APPENDIX

Appendix-1 Water Level and Quality of the Mekong River

Table Water Level of the Mekong River

Year	Water Level (m) High	Low
1965	+ 166.62	+ 158.20
1966	+ 170.75	+ 158.30
1967	+ 167.19	+ 158.58
1968	+ 168.20	+ 158.34
1969	+ 169.91	+ 158.08
1970	+ 169.89	+ 158.30
1971	+ 170.55	+ 158.66
1972	+ 167.90	+ 158.47
1973	+ 169.72	+ 158.49
1974	+ 170.24	+ 158.57
1975	+ 168.80	+ 158.37
1976	+ 169.31	+ 158.57
1977	+ 167.94	+ 158.72
1978	+ 170.84	+ 158.42
1979	+ 168.24	+ 158.27
1980	+ 169.94	+ 158.58
1981	+ 169.24	+ 158.69
1982	+ 168.78	+ 158.62

Data Source: Navigation and Irrigation Department
(at Wat Sop)

Table Frequency Distribution of Water Level, the Mekong River

Water Level	Frequency (%) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
less than +159	14.5	57.8	86.8	93.9	44.9	3.3	-	-	-	-	-	-	24.9
+159 - +160	70.4	42.2	13.2	6.1	42.2	16.7	-	-	-	-	-	20.2	17.5
+160 - +161	15.1	-	-	-	10.7	32.2	2.2	-	-	-	12.8	54.6	10.7
+161 - +162	-	-	-	-	1.1	23.9	7.2	-	-	1.6	41.1	21.2	8.0
+162 - +163	-	-	-	-	1.1	11.4	20.7	2.1	-	21.5	27.2	4.0	7.4
+163 - +164	-	-	-	-	-	10.0	18.8	3.5	2.5	34.4	8.3	-	6.5
+164 - +165	-	-	-	-	-	2.5	33.6	26.9	38.3	37.6	8.1	-	12.3
more than +165	-	-	-	-	-	-	17.5	67.5	59.2	4.9	2.5	-	12.7

Table Monthly Turbidity Record of the Mekong River

Month	1971			1972			1973		
	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
JAN	280	80	127	200	60	120	140	60	96
FEB	400	80	122	100	60	85	80	40	66
MAR	80	30	44	280	60	119	90	50	75
APR	60	20	40	120	80	91	80	60	73
MAY	200	40	118	120	80	104	120	80	99
JUN	800	100	255	120	40	83	190	120	155
JUL	800	60	381	1280	40	198	1450	180	668
AUG	1280	112	631	1900	460	1300	960	460	713
SEP	2480	280	822	1600	440	772	3200	560	1512
OCT	2240	280	680	640	160	396	1000	380	530
NOV	560	240	320	360	120	213	420	300	349
DEC	200	100	137	640	100	272	580	220	302

(Unit: degrees)

Table Monthly Alkalinity Record of the Mekong River

Month	1971			1972			1973		
	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
JAN	105	84	93	106	85	95	94	74	85
FEB	110	83	95	106	79	93	95	77	89
MAR	108	90	102	113	83	90	98	78	92
APR	116	95	104	102	85	92	98	84	92
MAY	125	86	103	196	85	88	98	75	84
JUN	115	76	95	102	64	81	89	55	71
JUL	110	70	84	86	54	66	87	62	71
AUG	117	63	84	128	41	80	139	62	89
SEP	98	67	80	89	50	66	134	51	99
OCT	106	65	83	86	61	67	87	56	74
NOV	106	76	87	90	62	76	85	60	72
DEC	114	84	96	89	62	74	94	64	77

(Unit: mg/l)

Table Monthly Record of pH, Electric Conductivity and $KMnO_4$-Consumed

Month	ph (1973)			E.C. (1972) (micro mho/cm)			$KMnO_4$-Con'd (1973) (mg/l)		
	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
JAN	7.5	7.2	7.3	212	167	200	9.7	5.6	7.3
FEB	7.6	7.3	7.4	250	179	219	9.8	2.5	6.4
MAR	8.2	7.4	7.8	256	185	222	9.5	2.5	5.0
APR	8.1	7.4	7.9	256	217	253	11.1	1.2	4.2
MAY	8.4	7.5	8.0	256	217	235	11.0	4.1	9.5
JUN	8.2	7.9	8.1	250	200	228	15.8	0.5	9.0
JUL	8.3	8.0	8.2	250	189	224	36.3	1.6	15.5
AUG	8.2	7.4	7.8	233	149	179	31.0	8.2	19.1
SEP	8.1	7.3	7.7	238	145	173	29.0	12.0	19.0
OCT	8.1	7.4	7.7	217	154	176	19.0	5.9	8.9
NOV	7.6	7.3	7.4	222	159	197	8.3	4.5	6.8
DEC	7.6	7.2	7.5	200	143	163	8.6	4.7	5.2

Appendix-2 Inventory of Existing Facilities

Facilities	Qty	Description
A. INTAKE FACILITIES		
Intake Tower		
Structure	1	reinforced concrete structure (shape of elongated circle) dimension; W6.0m x L9.0m x H25.0m intake water levels; HWL +171.5 LWL +159.5
Influent gate	3	Ø700 mm with screen
Drain pump	1	Ø200mm x 3.7kW
Chain block	1 1	5 ton capacity 10 ton capacity
Intake Pump		
Pump	3	vertical mixed flow type Ø300 x Ø260 x Q7.65 m3/min x H9.0m x 37kW (including one stand-by)
Column pipe	3	Ø300mm x L18m
Check valve	3	Ø250mm (swing type)
Sluice valve	3	Ø250mm
Pipe support	3	made of shaped steel
Pump House	1	reinforced concrete structure (shape of elongated circle) dimension; W5.6m x L8.6m x H4.8m
Transmission Pipe		
Pipe	1	Ø500mm x L30m steel pipe interior; coal tar epoxy exterior; painting
Flow meter	1	Ø500mm orifice plate
Inspection Bridge	1	shaped steel truss structure dimension; W1.5m x L30m

Facilities	Qty	Description
B. TREATMENT FACILITIES		
Mixing Basin		
Structure	1	reinforced concrete structure dimension; Ø2.8m x D4.0m (24.6 m3) detention time; 1.6 min.
Flash mixer	1	alum feeding point; in front of influent pipe
Piping	1	Ø500 - Ø400mm x L 38 m
Valves	2	Ø400 mm sluice valve
Flocculation Basin		
Structure	2	reinforced concrete structure up and down flow by baffle plate dimension; W4.0m x L23.0m x D4.9m (235 m3) detention time; 30 min.
Sedimentation Basin		
Structure	2	reinforced concrete structure type; rectangular horizontal flow dimension; W12.0m x L24.0m x D5.15m (1,480 m3) detention time; 3.2 hrs. overflow rate; 1.6 m3/hr.m2 effluent; effluent gutter W0.5m x L38m desludging; by man power
Piping	4	overflow pipe; Ø150m
Gravel Filter		
Structure	2	reinforced concrete structure located at the outlet of the sedimentation basin. dimension; W8.0m x L11.0m surface area; 88 m2 filtration rate; 125 m /day
Piping		washing; Ø50mm SGP inside of gravel layer

Facilities	Qty	Description
Clarified Water Conduit		
Structure	1	reinforced concrete structure dimension; W0.6m x L14.5m x D0.5m
Rapid Sand Filter		
Structure	4	type; constant rate filtration structure; reinforced concrete dimension; W5.5m x L8.2m surface area; 45.1 m2 filtration rate; 122 m /day water depth above sand; 1.2m total filter head; 3.1 m
Filter media		sand effective size; unknown uniformity coefficient; unknown thickness; 70 cm gravel size; unknown thickness; 50 cm
Under drain		perforated pipe (PVC) (opening ratio 0.3%)
Backwashing		by backwash pump
Surfacewashing		by fixed nozzle diffuser from distribution main
Washwater trough		B0.4 x H0.6 x L8.4m x 2 nos/filter B0.2 x H0.6 x L8.4m x 2 nos/filter
Controller	4	Ø250mm lever type controller
Filter head	4	by float type manometer
Piping of filter		
influent pipe	4	Ø300mm, steel pipe
effluent pipe	4	Ø250mm, - " -
backwash pipe	4	Ø400mm, - " -
surfacewash pipe	4	Ø200mm, - " -
drain pipe	4	Ø100mm, - " -
	8	Ø450mm, - " - (for washwater drain)
	1	Ø600mm, - " - (main pipe for drain)
overflow pipe	4	Ø200mm, - " -

Facilities	Qty	Description
Valves of filter		
influent valve	4	Ø300mm sluice valve with manual operating floor stand
effluent valve	8	Ø250mm sluice valve with manual operating floor stand
backwash valve	4	Ø400mm sluice valve with manual operating floor stand
surfacewash valve	4	Ø200mm sluice valve with manual operating floor stand
drain valve	8	Ø450mm flat valve with manual operating floor stand
	4	Ø100mm sluice valve with manual operating floor stand
Operation gallery	1	W3m x L25m roofed by asbestos cement
Inspection passage	1	W0.6m x L25m wooden structure
C. DISTRIBUTION FACILITIES		
Clear Water Reservoir		
Structure	2	reinforced concrete structure dimension; W16m x L32m x D4.0m (2,000 m3) detention time; 4.5 hrs. water level; HWL +170.60 LWL +166.60
Valves of reservoir		
Ø350	2	for connecting each reservoir with manual operating floor stand
Ø350	2	for connecting pump well each other with manual operating floor stand
Ø300	8	for connecting reservoir with pump well with manual operating floor stand
Water level meter	1	float type
Ventilator	1	made of wooden structure
Distribution Pump		
Pump	4	horizontal shaft centrifugal Ø250 x Ø200 x Q6.3 m3/min x H67m x 110kW (including one stand-by)

Facilities	Qty	Description
Piping		
suction pipe	4	Ø250mm, steel pipe
delivery pipe	4	Ø200mm, - " -
Valves		
suction	4	Ø250mm foot valve
delivery	4	Ø200mm check valve
	4	Ø200mm sluice valve
Backwash Pump		
Pump	2	horizontal shaft centrifugal Ø350 x Q14.5 m3/min x H16m x 60kW
Piping		
suction pipe	2	Ø350mm, steel pipe
delivery pipe	2	Ø350mm, - " -
Valves		
suction	2	Ø350mm foot valve
delivery	2	Ø350 check valve
	2	Ø350 sluice valve
Vacuum Pump		
Pump	2	
D. CHEMICAL FEEDING EQUIPMENT		
Alum Feeding Equip.		
Solution tank	2	reinforced concrete made dimension; W1.0m x L1.0m x D1.3m
Appurtenances		0.4kW mixers, level regulating tank, flow meter, flow control valve and feeding pipe Ø25mm, PVC
Feeding point	-	in front of influent pipe of mixing basin
Hypochlorite Feeding Equip.		
Solution tank	2	PVC made dimension; Ø63cm x D94cm
Feeding point	-	inlet of the reservoir

Facilities	Qty	Description
E. ELECTRIC EQUIPMENT		
Power Sub-station		
Main transformer	1	750kVA, 22 kv/380v
Appurtenances		MOF 15kv Metering out fit, oil circuit breaker, 15kv disconnecting switch, arrester
Power Distribution		
Operation panel	1	for sub-station
Distribution panel	1	for power distribution
Lighting panel	1	for power distribution
Generator	1	for emergency use
Motor Control Panel		
Intake pump	1	location; intake pump house type; cubicle indoor capacity; for 37kw x 3 starter; direct
Distribution pump	1	location; distribution pump house type; cubicle indoor capacity; for 110kw x 4 starter; condorfer
Backwash pump	1	location; distribution pump house type; cubicle indoor capacity; for 60kw x 2 starter; Reactor
Flash mixer	1	location; mixing basin type; self stand type, outdoor use capacity; for 7.5kw x 1
Central Control Panel	1	location; control center located beside Alum feeding room type; wall mount type, indoor appurtenances; motor starter for chemical mixer, control switch, indicating lamp and ammeter for intake pump, ad backwash pump

Facilities	Qty	Description
Instrumentation		
Water level	1	raw water level of intake
	2	water level of the reservoir
Flow meter	2	raw water flow distribution flow
F. BUILDINGS		
Alum Storage	1	reinforced concrete structure dimension; W6.25m x L13.0m winch for Alum stone transportation
Alum Feeding and Control Room	1	reinforced concrete structure dimension; W5.0m x L13.0m
Chlorination Room	1	reinforced concrete structure dimension; W4.1m x 8.0m
Distribution Pump House	1	reinforced concrete structure dimension; W6.0m x L24.5m
	1	traveling crane with capacity of 5 ton
Electric Room	1	reinforced concrete structure dimension; W5.0 x L9.0m
Office and Laboratory	1	wooden structure dimension; W8.5m x L13.0m
Hall	1	wooden structure dimension; W8.5m x L9.0m
Warehouse	4	wooden structure

Appendix-3 Present Conditions of the Existing Facilities

A. INTAKE FACILITIES

Intake Tower

No severe and critical damages on the structure is observed.

Influent gates are not in working condition due to the bent shaft of operating floorstand. Also no screen is equipped on the influent of gate.

Drain pump and chain blocks are in working condition.

Intake Pump

All pumps are currently operated with difficulty by repairing intermittently. Severe wear-off of impeller and bearings are observed.

Severe leakage from both check and gate valves are observed.

Almost all pipe supports for pumps are damaged at connections with column pipes and wall of the intake tower.

Pump House

No severe or critical damage is observed except the door and windows.

Some part of floor (checkered plate) are damaged.

Transmission Pipe

No severe wear-off on both interior and exterior surface is observed.

Inspection Bridge

No severe and critical damages is observed.

B. TREATMENT FACILITIES

Mixing Basin

No severe and critical damage is observed. Also no leakage is observed from the wall.

The flash mixer was already removed from the basin.

Pipes and valve are still in working condition.

Flocculation Basin

Some leakages from walls are observed, however, they will not affect its operation at the present.

Sedimentation Basin

Some leakages from outer walls are observed, however, they will not affect its operation.

Leakages from overflow pipes are observed.

Gravel Filter

No severe damage is observed.

Leakages from stop valves for washing pipes are observed.

Rapid Sand Filter

Some leakages from outer walls are observed, however, they will not affect for its operation.

All of Ø250mm controllers are not in working condition.

All of manometers are not in working condition.

Leakage from a surfacewash pipe (in pipe gallery) is observed.

Some leakages from valves are observed, they are from Ø250 sluice valves (8 nos), Ø450 sluice valve (4 nos). Also almost all bolts for valve are stained.

Other pipes and valves are in good condition.

Some part of roof for operation gallery are destructed (made of asbestos cement sheet).

Wash water troughs: Wear-off and holes observed.

Inspection passage is deteriorated due to humidity in the pipe gallery.

C. DISTRIBUTION FACILITIES

Clear Water Reservoir

No observation can be made on structural conditions because it is constructed under the ground.

Water level meter was already removed due to out of order.

Ventilator is almost destructed.

All valves are not in working condition.

Distribution Pump

All pumps have considerable vibration and unusual noise caused by cavitation.

Considerable leakages from check valves are observed also spindle of sluice valves are severely worn off because operation has been done so often for flow control.

No severe damages of piping are observed.

Backwash Pump

All of the pumps have the same conditions as the distribution pump.

Considerable leakages from check valves are observed, also considerable wear-off of the spindle of sluice valve are observed.

No severe damages is observed from piping.

Vacuum Pump

Currently operating with difficulties.

D. CHEMICAL FEEDING EQUIPMENT

Alum Feeding Equipment

Severe deterioration of surface of the solution tanks are observed due to no coating were applied on the concrete surface.

Mixer is still in working condition.

Level regulating tank is severely deteriorated.

Flow meter and control valve are presently used with difficulty.

Hypochlorite Feeding Equipment

Solution tanks are presently used, however their capacity will be too small. More over the feeding point of hypochlorite is not proper location. Totally the feeding system is necessary to revised.

E. ELECTRIC FACILITIES

Power Sub-station

Almost all equipment of power sub-station are deteriorated such as leakage of oil from transformers, out of order for MOF, PT, CT, Line Switch.

Power Distribution

All meters and protection relays for panels are out of order.

Generator is also out of order.

Motor Control Panel

Motor control panel for intake pump is used with difficulty;
for distribution pump is still in working condition; and
for backwash pump is still in working condition.

Motor Control Panel for Flash Mixer

Out of order.

Central Control Panel

All ammeters are out of order.

Instrumentation

All meters are out of order.
Transmitters for raw water and distribution flow meters are out of order.

Lighting

Almost all lighting fixtures are out of order or removed.

F. BUILDINGS

All buildings in the Plant are still serviceable except the followings.

Alum Storage

Winch for the transportation of Alum stone is out of order.

Alum Feeding and Control Room

Control room is recommended to be separated from Alum feeding room.

Office and Laboratory

During rainy season, the floor is always inundated by about 40 cm.

Appendix-4 Water Demand by Extended Service Area

Dong Dok Area - 1

CATEGORY	POPULATION	POPULATION SERVED	PER CAPITA CONSUMPTION (lpcd)	DAILY AVERAGE DEMAND (m^3/d)	DAILY MAXIMUM DEMAND (m^3/d)	HOURLY MAXIMUM DEMAND (m^3/d)
Domestic Demand	(4,700[1/]) 5,800	4,100	136	620	712	926
Non-domestic						
Education College	6,700	6,700	170	1,266	1,455	1,455
Institute of Forestory	200	200	170	38	44	57
Repair Shop	350	350	200	78	90	117
(Saw Mill)	150	150	50	(8)	(9)	(12)
(Institute of Politics)		8		(38)	(44)	(57)
(Saw Mill & Wood Craft[2/])	500	500	200	(111)	(128)	(128)
Sub-total				2,159	2,482	2,752
Dong Dak Area - 2				555	638	784
Total				2,714	3,120	3,536

NOTES: 1/ Breakdown of Population by Villages

Village	Year 1982	Year 1990
Sa Phang Muk	650	800
Pha Khao Muk	1,700	2,100
Sang Khou	700	900
Civilay	600	700
Tane Miay	1,000	1,300

2/ Future factory

( ) Future factory

Appendix-4 Water Demand by Extended Service Area

Phone Tong Area - 1

CATEGORY	POPULATION	POPULATION SERVED	PER CAPITA CONSUMPTION (lpcd)	DAILY AVERAGE DEMAND (m^3/d)	DAILY MAXIMUM DEMAND (m^3/d)	HOURLY MAXIMUM DEMAND (m^3/d)
(PHONE TONG AREA-1-1)						
Domestic Demand 1/ (Branch to Phone Tong village)	1,200	800	260	277	319	415
(PHONE TONG AREA-1-2)						
Domestic Demand 1/	1,200	800	260	277	319	415
Non-domestic Hospital		(150beds)	500	83	95	95
Sub-total				360	414	510
Phone Tong Area-2				277	319	415
Total				634	733	925

NOTES: 1/ 1982 population: 1,000

Appendix-4 Water Demand by Extended Service Area

Thadua Road Area-1

CATEGORY	POPULATION	POPULATION SERVED	PER CAPITA CONSUMPTION (lpcd)	DAILY AVERAGE DEMAND (m^3/d)	DAILY MAXIMUM DEMAND (m^3/d)	HOURLY MAXIMUM DEMAND (m^3/d)
Domestic Demand	2,700	1,900	138	290	334	434
Non-domestic Demand						
Tobacco factory	200	200			100	100
Fertilizer factory	300	300			150	150
Soap factory	150	150			50	50
Transportation station	150	150			80	80
Provincial Irrigation Dept.	250	250			40	40
Plywood (1)	380	380			300	300
Acetylene	50	50			50	70
Textile	350	370			90	90
Plywood (2) 2/	5,800	5,800			500	500
Technical School	550	550			80	80
Sub-total					1,794	1,894
Thadua Road Area - 2					1,479	1,776
Total					3,273	3,670

NOTES: 1/ Breakdown of Population by villages

Villages	Year 1982	Year 1990
Sone Sanouk	1,200	1,500
Nong Hai	1,000	1,200

2/ Including dormitory

3/ Requested by each factory

Appendix-4 Water Demand by Extended Service Area

Thong Pong Area

CATEGORY	POPULATION	POPULATION SERVED	PER CAPITA CONSUMPTION (lpcd)	DAILY AVERAGE DEMAND (m^3/d)	DAILY MAXIMUM DEMAND (m^3/d)	HOURLY MAXIMUM DEMAND (m^3/d)
Deomestic Demand 1/	1,600	1,100	136	166	191	248
Non-domestic						
Market					200	260
Saw Mill A					10	13
Saw Mill B	500	500	50	28	32	42
Repair shop	300	300	200	60	69	69
Cement & Line Factory	200	200	200	40	46	46
Future Factories					800	800
Total					1,348	1,478

NOTE: 1/ Present Population (1982) : 1,300

Notes for Appendix - 4

- Daily average demand includes 10% loss.
- Daily maximum demand = Daily average demand x 1.15
- Hourly maximum demand = Daily maximum demand x 1.30

Appendix-5 Hydraulic Analysis of Existing Distribution Networks

Pipe Line	Discharge Point	G.L.	Discharge Rate (l/sec)	Flow Rate (l/sec)	Pipe Dia. (mm)	Pipe Length (km)	I (o/oo)	Hf (m)	H (m)
Kaolieo System									
	A	+171	8.7						+234.0
A - 1'	1'	+170	19.5	223.7	Ø450	0.7	5.5	3.9	+230.1
1'- 1	1	+170	47.7	206.2	Ø450	2.3	4.2	9.7	+220.4
1 - 2	2	+170	46.2	163.5	Ø450	1.6	3.1	5.0	+215.4
2 - 3	3	+170	39.1	122.1	Ø390	1.0	3.6	3.6	+211.8
3 - 8	8	+169	65.1	87.1	Ø400	1.9	1.7	3.2	+208.6
8 - 17	17	+180	32.2	28.8	Ø400	2.3	0.2	0.5	+208.1
Chinaimo System									
	B	+170	5.3						+226.0
B - 7	7	+170	73.2	551.5	Ø1000	1.0	0.59	0.6	+225.4
7 - 6	6	+171	52.5	478.4	Ø700	2.4	2.58	6.2	+219.2
6 - 5	5	+170	46.4	+144.0	Ø450	3.1	2.42	+7.5	+211.7
5 - 14	14	+177	70.8	+ 30.0	Ø350	2.1	0.45	+1.0	+210.7
14 - 15	15		44.0	-218.1	Ø600	2.0	1.29	-2.6	+213.3
15 - 16	16		19.8	-262.1	Ø600	1.3	1.81	-2.4	+215.7
16 - 6	6	+171	52.5	-281.9	Ø600	1.7	2.07	-3.5	+219.2
5 - 4	4	+171	24.4	+ 67.6	Ø410	1.0	0.94	+0.9	+210.8
4 - 9	9		39.3	+ 43.2	Ø230	1.2	6.85	+8.2	+202.6
9 - 10	10		31.7	- 2.2	Ø150	1.1	0.22	-0.2	+202.9
10 - 14	14	+177	70.8	- 37.6	Ø250	2.2	3.53	-7.8	+210.7
14 - 5	5		46.4	- 30.0	Ø350	2.1	0.45	-1.0	+211.7
10 - 11	11	+172	92.0	+ 3.7	Ø150	1.4	0.58	+0.8	+202.0
11 - 12	12		30.8	- 82.2	Ø350	1.2	2.91	-3.5	+205.6
12 - 13	13		26.7	-113.0	Ø450	2.0	1.54	-3.1	+208.8
13 - 14	14	+177	70.8	-139.7	Ø450	0.8	2.28	-1.8	+210.7
14 - 10	10		31.7	+ 37.6	Ø250	2.2	3.52	+7.8	+202.9
10 - 9	9		39.3	+ 2.2	Ø150	1.1	0.22	+0.2	+202.6
9 - 11	11	+172	92.0	+ 6.1	Ø200	2.0	0.36	+0.7	+202.0
11 - 10	10		31.7	- 3.7	Ø150	1.4	0.58	-0.8	+202.9

LEGEND

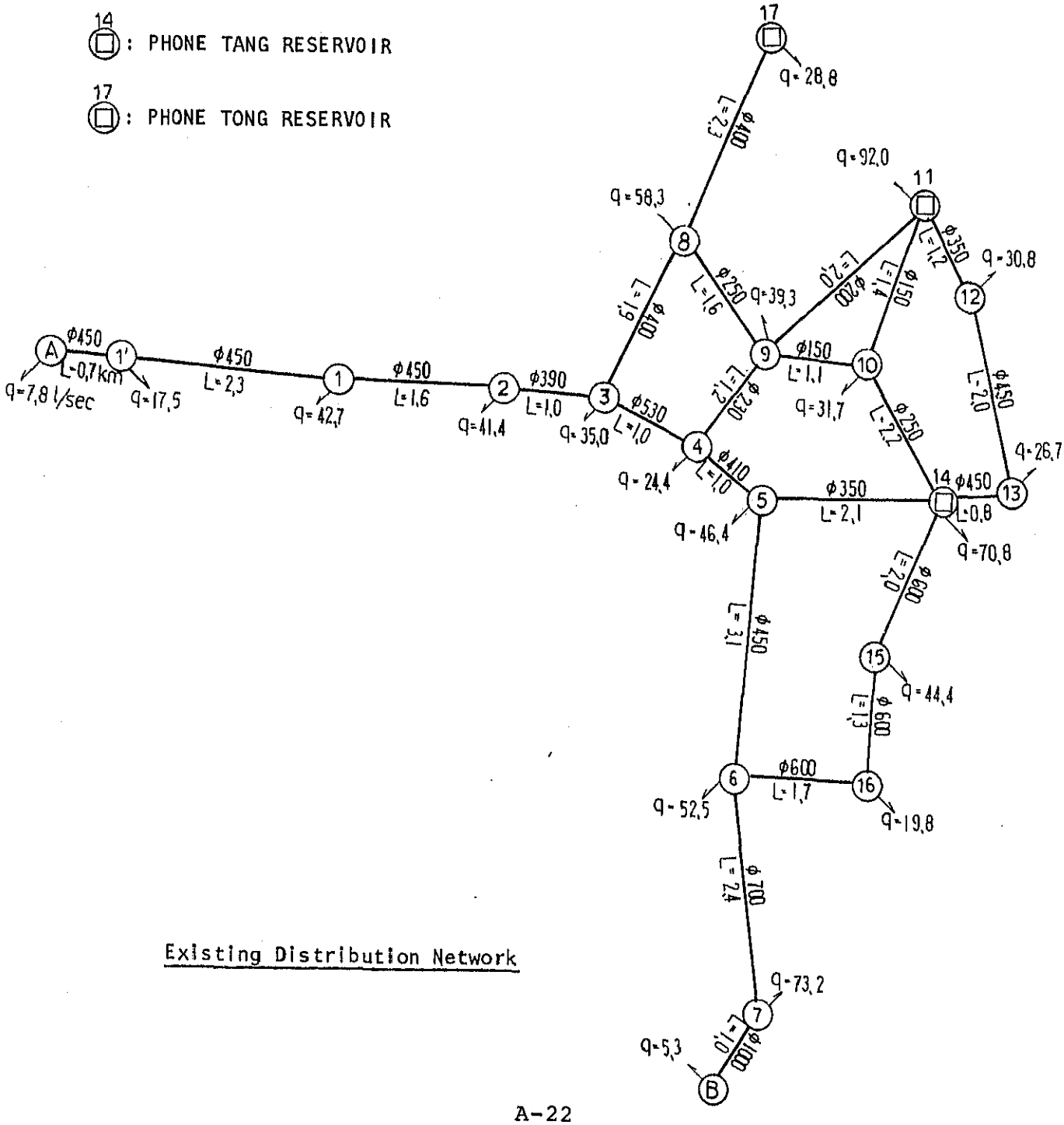
(A) : KAOLIEO PLANT

(B) : CHINAIMO PLANT

11 (□) : PHONE KHENE RESERVOIR

14 (□) : PHONE TANG RESERVOIR

17 (□) : PHONE TONG RESERVOIR



Existing Distribution Network

Appendix-6 Hydraulic Analysis of Extended Pipelines

Table Hydraulic Analysis of Route - A

Discharge Point	G.L.	Discharge Rate (m3/day)	Flow Rate (m3/day)	Dia. (mm)	Length (m)	I (o/oo)	Hf (m)	H (m)	He (m)
(1)	167	-						227.0	60
			3,120	250	850	2.75	2.3		
(2)	167	90						224.7	57.7
			3,030	"	900	2.60	2.3		
(3)	167	344						222.4	55.4
			2,686	"	1,430	2.08	3.0		
(4)	167	638						219.4	52.4
			2,048	"	400	1.26	0.5		
(5)	167	98						218.9	51.9
			1,950	"	240	1.15	0.3		
(6)	168	110						218.6	50.6
			1,840	"	460	1.03	0.5		
(7)	172	137						218.1	46.1
			1,703	"	490	0.90	0.4		
(8)	179	160						217.7	38.7
			1,543	"	840	0.75	0.6		
(9)	191	44						217.1	26.1
			1,499	"	90	0.71	0.1		
(10)	191	1,499						217.0	26.0

Note: (1) Booster pump station (H=202.0 + 25.0 = 227.0)
(2) Repair shop
(3) Pha Khao village
(4) Dong Noun area
(5) Sa Phong village
(6) Sang Khou village
(7) Saw mill wood craft
(8) Tane Mixy village
(9) Political institute
(10) Education collage & Institute of Forestory (Elevated Reservoir)

Table Hydraulic Analysis of Route - C

Discharge Point	G.L.	Discharge Rate (m3/day)	Flow Rate (m3/day)	Dia. (mm)	Length (m)	I (o/oo)	Hf (m)	H (m)	He (m)
(1)	167	-						202.0	35.0
			856	200	680	0.74	0.5		
(2)	167	-						201.5	34.5
			733	150	2,100	2.26	4.7		
(3)	187	733						196.8	9.8

Note: (1) Downstream of booster pump station

(2) Connection point with Existing Ø200 ACP

(3) Hospital, domestic demand, medicine factory and electric equipment

Table Hydraulic Analysis of Route - D

Discharge Point	G.L.	Discharge Rate (m3/day)	Flow Rate (m3/day)	Dia. (mm)	Length (m)	I (o/oo)	Hf (m)	H (m)	He (m)
(1)	172	-						225.4	53.4
			3,670	250	1,660	3.73	6.2		
(2)	176	100						219.2	43.2
			3,570	"	400	3.55	1.4		
(3)	177	434						217.8	40.8
			3,136	"	110	2.81	0.3		
(4)	177	200						217.5	40.5
			2,936	200	380	7.30	2.8		
(5)	175	80						214.7	39.7
			2,856	"	310	6.91	2.1		
(6)	170	40						212.6	42.6
			2,816	"	240	6.74	1.6		
(7)	171	450						211.0	40.0
			2,366	"	610	4.85	3.0		
(8)	174	90						208.0	34.0
			2,276	"	180	4.56	0.8		
(9)	172	2,276						207.2	35.2

Note: (1) Branch point at DIP Ø1,000
(2) Tobacco factory
(3) Nong Hai village
(4) Fertilizer and soap factory
(5) Transportation station
(6) Provincial irrigation department
(7) Plywood factory, Technical school & Acetilen factory
(8) Textile factory
(9) Plywood factory and Thadua Road area - 2

Table Hydraulic Analysis of Route - E

Discharge Point	G.L.	Discharge Rate (m3/day)	Flow Rate (m3/day)	Dia. (mm)	Length (m)	I (o/oo)	Hf (m)	H (m)	He (m)
(1)	170	-						229.3	59.3
			1,478	150	330	8.29	2.7		
(2)	169	260						226.6	57.6
			1,218	"	220	5.79	1.3		
(3)	169	14						225.3	56.3
			1,204	"	250	5.68	1.4		
(4)	170	28						223.9	53.9
			1,176	"	220	5.43	1.2		
(5)	170	69						222.7	52.7
			1,107	"	150	4.85	0.7		
(6)	170	13						222.0	52.0
			1,094	"	210	4.75	1.0		
(7)	170	108						221.0	51.0
			986	"	1,120	3.92	4.4		
(8)	174	500						216.6	42.6
			486	100	610	7.61	4.6		
(9)	176	140						212.0	36.0
			346	"	790	4.06	3.2		
(10)	172	300						208.8	36.8
			46	"	920	0.097	0.1		
(11)	172	46						208.7	36.7

Note:
(1) Connection point with DKP Ø450
(2) Market
(3) Saw mill
(4) Saw mill
(5) Repair shop
(6) Saw mill
(7) Mah Hai village
(8) Future factory
(9) Thong Pong village
(10) Future factory
(11) Cement factory

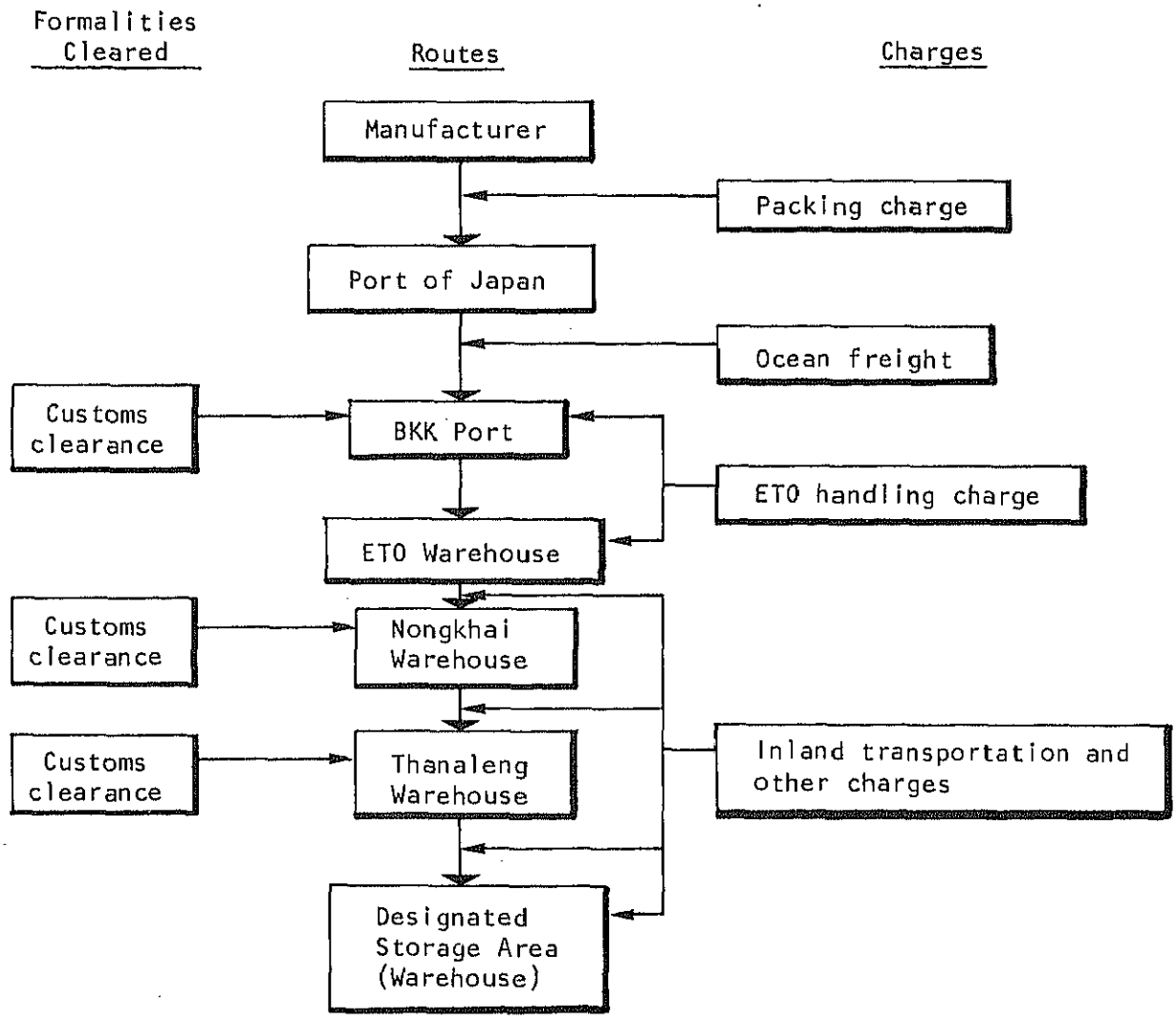
Appendix-7 Transportation of Materials and Equipment to be imported

Surveys on shipment of imported goods from Japan to Laos were made to obtain information about routes, delivery periods and costs involved. Following are the summary of the survey results:

Routes

Shipment of goods from Japan to Laos will be made as shown below:

Fig. 1 Shipment from Japan to Laos



Goods to be delivered are shipped from one of the ports of Japan after being packed and cleared at the Japanese customs. When the goods arrive at Bangkok port, they should be cleared by the Port Authority of Thailand (PAT) and are then handed over to Express Transportation Organization (ETO), monopolistic transportation organization which is handling all goods to be delivered to Laos through Tahiland. ETO will then transport the goods to Laos through Nongkhai. At Nongkhai, the goods have to be cleared by the Thai customs authority to go through formalities for export to Laos. The goods may be delivered directly to the site in Vientiane without transshipment at Thanaleng in Laos.

Delivery Period

An estimated period of delivery from Japan to Laos is shown below:

- Packing and customs clearance: 14 days
- Traffic: 7 to 10 days
- Inland transportation from Bangkok to the designated storage area: 14 days

The delivery period from Japan to the site amounts to about 40 days in average.

The delivery period by a manufacture to a purchaser in Japan varies between 1 to 4 months depending nature of goods. The delivery of vehicles such as truck crane and cargo truck, may take around 2 months.

Shipping Cost

As shown in Table-1, the shipping cost from Japan to Laos consist of various components of charges. The average rates of these components are surveyed as follows:

Table Average Rates of Shipping Charge

(Unit: Yen/ton)

Item	Amount
Packing charge	5,000
Ocean freight	13,000
Others	18,000
PAT charge	
ETO handling charge	
ETO inland transportation charge	
Entry charge to Laos	
Off-loading charge	
Total	36,000

Appendix-8 Local Materials and Labor Cost

Among items of materials locally available, a survey on availability and quality of aggregates was made.

Gravels and sands are mainly produced at Thon hon, 25 km downstream of Vientiane, and Nong Thavada upstream of Kaolieo. The gravels and sands are collected from the River during the dry season and area piled along the road. The quantity of gravels and sands is observed sufficient and, therefore, it is reported that the necessary amount of gravels and sands for the construction work will be supplied on timely basis if an advance order is placed.

With respect to the size of gravels, it is also reported that suppliers can supply materials of designated size to a certain extent. The sand is in general of big size which, however, is not considered to impair concrete strength as designed. The gravels contain some inferior stones which, however, is not considered to impair concrete strength as specified. Oversized stones should be removed by sieving before mixing.

Following shows the unit prices of locally available materials:

Table Unit Prices of Local Materials and Labor Cost

Items	Description	Unit	Unit Price (Kip)
Gravel		m3	350
Sand		m3	200
Brick	4 x 5	1,000 pc	3,000
Timber	soft wood	m3	7,500
	hard wood	m3	9,000
	plywood 9 mm	m2	134
	12 mm	m2	230
Gasoline		l	18.5
Diesel fuel		l	12.5
Skilled labor		man. day	150
Unskilled labor		man. day	50

Appendix-9 List of Construction Machine / Equipment Provided by NPP

Item	Capacity	Unit
Buldozer	D30	2
Back hoe	0.4 m3	2
Shovel (Pay Loader)	0.5 - 0.8 m3	2
Dump Truck	6 - 8 ton	4
Concrete mixer	0.5 - 1 m3	2
Re-Bar bender	Electric	1
Re-Bar cutter	Electric	1
Air compressor	2 - 3 m3/min	1
Concrete vibrator	Engine driven	2
Steel scaffolding		L.S.

Appendix-10 List of Construction Machine/Equipment and Tools to be Imported

Item No.	Description	Quantity	Remarks
1)	Truck Crane 10 ton	1	
2)	Truck Crane 3 ton	1	
3)	Fork Lift 2 ton	1	Engine Driven
4)	Winch 1,300 kg	1	Engine Driven with Cable ø12 mm, L = 250 m
5)	Chain Blocks 500 kg	2 sets	
6)	Welder	1 set	Eingine Driven
7)	Drain Pump Discharge: 5 liters/sec or more Design Head: 6 m or more	3 sets	For dewatering of trench excavation. With heavy duty inlet and outlet hose connection 10 meters in length
8)	Rotary Pipe Cutters for DCIP or CIP From 75 mm to 500 mm in nominal diameter	2 sets	Manually operated, consisting of cutter wheels and extension handle.
9)	Pipe Cutters for PVC Pipe From 75 mm to 250 mm in nominal diameter	2 sets	Wheel type tubing cutter, manually operated for PVC pipe up to 250 mm in diameter
10)	Bevelling Tool for PVC Pipe	2 sets	Cast Iron, Aluminium or Steel, manually operated
11)	Tools (each unit consisting of pipe wrench set, torque wrench set, and files set)	3 units	

(to be cont'd)

Item No.	Description	Quantity	Remarks
12)	Pumps for hydrostatic Testing of pipelines (complete with all piping, valves, hoses, pressure gauges, and accessories)	2 sets	For hydrostatic pressure testing of pipelines at 10 kg/cm2
13)	Tamper, Compaction	2 units	Gasoline driven Percussion, type, Portable. w/250 x 250 mm flat
14)	Concrete Pavement Cutter (blade of 400 mm in diameter)	2 units	With five(5) spare blades Gasoline driven
15)	Hand Pallet Truck	2 units	Manual operation, hydraulic lift
16)	Laboratory Equipment		
	a. Distiller for ammonia	1 unit	
	b. Turbidimeter	1 unit	
	c. pH meter	1 unit	
	d. Electric photo meter	1 unit	
	e. Residuse chlorine meter	1 unit	
17)	Fork and Saddle		
18)	Tools for carpentry, wood work and general civil work		
19)	Spare Parts for Machine/Equipment item 1) thru 10) and 12) thru 17)	LS	
20)	Cargo Truck, 3 ton	2	

Minutes of Discussion
on
Vientiane Water Supply
Extension and Improvement Project

In response to the request made by the Government of the Lao People's Democratic Republic for Vientiane Water Supply Extension and Improvement (hereinafter referred to as "the Project"), the Governement of Japan has sent, through the Japan International Cooperation Agency (hereinafter referred to as "JICA"), a team headed by Mr. Minoru ISHIDA, Second Economic Cooperation Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, to conduct a survey for 31 days from January 16th, 1983. The team carried out a field survey, held a series of discussions and exchanged views with the authorities concerned of the Government of the Lao People's Democratic Republic.

As the result of the study and discussions, both parties have agreed to recommend to their respective Governments to examine the results of the survey attached herewith towards the realization of the Project.

February 2nd, 1983

Mr. Minoru ISHIDA
Team Leader
The Japanese Survey Team

Mr. Boriboun SANASISANE
MANAGER of NAM PAPA LAO

ATTACHMENT

1. The objective of the Project is to extend and improve the existing water supply system in Vientiane city.

2. The Japanese Survey Team confirmed the request made by the Government of the Lao People's Democratic Republic and would carry out a detailed design of the Project as for the requested items which would be covered by grant aid. (The request with priority order is shown in Annex 1 and Annex II)

3. The Japanese Survey Team will convey to the Government of Japan the desire of the Government of the Lao People's Democratic Republic that the former takes necessary measures to co-operate in implementing the Project and bears the cost of the items requested by the latter (shown in Annex 1) according to the priority within the scope of Japanese economic cooperation program in grant form.

4. The Government of the Lao People's Democratic Republic will take necessary measures listed in Annex III on condition that the grant aid assistance by the Government of Japan is extended to the Project.

5. Both sides confirmed that Japanese Survey Team explained Japan's Grant Aid Program and Lao side understood it.

6. Besides above mentioned request, the Government of the Lao People's Democratic Republic also requested the machines and equipment for road repairment. The team mentioned that the request would be conveyed to the Government of Japan.

ANNEX - I

The following items are requested by the Governement of the Lao People's Democratic Republic as grant aid assistance.

I. the improvement work of the mechanical and electrical equipment of the Kaolieo treatment plant and bank protection works for the intake site of the plant including river bed settlement for the intake tower of the plant.

(1) Improvement works of the mechanical and electrical equipment of Kaolieo treatment plant.

- Intake pump equipment, including intake pumps, electric panel and other miscellaneous appurtenances.

- Distribution pump equipment, including distribution pumps, electric panel and other miscellaneous appurtenances.

- Water treatment equipment, including flush mixer of mixing well, filtered water controllers, backwash pumps and other necessary miscellaneous appurtenances.

- Chemical feeding equipment, including alum and chlorine feeder and other miscellaneous appurtenances.

- Instrumention equipment, including flow meters for raw water and distribution water, water level meters for raw water and reservoir and other necessary appurtenances.

- Power receiving facilities in power sub-station, including transformer, electric panels and other necessary appurtenances.

- Other miscellaneous works such as reparement of leakage from basins and office, lighting of rooms, appuratus for water quality test and eto. which will be the minimum extent to keep proper operation of the plant.

- Spare parts for the above mentioned equipment which are indispensable for proper operation of the plant.

- Hyprochlorine plant.

(2) Bank protection for the intake site of the plant.

- Bank revetement works at intake site to stop the erosion into the plant.

- River bed settlement around the intake tower for the protection from the collapsion.

II. The extension works of the water distribution system for the following areas : (in priority order)

(1) Dong Dok area
App. 1.3 Km from KM6 to Dong Dok education college

(2) Phone Tong area
App. 1.3 Km from Hong Seng river to Phone Tong elevated reservoir.
App. 1.9 Km from KM6 to Hospital 150 beds(Phone Tong).

(3) Thadeua road area
App. 4.2 Km from Thang Beng Chinaimo village to Ply wood factory (Nong Veng).

(4) Thong Pong area
App. 6.2 Km from Kaolieo treatment plant to cement factory through the National Road Route 13.

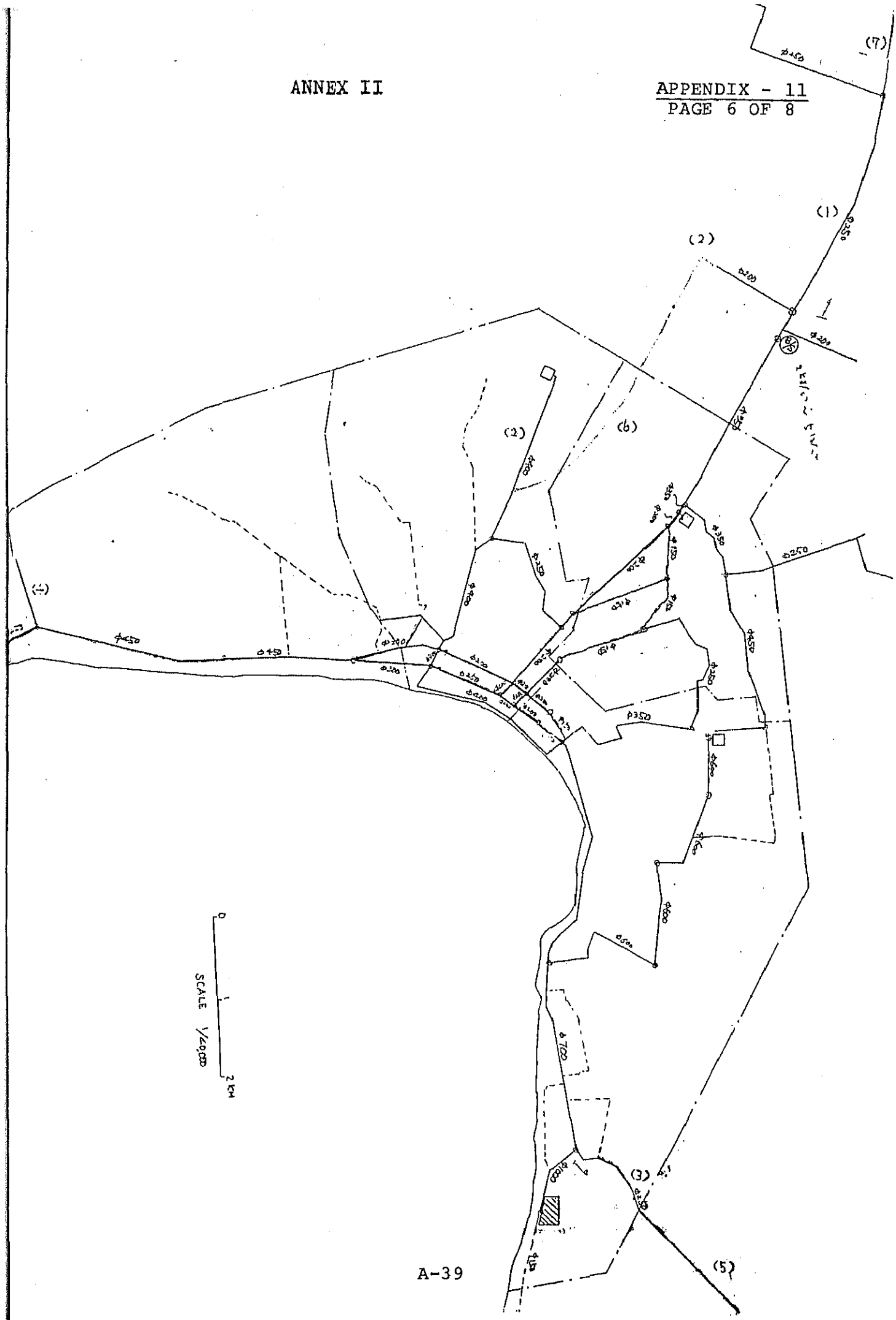
(5) Thadeua Road area
App. 2.4 Km from Ply wood factory to Sarakham village.

(6) Phone Tong area
App. 2.7 Km from Hong Seng river to Hospital 150 beds.

(7) Dong Dok area
App. 4.3 Km from Dong Dok to Police training School at Done Noun village.

III. Construction machines and equipment necessary for the Project as follows :

Fork Lift
Crane
Chain Block
Welder
Winch
Pipe Cutter
Torque Renti
Truck
Drain pump
Others (including some spare parts for construction machines mentioned in ANNEX III,5).


(1)
(2)
(3)
(4)
(5)
(6)
(7)
SCALE 1/50000
0
1
2 KM

ANNEX III

Following arrangements are requested to be taken by the Government of the Lao People's Democratic Republic.

1. To secure a lot of land necessary for the bank protection works at the intake site of Kaolieo treatment Plant and extension works of the distribution pipeline for proposed areas, and to clear, fill and level the site as needed before the start of the works.

2. To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities outside of the site.

3. To ensure prompt unloading, tax exemption, customs clearance, and prompt internal transportation therein of the products purchased under the grant.

4. To arrange local labor, materials, fuel, and others available in Laos for the project.

5. To provide the following construction machines and equipment necessary for the construction.

Buldozer
Backhoe
Shovel (Payloader)
Dump truck
Concrete mixer
Bar bender
Bar cutter
Air compressor
Concrete vibrator engine type
Steel scaffolding

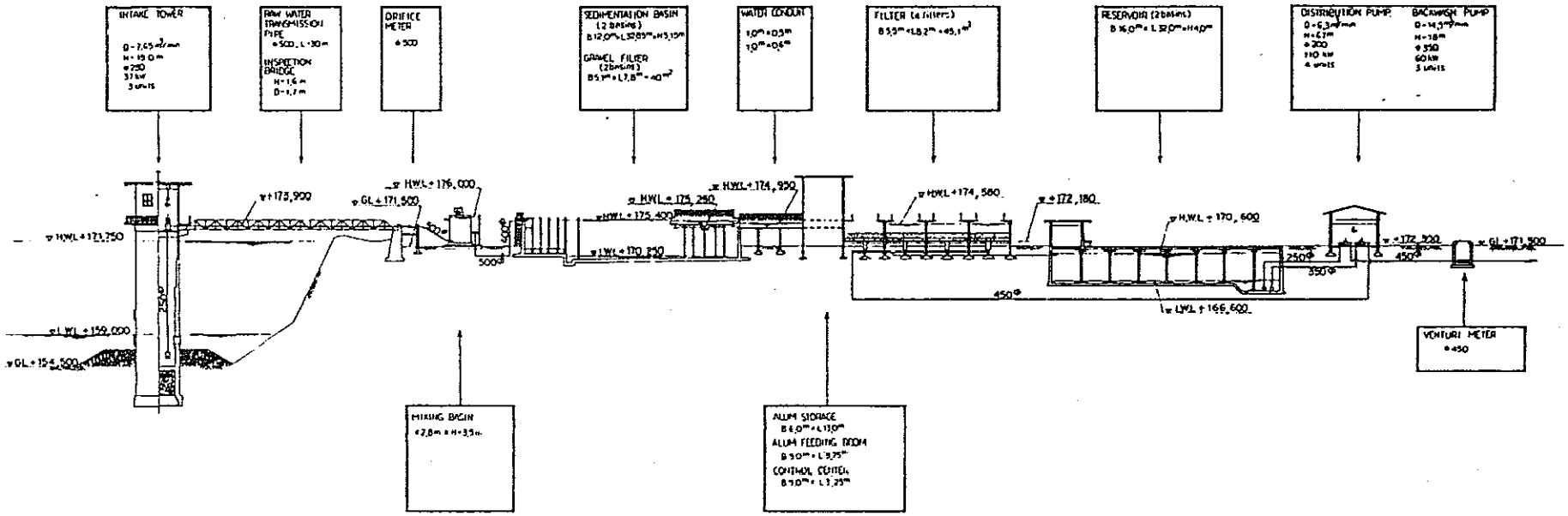
6. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Laos with respect to the supply of the products and services under the verified contracts.

7. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into Laos and stay therein for the performance of their works.

8. To maintain and use properly and effectively the distribution pipeline, the bank reveted and the equipment purchased, installed and constructed under the grant.

9. To bear all the expenses, other than those to be borne by the grant, necessary for the improvement works of the equipment of Kaolieo treatment Plant, the bank protection works and the extension works of the distribution pipeline for water supply.

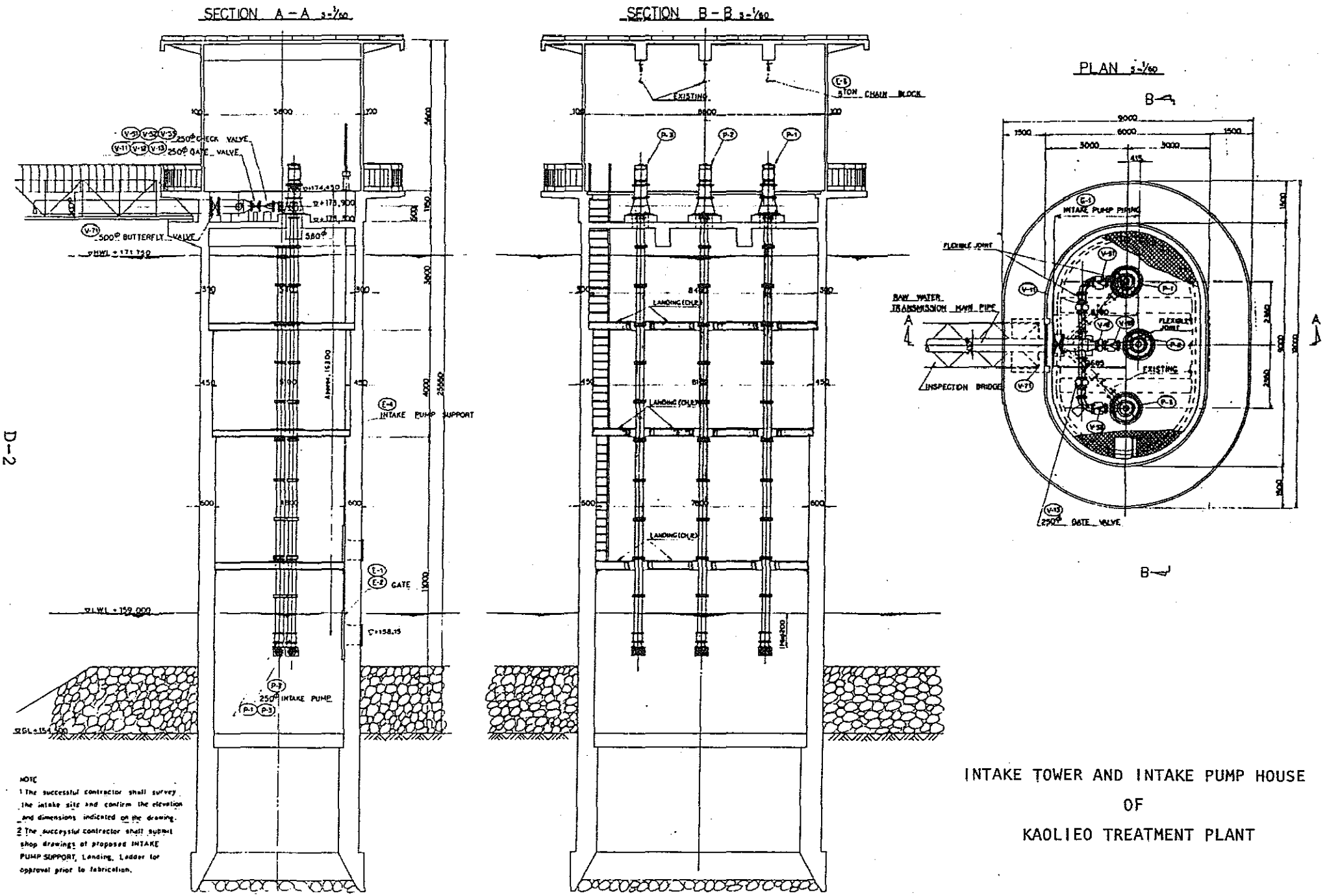
DRAWINGS



HYDRAULIC PROFILE

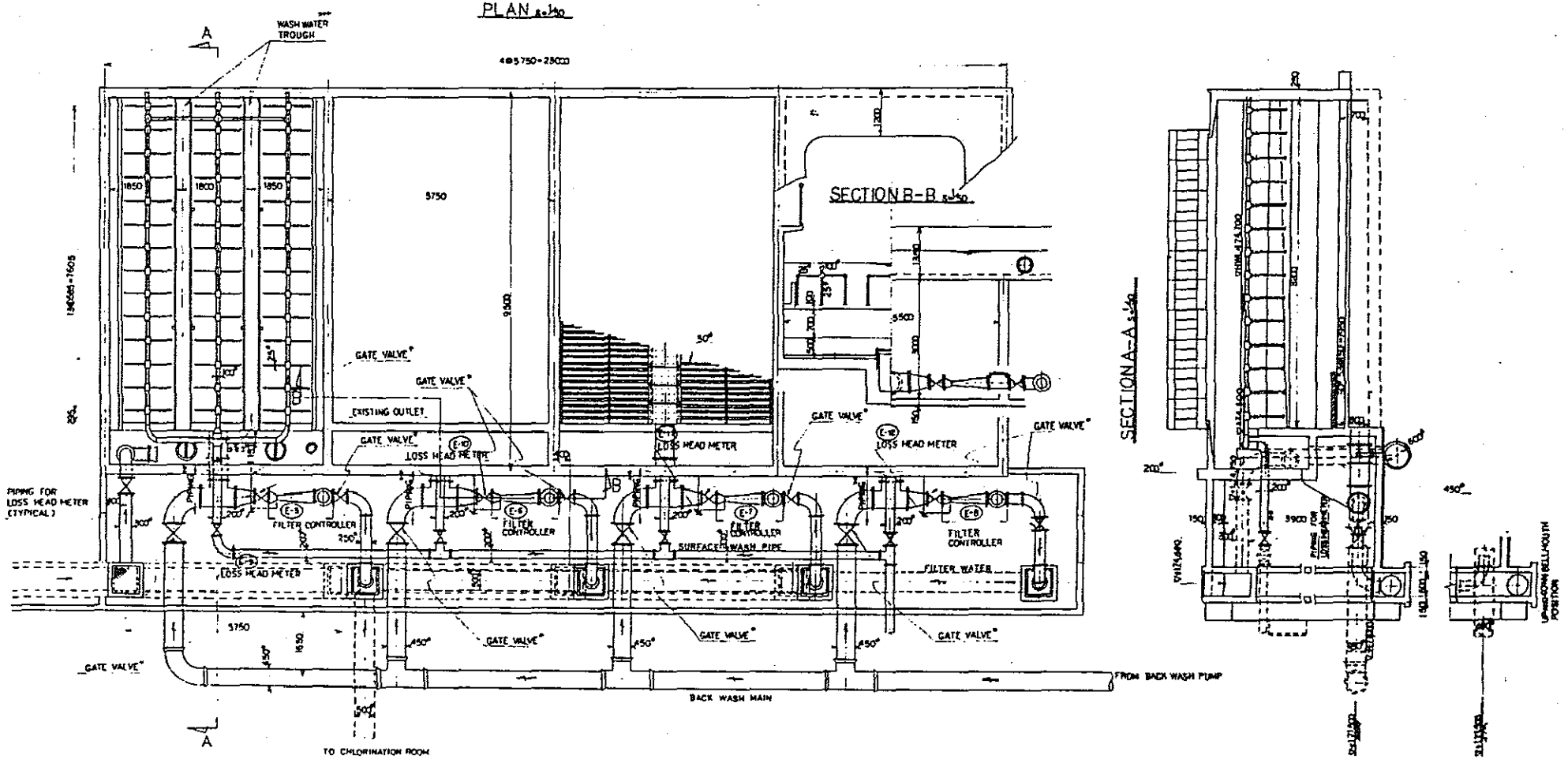
OF

KAOLIEO TREATMENT PLANT



D-2

INTAKE TOWER AND INTAKE PUMP HOUSE
OF
KAOLIEO TREATMENT PLANT



D-3

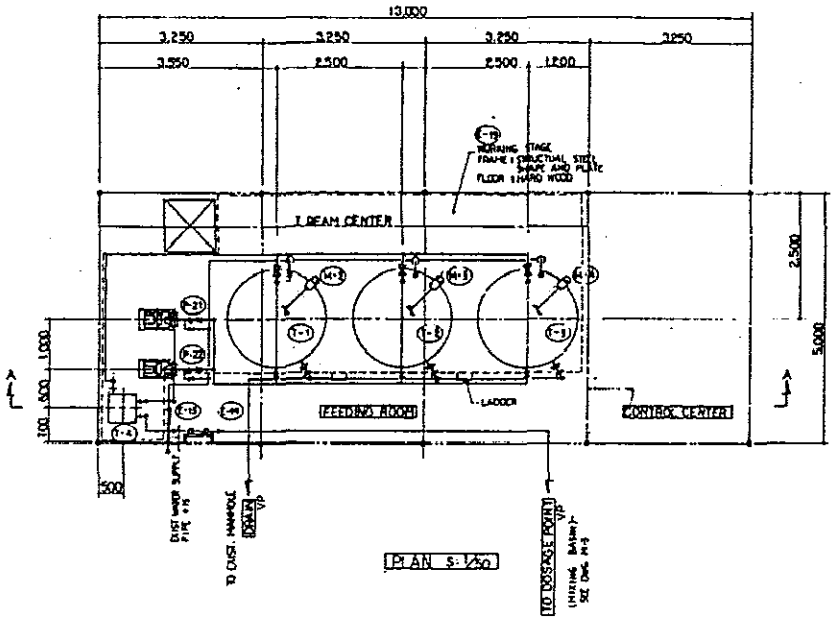
NOTE

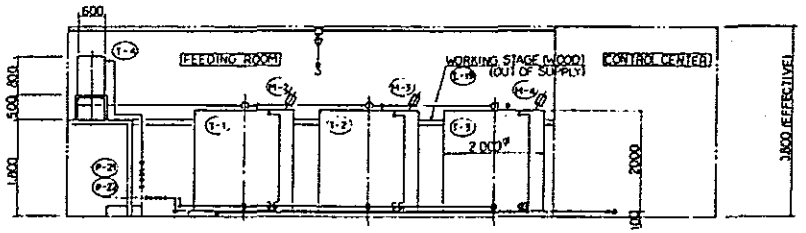
1 Gate Valve with Asterisk marked shall be repaired on leakage by appropriate manner as specified

2 Piping with double Asterisk marked** shall be replaced with new pipe materials furnished by the Contractor

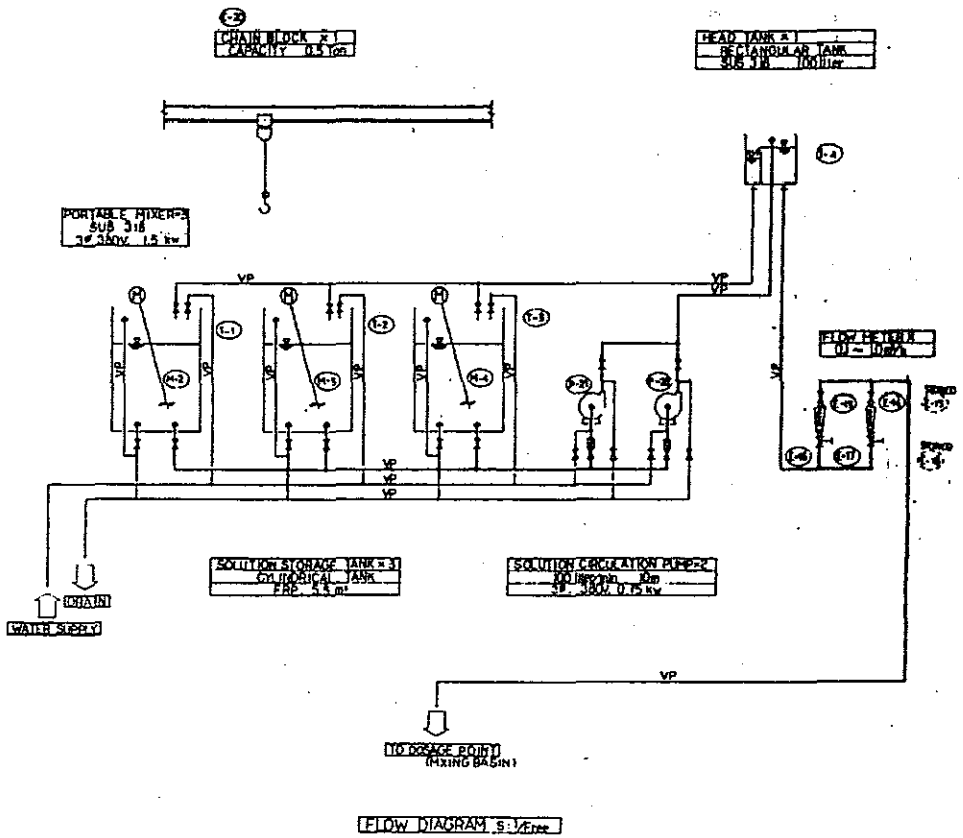
3 All wash water troughs(SS) shall be replaced as shown on the drawing CP-3

RAPID SAND FILTER
OF
KAOLIEO TREATMENT PLANT





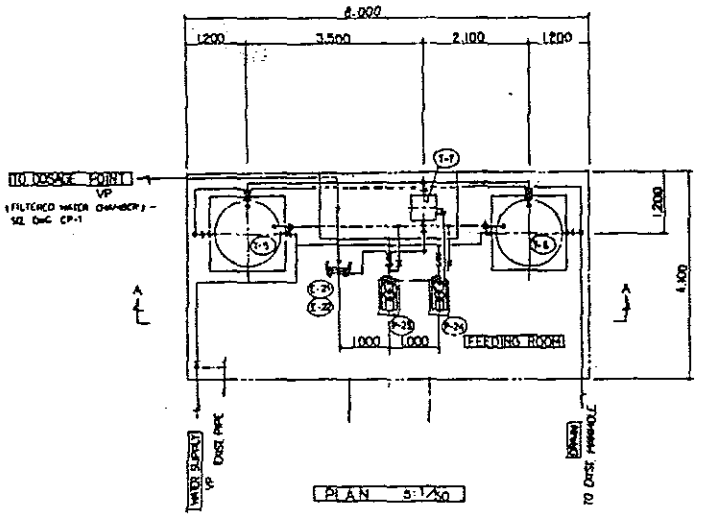
A A SECTION S:1/50



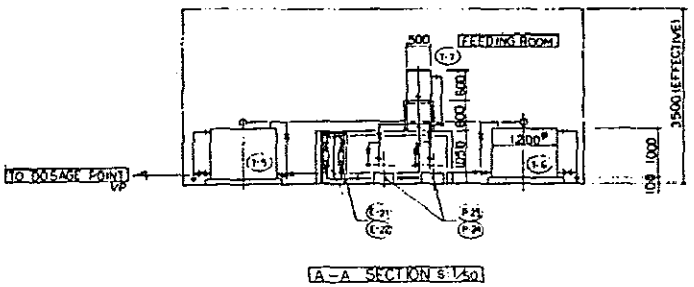
FLOW DIAGRAM S:1/Free

NOTE: Contractor shall provide all necessary piping including valves to complete the system specified and shown on the drawing. The size of the feeding pipes is contractors option. The successful contractor shall submit shop drawings for approval prior to fabrication and installation of the materials.

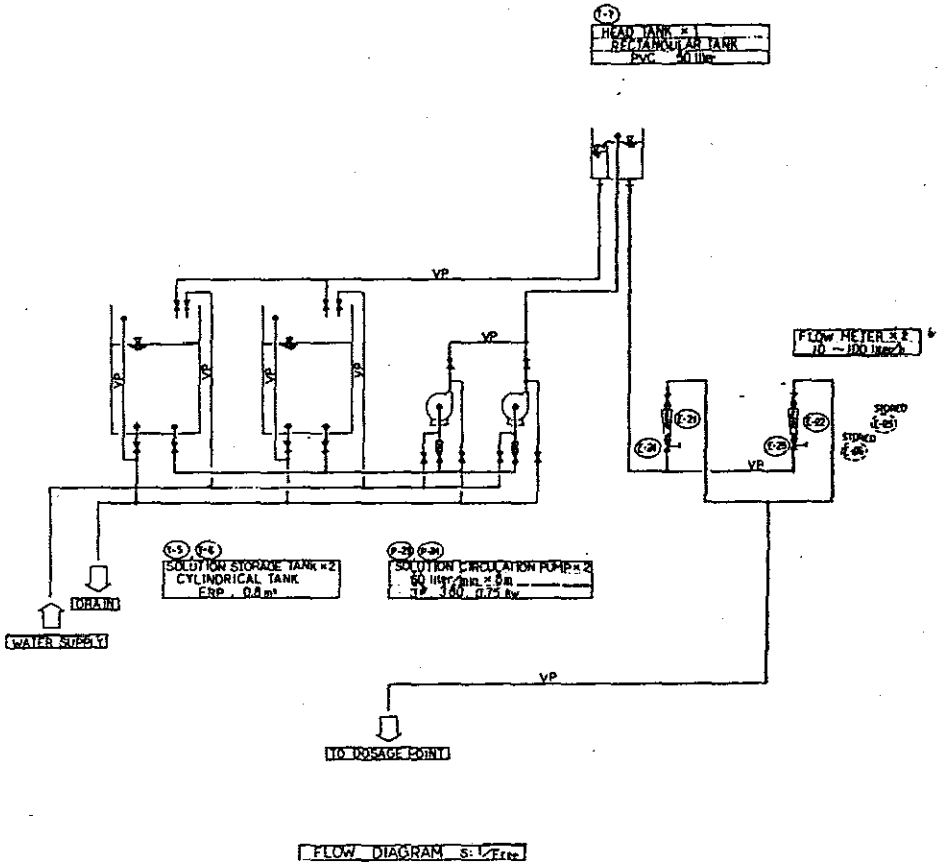
ALUM FEEDING SYSTEM
OF
KAOLIEO TREATMENT PLANT



PLAN S:1/50



A-A SECTION S:1/50

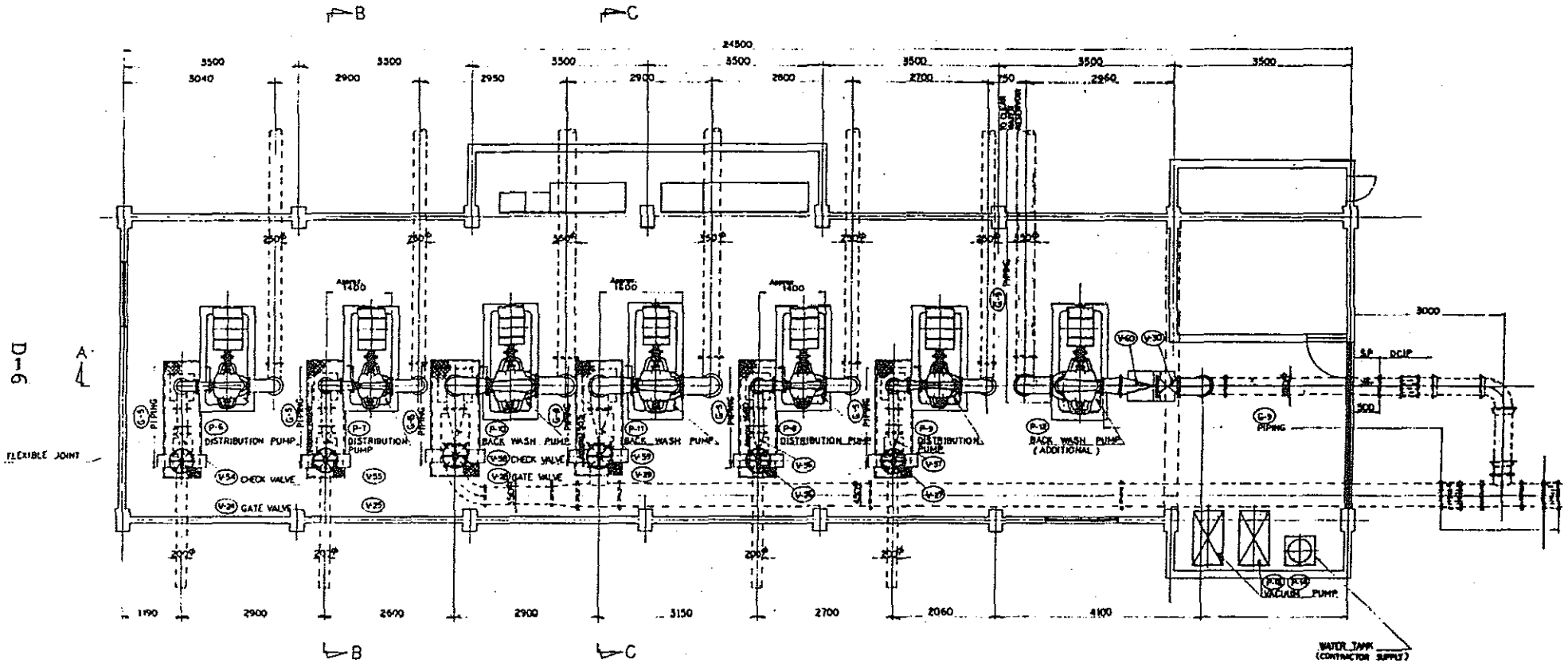


FLOW DIAGRAM S:1/Free

note: Contractor shall provide all necessary pipes including valves to complete the system specified and shown on the drawing. The size of the feeding pipes is construction system. The successful contractor shall submit shop drawings for approval prior to fabrication and installation of the materials.

HYPOCHLORITE FEEDING SYSTEM
OF
KAOLIEO TREATMENT PLANT

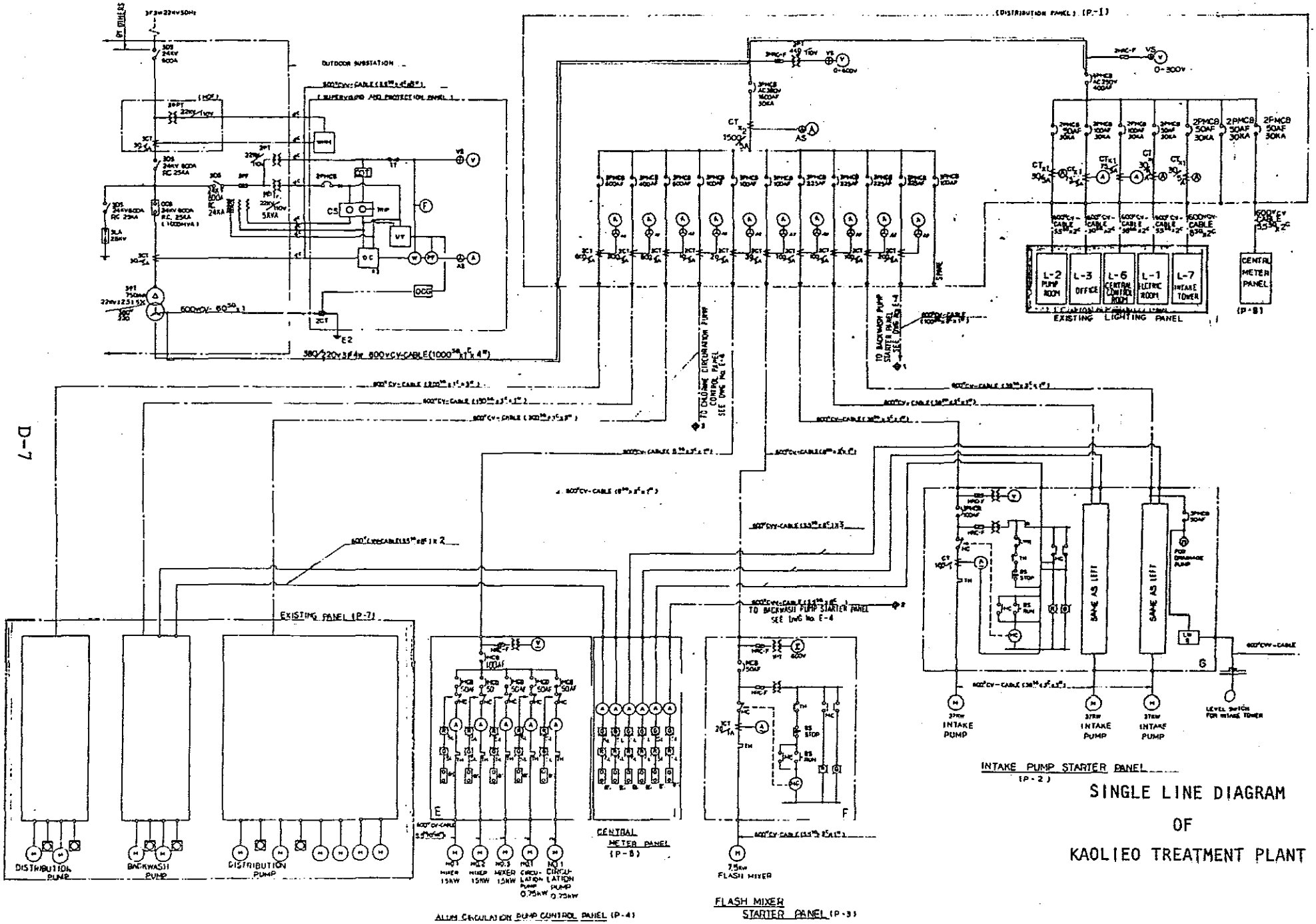
PLAN 1-40



DISTRIBUTION PUMP HOUSE

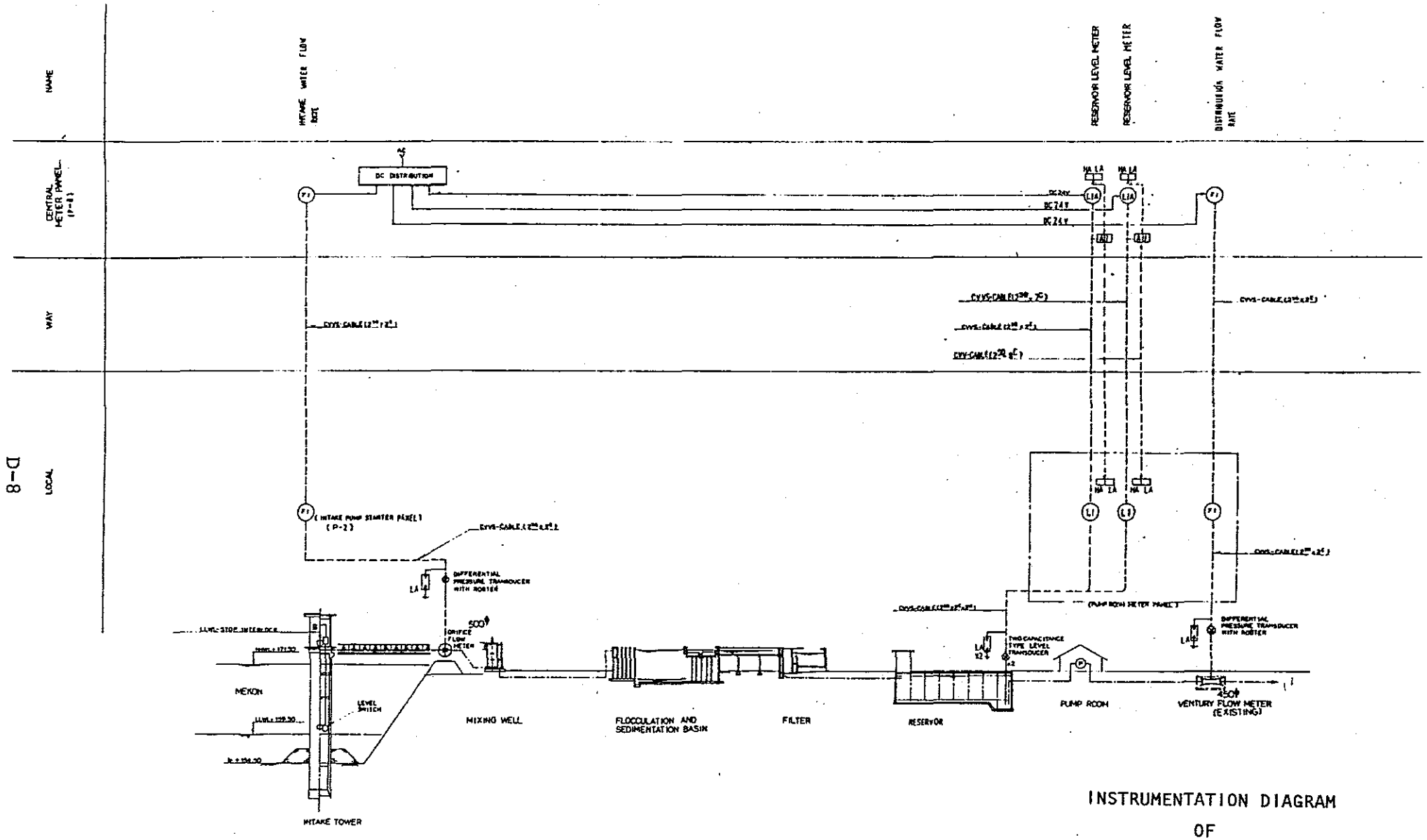
OF

KAOLIEO TREATMENT PLANT

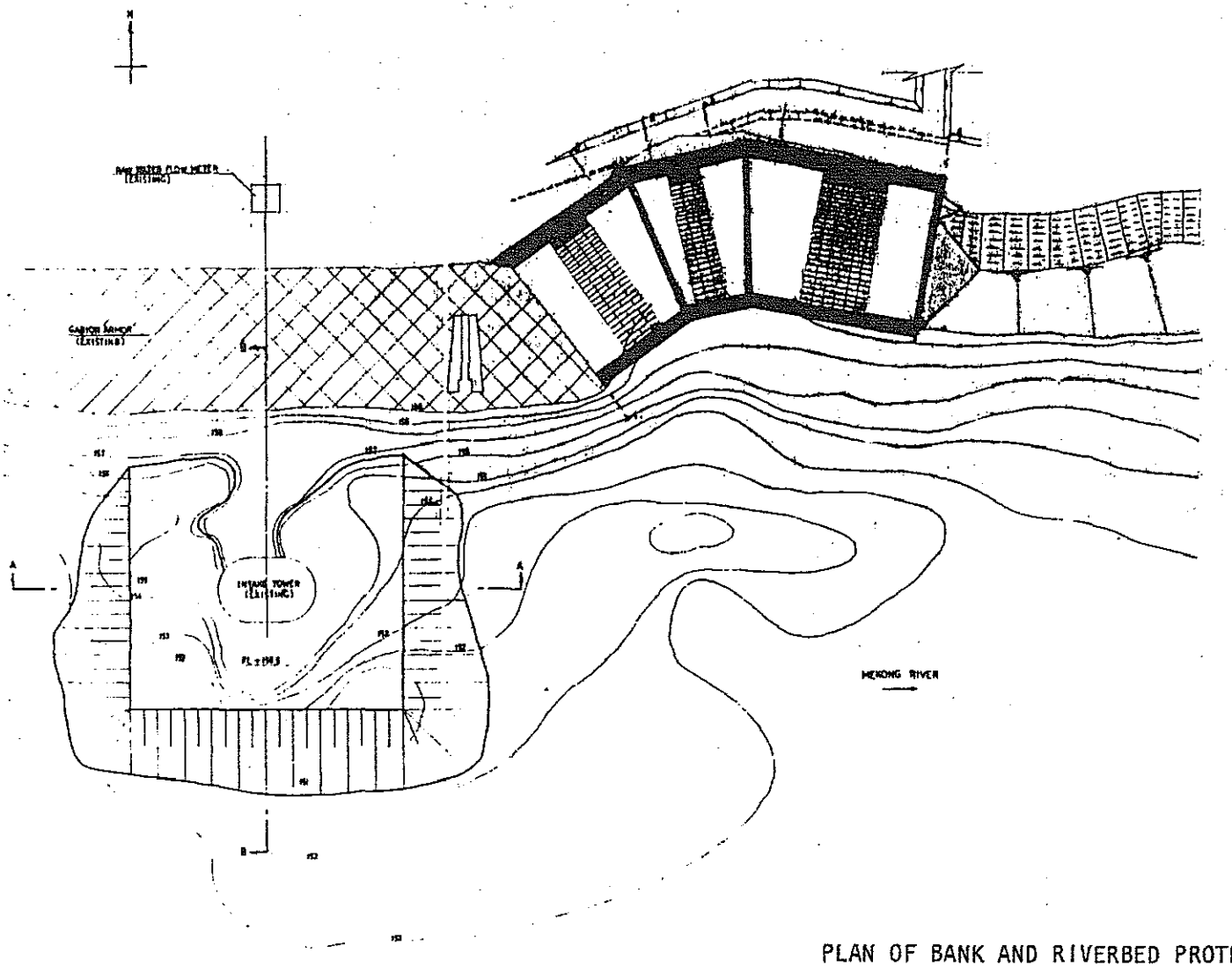


D-7

SINGLE LINE DIAGRAM OF KAOLIEO TREATMENT PLANT

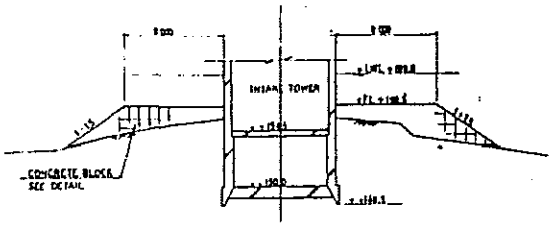


INSTRUMENTATION DIAGRAM
OF
KAOLIEO TREATMENT PLANT

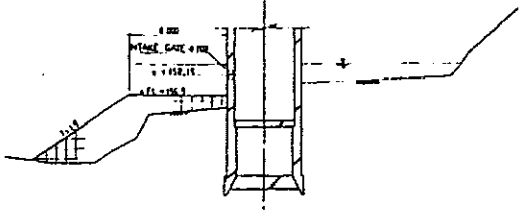


PLAN OF BANK AND RIVERBED PROTECTION
OF
KAOLIEO TREATMENT PLANT

TYPICAL SECTION OF RIVERBED SETTLEMENT AROUND INTAKE TOWER S=1:200

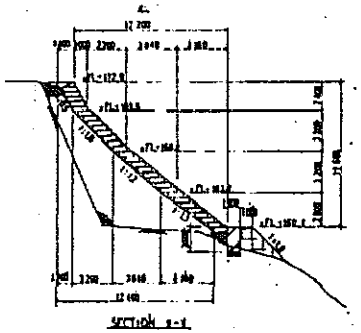


SECTION A-A

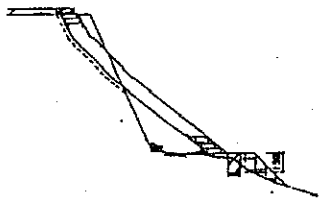


SECTION B-B

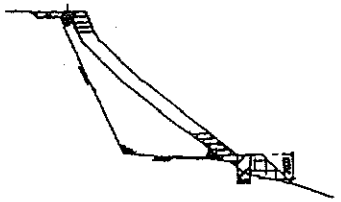
TYPICAL SECTION OF BANK PROTECTION S=1:300



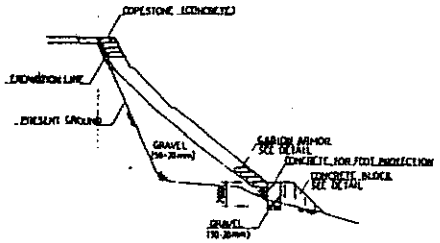
SECTION 4-4



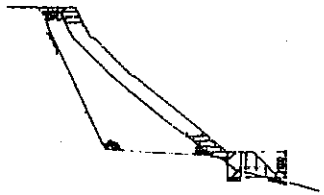
SECTION 6-6



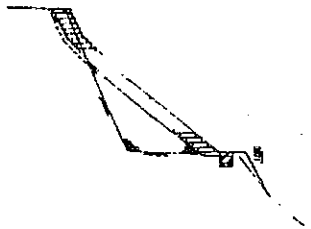
SECTION 5-5



SECTION 3-3



SECTION 2-2



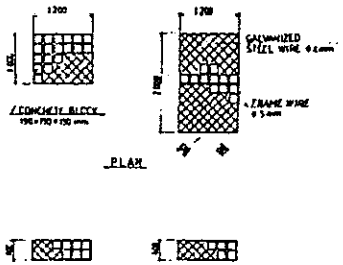
SECTION 1-1

CONCRETE BLOCK DETAIL S=1:50

PLAN

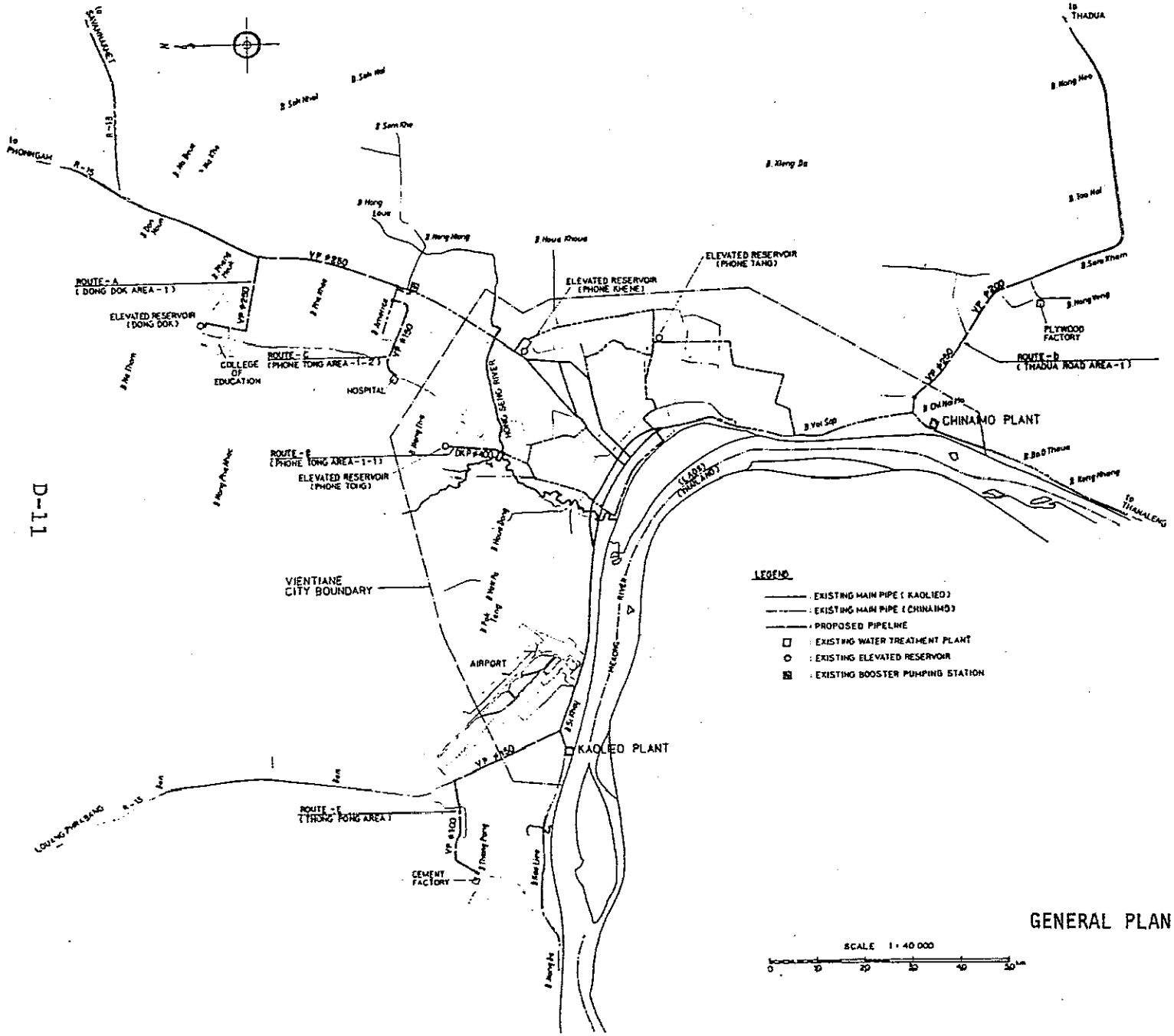
SIDE VIEW

TYPICAL GABION ARMOR DETAIL S=1:50



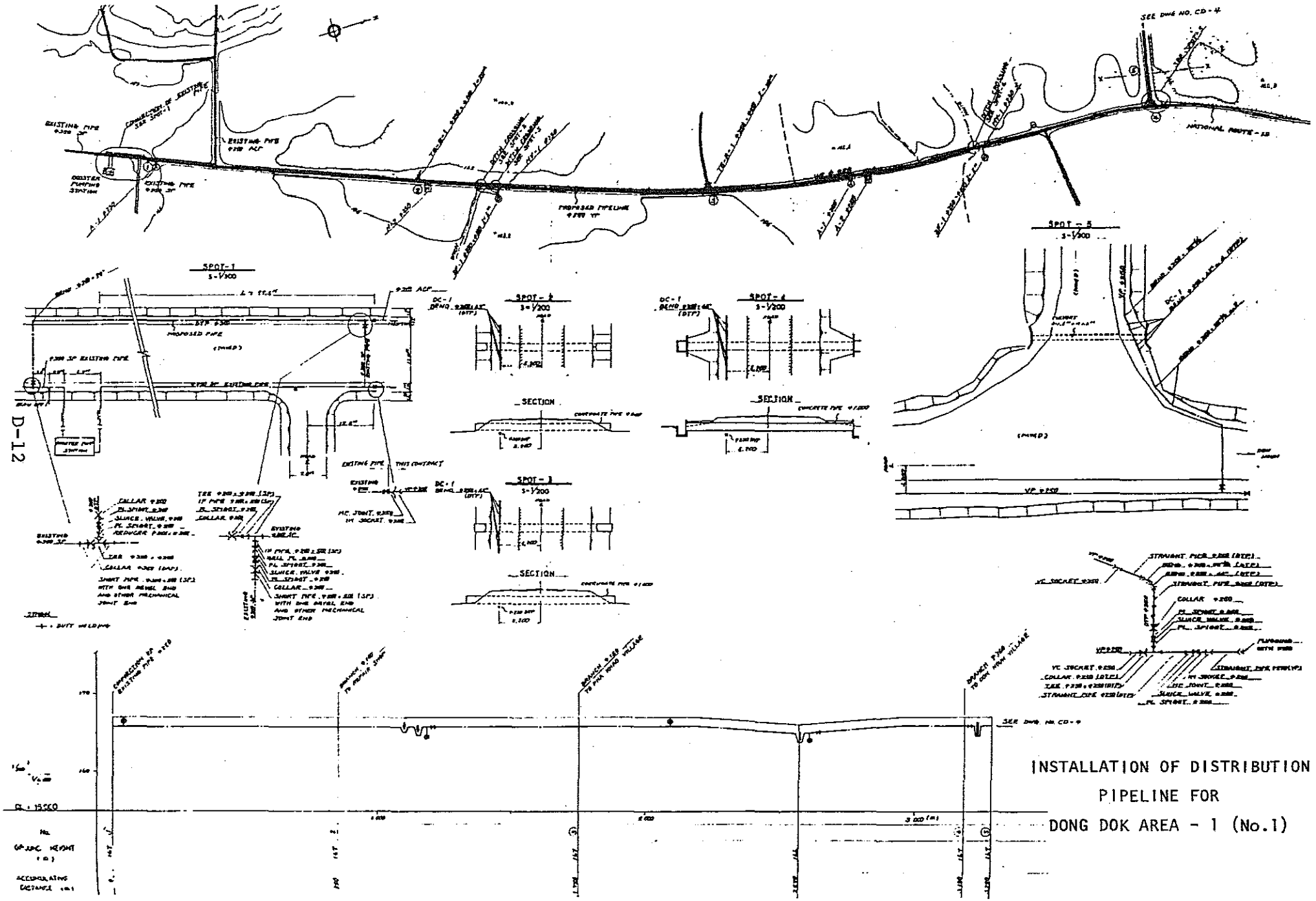
SECTION

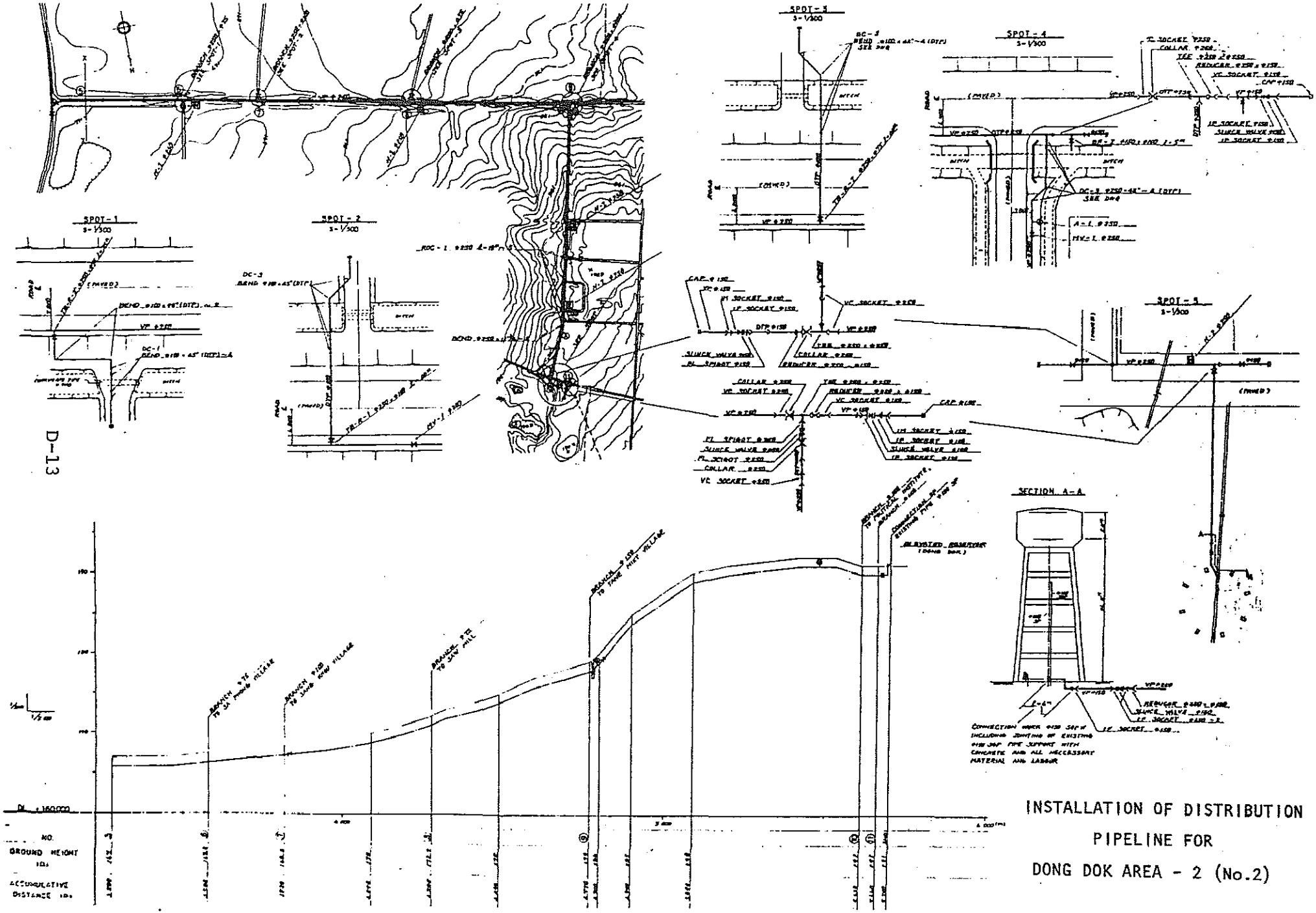
SECTION OF BANK AND RIVERBED PROTECTION OF KAOLIEO TREATMENT PLANT

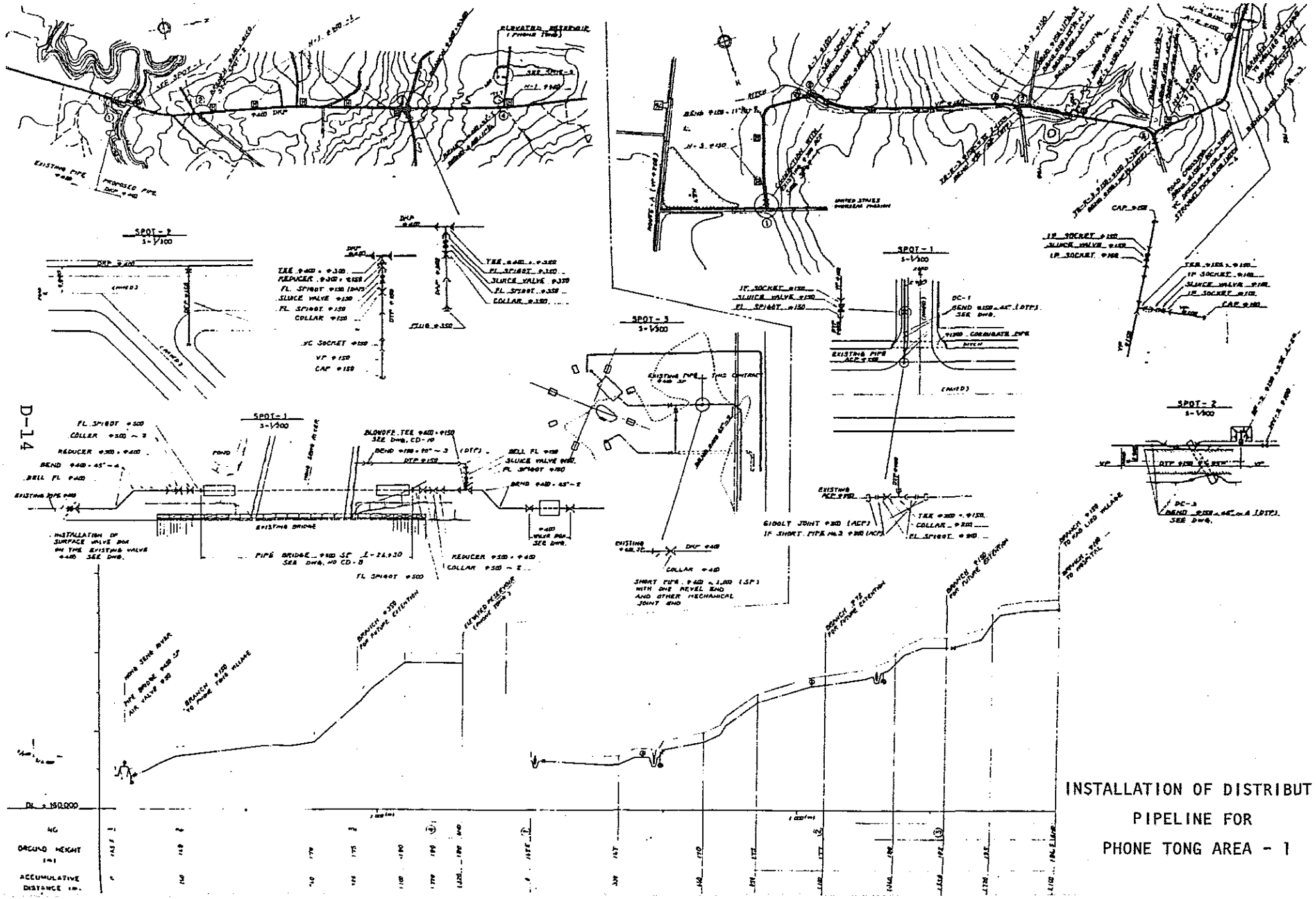


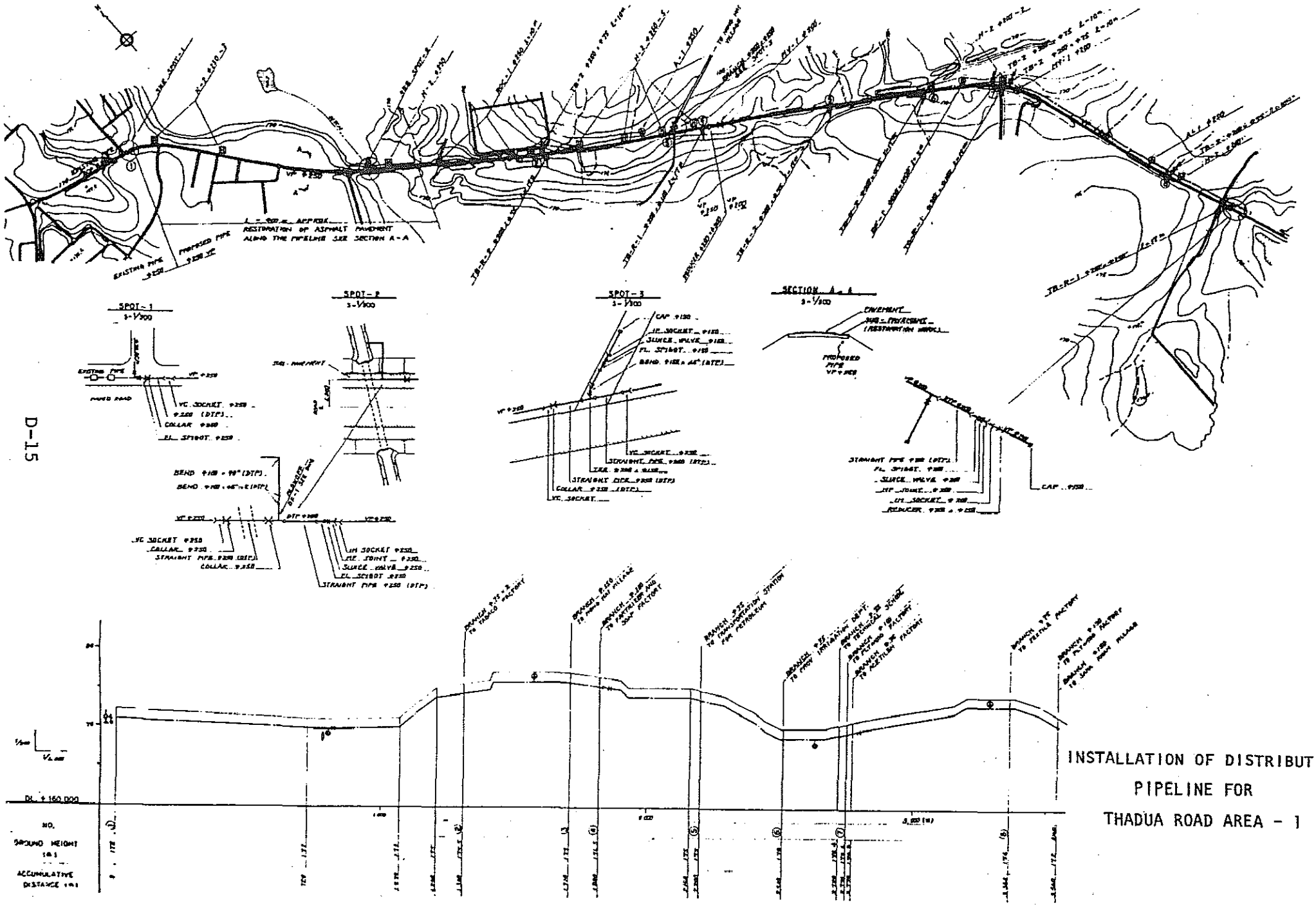
D-11

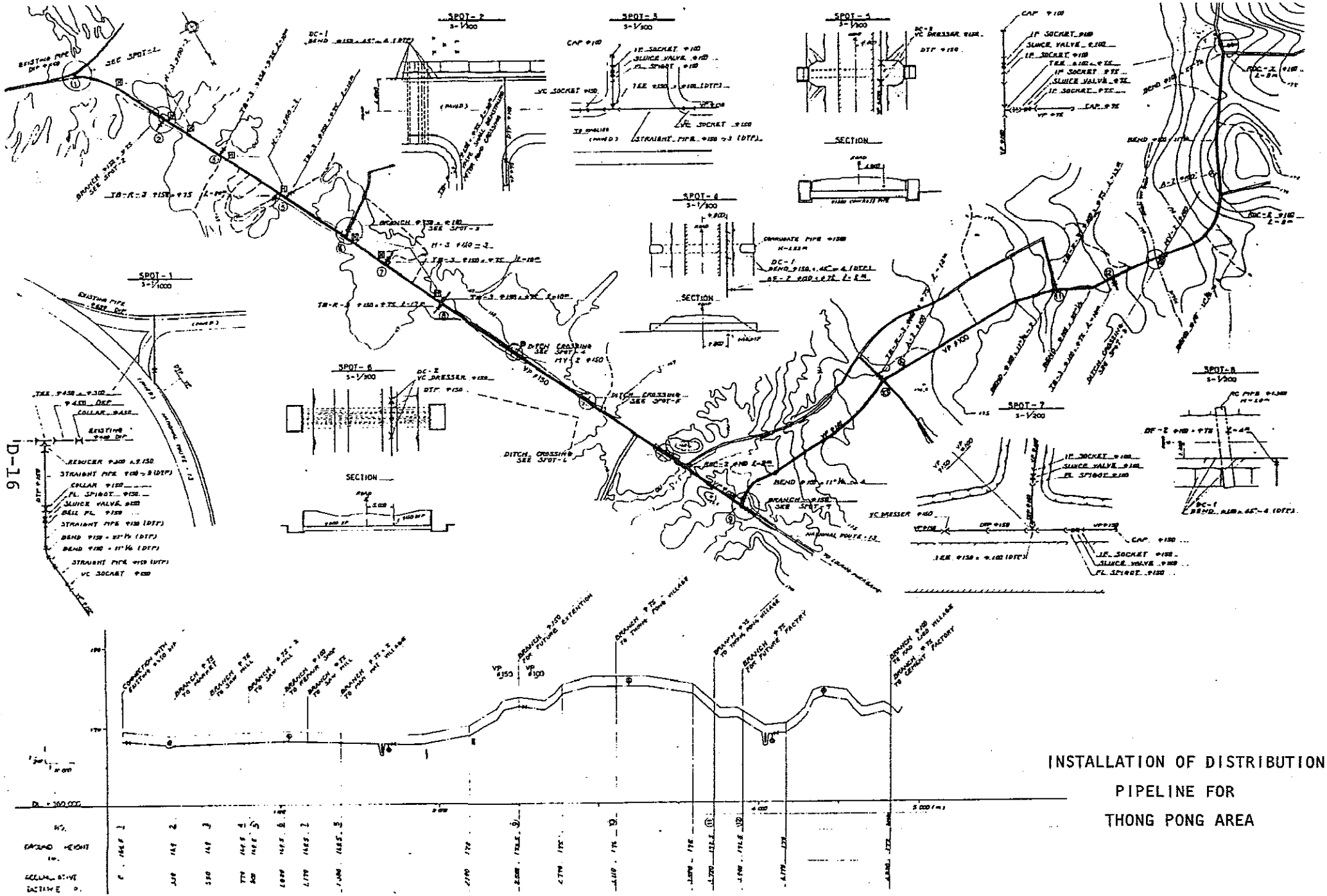
GENERAL PLAN OF DISTRIBUTION PIPELINE


SPOT - 1
SPOT - 2
SPOT - 3
SPOT - 4
SPOT - 5
SECTION
SEE DWG NO. CD - 4
SEE DWG NO. CD - 9
NATIONAL ROUTE - 10
PROPOSED PIPELINE
EXISTING PIPE
EXISTING PUMPING STATION
D-12
INSTALLATION OF DISTRIBUTION
PIPELINE FOR
DONG DOK AREA - 1 (No.1)

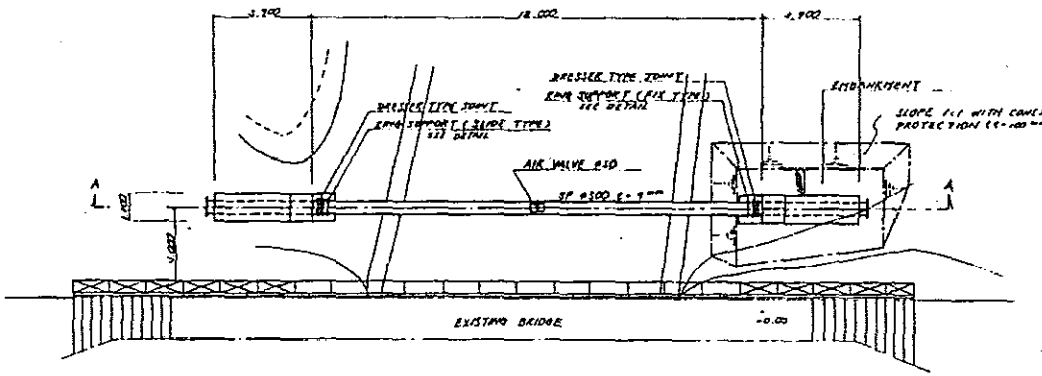

SPOT - 1
SPOT - 2
SPOT - 3
SPOT - 4
SPOT - 5
SECTION A - A
D-13
INSTALLATION OF DISTRIBUTION
PIPELINE FOR
DONG DOK AREA - 2 (No.2)

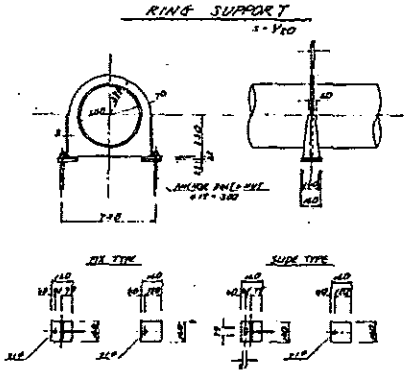

INSTALLATION OF DISTRIBUTION
PIPELINE FOR
PHONE TONG AREA - 1

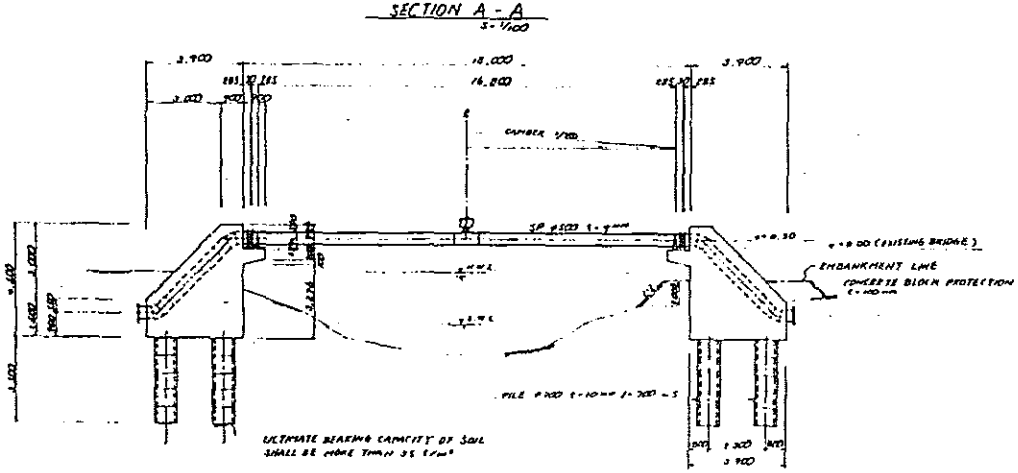

SPOT - 1
SPOT - 2
SPOT - 3
SECTION A - A
INSTALLATION OF DISTRIBUTION
PIPELINE FOR
THADUA ROAD AREA - 1

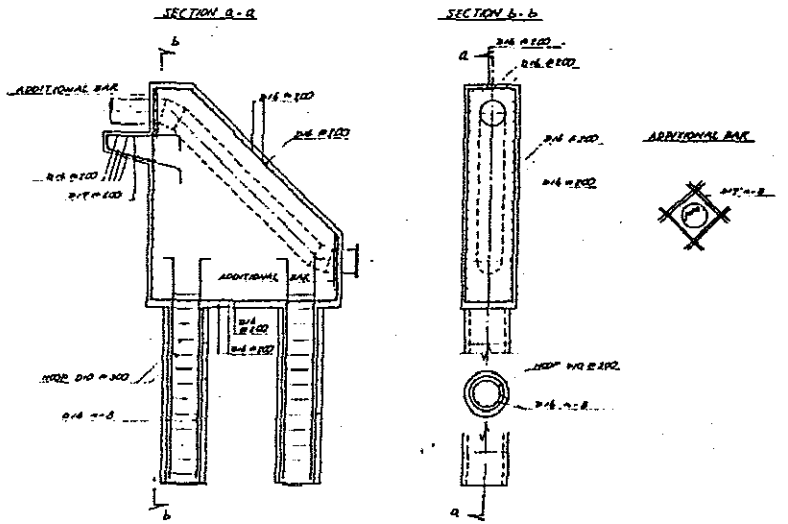

SPOT - 1
SPOT - 2
SPOT - 3
SPOT - 4
SPOT - 5
SPOT - 6
SPOT - 7
SPOT - 8
SECTION
DITCH CROSSING SEE SPOT - 4
DITCH CROSSING SEE SPOT - 5
DITCH CROSSING SEE SPOT - 6
DITCH CROSSING SEE SPOT - L
BRANCH TO SAWMILL
BRANCH TO SAW MILL
BRANCH TO REPAIR SHOP
BRANCH TO SAW MILL
BRANCH TO SAW MILL
BRANCH FOR FUTURE EXTENTION
BRANCH TO THONG PONG VILLAGE
BRANCH TO THONG MUN VILLAGE
BRANCH FOR FUTURE FACTORY
BRANCH TO LAO VILLAGE
BRANCH TO CEMENT FACTORY
INSTALLATION OF DISTRIBUTION
PIPELINE FOR
THONG PONG AREA

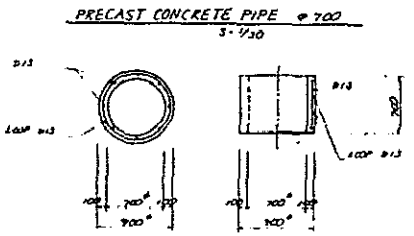
D-16





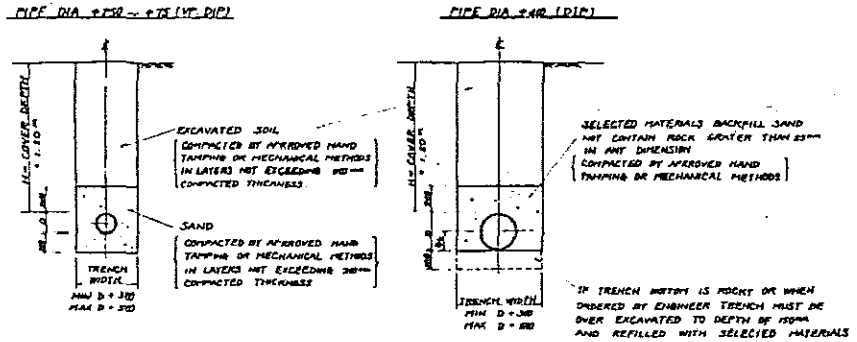




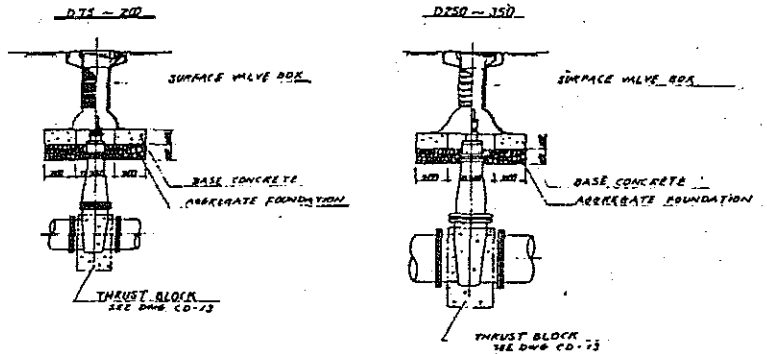


INSTALLATION OF DISTRIBUTION PIPELINE FOR PIPE BRIDGE (HONG SENG RIVER)

TYPICAL TRENCH DETAIL

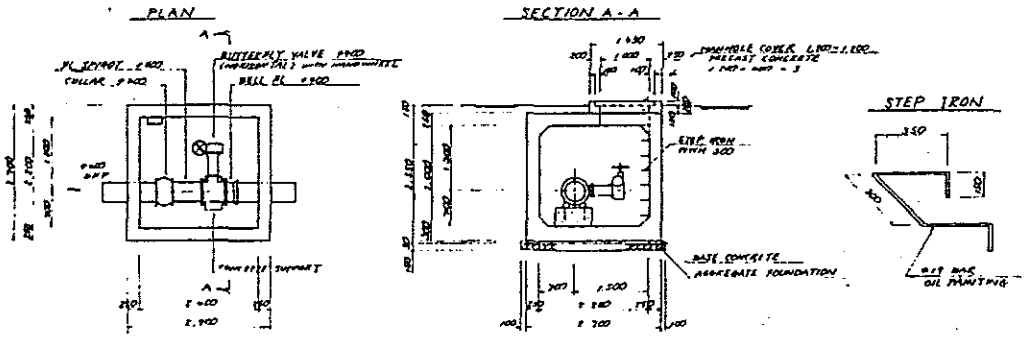


VALVE BOX

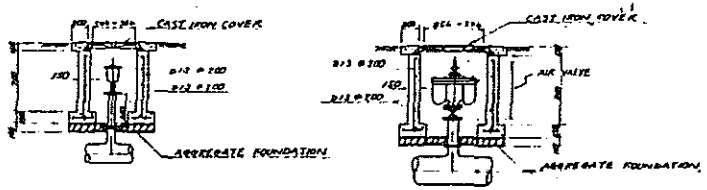


ϕ400 BUTTERFLY VALVE CHAMBER

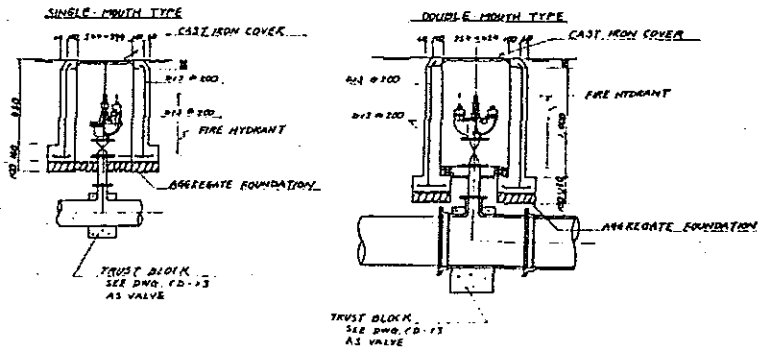
S = 1/50



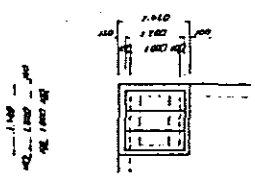
AIR VALVE CHAMBER



FIRE HYDRANT CHAMBER

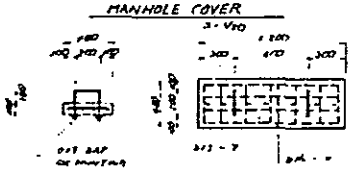


MANHOLE

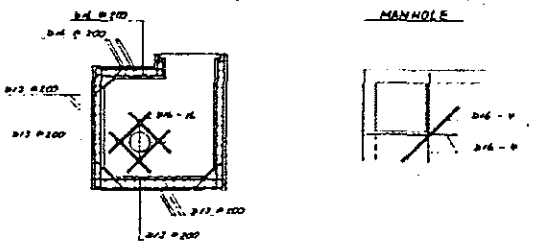


MANHOLE COVER

S = 1/10



REINFORCEMENT LAYOUT



TYPICAL TRENCH WORK, VALVE BOX, VALVE CHAMBER, AIR VALVE CHAMBER AND FIRE HYDRANT CHAMBER