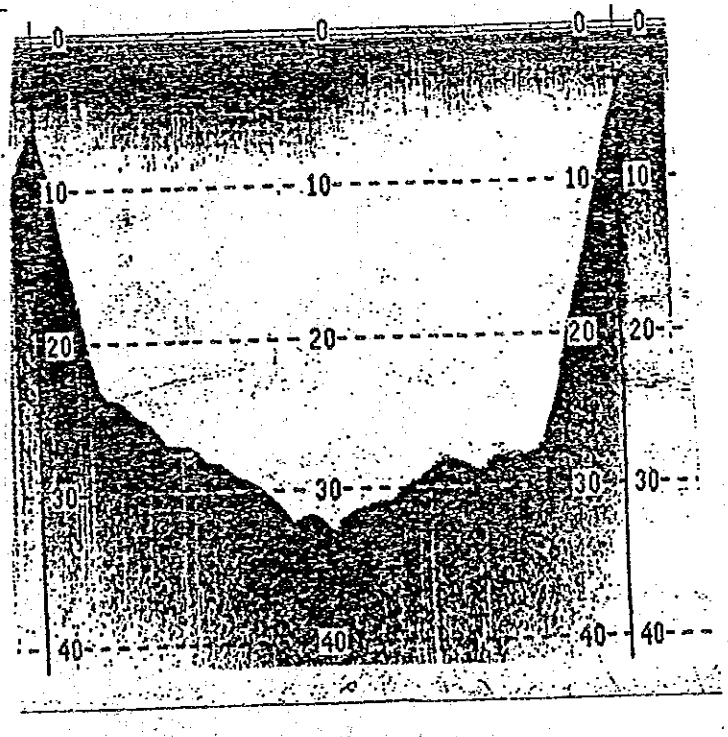
AIRAI SIDE



SECTION ③ – ③

AIRAI SIDE

KOROR SIDE



SECTION ④ – ④

Fig. AN – 2 – (3/3) GEOGRAPHICAL SURVEY RESULT

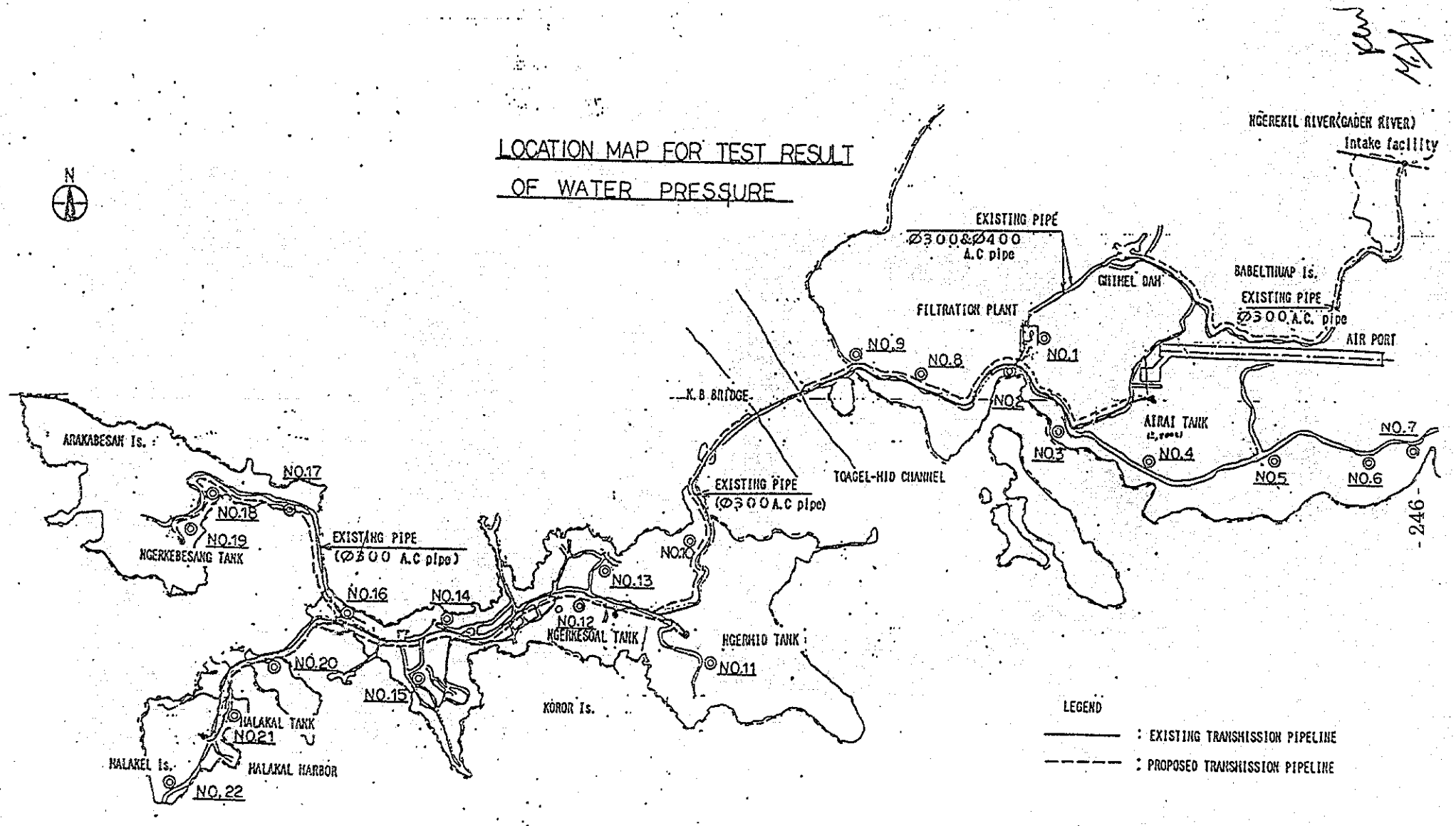
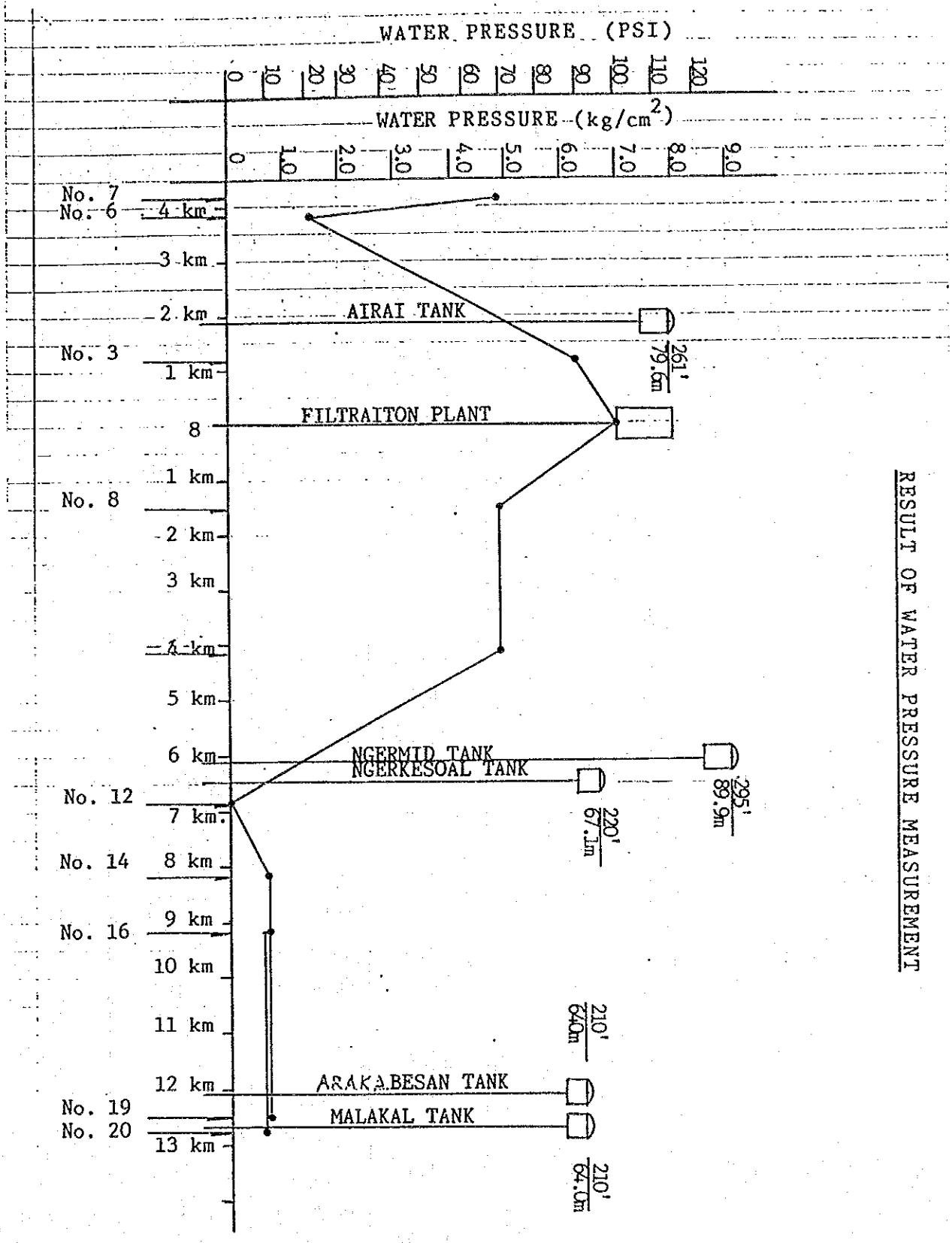


Fig. AN-3-(1/2) Locations of water pressure measurement



RESULT OF WATER PRESSURE MEASUREMENT

Fig AN-3-(3/3) RESULT OF WATER PRESSURE MEASUREMENT

MEASURED RESULTS OF WATER PRESSURE AT EACH POINT

No	MEASURING POINT	DATE	TIME	PRESSURE	
				PSI	(KG/CM²)
1	TREATMENT PLANT	15 DEC.'89	16:45	100	7.0
2	CROCODILE LOUNGE	"	16:50	100	7.0
3	AIRAI VILLAGE	"	17:00	90	6.3
4	-ditto-	"	17:03	60	4.2
5	-ditto-	"	17:06	35	2.5
6	-ditto-(AIRAI ELEM.SCH.)	"	17:35	22	1.5
7	END OF AIRAI VILLAGE	"	17:25	70	4.9
8		"	17:46	70	4.9
9	OSEL RESTAURANT	"	17:57	10	0.7
10		"	18:05	70	4.9
11		"	18:15	70	4.9
12		"	18:25	0	0
13		"	18:33	LESS THAN 10	<0.7
14	NEAR PALAU HOTEL	"	18:39	10	<0.7
15	NEAR MR. K. WONG'S HOUSE	"	18:45	0	0
16	INTERSECT'N TO ARKABESAN	"	18:52	LESS THAN 10	< 0.7
17	NEAR COMM. CENTER	"	18:58	LESS THAN 10	< 0.7
18		"	19:02	0	0
19		"	19:08	0	0
20	OICC	"	19:14	LESS THAN 10	< 0.7
21	NEAR MALAKAL TANK	"	19:19	LESS THAN 10	< 0.7
22	MMDC	"	19:30	15	1.1

Table AN-1 MEASURED RESULTS OF WATER PRESSURE

M.A KEW

Table AN-2 Tidal current Velocity in Tagal-mid Channel

Remarks 1) Measurement point: At center of K.B Bridge
2) Measurement: Dec. 15th 1989

Water Depth (m)	a) 9:15 a.m.	b) 10:15 a.m.	c) 11:15 a.m.	d) 0:15 pm
0 water surface	0.55 m/sec	0.40 m/sec	0.05 m/sec	0.30 m/sec
1	0.35 "	0.35 "	0.10 "	0.30 "
5	0.45 "	0.35 "	0	0.25 "
10	0.50 "	0.35 "	0	0.25 "
15	0.50 "	0.35 "	0	0.25 "
20	0.50 "	0.30 "	0	0.25 "
25	0.47 "	0.30 "		0.25 "
Current direction :	315° (To N.W)	315° (To N.W)		165° (To S.E)

Fig. AN- 4 TIDAL CURRENT VELOCITY AND DIRECTION

M.N Kew

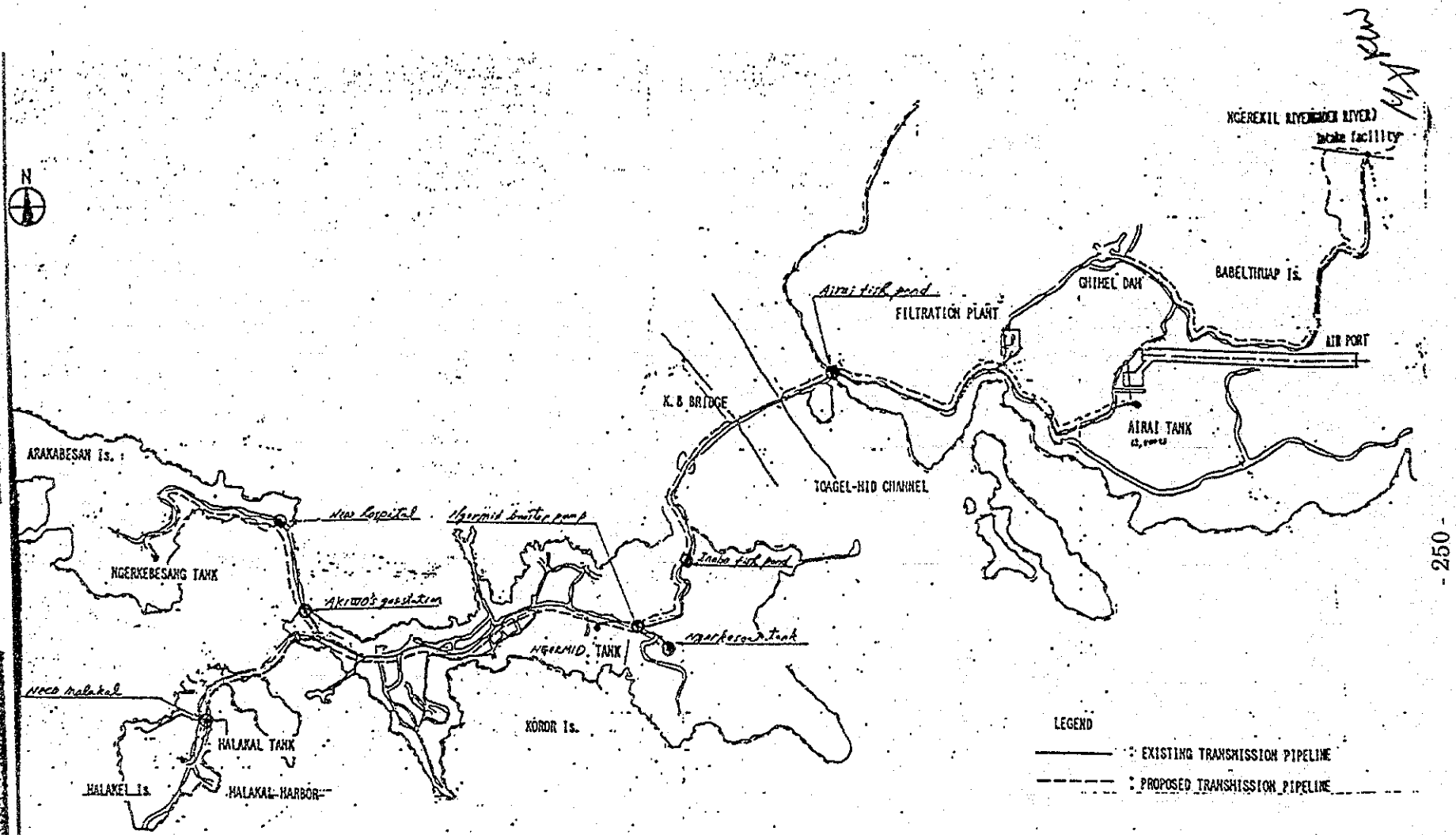


Fig. AN-5 POSITION OF FLOW METER

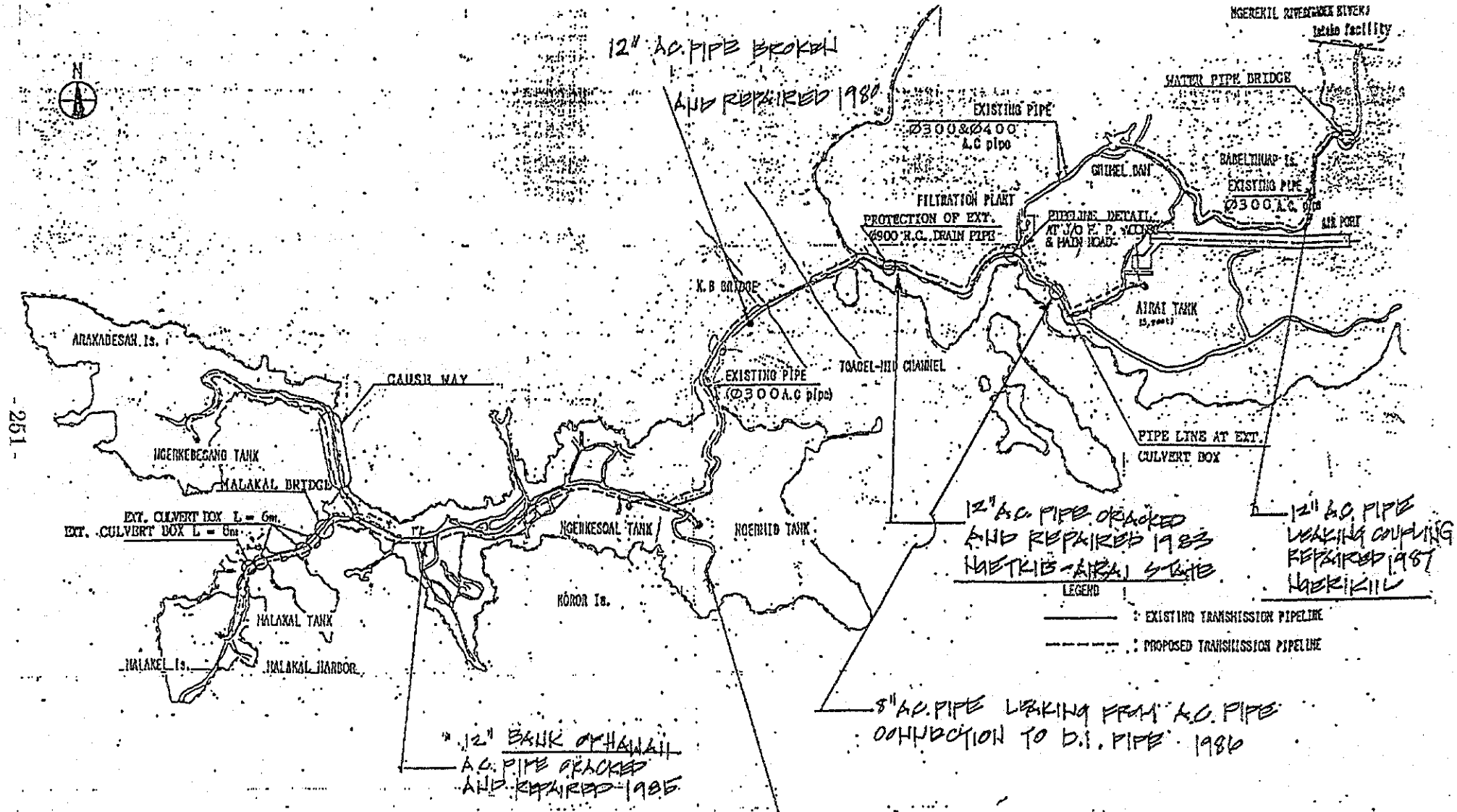


Fig. AN-6 LOCATION OF MAJOR WATER LINE LEAKS

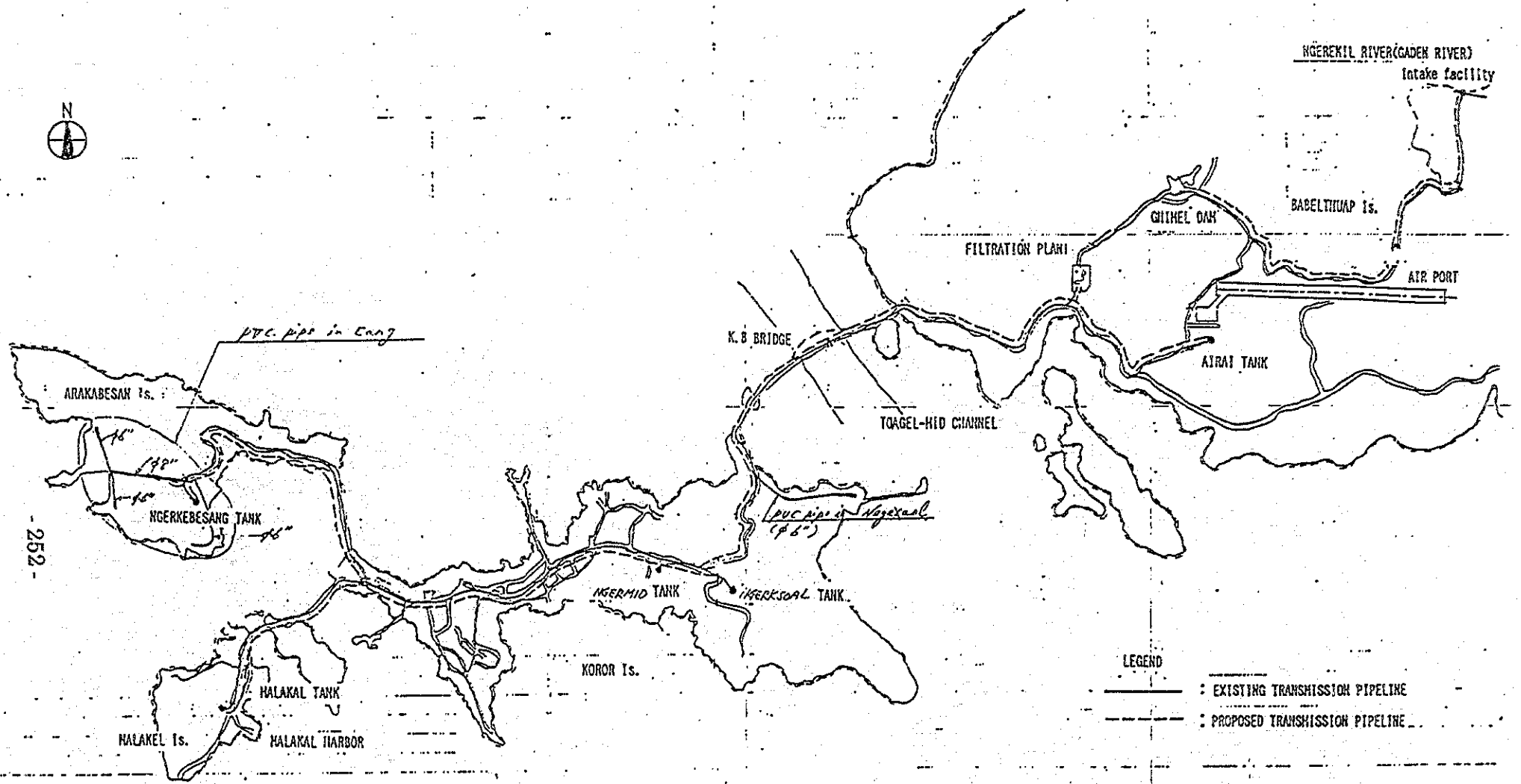


Fig AN-7 POSITIONS OF PVC PIPES TO BE INSTALLED BY US AID'S PROJECT

18 Dec '89
by PWB.

KOROR/AIRAI WATER SYSTEM
AVERAGE BILLING - 7/31 - 8/31/89

ROUTE NO/HAMLET		NUMBER OF ACCOUNT	METERED USAGE MG	METER CHARGE	FLAT RATE	TOTAL
R01001	MEKETII	100	0.461	231.	290.	521.
R01002	IKELAU	74	0.493	246.	135.	381.
R01003	MEDALII	227	1.939	970.	585.	1.555.
R01004	NGERBECHED	250	2.229	1.115.	320.	1.435
R01005	IDID	104	0.623	311.	265.	576.
R01006	DNGERONGER	100	0.307	153.	330.	483.
R01007	IYEBUKEL	139	0.859	429.	270.	699.
R01008	NGERKESUAOL	107	0.343	172.	255.	427.
R01009	NGERCHEMAI	220	1.800	901	285.	1.186.
R01010	MEYUNGS	137	0.557	276.	335	611.
R01011	NGERMID	69	0.521 ~~0.557~~	260.	80.	340.
R0100C	COMMERCIAL	114	1.947	946. ~~210.~~	210. ~~1,207~~	1,208
R0100G	GOVERNMENT	70	—o—	—o—	350.	350.
	TOTAL:	1,705	12.127 M.G.	$6,062	$3.710	$9,772

SHY

TOTAL METERED : 1,163

TOTAL UNMETERED: 542

Table AN-3 NUMBER OF FLOW METER

KLW
M.A

Table AN-4. Number of service connections and water meters

Area	Number of service connections	Number of working water meters	Number of damaged water meters and unequipped water meters
Koror	1,705	1,163	542
Airai	300	—	300
Total	2,005	1,163	842 (approx 42%)

Table AN-5. Back-wash water volume of sand filter

1. Back-wash water volume per one unit/day

Back-wash water volume(V): Approx. 3140 ~ 4710 gallons/day

where

Rate of back-wash per sq ft/min. (q) = 10 ~ 15 gallons

Time of back-wash (t) = 4 min.

Diameter of sandfilter (D) = 20 ft.

$V = \frac{\pi D^2}{4} \times q \times t = \frac{3.14 \times 10^2}{4} (10 \sim 15) \times 4 = 3140 \sim 4710$ gallons/day

= Approx. 11.9 ~ 17.8 m^3/day

2. Back-wash water volume per four (4) units/day

$V_0 = V \times 4 = 12,560 \sim 18,840$ gallons/day

= Approx 48 ~ 71 m^3/day

M.A KEW

Table An-6 CONTENTS OF US'S PROJECT FOR WATER SUPPLY SYSTEM IN AIRAI AND KOROR AREA.

1. WATER SUPPLY FACILIES WHICH HAS BEEN CONSTRUCTED UNTIL 1978

- NGEREKIL RIVER DAM
- NGEREKIL RIVER PUMP STATION
- RAW WATER TRANSMISSION PIPELINE
- GIHMEL DAM
- AIRAI WATER TREATMENT PLANTS
- CLEAN WATER TRANSMISSION PIPELINES
- CLEAN WATER DISTRIBUTION PIPELINES
- WATER TANKS
- ALL OTHER RELATED EXISTING FACILITIES EXCEPT OLD JAPANESE INSTALLED PIPELINE

2. WATER SUPPLY FACILITIES TO BE CONSTRUCTED BY PALAU WATER DEVELOPMENT PROJECT II IN AIRAI AND COROR AREA.

(ii) Installation of submersible water pumps, pump houses, chain link fences, PVC transmission lines, chemical feed system, electrical support for eight (8) wells located in Arakabesang, Koror and Airai.

(iii) Rewiring of the control panels for two (2) existing water pumps and installation of a new water pump at Gaden river pump station as well as installation of an oil-controlled swing check valve.

(iv) Installation of pipe modifications at Gihmel dam and installation of one sand filter with related piping, valves and connections to existing pipes, sump box with drain line and all other incidentals related to the Airai water treatment plant filters.

v. (PVC lines in ... Edang ... and Ngesaol

MN Kew

APPENDIX X

CONSTRUCTION EQUIPMENT, MATERIAL AND LABOR AVAILABLE LOCALLY

CONSTRUCTION EQUIPMENT, MATERIAL AND LABOR LOCALLY AVAILABLE (1989)

1. Construction Labor
   - Worker
   - Surveyer
   - Typist
   - Carpenter
   - Draft man
   - Driver

2. Construction Material
   - Reinforcing steel
   - Sand
   - Diesel oil
   - Cement
   - Timber
   - Crashed stone
   - Ready-mixed concrete (4,000PSI)
   - Ready-mixed concrete (3,500PSI)
   - Ready-mixed concrete (3,000PSI)
   - Ready-mixed concrete (2,500PSI)
   - Ready-mixed concrete (2,000PSI)
   - Ready-mixed concrete (1,500PSI)
   - Ready-mixed concrete (1,000PSI)
   - Concrete block (8" x 8" x 16")
   - Concrete block (6" x 8" x 16")
   - Concrete block (4" x 8" x 16")

3. Construction Equipment
   - Truck crane 35 ton
   - Back hoe
   - Vibro roller
   - Tire roller
   - Pay loader
   - Dump truck 8 ton
   - Dump truck 10.5 ton
   - Dump truck 12 ton

Flat bed crane 6 ton
Flat bed crane 3 ton
Air compressor 600 CFM
Fork lift 5 ton
Grader
Generator 90 kw (128hp)
Generator 30 kw (43hp)
Concrete mixer 15 CF
Concrete mixer 3-1/2 CF
Compactor
Engine welding machine
Electric welder
Engine vibrator
Electric vibrator
3" water pump
2" water pump
Lathe
Table drill

APPENDIX XI

REFERENCES

References

- Map of Palau Islands
- Drawings of existing water and sewer Facilities
- First National Development Plan (1987-1991) of Republic of Palau
- Koror Master Plan 1976
- Soil Survey of Islands of Palau
- Water Resources Data Hawaii and Other Pacific Area, Water Year 1986
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- Palau Water Preliminary Engineering Report
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- Specifications of Koror - Babelthuap Bridge
- Maintenance Manual of Koror - Babelthuap Bridge
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- Abstract of Statistics 1983
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- Field Investigation, Preliminary Design Calculations