

GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
STATE OF ERITREA
MINISTRY OF LAND, WATER AND ENVIRONMENT

STUDY
ON
GROUNDWATER DEVELOPMENT AND WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION
OF
ERITREA

FINAL REPORT

DEKEMHARE

VOLUME III DRAWINGS

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JANUARY 1999

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GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
STATE OF ERITREA
MINISTRY OF LAND, WATER AND ENVIRONMENT

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FINAL REPORT

DEKEMHARE

VOLUME III DRAWINGS

JANUARY 1999

SANYU CONSULTANTS INC.



List of Reports

This volume is part of the following reports:

Executive Summary

Debarwa	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Mendefera	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Adiquala	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Dekemhare	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Segeneiti	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Adi Keyih	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Senafe	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings

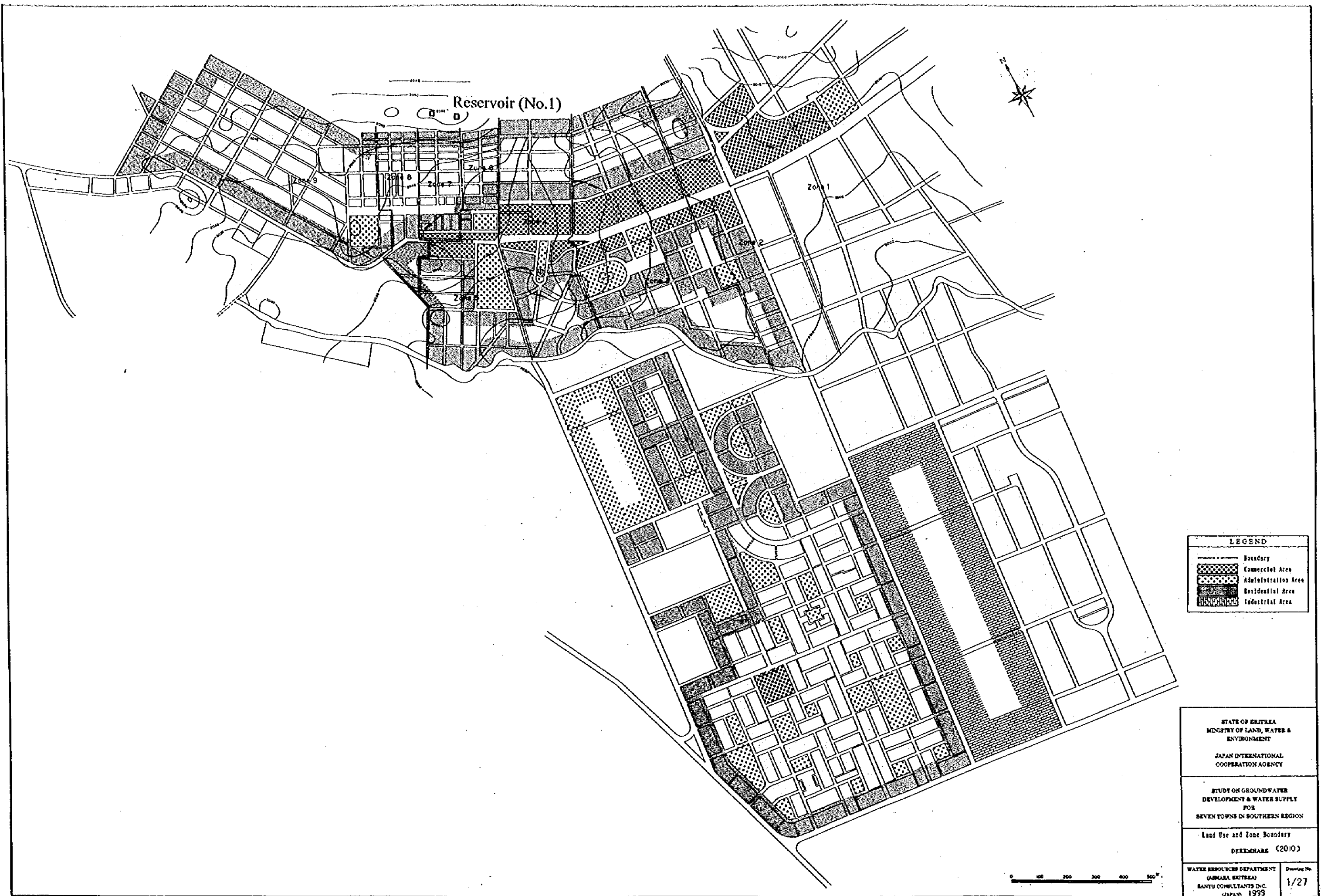
Operation and Maintenance Manual for Water Supply Facility

Hygiene Education Manual

Training Manual for Staff of WSA

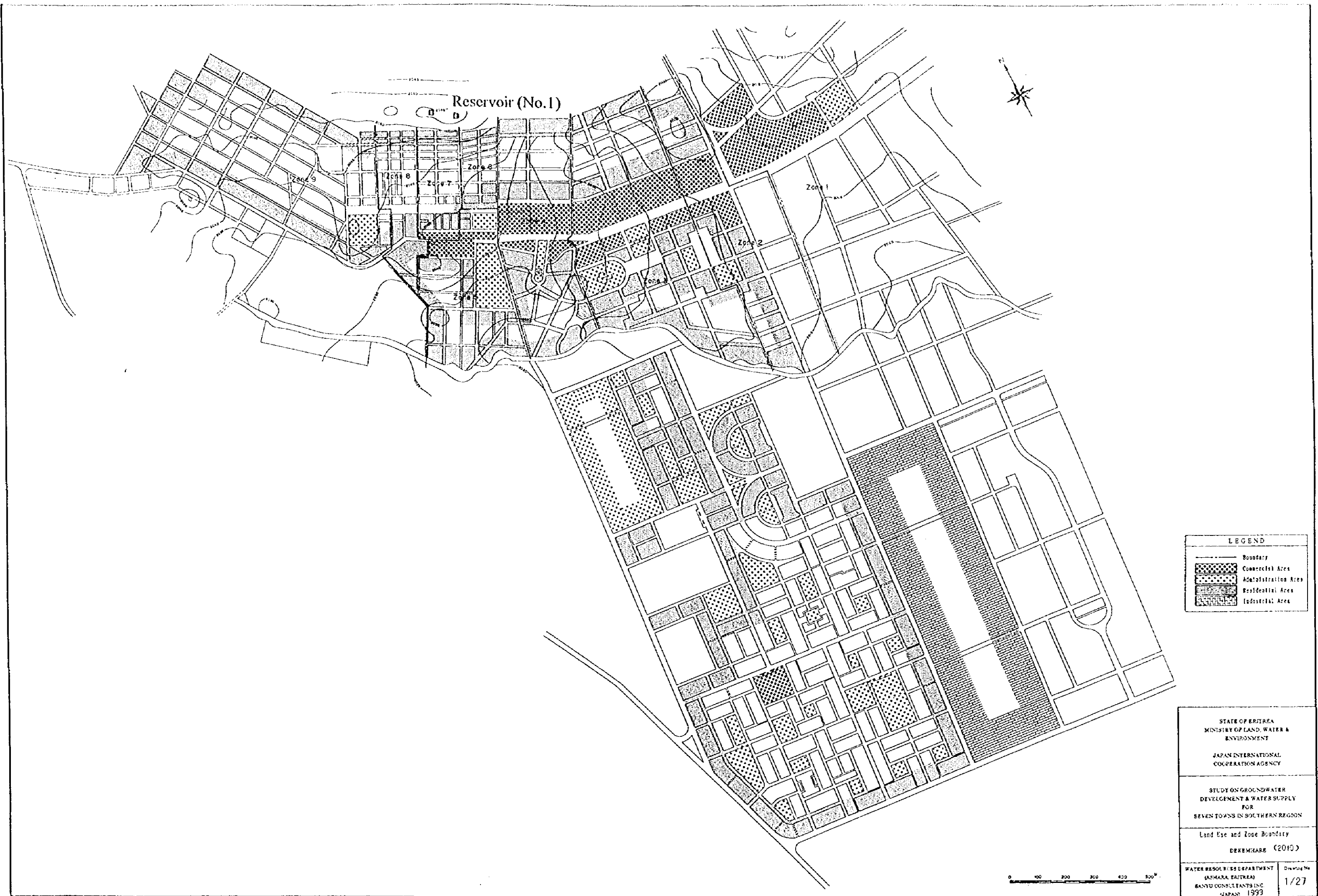
Table of Contents (DEKEMHARE)

1. Land Use and Zone Boundary	Drawing No. 1/27
2. Plan & Profile for Transmission Pipeline (1/8)	Drawing No. 2/27
3. Plan & Profile for Transmission Pipeline (2/8)	Drawing No. 3/27
4. Plan & Profile for Transmission Pipeline (3/8)	Drawing No. 4/27
5. Plan & Profile for Transmission Pipeline (4/8)	Drawing No. 5/27
6. Plan & Profile for Transmission Pipeline (5/8)	Drawing No. 6/27
7. Plan & Profile for Transmission Pipeline (6/8)	Drawing No. 7/27
8. Plan & Profile for Transmission Pipeline (7/8)	Drawing No. 8/27
9. Plan & Profile for Transmission Pipeline (8/8)	Drawing No. 9/27
10. Plan of Distribution Pipeline (2005)	Drawing No. 10/27
11. Plan of Distribution Pipeline (2010)	Drawing No. 11/27
12. Plan of Distribution Pipeline (2015)	Drawing No. 12/27
13. Location of Proposed Communal Water Point	Drawing No. 13/27
14. Structure of Borehole Pump Station	Drawing No. 14/27
15. Borehole Pump Station	Drawing No. 15/27
16. Structure of Booster Pump Station	Drawing No. 16/27
17. Booster Pump Station	Drawing No. 17/27
18. 30m ³ Receiving Tnk	Drawing No. 18/27
19. 440m ³ Reservoir	Drawing No. 19/27
20. 15m ³ Elevated Reservoir	Drawing No. 20/27
21. Typical Valve Box	Drawing No. 21/27
22. Typical Air Valve and Washout Valve	Drawing No. 22/27
23. Typical Excavation, Joint Protection & Crossing River	Drawing No. 23/27
24. Public Faucet	Drawing No. 24/27
25. School Latrine	Drawing No. 25/27
26. School Latrine	Drawing No. 26/27
27. Double Pit VIP Latrine	Drawing No. 27/27



LEGEND	
	Boundary
	Commercial Area
	Administration Area
	Residential Area
	Industrial Area

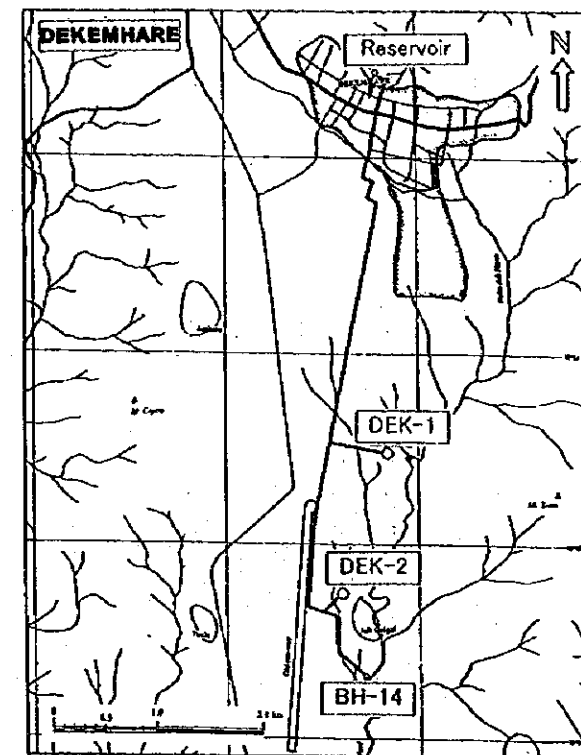
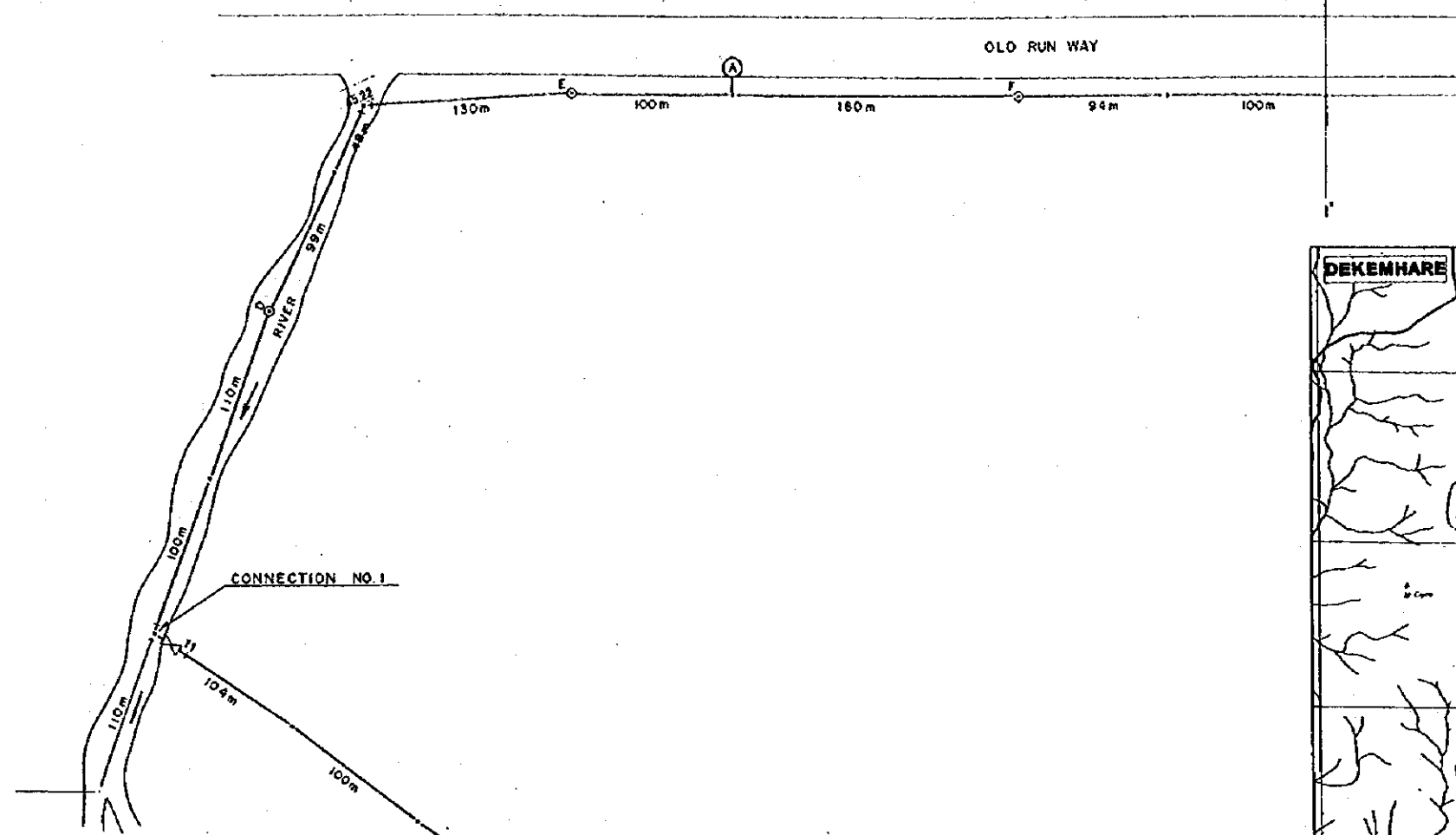
STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
Land Use and Zone Boundary DECEMBER (2010)	
WATER RESOURCES DEPARTMENT (ASMARA, ERITREA) SANTU CONSULTANTS INC. JAPAN, 1993	Drawing No. 1/27



LEGEND	
	Boundary
	Commercial Area
	Administration Area
	Residential Area
	Industrial Area

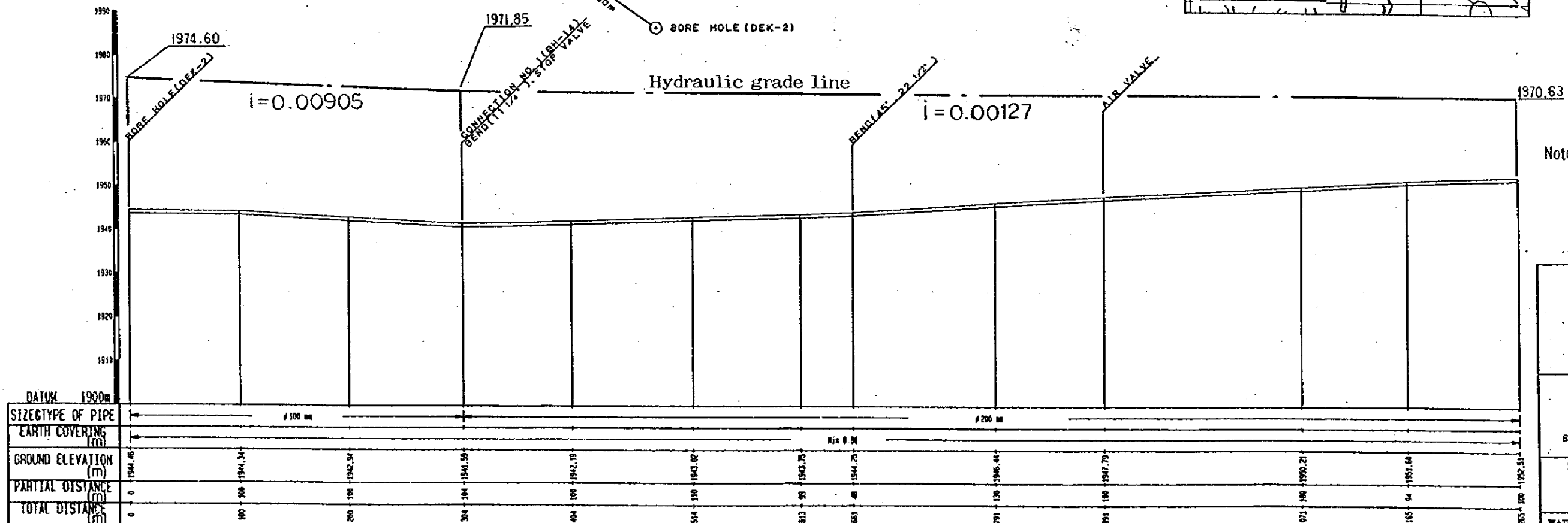
STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
Land Use and Zone Boundary DEKEMHARE (2010)	
WATER RESOURCES DEPARTMENT (ASMARA, ERITREA) SANTU CONSULTANTS INC. JAPAN, 1999	Drawing No 1/27

PLAN



LEGEND	
	BEND 90°
	BEND 45°
	BEND 22 1/2°
	BEND 11 1/4°
	TEE
	WASH OUT
	AIR VALVE
	STOP VALVE

PROFILE



Note: Water hammer analysis will be required and its countermeasure will be taken, if necessary

DATUM	1900m
SIZE/TYPE OF PIPE	100 mm
EARTH COVERING (m)	100 mm
GROUND ELEVATION (m)	1944.46, 1944.34, 1942.34, 1941.59, 1942.19, 1943.92, 1943.75, 1944.25, 1946.44, 1947.79, 1950.21, 1951.56
PARTIAL DISTANCE (m)	0, 100, 200, 304, 400, 544, 613, 653, 791, 891, 1071, 1165
TOTAL DISTANCE (m)	1255

STATE OF ERITREA
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JAPAN INTERNATIONAL COOPERATION AGENCY

STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION

Plan & Profile for Transmission Pipeline (2005)

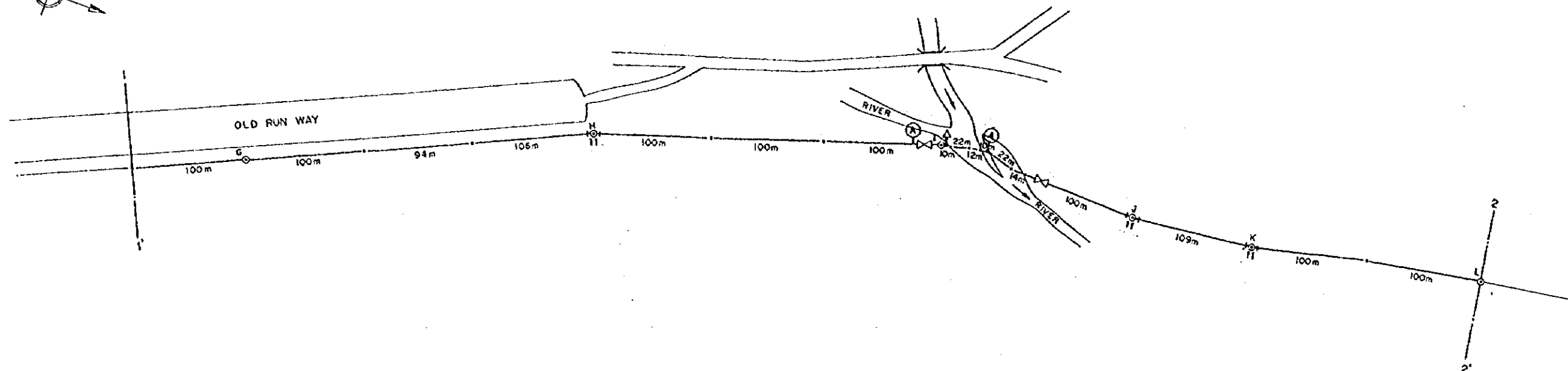
DEKEMHARE

WATER RESOURCES DEPARTMENT (ASMARA, ERITREA)
BANTU CONSULTANTS INC. (JAPAN) 1999

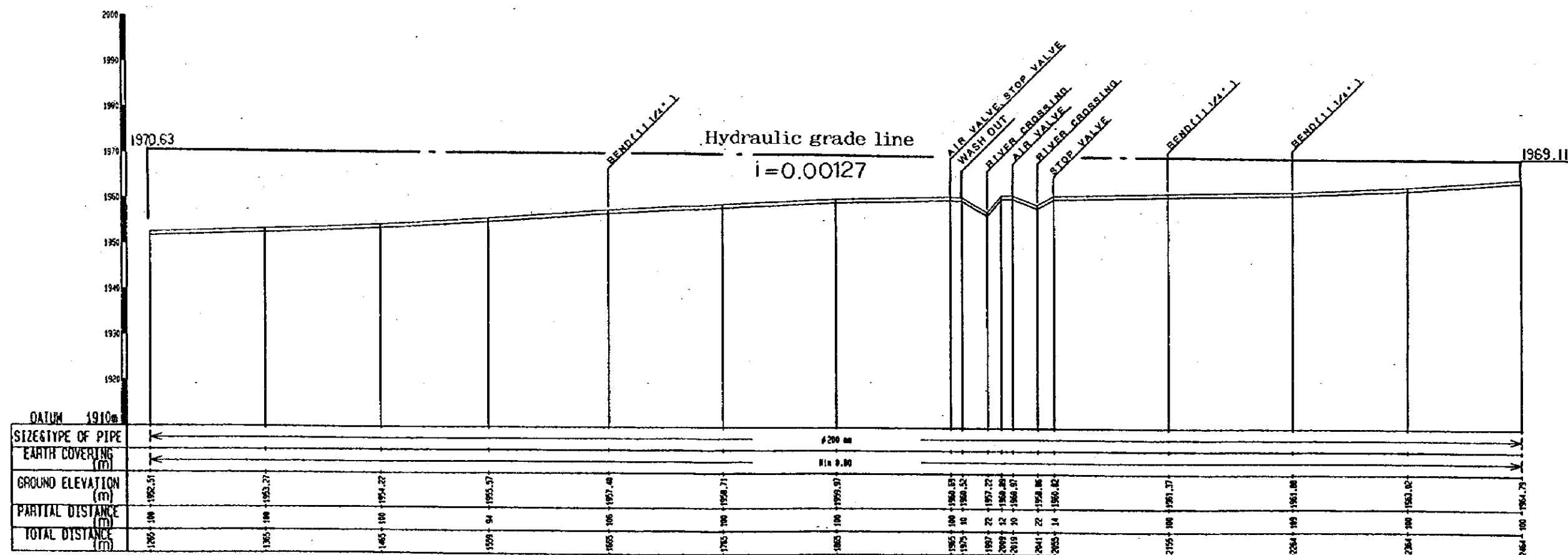
Drawing No. 2/27



PLAN



PROFILE



LEGEND	
	BEND 90°
	BEND 45°
	BEND 22 1/2°
	BEND 11 1/4°
	TEE
	WASH OUT
	AIR VALVE
	STOP VALVE

STATE OF ERITREA
MINISTRY OF LAND, WATER & ENVIRONMENT

JAPAN INTERNATIONAL COOPERATION AGENCY

STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION

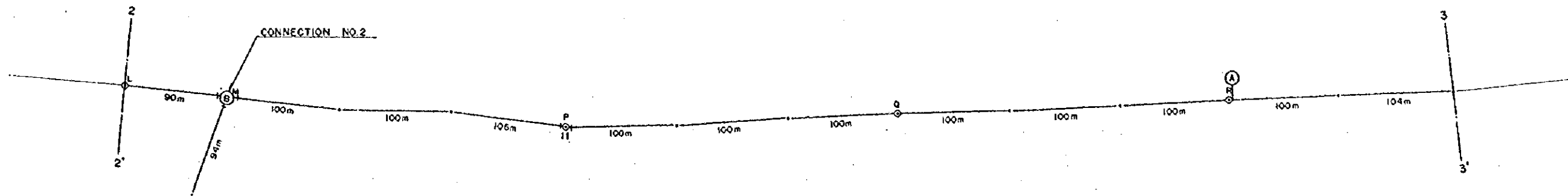
Plan & Profile for Transmission Pipeline (2005)
DEBEMHARE

WATER RESOURCES DEPARTMENT (ASMARA, ERITREA)
SANTU CONSULTANTS INC. (JAPAN) 1999

Drawing No.
3/27



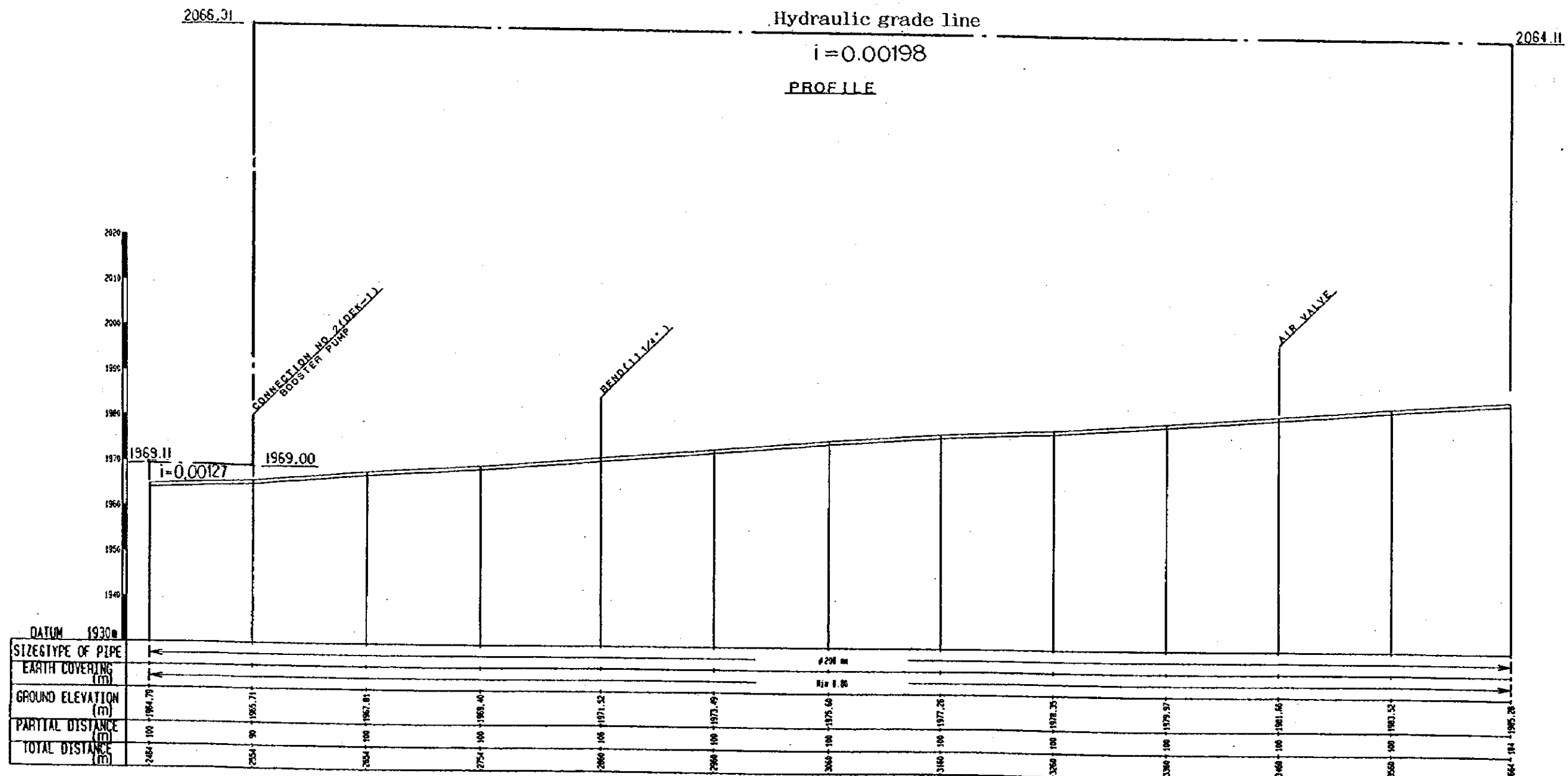
PLAN



Hydraulic grade line

$$i = 0.00198$$

PROFILE



LEGEND

	BEND 90°
	BEND 45°
	BEND 22 1/2°
	BEND 11 1/4°
	TEE
	WASH OUT
	AIR VALVE
	STOP VALVE

STATE OF ERITREA
MINISTRY OF LAND, WATER &
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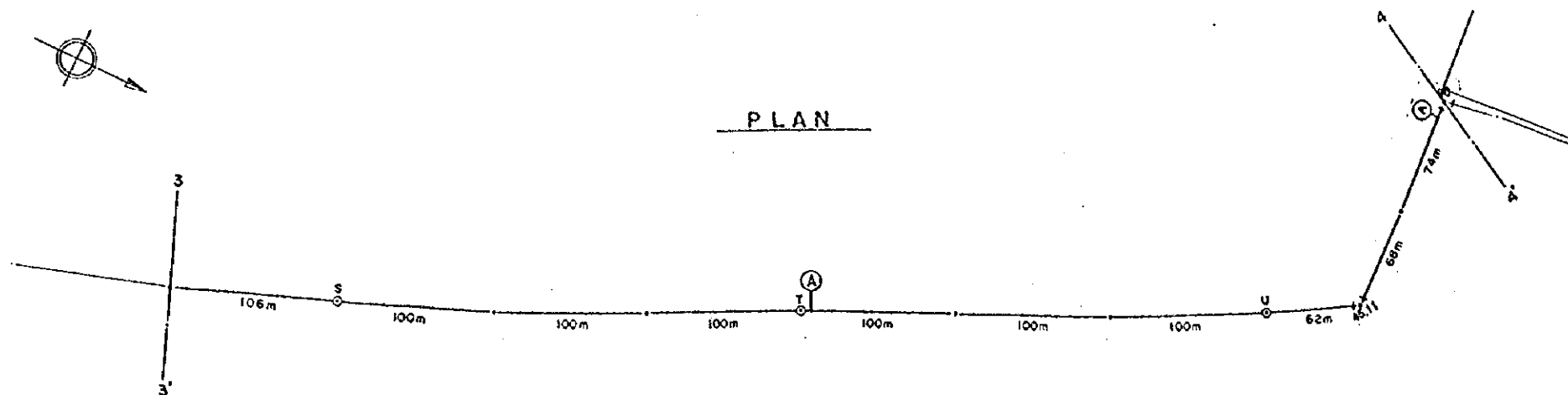
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STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

Plan & Profile for Transmission Pipeline
(2005)
DSEKEMHARE

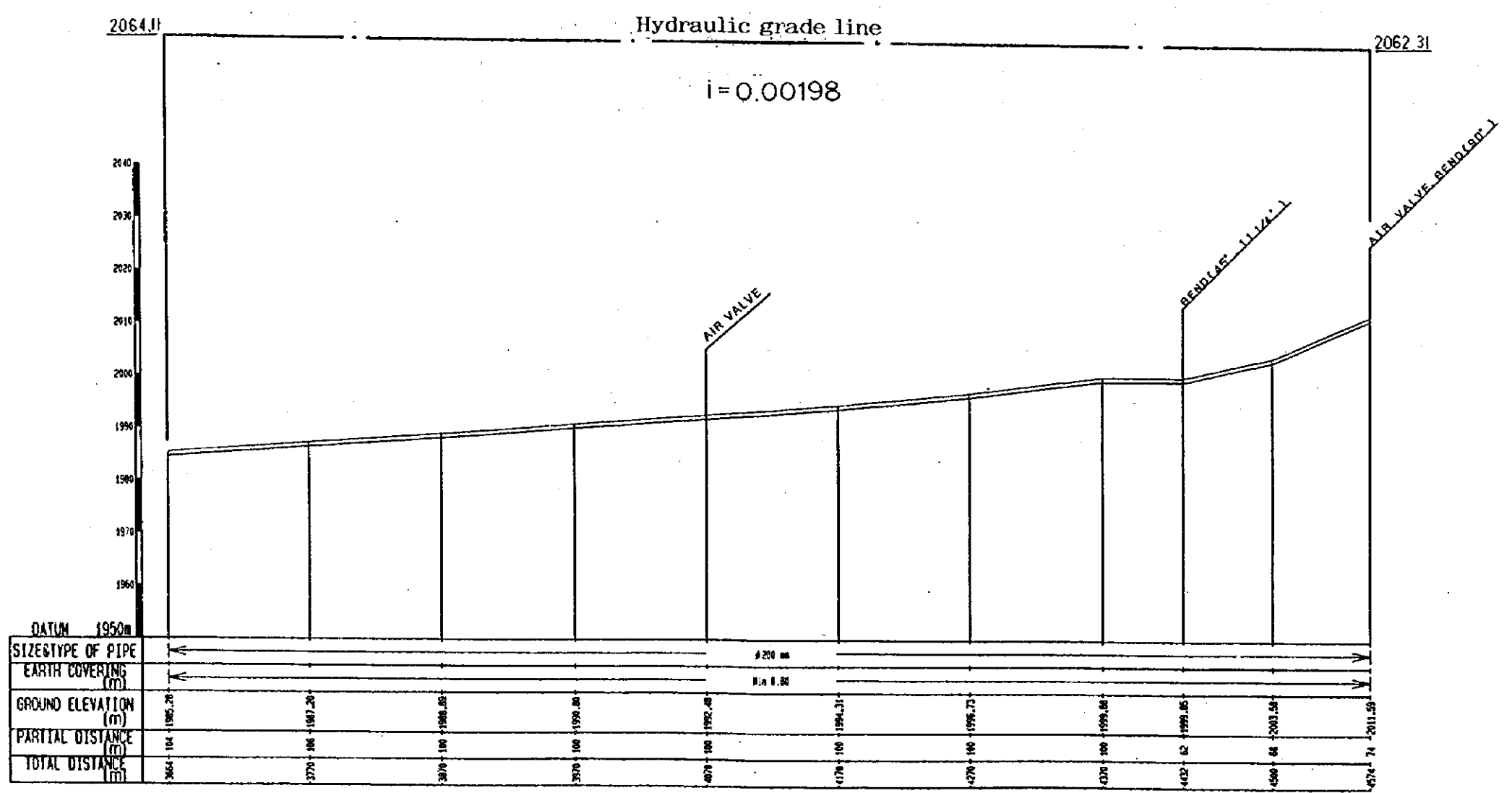
WATER RESOURCES DEPARTMENT
(ASMAR, ERITREA)
SANTU CONSULTANTS INC.
(JAPAN) 1999

Drawing No.
4/27



LEGEND	
	BEND 90°
	BEND 45°
	BEND 22 1/2°
	BEND 11 1/4°
	TEE
	WASH OUT
	AIR VALVE
	STOP VALVE

PROFILE



STATE OF ERITREA
 MINISTRY OF LAND, WATER & ENVIRONMENT

 JAPAN INTERNATIONAL COOPERATION AGENCY

STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION

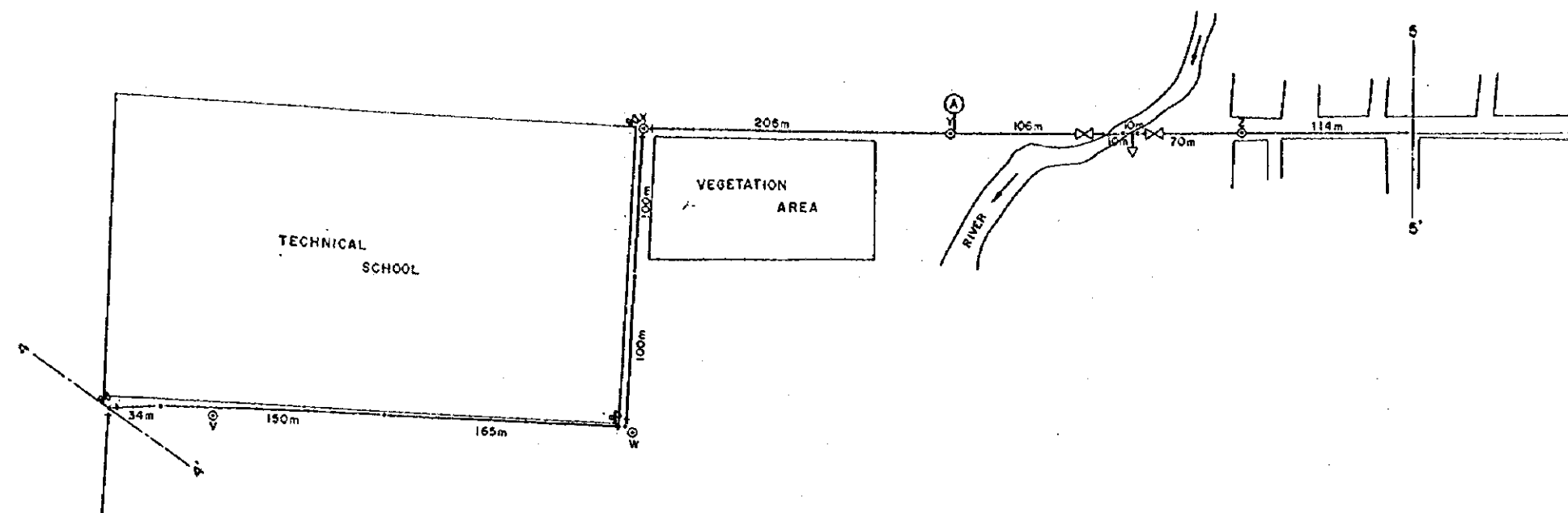
 Plan & Profile for Transmission Pipeline (2005)
 DEBEMHARE

WATER RESOURCES DEPARTMENT (ASKARA, ERITREA)
 BANTU CONSULTANTS INC. (JAPAN) 1999

Drawing No. 5/27



PLAN

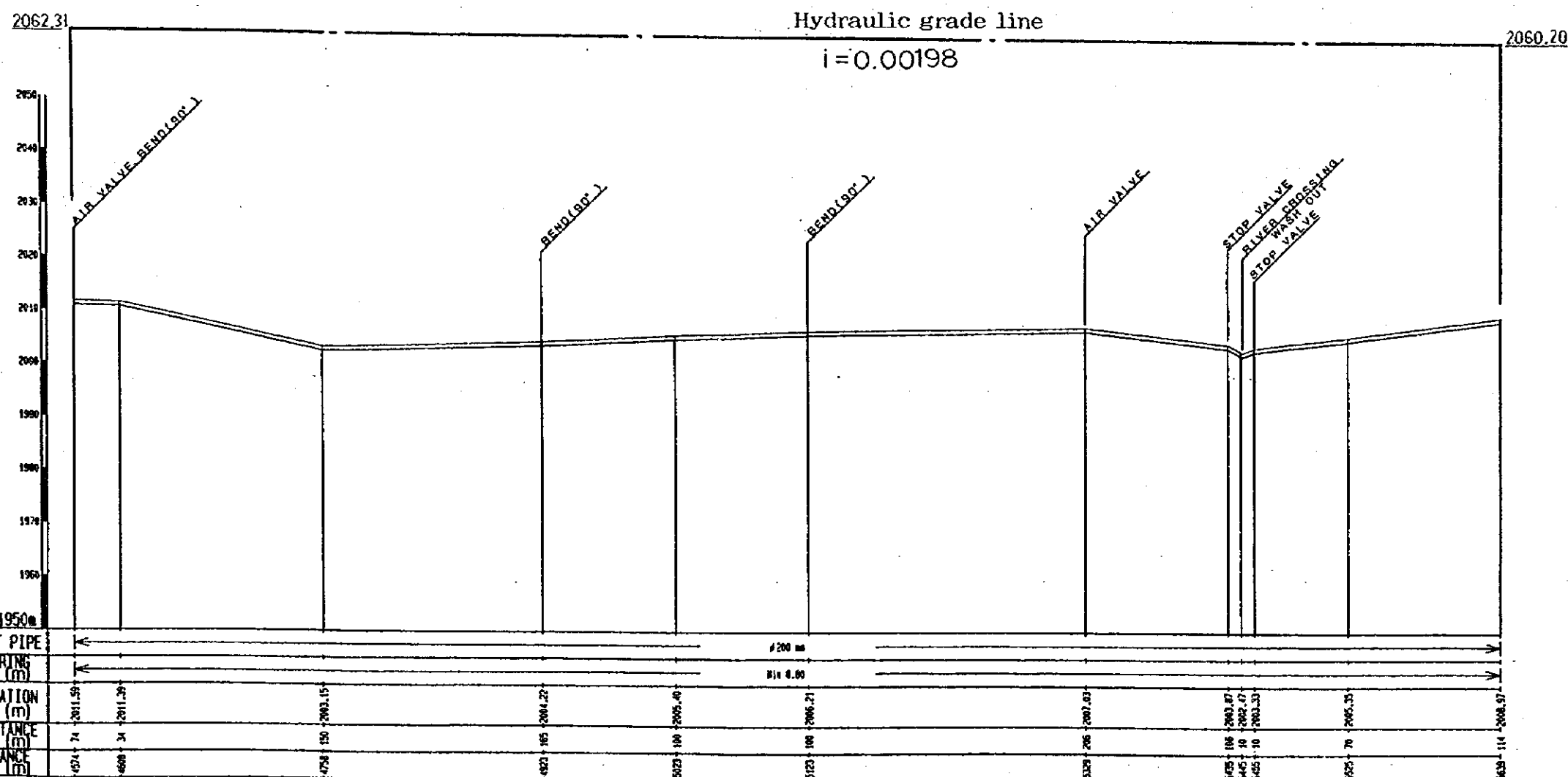


LEGEND	
	BEND 90°
	BEND 45°
	BEND 22 1/2°
	BEND 11 1/4°
	TEE
	WASH OUT
	AIR VALVE
	STOP VALVE

PROFILE

Hydraulic grade line

$$i = 0.00198$$



DATUM 1950m

SIZE/TYPE OF PIPE	200 mm
EARTH COVERING (m)	0.80
GROUND ELEVATION (m)	
PARTIAL DISTANCE (m)	
TOTAL DISTANCE (m)	624

STATE OF ERITREA
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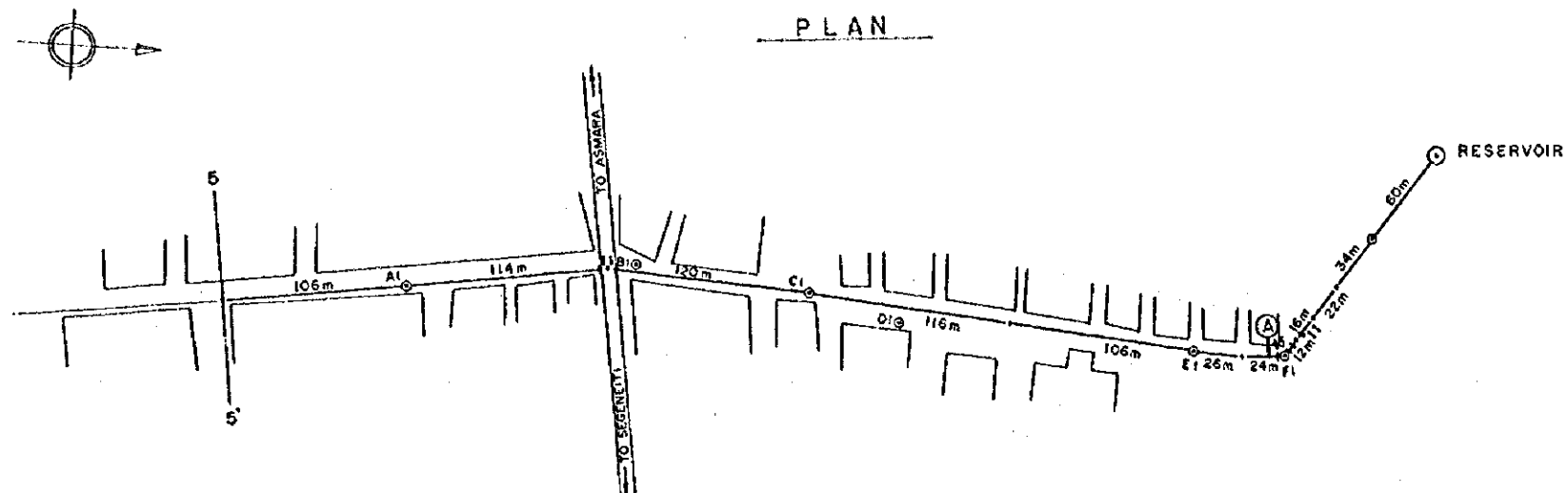
STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

Plan & Profile for Transmission Pipeline
(2005)

DEKEMHARE

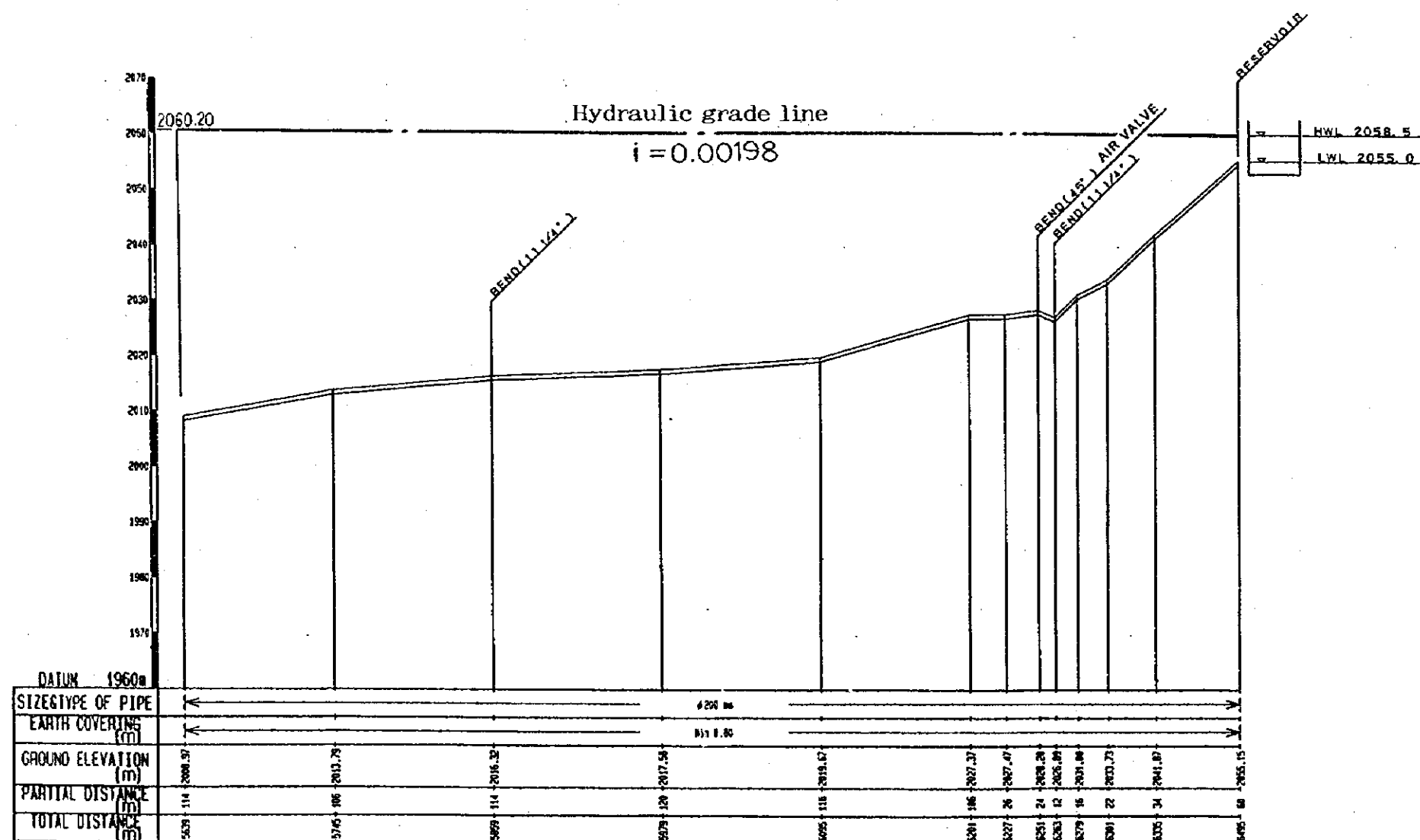
WATER RESOURCES DEPARTMENT
(ASMARA, ERITREA)
SANTU CONSULTANTS INC.
(JAPAN) 1999

Drawing No.
6/27



LEGEND	
	BEND 90°
	BEND 45°
	BEND 22 1/2°
	BEND 11 1/4°
	TEE
	WASH OUT
	AIR VALVE
	STOP VALVE

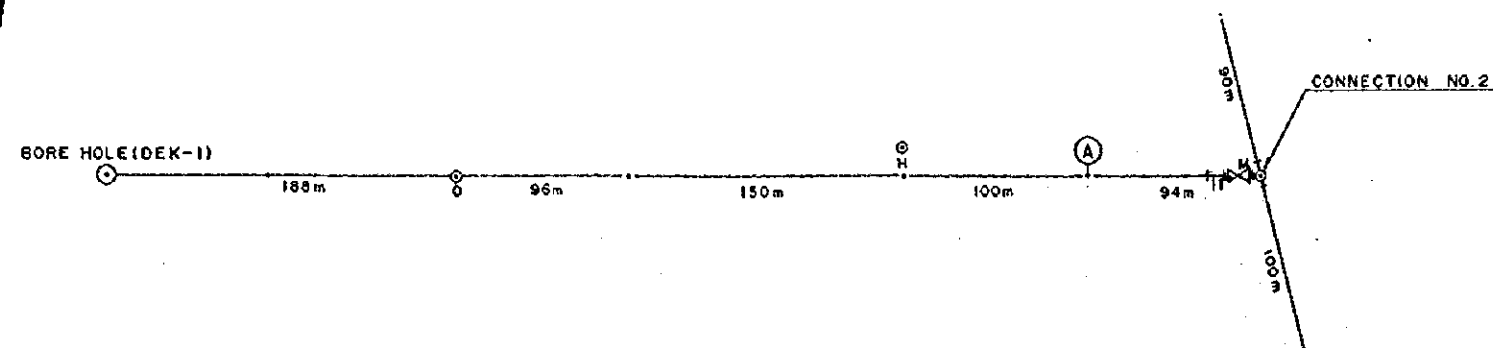
PROFILE



STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
Plan & Profile for Transmission Pipeline (2005)	
DEKEHARE	
WATER RESOURCES DEPARTMENT (ASMARA, ERITREA) SANTU CONSULTANTS INC. (JAPAN), 1993	Drawing No. 7/21

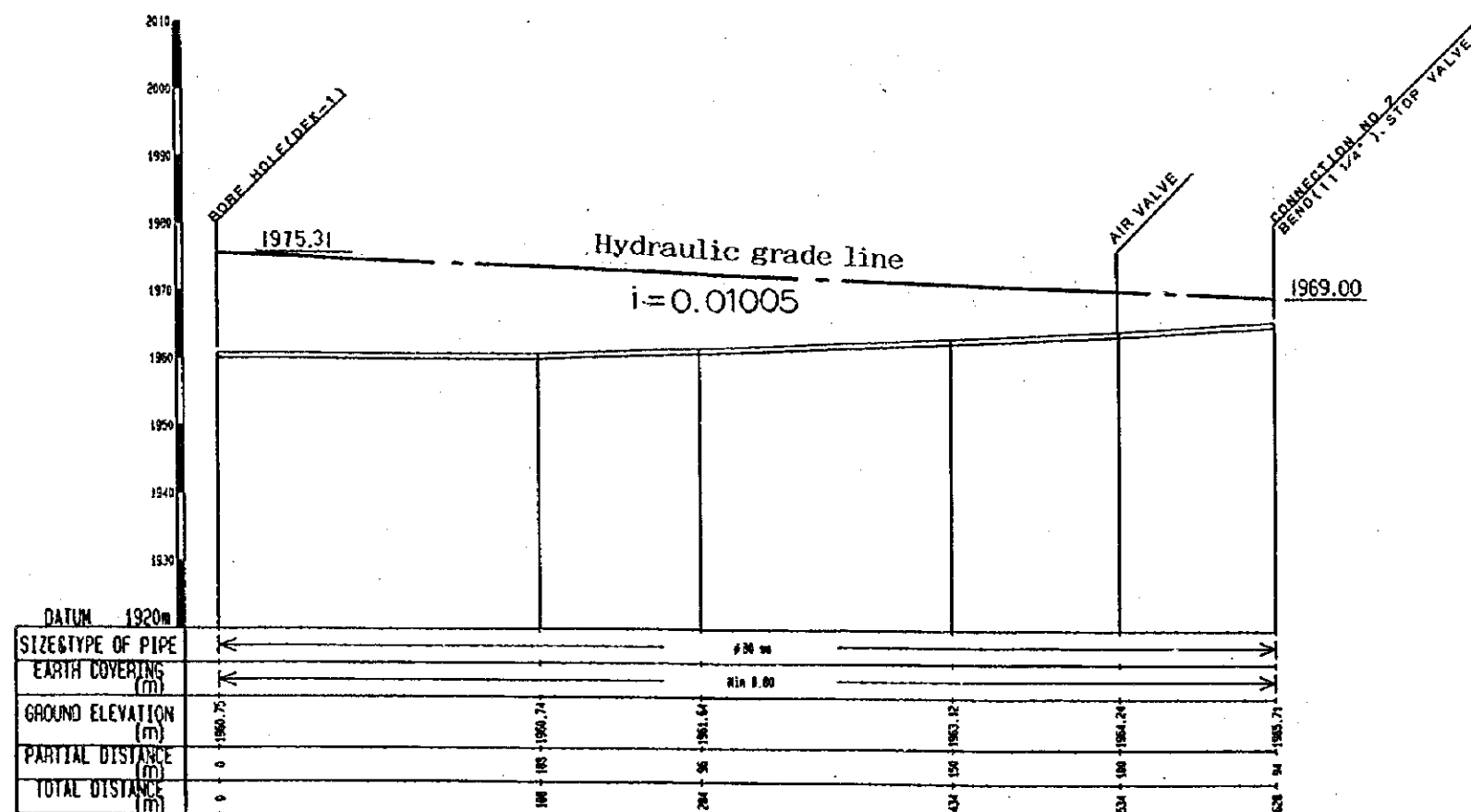


PLAN

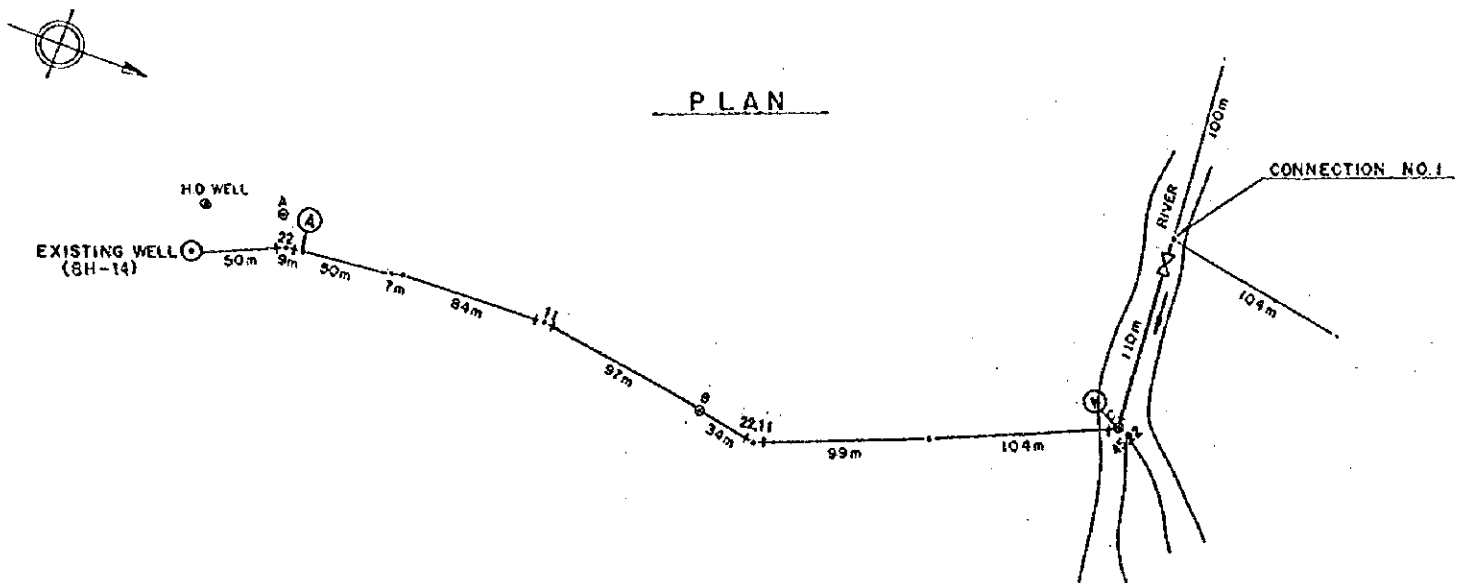


LEGEND	
	BEND 90°
	BEND 45°
	BEND 22 1/2°
	BEND 11 1/4°
	TEE
	WASH OUT
	AIR VALVE
	STOP VALVE

PROFILE

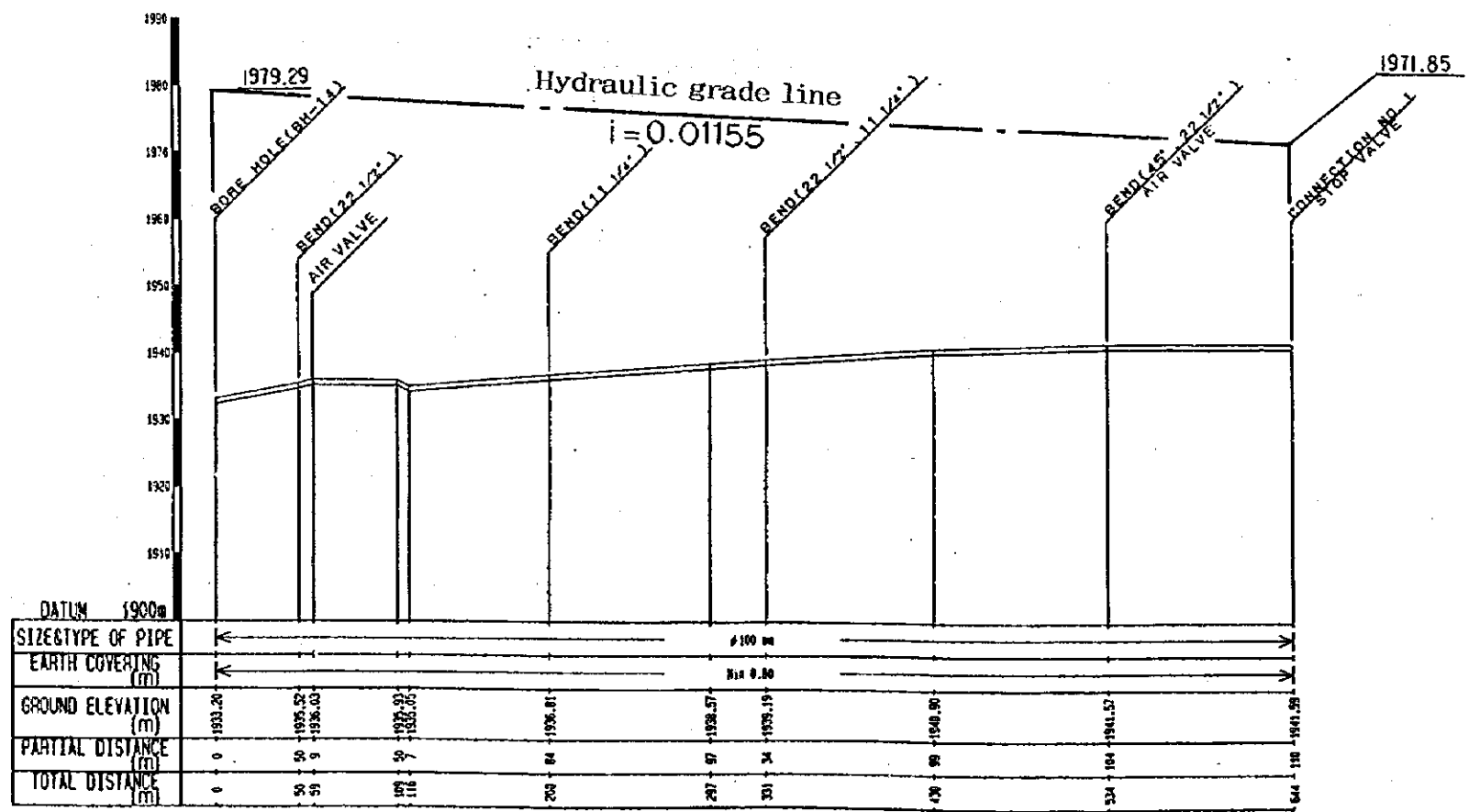


STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
Plan & Profile for Transmission Pipeline (2005) DEKEMHARE	
WATER RESOURCES DEPARTMENT (ASMARA, ERITREA) BANTU CONSULTANTS INC. (JAPAN), 1993	Drawing No. 8/27

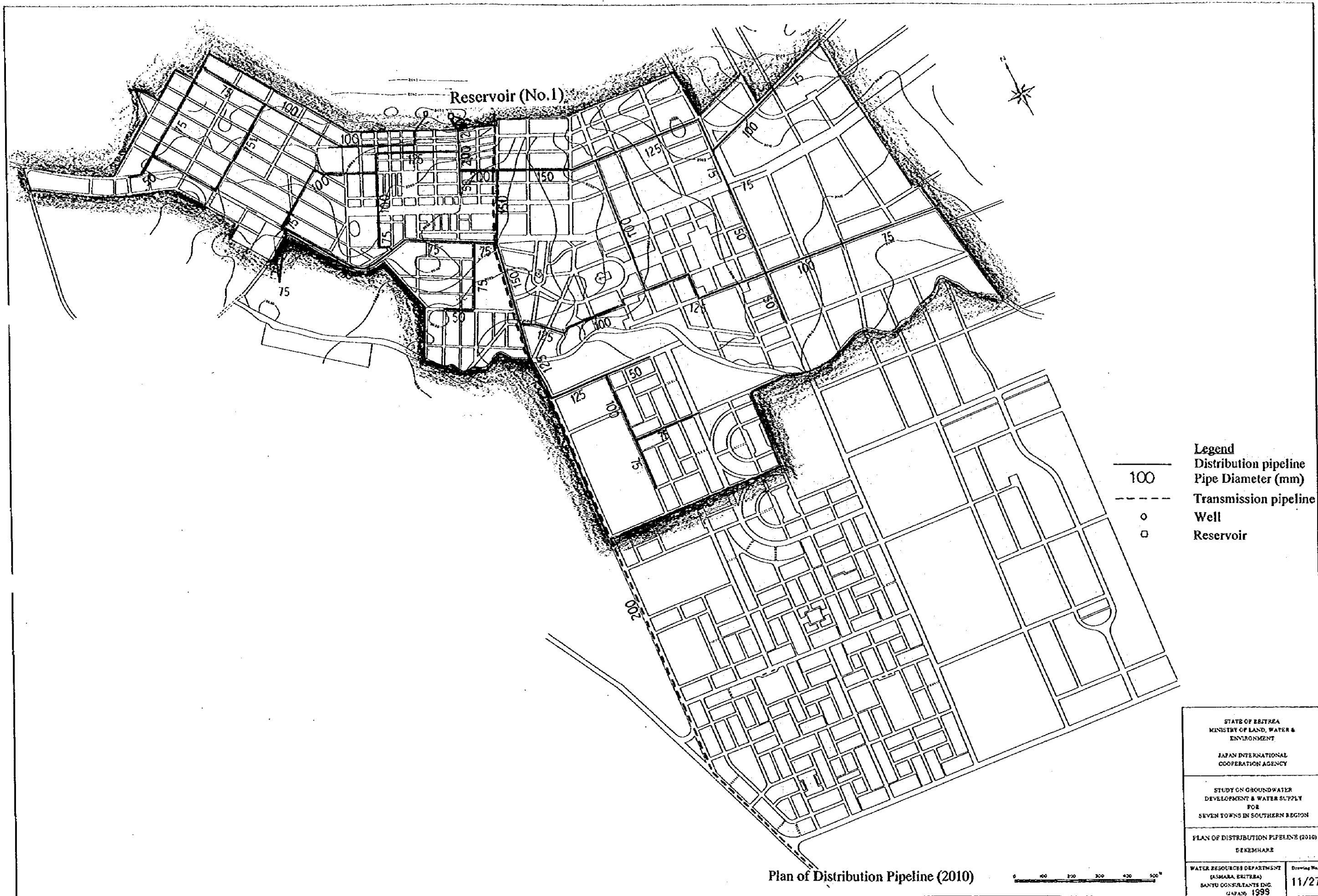


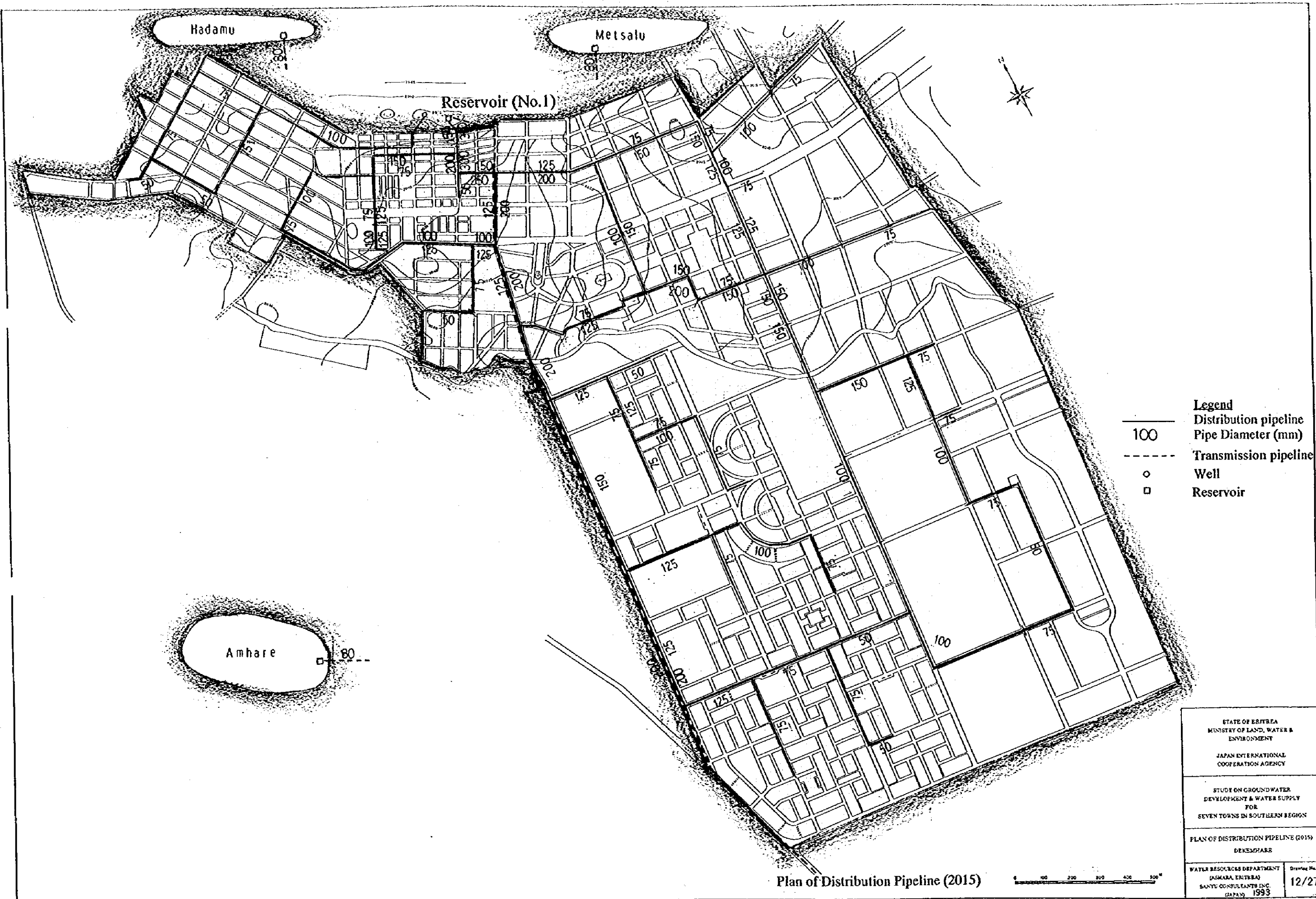
LEGEND	
	BEND 90°
	BEND 45°
	BEND 22 1/2°
	BEND 11 1/4°
	TEE
	WASH OUT
	AIR VALVE
	STOP VALVE

PROFILE



STATE OF ERTREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
Plan & Profile for Transmission Pipeline (2005)	
DEKEMHARE	
WATER RESOURCES DEPARTMENT (ASMARA, ERTREA) BANTU CONSULTANTS INC. (JAPAN) 1993	Drawing No. 9/27



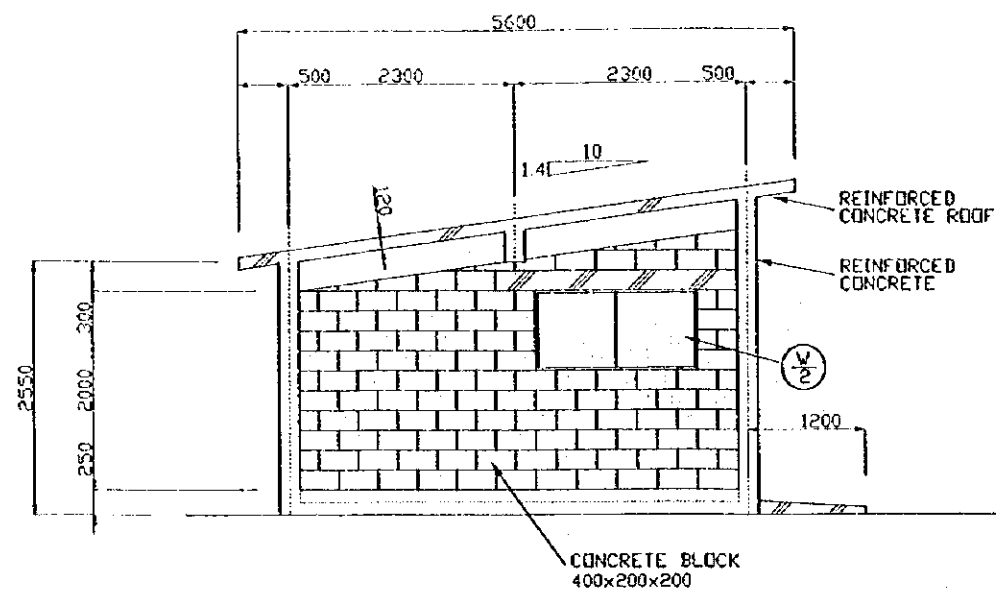


Plan of Distribution Pipeline (2015)

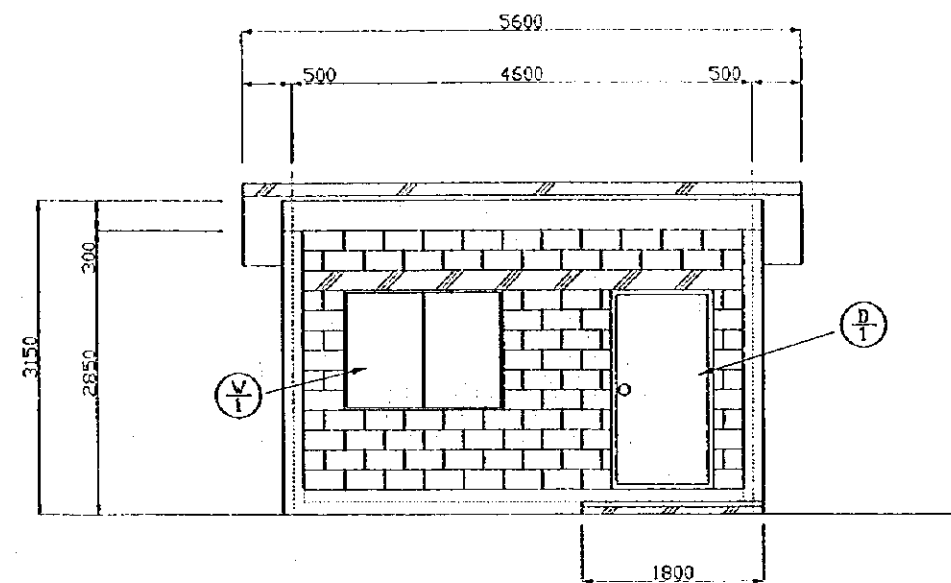
- Legend**
- Distribution pipeline
 - Transmission pipeline
 - Well
 - Reservoir

STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
PLAN OF DISTRIBUTION PIPELINE (2015) DEKEMHARE	
WATER RESOURCES DEPARTMENT (ASMARA, ERITREA) SANTU CONSULTANTS INC. (JAPAN) 1993	Drawing No. 12/27

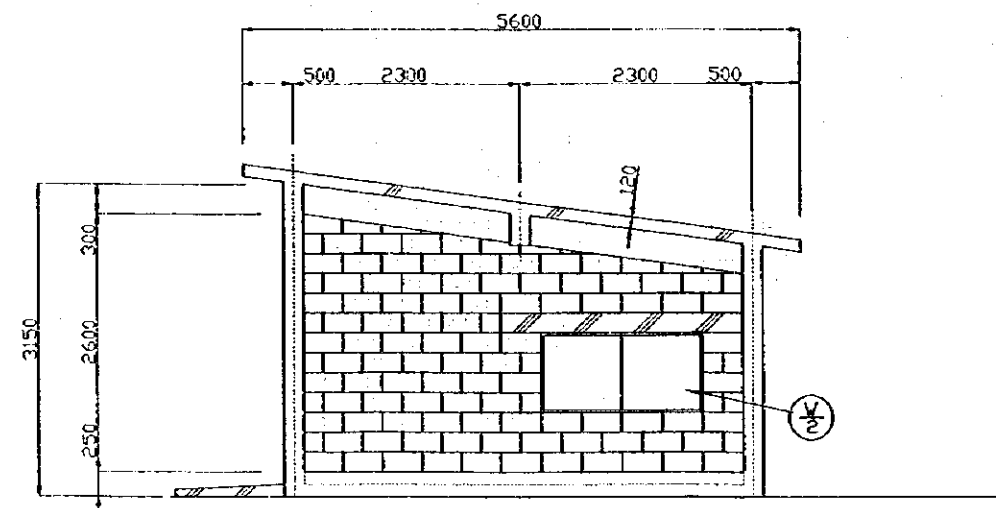




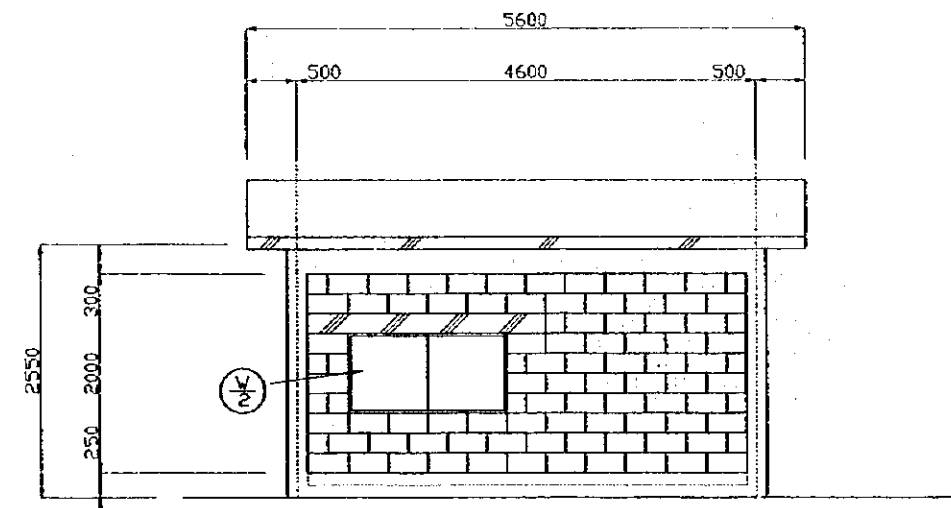
D-ELEVATION



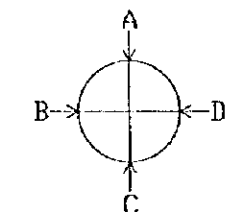
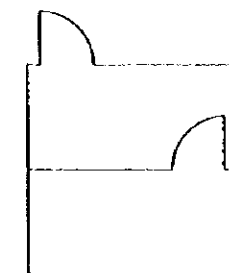
A-ELEVATION



B-ELEVATION



C-ELEVATION



	W	H	ea
(D) STEEL DOOR	800	1,900	2
(W/1) WINDOW WITH WIRED GLASS	900	900	1
(W/2) WINDOW WITH WIRED GLASS	900	600	3

STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

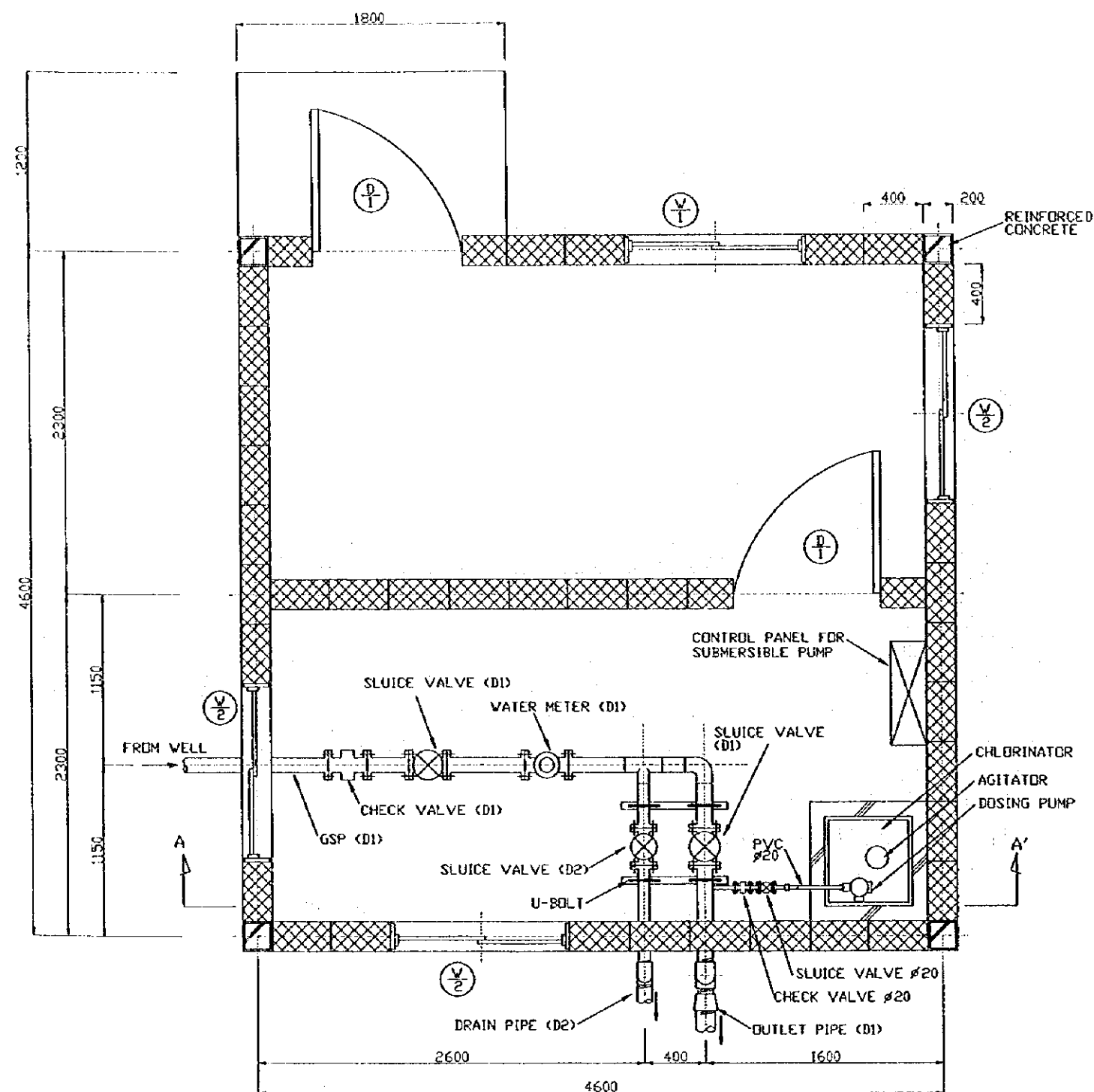
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STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

STRUCTURE OF BOREHOLE PUMP STATION
DEKEMHARE

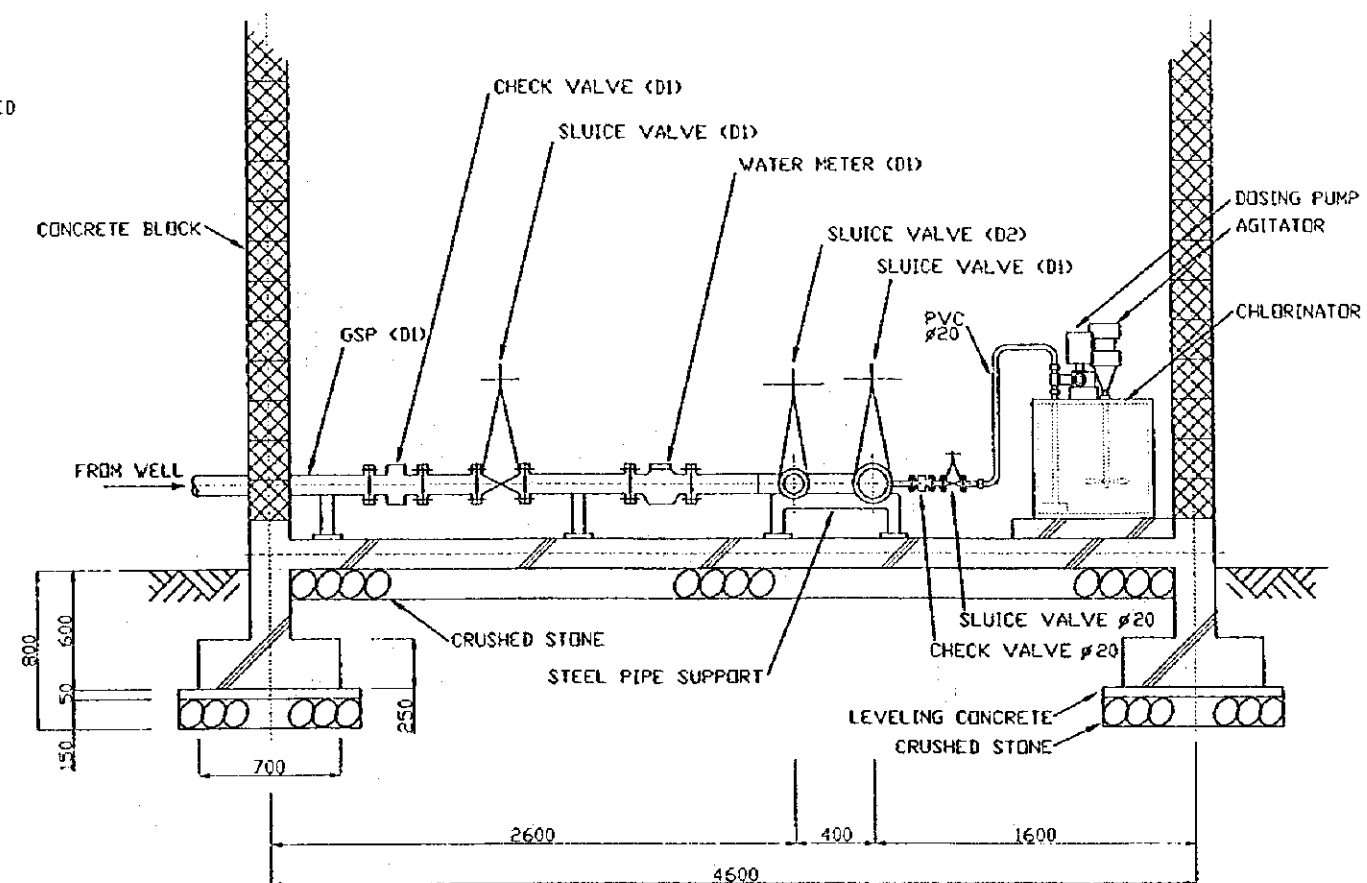
WATER RESOURCES DEPARTMENT
SANYU CONSULTANTS INC.
(JAPAN) 1999

Drawing No.
14/27



PLAN

	W	H	ea
⊙	800	1,900	2
⊕	900	900	1
⊕	900	600	3



SECTION A-A'

Water Source	D1	D2
BH-14	80	50
DEK-2	80	50
DEK-1	65	50

STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

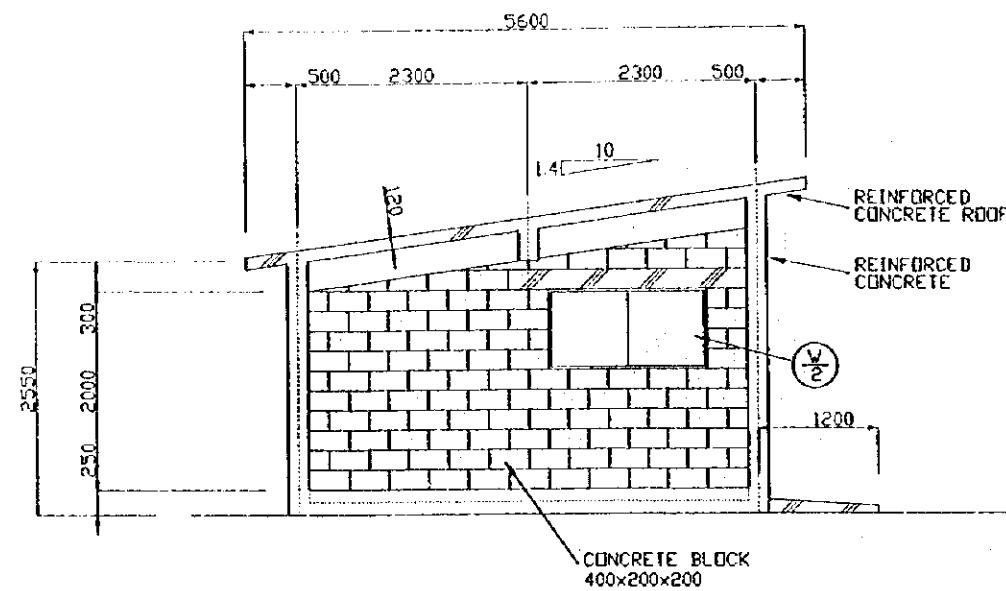
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STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

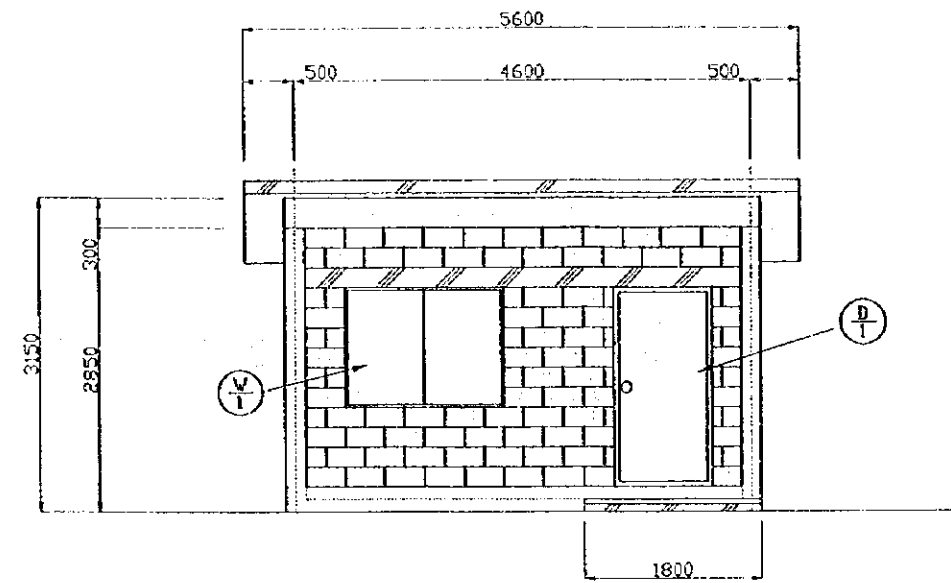
BOREHOLE PUMP STATION
DEKEMHARE

WATER RESOURCES DEPARTMENT
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(JAPAN) 1999

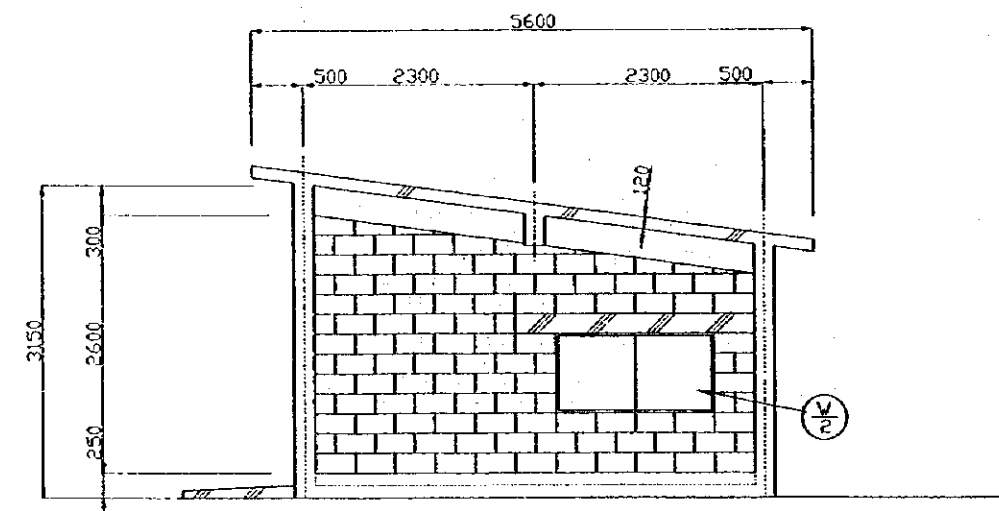
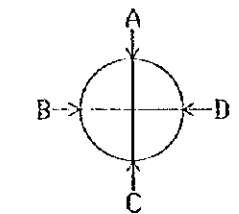
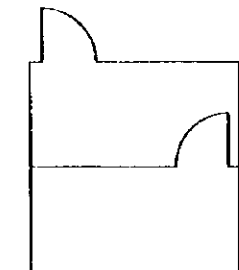
Drawing No
15/27



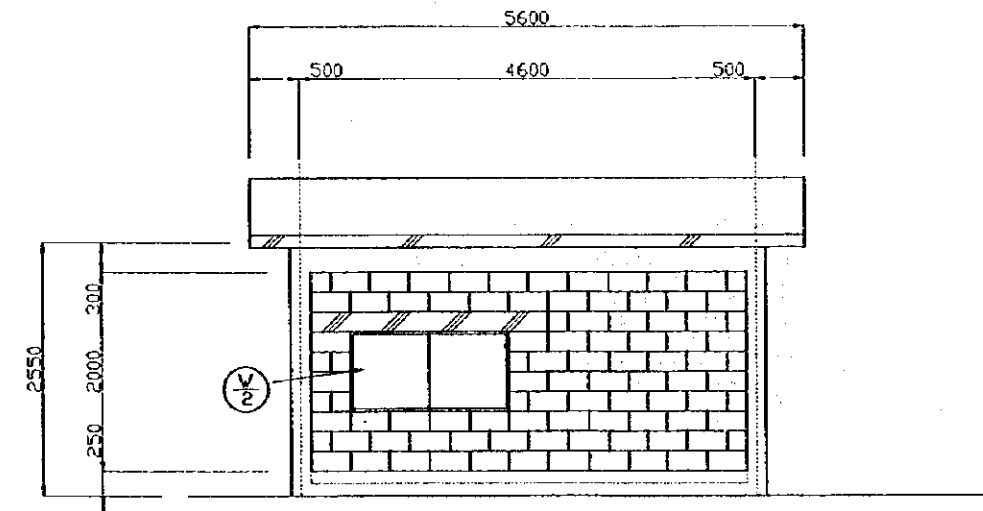
D-ELEVATION



A-ELEVATION



B-ELEVATION



C-ELEVATION

	W	H	ea
⊙ D/1	STEEL DOOR	800 X 1,900 X 2	
⊙ W/1	WINDOW WITH WIRED GLASS	900 X 900 X 1	
⊙ W/2	WINDOW WITH WIRED GLASS	900 X 600 X 3	

STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

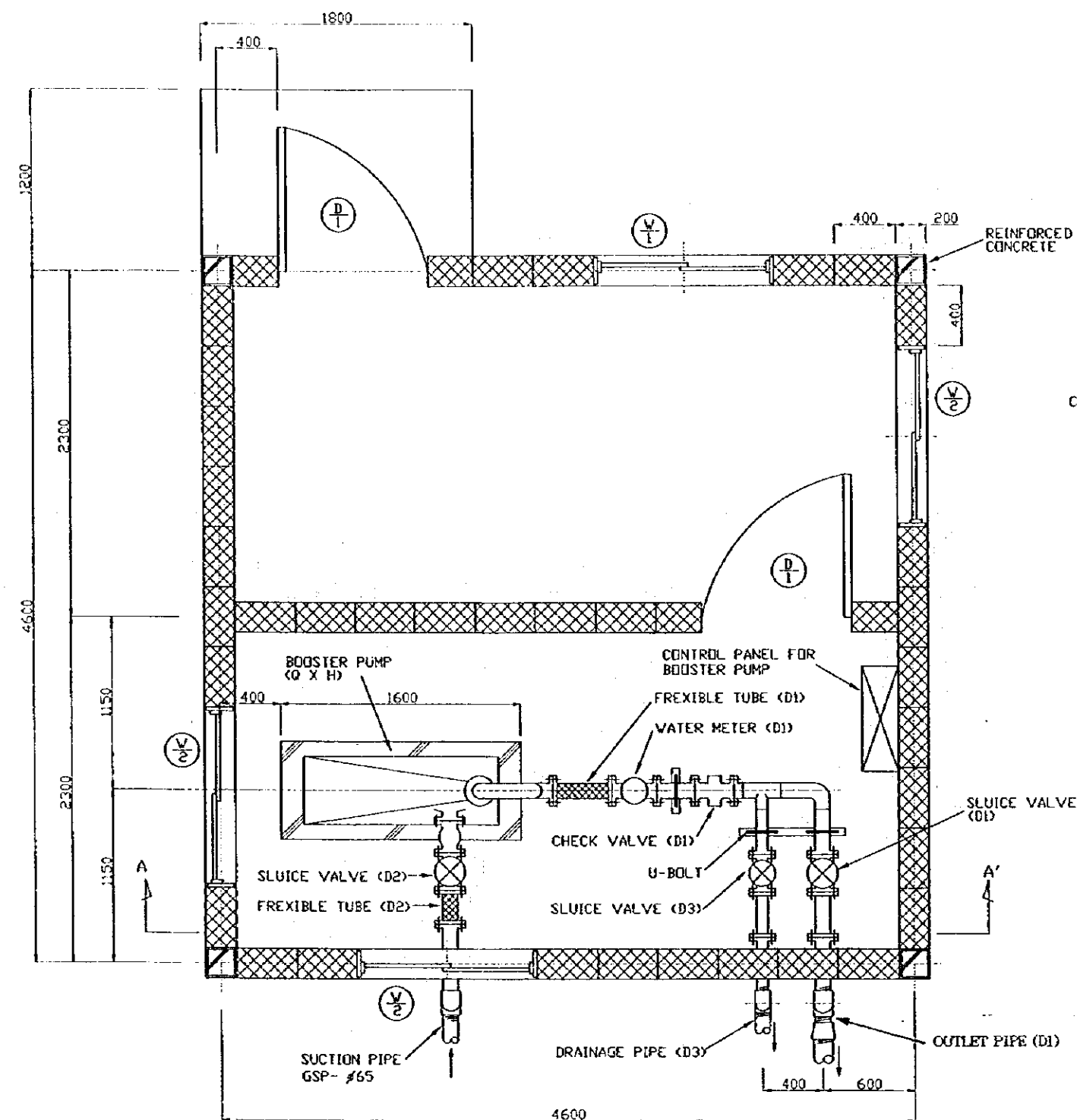
JAPAN INTERNATIONAL
COOPERATION AGENCY

STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

STRUCTURE OF BOOSTER PUMP STATION
DEKEMHARE

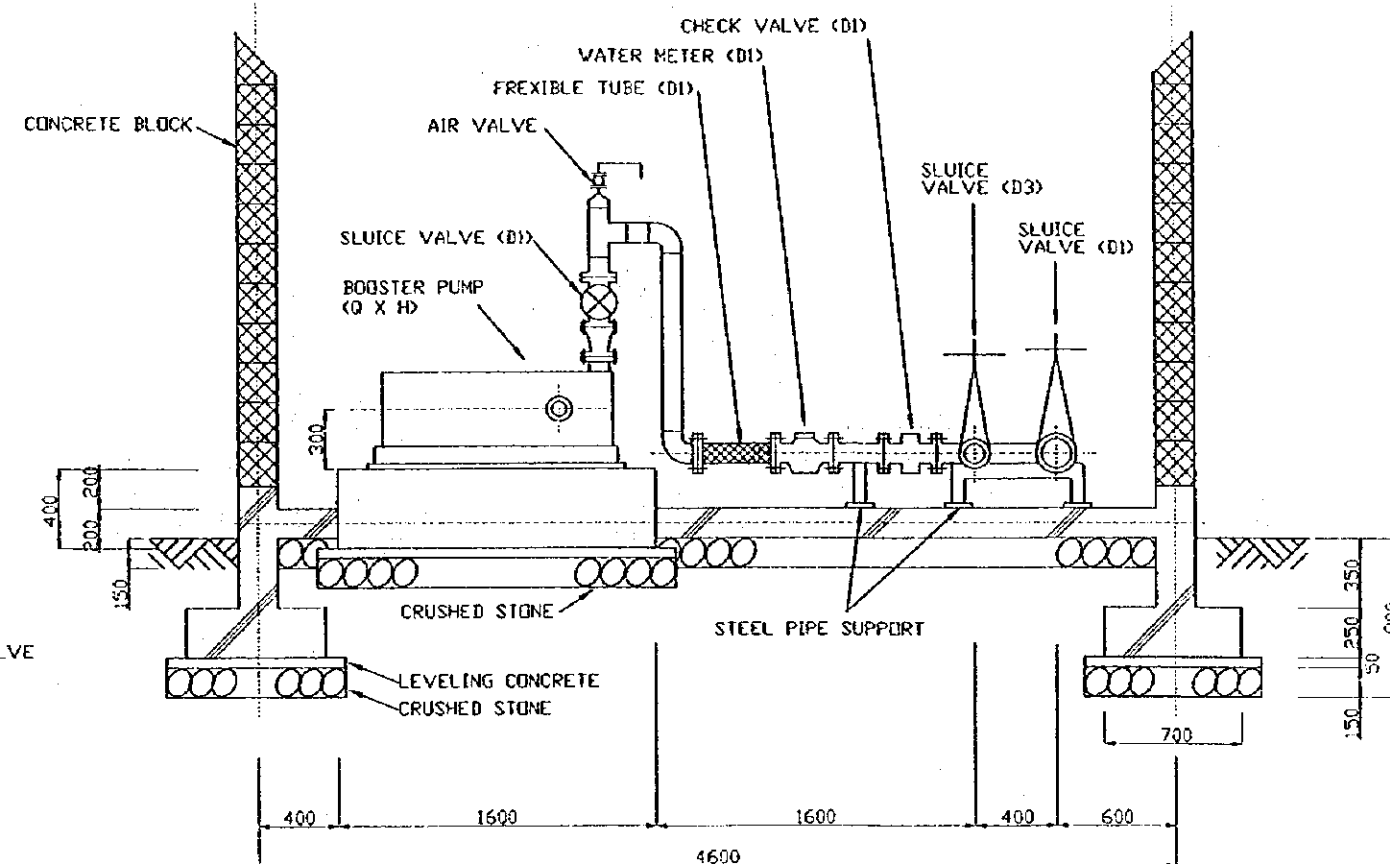
WATER RESOURCES DEPARTMENT
SANYU CONSULTANTS INC.
(JAPAN) 1999

Drawing No.
16/27



PLAN

	W	H	ea
STEEL DOOR	800	1,900	2
WINDOW WITH WIRED GLASS	900	900	1
WINDOW WITH WIRED GLASS	900	600	3



SECTION A-A'

Water Source	D1	D2	D3	Q (lit/m)	H (m)
BOOSTER-41	125	100	50	918	101
BOOSTER-42	65	50	50	218	15

STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

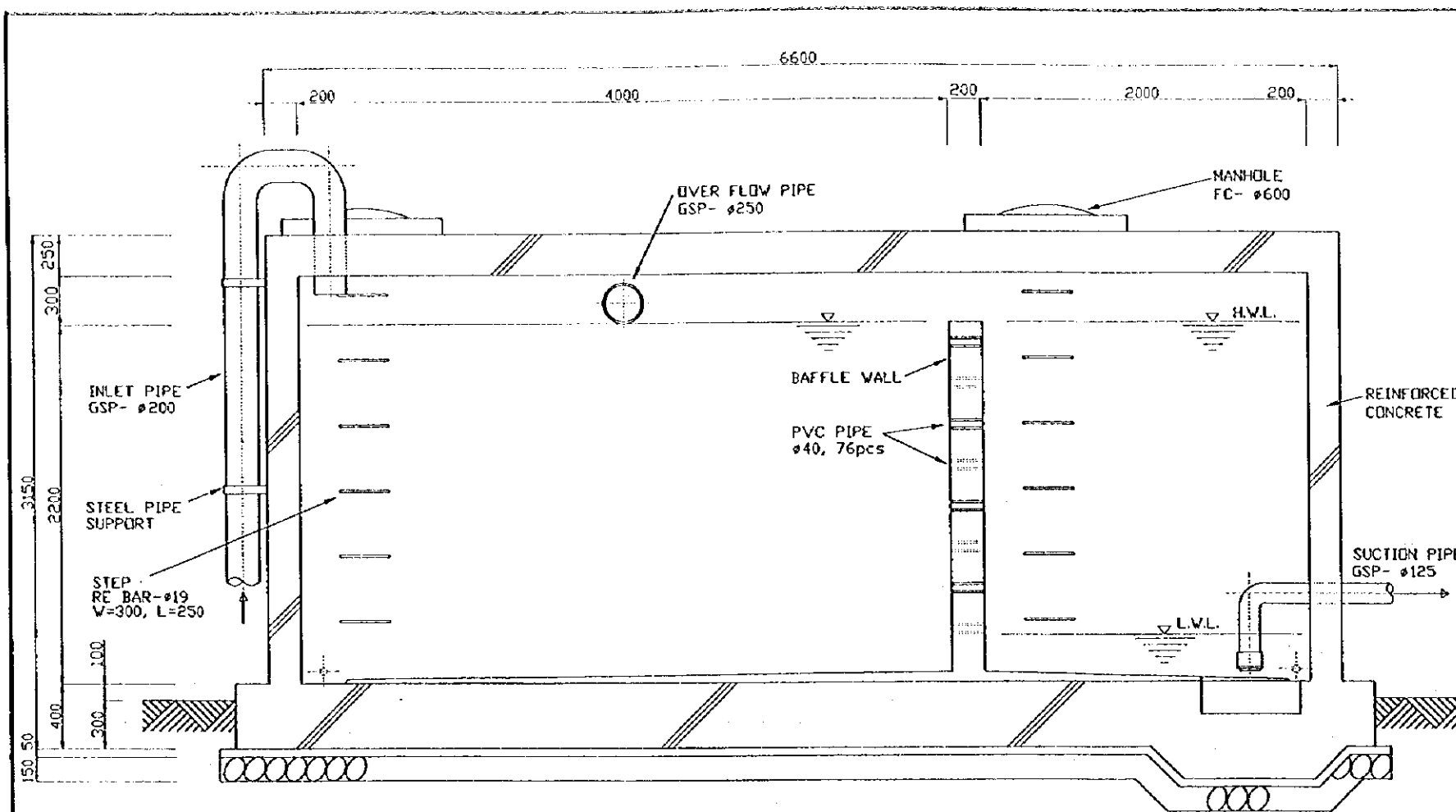
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STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

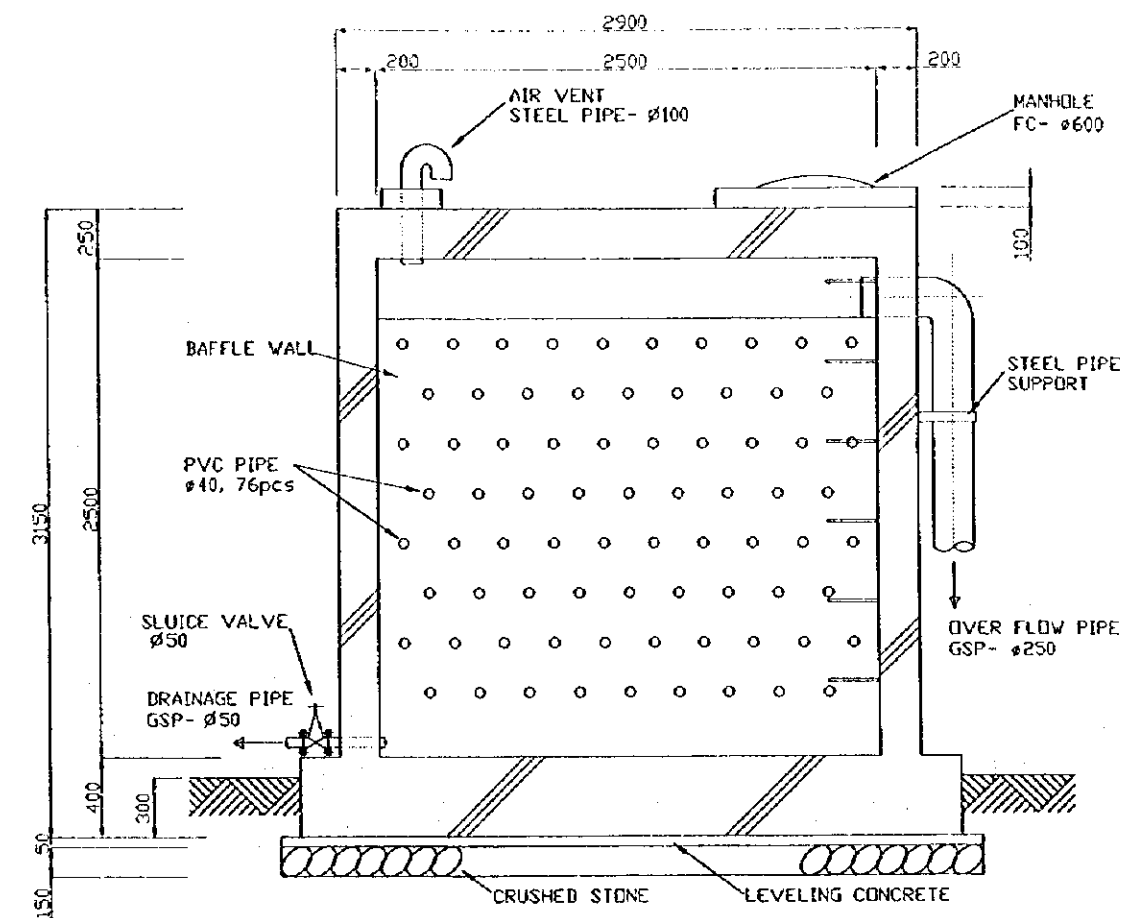
BOOSTER PUMP STATION
DEKEMHARE

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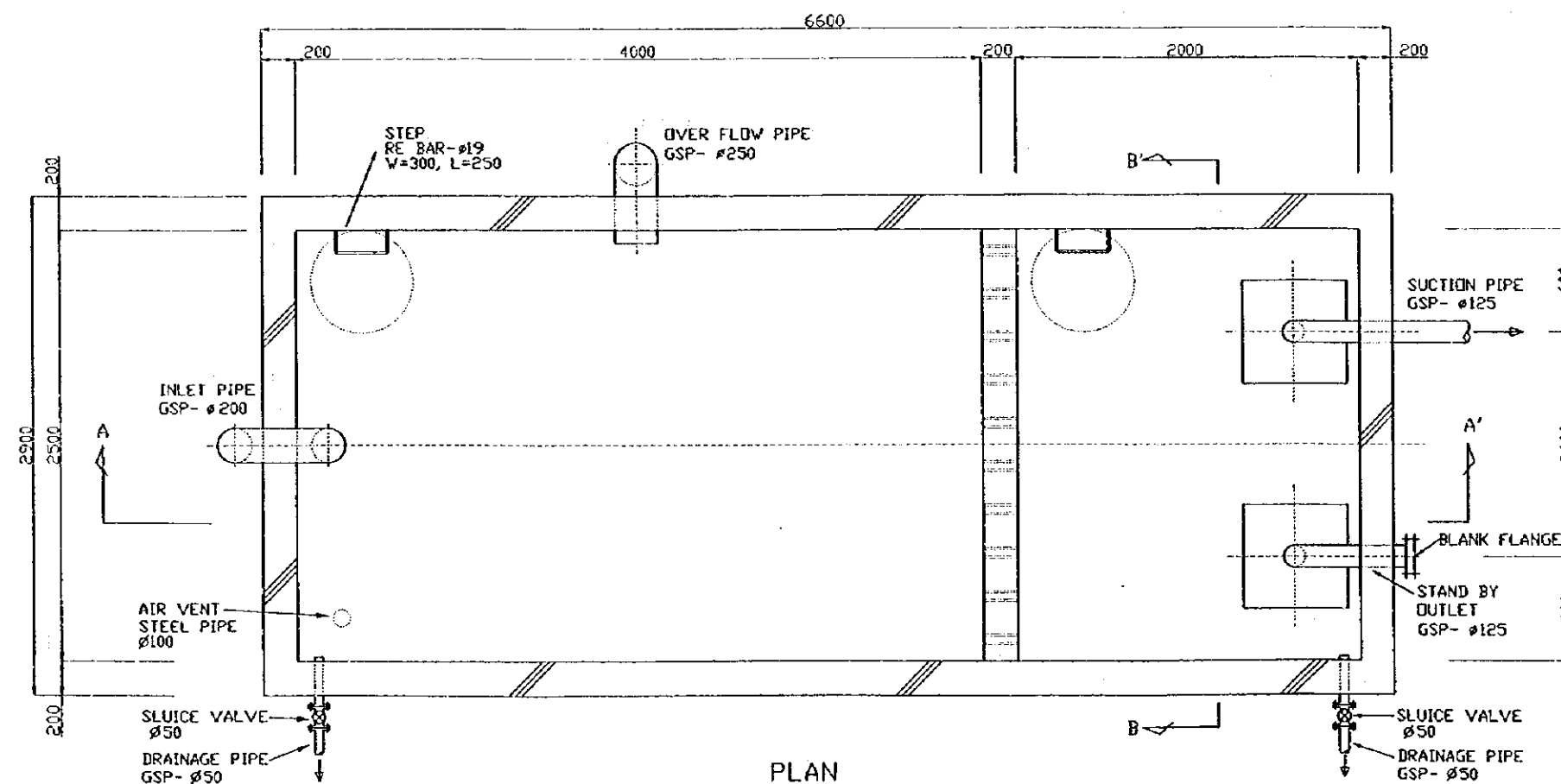
Drawing No
17/27



SECTION A-A'



SECTION B-B'



PLAN

STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

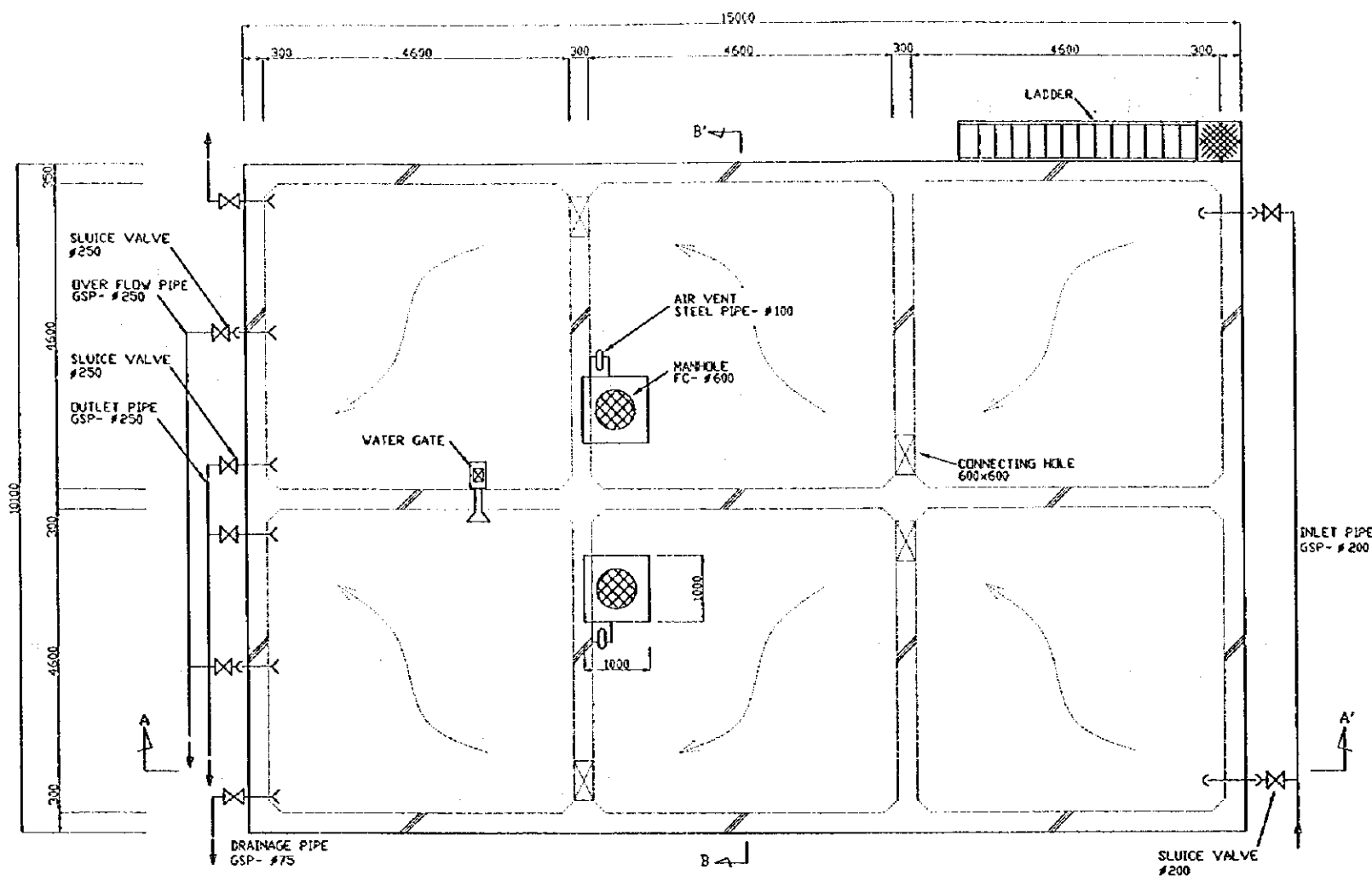
JAPAN INTERNATIONAL
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STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

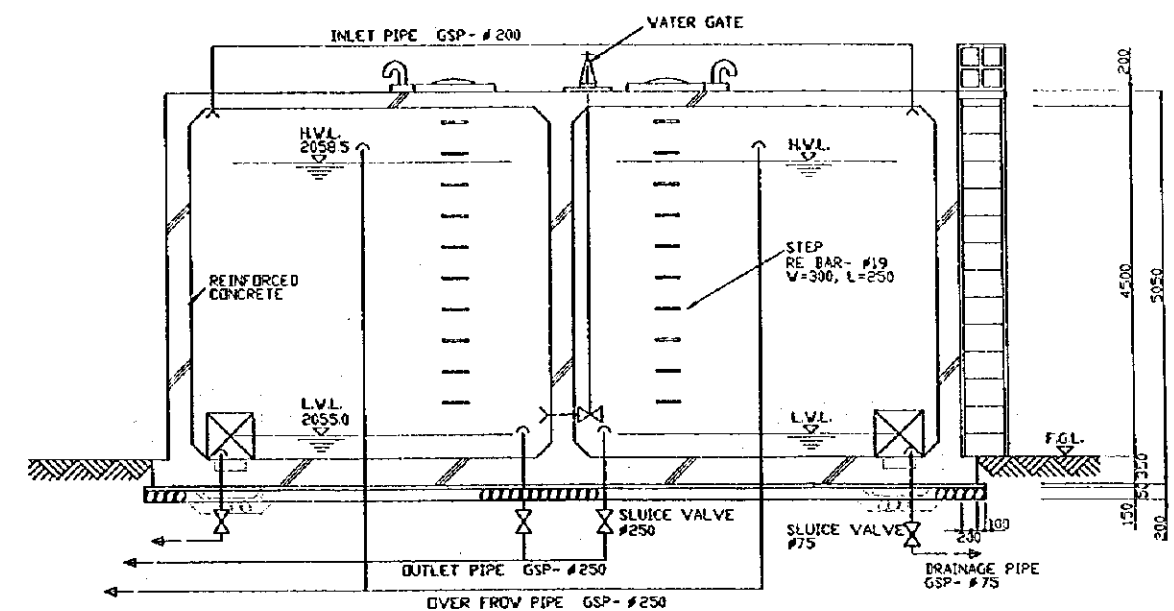
30m³ RECEIVING TANK
DEKEMHARE

WATER RESOURCES DEPARTMENT
SANYU CONSULTANTS INC.
(JAPAN) 1999

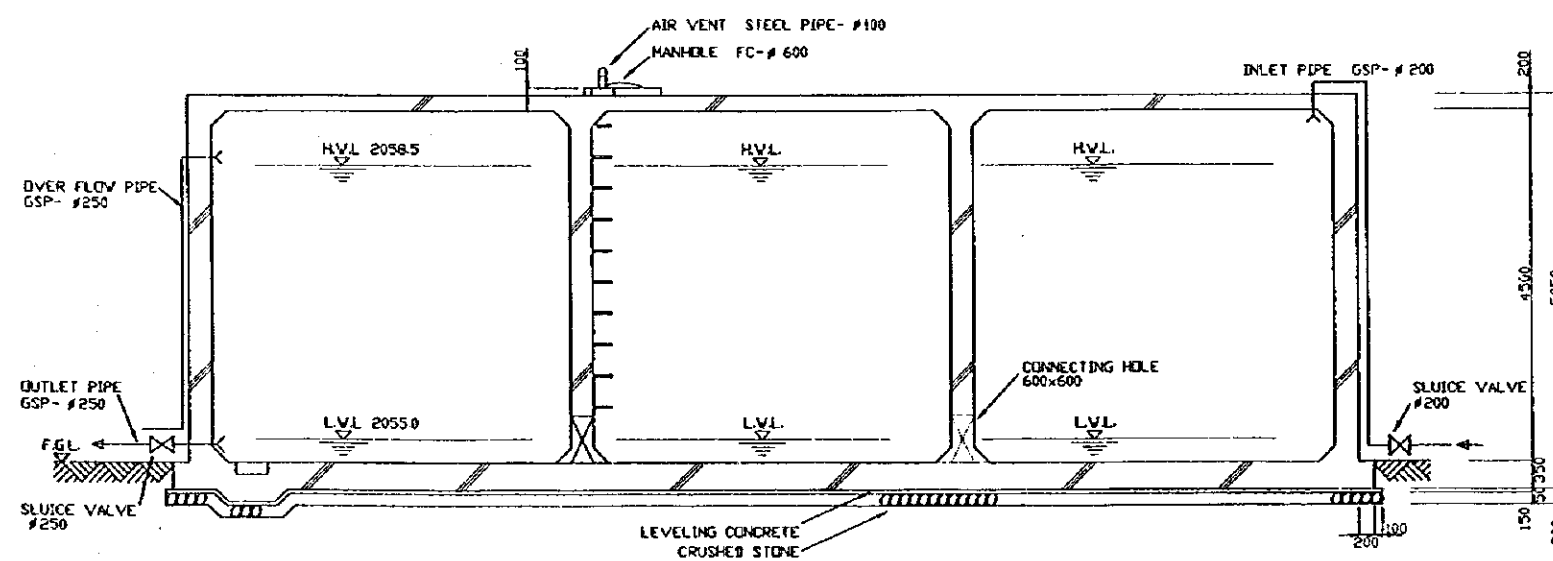
Drawing No.
18/27



PLAN



SECTION B-B



SECTION A-A

STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

JAPAN INTERNATIONAL
COOPERATION AGENCY

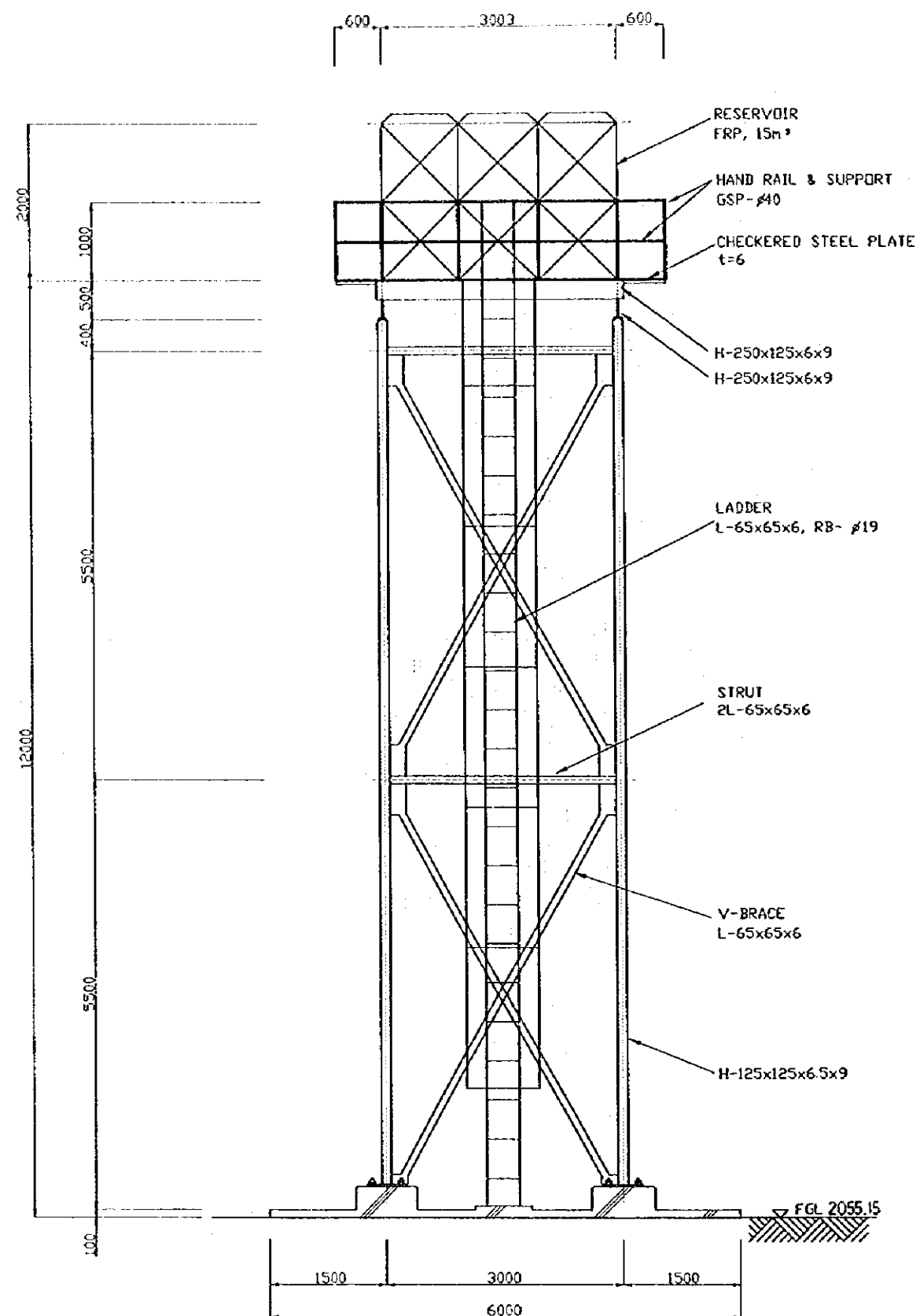
STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

440m³ RESERVOIR
DEKEMHARE

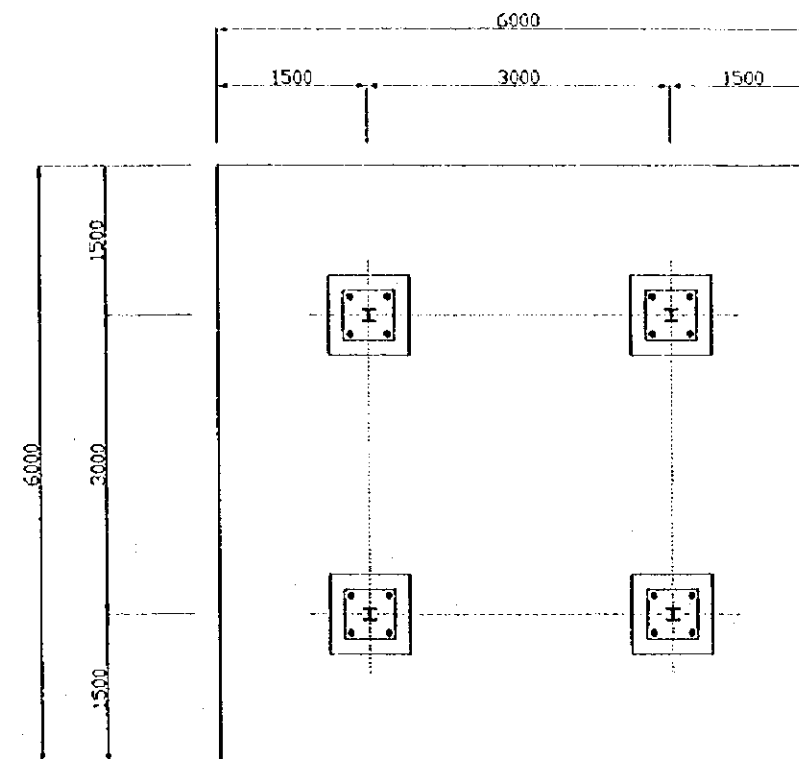
WATER RESOURCES DEPARTMENT
SANYU CONSULTANTS INC.
(JAPAN) 1999

Drawing No.

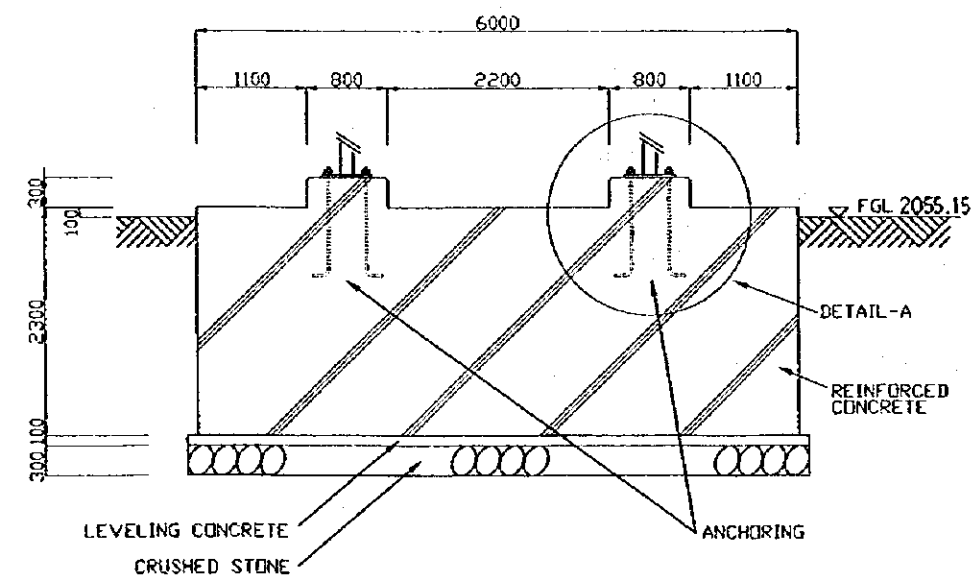
19/27



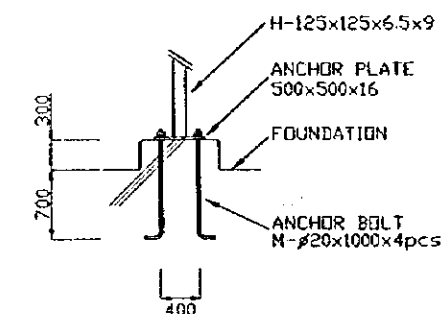
ELEVATION



PLAN



FOUNDATION



DETAIL -A

STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

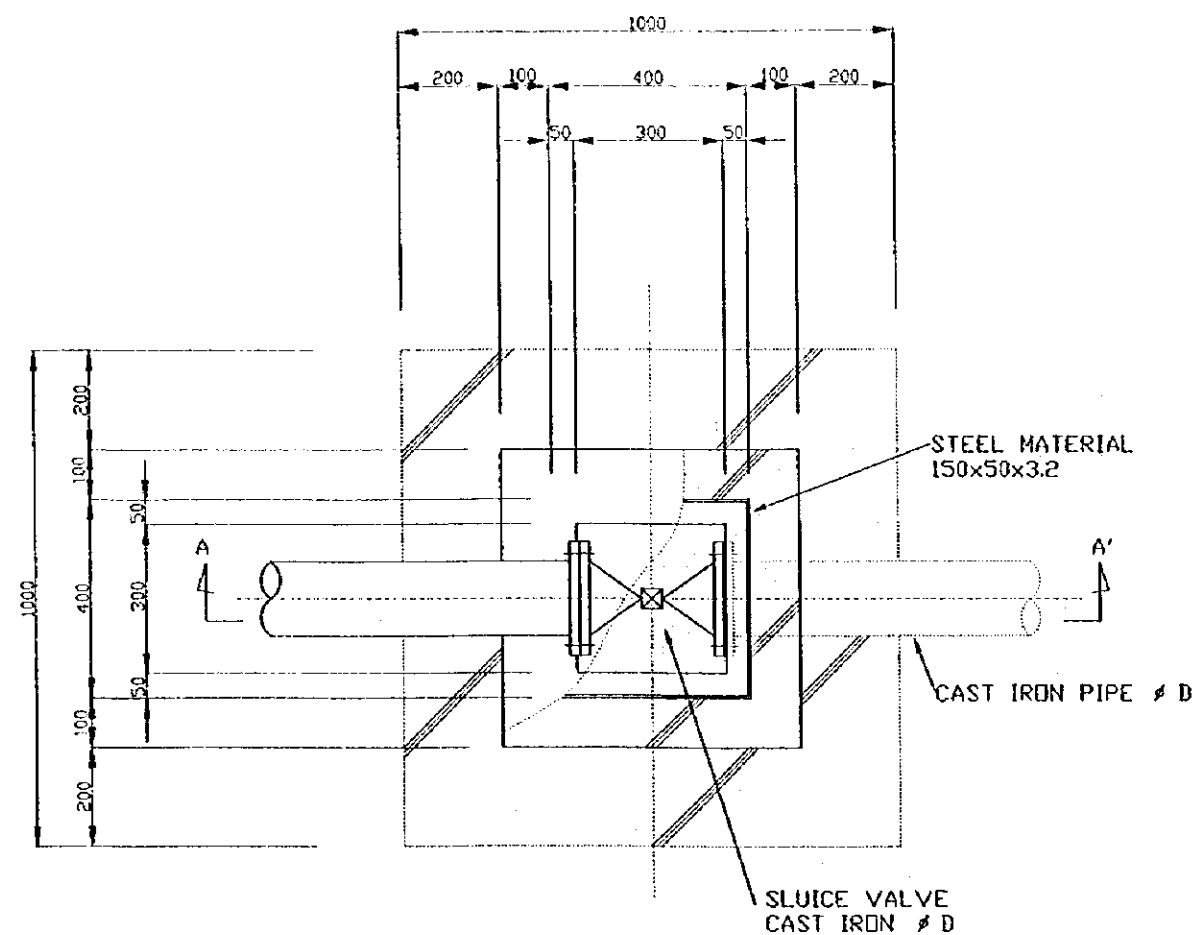
JAPAN INTERNATIONAL
COOPERATION AGENCY

STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

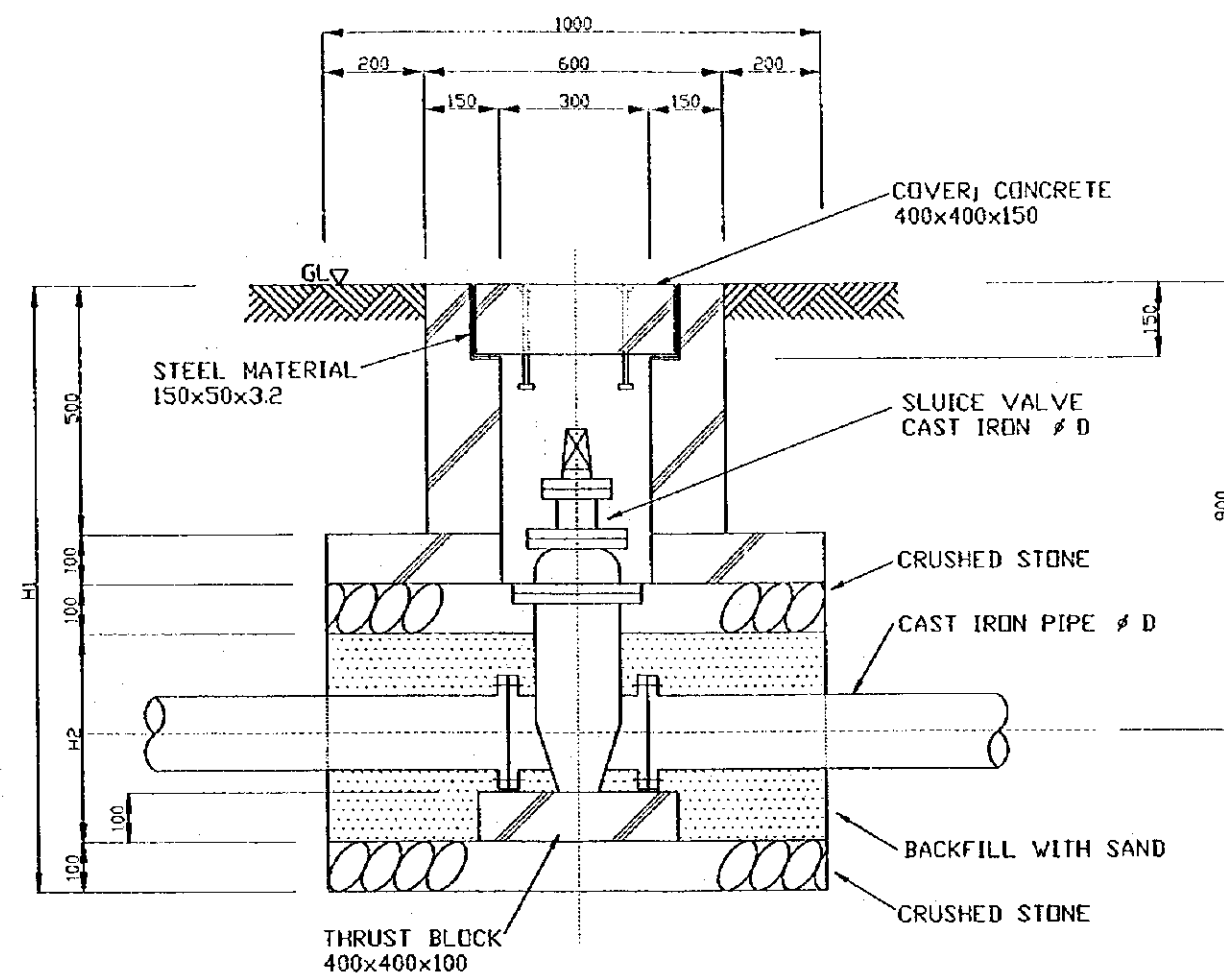
15m³ ELEVATED RESERVOIR
DEKEMHARE

WATER RESOURCES DEPARTMENT
SANYU CONSULTANTS INC.
(JAPAN) 1999

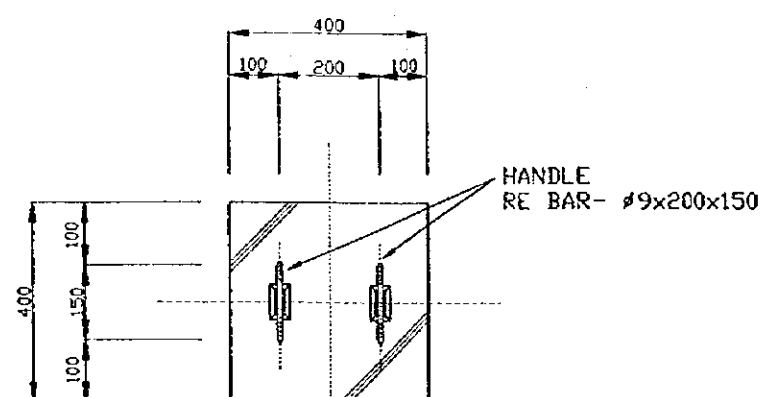
Drawing No
20/27



PLAN



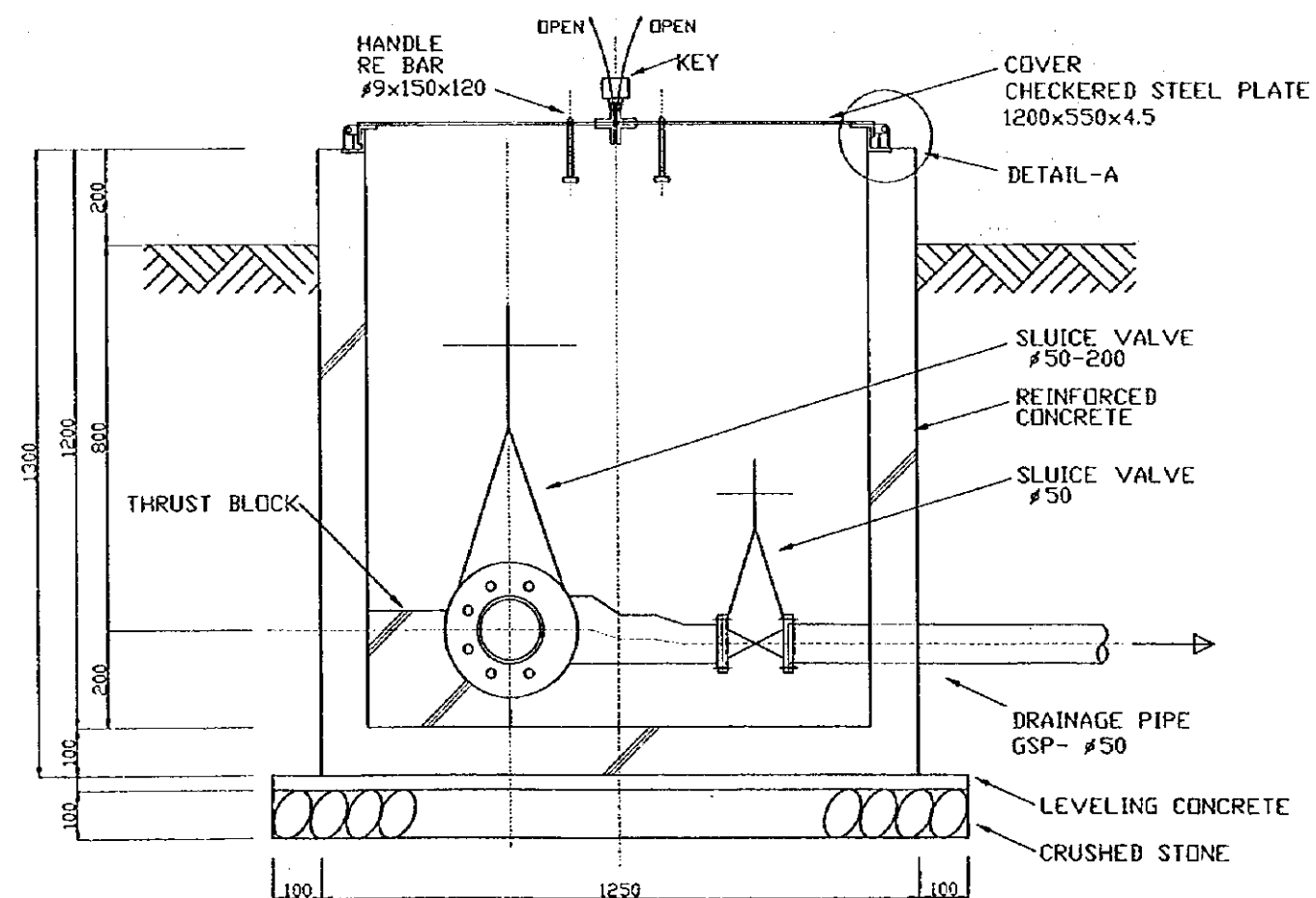
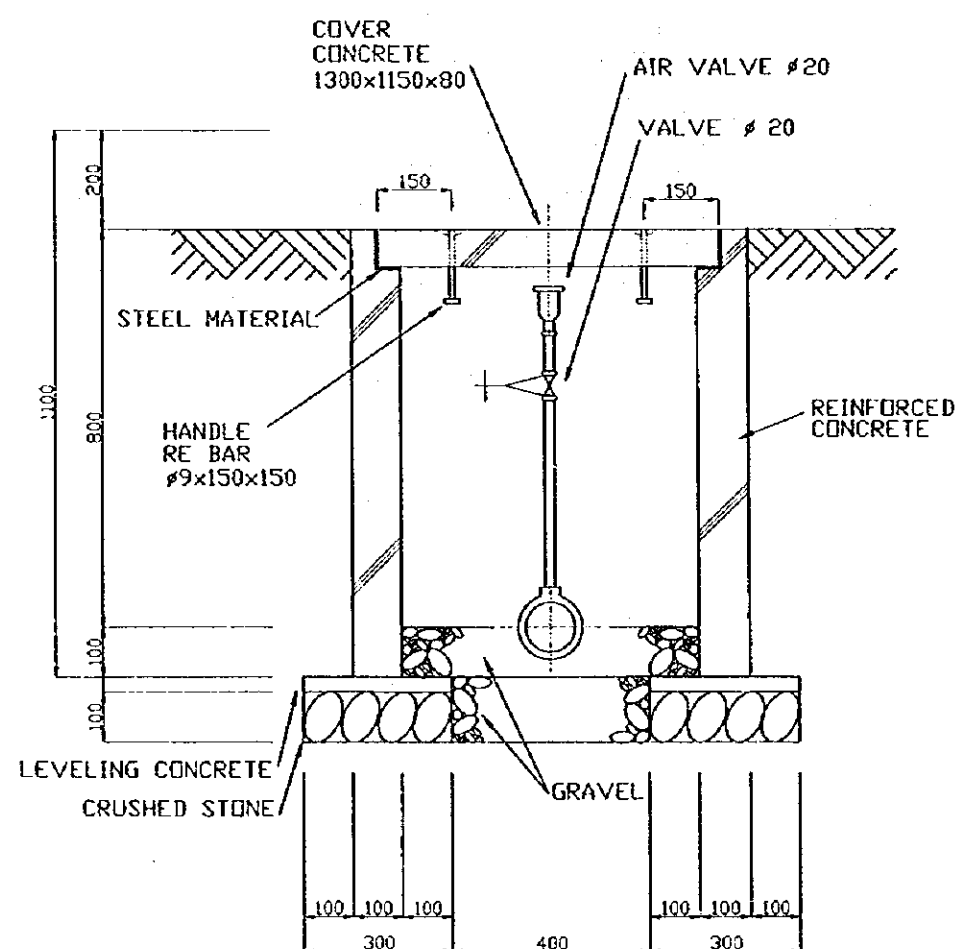
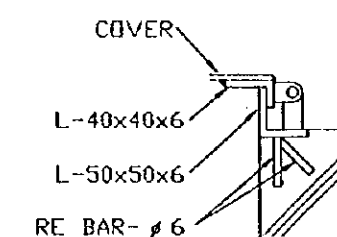
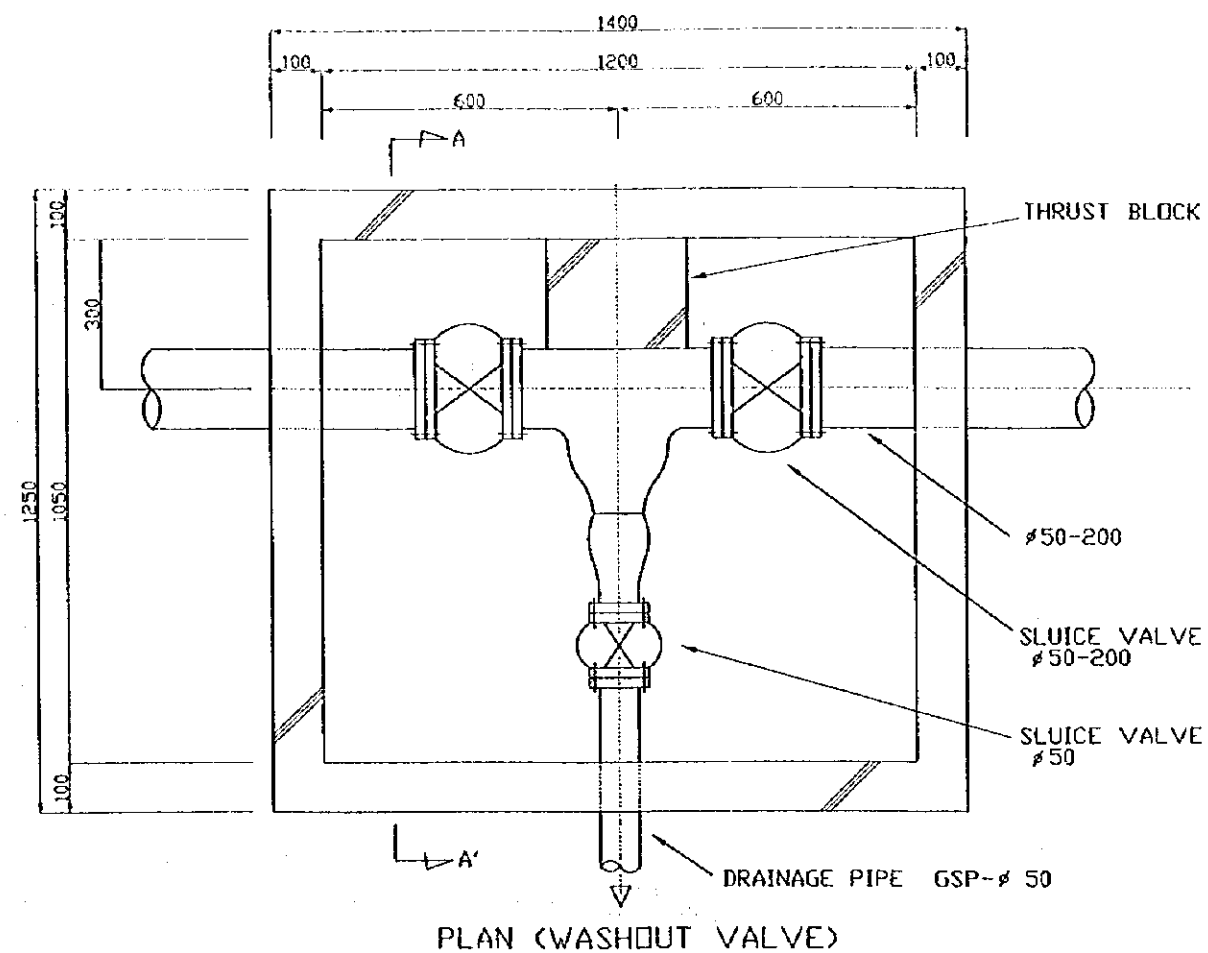
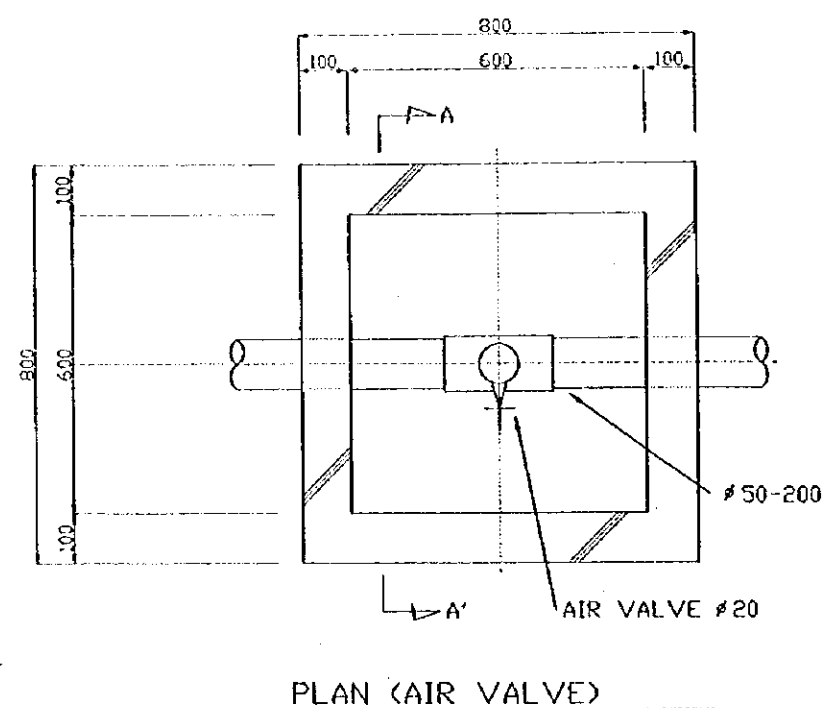
SECTION A-A'



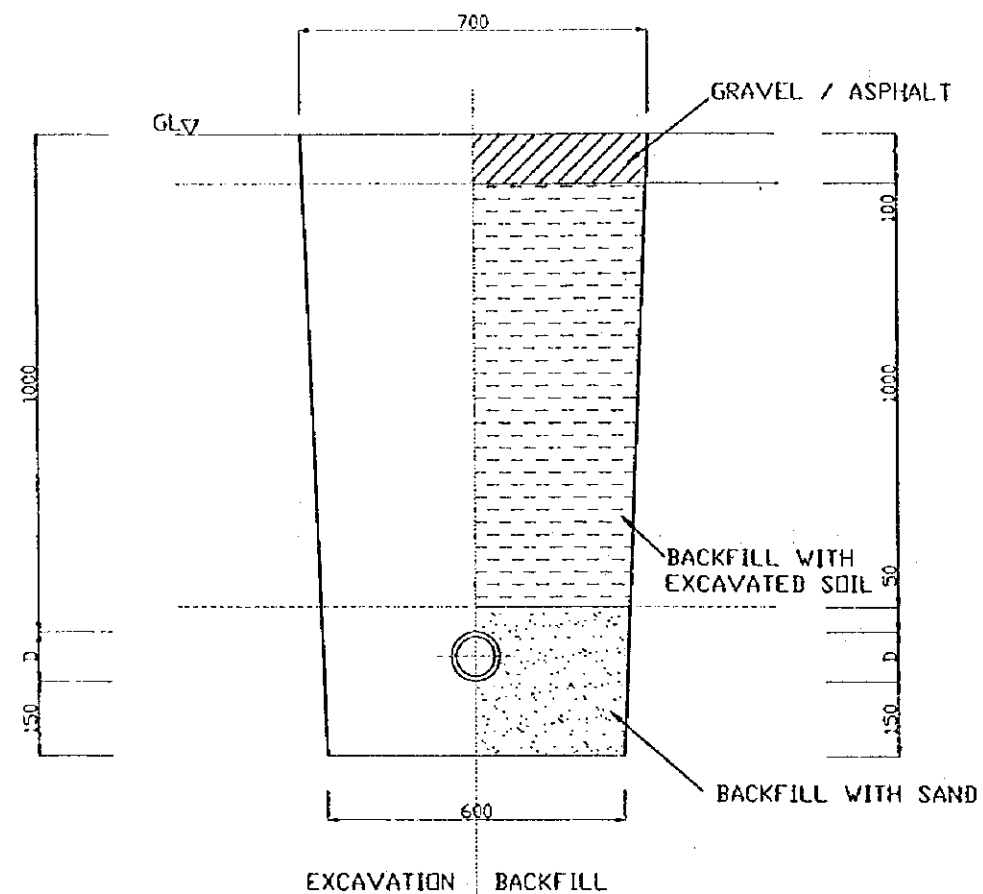
COVER

øD	H1	H2
50	1180	380
80	1200	400
100	1220	420
125	1250	450
150	1280	480
200	1330	530

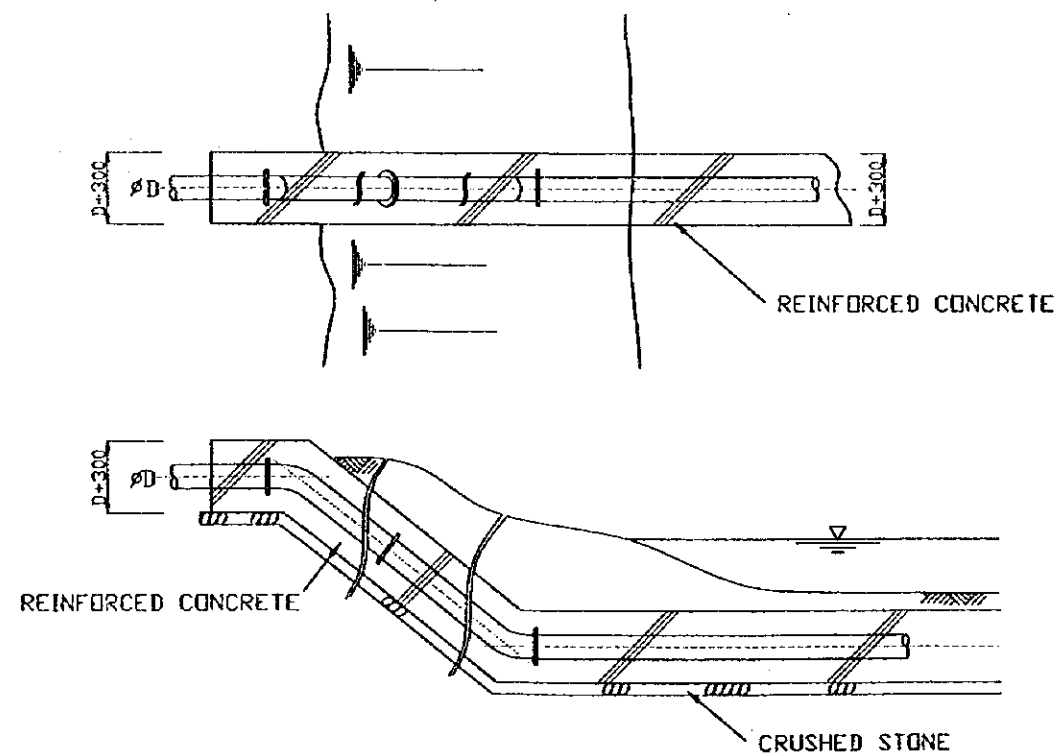
STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
TYPICAL VALVE BOX	
WATER RESOURCES DEPARTMENT SANYU CONSULTANTS INC. (JAPAN) 1999	Drawing No. 21/27



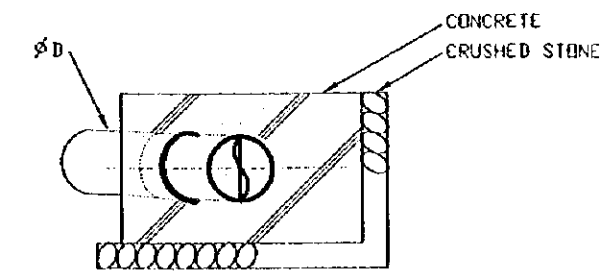
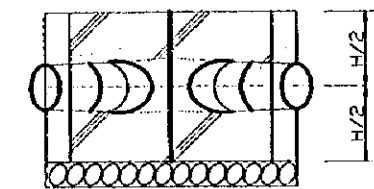
EXCAVATION FOR PIPE LINE



TYPICAL RIVER CROSSING WORK



JOINT PROTECTION



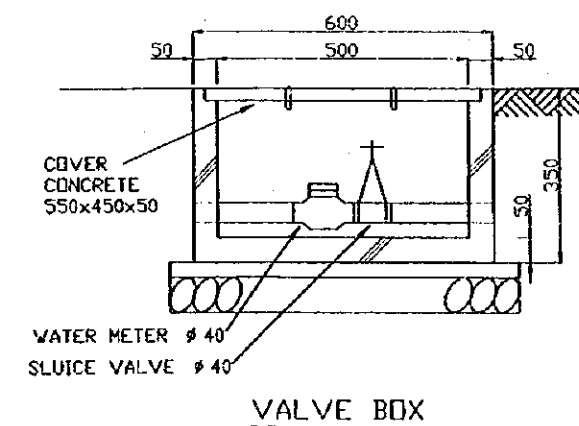
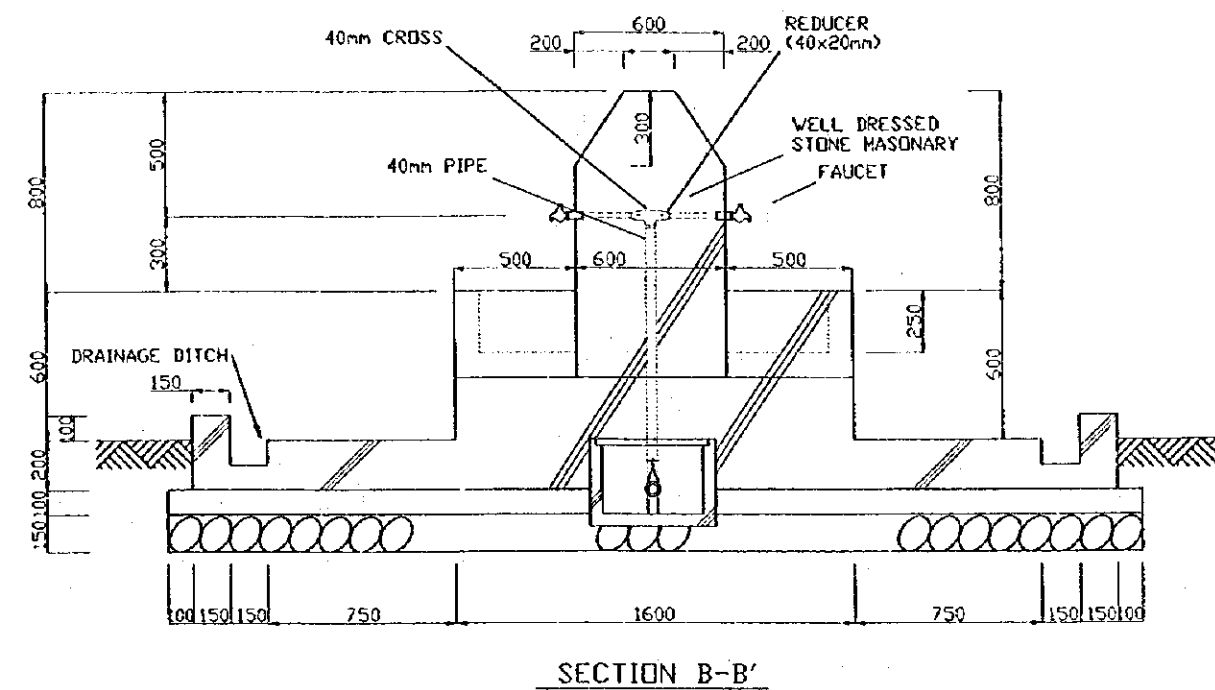
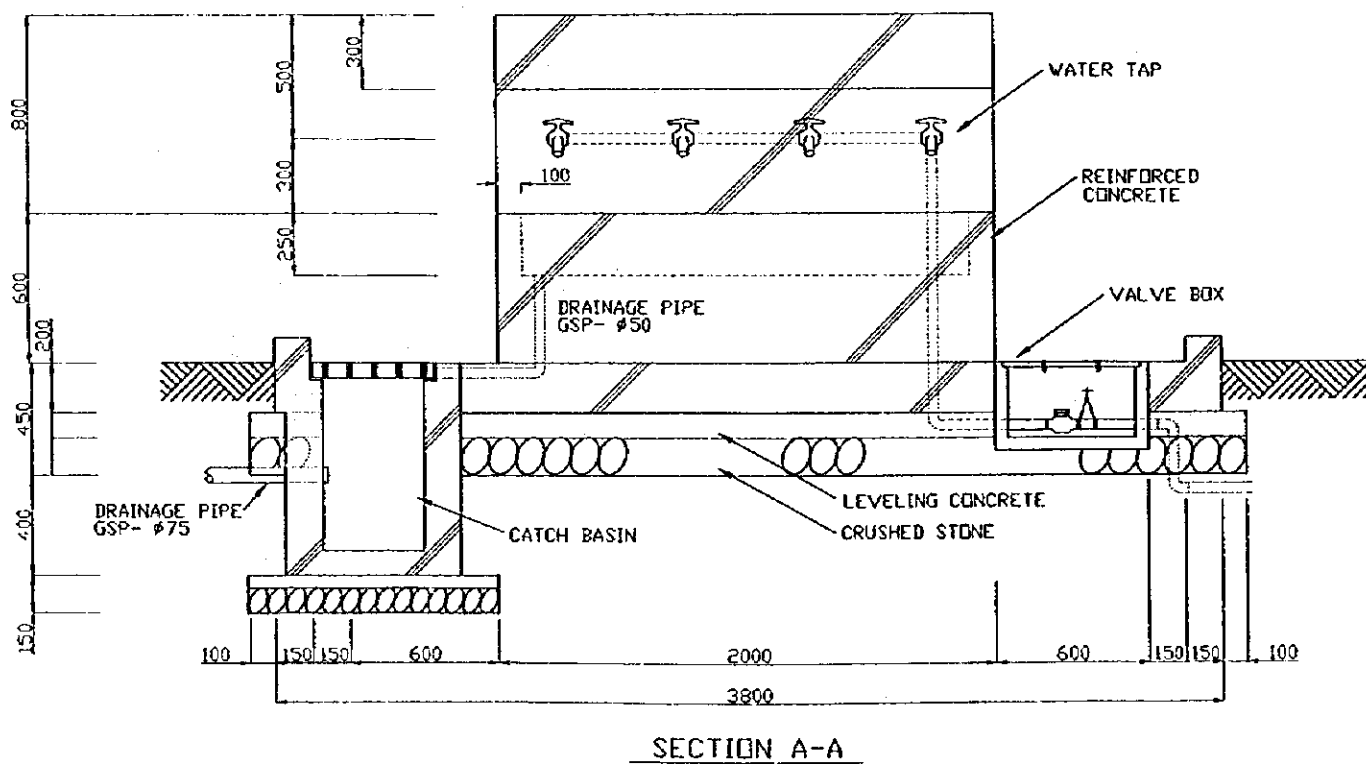
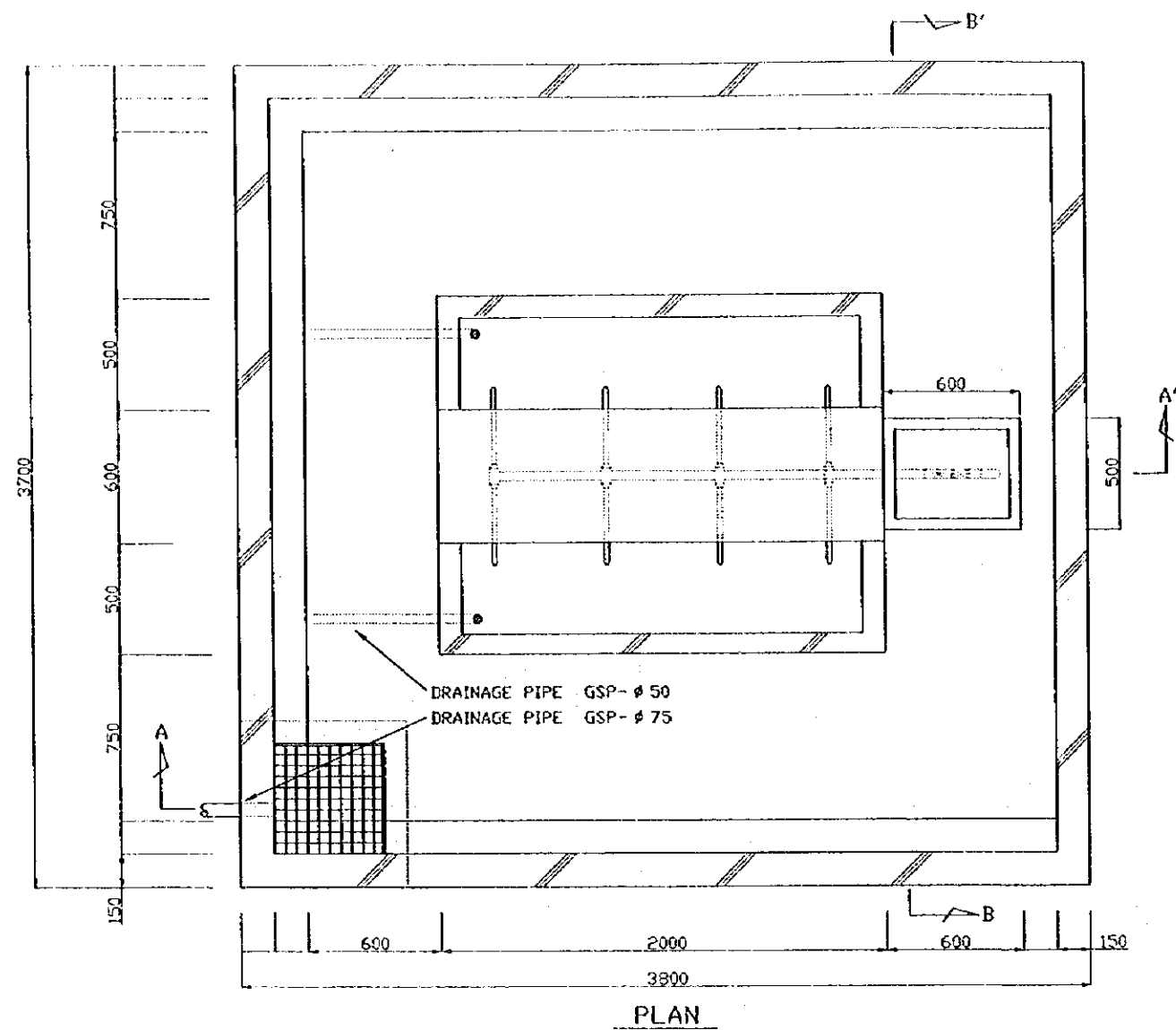
SECTION A-A'

ϕD	H	L
50	150	250
75	240	250
100	300	300
125	350	350
150	400	450
200	500	600
250	650	700
300	700	800

PLAN

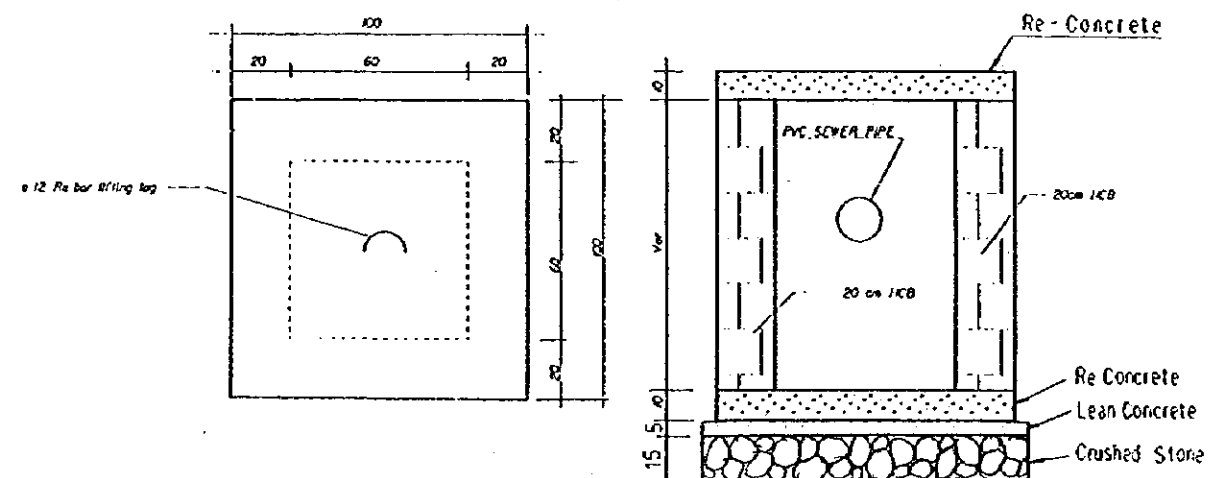
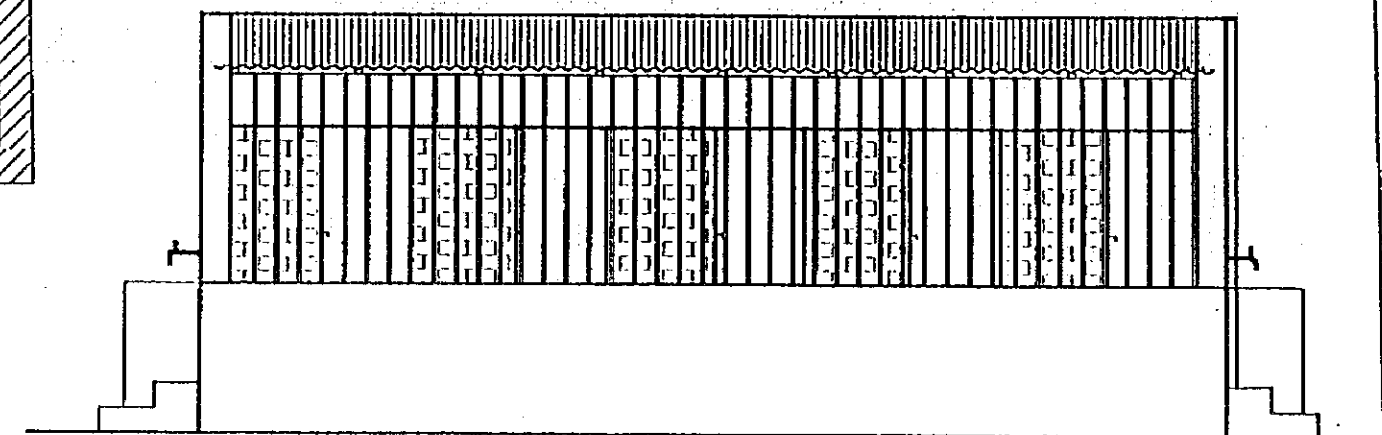
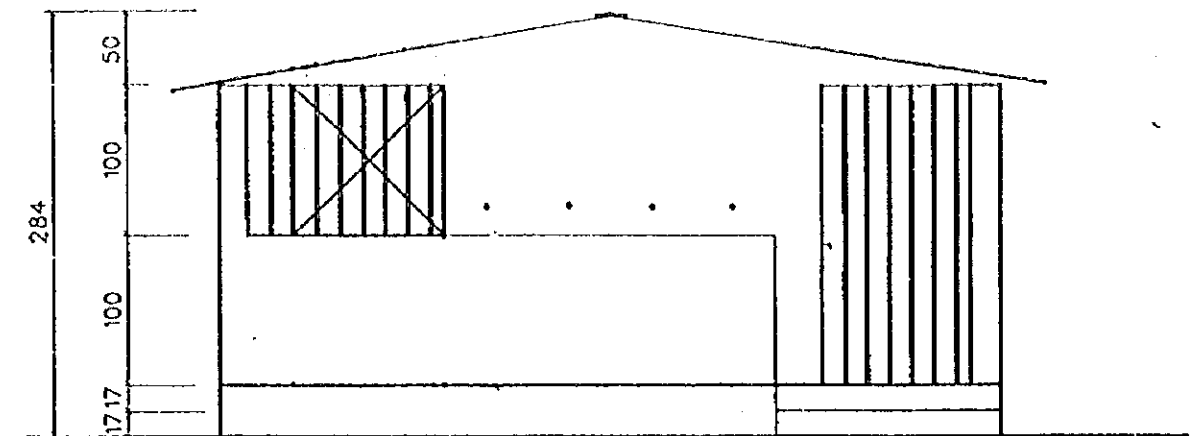
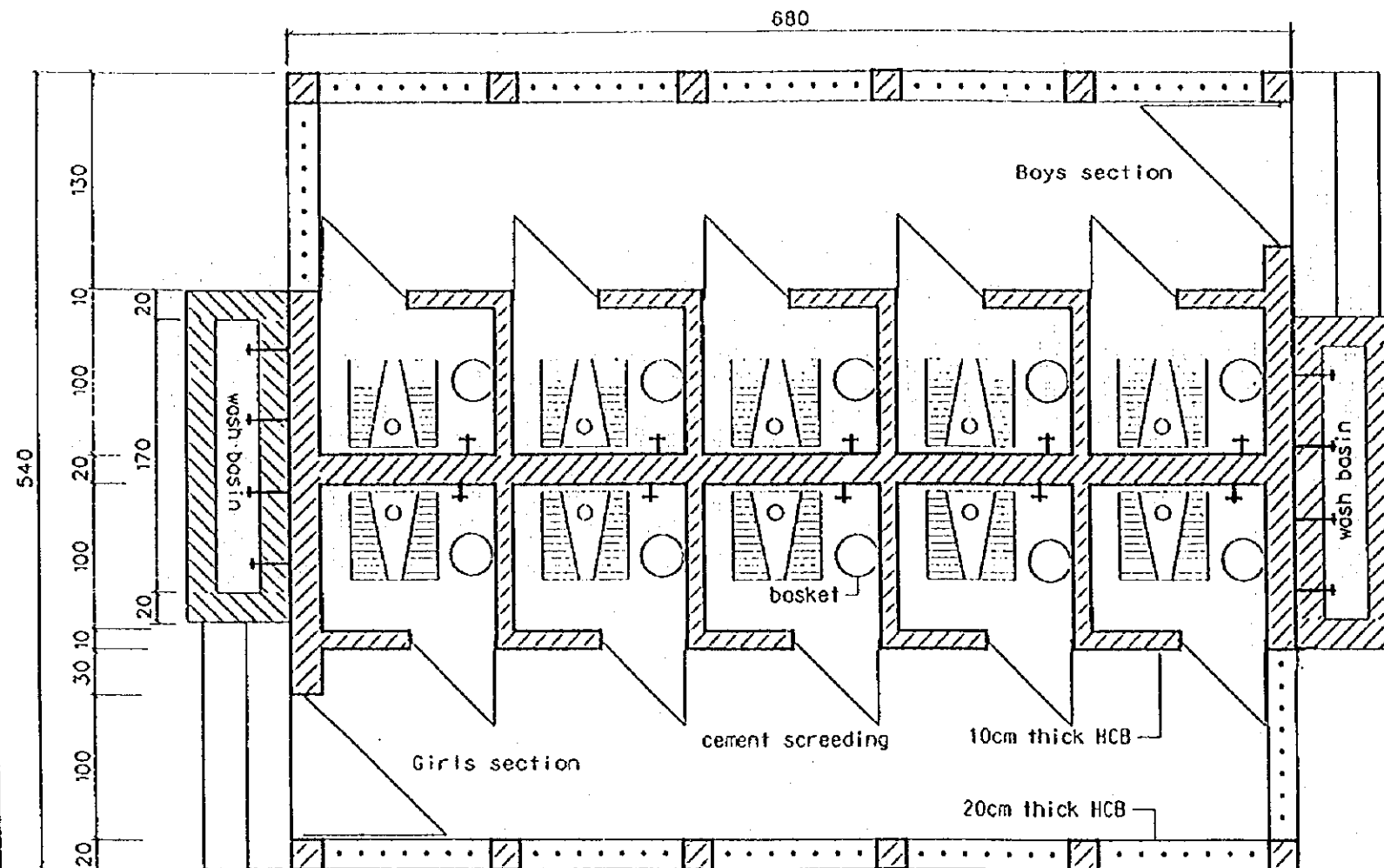
REMARKS : THRUST CONCRETE SHALL BE CASTED AT THE HORIZONTAL BENDS, VERTICAL BENDS, TEES, END POINTS OF PIPE.

STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
TYPICAL EXCAVATION, JOINT PROTECTION & CROSSING RIVER	
WATER RESOURCES DEPARTMENT SANYU CONSULTANTS INC. (JAPAN) 1999	Drawing No 23/27

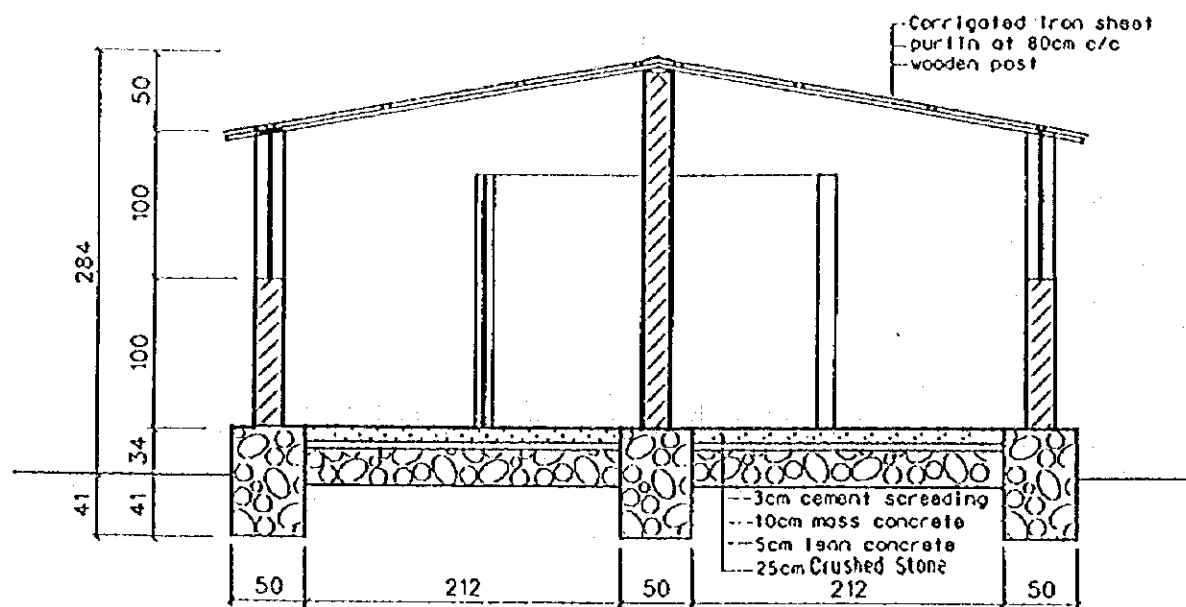


STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
PUBLIC FAUCET	
WATER RESOURCES DEPARTMENT SANYU CONSULTANTS INC. (JAPAN) 1999	Drawing No. 24/27

School latrine

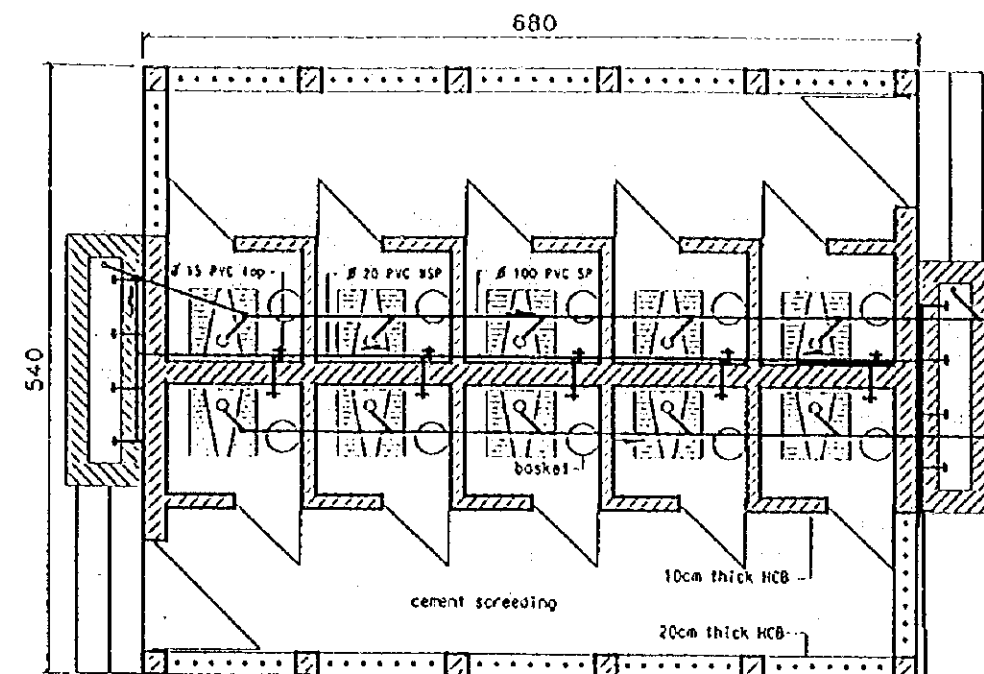


STATE OF ERITREA MINISTRY OF LAND, WATER & ENVIRONMENT	
JAPAN INTERNATIONAL COOPERATION AGENCY	
STUDY ON GROUNDWATER DEVELOPMENT & WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION	
School Latrine (1/2)	
WATER RESOURCES DEPARTMENT (ASMARA, ERITREA) BANYU CONSULTANTS INC. (JAPAN, 1999)	Drawing No. 25/27



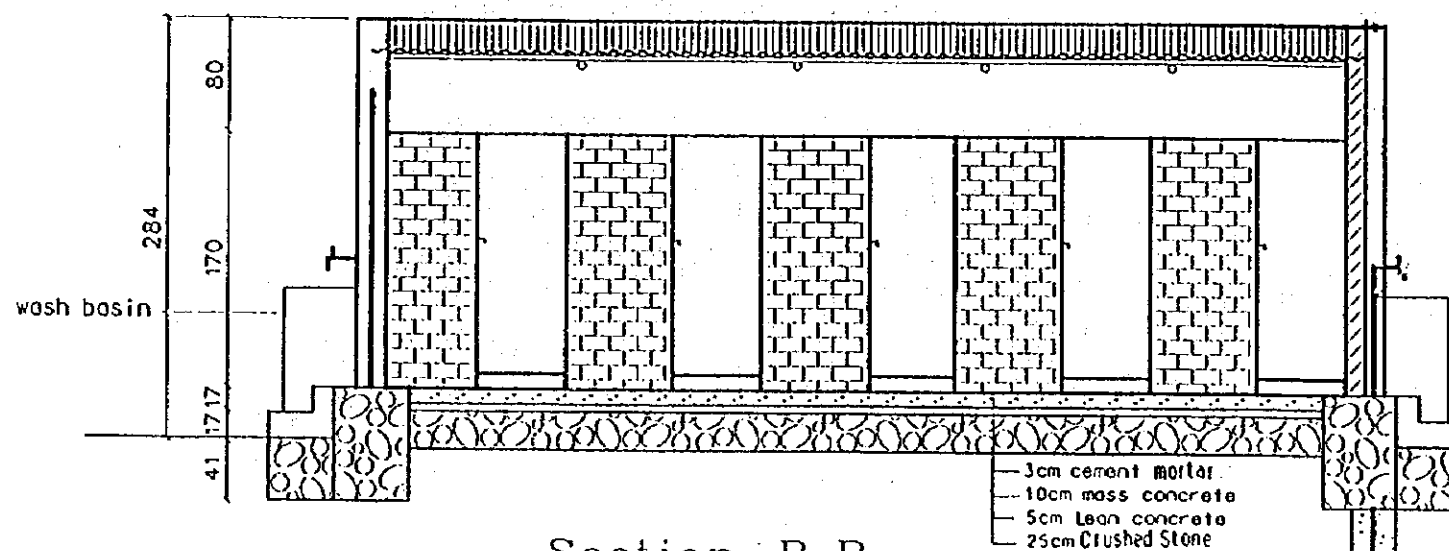
Section A-A

Scale 1:50



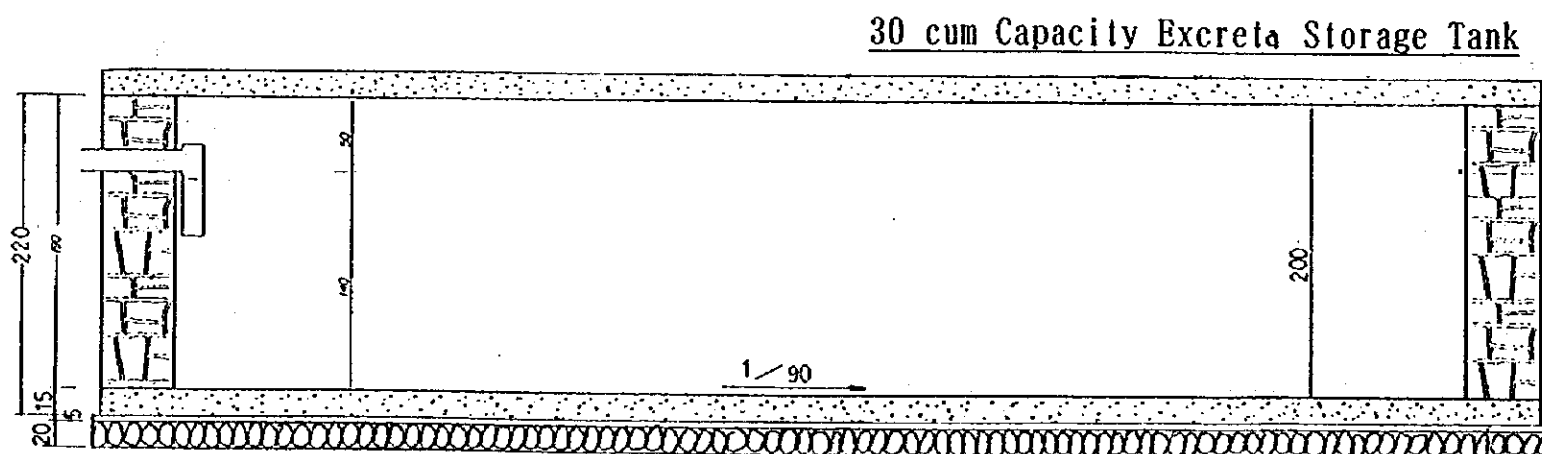
Pipe line layout

Scale 1:75

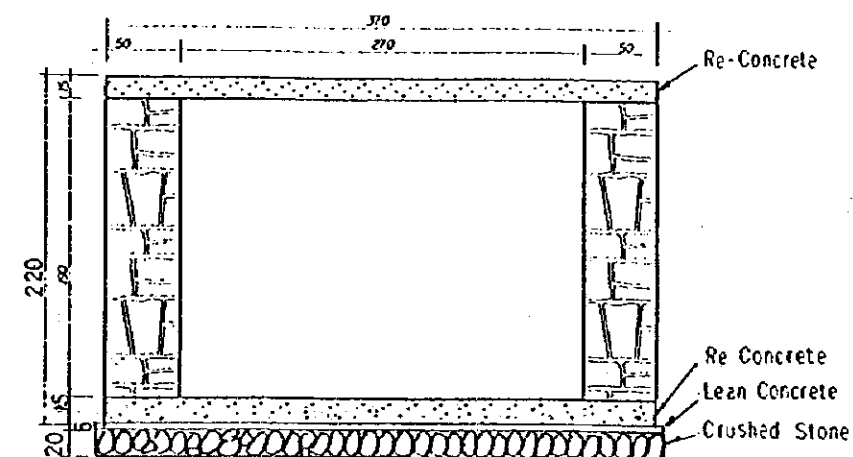


Section B-B

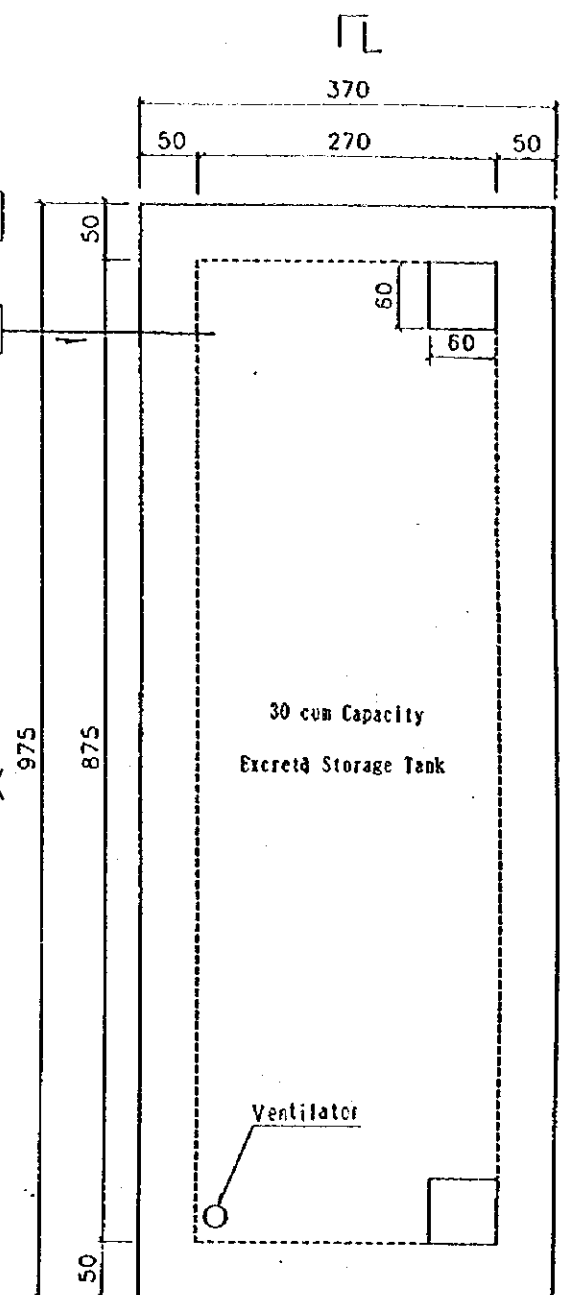
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Section L-L



Section X-X



STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

JAPAN INTERNATIONAL
COOPERATION AGENCY

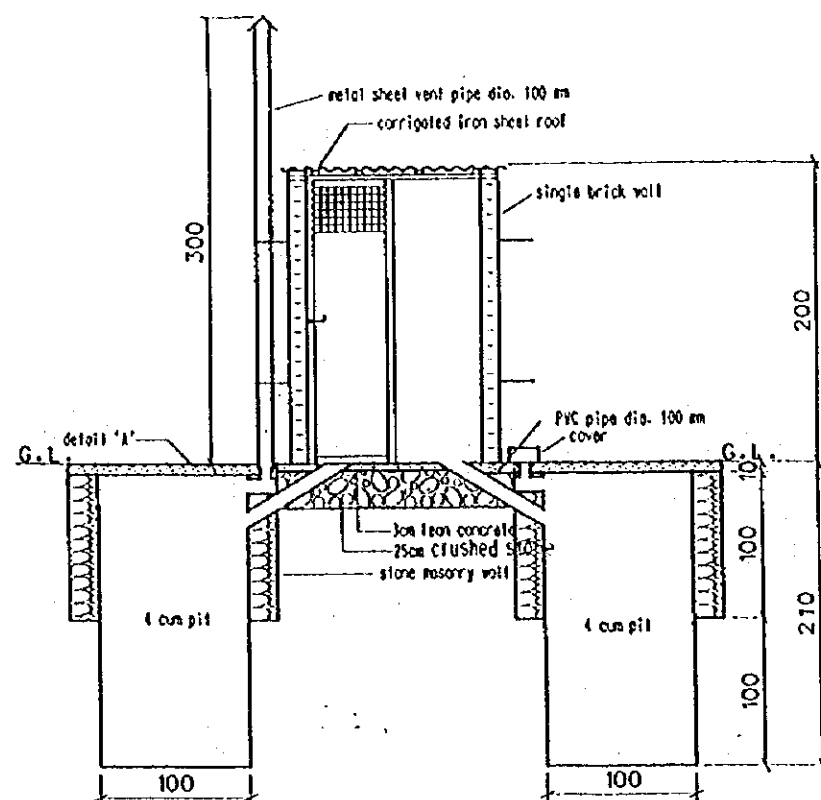
STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

School Latrine (2/2)

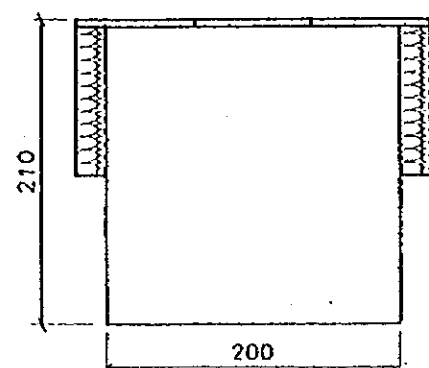
WATER RESOURCES DEPARTMENT
(ASMARA, ERITREA)
SANTU CONSULTANTS INC.
JAPAN, 1999

Drawing No.
26/27

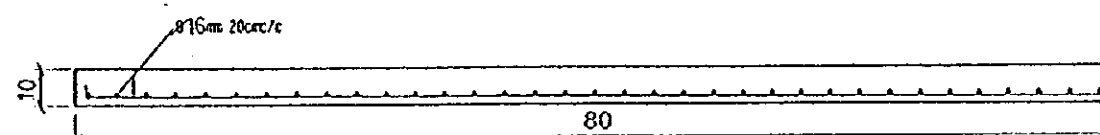
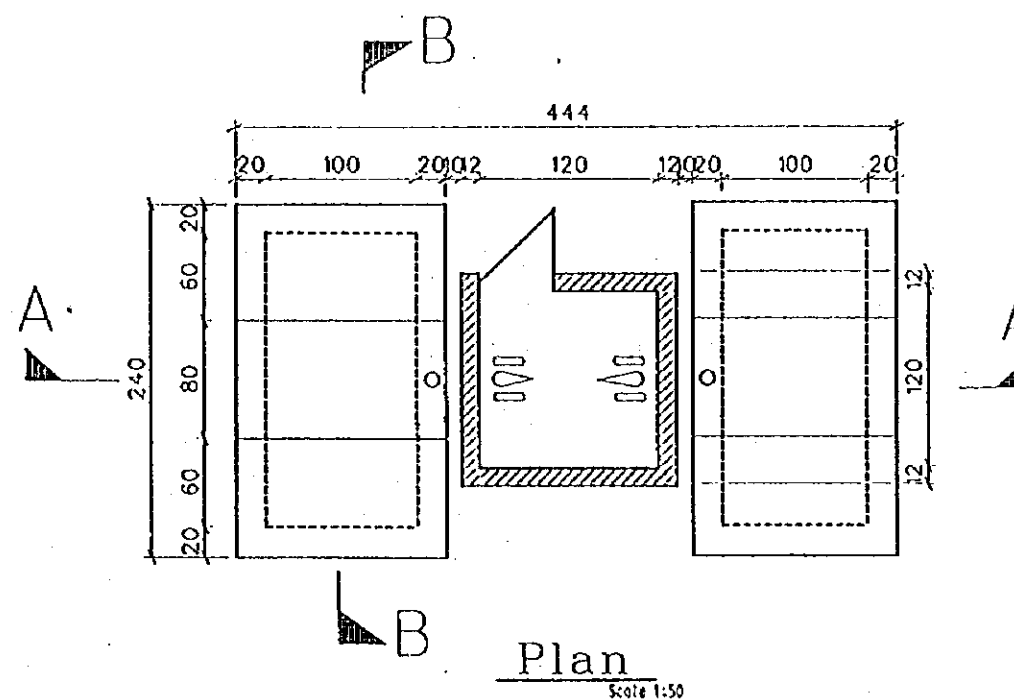
DOUBLE PIT VIP LATRINE



Section 'A-A'
Scale 1:50



Section 'B-B'
Scale 1:50



Pit roof slab (140x80)
Detail 'A'
Scale 1:20

STATE OF ERITREA
MINISTRY OF LAND, WATER &
ENVIRONMENT

JAPAN INTERNATIONAL
COOPERATION AGENCY

STUDY ON GROUNDWATER
DEVELOPMENT & WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION

DOUBLE PIT VIP LATRINE

WATER RESOURCES DEPARTMENT
(ASMARA, ERITREA)
BANTU CONSULTANTS INC.
(JAPAN, 1999)

Drawing No.
27/27

JICA