13.4 Cost Estimation

13.4.1 General

The project cost should be estimated under the following conditions.

- The project cost consists of construction cost, associated cost and contingency.
- The civil works are contracted on the contract basis. The machinery and equipment required for construction works will be provided by the contractors. Therefore, depreciation costs of machinery and equipment are included in the estimated construction cost.
- The exchange rates between Egyptian Pound and U.S.Dollar are adopted based on the average from October in 1997 to March in 1998.

  1 U.S.Dollar = 3.39 L.E

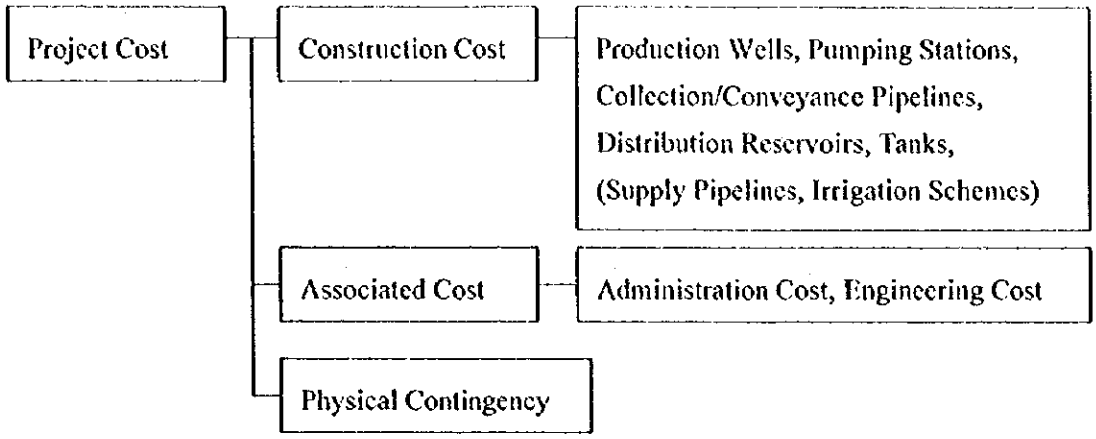
- Land acquisition cost is not necessary because project sites belong to government.

13.4.2 Construction and Project Cost

Unit costs for various items of work should have been analyzed at the time of March in 1998 based on the unit costs of similar projects, quotations of contractors and current market prices. Construction costs are estimated by these unit costs for individual components. Costs of temporary and preparatory works for each component are assumed to be included within the costs of miscellaneous works. Project cost includes contingencies, engineering and administration cost. Engineering and administration costs are assumed as 5 % of the construction cost respectively. In addition, physical contingency is estimated at 15 % of capital cost. These percentages are adopted based on the other similar projects.

Project cost of each plan is shown in Table 13.4.2-1~Table 13.4.2-5.

Project Cost Component



1) Production Well

The unit construction cost of production well is estimated under considering the quotations of constructors. This unit cost includes the drilling, supervision, electrical logging, aquifer test operations, equipment of hole with casings, screens and pumping equipment which are equivalent to international standard. Pumping equipment cost consists of pumping unit, transformer, control panel and accessories.

2) Pumping Station

The construction cost of pumping station is estimated on the basis of unit construction costs of civil works and unit prices of pumping equipment. Unit construction costs for civil works are available in SSDA, WRRI and MPWWR. Pumping equipment consists of pump, valve, power control panel, connecting pipes and installation of equipment. These unit prices are estimated reflecting on the quotation of contractors.

3) Collection and Conveyance Pipeline

The unit construction costs of pipeline are estimated considering unit costs of SSDA and contractor's quotations. And miscellaneous cost as appurtenant facilities like siphon, valve pit, fence, etc. is included as 5 % of pipeline cost in total construction cost. In addition, construction cost of pipeline in Wadi Watir (Plan 2) excludes the cost for flood protection.

4) Distribution Reservoir, Tank and Supply Pipeline

The unit construction costs of distribution reservoir, tank and supply pipeline are estimated under considering the unit costs of SSDA and quotations of constructors.

5) Other Civil Works

Unit construction costs for civil works as dam, dike and irrigation scheme are estimated reflecting on the costs of WRRI and MPWWR.

13.4.3 Operation and Maintenance Cost

Operation and maintenance cost consists of the annual salaries/wages of the staff for O/M, operation cost of pump, repairing/maintenance cost of facilities, depreciation and fuel cost for transportation, administration and general expenditure. These costs are calculated on the basis of the unit costs and information about O/M provided by SSDA, WRRI and MPWWR (Table 13.4.3-1).

1) Average Life Expectancies

The average life expectancies of the facilities are assumed in the consideration of similar projects as follows :

- Production wells	25 years
- Pumping stations and Pipelines	25 years
- Dams and Barrages	50 years
- Mechanical and Electrical equipment	15 years

2) Salary and Wage

Annual salaries/wages of staffs for O/M of a production well system including transmission pipeline is calculated under assumption as follows. In the case that the number of wells exceeds 30, the group of staffs for O/M will be added.

- Engineer	1 person x 1 day/month x 12 months
- Technician	1 person x 6 days/month x 12 months
- Workers	1 person x 30 days/month x 12 months

For pumping station, number of staffs for O/M is assumed in the consideration as follows and annual salaries/wages are estimated.

- Engineer	1 person x 1 day/month x 12 months
- Technician	2 persons x 15 days/month x 12 months
- Workers	3 persons x 30 days/month x 12 months

And also the number of staffs for conveyance facilities is assumed as follows.

- Engineer	1 person x 1 day/month x 12 months
- Technician	1 person x 30 days/month x 12 months
- Workers	1 person x 30 days/month x 12 months

These assumptions are based on the information by the staffs of SSDA & Municipality in South Sinai.

3) Operation Cost of Pumping

Cost of pump operation is estimated on the basis of pump operating hours and unit cost of electricity.

(1) Pump operating hours

Annual water demands for Plan 1, Plan 2, Plan 3 and Plan 4 are estimated as the average volume through the year. Then pump operating hours for water supply and irrigation are assumed to be 24 hours per day. On the other hand, Plan 5 is planned to be utilized for rural people and pump operating hours is proposed to be 5 hours per day.

(2) Cost of electricity

Consumption charge: 0.3 L.E/kwh

4) Depreciation and Fuel Cost for Transportation

It is possible to estimate depreciation and fuel cost by annual operating time, unit depreciation and fuel cost as follows.

- Annual Depreciation & Fuel Cost =

annual operating time x (unit depreciation cost + fuel cost)

(1) Unit depreciation cost of vehicle (Pickup Truck 2,800 cc , Diesel 88 PS)

- Vehicle 80,000 L.E x 1/ (6 hours/day x 365 days x 10 years) = 4 L.E/hour

(2) Unit fuel cost

- 0.037 liter/PS/hour x 88 PS x 0.4 L.E/liter = 1 L.E/hour

(3) Driving time

- 4~6 hours/time x 6 times/month x 12 months = 288~432 hours

5) Maintenance Cost of Facilities

Maintenance cost of facilities is estimated under assumption as follows.

- pumping unit : annual repairing cost will be estimated at 1.3 % to the price of pumping unit.
- pipeline : annual rehabilitation will be conducted over 0.2 % of whole pipeline.
- reservoir/tank : maintenance for waterproof is necessary in frequency as one time in 5 years.

6) Administration and General Expenditure Cost

Administration and general expenditure cost is assumed to be 5 % of personnel expenses.

13.5 Implementation Plan

13.5.1 Organization for Project Implementation

1) South Sinai Development Authority, MOD

South Sinai Development Authority has responsibility for developing water supply system except developing wells for agriculture. This authority conduct design and construction of intake facility, conveyance/transmission pipeline, distribution reservoir and supply pipeline. In addition, conveyance/transmission system for water supply is operated and maintained by the authority.

The projects under construction by SSDA

- Transmission pipeline, which has a capacity of 0.120 m^3/s, with the length of 100 km from Abu Rudeis to El Tur. After completion of this pipeline, it become possible to supply Nile water from Suez to Sharm El Sheikh via Abu Rudeis and El Tur.
- Desalination stations in Sharm El Sheikh with a capacity of 4,000m^3/day water supply.
- Wells in St. Catherine and Nuweiba
- Extension of supply pipeline in each city

The projects proposed by SSDA

- Transmission pipeline, which length is 160 km, with a capacity of 0.570 m^3/s from Suez to Abu Rudeis. This pipeline will be connected to the pipeline at Abu Rudeis and supply water to El Tur and Sharm El Sheikh (this project is supposed to be implemented in several years).

- Transmission pipeline including 14 pumping stations, which total length is 270 km, with a capacity of 1.200 m^3/s from Suez to Dahab via Nakhl, Taba and Nuweiba (this project is now under consideration).

- Desalination station in Taba with a capacity of 2,000 m^3/day.

2) MPWWR

General Directorate of Water Resources in South Sinai, MPWWR and WRRI basically has a responsibility for design and implementation of Water Resources Development Project for agricultural and rural water supply.

The projects supervised and executed by WRRI

- Several wells in Wadi Feiran, Wadi Sidri and South El Qaa Plain

The projects in Wadi Watir proposed by WRRI

- Water tanks and pipeline to supply water with a capacity of 9,000 m^3/day from Ain Furtaga to Nuweiba.

- 17 check dams for flood control, recharging groundwater and erosion control.

- 5 storage dams for flood control, local water supply and rural development.

- 5 deep wells with the depth of 800 meters and 2 shallow wells with the depth of 400 meters to supply water for drinking/tourism (1,500 m^3/day) and rural development (2,000 m^3/day).

13.5.2 Implementation Plan

Implementation plans for the projects are proposed considering the balance of water demand and supply in the future. Also it is important to consider efficiency for water supply within each area. In addition, it is necessary to deliberate site conditions, availability of construction materials, equipment and machinery.
Proposed implementation and disbursement schedule are shown in Table 13.5.2-1.

Table 13.4.2-1 Cost Estimation for the Project of Plan 1

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Wells					
1. Well Drilling (1,000m)	nos	92	2,196,900	202,114,800	
2. Well Pumps	nos	92	501,000	46,092,000	
3. Well House	nos	92	7,200	662,400	
4. Miscellaneous				12,443,460	5% of Above 1~3
Sub-total				261,312,660	
B. Collection Pipeline					
1. SP Φ125 (high pressure)	km	27.6	208,347	5,750,377	
2. PVC Φ150	km	32.6	98,872	3,223,227	
3. PVC Φ200	km	4.5	129,354	582,093	
4. PVC Φ250	km	9.0	175,718	1,581,462	
5. PVC Φ300	km	9.0	248,498	2,236,482	
6. PVC Φ350	km	13.5	321,280	4,337,280	
7. PVC Φ400	km	12.3	380,696	4,682,561	
8. SP Φ700	km	0.5	1,015,075	507,538	
9. SP Φ900	km	0.2	1,425,363	285,073	
Sub-total				23,186,093	
C. Pumping Station					
1. Collected Tank	nos	2	705,744	1,411,488	
2. Booster Pump and Other Equipment	LS	1	4,977,000	4,977,000	
3. Building	nos	1	408,000	408,000	
4. Miscellaneous				269,250	5% of Above 2~3
Sub-total				7,065,738	
D. Surge Tank	nos	1	26,659	26,659	
E. Pressure Reduce Tank	nos	4	199,021	796,084	
F. Conveyance Pipeline					
1. SP Φ600	km	13.5	821,193	11,086,106	
2. SP Φ700	km	39.5	1,015,075	40,095,463	
3. SP Φ900	km	11.0	1,425,363	15,678,993	
Sub-total				66,860,562	
G. Distribution Water Reservoir	LS	4	1,402,605	5,610,420	
H. Total Construction Cost				364,858,216	
I. Administration Cost				18,242,911	5% of Above H
J. Engineering Cost				18,242,911	5% of Above H
K. Physical Contingency				60,201,606	15% of Above H~J
Total				461,545,644	

Table 13.4.2-2 Cost Estimation for the Project of Plan 2

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Wells					
1. Well Drilling (1,000m)	nos	56	2,196,900	123,026,400	
2. Well Pumps	nos	56	501,000	28,056,000	
3. Well House	nos	56	7,200	403,200	
4. Miscellaneous				7,574,280	5% of Above 1～3
Sub-total				159,059,880	
B. Collection Pipeline					
1. SP Φ125 (high pressure)	km	16.8	208,347	3,500,230	
2. PVC Φ150	km	19.8	98,872	1,957,666	
3. PVC Φ200	km	3.0	129,354	388,062	
4. PVC Φ250	km	18.0	175,718	3,162,924	
5. PVC Φ300	km	6.0	248,498	1,490,988	
6. SP Φ600	km	6.2	821,193	5,091,397	
Sub-total				15,591,267	
C. Pumping Station					
1. Collected Tank/Pump Sump	nos	8	531,353	4,250,826	
2. Booster Pump and Other Equipment	LS	4	4,394,753	17,579,012	
3. Building	nos	4	408,000	1,632,000	
4. Miscellaneous				960,551	5% of Above 2～3
Sub-total				24,422,389	
D. Surge Tank	nos	4	20,071	80,284	
E. Pressure Reduce Tank	nos	7	172,800	1,209,600	
F. Conveyance Pipeline					
1. SP Φ200	km	3.0	274,343	823,029	
2. SP Φ400	km	2.0	497,561	995,122	
3. SP Φ500	km	10.0	647,829	6,478,290	
4. SP Φ700	km	52.0	1,015,075	52,783,900	
5. SP Φ800	km	80.0	1,263,940	101,115,200	
6. SP Φ1000	km	34.0	1,712,104	58,211,536	
Sub-total				220,407,077	
G. Distribution Water Reservoir					
Distribution Water Reservoir(Taba)	LS	2	1,217,813	2,435,626	
Distribution Water Reservoir(Nuweiba)	LS	2	176,410	352,820	
H. Total Construction Cost				423,558,943	
I. Administration Cost				21,177,947	5% of Above H
J. Engineering Cost				21,177,947	5% of Above H
K. Phisical Contingency				69,887,226	15% of Above H～J
Total				535,802,063	

Table 13.4.2-3 Cost Estimation for the Project of Plan 3

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Wells					
1. Well Drilling (155m)	nos	9	408,680	3,678,120	
2. Well Pumps	nos	9	200,000	1,800,000	
3. Well House	nos	9	7,200	64,800	
4. Miscellaneous				277,146	5% of Above 1~3
Sub-total				5,820,066	
B. Collection Pipeline					
1. SP Φ125	km	1.1	199,947	219,942	
2. PVC Φ150	km	6.0	98,872	593,232	
3. PVC Φ200	km	8.0	129,354	1,034,832	
4. PVC Φ250	km	2.5	175,718	439,295	
5. PVC Φ300	km	1.0	248,498	248,498	
Sub-total				2,535,799	
C. Collected Tank	nos	1	90,092	90,092	
D. Conveyance Pipeline					
PVC Φ450	km	9.0	471,742	4,245,678	
G. Distribution Water Reservoir	LS	2	385,827	771,654	
H. Total Construction Cost				13,463,289	
I. Administration Cost				673,164	5% of Above H
J. Engineering Cost				673,164	5% of Above H
K. Physical Contingency				2,221,443	15% of Above H~J
Total				17,031,060	

Table 13.4.2-4 Cost Estimation for the Project of Plan 4

Cost Estimation for the Project of Plan 4A & 4C

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Wells					
1. Well Drilling (1,000m)	nos	19	2,196,900	41,741,100	
2. Well Pumps	nos	19	501,000	9,519,000	
3. Well House	nos	19	7,200	136,800	
4. Miscellaneous				2,569,845	5% of Above 1~3
Sub-total				53,966,745	
B. Pipeline					
1. SP Φ125 (high pressure)	km	5.7	208,347	1,187,578	
2. PVC Φ150	km	1.0	68,525	68,525	
Sub-total				1,256,103	
C. Distribution Water Reservoir	LS	19	194,371	3,693,049	
D. Total Construction Cost				58,915,897	
E. Administration Cost				2,945,795	5% of Above D
F. Engineering Cost				2,945,795	5% of Above D
G. Physical Contingency				9,721,123	15% of Above D~F
Total				74,528,610	

Cost Estimation for the Project of Plan 4B

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Wells					
1. Well Drilling (1,000m)	nos	22	2,196,900	48,331,800	
2. Well Pumps	nos	22	501,000	11,022,000	
3. Well House	nos	22	7,200	158,400	
4. Miscellaneous				2,975,610	5% of Above 1~3
Sub-total				62,487,810	
B. Pipeline					
1. SP Φ125 (high pressure)	km	6.6	208,347	1,375,090	
2. PVC Φ150	km	1.1	68,525	75,378	
Sub-total				1,450,468	
C. Distribution Water Reservoir	LS	22	194,371	4,276,162	
D. Total Construction Cost				68,214,440	
E. Administration Cost				3,410,722	5% of Above D
F. Engineering Cost				3,410,722	5% of Above D
G. Physical Contingency				11,255,383	15% of Above D~F
Total				86,291,267	

Table 13.4.2-5 (1) Cost Estimation for the Project of Plan 5

Cost Estimation for the Project of Plan 5A

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Wells					
1. Dug Well (20m)	nos	1	60,000	60,000	
2. Well Pumps	nos	1	37,000	37,000	
3. Well House	nos	1	7,200	7,200	
4. Miscellaneous				5,210	5% of Above 1~3
Sub-total				109,410	
B. Pipeline					
1. PVC Φ40	m	25	46	1,150	
2. PVC Φ80	m	50	60	3,000	
Sub-total				4,150	
C. Distribution Water Reservoir	LS	1	12,143	12,143	
D. Total Construction Cost				125,703	
E. Administration Cost				6,285	5% of Above D
F. Engineering Cost				6,285	5% of Above D
G. Physical Contingency				20,741	15% of Above D~F
Total				159,014	

Cost Estimation for the Project of Plan 5B

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Wells					
1. Dug Well (20m)	nos	1	60,000	60,000	
2. Well Pumps	nos	1	45,000	45,000	
3. Well House	nos	1	7,200	7,200	
4. Miscellaneous				5,610	5% of Above 1~3
Sub-total				117,810	
B. Pipeline					
1. PVC Φ40	m	25	46	1,150	
2. PVC Φ80	m	50	60	3,000	
Sub-total				4,150	
C. Distribution Water Reservoir	LS	1	28,925	28,925	
D. Total Construction Cost				150,885	
E. Administration Cost				7,544	5% of Above D
F. Engineering Cost				7,544	5% of Above D
G. Physical Contingency				24,896	15% of Above D~F
Total				190,869	

Table 13.4.2-5 (2) Cost Estimation for the Project of Plan 5

Cost Estimation for the Project of Plan 5C

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Wells					
1. Dug Well (20m)	nos	2	60,000	120,000	
2. Well Pumps	nos	2	45,000	90,000	
3. Well House	nos	2	7,200	14,400	
4. Miscellaneous				11,220	5% of Above 1~3
Sub-total				235,620	
B. Pipeline					
1. PVC Φ40	m	50	46	2,300	
2. PVC Φ80	m	100	60	6,000	
Sub-total				8,300	
C. Distribution Water Reservoir	LS	2	73,925	147,850	
D. Total Construction Cost				391,770	
E. Administration Cost				19,589	5% of Above D
F. Engineering Cost				19,589	5% of Above D
G. Physical Contingency				64,642	15% of Above D~F
Total				495,590	

Table 13.4.2-6 Cost Estimation for Supply Pipeline

Item	Plan 1	Plan 2	Plan 3	Remarks
1. Supply Pipeline Length				
Population Density in 1996 (person/km2)	684	608	939	
Urban Population in 1996 (person)	8,216	2,405	12,072	
Service Population in Target Year (person)	235,845	104,851	110,023	
Population Increase (person)	227,629	102,446	97,951	
Proposed Service Area (km2)	333	220	104	
Supply Pipeline Density (km/km2)	5	5	5	
Supply Pipeline Length (km)	1,665	1,100	520	
2. Project Cost of Supply Pipeline				
Supply Pipeline (PVCΦ150mm)	164,621,880	108,759,200	51,413,440	LE
Administration & Engineering Cost	16,462,188	10,875,920	5,141,344	LE
Contingency	27,162,610	17,945,268	8,483,218	LE
Total	208,246,678	137,580,388	65,038,002	LE

Note) Unit Construction Cost of Pipeline 98,872 LE/km

Table 13.4.2-7 Cost Estimation for Irrigation Pipeline

Item	Plan 4A	Plan 4B	Plan 4C	Remarks
1. Project Area (ha)	714	840	714	
2. Unit Construction Cost				
a. Land Consolidation		6,800		LE/ha
b. Drip Irrigation System				
Drip Irrigation Syastem (per 1ha)		13,600		LE/ha
Miscellaneous (5% of Above)		680		LE/ha
Total of b		14,280		LE/ha
3. Project Cost of Drip Irrigation System				
Land Consolidation	4,855,200	5,712,000	4,855,200	LE
Drip Irrigation System	10,195,920	11,995,200	10,195,920	LE
Administration & Engineering Cost	1,505,112	1,770,720	1,505,112	LE
Contingency	2,483,435	2,921,688	2,483,435	LE
Total	19,039,667	22,399,608	19,039,667	LE

Table 13.4.2-8 (1) Unit Construction Cost of Pipeline

Unit Construction Cost of Pipe Line(PVCΦ100) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	2,806	8	22,448	
2. Backfilling with Soil	m3	2,350	5	11,750	
3. Backfilling with Sand	m3	448	18	8,064	
4. PVC Pipe Fitting Φ100 mm	m	1,000	23	23,000	
5. Miscellaneous	L.S.			3,263	5% of Above 1~4
Total				68,525	

Unit Construction Cost of Pipe Line(PVCΦ150) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	3,023	8	24,184	
2. Backfilling with Soil	m3	2,470	5	12,350	
3. Backfilling with Sand	m3	535	18	9,630	
4. PVC Pipe Fitting Φ150 mm	m	1,000	48	48,000	
5. Miscellaneous	L.S.			4,708	5% of Above 1~4
Total				98,872	

Unit Construction Cost of Pipe Line(PVCΦ200) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	3,247	8	25,976	
2. Backfilling with Soil	m3	2,590	5	12,950	
3. Backfilling with Sand	m3	626	18	11,268	
4. PVC Pipe Fitting Φ200 mm	m	1,000	73	73,000	
5. Miscellaneous	L.S.			6,160	5% of Above 1~4
Total				129,354	

Unit Construction Cost of Pipe Line(PVCΦ250) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	3,480	8	27,840	
2. Backfilling with Soil	m3	2,710	5	13,550	
3. Backfilling with Sand	m3	720	18	12,960	
4. PVC Pipe Fitting Φ250 mm	m	1,000	113	113,000	
5. Miscellaneous	L.S.			8,368	5% of Above 1~4
Total				175,718	

Unit Construction Cost of Pipe Line(PVCΦ300) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	3,721	8	29,768	
2. Backfilling with Soil	m3	2,831	5	14,155	
3. Backfilling with Sand	m3	819	18	14,742	
4. PVC Pipe Fitting Φ300 mm	m	1,000	178	178,000	
5. Miscellaneous	L.S.			11,833	5% of Above 1~4
Total				248,498	

Unit Construction Cost of Pipe Line(PVCΦ350) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	3,961	8	31,688	
2. Backfilling with Soil	m3	2,943	5	14,715	
3. Backfilling with Sand	m3	921	18	16,578	
4. PVC Pipe Fitting Φ350 mm	m	1,000	243	243,000	
5. Miscellaneous	L.S.			15,299	5% of Above 1~4
Total				321,280	

Table 13.4.2-8 (2) Unit Construction Cost of Pipeline

Unit Construction Cost of Pipe Line(PVC Φ400) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	4,218	8	33,744	
2. Backfilling with Soil	m3	3,064	5	15,320	
3. Backfilling with Sand	m3	1,028	18	18,504	
4. PVC Pipe Fitting Φ400 mm	m	1,000	295	295,000	
5. Miscellaneous	L.S.			18,128	5% of Above 1~4
Total				380,696	

Unit Construction Cost of Pipe Line(PVC Φ450) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	4,482	8	35,856	
2. Backfilling with Soil	m3	3,184	5	15,920	
3. Backfilling with Sand	m3	1,139	18	20,502	
4. PVC Pipe Fitting Φ400 mm	m	1,000	377	377,000	
5. Miscellaneous	L.S.			22,464	5% of Above 1~4
Total				471,742	

Unit Construction Cost of Pipe Line(SP Φ125) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	2,930	8	23,440	
2. Backfilling with Soil	m3	2,426	5	12,130	
3. Backfilling with Sand	m3	492	18	8,856	
4. Steel Pipe Fitting Φ125 mm	m	1,000	146	146,000	
5. Miscellaneous	L.S.			9,521	5% of Above 1~4
Total				199,947	

Unit Construction Cost of Pipe Line(SP Φ125, high pressure) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	2,930	8	23,440	
2. Backfilling with Soil	m3	2,426	5	12,130	
3. Backfilling with Sand	m3	492	18	8,856	
4. Steel Pipe Fitting Φ125 mm	m	1,000	154	154,000	
5. Miscellaneous	L.S.			9,921	5% of Above 1~4
Total				208,347	

Unit Construction Cost of Pipe Line(SP Φ200) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	3,259	8	26,071	
2. Backfilling with Soil	m3	2,599	5	12,995	
3. Backfilling with Sand	m3	627	18	11,283	
4. Steel Pipe Fitting Φ200 mm	m	1,000	211	210,930	
5. Miscellaneous	L.S.			13,064	5% of Above 1~4
Total				274,343	

Unit Construction Cost of Pipe Line(SP Φ400) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	4,225	8	33,800	
2. Backfilling with Soil	m3	3,070	5	15,351	
3. Backfilling with Sand	m3	1,030	18	18,547	
4. Steel Pipe Fitting Φ400 mm	m	1,000	406	406,170	
5. Miscellaneous	L.S.			23,693	5% of Above 1~4
Total				497,561	

Table 13.4.2-8 (3) Unit Construction Cost of Pipeline

Unit Construction Cost of Pipe Line(SPΦ500) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	4,756	8	38,049	
2. Backfilling with Soil	m3	3,306	5	16,530	
3. Backfilling with Sand	m3	1,256	18	22,611	
4. Steel Pipe Fitting Φ500 mm	m	1,000	540	539,790	
5. Miscellaneous	L.S.			30,849	5% of Above 1~4
Total				647,829	

Unit Construction Cost of Pipe Line(SPΦ600) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	5,314	8	42,512	
2. Backfilling with Soil	m3	3,537	5	17,685	
3. Backfilling with Sand	m3	1,491	18	26,892	
4. Steel Pipe Fitting Φ600 mm	m	1,000	695	695,000	
5. Miscellaneous	L.S.			39,101	5% of Above 1~4
Total				821,193	

Unit Construction Cost of Pipe Line(SPΦ650) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	5,610	8	44,880	
2. Backfilling with Soil	m3	3,657	5	18,285	
3. Backfilling with Sand	m3	1,621	18	29,178	
4. Steel Pipe Fitting Φ650 mm	m	1,000	782	782,000	
5. Miscellaneous	L.S.			43,717	5% of Above 1~4
Total				918,060	

Unit Construction Cost of Pipe Line(SPΦ700) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	5,914	8	47,312	
2. Backfilling with Soil	m3	3,778	5	18,890	
3. Backfilling with Sand	m3	1,752	18	31,536	
4. Steel Pipe Fitting Φ700 mm	m	1,000	869	869,000	
5. Miscellaneous	L.S.			48,337	5% of Above 1~4
Total				1,015,075	

Unit Construction Cost of Pipe Line(SPΦ800) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	6,536	8	52,288	
2. Backfilling with Soil	m3	4,010	5	20,050	
3. Backfilling with Sand	m3	2,023	18	36,414	
4. Steel Pipe Fitting Φ800 mm	m	1,000	1,095	1,095,000	
5. Miscellaneous	L.S.			60,188	5% of Above 1~4
Total				1,263,940	

Unit Construction Cost of Pipe Line(SPΦ900) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	7,200	8	57,600	
2. Backfilling with Soil	m3	4,251	5	21,255	
3. Backfilling with Sand	m3	2,313	18	41,634	
4. Steel Pipe Fitting Φ900 mm	m	1,000	1,237	1,237,000	
5. Miscellaneous	L.S.			67,874	5% of Above 1~4
Total				1,425,363	

Table 13.4.2-8 (4) Unit Construction Cost of Pipeline

Unit Construction Cost of Pipe Line(SPΦ1000) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	7,884	8	63,072	
2. Backfilling with Soil	m3	4,483	5	22,415	
3. Backfilling with Sand	m3	2,616	18	47,088	
4. Steel Pipe Fitting Φ1100 mm	m	1,000	1,498	1,498,000	
5. Miscellaneous	L.S.			81,529	5% of Above 1~4
Total				1,712,104	

Unit Construction Cost of Pipe Line(SPΦ1100) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	8,612	8	68,896	
2. Backfilling with Soil	m3	4,724	5	23,620	
3. Backfilling with Sand	m3	2,937	18	52,866	
4. Steel Pipe Fitting Φ1100 mm	m	1,000	1,792	1,792,000	
5. Miscellaneous	L.S.			96,869	5% of Above 1~4
Total				2,034,251	

Unit Construction Cost of Pipe Line(SPΦ1200) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	9,359	8	74,872	
2. Backfilling with Soil	m3	4,956	5	24,780	
3. Backfilling with Sand	m3	3,271	18	58,878	
4. Steel Pipe Fitting Φ1200 mm	m	1,000	2,129	2,129,000	
5. Miscellaneous	L.S.			114,377	5% of Above 1~4
Total				2,401,907	

Unit Construction Cost of Pipe Line(PVCΦ40) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	2,558	8	20,464	
2. Backfilling with Soil	m3	2,208	5	11,040	
3. Backfilling with Sand	m3	349	18	6,282	
4. PVC Pipe Fitting Φ40 mm	m	1,000	6	6,000	
5. Miscellaneous	L.S.			2,189	5% of Above 1~4
Total				45,975	

Unit Construction Cost of Pipe Line(PVCΦ80) Distance : 1000m

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
1. Excavation	m3	2,724	8	21,792	
2. Backfilling with Soil	m3	2,305	5	11,525	
3. Backfilling with Sand	m3	414	18	7,452	
4. PVC Pipe Fitting Φ80 mm	m	1,000	16	16,000	
5. Miscellaneous	L.S.			2,838	5% of Above 1~4
Total				59,607	

Table 13.4.2-9 Unit Construction Cost of Collected Tank and Pump Sump

Unit Construction Cost of Collected Tank and Pump Sump for Plan1

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	1,177	8	9,416	
Backfilling with Soil	m3	228	5	1,140	
Graveling	m3	214	30	6,420	
Sub-total				16,976	
B. Concrete Works					
Lean Concrete	m3	71.2	140	9,968	
Plain Concrete	m3	1,055.8	240	253,392	
Reinforced Bar	t	73.906	1,200	88,687	
Form Work	m2	1,611.0	110	177,210	
Sub-total				529,257	
C. Water Proofing Works					
Tank Inner	m2	1,038.6	80	83,088	
Tank Outer	m2	1,022.0	12	12,264	
Sub-total				95,352	
D. Miscellaneous	L.S.			64,159	10% of Above A~C
Total				705,744	

Unit Construction Cost of Collected Tank and Pump Sump for Plan2

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	886	8	7,089	
Backfilling with Soil	m3	172	5	858	
Graveling	m3	161	30	4,834	
Sub-total				12,781	
B. Concrete Works					
Lean Concrete	m3	54	140	7,505	
Plain Concrete	m3	795	240	190,778	
Reinforced Bar	t	56	1,200	66,772	
Form Work	m2	1,213	110	133,421	
Sub-total				398,476	
C. Water Proofing Works					
Tank Inner	m2	782	80	62,557	
Tank Outer	m2	769	12	9,234	
Sub-total				71,791	
D. Miscellaneous	L.S.			48,305	10% of Above A~C
Total				531,353	

Unit Construction Cost of Collected Tank for Plan3

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	93	8	744	
Backfilling with Soil	m3	17	5	85	
Graveling	m3	26	30	780	
Sub-total				1,609	
B. Concrete Works					
Lean Concrete	m3	8.7	140	1,218	
Plain Concrete	m3	95.7	240	22,968	
Reinforced Bar	t	6.699	1,200	8,039	
Form Work	m2	293.9	110	32,329	
Sub-total				64,554	
C. Water Proofing Works					
Tank Inner	m2	170.2	80	13,616	
Tank Outer	m2	176.9	12	2,123	
Sub-total				15,739	
D. Miscellaneous	L.S.			8,190	10% of Above A~C
Total				90,092	

Table 13.4.2-10 Unit Construction Cost of Surge Tank and Pressure Reduce Tank

Unit Construction Cost of Surge Tank (Plan1)

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	20	8	160	
Backfilling with Soil	m3	5	5	25	
Graveling	m3	4	30	120	
Sub-total				305	
B. Concrete Works					
Lean Concrete	m3	2.9	140	406	
Plain Concrete	m3	26.4	240	6,336	
Reinforced Bar	t	1.848	1,200	2,218	
Form Work	m2	95.2	110	10,472	
Sub-total				19,432	
C. Water Proofing Works					
Tank Inner	m2	46.7	80	3,736	
Tank Outer	m2	63.5	12	762	
Sub-total				4,498	
D. Miscellaneous	L.S.			2,424	10% of Above A~C
Total				26,659	

Unit Construction Cost of Surge Tank (Plan2)

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	15	8	120	
Backfilling with Soil	m3	4	5	19	
Graveling	m3	3	30	90	
Sub-total				230	
B. Concrete Works					
Lean Concrete	m3	2	140	306	
Plain Concrete	m3	20	240	4,770	
Reinforced Bar	t	1	1,200	1,670	
Form Work	m2	72	110	7,884	
Sub-total				14,630	
C. Water Proofing Works					
Tank Inner	m2	35	80	2,813	
Tank Outer	m2	48	12	574	
Sub-total				3,387	
D. Miscellaneous	L.S.			1,825	10% of Above A~C
Total				20,071	

Unit Construction Cost of Pressure Reduce Tank (Plan1)

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	807	8	6,456	
Backfilling with Soil	m3	321	5	1,605	
Graveling	m3	48	30	1,440	
Sub-total				9,501	
B. Concrete Works					
Lean Concrete	m3	16.1	140	2,254	
Plain Concrete	m3	176.7	240	42,408	
Reinforced Bar	t	12.369	1,200	14,843	
Form Work	m2	672.2	110	73,942	
Sub-total				133,447	
C. Water Proofing Works					
Tank Inner	m2	436.2	80	34,896	
Tank Outer	m2	257.0	12	3,084	
Sub-total				37,980	
D. Miscellaneous	L.S.			18,093	10% of Above A~C
Total				199,021	

Unit Construction Cost of Pressure Reduce Tank (Plan2)

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	701	8	5,605	
Backfilling with Soil	m3	279	5	1,394	
Graveling	m3	42	30	1,250	
Sub-total				8,249	
B. Concrete Works					
Lean Concrete	m3	14	140	1,957	
Plain Concrete	m3	153	240	36,821	
Reinforced Bar	t	11	1,200	12,887	
Form Work	m2	584	110	64,200	
Sub-total				115,865	
C. Water Proofing Works					
Tank Inner	m2	379	80	30,298	
Tank Outer	m2	223	12	2,678	
Sub-total				32,976	
D. Miscellaneous	L.S.			15,709	10% of Above A~C
Total				172,800	

Table 13.4.2-11 (1) Unit Construction Cost of Distribution Reservoir

Unit Construction Cost of Distribution Water Reservoir for Plan1

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	6,484	8	51,872	
Backfilling with Soil	m3	952	5	4,760	
Graveling	m3	11	30	330	
Sub-total				56,962	
B. Concrete Works					
Lean Concrete	m3	158.3	140	22,162	
Plain Concrete	m3	1,612.2	240	386,928	
Reinforced Bar	t	112.854	1,200	135,425	
Form Work	m2	4,216.6	110	463,826	
Sub-total				1,008,341	
C. Water Proofing Works					
Tank Inner	m2	2,332.7	80	186,616	
Tank Outer	m2	1,931.3	12	23,176	
Sub-total				209,792	
D. Miscellaneous	L.S.			127,510	10% of Above A~C
Total				1,402,605	

Unit Construction Cost of Distribution Water Reservoir for Plan2 (Nuweiba Reservoir)

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	5,630	8	45,038	
Backfilling with Soil	m3	827	5	4,133	
Graveling	m3	10	30	287	
Sub-total				49,458	
B. Concrete Works					
Lean Concrete	m3	137	140	19,242	
Plain Concrete	m3	1,400	240	335,951	
Reinforced Bar	t	98	1,200	117,583	
Form Work	m2	3,661	110	402,717	
Sub-total				875,493	
C. Water Proofing Works					
Tank Inner	m2	2,025	80	162,030	
Tank Outer	m2	1,677	12	20,122	
Sub-total				182,152	
D. Miscellaneous	L.S.			110,710	10% of Above A~C
Total				1,217,813	

Unit Construction Cost of Distribution Water Reservoir for Plan2 (Taba Reservoir)

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	816	8	6,524	
Backfilling with Soil	m3	120	5	599	
Graveling	m3	1	30	42	
Sub-total				7,165	
B. Concrete Works					
Lean Concrete	m3	20	140	2,787	
Plain Concrete	m3	203	240	48,665	
Reinforced Bar	t	14	1,200	17,033	
Form Work	m2	530	110	58,337	
Sub-total				126,822	
C. Water Proofing Works					
Tank Inner	m2	293	80	23,471	
Tank Outer	m2	243	12	2,915	
Sub-total				26,386	
D. Miscellaneous	L.S.			16,037	10% of Above A~C
Total				176,410	

Table 13.4.2-11 (2) Unit Construction Cost of Distribution Reservoir

Unit Construction Cost of Distribution Water Reservoir for Plan3

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	1,225	8	9,800	
Backfilling with Soil	m3	315	5	1,575	
Graveling	m3	103	30	3,090	
Sub-total				14,465	
B. Concrete Works					
Lean Concrete	m3	34.3	140	4,802	
Plain Concrete	m3	410.3	240	98,472	
Reinforced Bar	t	28.721	1,200	34,465	
Form Work	m2	1,259.9	110	138,589	
Sub-total				276,328	
C. Water Proofing Works					
Tank Inner	m2	667.6	80	53,408	
Tank Outer	m2	545.9	12	6,551	
Sub-total				59,959	
D. Miscellaneous	L.S.			35,075	10% of Above A~C
Total				385,827	

Unit Construction Cost of Distribution Water Reservoir for Plan4

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	463	8	3,704	
Backfilling with Soil	m3	167	5	835	
Graveling	m3	39	30	1,170	
Sub-total				5,709	
B. Concrete Works					
Lean Concrete	m3	13.1	140	1,834	
Plain Concrete	m3	262.4	240	62,976	
Reinforced Bar	t	18.368	1,200	22,042	
Form Work	m2	534.3	110	58,773	
Sub-total				145,625	
C. Water Proofing Works					
Tank Inner	m2	277.8	80	22,224	
Tank Outer	m2	261.9	12	3,143	
Sub-total				25,367	
D. Miscellaneous	L.S.			17,670	10% of Above A~C
Total				194,371	

Unit Construction Cost of Distribution Water Reservoir for Plan5A

Item	Unit	Quantity	Unit Cost (LE)	Cost (LE)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	8	8	64	
Backfilling with Soil	m3	3	5	15	
Graveling	m3	1	30	30	
Sub-total				109	
B. Concrete Works					
Lean Concrete	m3	0.9	140	126	
Plain Concrete	m3	11.4	240	2,736	
Reinforced Bar	t	0.798	1,200	958	
Form Work	m2	48.0	110	5,280	
Sub-total				9,100	
C. Water Proofing Works					
Tank Inner	m2	18.2	80	1,456	
Tank Outer	m2	31.2	12	374	
Sub-total				1,830	
D. Miscellaneous	L.S.			1,104	10% of Above A~C
Total				12,143	

Table 13.4.2-11 (3) Unit Construction Cost of Distribution Reservoir

Unit Construction Cost of Distribution Water Reservoir for Plan5B & Plan5C

Item	Unit	Quantity	Unit Cost (L.E)	Cost (L.E)	Remarks
A. Earth Works					
Excavation (ordinary soil)	m3	14	8	112	
Backfilling with Soil	m3	4	5	20	
Graveling	m3	3	30	90	
Sub-total				222	
B. Concrete Works					
Lean Concrete	m3	1.9	140	266	
Plain Concrete	m3	25.7	240	6,168	
Reinforced Bar	t	1.799	1,200	2,159	
Form Work	m2	113.9	110	12,529	
Sub-total				21,122	
C. Water Proofing Works					
Tank Inner	m2	51.3	80	4,104	
Tank Outer	m2	70.6	12	847	
Sub-total				4,951	
D. Miscellaneous	L.S.			2,630	10% of Above A~C
Total				28,925	

Table 13.4.3-1 Operation and Maintenance Cost

Unit : 1000LE

Description	Plan1	Plan2	Plan3	Plan4A & 4C	Plan4B	Plan5A	Plan5B	Plan5C
1. Salary and Wages	51	113	6	6	6	6	6	6
2. Pump Operation Cost	10,502	13,560	340	1,892	2,247	1	1	2
3. Depreciation and Fuel Cost for Transportation	7	13	2	2	2	2	2	2
4. Maintenance Cost of Facilities	1,037	1,368	63	238	274	0	2	5
5. Administration and General Expenditure Cost	3	6	0	0	0	0	0	0
Total	11,600	15,060	411	2,138	2,529	9	11	15

1. Salaries and Wages

Description	Unit Cost (LE/M)	Plan1 Person (M/Year)	Plan1 Annual Cost (1,000LE)	Plan2 Person (M/Year)	Plan2 Annual Cost (1,000LE)	Plan3 Person (M/Year)	Plan3 Annual Cost (1,000LE)	Plan4A & 4C Person (M/Year)	Plan4A & 4C Annual Cost (1,000LE)	Plan4B Person (M/Year)	Plan4B Annual Cost (1,000LE)	Plan5A Person (M/Year)	Plan5A Annual Cost (1,000LE)	Plan5B Person (M/Year)	Plan5B Annual Cost (1,000LE)	Plan5C Person (M/Year)	Plan5C Annual Cost (1,000LE)
(1) Production Wells																	
- Engineer	800	1.2	1.0	1.2	1.0	0.4	0.3	0.4	0.3	0.4	0.3	0.4	0.3	0.4	0.3	0.4	0.3
- Technician	500	7.2	3.6	7.2	3.6	2.4	1.2	2.4	1.2	2.4	1.2	2.4	1.2	2.4	1.2	2.4	1.2
- Workers	400	36.0	14.4	36.0	14.4	12.0	4.8	12.0	4.8	12.0	4.8	12.0	4.8	12.0	4.8	12.0	4.8
Subtotal			19.0		19.0		6.3		6.3		6.3		6.3		6.3		6.3
(2) Pumping Stations																	
- Engineer	800	0.4	0.3	1.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Technician	500	12.0	6.0	48.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Workers	400	36.0	14.4	144.0	57.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal			20.7		82.9		0.0		0.0		0.0		0.0		0.0		0.0
(3) Conveyance Facilities																	
- Engineer	800	0.4	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Technician	500	12.0	6.0	12.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Workers	400	12.0	4.8	12.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal			11.1		11.1		0.0		0.0		0.0		0.0		0.0		0.0
Total			50.8		113.0		6.3		6.3		6.3		6.3		6.3		6.3

2. Pump Operation Cost

Description	Unit Cost (LE/kwh)	Plan1 Operation Time (1,000kwh)	Plan1 Annual Cost (1,000LE)	Plan2 Operation Time (1,000kwh)	Plan2 Annual Cost (1,000LE)	Plan3 Operation Time (1,000kwh)	Plan3 Annual Cost (1,000LE)	Plan4A & 4C Operation Time (1,000kwh)	Plan4A & 4C Annual Cost (1,000LE)	Plan4B Operation Time (1,000kwh)	Plan4B Annual Cost (1,000LE)	Plan5A Operation Time (1,000kwh)	Plan5A Annual Cost (1,000LE)	Plan5B Operation Time (1,000kwh)	Plan5B Annual Cost (1,000LE)	Plan5C Operation Time (1,000kwh)	Plan5C Annual Cost (1,000LE)
Submersible Pump 30m3/hrx315mx45kw	0.30	31,536	9,461	18,922	5,676		0	6,307	1,892	7,490	2,247		0		0		0
Submersible Pump 30m3/hrx124mx18.5kw	0.30		0		0	1,134	340		0		0		0		0		0
Submersible Pump 1m3/hrx26mx1.5kw	0.30		0		0		0		0		0	3	1		0		0
Submersible Pump 5m3/hrx20mx1.5kw	0.30		0		0		0		0		0		0	3	1	5	2
Booster Pump 13m3/minx38mx132kw	0.30	3,469	1,041		0		0		0		0		0		0		0
Booster Pump 8.1m3/minx95mx250k	0.30		0	26,280	7,884		0		0		0		0		0		0
Total			10,502		13,560		340		1,892		2,247		1		1		2

3. Depreciation and Fuel Cost for Transportation

Description	Unit Cost (LE/hr)	Plan1 Driving Time (hrs)	Plan1 Annual Cost (1,000LE)	Plan2 Driving Time (hrs)	Plan2 Annual Cost (1,000LE)	Plan3 Driving Time (hrs)	Plan3 Annual Cost (1,000LE)	Plan4A & 4C Driving Time (hrs)	Plan4A & 4C Annual Cost (1,000LE)	Plan4B Driving Time (hrs)	Plan4B Annual Cost (1,000LE)	Plan5A Driving Time (hrs)	Plan5A Annual Cost (1,000LE)	Plan5B Driving Time (hrs)	Plan5B Annual Cost (1,000LE)	Plan5C Driving Time (hrs)	Plan5C Annual Cost (1,000LE)
Depreciation cost	4	1,440	5.8	2,520	10.1	360	1.4	360	1.4	360	1.4	360	1.4	360	1.4	360	1.4
Fuel Cost	1	1,440	1.4	2,520	2.5	360	0.4	360	0.4	360	0.4	360	0.4	360	0.4	360	0.4
Total			7.2		12.6		1.8		1.8		1.8		1.8		1.8		1.8

4. Maintenance Cost of Facilities

Unit : 1000LE

Description	Plan1	Plan2	Plan3	Plan4A & 4C	Plan4B	Plan5A	Plan5B	Plan5C
Pumping Unit	664	700	23	124	143	0	1	1
Pipeline	180	455	14	3	3	0	0	0
Reservoir/Tank	193	213	26	111	128	0	1	4
Total	1,037	1,368	63	238	274	0	2	5

Table 13.5.2-1 Implementation and Disbursement Schedule

Item		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Plan 1	Intake Facilities	- - -	- - -	———	———	———	———			———	———				———	———				
	Conveyance Facilities	- - -	- - -	———	———	———														
	Disbursed Cost	4,665	4,665	90,474	90,474	90,474	57,070			38,399	38,399				23,463	23,463				461,546
Plan 2	Intake Facilities	- - -	- - -		———	———	———	———		———	———					———	———			
	Conveyance Facilities	- - -	- - -	———	———	———	———	———												
	Disbursed Cost	4,430	4,430	58,511	97,179	97,179	97,179	97,179		26,175	26,175					13,683	13,683			535,802
Plan 3	Intake Facilities	- - -	———			———														
	Conveyance Facilities	- - -	———																	
	Disbursed Cost	387	13,152			3,492														17,031
Plan 4A	Intake Facilities	- - -	———					———					———							
	Conveyance Facilities	- - -	———																	
	Disbursed Cost	1,355	41,290					17,657					14,227							74,529
Plan 4B	Intake Facilities	- - -	———	———					———					———						
	Conveyance Facilities	- - -	———																	
	Disbursed Cost	1,568	28,434	21,049					21,049					14,190						86,290
Plan 4C	Intake Facilities	- - -	———					———					———							
	Conveyance Facilities	- - -	———																	
	Disbursed Cost	1,355	41,290					17,657					14,227							74,529
Plan 5A	Intake Facilities	- - -	———																	
	Conveyance Facilities	- - -	———																	
	Disbursed Cost	5	154																	159
Plan 5B	Intake Facilities	- - -	———																	
	Conveyance Facilities	- - -	———																	
	Disbursed Cost	6	185																	191
Plan 5C	Intake Facilities	- - -	———																	
	Conveyance Facilities	- - -	———																	
	Disbursed Cost	15	481																	496

Note) - - - : Survey and Detail Design , ——— : Construction
Project costs are indicated in 1,000LE.

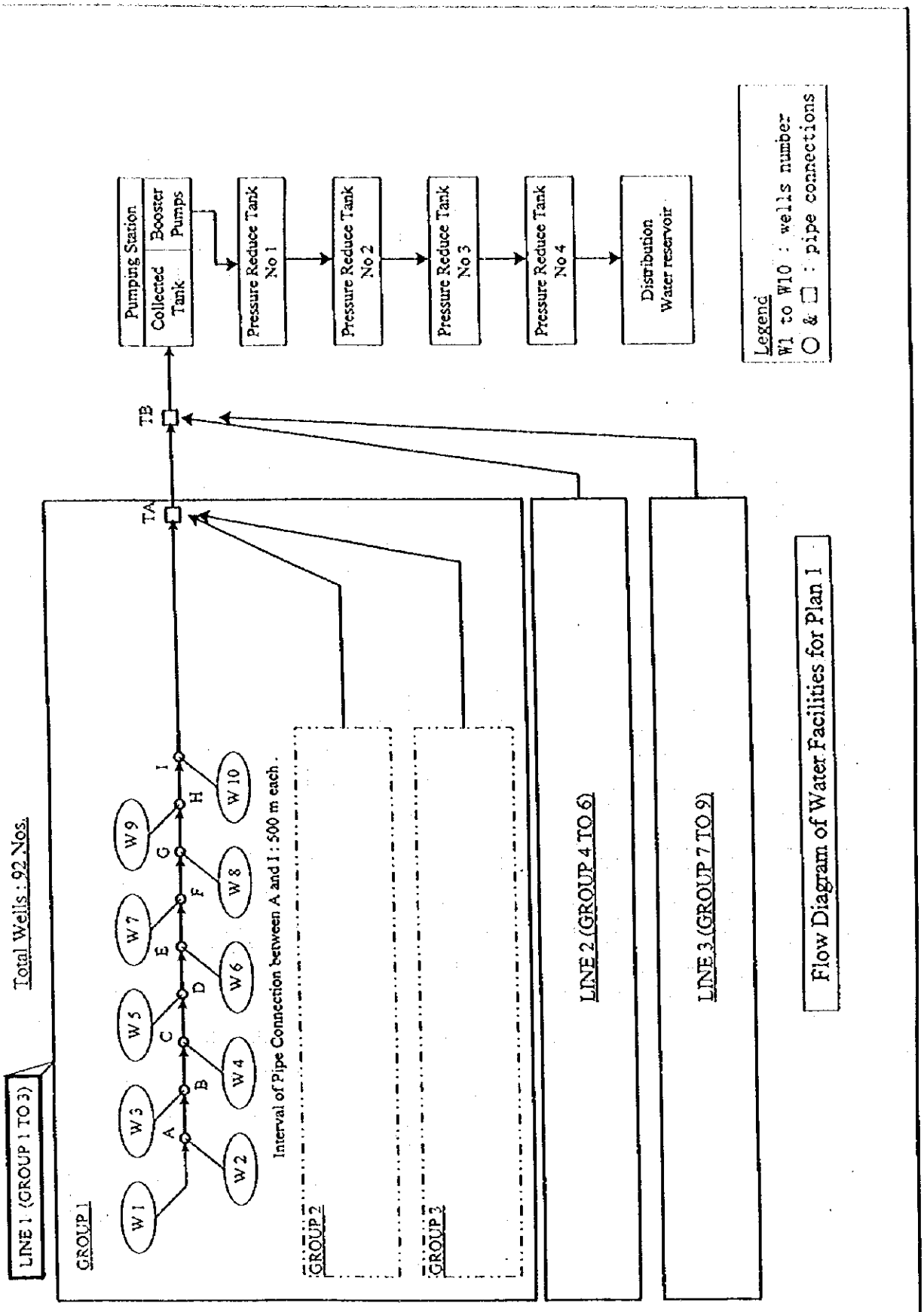


Fig. 13.2-1(1) Flow Diagram of Water Facilities (Plan1)

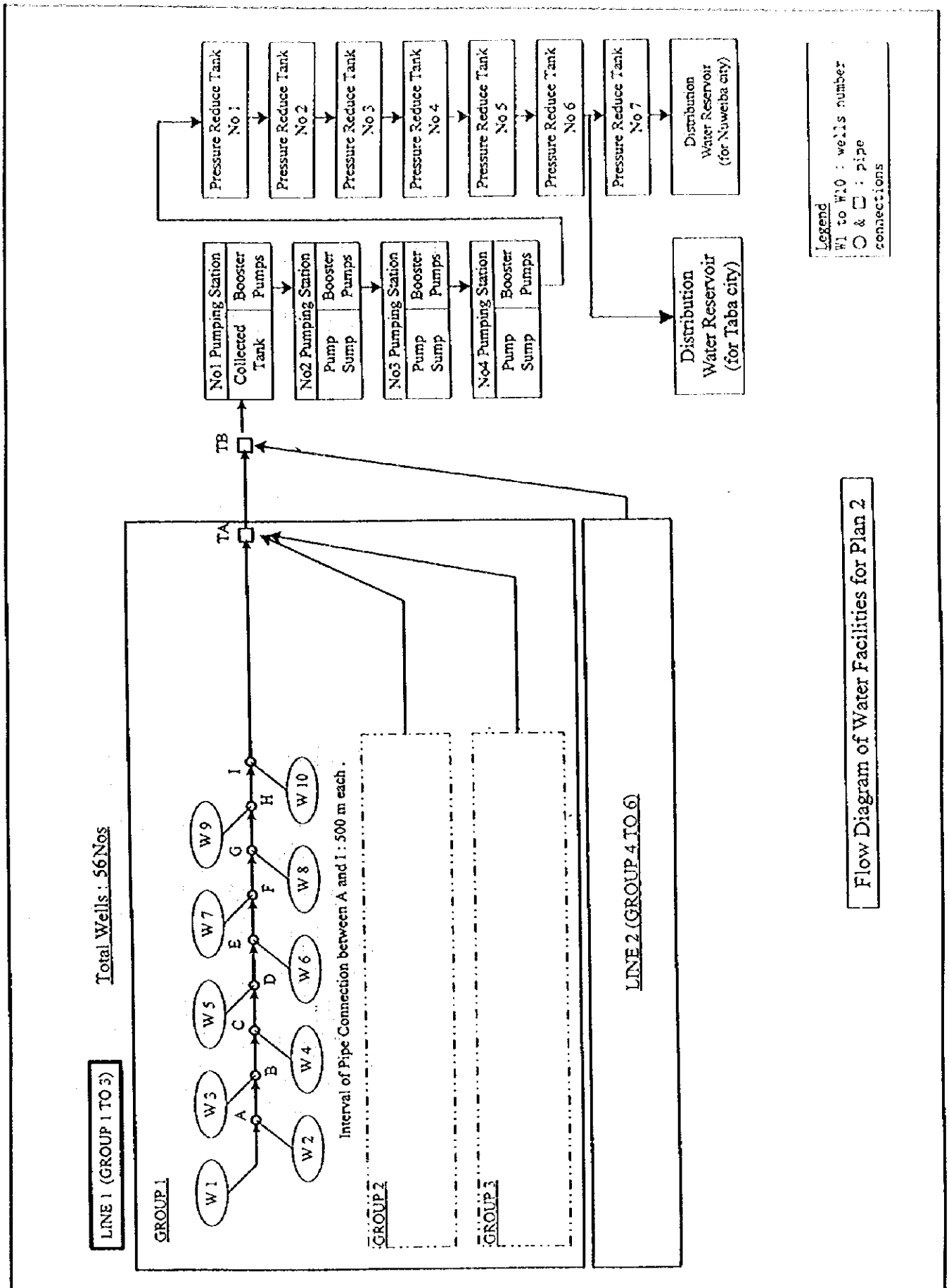


Fig. 13.2-1(2) Flow Diagram of Water Facilities (Plan2)

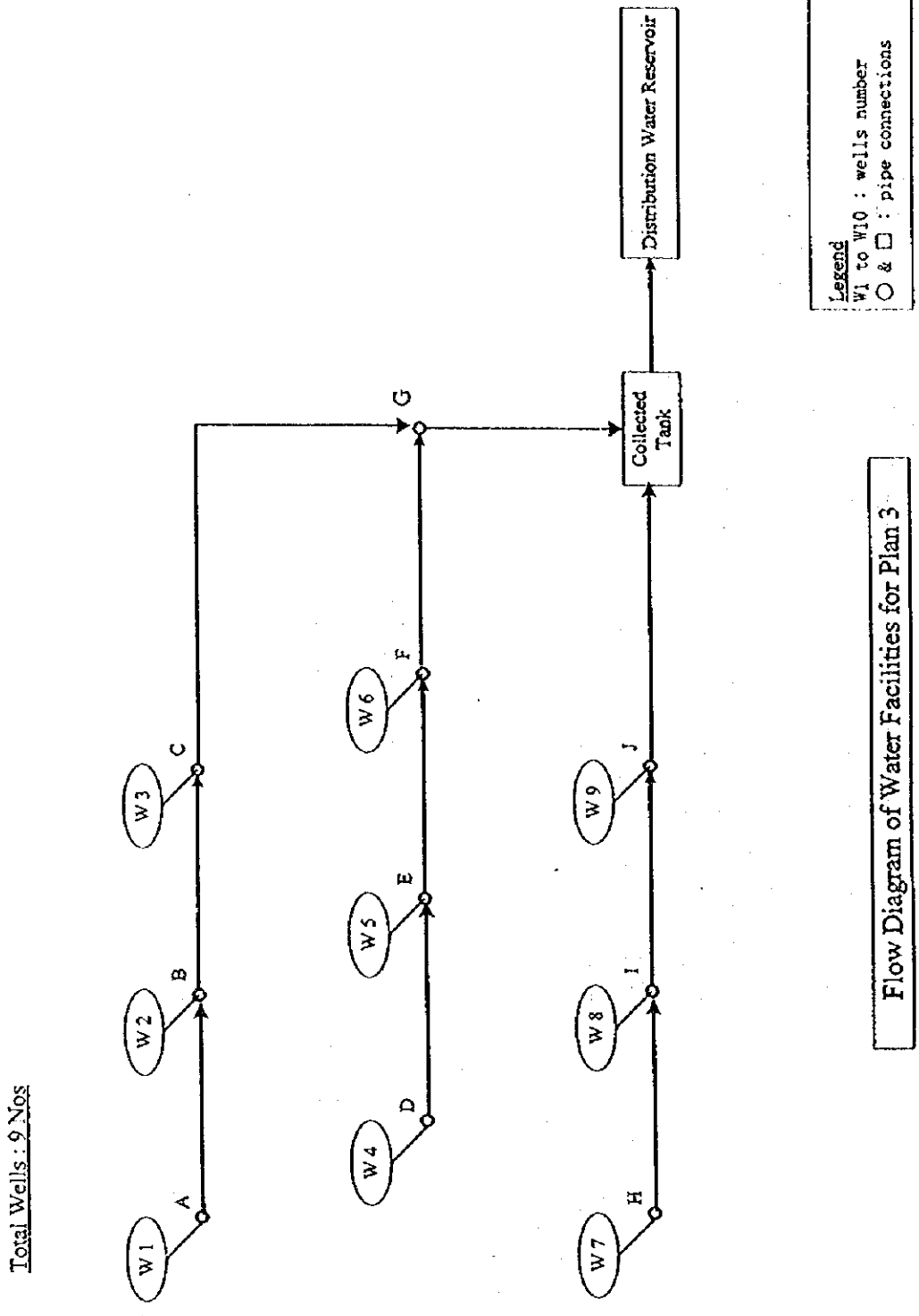


Fig. 13.2-1(3) Flow Diagram of Water Facilities (Plan3)

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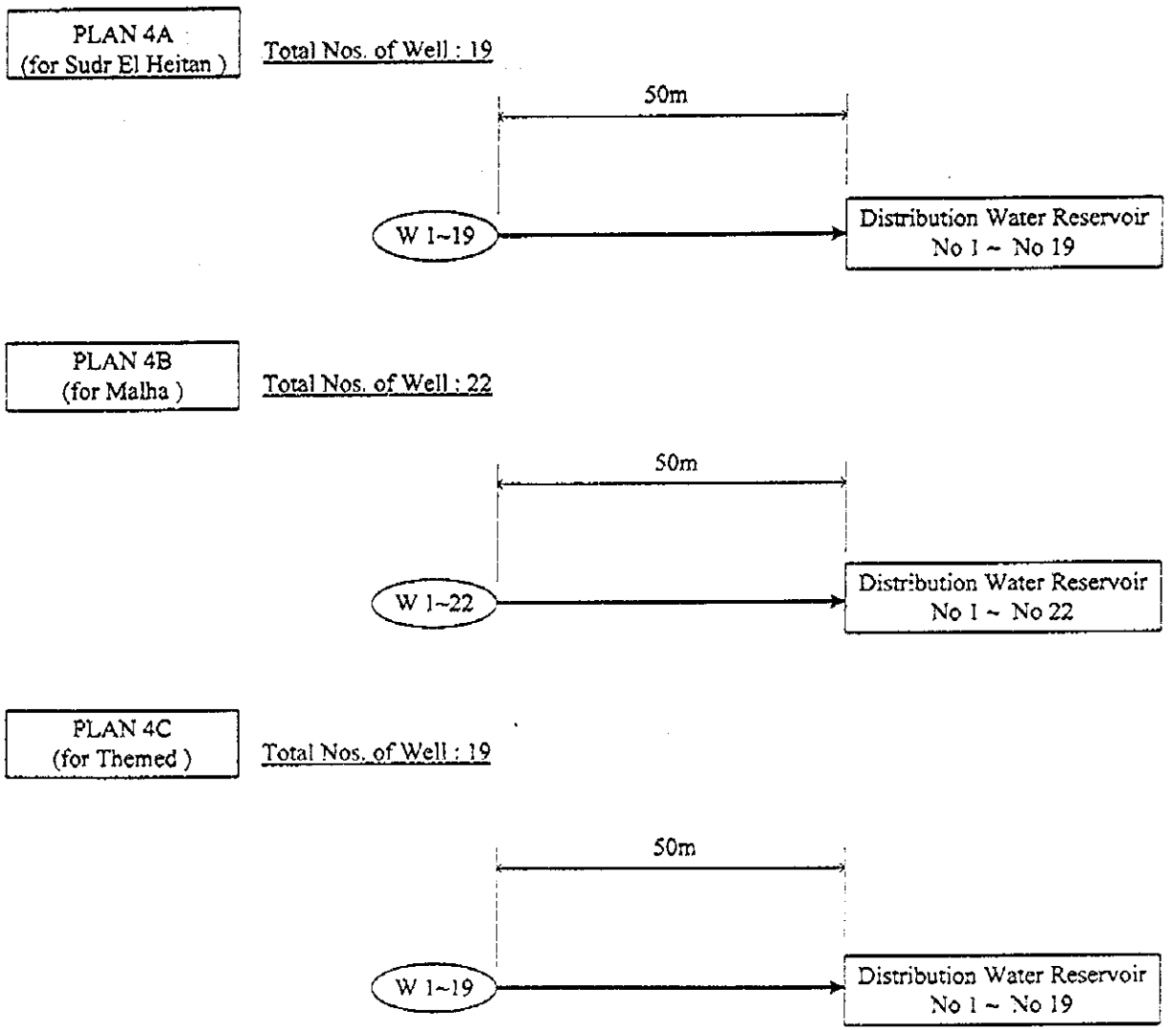
Fig. 13.2-1(4) Flow Diagram of Water Facilities (Plan4)



Flow Diagram of Water Facilities for Plan 4
(For Agriculture)

Legend
W1 to W2 : wells number
○ & □ : pipe connections

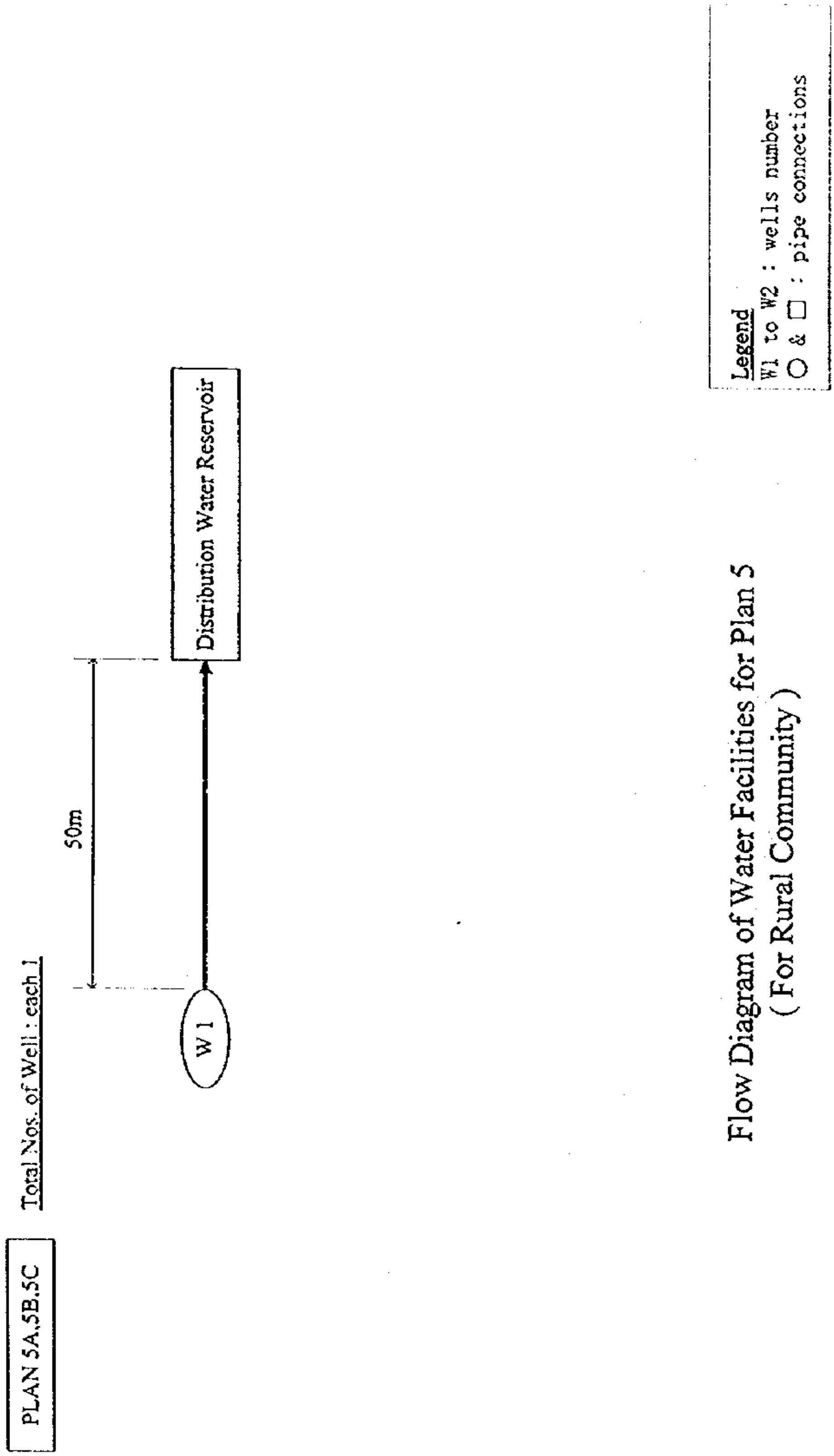


Fig. 13.2-1(5) Flow Diagram of Water Facilities (Plan5)

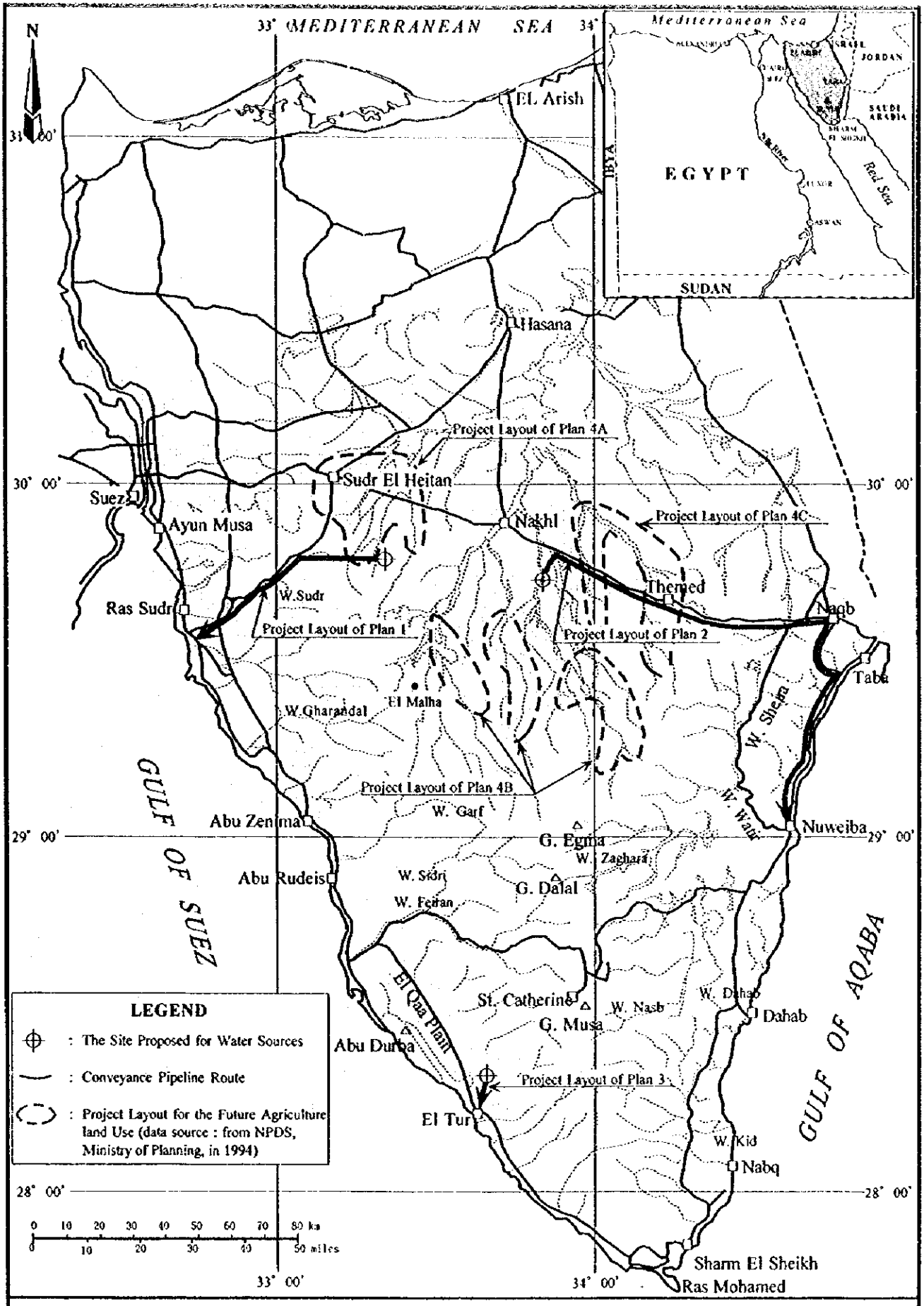


Fig. 13.2-2 (1) Project Layout (Plain 1,2 and 4)

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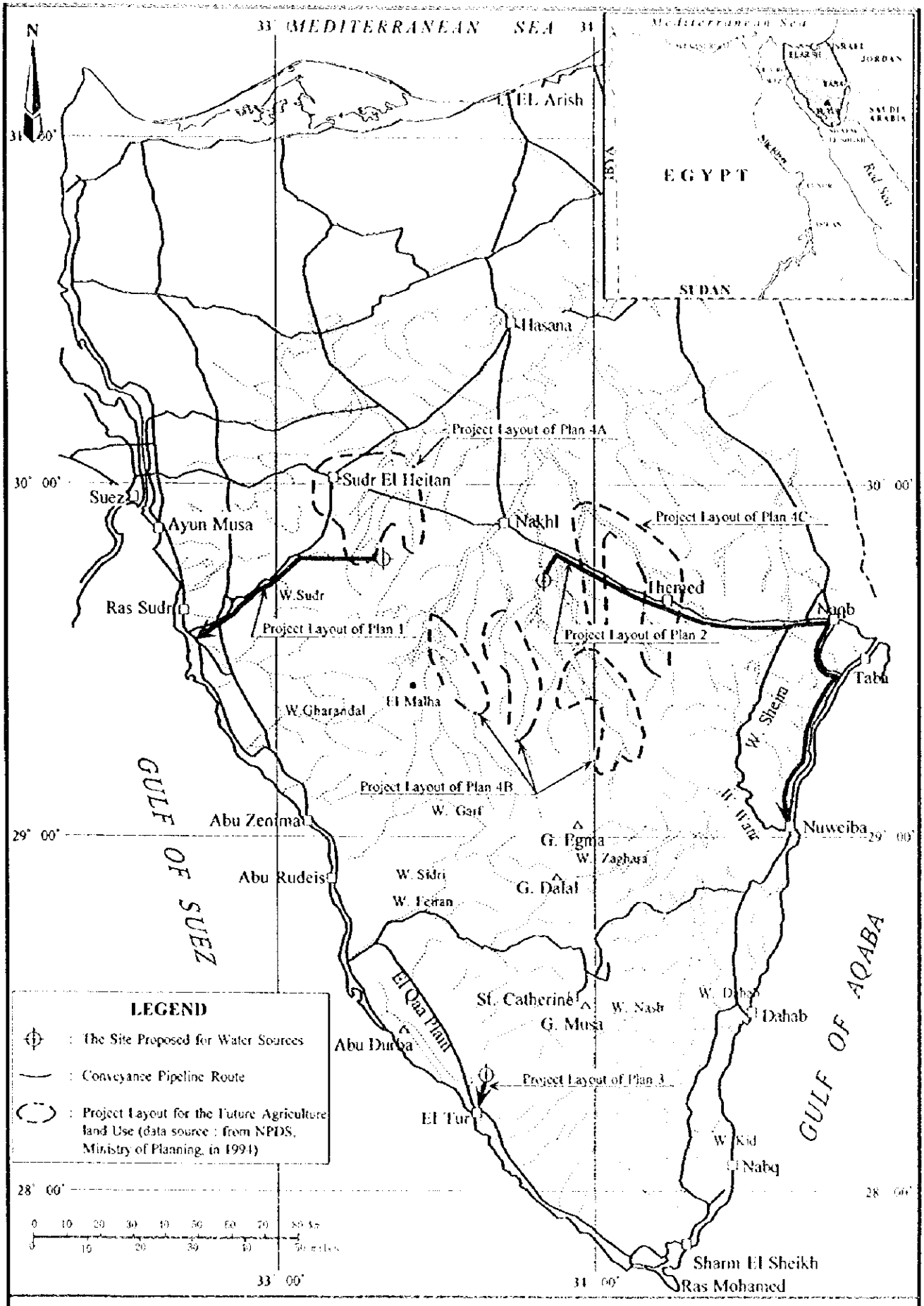

Fig. 13.2-2 (1) Project Layout (Plain 1,2 and 4)

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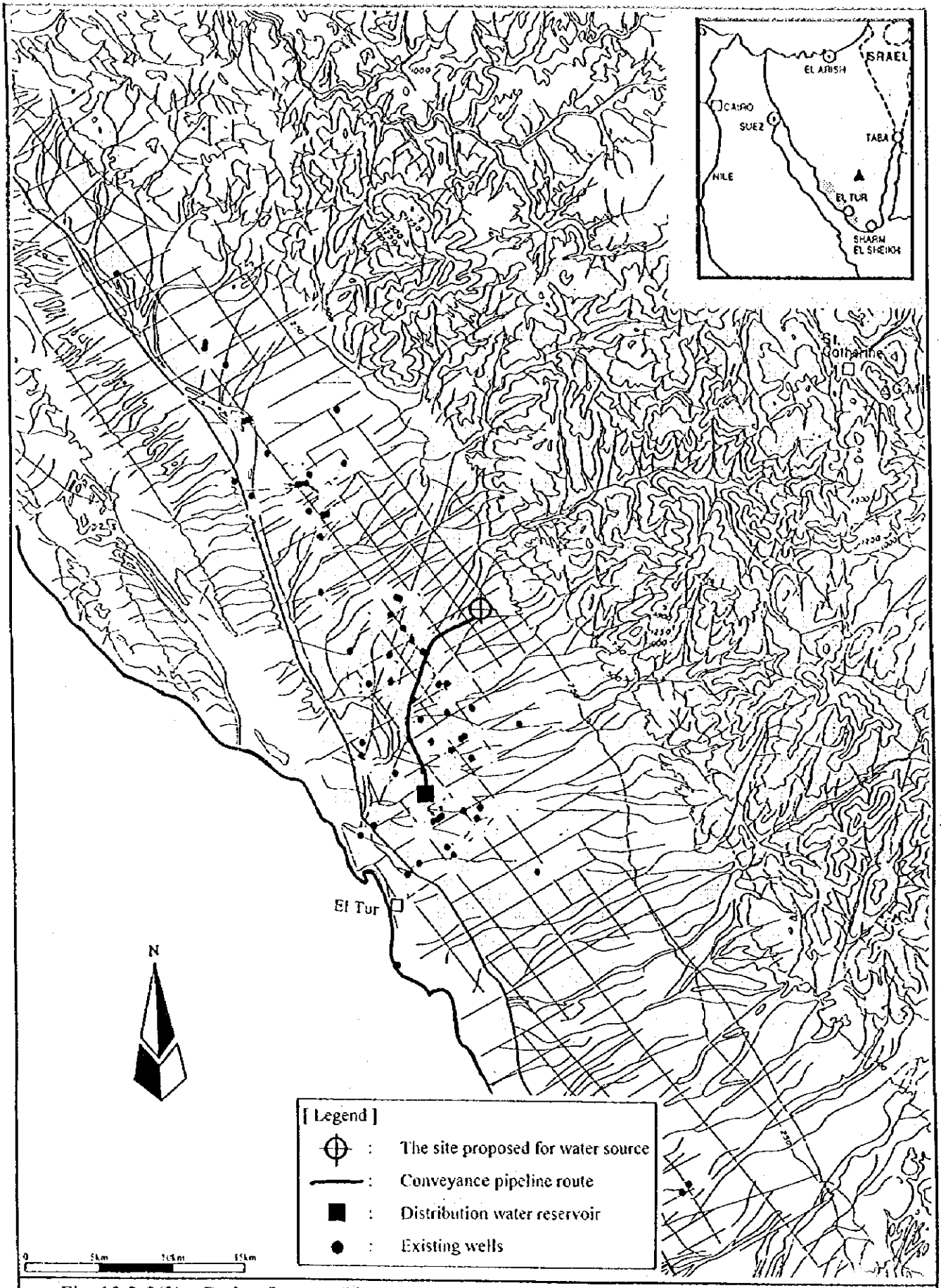

Fig. 13.2-2(2) Project Layout (Plan3)

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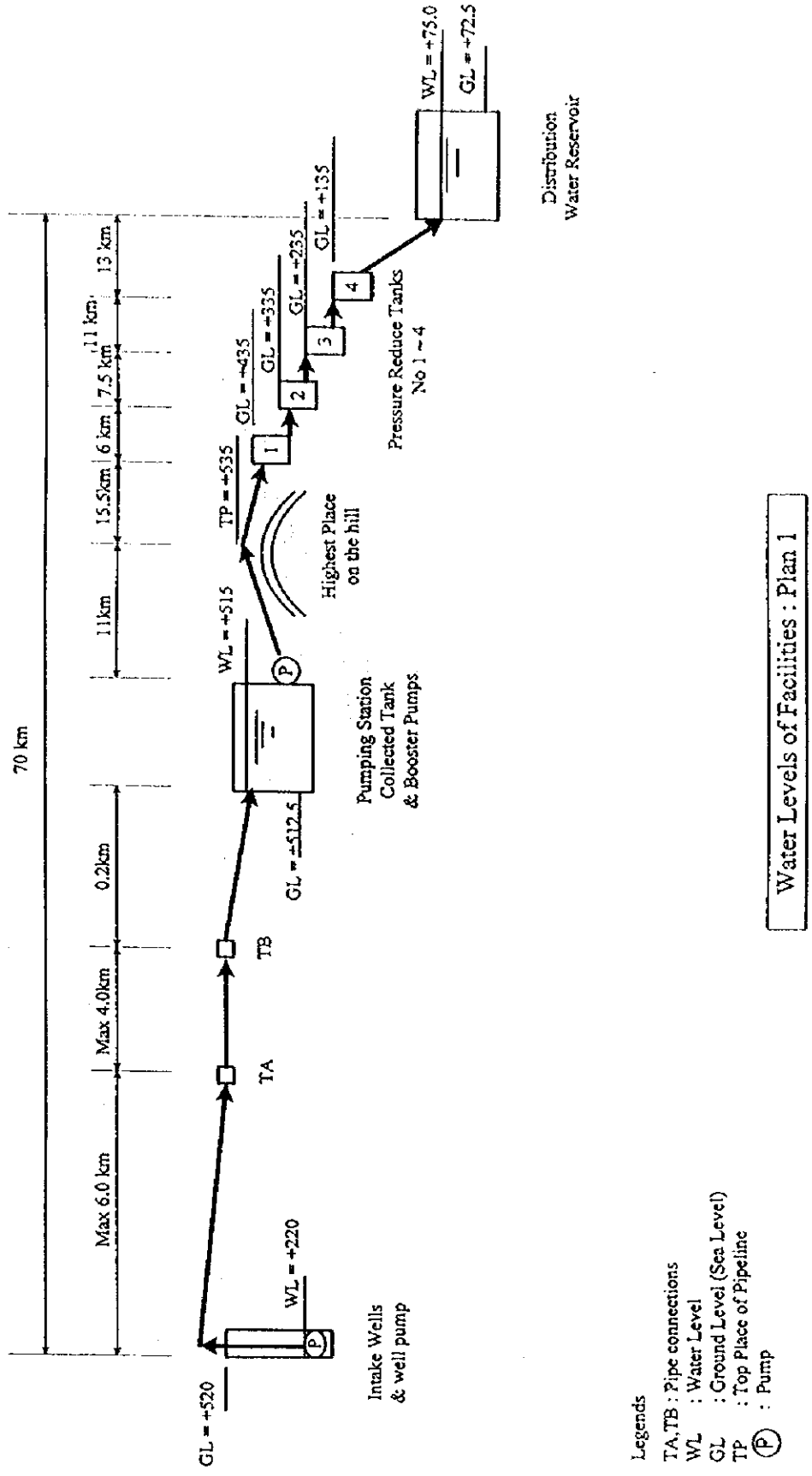

Fig. 13.2-3(1) Water Levels of Facilities (Plan1)

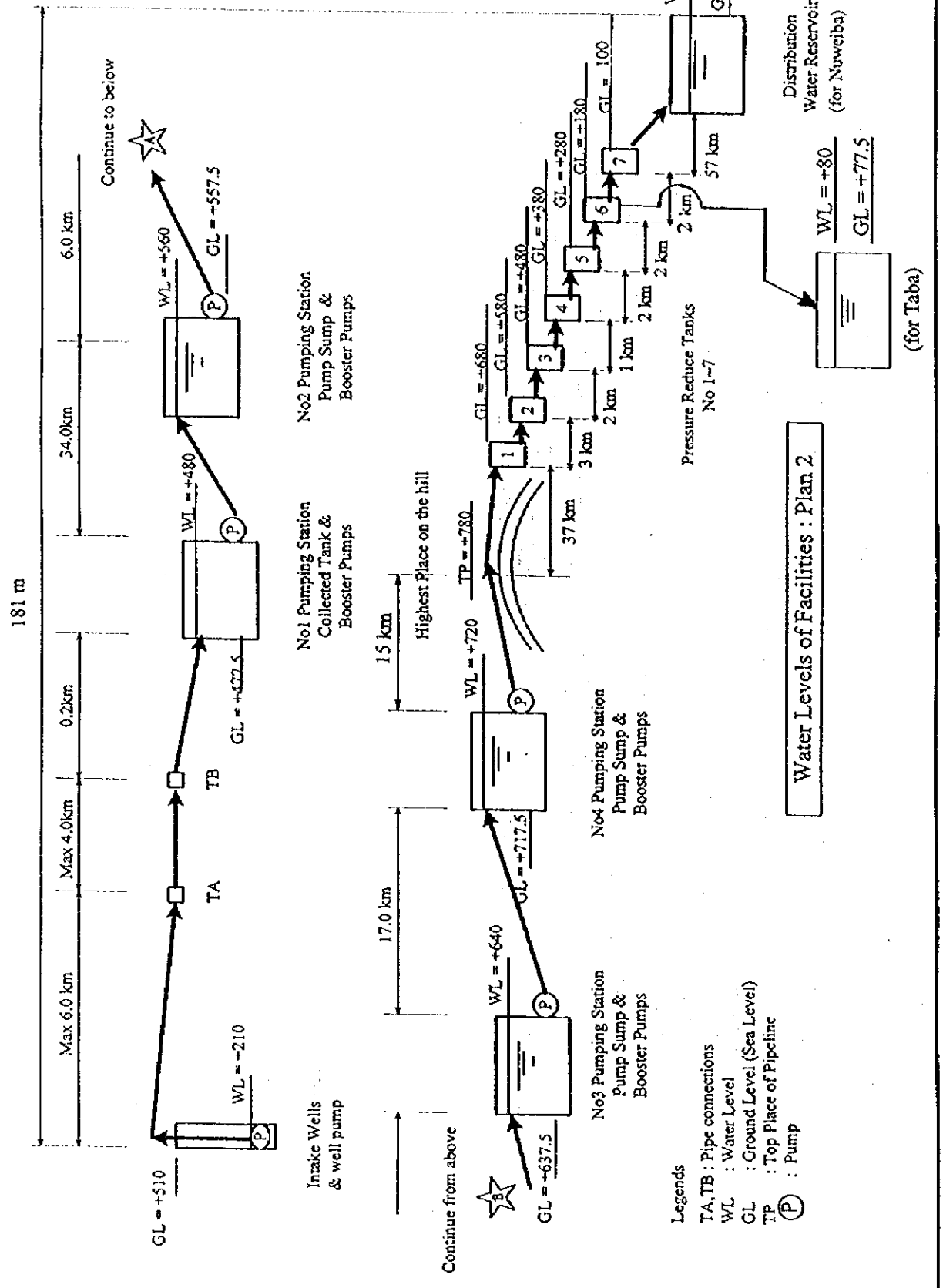

Fig. 13.2-3(2) Water Levels of Facilities (Plan2)

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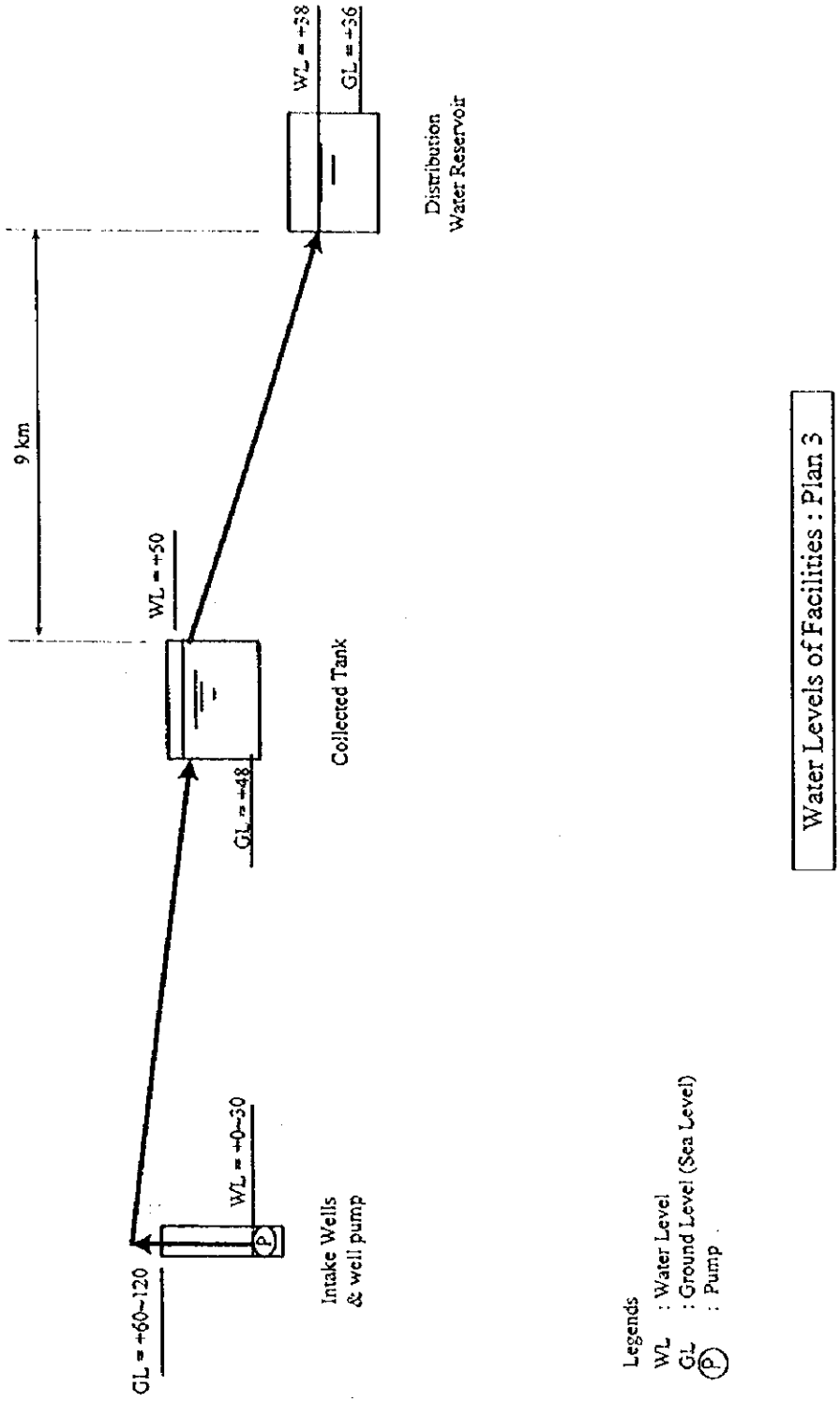

Fig. 13.2-3(3) Water Levels of Facilities (Plan3)

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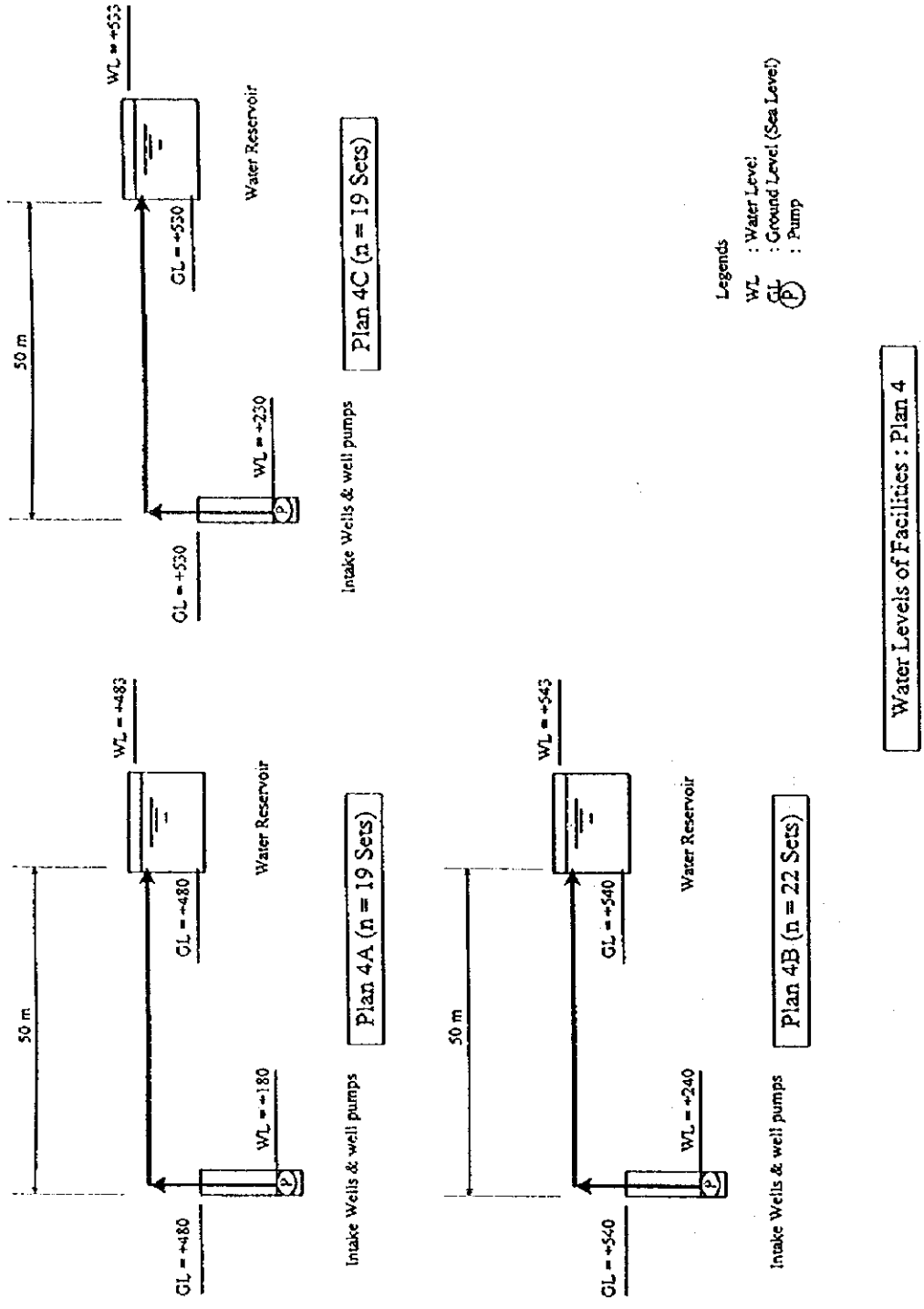

Fig. 13.2-3(4) Water Levels of Facilities (Plan4)

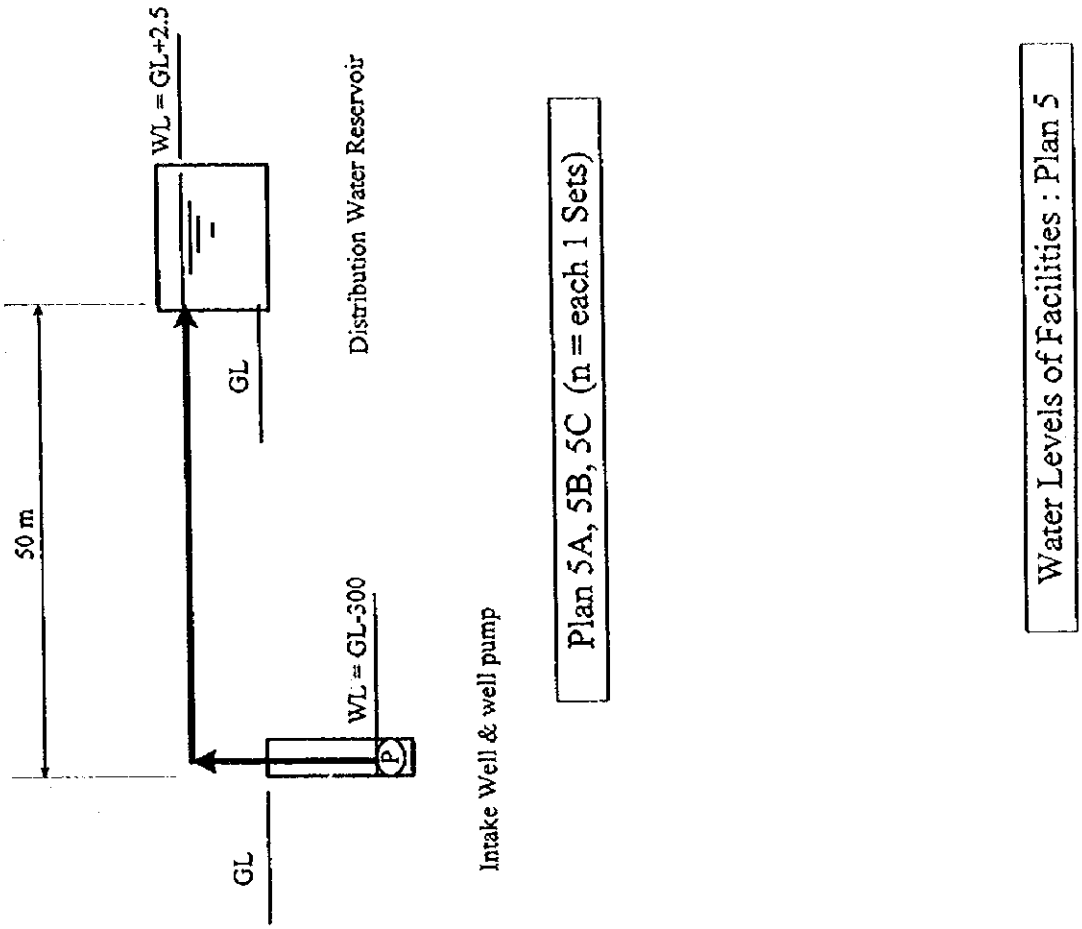

Fig. 13.2-3(5) Water Levels of Facilities (Plan5)

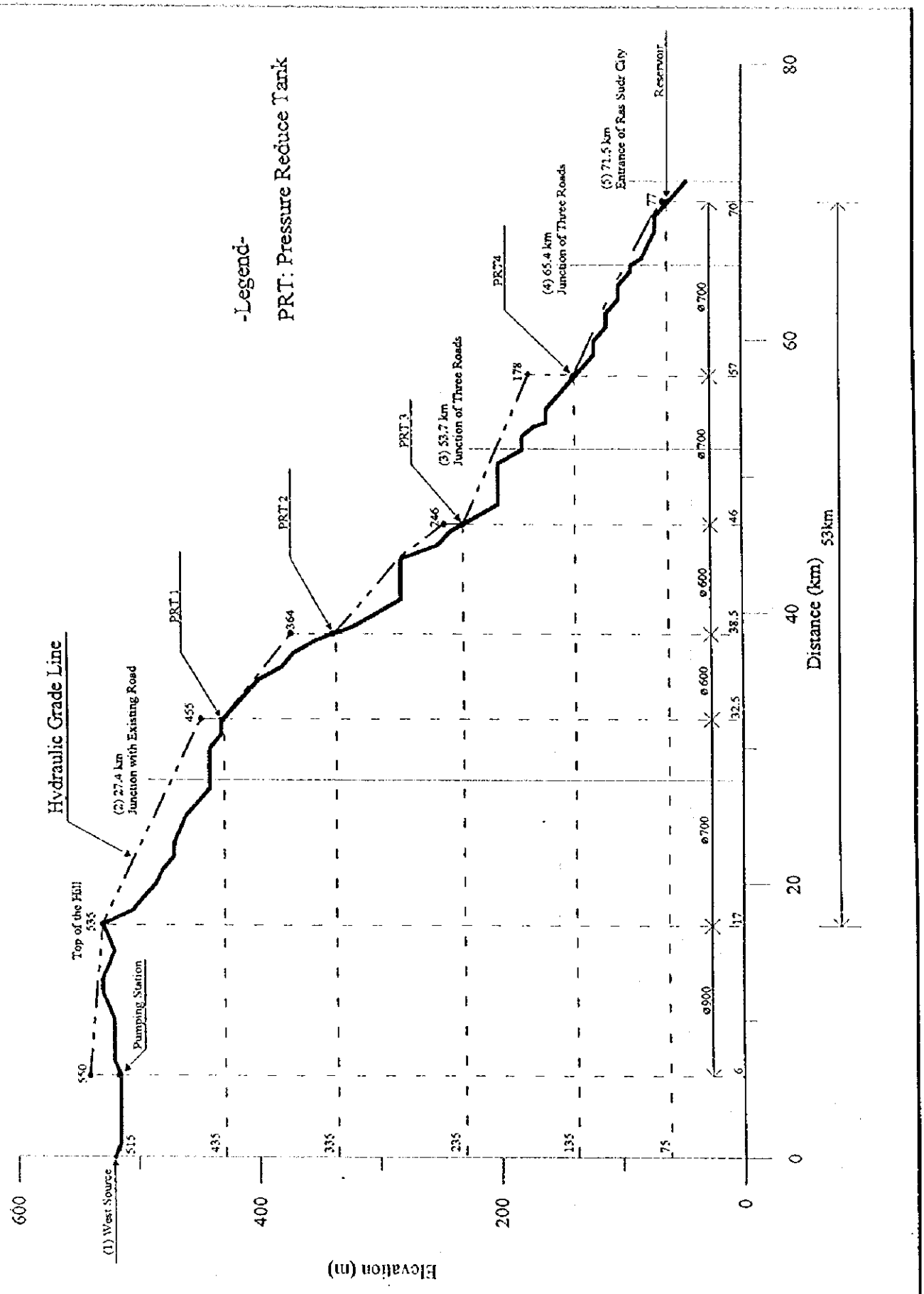

Fig. 13.2-4(1) Longitudinal Profile of Conveyance Pipeline (Plan1)

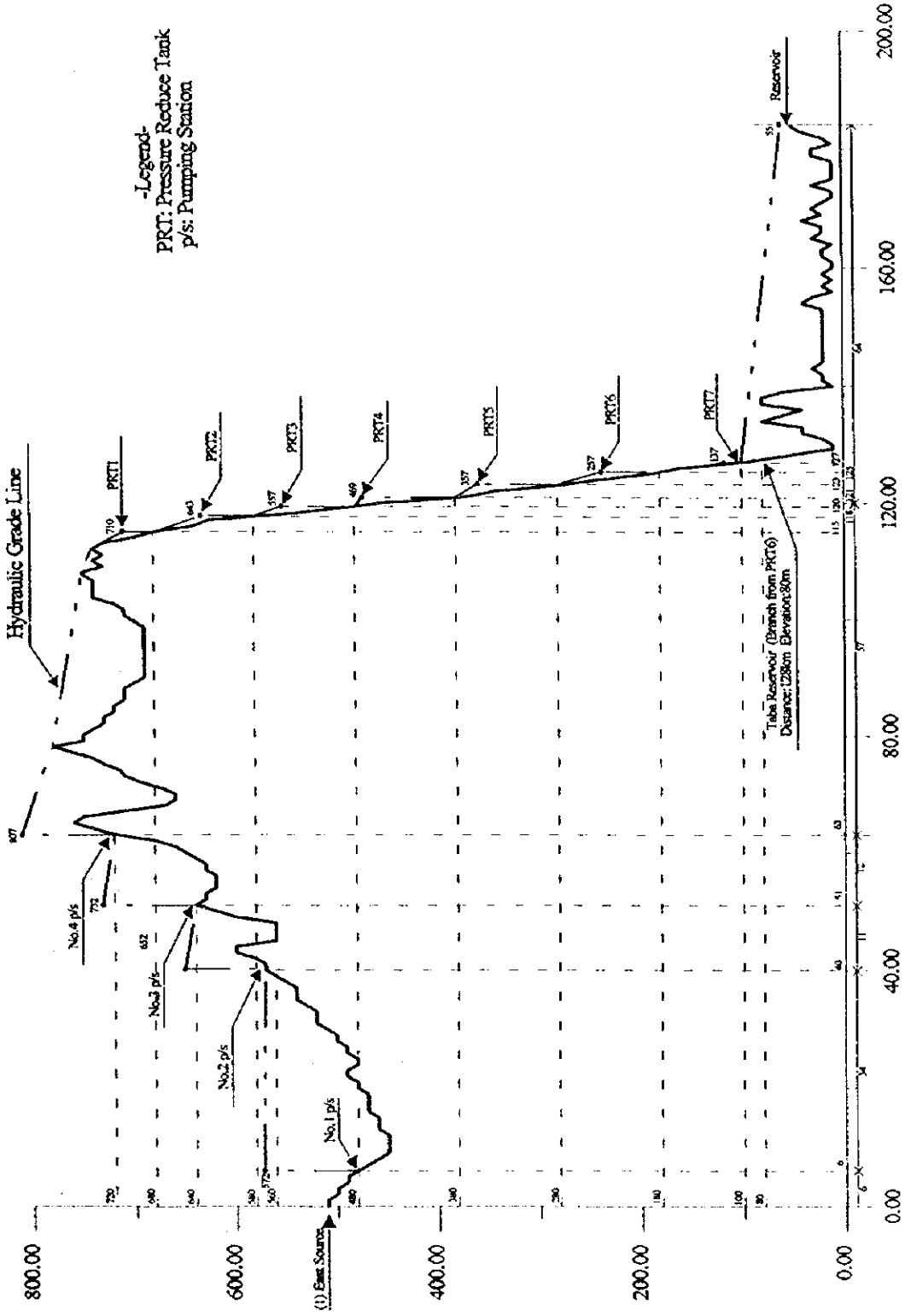

Fig. 13.2-4(2) Longitudinal Profile of Conveyance Pipeline (Plan2)

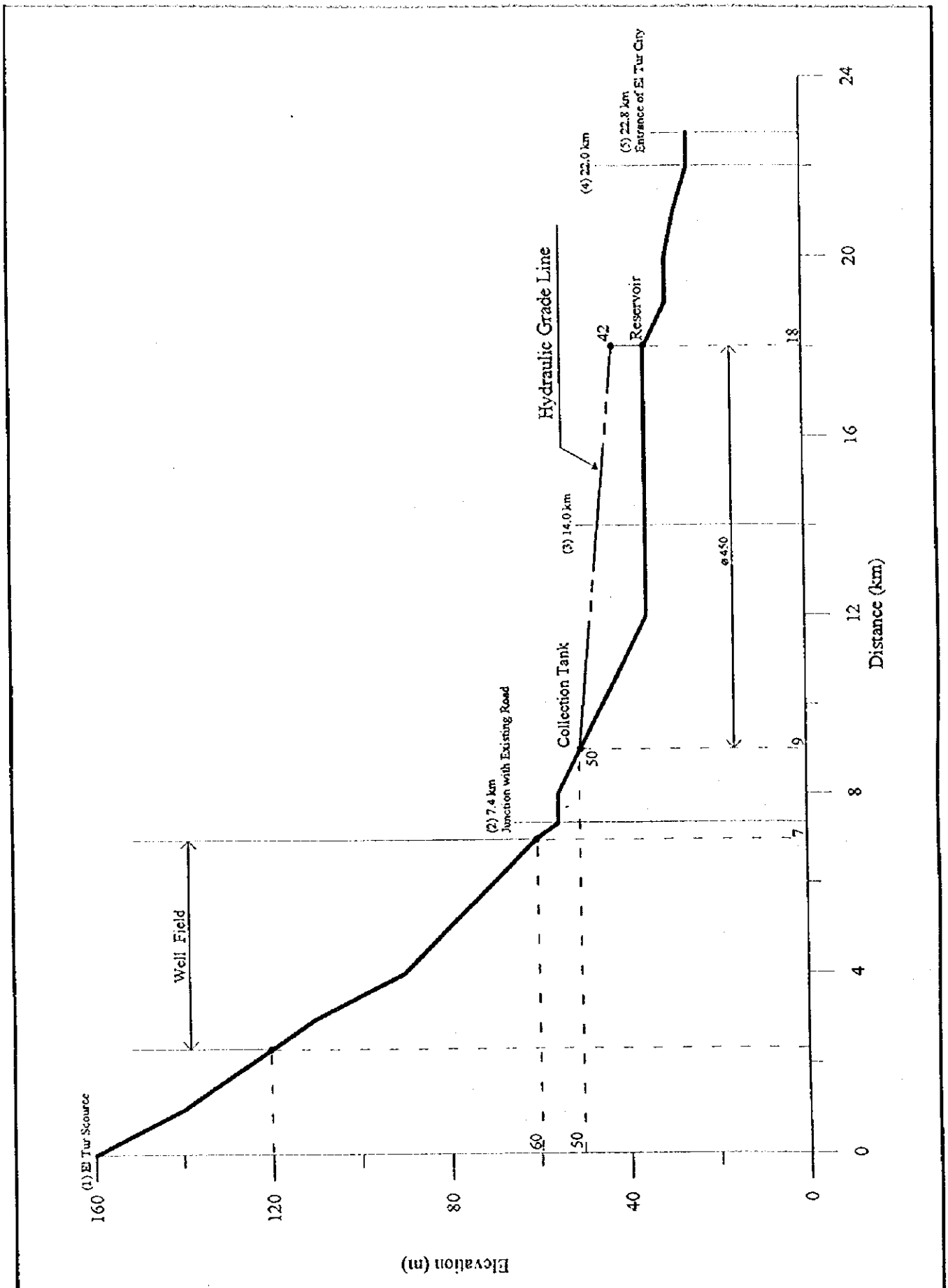

Fig. 13.2-4(3) Longitudinal Profile of Conveyance Pipeline (Plan3)

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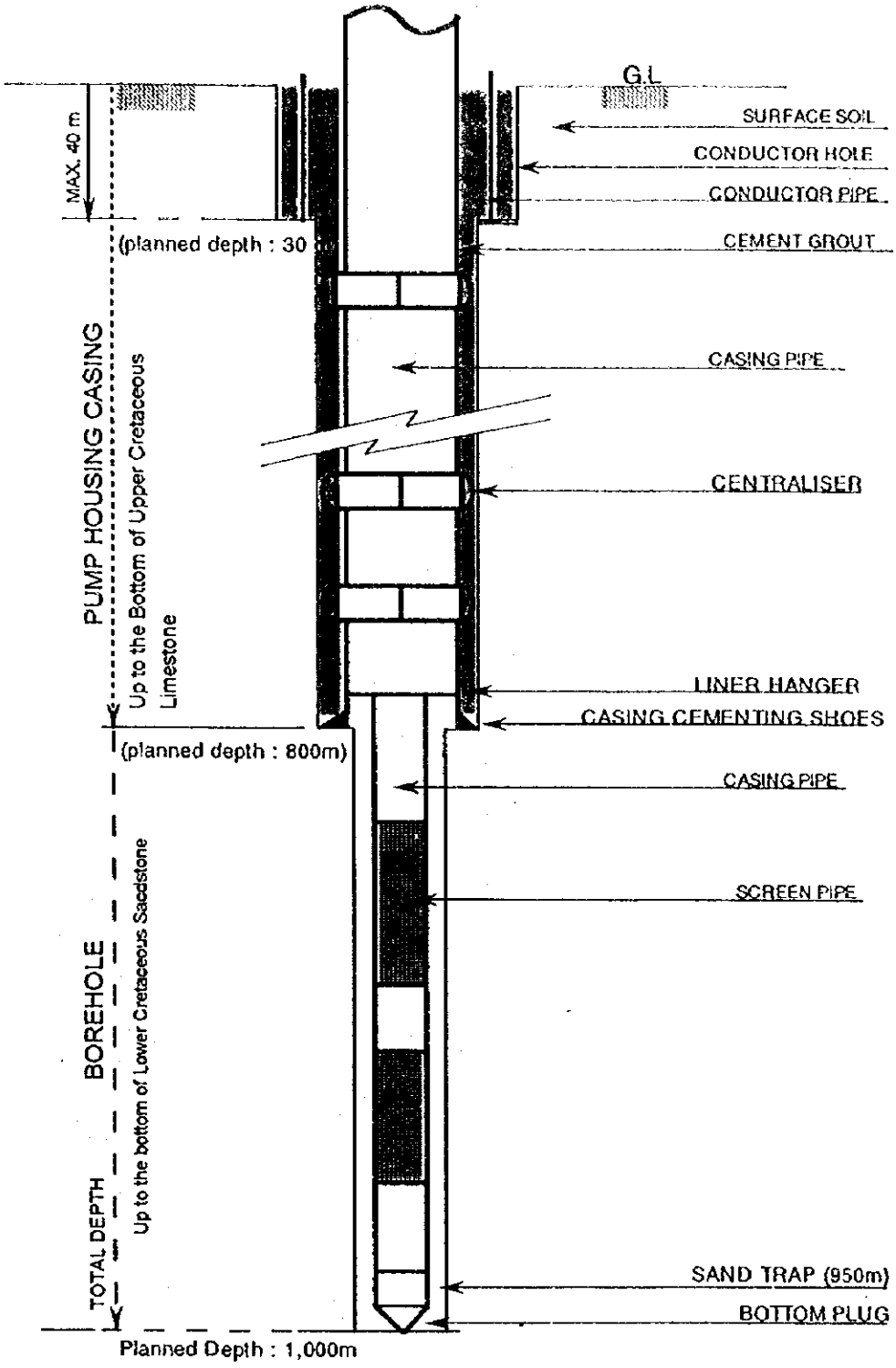
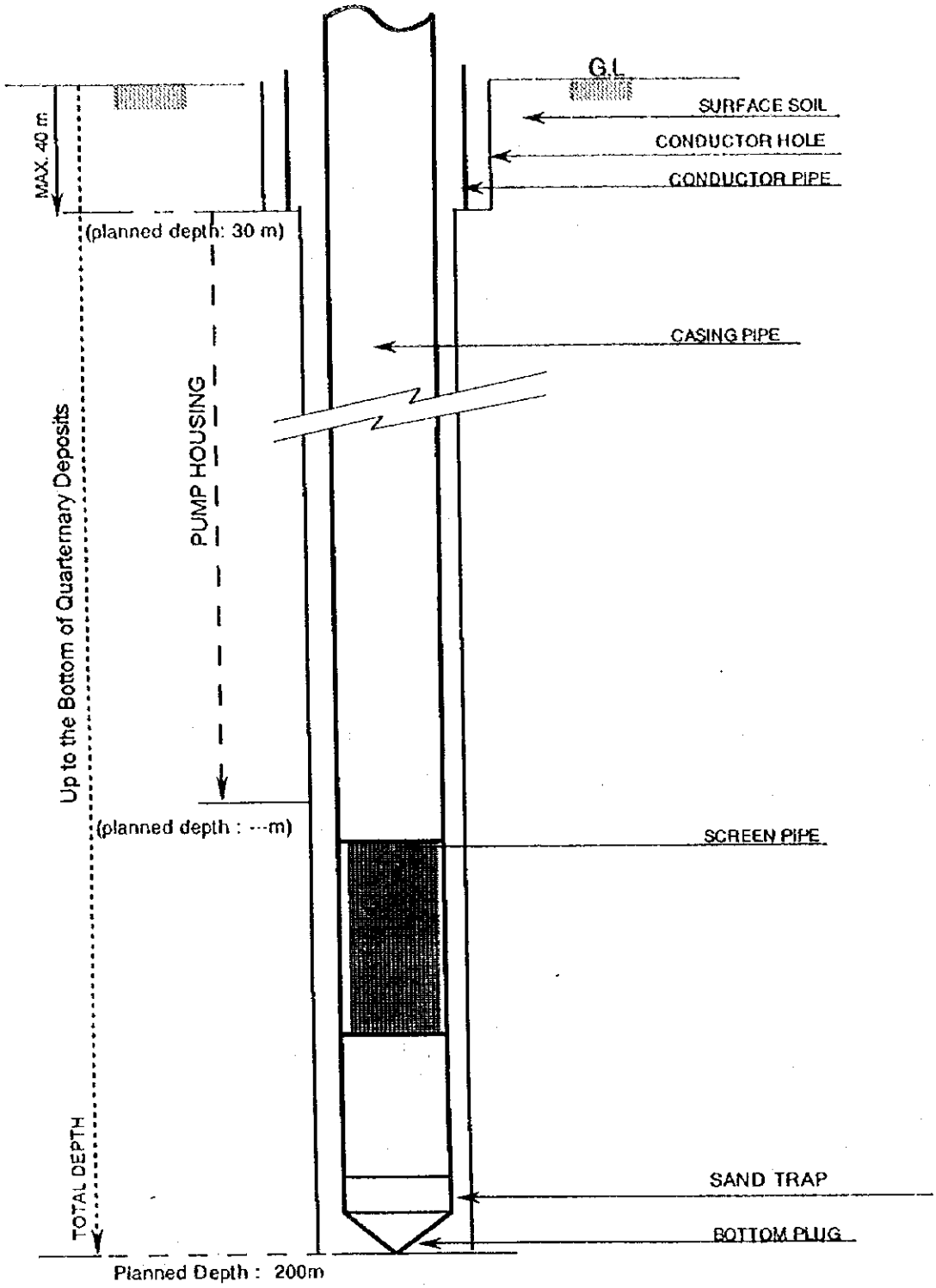


Planned Depth	Pump House			Borehole		Conductor	
	Planned Depth	Hole Dia	Casing Dia	Hole Dia.	Casing/Screen Dia	Hole Dia.	Casing Dia.
1,000m	800 m	17-1/2"	12-1/4"	12-1/4"	8-5/8"	26"	20"

Fig. 13.2-5(1) Standard Design for Production Well (Plan1, 2 and 4)



Planned Depth	Pump Housing			Borehole		Conductor	
	Planned Depth	Hole Dia	Casing Dia	Hole Dia	Casing/Screen Dia	Hole Dia.	Casing Dia.
200m	--- m	17-1/2"	12-1/4"	17-1/2"	12-1/4"	26"	20"

Fig. 13.2-5(2) Standard Design for Production Well (Plan3)

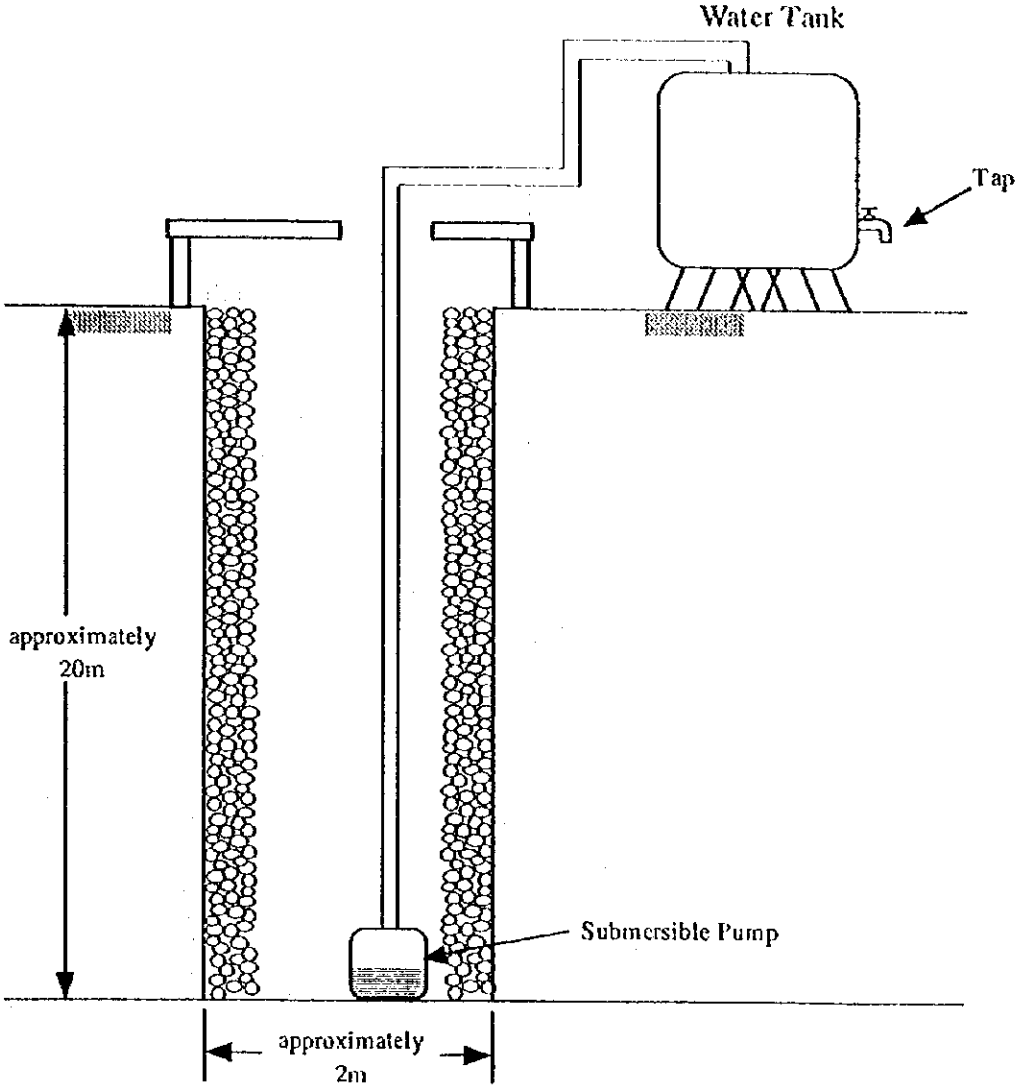


Fig. 13.2-5(3) Standard Design for Production Well (Plan5)

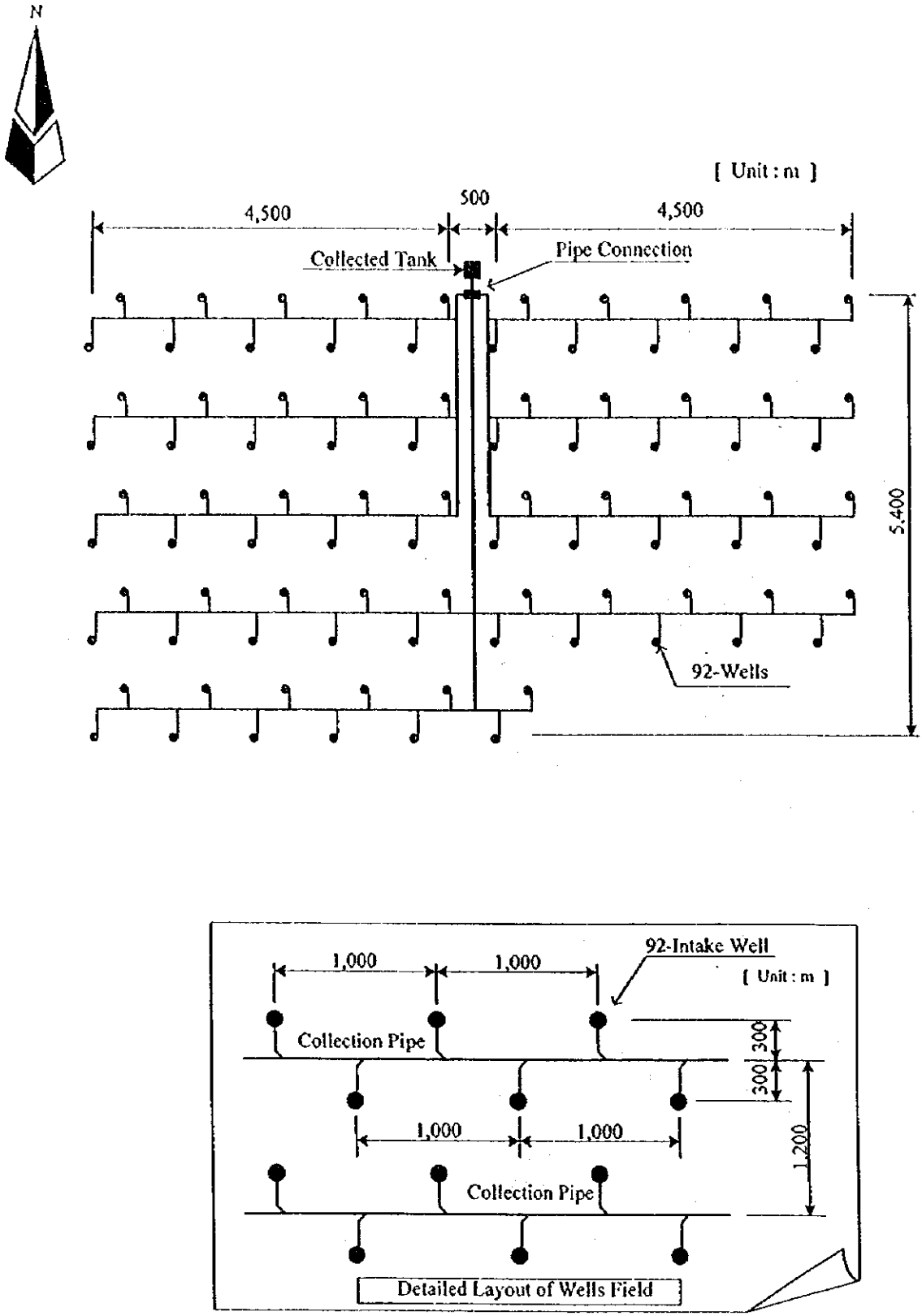


Fig. 13.2-6(1) Layout of Well Field (Plan1)

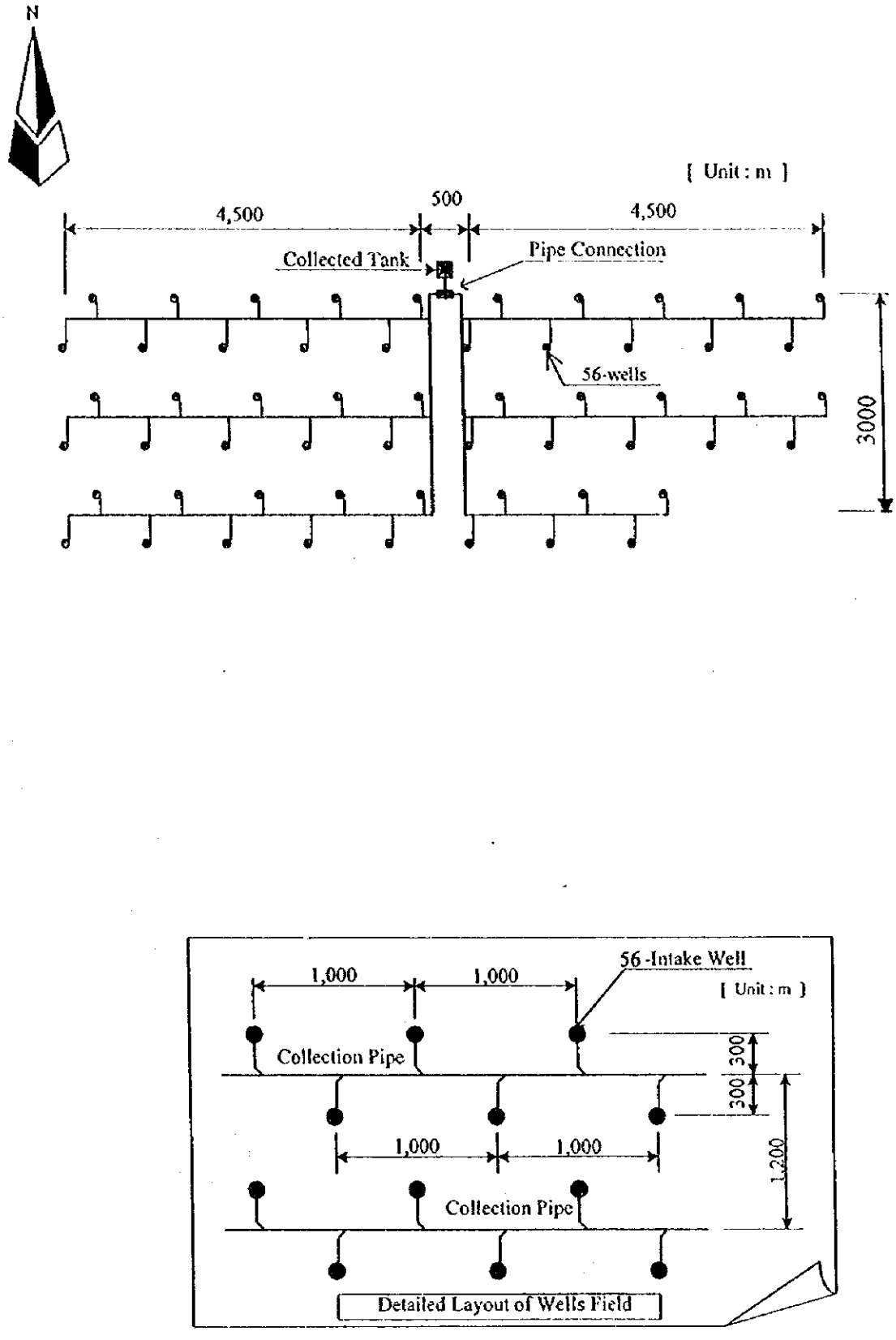
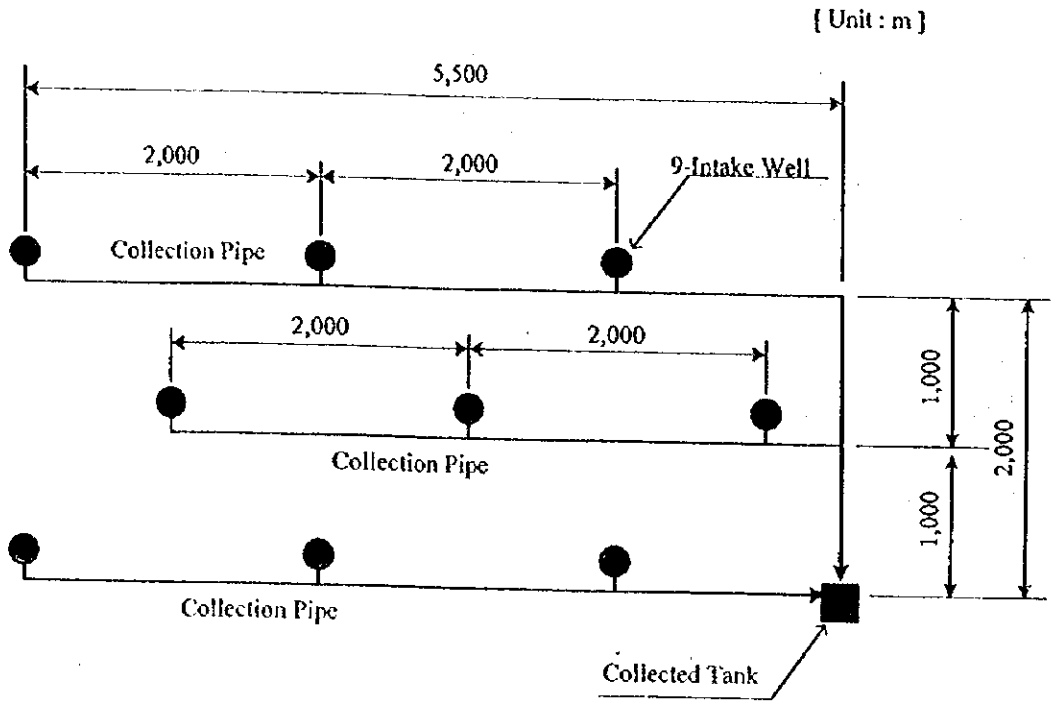


Fig.13.2-6(2) Layout Well Field (Plan2)



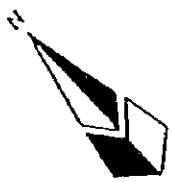
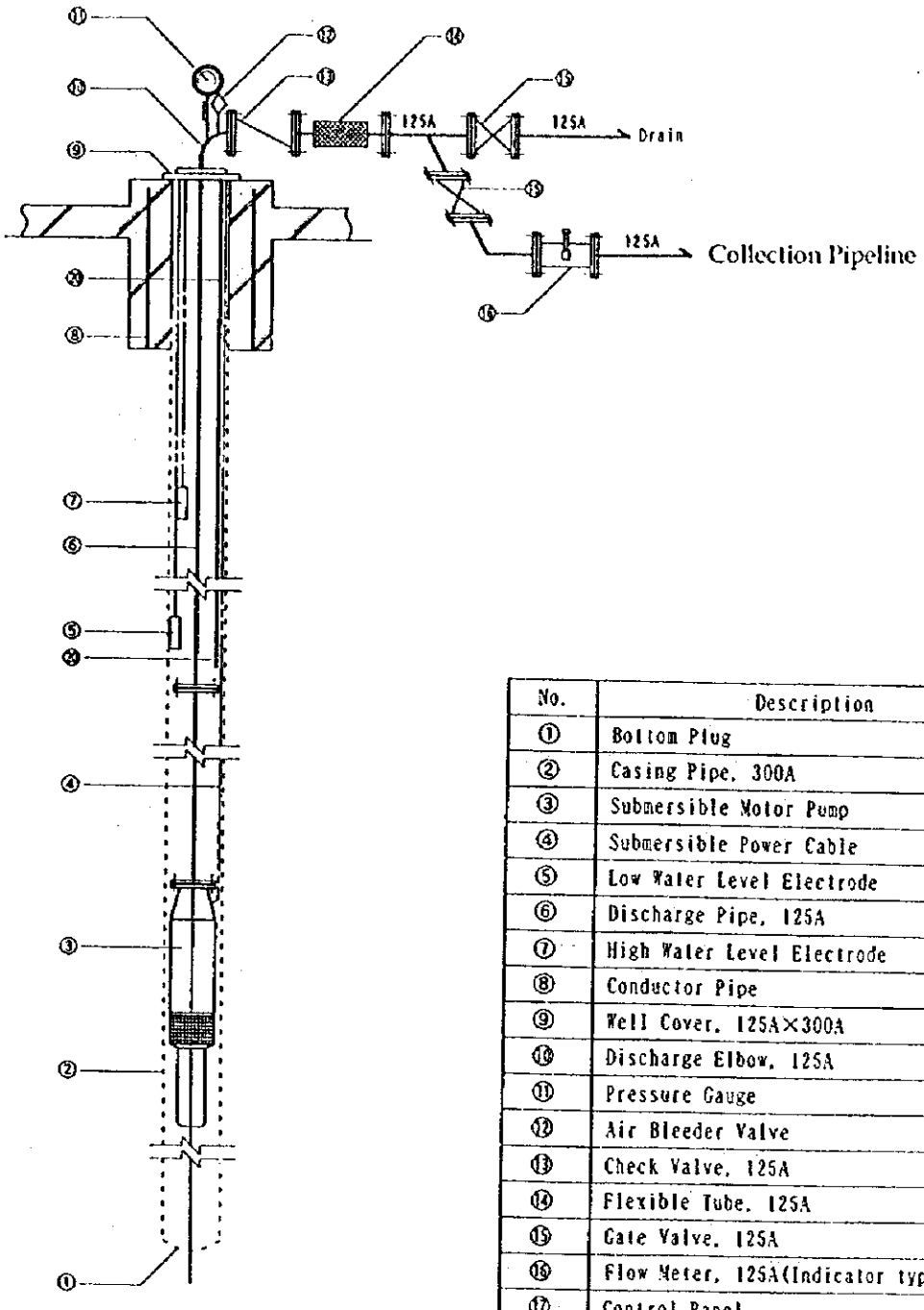


Fig. 13.2-6(3) Layout of Well Field (Plan3)

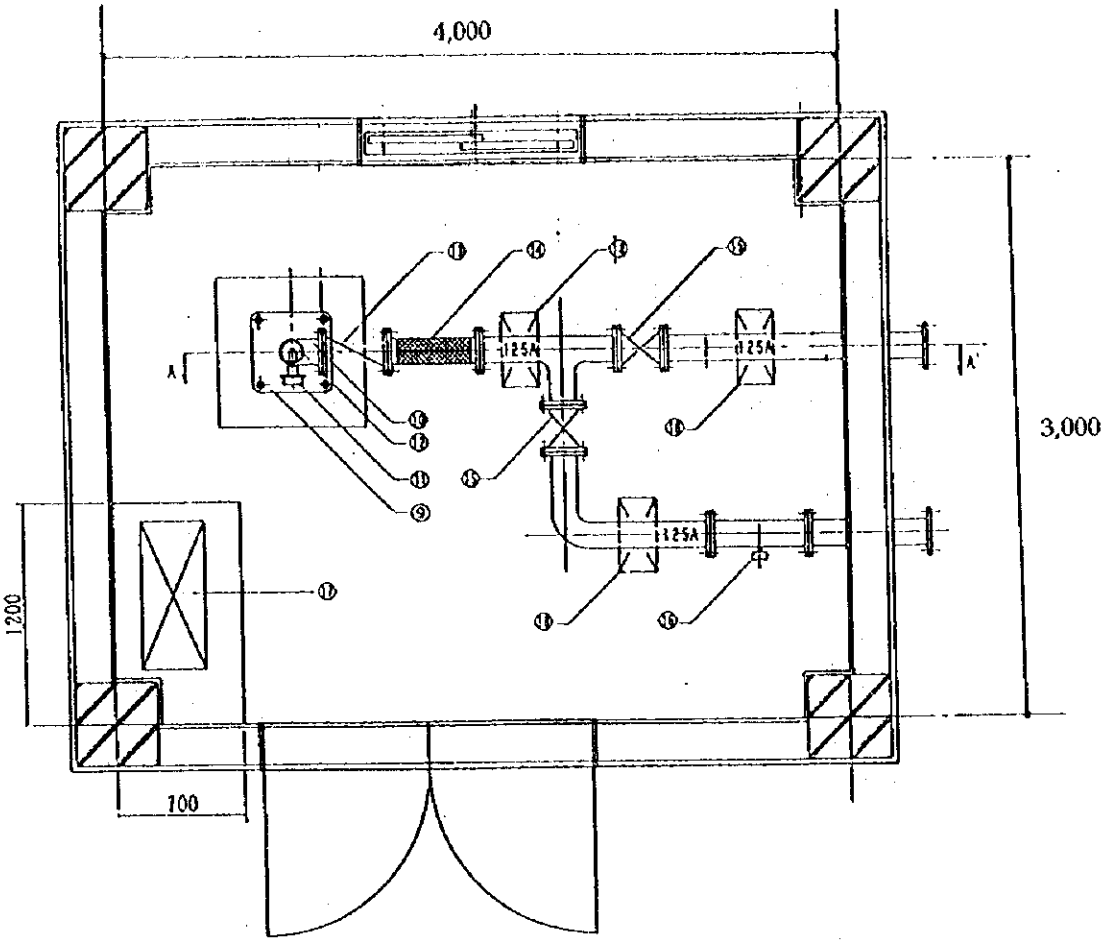
Intake Well (Scale : Free)



No.	Description
①	Bottom Plug
②	Casing Pipe, 300A
③	Submersible Motor Pump
④	Submersible Power Cable
⑤	Low Water Level Electrode
⑥	Discharge Pipe, 125A
⑦	High Water Level Electrode
⑧	Conductor Pipe
⑨	Well Cover, 125A×300A
⑩	Discharge Elbow, 125A
⑪	Pressure Gauge
⑫	Air Bleeder Valve
⑬	Check Valve, 125A
⑭	Flexible Tube, 125A
⑮	Gate Valve, 125A
⑯	Flow Meter, 125A(Indicator type)
⑰	Control Panel
⑱	Pipe Supporter
⑲	Cushioning Material
⑳	Measuring Pipe (VP20) for water level

Fig. 13.2-7 Layout of Intake Pump House (1/2)

Intake Pump House (Scale : Free)



A ~ A (Scale : Free)

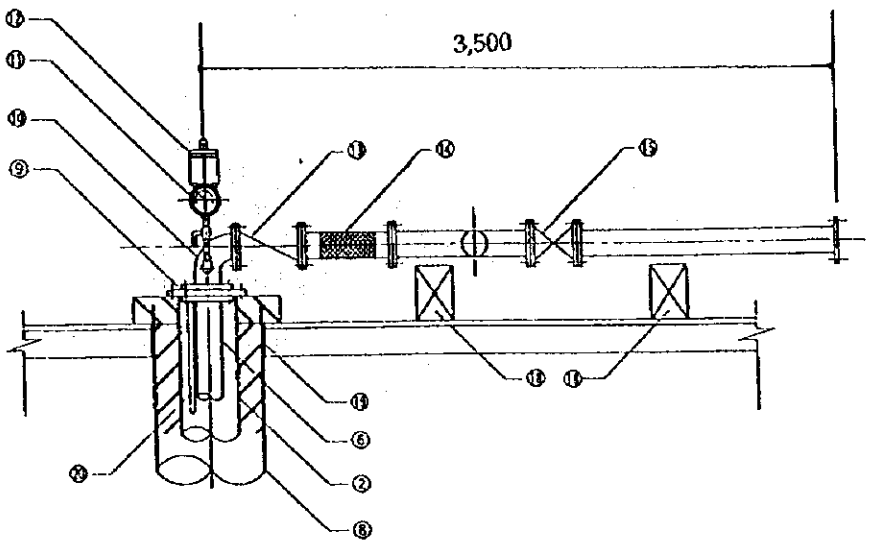
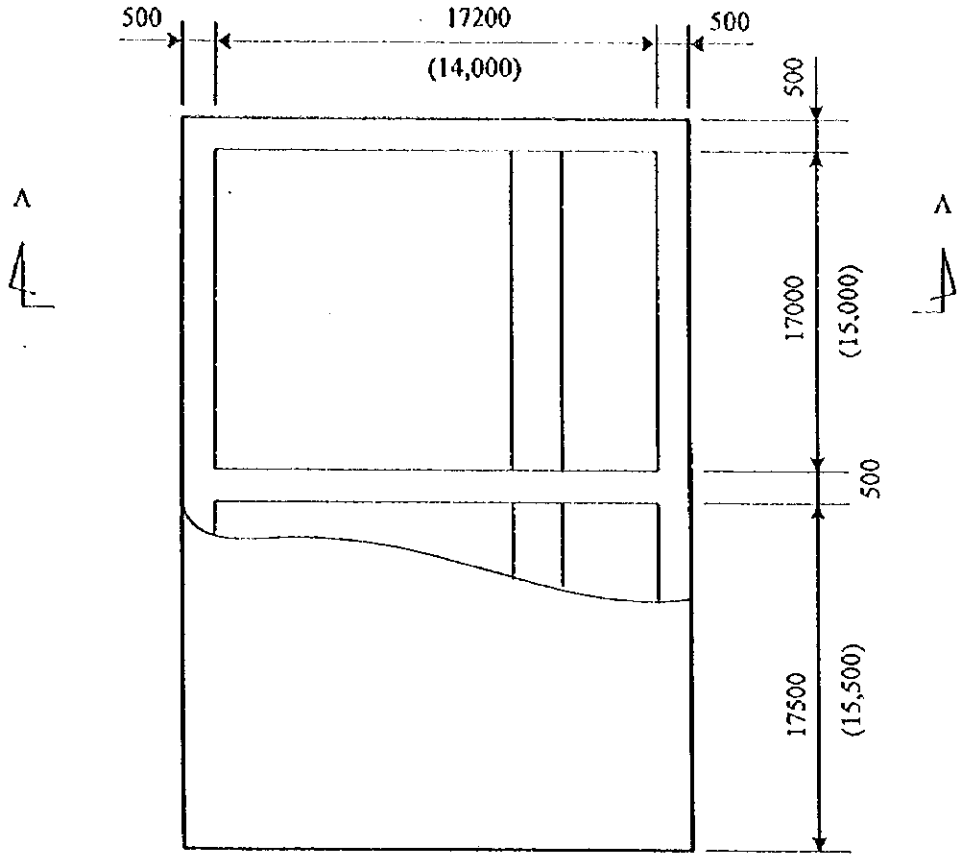
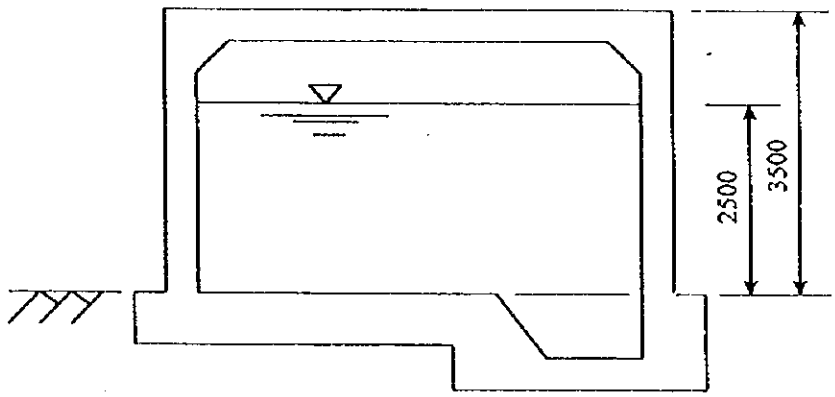


Fig. 13.2-7 Layout of Intake Pump House (2/2)





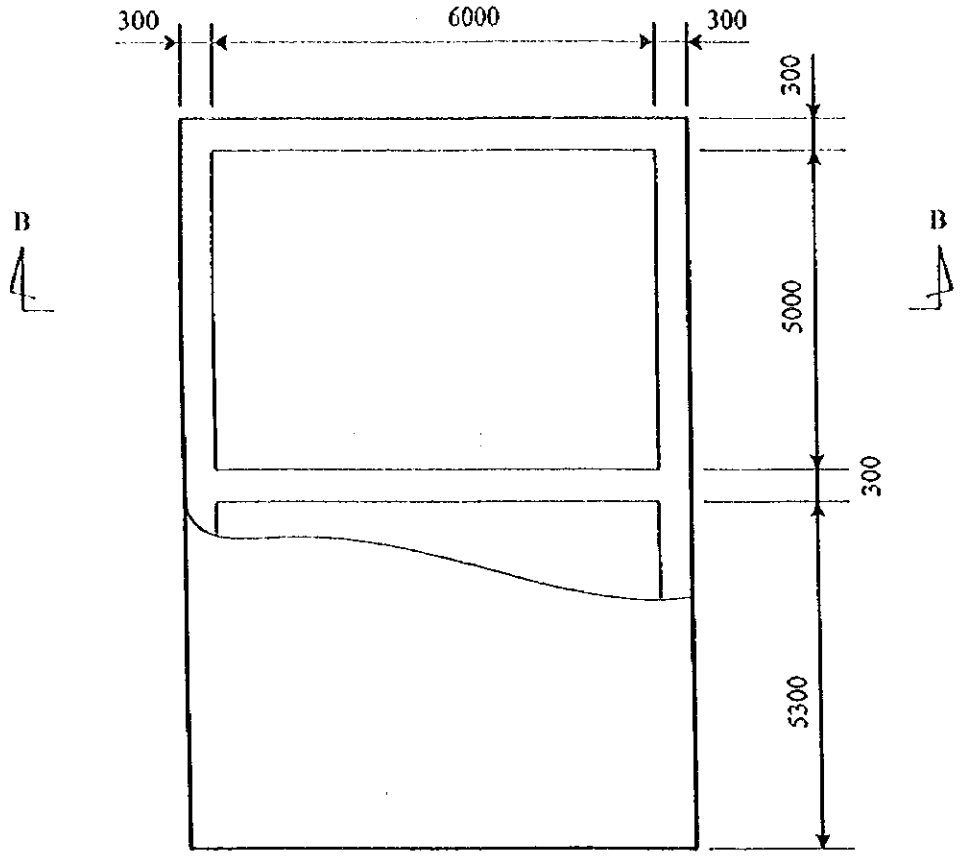
Section A ~ A

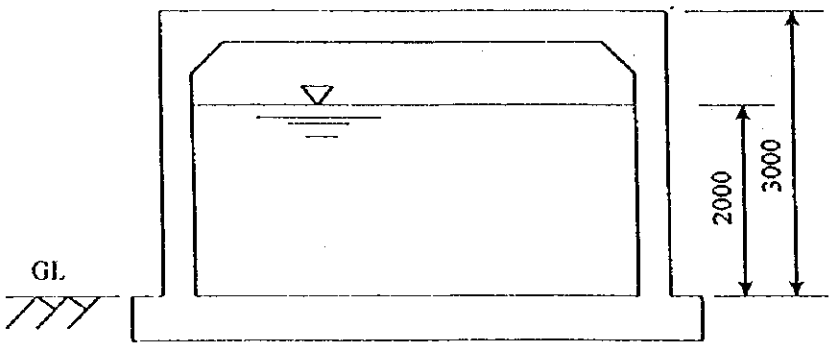
Item	Unit	Development Plan	
		Plan 1	Plan 2
(1)Collected tanks			
Nos.	nos.	2	2
Capacity	m^3	600	400
Structure	--	concrete	concrete
(2)Pump Sump of P/S			
Nos.	nos.	---	6
Capacity	m^3	---	400
Structure	--	---	concrete

Collected Tank and Pump Sumps for Plan 1 & Plan2

( ): Plan 2

Fig. 13.2-8(1) Collected Tank and/or Pump Sump (Plan1 and 2)





Section B ~ B

Item	Unit	Plan 3
(1)Collected tanks		
Nos.	nos.	1
Capacity	m^3	120
Structure	--	concrete

Collected Tank for Plan 3

Fig. 13.2-8(2) Collected Tank and/or Pump Sump (Plan3)

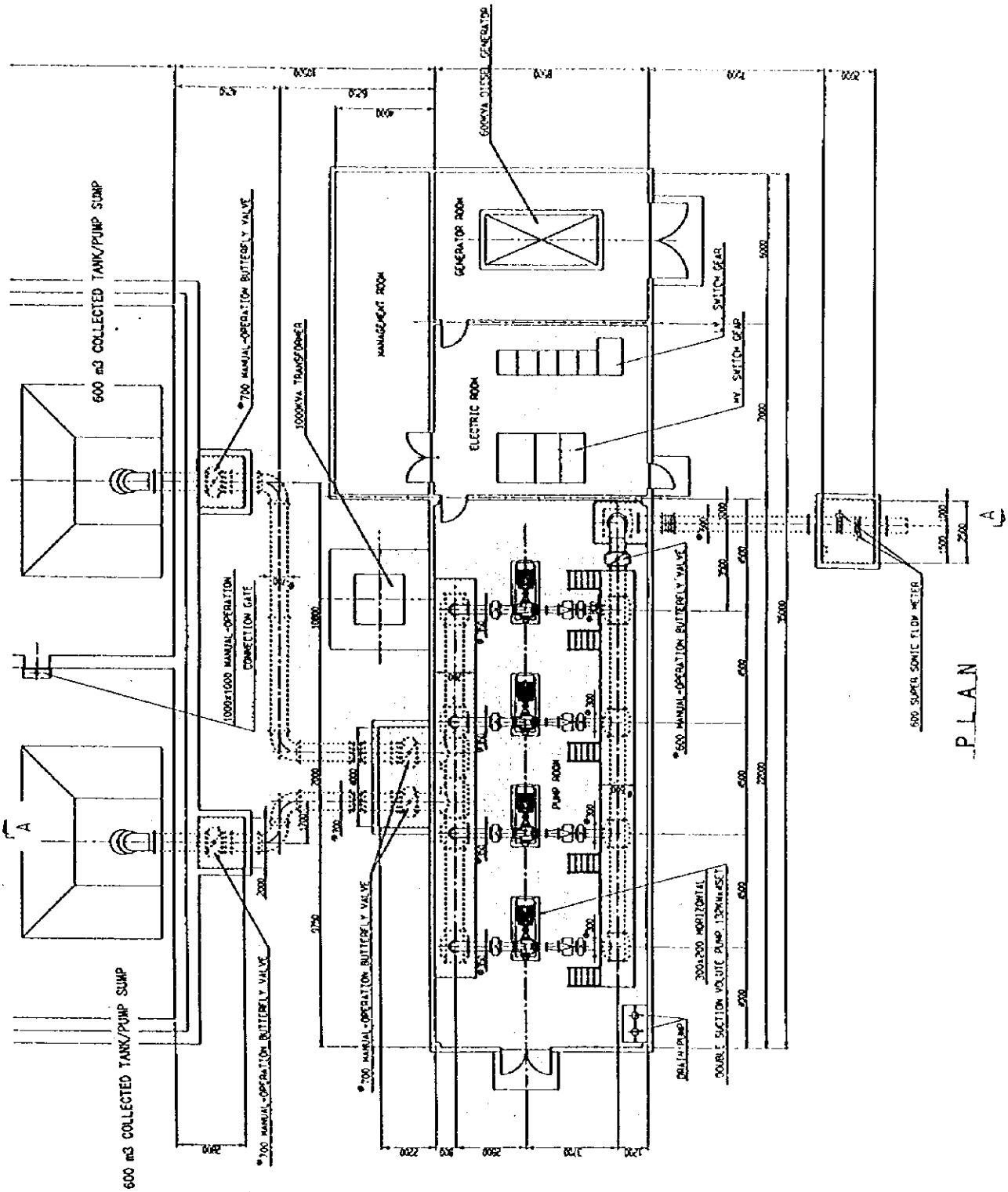


Fig. 13.2-9(1) Plan of Pump Station (Plan1) (1/3)

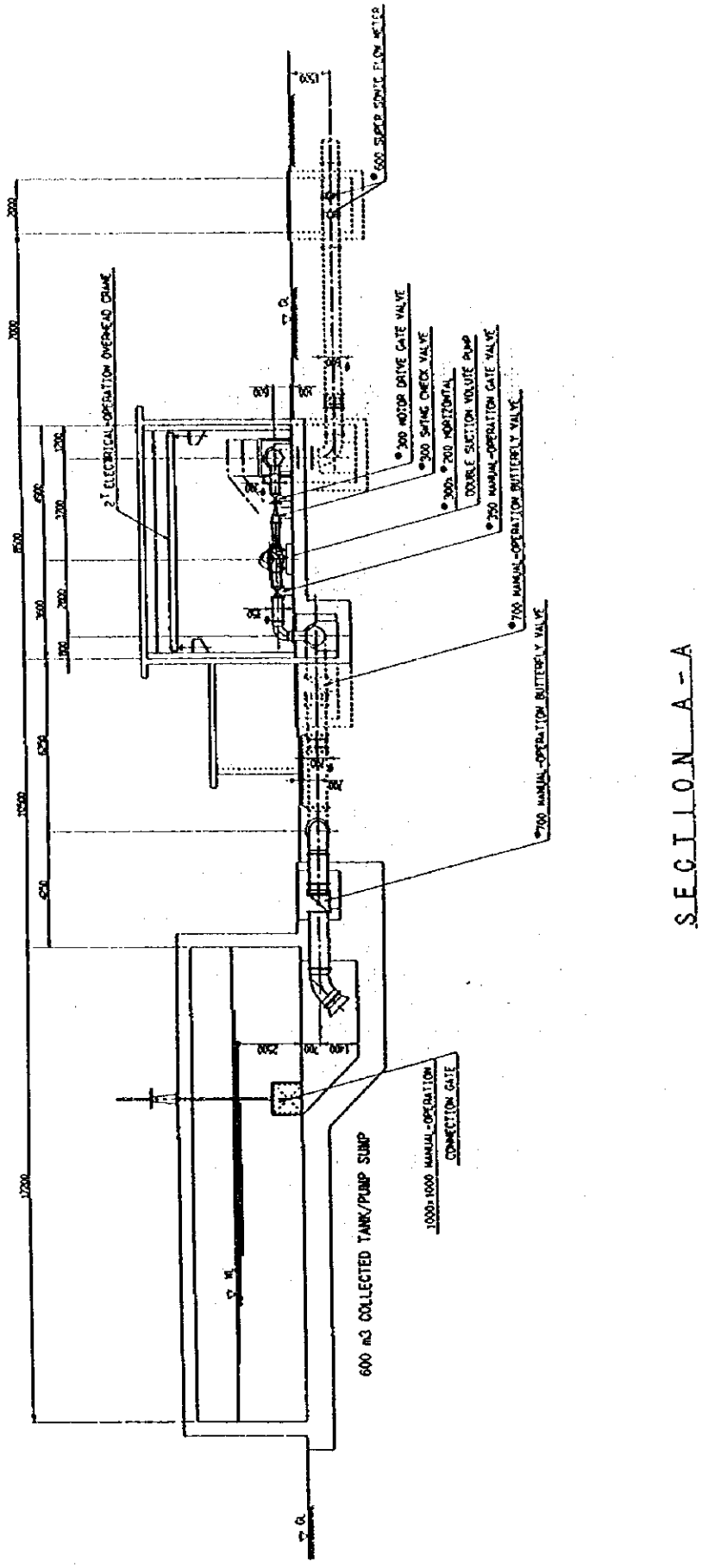


Fig. 13.2-9(1) Section of Pump Station (Plan1) (2/3)

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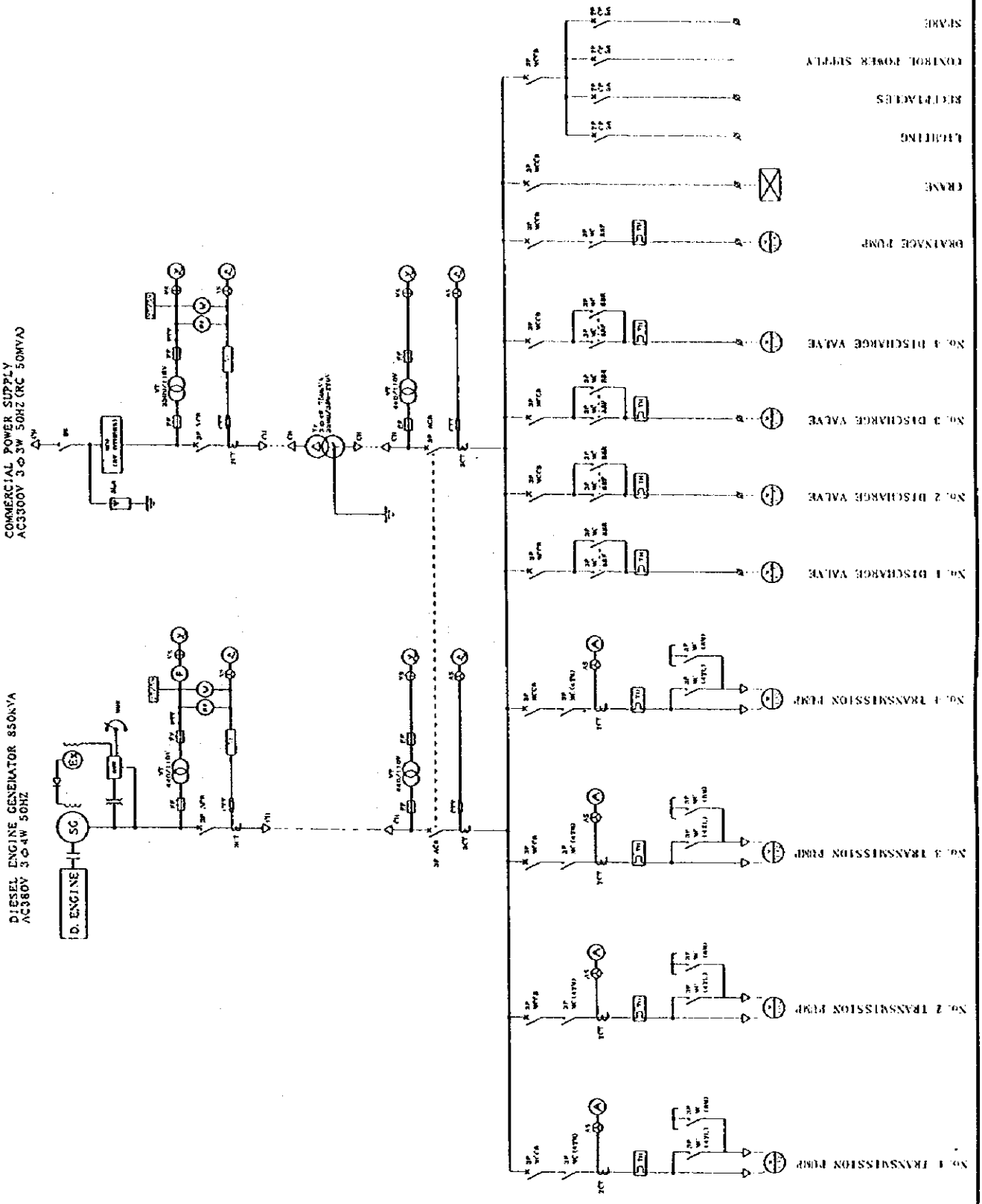

Fig. 13.2-9(1) Single-Line Diagram of Pump Station (Plan1) (3/3)

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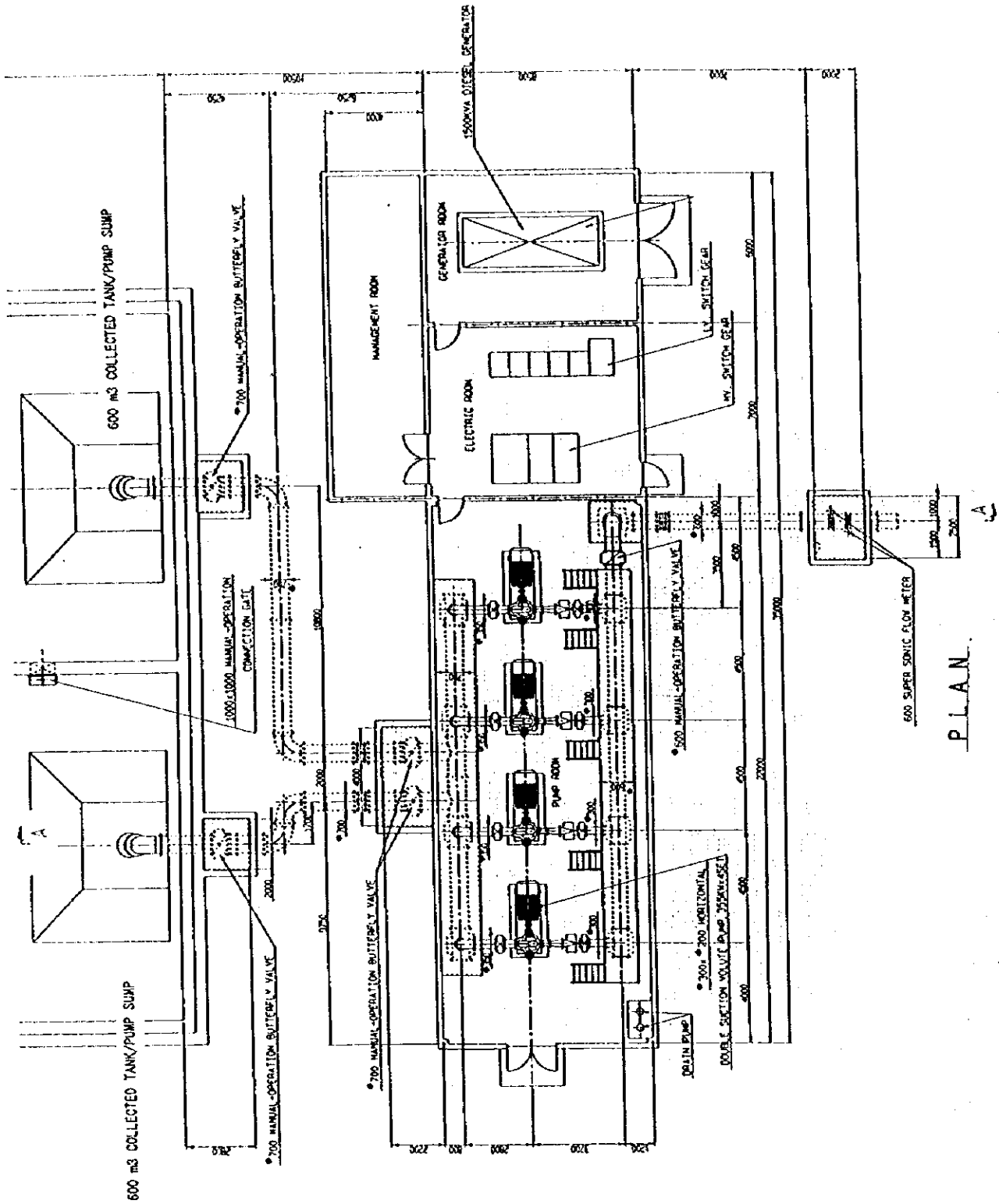

Fig. 13.2-9(2) Plan of Pump Station (Plan2) (1/3)

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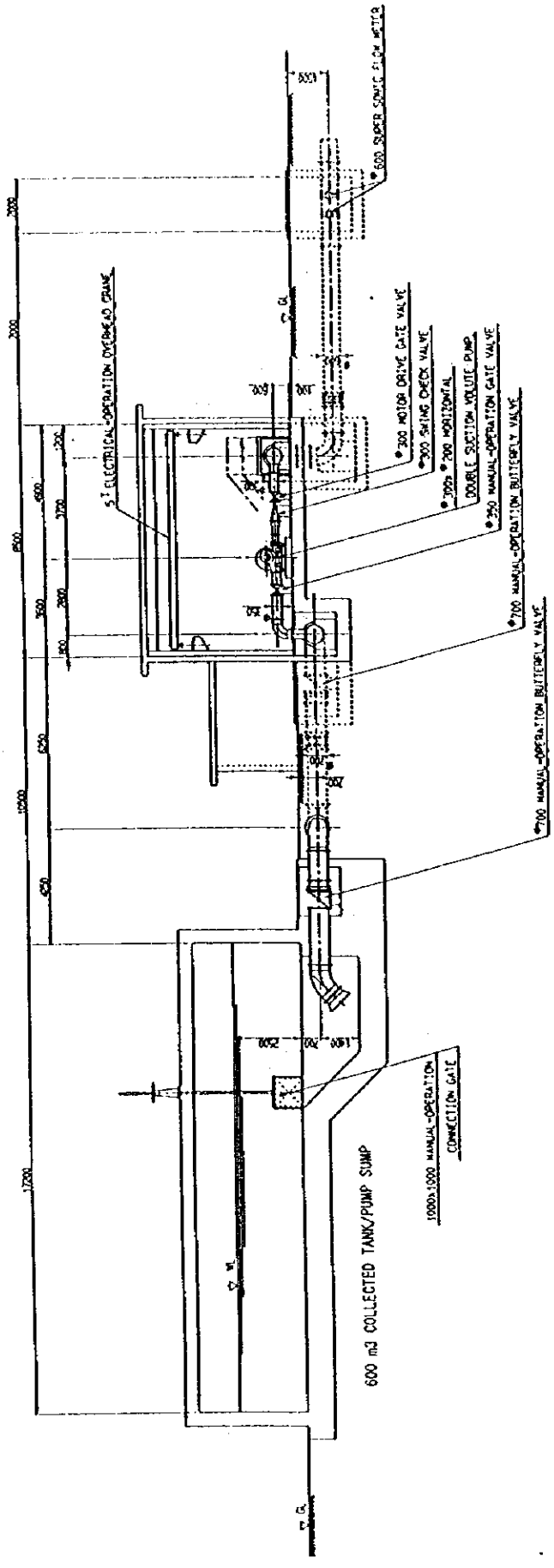

Fig. 13.2-9(2) Section of Pump Station (Plan2) (2/3)

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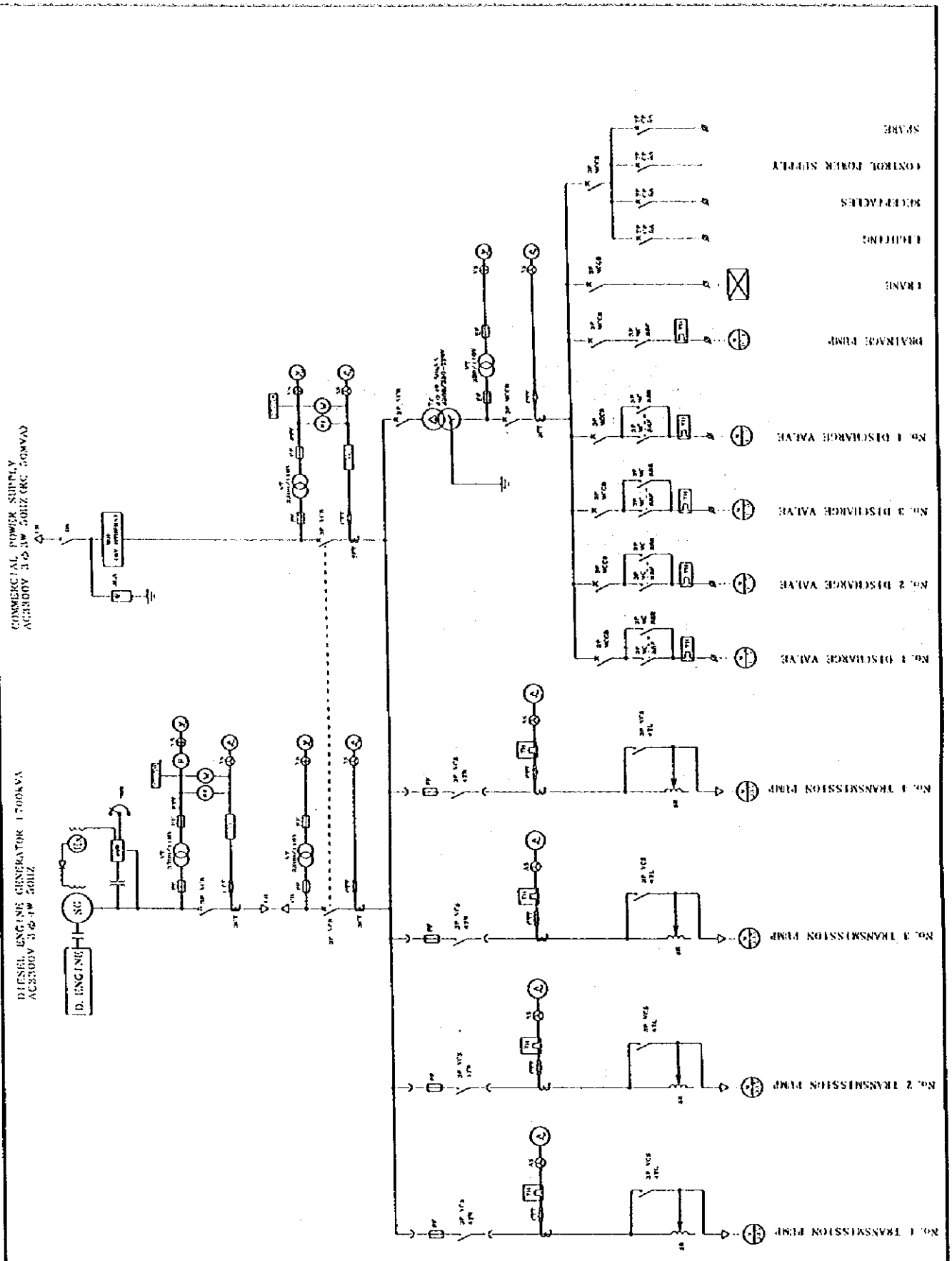

Fig. 13.2-9(2) Single-Line Diagram of Pump Station (Plan2) (3/3)

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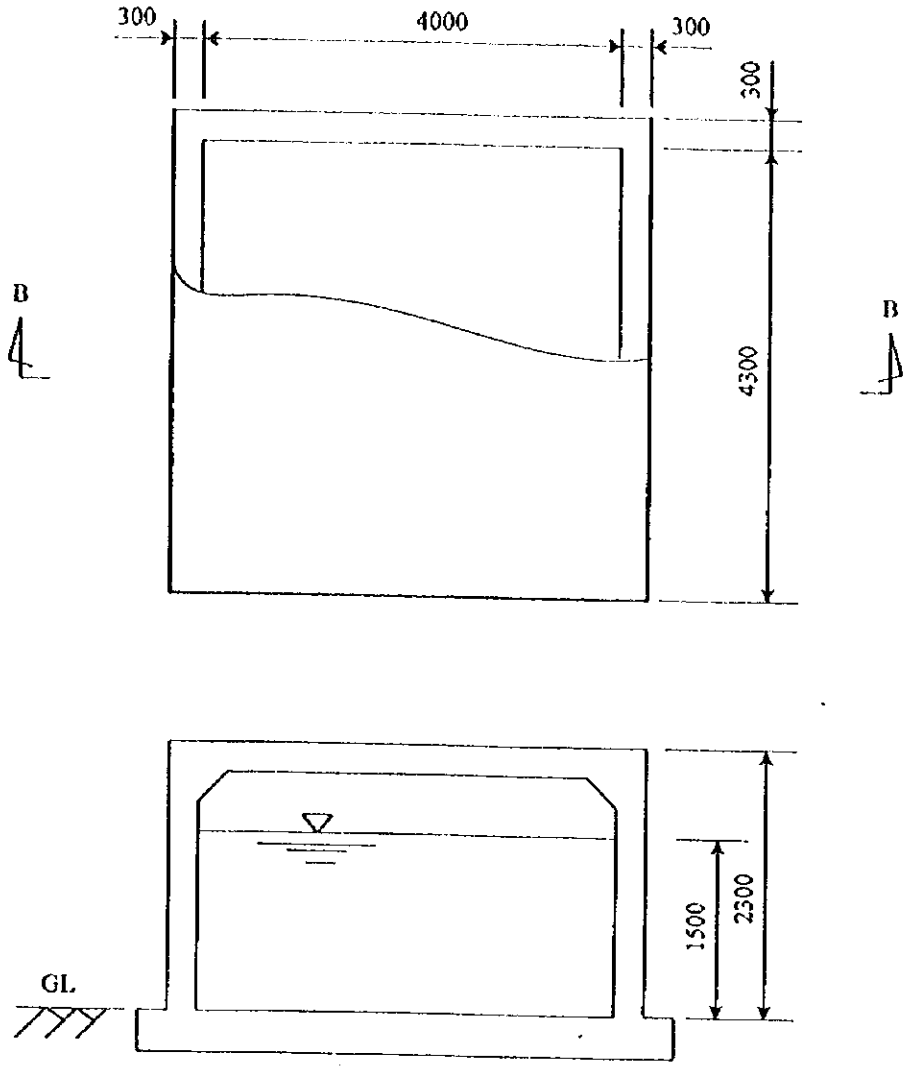
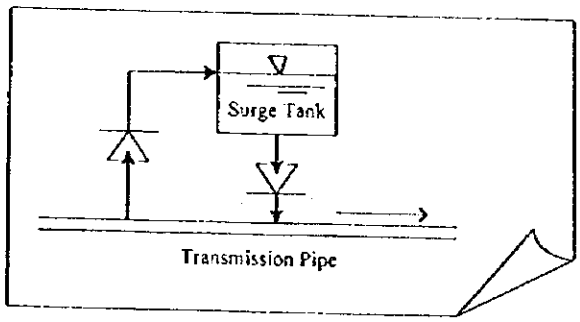


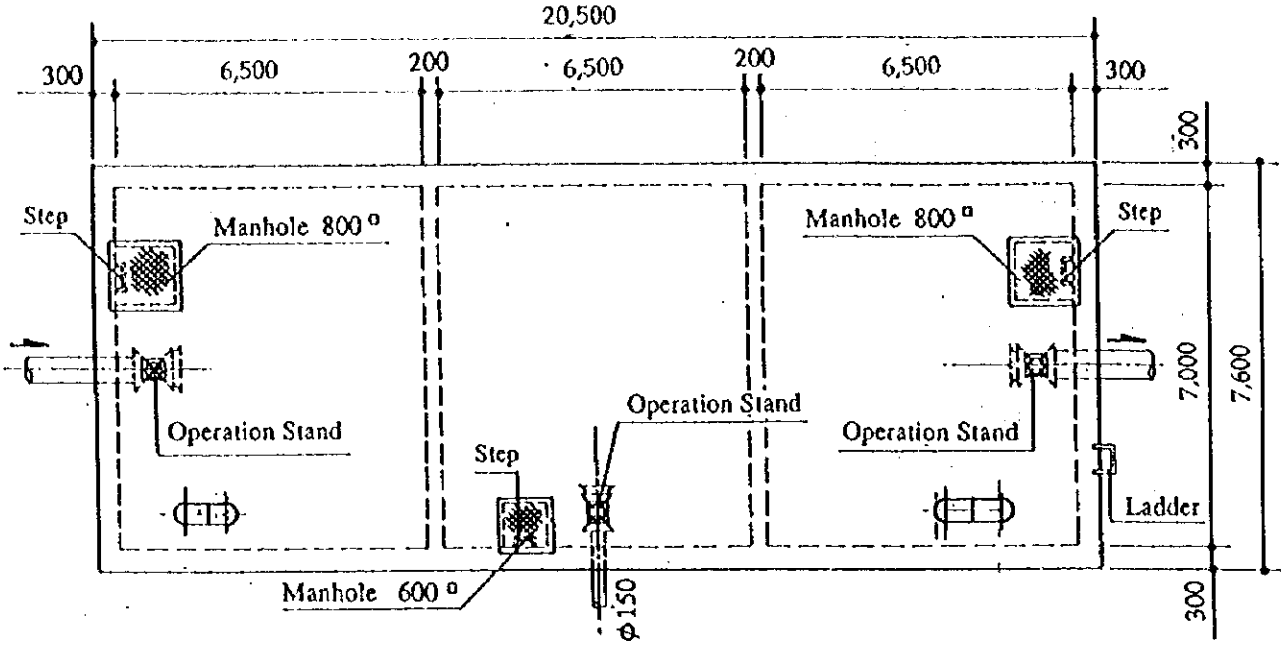
Section B ~ B

Production Number	
Plan 1 No1 Pumping Station	1 No.
Plan 2 No2 Pumping Station	2 Nos.
Plan 2 No4 Pumping Station	2 Nos.



Surge Tank

Fig. 13.2-10 Surge Tank for Conveyance Pipeline



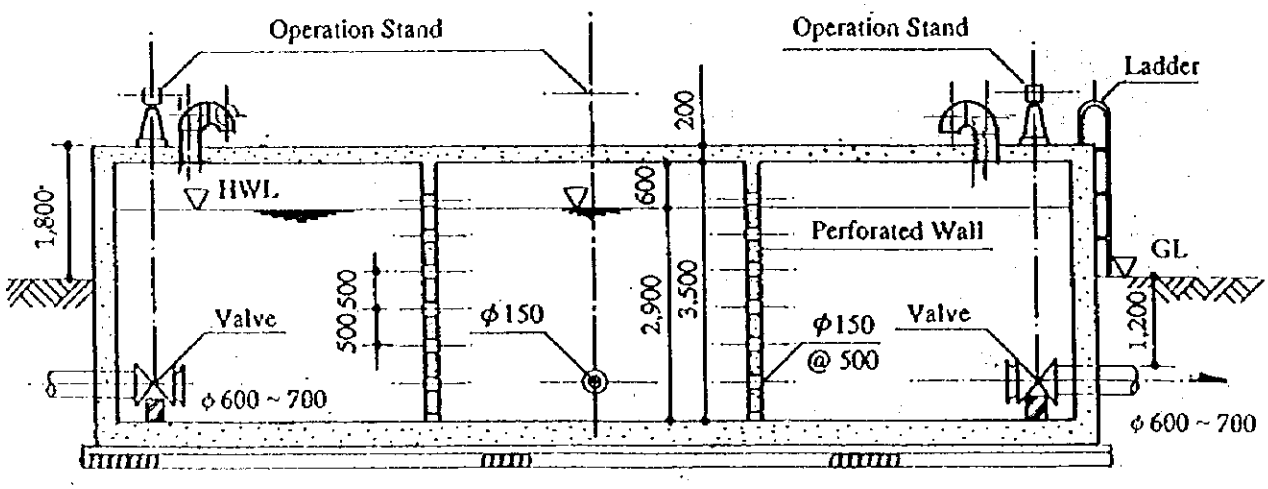
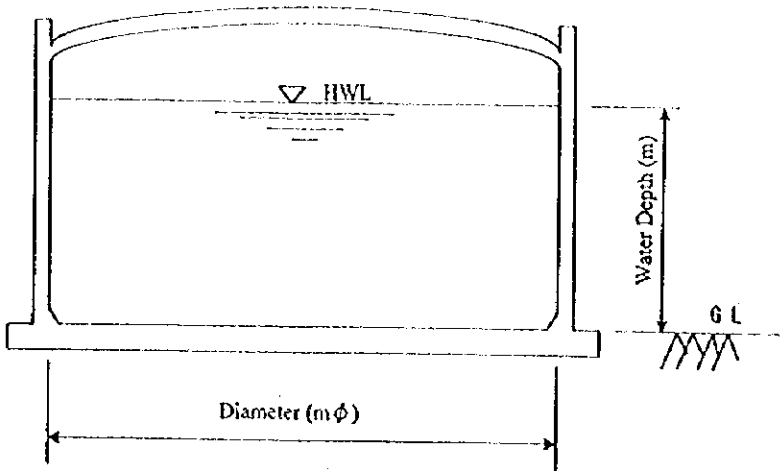
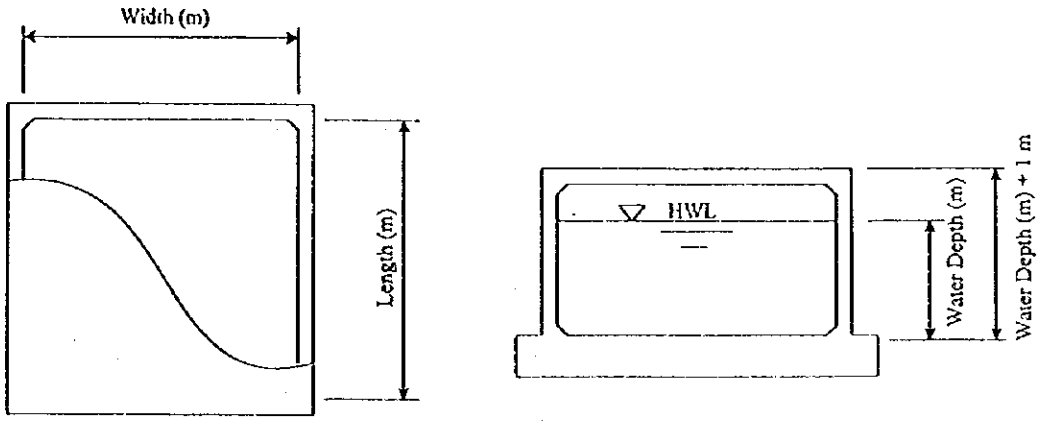


Fig. 13.2-11 Break Pressure Tank for Conveyance Pipeline

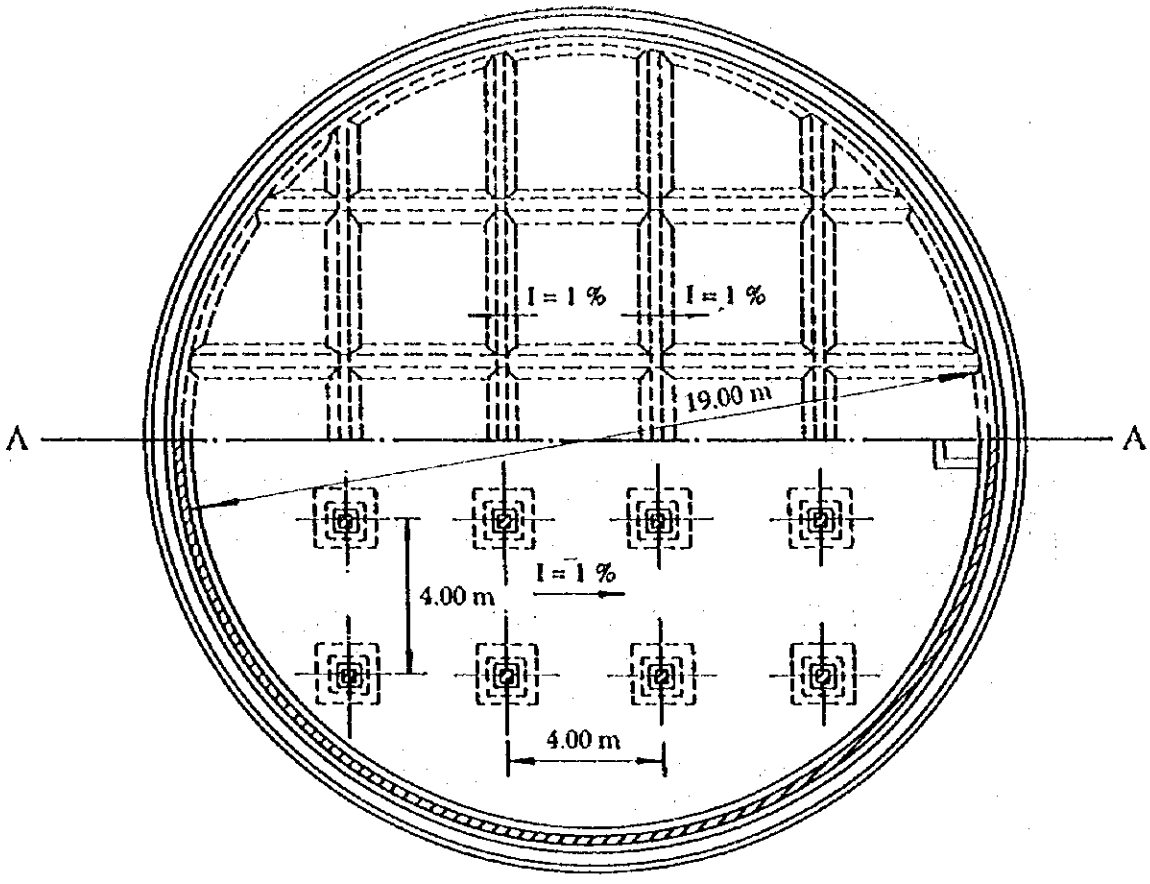


Item	Unit	Plan 1	Plan 2	Plan 3	Plan 4		
					4A	4B	4C
Nos.	nos	4	2+2	2	19	22	19
Type	--	circle	circle	circle	circle	circle	circle
Capacity	m^3	7,250	750x2 (Taba Reservoir) 15 (Taba Reservoir)	1,400	360	360	360
Diameter	m ϕ	43.0	7900x2 (Nuweiba Reservoir) 48 (Nuweiba Reservoir)	19.0	11.0	11.0	11.0
Water Depth	m	5.0	5.0	5.0	4.0	4.0	4.0
Retention time	Hr	12.0	12.0	12.0	12.0	12.0	12.0
Structure	--	concrete	concrete	concrete	concrete	concrete	concrete

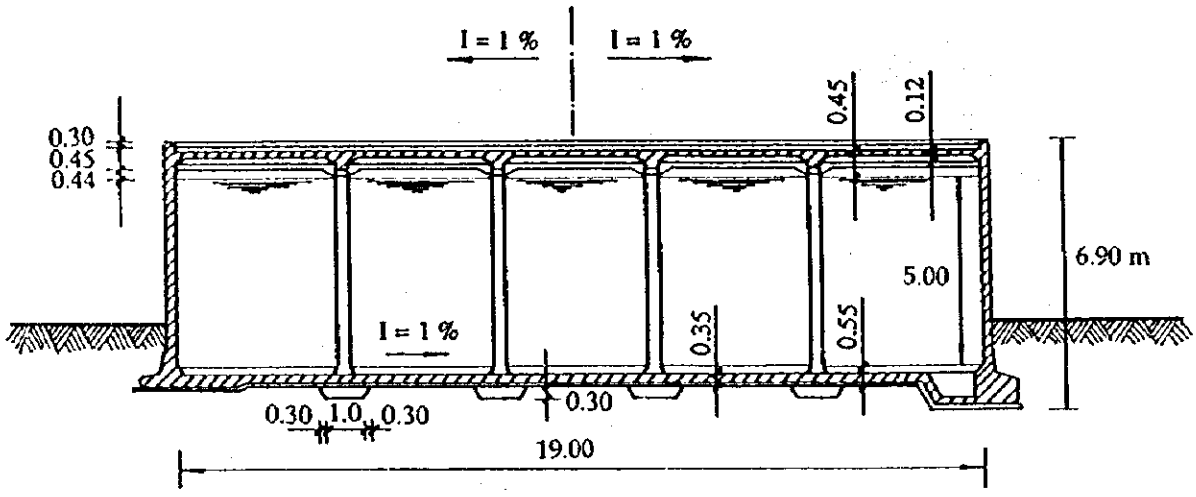


Item	Unit	Plan 5		
		5A	5B	5C
Nos.	nos	1	1	2
Type	--	square	square	square
Capacity	m^3	5	25	25
Width/Length	m□	1.6	3.0	3.0
Water Depth	m	2.0	3.0	3.0
Retention time	hr	24.0	24.0	24.0
Structure	--	concrete	concrete	concrete

Fig. 13.2-12 Distribution Water Reservoir (1/2)

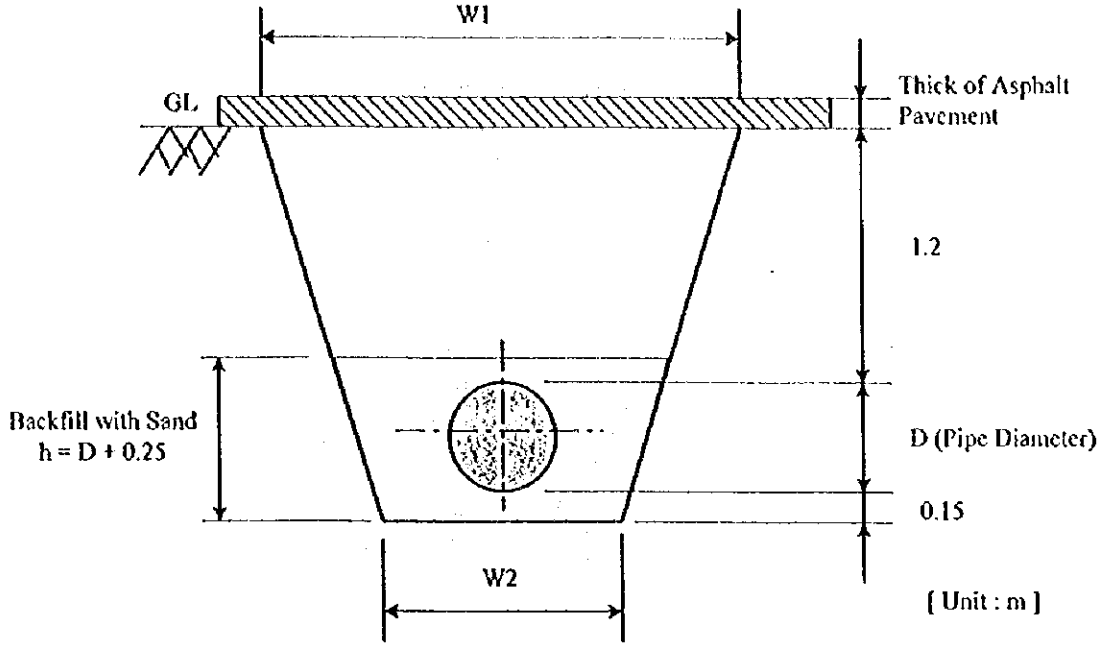


ROOF AND SEMI-PLAN



A -A SECTIONAL ELEVATION

Fig. 13.2-12 Distribution Water Reservoir (2/2)

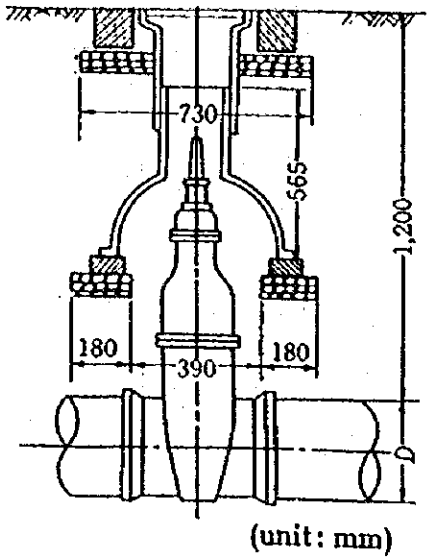


Trench Standard of Pipe Laying Works

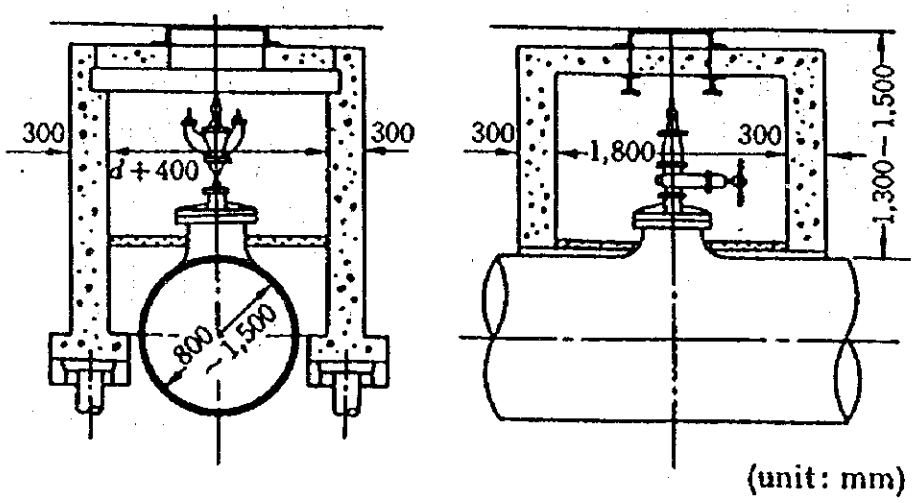
[unit : m]

Diameter	W_1	W_2	H (Min)
0.100	2.77	1.10	1.45
0.125	2.83	1.13	1.48
0.150	2.88	1.15	1.50
0.200	2.99	1.20	1.55
0.250	3.10	1.25	1.60
0.300	3.21	1.30	1.65
0.350	3.31	1.35	1.70
0.400	3.42	1.40	1.75
0.450	3.53	1.45	1.80
0.500	3.64	1.50	1.85
0.550	3.74	1.55	1.90
0.600	3.85	1.60	1.95
0.650	3.96	1.65	2.00
0.700	4.07	1.70	2.05
0.800	4.28	1.80	2.15
0.900	4.50	1.90	2.25
1.000	4.71	2.00	2.35
1.100	4.93	2.10	2.45
1.200	5.14	2.20	2.55

Fig. 13.2-13 Typical Drawings of Pipe Laying Works (1/6)

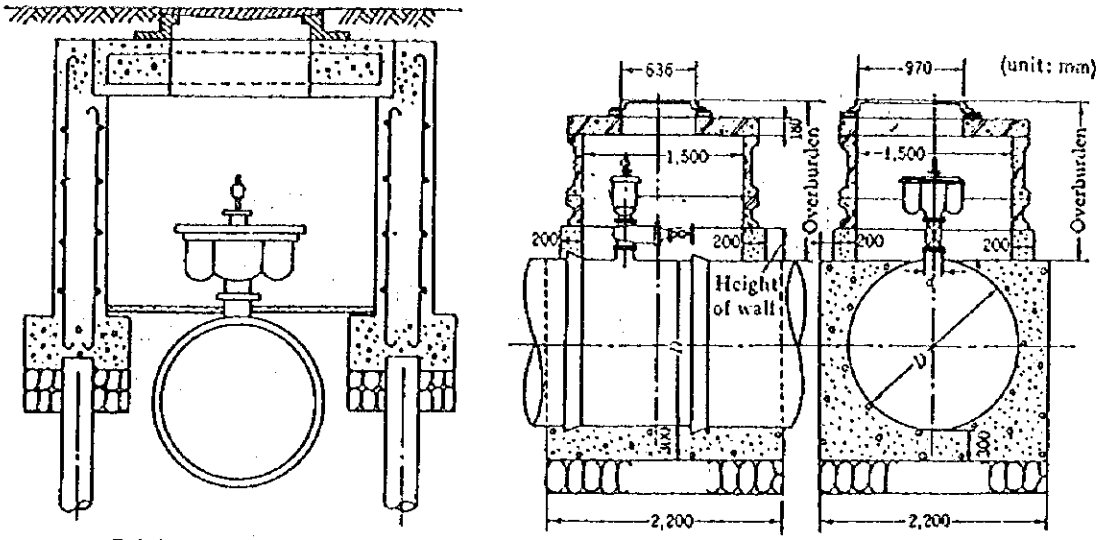


Valve Box Protector

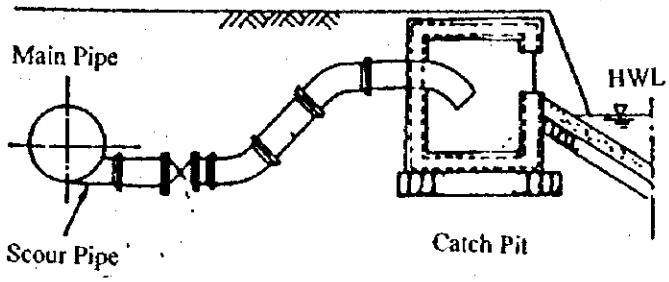


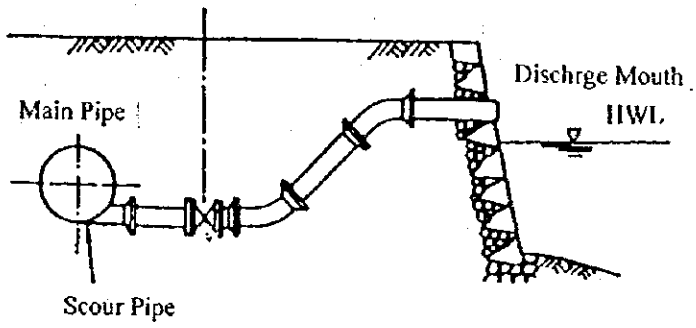
Manhole and Manhole Room

Fig. 13.2-13 Typical Drawings of Pipe Laying Works (2/6)



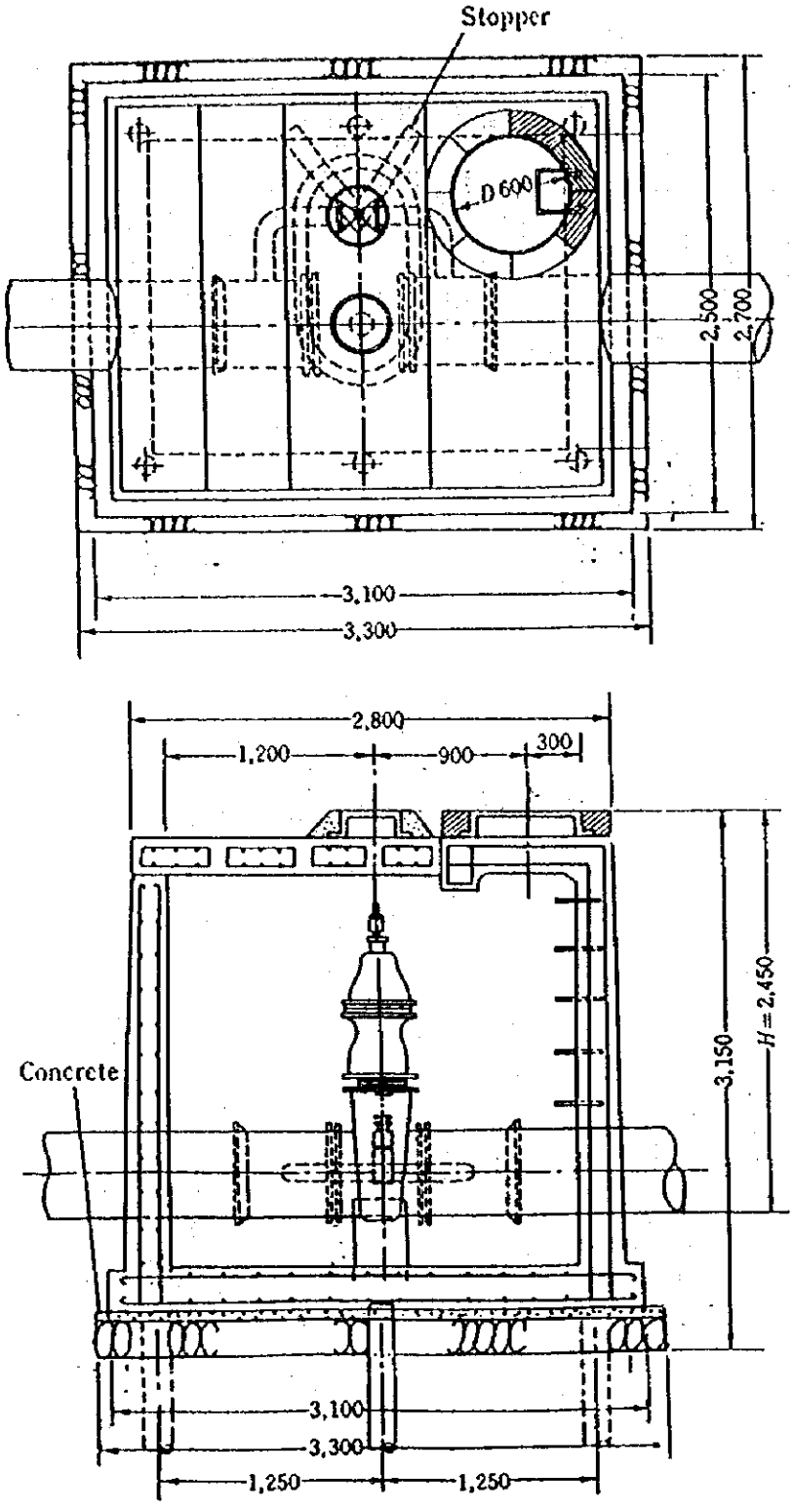
Example for Two Mouths Air Valve Room





Scour Pipe and Catch Pit, Discharge Mouth

Fig. 13.2-13 Typical Drawings of Pipe Laying Works (3/6)



Example for Diameter 500 mm Vertical Sluice Valve Room

Fig. 13.2-13 Typical Drawings of Pipe Laying Works (4/6)

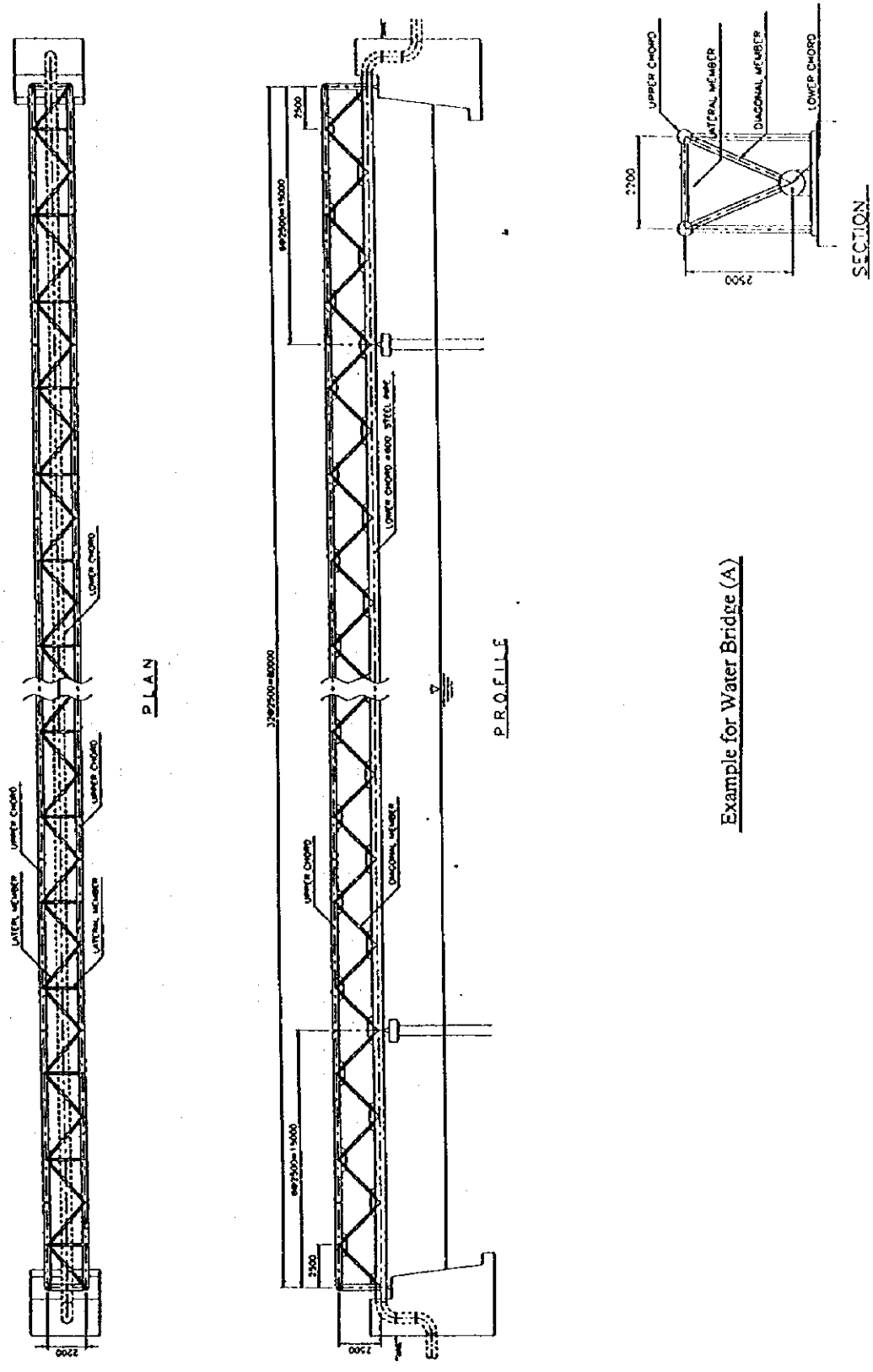
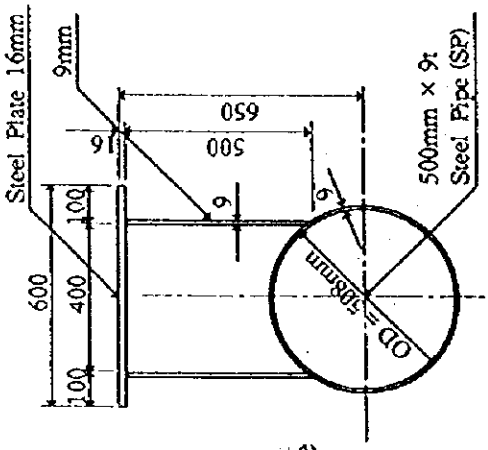
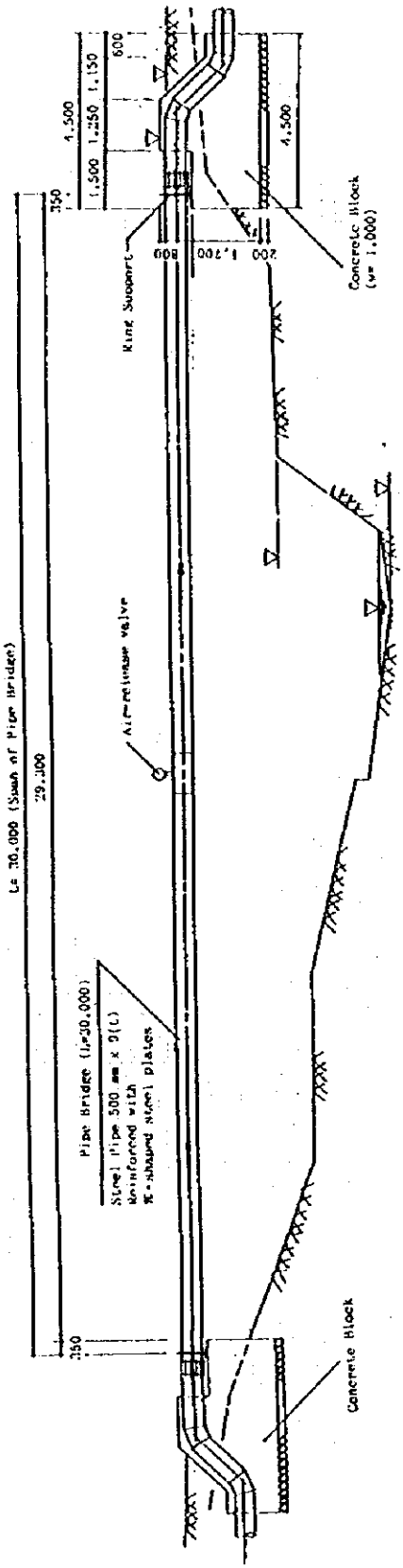


Fig. 13.2-13 Typical Drawings of Pipe Laying Works (5/6)



Sectional Detail of Pipe Bridge



Example for Water Bridge (B)

Fig. 13.2-13 Typical Drawings of Pipe Laying Works (6/6)

CHAPTER XIV ENVIRONMENTAL ASPECTS

14.1 Existing Environmental Conditions

14.1.1 Social Conditions

1) Population and Residential Areas

The total population of South Sinai was estimated at 54,495 in 1996. The population growth over 10 years (1986 to 1996) was 25,566 which is an increase during this period of 88.4 %. The distribution of population is divided into urban area and rural area. The urban area has a population of 29,323 and the rural area has a population of 25,172. Inhabitants in rural areas consist almost entirely of Bedouin of tribes.

The majority of residential areas are located along the coastal line of the Gulf of Suez and Gulf of Aqaba. El Tur is the largest settlement in population size and is located on the coast of Gulf of Suez. St. Catherine is the only large settlement that is located in the mountain area.

Bedouin tribes inhabit the wadis of the mountain area and the inland area, including settlements above mentioned.

Zones	1982 (Registered)	1986 (Census)	1996 (Census)	Increase (%) 1996/1986
El Tur	3,335	6,483	14,155	118.3
Ras Sudr	4,659	5,392	6,501	20.6
Abu Zeneima	2,541	3,023	5,570	84.3
Abu Rudis	4,004	5,129	7,438	45.0
St. Catherine	3,269	3,363	4,219	25.5
Sharm El Sheikh	933	1,556	7,197	362.5
Dahab	1,025	1,584	3,758	137.2
Nuweiba	1,142	2,399	5,657	135.8
Total	20,908	28,929	54,495	88.4

Source: Statistical YearBook 1990-1995, July 1996, CAPMAS
Data Center of South Sinai Governorate, 1996
Note: Population of Egypt in 1982 was interpolated on the basis of the census population in 1976 and 1986. The population figures of Egypt exclude Egyptian abroad.

2) Economic Activities

(1) Agriculture

Existing agriculture in South Sinai is basically divided into the following two subsectors:

i) Traditional Agriculture

Traditional agriculture is primarily based on nomadic and seminomadic herding, and a limited amount of dry land farming. The traditional agriculture is distributed in the wadis of the mountain areas such as Wadi Feiran and St. Catherine area.

ii) Irrigated crop production

The irrigated crop production is mainly distributed in the coastal areas of the Gulf of Suez and Aqaba, particularly in the area of El Tur, Abu Zenima, Dahab and Nuweiba.

Historically, the traditional agriculture in this area has been practiced for long time. Irrigated farming on the other hand has been practiced for only several decades in this area, particularly the St. Catherine area. The size of agriculture lands of both agricultural subsectors was estimated at 480 feddans in 1979. It increased to 1,400 feddans in 1994. The distribution of existing agricultural areas is shown in Fig 14.1.1-1.

Water supply system for agriculture depends mostly on wells, both public and private. The number of public wells has increased from 34 in 1985 to 41 in 1992. At the same time, the number of private wells has increased from 173 to 407. The primary crops in South Sinai are olives, almonds, palms, vegetables and fruits. Vegetables and fruits are planted for local consumption; olive is planted for national consumption. There are olive farms of Ministry of Agriculture near Nuweiba.

(2) Industry

Recently, the industry in South Sinai has expanded to include several other activities such as food, petroleum and technical industries. Petroleum industry (oil and gas) constitutes 25 % of the national petroleum industry. The distribution of petroleum industry is in the coastal area of the Gulf of Suez. The number of industries in South Sinai is as follows:

Type of industry	Petroleum	Mining	Food	Engineering	Construction
The number	23	3	22	3	9

Source: Statistical Book 1996, South Sinai Government

(3) Mining

Historically, mining was the principal industry in South Sinai. It was famous for several kind of mineral productions. Copper was mined and smelted near Wadi El Maghara, east Abu-Zenima in Pharaonic times. Turquoise mining was continued on a

small scale until the 1967 invasion. Currently, the mineral activities include the following three main categories:

i) Metallic
ii) Nonmetallic
iii) Construction materials

The metallic category includes copper and manganese. The nonmetallic materials consist of coal, glass sand, kaolin clay, limestone, sulfur, turquoise and gypsum. The construction category includes sand, gravel, limestone, dolomite aggregate and gypsum. The distribution of mineral industry is mainly in the coastal area of the Gulf of Suez and the mountain areas.

(4) Tourism

Historically, tourism in South Sinai was limited to religious purpose. St. Catherine with its famous monastery and Gebel Musa have been important for a long time.

El Tur was the base and marine connection to St. Catherine monastery until 1967. Most of their buildings were quarantine stations for Moslem pilgrims returning from Mecca. At present, tourism is distributed mainly in the following three areas:

i) the central mountain area surrounding St. Catherine which forms a focus for cultural and sightseeing tourism.
ii) near complementary resources include the oasis, Bedouin settlements and ruins.
iii) the coastal areas of the Gulf of Suez and Gulf of Aqaba which have functions as resort of swimming and diving

In fact, these areas have rich natural environment, cultural properties and scenic resources, and several areas are protected as conservation areas of the country. Therefore, tourism facilities have developed an accompanying growth of tourists. The number of hotels has increased from 5 in 1979 to 37 in 1992. The number of tourists has also increased from few hundreds in 1979 to 388,277 in 1992. Even now, resort hotels are under construction along the coastal lines of Gulf of Aqaba and Gulf of Suez.

3) Infrastructures and Social Services

(1) Roads

The principal road networks in South Sinai can be divided into the following 3 routes.

i) Route from Suez to Sharm El Sheikh along the coastal lines of the Gulf of Suez
ii) Route from Sharm El Sheikh to Taba along the coastal lines of Gulf of Aqaba

iii) Route from Suez through Nakhl to Taba along the northern boundary of South Sinai

These roads are in a good condition because they have been upgraded during the last decade. However, the regional roads connecting the mountain area and the tracks running in wadis and desert are generally in poor condition.

(2) Water Supply

Sources of water supply in South Sinai are divided into wells, water from the Nile River and desalted water from seawater.

Each settlement has its public or private wells. The settlements of Ras Sudr, Abu Zenima and Abu Rudeis can receive water from storage tanks through pipelines from the Nile River. Sharm El Sheikh, Dahab and Nuweiba along the Gulf of Aqaba rely on desalted water from seawater.

However, much of the well water in South Sinai is unsuitable for human consumption, particularly in the mountain area. The mountain area and its wadis depend mostly on wells, particularly the private. Sharm El Sheikh, which is a principal resort town, receive part of its water by means of transportation on water tank lorries from El Tur. The sources of drinking water in each settlement of South Sinai is as follows:

Unit: m^3/day

Settlement Name	Wells	Desalination	The River Nile	Total
El Tur	4,000	0	0	4,000
Ras Sudr	0	0	3,000	3,000
Abu Zenima	0	0	600	600
Abu Rudeis	100	0	900	1,000
St. Catherine	390	0	0	390
Sharm El Sheikh	1,000	5,960	0	6,960
Dahab	0	2,000	0	2,000
Nuweiba	0	700	0	700
Total	5,490	8,660	4,500	18,650

Source: Statistical Book 1996, South Sinai Governorate

(3) Health Care and Services

Relatively high infant mortality rates are directly related to unsanitary conditions and inadequate health care. The main causes of infant mortality are gastrointestinal diseases and related diarrhea. Furthermore, nutrition and food consumption habits of the Bedouins appear to be inadequate for maintenance of good health. Also, most of the Bedouins rely on medicinal plants except for serious sickness. At present, hospitals in South Sinai are established in El Tur, Abu Rudeis, St. Catherine and

Nuweiba.

(4) Education

There are 58 primary, 20 preparatory and 13 secondary schools. Bedouin villages generally have primary and preparatory schools in the villages.

4) Ruin and Cultural Properties

Significant ruins and cultural properties in South Sinai are concentrated in the St. Catherine area and its surroundings. This area can be divided into the three areas of St. Catherine Area, Feiran area and Serabit El-Khadim. These distributions are shown in Fig 14.1.1-2.

(1) Feiran Area

Wadi Feiran is one of the largest and most famous wadis in Sinai. Near the summit of Mount Serbal, which is located in the south of Wadi Feiran, there are many early inscriptions that have been cut into the rock. In these inscriptions, the most imposing example is in "Wadi Mukattab" i.e. "Valley of the Inscriptions". In the middle of Wadi Feiran near the junction of the Wadis tributaries, there are remains of a monastery and many other ruins. In addition, there are many hundreds of inscriptions and drawings in Wadi El-aleiyat, Wadi El-Sheikh, Wadi El-Ahmer and elsewhere. The inscriptions in South Sinai are a source of information especially on the ancient mining and expedition system.

(2) St. Catherine Area

The monastery of St. Catherine is located in a valley at the foot of Gebel Musa, at an elevation of 1,570 m. It has been a center of Christian worship for over 1,600 years, containing one of the worlds' most ancient and important monastic libraries. The monastery consists of the citadel itself and its annexes, the gardens, the cemetery and the ossuary.

(3) Serabit El-Khadim Area

The temple of Serabit El-Khadem stands at an altitude of 840 m, on a highland, bounded to the north by Wadi Sawik. Already during the Middle Kingdom, a temple was constructed here. It is one of the very few Egyptian temples constructed outside the Nile Valley.

5) Traibal Organization

The original population in Sinai is Bedouins. The Bedouin population in South Sinai was estimated at 24,000 in 1996. Bedouins consist of several tribes. Distribution of these tribes is shown in Fig 14.1.1-3. Recently, all Bedouins are not nomadic and some are sedentary and thus transhumance or seminomadic, who are nowadays limited in movement. Their seasonal activities offer different resources for income. The main economic activities of Bedouins in South Sinai are livestock raising, minor seasonal agriculture, horticulture and fishing. However, these are the traditional economic activities. In the latest 20 years some activities have been newly introduced to the area and are nowadays practiced by the Bedouins. These activities consist of irrigated agriculture used pumping and drip irrigation, guide for tourists and fishing by boat with engine.

The new economic activities have increased Bedouin's income and have changed their life styles. Nowadays, they live in concrete block-made houses and can buy various kind of goods, besides visiting doctors in Suez or Cairo, and sending children to continue their education in El Tur or Nuweiba.

A study of Bedouins in South Sinai was carried out in 5 villages; El Malha village, Wadi village, Wadi Saal village, Sheikh Attia village and Ayun Musa village. El Malha village is located in the desert about 50km southwest from Nakhl. Wadi village is about 5km north from El Tur city. Wadi Saal village is situated on the halfway between St. Catherine and Nuweiba city. Sheikh Attia village is in the Wadi Watir about 20km north from Nuweiba city. Ayun Musa village is near from Ras Sudr City.

(1) Population

In case of Bedouin people "Inhabitants" means not only the person who use the dug wells living in the village but also persons who use dug wells living far from the center of the village. Actually there are inhabitants who fetch water more than 20km away. There are two kinds of inhabitants. One is the resident population who always lives in the village and work near the village. Another is the nonresident population who moves with their stocks for grazing from place to place. The following table shows the population of Bedouin villages.

	Less than 6 years old	6 years to 12 years old	More than 12 years old	Total
El Malha village	200	200	1,350	1,750
Wadi village (Haweitat)	50	50	600	700
Wadi Saal village (Muzeina)	100	100	800	1,000
Sheikh Attia village	50	50	1,900	2,000
Ayun Musa village	100	100	1,300	1,500
Total	500	500	5,950	6,950

To examine movement of population, the JICA Study Team interviewed each 'tribal chief' of the villages about population and birth. The number of family members in one household is from five to eight persons. It is quite different from village to village.

In recent years, the number of nuclear families is increasing. The following are results from calculations of the number of children for each couple, assuming that a couple live for thirty (30) years after marriage.

	Population (Capita)	Number of Household	Number of Family Member	Birthrate per Village*1	Birthrate per Family*2	Number of children*3
El Malha village	1,750	250	7.0	13 – 15	0.0560	1.68
Wadi village (Haweitat)	700	100	7.0	5 – 10	0.0750	2.25
Wadi Saal village (Muzeina)	1,000	200	5.0	16 – 17	0.0825	2.48
Sheikh Attia village	2,000	270	7.4	8 – 9	0.0315	0.95
Ayun Musa village	1,500	200	7.5	16 – 17	0.0825	2.48
Total	6,950	1,020	6.8	58 - 68	0.0612	1.84

*1: Number of Birth / Village / Year
*2: Number of Birth / Number of Household / Year
*3: Number of Birth / Number of Household / Year * 30Years

The number of family member is in a range from 5.0 to 7.5 averaging 6.8. The number of children per family is between 0.95 and 2.48 averaging 1.84. It suggests that the population of El Malha Village and Sheikh Attia Village may decrease in the future because the number of children is less than 2.0 per family while that of other village is more than 2.0 per family. Concerning that the average number of children in the five villages is only 1.84 for one household, the future population of Bedouin will stop increasing.

(2) Marriage

It is generally said that the Bedouin used to choose their marriage partner from the same tribe. If they marry another tribal people, they may lose their field and their livestock.

In the old time, to keep the cultivated land and the number of stock, parents married their daughters and sons to their relatives. It was customary in Bedouin villages to do like this. Marriage of Bedouins was a matter of greatest importance. However to choose a marriage partner from another Bedouin village is not so important in recent years. The loving couple can decide to marry of their own will in some villages. Even now, however it is desirable in El Malha village, Wadi village and Ayun Musa village that villagers marry a partner who belongs to the same tribe. The loving couple can decide to marry of their own will in Sheikh Attia village and Wadi Saal village. On the other hand the man of power usually chooses the marriage partner from with close ties and they take two (2) or three (3) women to wives.

Marriageable age for men and women of Bedouin tribes are more than twenty (20) years old and more than eighteen (18) years old respectively. Marriageable age of Bedouin villages is generally younger than that of urban area, because who are living in urban areas need much money to prepare house and furniture. It is just the same with Bedouin villages, but the preparation cost of marriage in a Bedouin village is cheaper than in urban area.

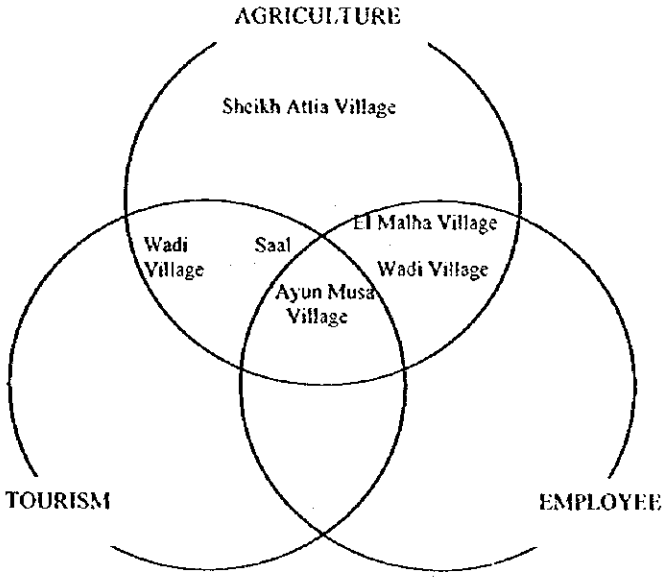
(3) Industrial Population

In old days, Bedouin's main job was agriculture. But this situation will change in the future. The following table shows the composition of the industrial population in Bedouin villages.

	Primary industry*1	Secondary industry*2	Tertiary industry*3
El Malha village	70%	5%	25%
Wadi village (Haweitat)	50%	45%	5%
Wadi Saal village (Muzeina)	100%*4	0%	100%*4
Sheikh Attia village	100%	0%	0%
Ayun Musa village	40%	20%	40%

*1: agriculture, fishery
*2: manufacturing, construction
*3: office work
*4: All inhabitants of Wadi Saal village are farmer with a side job.

Compared with Wadi village and Ayun Musa village, agriculture is even now the major industry in El Malha village, Wadi Saal village and Sheikh Attia village. The Locations of these three (3) villages are so far from the center of cities that inhabitants can not go to cities to work. All the inhabitants of Wadi Saal village and Sheikh Attia village engage in agriculture for lack of opportunity of employment. On the other hand the two (2) villages Wadi village and Ayun Musa village have a good location to find job. Many inhabitants of these villages belong to the city office or a private company. To work as employee is more stable than to engage in agriculture, because shortage of agricultural water is a major cause of decrease in income. By reason of a shortage of water source, some inhabitants of El Malha village give up agriculture and go to Nakhl city to work. Next figure shows the assortment of work in Bedouin villages.



Agriculture is the only industry that inhabitants of Sheikh Attia village can engage in. The number of inhabitants who engage in other jobs is increasing in the four (4) villages. For example Wadi Saal village and Ayun Musa village are tourist attractions in South Sinai. Especially inhabitants of Ayun Musa village can make a comfortable income from souvenir goods. If there are some industries such as tourist industry in Bedouin village, they can engage in other job than agriculture. However, if they don't have any industry, educated Bedouins can work as engineers, teacher, etc. Better jobs are sought after in each village and Bedouins who engage in other jobs than agriculture will increase in the future.

(4) Public facilities

i) Educational facilities

Educational facilities in each village are as follows:

	Primary school	Secondary school
El Malha village	O	O
Wadi village	O	O
Sheikh Attia village	O	×
Wadi Saal village	O	×
Ayun Musa village	O	×

El Malha village
Number of pupils: 35 (the total number of primary and secondary school pupils)
Number of teachers: 10

Wadi village
Number of pupils: 200 (primary school), 60 (secondary school)
Number of teachers: 25

Wadi Saal village
Number of pupils: 43 (Male: 30、Female: 13) (primary school)
Number of teachers: 8

El Sheikh Attia village
Number of pupils: 20 (primary school)
Number of teachers: unknown

Ayun Musa village
Number of pupils: 30 (primary school)
Number of teachers: 7

The following figure shows the ratio of pupils who go on to the next stage of education:

	El Malha village	Wadi village	Wadi Saal village	Sheikh Attia village	Ayun Musa village
University	0%	0%	10%	0%	0%
High School	0%	75%	30%	0%	5%
Secondary	25%	100%	50%	0%	15%
Primary	25%	100%	100%	50%	30%

In case of Egypt, where there is no compulsory education, the number of pupils in Bedouin villages is less than in city areas. Because most Bedouins engage in agriculture, they think that children are also respectable labors. It is natural that

Bedouins don't think education is important. However recently, the leaders of each Bedouin village recommend the villagers to attend the school. Therefore the number of children who attend school is increasing. In case of Saal village, this village is spread 20km from the center of the village. Children whose houses are far from the school take a room near school.

But this situation has caused some problems. To engage teachers is a very important problem in Bedouin villages. In case of Ayun Musa village, all the teachers come from Suez everyday. Some teachers retire to work in this village by reason of the time spent in commuting. In case of Wadi village, the ratio of pupils who go on to secondary school is rising in recent years. The school building for secondary school has not enough capability to accept all the pupils. Therefore only half of the pupils have to go to school in El Tur city.

The school attendance rate will be on a steadily rising trend. A problem to be solved in each village is to expand the school buildings.

ii) Welfare facilities

The table below shows welfare facilities in each village:

	Clinic	Drugstore
El Malha village	×	×
Wadi village	O	×
Sheikh Attia village	O	×
Wadi Saal village	×	×
Ayun Musa village	×	×

El Malha village

Only one (1) drug store exists in Nakhl city. The villagers buy medicine from this drugstore. Serious patients are transferred to hospitals in El Arish city.

Wadi village

There is a clinic in this village. One (1) doctor and four (4) nurses take care of only non-serious patients. Serious patients go to hospital in El Tur city.

Wadi Saal village

Patients go to hospital in Dahab city or Nuweiba city. There is neither a clinic nor a drugstore in the village.

El Sheikh Attia village

One (1) doctor lives in the village and treats wounds for villagers. Serious patients go to hospital in El Arish city or Nuweiba city.

Ayun Musa village

A doctor left this village five years ago. Now, There is neither clinic nor drugstore. Patients usually go to hospital in Ras Sudr city.

Except Ayun Musa village, most villages are far from cities. Therefore serious patients have to go to hospitals in cities far from their village. They are very concerned about this situation and eager to establish a clinic in their villages.

iii) Public service

The following is the present condition of public services in each village:

	Electricity	Public water	Gas	Sewerage
El Malha village	×	×	○	×
Wadi village	○	○	○	×
Sheikh Attia village	×	×	×	×
Wadi Saal village	×	×	×	×
Ayun Musa village	○	○	○	×

○-available ×-not available

Villagers of Wadi village and Ayun Musa village use well water only for agriculture, and drink public water only. Leaders of these villages think that well water is not good for health. Villagers of the other three villages use well water for agriculture and drinking. Almost all Bedouins are interested in the water quality of the well water in their villages.

Three public services (Electricity, Public water, Gas) are available for two villages (Wadi village and Ayun Musa village). Under the present circumstances, there is no plan to provide these public services in the other three villages (El Malha village, Sheikh Attia village and Wadi Saal village).

It was usual that the public services were generally not available in the old time, and the Bedouins didn't want these public services. Now however, all Bedouin villages hopes to get access to these four public services (Electricity, Public water, Gas and Sewerage) for civilized life.

(5) Condition of well

Information of wells in the Bedouin villages is given below.

	Number	Condition	Use for
El Malha village	50	Drawdown	Drinking and Agriculture
Wadi village	30	Drawdown	Agriculture
Wadi Saal village	10	Drawdown	Drinking and Agriculture
Sheikh Attia village	14	Good	Drinking and Agriculture
Ayun Musa village	3	Good	Agriculture

El Malha village

This village is blessed with an abundant quantity of wells. However in recent years, inhabitants feel a shortage of water resources. The reason water level of dug wells is drawn down is that rainfall in this area is very light.

Wadi village

This village sells water (120m^3/day) to the city office of El Tur and hotels in Sharm El Sheikh city. After summer season, well water is decreasing at a quick. They dig wells about 2m deep. As a consequence of this situation, twenty wells are drying up.

Wadi Saal village

At present, the condition of only one well is good. The water level of the other nine wells is drawn down. There is a rule for using well water in this village. When the surface of water is less than 2m from the bottom of the well, the villagers must wait more than 24 hours.

Sheikh Attia village

Water level of wells doesn't go down. Crop is not cultivated in this village, so villagers in this village don't use so much water.

Ayun Musa village

This area is rich in water resources and the water level of wells doesn't go down. Villagers feel that well water in this village is salty, and therefore don't drink well water but public water.