CHAPTER 4 BASIC DESIGN

Chapter 4 Basic Design

4.1 Design Policy

(1) Outline

The Project is a part of the rural water supply project for Mt.Pinatubo disaster areas' reconstruction and restoration project for rural people. The main point of the rural water supply project is to construct 866 wells equipped with hand pumps.

The Project is regarded as a supporting project of the resettlement area plan already implemented for refugees evacuated from Mt. Pinatubo disaster areas.

As the Project will be implemented under the Japanese Government's grant aid cooperation, the rules of the grant aid cooperation mainly become the prerequisites for the Project design.

Thus, the Project's basic design was prepared based on the following basic policies:

- To be consistent with the Philippines' water supply national policies, rules, standards, past projects, and related disaster reconstruction and restoration plans.

  In particular, the basic design should be in accordance with the National Water Resources Council's Rural Water Supply Design Manual.

- To use a standardized design and prepare the design for economical facilities such as:

  - Water supply purpose shall be limited only to domestic water supply, and design boundary shall be up to the public stand pipe.
  - To make the water supply system simple without remote operation; monitoring facilities shall be installed. All facilities shall be of a manual operation type.

- To take account of Project areas' climatic conditions and DPWH and MPR-PMO's present conditions, organizational structures and rules.

In particular, for the construction of water intake facilities, pipelines, and water distribution tanks, materials easy to transport to Project areas and easy to be constructed shall be adopted.

- To select construction equipment, materials, and construction methods that suit the natural environment.

  Due to mountainous topography, erosion protection measures shall be provided.

- Project construction shall be carried out using new equipment to be provided under the Project.

- To considerate DPWH and MPR-PMO's usual equipment types and existing spare parts, easy operation and maintenance, as well as efficiencies.

  Out of requested equipment list, only necessary ones will be provided, although some items could be added if the necessity arises.

4.2 Study and Examination on Design Criteria

(1) Construction of Water Supply Facilities

Project Areas:

Areas included in the disaster areas' overall water supply improvement plan are the 12 resettlement areas and 369 damaged Barangays of 46 municipalities that are scattering in 5 provinces which suffered the disaster (refer to Table 3.6).

Among these areas, resettlement areas and Barangays having a higher priority shall be included in the Project for the construction of water supply facilities.

Water Sources and Water Supply Facilities:

The Project's water sources shall be wells or springs that do not dry up throughout the year. Water supply facilities shall be either hand pumps or stand pipes connected to the pipelines.

The number of facilities to be provided reaches 874.

(2) Basic Consideration for Basic Design of the Water Supply Plan

Unit Consumption

Per capita demand stated in the Rural Water Supply Design Manual (NWRC) is 30 lit/cd of Level I and 60 lit./cd of Level II. However, systems of Level I and II are planned using the per capita demand attached to Level I in the NWRC. Stated in the M/D is the rate agreed by both Japan and Philippines counterparts during the field survey period.

Designed Service Population

The served population is determined upon the target and actual population of the resettlement sites, as explained in Table 3.5. This was done considering the trend of the growth rate during the 1991 to 1992 period.

Table 4.1 shows the data concerning basic number for the design demand.

Table 4.1 Design Mean Daily Water Supply Amount

Project Site	Population Served	Daily Ave. Water Demand (m3/day)
ZAMBALES		
1. Dampay Salasa, Palauig	1,555	47
2. Baquilan, Botolan	3,838	115
3. Loob Bunga, Botolan	10,170	305
4. Iram, New Cabalan	4,200	126
5. Cawag, Subic	9,600	288
PAMPANGA		
6. Camias, Porac	3,840	115
TARLAC		
7. Kalangitan, Capas	6,000	180
8. Dueg, San Clemente	3,000	90

Daily Max. Demand

Daily Max. Demand = 1.3 x Daily Average Demand

Hourly Max. Demand

The recommended hourly max. rate for the Project is 2.5 (calculated by the formula: c = hourly max. demand/daily averg. demand x 24) as mentioned in the Manual.

(3) Basic Considerations for Well Design

Design Well Depth

The well sites - since they are located in high rolling lands - shall be selected at relatively low parts of the Project areas. It was determined that the depths of the Project's boreholes were to be in the range of 50 to 70 m having an average depth of 80 m.

The groundwater table of the Project sites is estimated to be between 20 to 40 m - GL, based on the existing well data and hydrogeological reports.

Success and Drilling Rates of Boreholes

The borehole success rate is considered to be 5 wells out of 7 wells. Moreover, 7 wells out of the existing 58 wells within the Project sites (High Resettlement Area) are evaluated as mostly dry holes due to very low groundwater level.

The design borehole success rate is 85%; the non-success is summarized as follows:

		Non-Success Rate	
Deep well	2 wells out of 7 wells	=	29%
Shallow well	7 wells out of 58 wells	=	12%
Total	9 wells out of 65 wells	=	14%

Drilling time reaches 9 m/day in both geological areas described below:

- Hard rock areas : Igneous rock of Paleocene or Cretaceous era
- Volcanic rock areas : Volcanic deposits of Pleistocene or Tertiary era

Drilling Method and Casing

Using the DTH method, the required minimum diameter of the wells' permanent casing should be of 100 mm, due to hand pump installation.

Selection of Drilling Sites

The detailed survey not being yet done, no precise points have been decided.

Hand Pump Installation

- The borehole must be judged as a "dry hole" if groundwater is not found within a depth of 100 m.
- If the static water level of a well was more than 40 m below the ground surface,

it would be impossible to draw water using a hand pump. In this case, no hand pump installation is to be made.

- o If a pumping test reveals a pumping rate of more than the design criteria, 15 liters/min., a hand pump must be installed without question.
- o If a pumping test indicates a pumping rate of less than the design criteria, whether to install a hand pump will be a matter decided upon after discussions are held with the Philippines side,

Only then, the following yields should be taken into consideration: if a well yields 7 liters/min., the hourly yield will be 420 liters; the daily yield will be 5,040 liters per 12 hours operation. It would be possible for this well to supply 20 liters/day/person of water to 250 residents. Obviously, abandoning the constructed borehole should be out of question.

(4) Basic Considerations for the Piped Water Supply System Plan

Tap Diameter and Service Pressure

The pipe diameter of the taps is planned to be 30 mm. The service pressure should be of 3 m at the faucet point.

Public Faucet

The taps number of public faucets will be determined by using the standard set in the the NWRC's Rural Water Supply Design Manual for a tap serving 100 persons.

4.3 Basic Plan

4.3.1 Hand Pump Equipped Well Facilities

The cylinder diameter of this class of hand pump is usually 50 - 90 mm. Consequently, the minimum diameter if permanent casing shall be 100 mm, the minimum drilling diameter shall be 150 mm.

The geological conditions of the Project Area suggests the existence of a decomposed and collapsible layer. Therefore, temporary casing works to prevent collapsing of the holes during the drilling are required.

Thus, two types of borehole are designed as shown in Fig. 4.1 and 4.2 although the

boreholes belonging to the Type-II structure constitute only around 20% of total drilling.

The design of the borehole structure was made based on the following conditions:

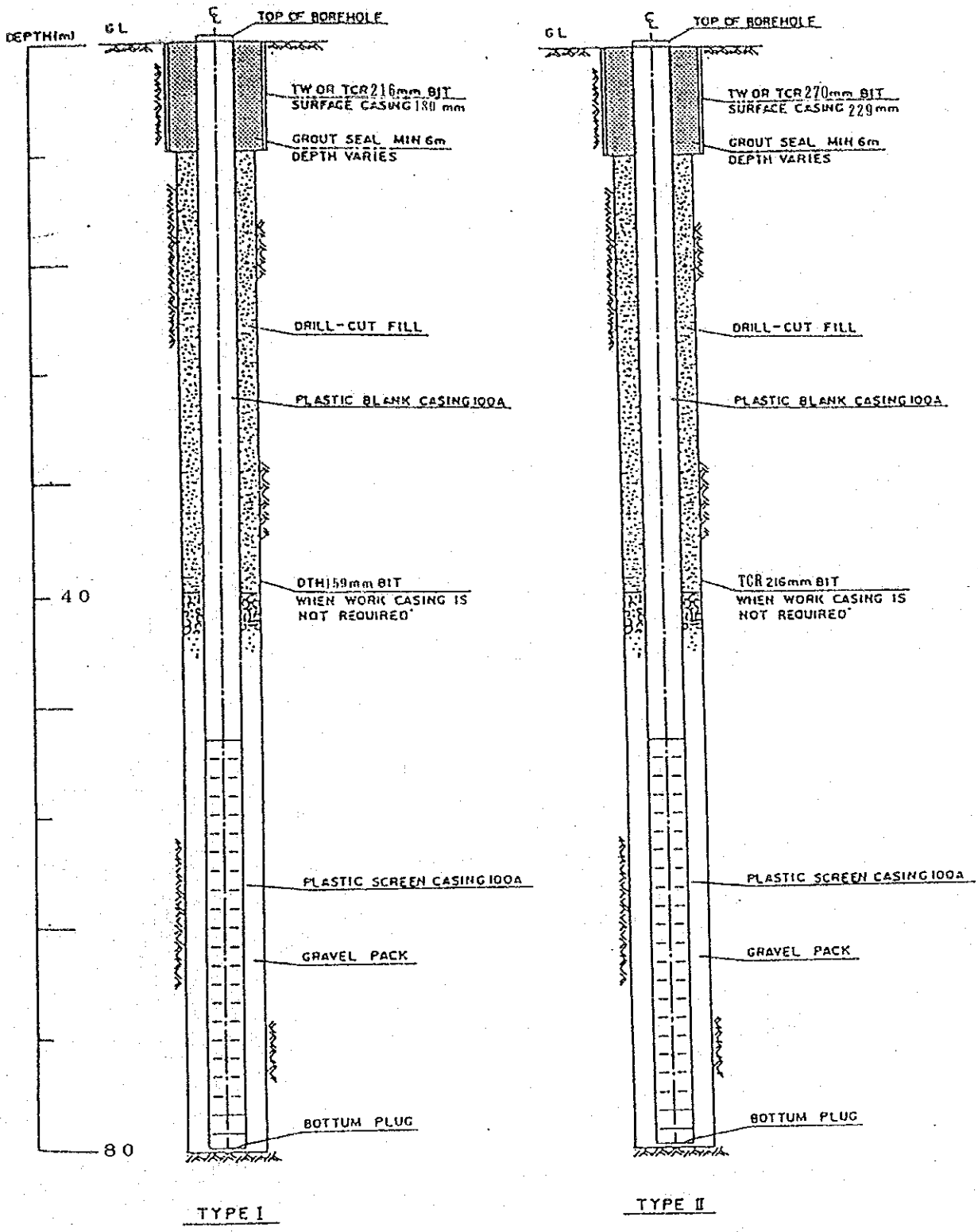
- The borehole depths shall be in the range of 60 to 100 m with the average depth being 80 m.
- The drill bit diameter for the final drilling shall be selected to make a minimum clearance of 56 mm between the screen pipe and the borehole wall in order to allow space for effective gravel packing.
- Center risers shall be installed at the joints of the screen pipe (4 m intervals). This will keep the screen pipe at the center of the borehole, and will allow uniform gravel packing around each screen pipe section.
- Plans shall be made to use 311.2 mm (12 1/4 inch) diameter tricorn bits for the surface drilling of Project boreholes. The surface temporary casing shall be equipped with metal shoe to prevent air leakage during air-percussion drilling.

Appurtenant Facilities

The appurtenant facilities for the hand pump operated wells, such as concrete slabs, drainage ditches, and infiltration pits, are to be installed around the wells to prevent well pollution and erosion of ground surface.

The slabs shall be made of reinforced concrete, having 9 mm round steel bars at 150 mm intervals to prevent cracking.

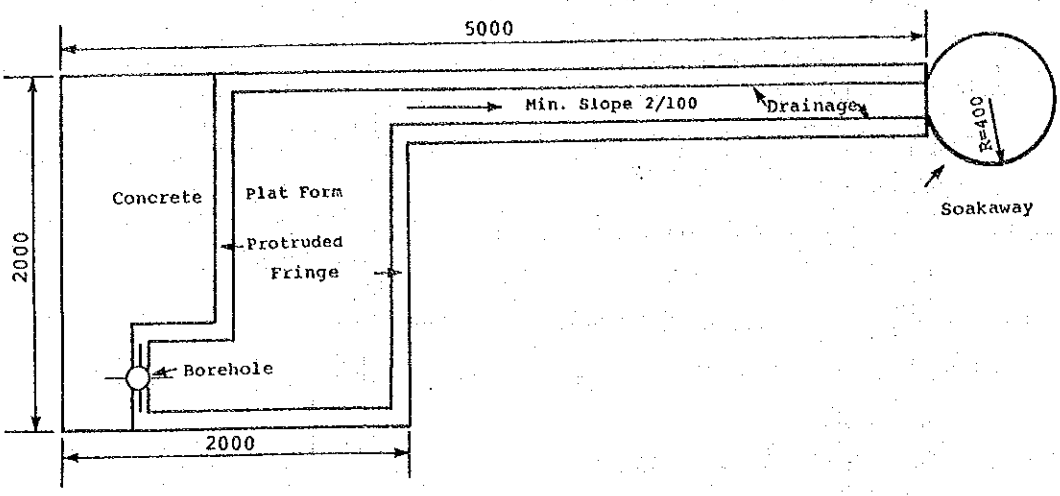
The details of the appurtenant facilities are shown in Fig . 4.2.



Well structure in hard rock areas

Well structure in volcanic rock areas

Fig. 4.1 4" Deep Well Structure



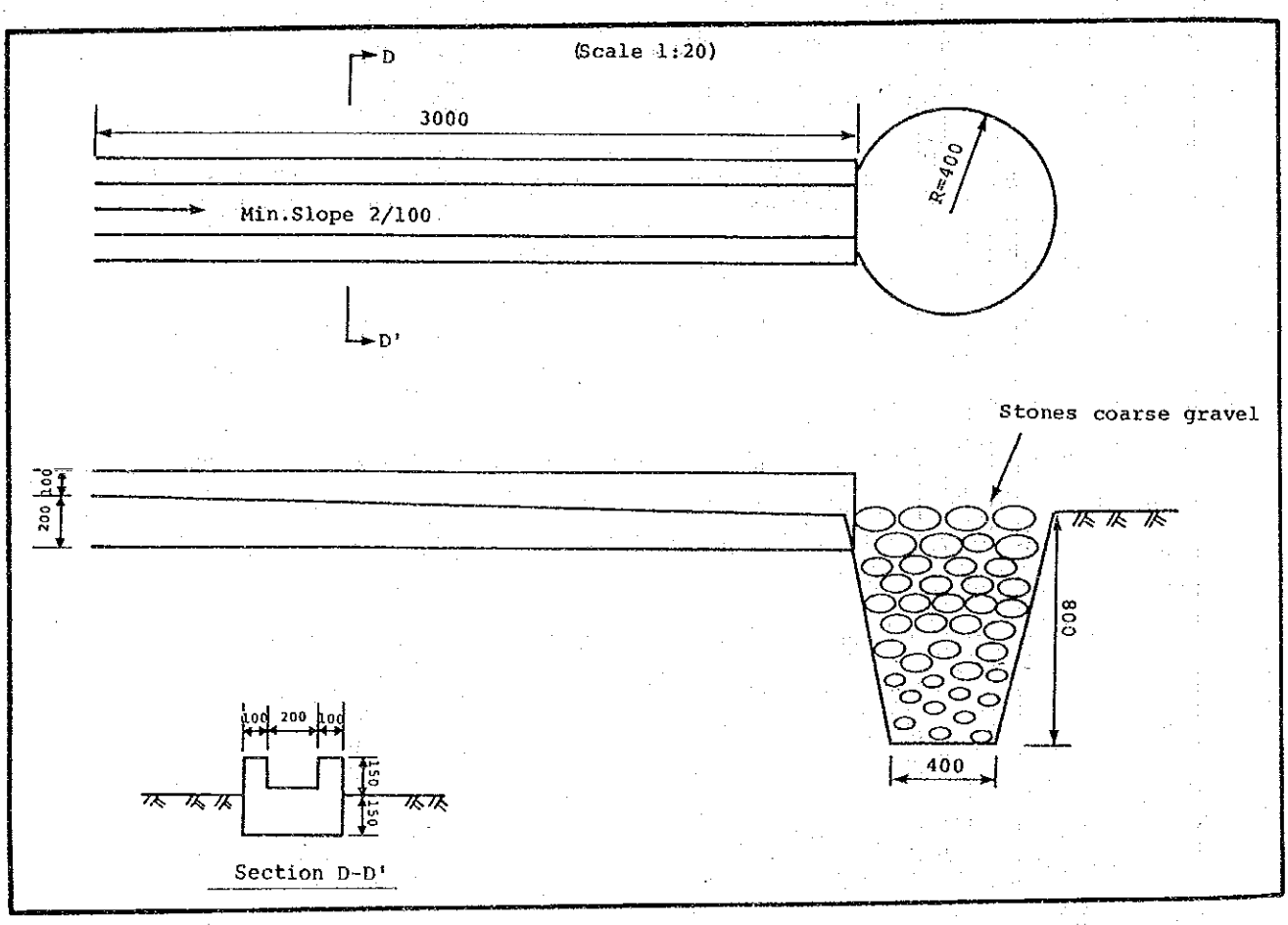


Fig. 4.2 Related Structure

4.3.2 Spring Water Use Facilities

1) Design Water Supply Amounts:

Design water supply amounts, such as daily average, daily maximum, and hourly maximum water supply amounts, must be obtained for the design of the facilities.

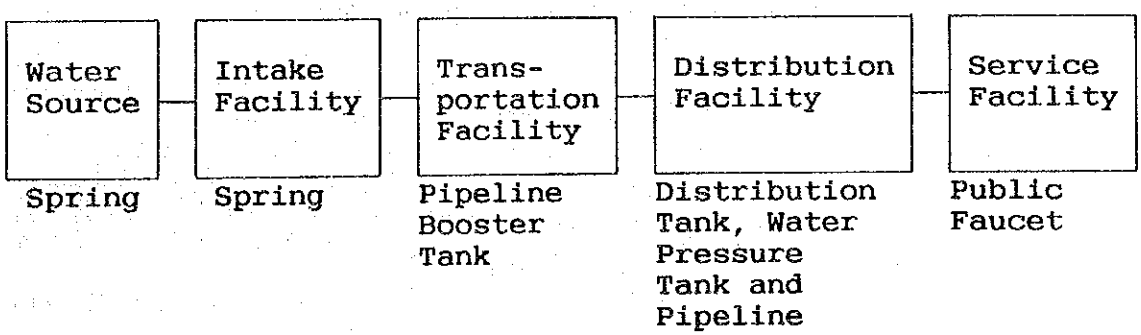
Design water supply amounts for the three Project areas having spring water use facilities were calculated as shown in Table 4.2.

Table 4.2 Design Water Demand for Spring Water Use

Project Site	Daily Ave. (m3/day)	Daily Max. (m3/day)	Hourly Max. (m3/hr)
ZAMBALES			
Dampay Salasa, Palauig	47	61	4.9
Iram, New Cabalan	126	164	13.1
TARLA			
Dueg, San Clemente	90	117	9.4

2) Design of Water Supply System:

The water supply system will take spring water and distribute it thorough the above ground distribution tank by gravity flow as shown in the following figure.



There are existing water supply systems in the three areas. Facilities and materials of these systems are inadequate and the systems will not conform to the new facility design. Thus, entirely new water supply systems shall be planned.

By taking account of the area topography and village distribution partners, the pipelines from the distribution tanks will be basically installed along area roads then branched off.

Public stand pipes will be installed, at least one in each residential community and each public facility at 100 to 200 m intervals. Water supply systems were designed by assuming that every stand pipe will supply the same amount of water.

The water supply system in each area as shown in Fig. 4.3.

Although the pipeline system is designed for Iram area, the system shall be entirely reexamined because the area requires a pumping facility that does not meet the basic policies of the Project.

Features of each spring water use water supply system are clarified in Table 4.3.

Table 4.3 Features of Spring Water Use Water Supply Systems

Name of Project Area	Daily Max. Supply (m³/day)	Hourly Max. Supply (m³/hr)	Supply System Type	Intake Facility		Distribution Facility		
				Settling Basin	Conveyance Pipeline (m)	Distribu-tion Tank	Pipeline m	Stand Pipe
ZAMBALES:								
Dampay Salasa	61	5.0	Gravity Flow	Required	1,350	On the ground	2,400	Required
Iram	164	13.0	Gravity Flow	Required	3,450	On the ground	1,925	Required
TARLAC:								
Dueg.	117	9.5		Required	2,350	On the ground	10,255	Required

Design flow velocities in the pipelines are as listed in Table 4.4:

Table 4.4 Design Velocity of Conveyance Pipe

Site	Daily max.	Velocity	Calc. Dia.	Dia. Selected
Dampay Salasa	61m3/D =42.4 l/min =0.706 l/sec	0.9m/sec	26mm	65mm
Iram	164m3/D =114 l/min =1.89l/sec	0.8m/sec	61mm	125mm
Dueg	117m3/D =81 l/min =1.35l/sec	0.9m/sec	46mm	100mm

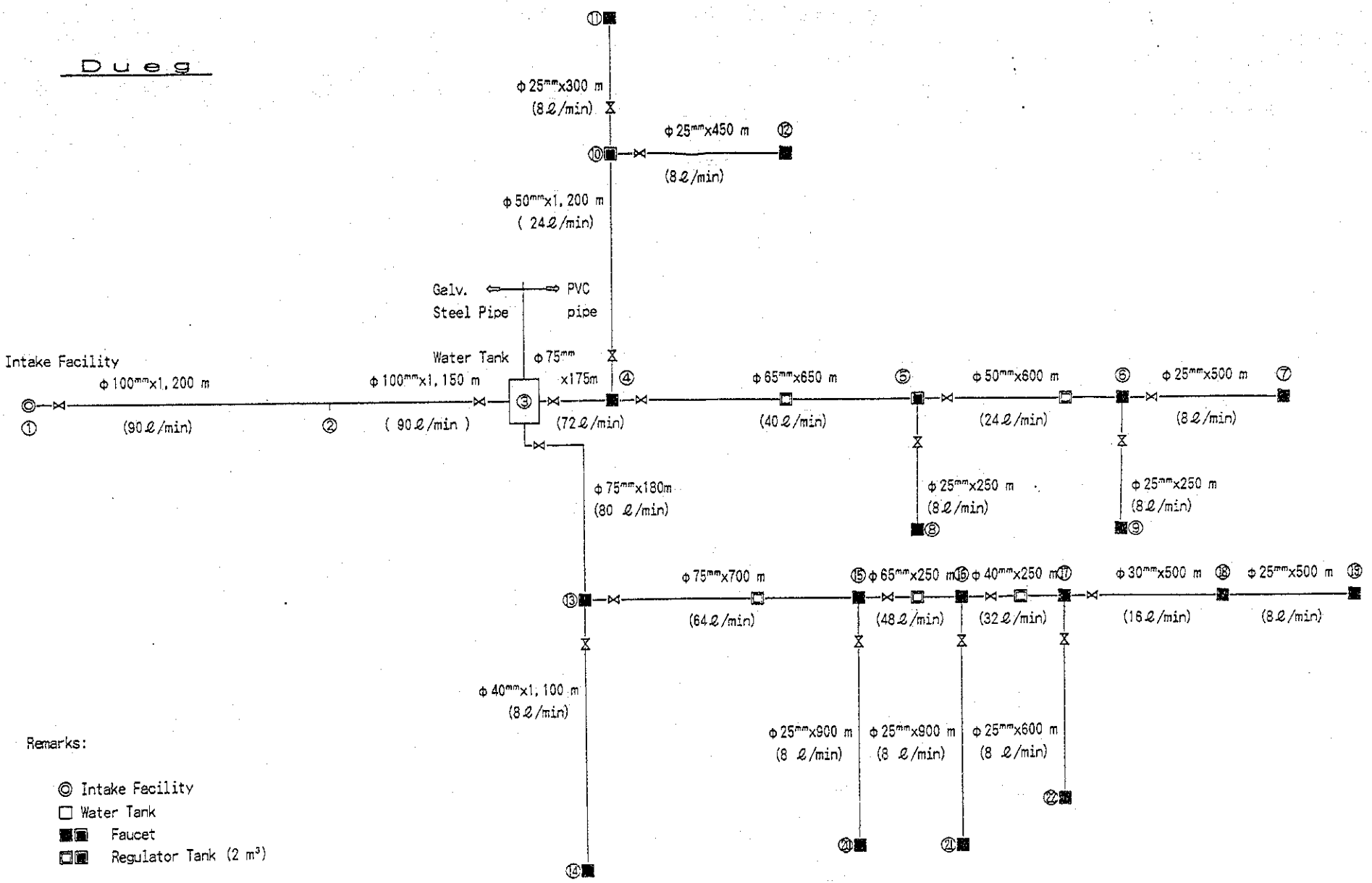
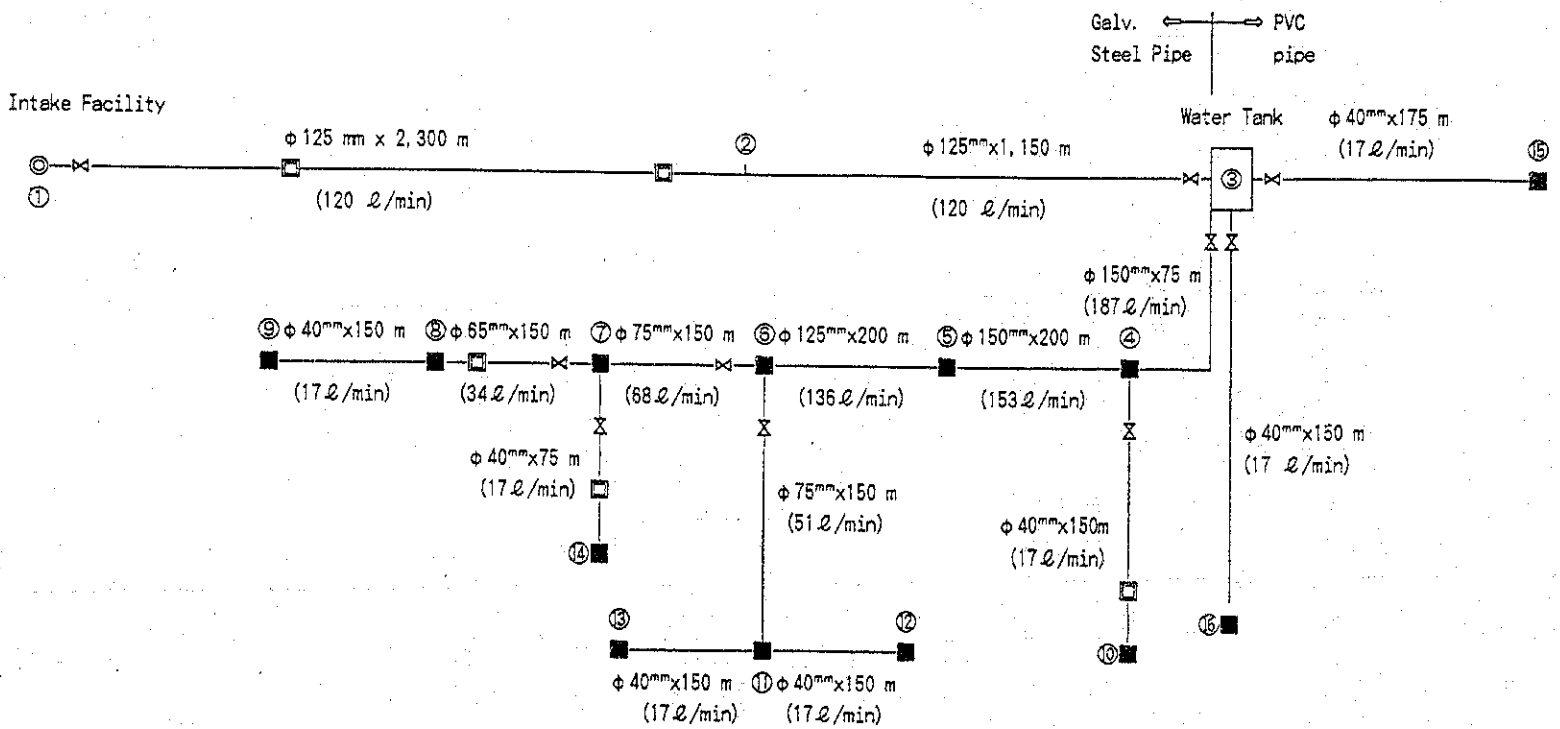


Fig. 4.3 Designed Pipeline System (1/3)



Remarks:

- ◎ Intake Facility
- □ Water Tank
- ■ Faucet
- ■ Regulator Tank (2 m³)

Fig. 4.3 Designed Pipeline System (2/3)

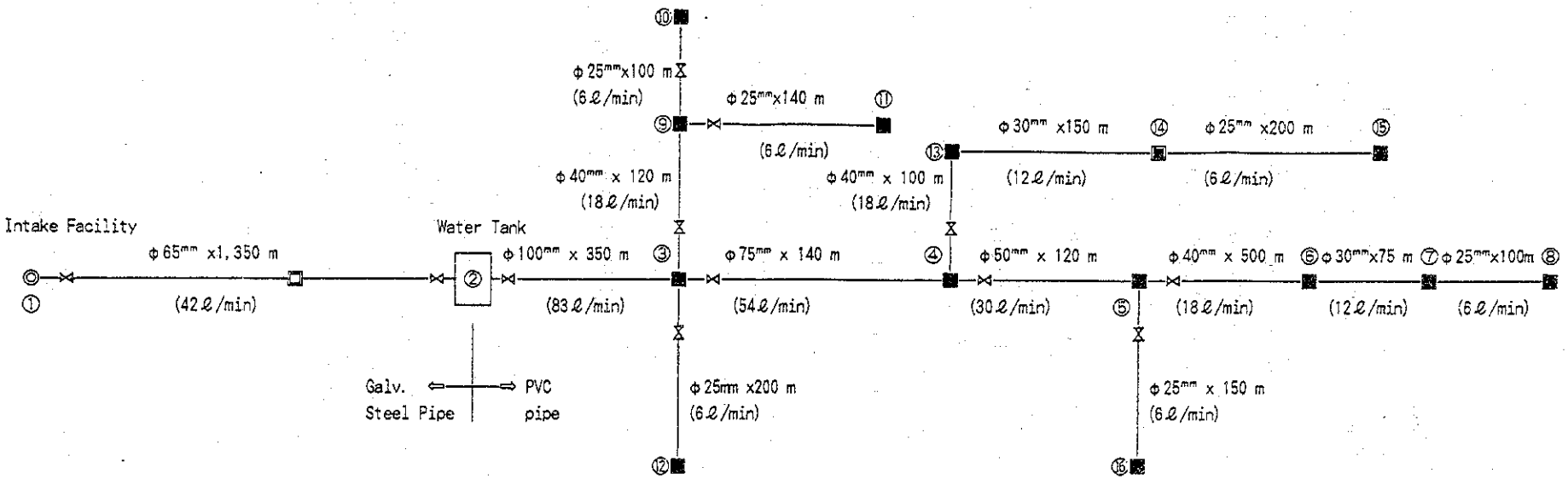


Fig. 4.3 Designed Pipeline System (3/3)

3) Intake Facility:

Design Intake Amount:
As the water supply system will use spring water and the source water qualities were evaluated as being safe, the water will be supply without any treatment.

Thus, water for water treatment facility use will be unnecessary. Further, hydraulic loss in the intake facility is negligible. Therefore, design intake amount was decided upon as same to the design daily maximum supply amount.

Water Intake System:
To secure a stable amount of spring water intake, an intake chamber shall be installed at the water source. In addition, a drainage ditch shall be provided around the water source to prevent the inflow of dirt and filthy water.

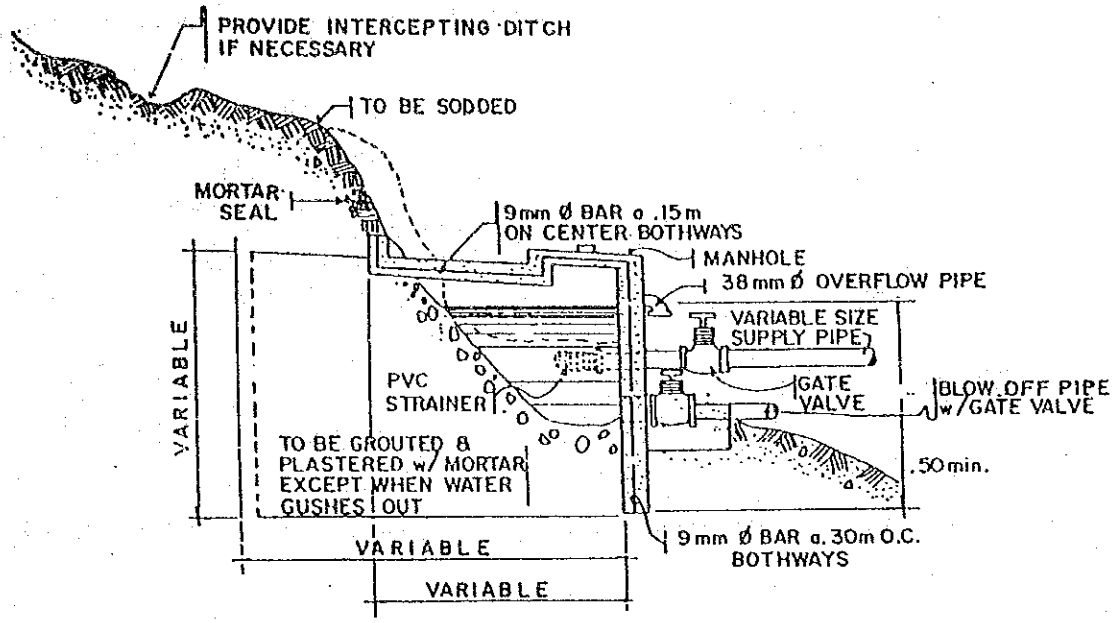
The intake structure type which suits to the surrounding environment and which does not obstruct flood flow was selected (see Fig. 4.4).

Intake Chamber:
The intake chamber shall be a simple structure. It will have a capacity of 10 to 20 minutes design intake amount.

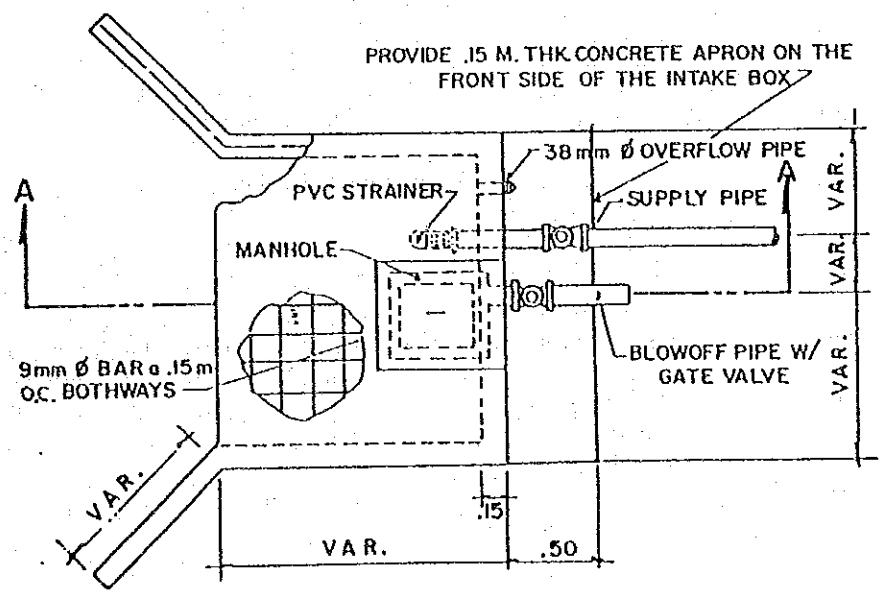
Setting Basin:
The setting basin will have a gravity flow flushing system through a gate or valve installed at the bottom of the chamber.

4) Water Distribution Facility:

The distribution tanks are to control water distribution amount. As the areas have favorable topographies, it is possible to obtain sufficient elevations for gravity flow distribution. Thus, the tanks are designed as an on-the-ground type.



SECTION A-A



PLAN

NOTE : Drawn not to scale

Fig. 4.4 Standard Intake Facilities

Capacity of the Distribution Tanks:

According to the Philippine rural water supply facility design manual, a distribution tank capacity shall be more than 1/4 of the design daily maximum supply amount.

The capacity and height of the distribution tank in each Project area are as follows:

Table 4.5 Design Capacity of Distribution Tank

Area	Capacity (m3)	Scale	Height of basement
Dampay Salasa	20	3.0W x 3.5L x 2.0H	4.0 m
Iram	50	5.0W x 5.0L x 2.0H	0.3 m
Dueg	40	4.5W x 4.5L x 2.0H	0.3 m

5) Pipeline Systems

Design Criteria

The design criteria for the water conveyance and distribution pipes are shown in Table 4.6.

The selection of pipe materials, fittings, and pressure regulating systems are shown in Table 4.6.

Table 4.6 Design Criteria for Pipeline Systems

Description	Transmission Pipes Daily Max. Water Demand	Distribution Pipes Hourly Max. Water Demand
Pipe Diameter	To be calculated from Hazen-Williams formula	
Pipe Materials	Steel pipe	PVC
Pipe Fittings	Screw joint	RR connection system or TS connection system
Pressure Reducing system	To be used for regulating tank pressure which is maintained at less than 7 kg/cm^2. Tank capacity has a period of 3 minutes water supply (Detailed is shown in Table 5.7).	
Water Taps	One tap serves 100 people and the tap diameter is 20 mm.	
Tap Diameter	The pipe diameter of taps are calculated by hourly maximum water supply capacity.	
Other Necessaries Equipment	Air relief valves, sluice valves, and others are needed.	

The diameter of the pipeline is calculated from the Hazen-Williams formula using the following water flow capacity rate:

Transmission pipeline	Daily Max. Demand
Distribution pipeline	Hourly Max. Demand

Hazen - Williams formula is demonstrated below:

$$V = 0.84935\ C.R^{0.63}.I^{0.54}(m/sec)$$

where V = velocity of flow (m/sec)

R = hydraulic radius (m)*

C = coefficient depending on the roughness and age of the pipe (110 to 140)

I = slope of the hydraulic grade line

* hydraulic radius is d/4 under round pipe and the formula can be conducted also as

$$V = 0.35464\ C.d^{0.63}.I^{0.54}(m/sec) \quad \ldots\ldots\ldots\ldots \quad (1.1)$$

where $Q(m^3/sec)$ = flow rate and $v = 4Q/d^2$

then the values of Q, d, I are given by (1.1) as

$$Q = 0.27853\ C.d^{2.63}.I^{0.54} \quad \ldots\ldots\ldots\ldots \quad (1.2)$$

$$d = 1.6258\ C^{-0.38}.I^{-0.205}.Q^{0.38} \quad \ldots\ldots\ldots\ldots \quad (1.3)$$

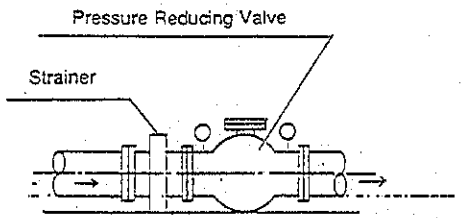
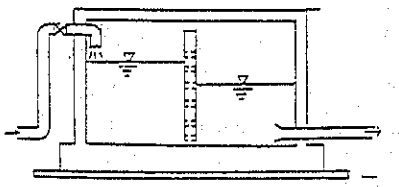
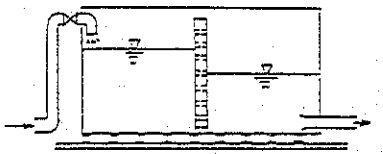
$$I = h/l = 10.666\ C^{-1.85}.d^{-4.87}.Q^{-1.85}$$

Pipeline Installation

As steel pipes will be used for the water conveyance pipelines, the pipes may be installed on the ground. But by taking account of possible corrosion at steep slope areas, they shall be buried under the ground. PVC pipes for the water distribution pipelines shall be buried under the ground because they are weak against impacts.

Standard installation depth of PVC pipes is more than 1.5 m in Japan. However, as vehicle loads in Project areas are small, 1.0 m would be appropriate. Thus, burying depth of 1.0 m is designed for the Project.

Table 4.7 Comparison of Pressure Reducing Method

System / Description	Pressure Reducing Valve	Pressure Regulating Tank	
Structures	Valves	RC Structure	FRP Tank
Procurement	From Japan	Local	From Japan
			
Structure and Construction	(Merit) 1. The installation space is the smallest of all and construction items are very simple. (Demerits) 1. Value control requires a skilled technician. 2. Frequent maintenance work is required. (Valve and strainer maintenance)	(Merits) 1. The system's structure is simple. Maintenance is easy. 2. All material can be obtained in the area. 3. The strongest against impact from the outside. (Demerits) 1. Tank interior should be protected by water proof paint. 2. Transportation of material is difficult.	(Merits) 1. The system's structure is simple. Maintenance is easy. 2. Water proofing is not necessary. 3. The material is small, light, and easy to handle and transport. (Dements) 1. The structure is prefabricated. FRP structures are not very strong against impact from the outside. 2. The material cannot be procured locally.
Construction Period	Only valves need to be installed. The construction period is the shortest of all.	The construction period is the longest of all.	Shorter construction period than the RC structure.
Economical Point	The valves cannot be obtained in locally. Imported valves are costly.	All materials can be obtained in locally and the cost is the cheapest.	The tank materials cannot be obtained in locally and imported materials are costly.
Examinations Results	X Unsatisfactory	O Satisfactory	Δ Not economical

Water Pressure Reducing Facility for Pipelines

Water pressure reducing chambers shall be provided at the high water pressure points of the water conveyance and distribution pipelines shown in Table 4.7 and no consideration will be given to use stranger material pipes at those points.

Allowable maximum water pressures in pipes for pipeline and associated facility design are as shown below, and water pressure reducing chambers shall be provided to satisfy the allowable pressures:

SPG: 25 kg/cm^2 (water head of 250m); one half of the maximum operating static pressure 50 kg/cm^2

PVC: 7 kg/cm^2 (water head of 70 m); one half of the maximum operating static pressure 15.7 kg/cm^2

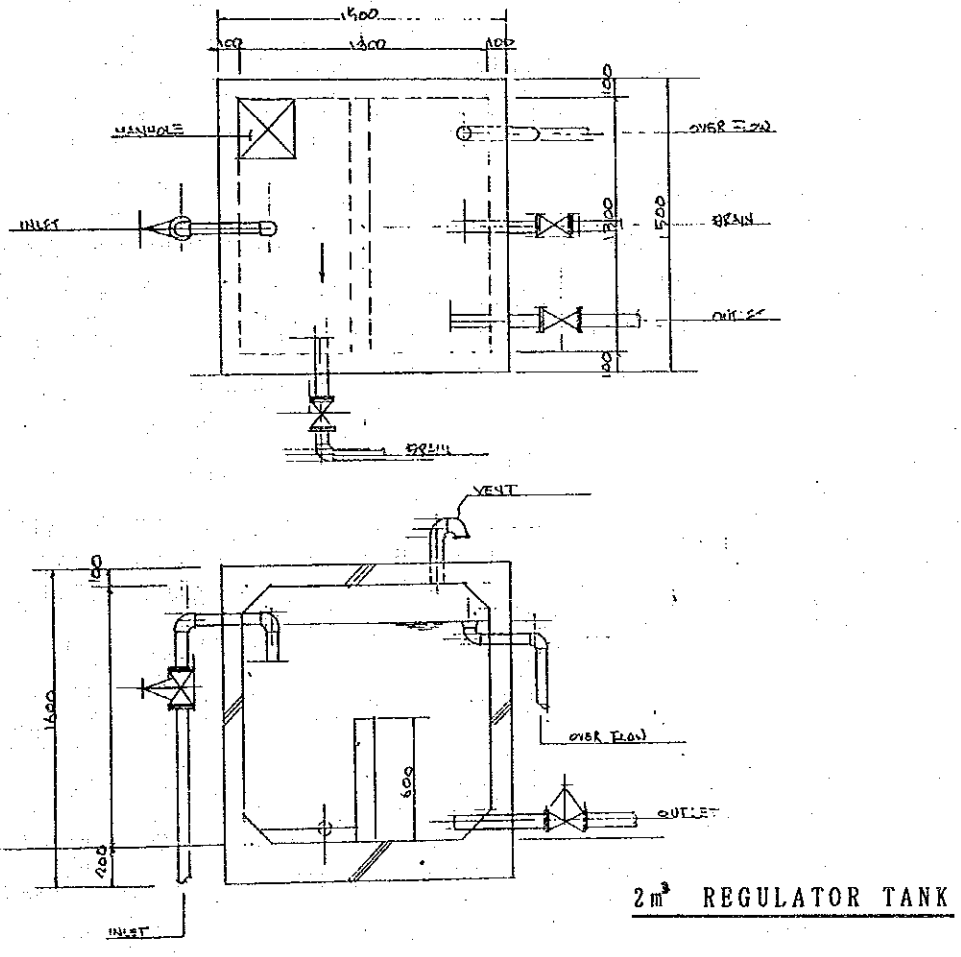


Fig. 4.5 Standard Reducing Pressure Tank

Necessary Pipeline Lengths and Pipe Diameters

Pipeline lengths, pipe diameters, and head losses were examined based on the design water supply amount, water distribution routes. The following pipeline lengths and pipe diameters are required for each Project area (refer Annex for the details):

Table 4.8 Calculated Pipe Diameter

Site	Total Length of Pipeline		
	Dampa Salasa	Iram	Dueg
Transmission line	-	-	-
dia.100 mm	-	3,450	2,350
65	1,350	-	-
Distribution Line	-	-	-
dia.100mm	333	308	-
75	136	339	-
65	-	167	1,463
50	117	-	1,010
40	244	738	227
30	422	-	536
25	1,148	329	6,166
Total	2,400	1,925	10,255

Public Stand Pipes

Number of public stand pipes and the locations to be provided were decided upon based on the community numbers and population, and the supply rate of one stand pipe per 100 people. A community having a large population will have more than one stand pipes. Thus, as shown in Table 4.9, stands having two or three faucets are planned.

Table 4.9 Required Public Stand Pipes

Site	No, of Blocks Served (No.of Stand Pipe)	Popula.	Discharge (l/min per Stand)	Popula. per Stand	No. of Taps / Stand
- Dampay Salasa	14	1,555	6	111	1
- Iram	13	4,200	17	323	3
- Dueg	20	3,000	8	150	2

Appurtenant Facilities

The appurtenant facilities for the piped water supply system, such as drainage ditches, and infiltration pits, are to be installed around the reservoir tank and regulator tank to prevent erosion of ground surface.

The structure shall be similar to that of well appurtenant facilities, i.e. of concrete, having 9 mm round steel bars at 150 mm intervals to prevent cracking.

4.3.3 Equipment and Materials

(1) Selection of Main Equipment and Materials

Main equipment and materials to be utilized are selected in this chapter, based on the design of well and spring water as studied in last section and construction planning as studied in next section.

Equipment and materials to be necessary for implementation of this project are listed as follows.

Construction of Well

- Equipment
  - . Well Drilling Rig
  - . Maintenance Service Truck and Supporting Vehicle (including Vehicle for drilling tools, pumping test and concrete pad)
  - . Borehole Testing Equipment
  - . Spare parts for above
- Materials
  - . Well casing and screen
  - . Mud agent
  - . Hand pump set
  - . Cement, sand, gravel, etc.

Spring Construction

- Equipment
  - . Construction Equipment (also to be used for access road construction)
  - . Supporting Vehicle
- Materials
  - . Materials for Water Tank
  - . Materials for pipeline, tank, valves, etc.
  - . Cement, sand, gravel, reinforced bar, etc.

Maintenance Workshop

Selection for suitable equipment and materials are described hereunder.

Well service rig, supporting vehicle for well construction and piped system facilities construction, as well as construction equipment fot these are described in one group.

1) Well Drilling Rig

Capacity/General Specification

The design of well depth is averaged at 80 m, and it will be required to drill max. 100 m according to geological condition. Therefore the rig shall have nominal capacity of not less than 200 m depth.

The rig shall be able to use down-the-hole (D.T.H.)hammer drilling method for rock and hard formation and rotary mud drilling for sedimentary formation.

The rig shall be of a truck mounted type for quick mobilization. The mud pump for mud rotary shall be mounted on the same truck.

Quantity

Required numbers of well drilling rig and DTH drilling tools are five (5) units and Three (3) sets respectively, based on reasons described hereunder. The summary of project implementing schedule using 5 units of well drilling rig is mentioned in section 4.2 "Examination of Request Contents"

The plan's target of construction totals 866 nos of well within 8 years. Considering the maintenance period, the site conditions such as topology, geology and climates, one unit of rig is capable to construct 25 nos of well(2 - 2.5 nos/month), therefore 5 units of well drilling rig is required as follows.

866 nos ÷ 8 years ÷ 25 nos/(year unit) = 4.33 units
= 5 units

The construction of 64 nos of well by general grant aid shall be constructed in hilly area and scheduled construction within 7 months per year which excludes the rainy season from June to October. The Total construction period, in 2 stages i.e. 2 fiscal years, will supply equipment, preparation works require for approx. 7 months, actual construction period shall be 7 months. Thus, 5 units of drilling rig are required as same manner of above.

64 wells ÷ (7 months x 2 wells/month) = 4.57 units
= 5 units

The required nos of DTH hammer drilling tools and high pressure air compressor shall be calculated from the proportion of well nos. to be constructed in base rock formation against all well nos of proposed general grant aid project, which is assumed equal to the proportion of drilling in base rock formation in total water supply project in the affected area:

41 nos ÷ 64 nos = 64 %
(in base rock formation) (Total)

5 units x 64 % = 3.2 units
≒ 3 units

Therefore required nos of DTH hammer tools and High pressure compressor shall be of 3 sets.

2) Maintenance Service Truck, Supporting Vehicle, Construction Equipment

The type and required numbers of vehicle and construction equipment necessary for the implementation of the project is summarized for each construction works in Table 4.10.

Table 4.10 Type and Number Construction Vehicles Required for Project

Construction Works	Nos. of Team	Type of Vehicle and Construction Equipment											Total
		A	B	C	D	E	F	G	H	I	J	K	
Supervising	1						1						1
Survey	1						1						1
Well Drilling	5	3	5			5	3		3	2			21
Pumping Test	2			2									2
Pump pad	2			1	1								2
Pump setting	1												0
Spring	1		1		1	1		1					4
Road repairing	1					1					1	1	3
Total		3	6	3	2	7	5	1	3	2	1	1	34

A: Maintenance Service Truck of medium payload capacity with crane (to be use a cargo truck when construction)
B: Maintenance Service Truck with crane and long body (to be use as cargo truck when construction)
C: Small cargo truck with crane
D: Dump truck
E: Station wagon type light vehicle
G: Low body trailer with tractor
H: Water tank lorry
I: Fuel tank lorry
J: Bulldozer
K: Grader

The study for each vehicle and construction equipment based on the above quantity and its usage are described hereunder.

Maintenance Service Truck (To be used as cargo truck when constructing)

The requested Maintenance service truck shall be used as transportation, mounting of supporting equipment for well construction and rehabilitation of well, such as change of pump or cleaning of constructed well.

The truck shall be all wheel drive to move in bad road condition in proposed project area and shall have a medium Payload capacity considering the weight of supporting equipment.

i) Cargo truck of medium payload capacity with crane
Considering the hard access to roads, high pressure air compressor for DTH drilling method and heavy equipment for maintenance shall be mounted on the truck as for safety reasons.

This cargo truck, used for the maintenance of the wells, shall be equipped with more than 3 tons capacity hydraulic crane to also be able to load or unload the supporting equipment and to change the pump fasilities of constructed hand pump wells .

The numbers of high pressure air compressor for DTH hammer drilling are 3 units, thus 3 units for the said cargo truck.

ii) Cargo truck with crane and Long body
Used for routine maintenance of constructed wells and transportation of drilling tools, casing and screens which are essential for every well construction.

This cargo truck shall have a long body to be able to transport 6 m long drill pipes, casing, screen and others, and shall be equipped with more than 1.5 tons capacity hydraulic crane to load and unload different materials and to use for rutine maintenance of wells.

Each well drilling rig shall work with this cargo truck and each site office will need one truck of this type for maintenance works, until totaling 5 units if necessary.

Although the requested maintenance service truck iconsists of 5 units, the above mentioned 8 units of trucks are essential for the operation of well drilling rigs and for the well maintenance works, therefore it shall be supplied by the Project.

Cargo Truck

i) Cargo truck with crane and long body

Besides well construction, the spring water supply system construction work shall be undertaken. In that matter, the truck shall be used for transportation of materials. It is also equiped with more than 3 tons hydraulic crane.and a long body.

ii) Small cargo truck with crane

Shall be used for borehole test such as borehole logging, pumping test after well drilling and transportation of equipment such as mixer for the construction of concrete pad.

Pumping test shall be done by 2 teams, and construction of concrete pad shall be planned to be done by 1 team, therefore 3 units are necessary. These works are essential for well drilling, therefore this small cargo truck shall be supplied by the Project.

iii) Dump truck

One unit of dump truck shall be used for well construction and the transportation of sand and gravel for the construction concrete pad; another one unit shall be used for the construction of piped water supply systems and for the transport of sand and gravel. Thus, 2 units are necessary for the Project.

Light Vehicle

i) Pickup type light vehicle

For transportation of small volume materials, each team (drilling, spring water, road improvement) shall be provided these pickup trucks.

ii) Station Wagon type light vehicle

For geo-electric survey, crews of supervisor and well drilling teams.

Other Special Vehicles

i) Water Tank Lorry

Water tank lorry of approx. 4,000 l capacity shall be necessary to transport water to make mud-water for drilling. Although five well drilling rig units are required, 3 units of water tank lorry shall be used in parallel to cover all well drilling rigs.

ii) Fuel Tank Lorry

Fuel tank lorry of approx. 4,000 l capacity shall be necessary to transport fuels for well drilling rigs, air compressors and construction equipment .twice a week per site; 2 units of fuel tank lorry shall be used to cover 3 to 5 sites. Portable fuel tank shall be prepared at each well drilling sites and spring water facility construction site.

These two special vehicles are essential for the operation of 5 well drilling rigs, thus it shall be supplied by the Project.

iii) Low body trailer with tractor

For the transportation of construction equipment such as bulldozer, backhoe one unit of low body trailer is necessary.

iv) Construction Equipment

Due to poor and hilly roads, it will be difficult to mobilize well drilling rig and equipment to the sites; difficulties may occur. Therefore Bulldozer and grader shall be necessary for access road repairings and site grading.

3) Equipment for Borehole Test and Borehole Monitoring

Borehole testing equipment for well construction shall consists of borehole logger, pumping test equipment, water level meter and water analysis test kit, as a request of the Philippines side..

The pumping test is planned to be done by 2 teams in the Project, and the same team structure is adequate for its use when implementing the future well construction works by Philippines Government. Therefore borehole testing equipment such as borehole logger and pumping equipment shall be supplied for each borehole test teams and 2 sets shall be provided by the Project.

Borehole logger

The logger shall be able to measure resistivity, spontaneous potential of borehole upto 200m depth and shall be of self recording type.

Pumping Test Equipment

The pumping test shall be done by submersible motor pump made for 4 inches wells. It is assumed the dynamic water level as 60 m depth, therefore submersible pump shall have total head of 70 m and capacity of 100 lit/min and shall be equipped with suitable generator.

Water table and quality of constructed well shall be checked by site office as a routine monitoring works. Thus, each site office shall responsible of these monitoring equipment. Therefore, 5 units for 5 site offices shall be supplied by the Project.

Water level meter

The water level meter shall be used when pumping test and long term monitoring of water level of wells and shall have capacity of 100 m depth.

Water Analysis Kit

The equipment shall be portable and able to measure more than 10 items such as turbidity, color, Nitrogen, chlorine, hexavalent chromium; it should also include a pocket type electric conductivity meter and pH meter.

4) Materials for Well Construction

The materials are basically to be imported to Philippines except for the hand pump, shall be procured from Japan.

Casing and Screens

The material of casing and screens shall be FRP (Fiber Reinforced Plastic) which are previously used in DPWH, having high durability and strength and light weight for easier handling.

The unit length of casing and screen shall be 4 m, required numbers per well of average depth of 80 m shall be as under.

Casing : (100 mm dia.) 4 m x 16 nos = 64 m
Screen : (100 mm dia.) 4 m x 4 nos = 16 m(20% of total)
Total = 80 m

10% should be added to required numbers:

Casing : 16 nos x 64 wells x 1.1 = 1,127 nos
Screen : 4 nos x 64 wells x 1.1 = 282 nos

The bottom plug shall be of the same material to casing and total numbers shall add 10% of spare.

The centralizer shall be set every 8 m length of casing; the material shall be economical, have sufficient strength of PVC and total numbers shall add 10% of spare.

Mud Agent

The total drilling length of 64 wells is approx. 5,120m. The length to be drilled by mud rotary is approx 2,250 m and approx 2,870 m by DTH hammer. The mud agents shall be prepared according to above drilling length including 15% of waste as under.

Biodegradable polymer (RESTER)	4,500 kg
Foam agent	2,070 kg

Hand pump Set

The hand pump shall set for 64 wells. Considering future change, around 10% of spare set shall be added, thus total 70sets shall be prepared. Pump cylinder shall be deep set plunger type and riser pipes; connecting rod shall have a total 50 m per set.

Products shall be made in the Philippines which shall be economical, and spare parts locally available.

5) Materials for the Construction of Piped Water Supply System by Spring

Materials for Pipe Line

Considered are the total length of pipe line, the difference of altitude and the topological conditions. Materials shall be selected as follows. Materials shall be basically procured in the Philippines except panel type water storage tank which shall be imported.

- Pipes for Supply Pipe Line

Head between intake point(spring) and water storage tank of area shall be 100 - 150 m, the pipe line will be laid in steep hilly and remote places from villages difficult to reach by car. Pipes shall then be made out of steel for water service (SGP carbon steel pipes with zinc galvanized). Diameter shall be determined based on the hydraulic calculation of water supply system design.

- Pipes for Distribution Line

In the villages, repairing and maintenance of distribution line encounters no major difficulties, therefore pipes shall be made of PVC which is economical and easily handled. Diameter shall be determined based on the hydraulic calculation.

Additional 10% of these previously mentioned pipes should be prepared. The study of Materials of pipes are summarized in Table 4.11.

Water Storage Tank

Considering the difficult access to the proposed sites, topological condition, tank shall be of panel type which has merit of easier mobilization, construction and flexibility of size expansion.

The study of materials are summarized in Table 4.12.

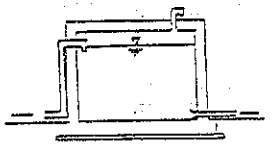
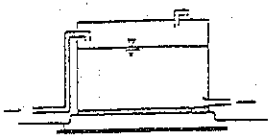
Faucets

Faucets shall be made in the Philippines. Numbers shall be calculated based on populations of users and shall add 15% spare.

Table 4.11 Relative Advantages of Pipe Material

Descriptions \ Type of pipe	Ductile Cast Iron Pipe		Steel Pipe		PVC	
Procurement	From Japan		Local		Local	
Materials Tension Bend Specific Gravity	Min. 42.8 Min. 61.1 7.05		Min. 41 Min. 41 7.85		Min. 5.3 as 20°C 8 to 10 as 20°C 1.43	
Characteristics • Impact from outside • Impact from inside (Max. static pressure)	6 to 10 kg - m/cm² 7.5 to 4.0 kg/cm² Merits (1) Intensive and corrosion resistance (2) Strong against impact (3) Mechanical joint is flexible and expansive (4) Easy to construct (5) Many kinds of joints Demerits (1) Heavy (2) Needs specials protection against joint removal (3) Needs outside lining in humus (4) Large size pipes are impossible to repair from the inside		Merits (1) Intensive (tension and bend) (2) Strong to impact (3) No need countermeasure to joint remove by welding joint (4) Light (5) Easy to manufacture Demerites (1) Needs temperature expansion joint or flexible joint (2) Weak against electric corrosion (3) Takes a long time welding and line. Difficult to construct in spring ground. (4) Very flexible (large size pipe)		0.07 to 0.1 kg - m/cm² 15.7 kg/cm² Merits (1) Corrosion and electric corrosion resistance (2) Light, easy to construct (3) Adhesive (4) Inside roughness does not change (5) Inexpensive Demerits (1) Weak against impact at low temperatures (2) Weak against ultraviolet rays and organic solvents (3) Caution to fire solvent cement (4) Needs temperature expansive and flexible joints.	
Costs Ratio φ 100 mm 150 200 250	3.7 2.6 2.3 1.9		2.4 1.9 - -		1 1 1 1	
Examination Results	Surface Unsatisfactory	Underground Unsatisfactory	Surface Satisfactory	Underground Satisfactory	Surface Unsatisfactory	Underground Satisfactory

Table 4.12 Comparison of Distribution Tank

Systems	RC Structural Tank	FRP Panel Tank
Procurement	Local	From Japan
Outline Drawings	Ground type 	Ground type Elevated type 
Structures and Constructions	(Merits) 1. Strongest against impact from the outside (RC structure) 2. Procurement can be made locally (Demerits) 1. Many types of material are needed for the construction work, but it is difficult to transport the material because of conditions in the Project area. 2. Waterproof is required in the tank. 3. Requires the strongest foundation for supporting heavy tanks. 4. Construction materials, such as molding boxes (round shape), scaffolding, for the high elevated tank cannot be procured locally.	(Merits) 1. The foundation structure is the smallest. 2. Transportation is the easiest (Demerits) 1. The FRP structure is not very strong against impacts from the outside. 2. Tank materials (FRP) cannot be procured locally.
Construction Period	There are many items needed for construction, such as reinforcement, molding box, etc. Construction period is the longest. (Grand type: 5.5 months High elevated type: 12.5 months)	The only RC structure is the foundation. FRP material is light and the construction period is short. (Grand type: 2.2 months High elevated type: 4.4 months)

Valves, Joints, etc.

Following materials are necessary for water supply system:

Air valves (in place of many unevenness of surface)
Stop valves
Joints

TS joint, RR joint, TS collar joint shall be used for PVC pipes and shall be selected as suitable ones according to the diameter and position. Threaded socket joints shall be used for SGP steel pipes.

Above materials shall be procurable in the Philippines and shall be added 15% of spare.

6) General Materials

Cement, sands, gravel, reinforced steel bars and others are necessary for the construction of well and spring facilities. These materials shall be procured in San Fernando, the nearest major city to the sites. Quantities shall be determined according to the design.

7) Maintenance Workshop Tools

Workshop tools shall be selected to maintain the well construction equipment, auxiliary drilling works and well maintenance. This item was not requested previously, however it was found that newly formed MPR-PMO did not have sufficient maintenance equipment, thus it was additionally requested by the Philippines.

In this project, the workshop tools are selected as under, mainly for the maintenance of well construction equipment set and to be brought by supply of Equipment.

. Portable lathe (for threading of pipes and parts machining)	1 unit
. Electric tools (Electric saw, grinder, drills, etc)	1 set
. Mechanic tools	1 set
. Tools for pipe works	1 set
. Diesel generator, 50KVA	1 set
. Diesel welder/generator (shall be used in construction sites of this project also)	3 sets

These equipment shall be used in the maintenance section of San Fernando's MPR-PMO project office. A diesel generator shall be brought given the difficulties of power supply in the Philippines.

8) Spare Parts

Spare parts for supply equipment such as well drilling rig, air compressor, vehicles and workshop tools shall be brought for approx. 2 years normal operations.

4.4 Implementation Plan

4.4.1 Project Implementation System

1) Project Implementation Agency

The Department of Public Works and Highways (DPWH) of the Government of the Philippines will be responsible for implementing the Project. The actual Project construction will be undertaken directly by the MPR-PMO of DPWH.

After the Government of Philippines and the Government of Japan sign the Exchange of Notes, MPR-PMO will secure the personnel necessary for the Project construction, and procure the equipment and materials necessary for the Project (equipment and materials other than those provided by the Japanese side) at its own expense. It will conduct the construction of the hand pump operated deep wells and level II water supply facilities of spring water sources by using the equipment and materials provided under the Project.

With the cooperation of other Philippines agencies concerned, DPWH will sign the Exchange of Notes together with the Government of Japan. It will smoothly carry out various procedures, such as banking arrangements, tax exemption and customs clearance for the imported equipment and materials for the Project, site procurement, tax exemption and customs clearance for Japanese engineers required for the Project implementation, etc.

2) Consultant

Immediately after signing the Exchange of Notes for the Project by the Japanese and Philippines governments, the consultant will make a contract with DPWH to proceed with the following consulting services:

a) Assisting with the equipment and materials procurement, in the preparation of the detailed design and tender documents.
b) Assisting with the tendering and evaluation of tender documents.contractor in preparation of the agreement.
d) Supervision of procurement and transportation of equipment and materials, and the contractor of the Project.
e) Site selection, facilities design and technical transfer.
f) Other related services

3) Contractor

The contractor shall procure the equipment and materials specified in the contract and transport them to the Philippines. The contractor shall construct the water supply facilities and dispatch engineers to the Philippines for the set period of the contract. The contract will facilitate the transfer of techniques related to the construction of hand pump operated wells and piped water supply facilities.

4.4.2 The Boundary of Responsibility for the Project

The Project work will include the construction of 866hand pump wells, 8 piped water supply facilities and the provision of necessary equipment and materials.

The Project can be implemented within the limitations of the Japanese grant aid program. The responsibilities of the Philippines and the Japanese government in relation to the Project are as follows:

1) Items to be covered by the grant aid from the Japanese Government:

a) Procurement, transportation, and delivery of the major equipment and materials described in Section 4.3.3 "Equipment and Materials."
b) The necessary measures for the construction of hand pump operated bore holes at 64 facilities and piped water supply systems of spring sources at 3 sites.
c) Design management services related to the above Project items including the dispatch of design management engineers.

2) Items to be borne by the Government of Philippines

a) Promotion of the Project until its completion.
b) Secure sufficient number of personnel at its own expense for over all implementation of the Project.
c) Procurement of equipment and materials, and construction of water supply facilities which will not be provided by the grant aid from the Government of Japan.
d) Acquiring land and construction of structures which are needed for the implementation of the Project.
e) Ensuring tax exemption and customs clearance for the Project goods at the port of disembarkation

f) Exempting Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Philippines with respect to the supply of the products and services under the verified contracts.
g) Granting permission for the entry of the Japanese nationals whose services may be required in connection with the supply of the products under the contract.
h) Bearing all the expenses, other than those to be borne by the Grant Aid, necessary for the execution of the Project.
i) To organize the responsible agencies needed for the Project implementation and for Project facilities management and operation after Project construction and to assign counterpart personnel to the agencies.
j) To ensure the necessary budget and personnel for the proper operation and maintenance of the constructed Project facilities and equipment.

4.4.3 Construction Supervision Plan

For the implementation of the Project, the Government of Philippines will undertake the following work by using a consultant firm (hereinafter referred to as the consultant).

1) Detailed Design

Based on the Basic Design Study of the Project, the consultant will conduct field surveys and prepare the detailed design and tender documents. During this detailed design, the consultant will confirm the Project implementation organization and the amount of budgetary fund of the Government of Philippines. The consultant will also confirm the progress of the undertakings which will be borne by the Government of Philippines in accordance with the previous agreement and will reflect in the progress of the tender documents.

2) Tendering and Signing of the Contract

The consultant will conduct tendering announcement, pre-qualification evaluation, tender document delivery, and tender evaluation. The consultant will then assist the Government of Philippines in preparing a construction contract agreement with a Japanese contractor.

3) Construction Supervision

- Work to be Conducted in Japan

After signing of the construction contract, the consultant will examine the drawings and documents submitted by the contractor and will inspect the equipment and materials procured by the contractor.

- Construction Supervision at the Project Site

The consultant will undertake various proceedings required for starting the Project construction, witness the local procurement of equipment and materials, inspect work progress, advise and supervise the contractor, conduct quality and cost control in order to complete Project construction within the schedule specified in the Exchange of Notes for the Project.

- Construction Supervision System

Civil engineering work for the Project is divided into the construction of access roads and wells, and water supply system.

To conduct the construction supervision, one civil engineer will remain at the site continuously and one chief project engineer will visit the site at the commencement and completion of the Project.

4.4.4 Construction Plan

1) Basic Policies

Among the overall water supply Plan of 874 facilities, the Japanese side shall provide the technical advice and construction supervision for constructing supervision for constructing a certain number of the water supply facilities which can be covered by the Japanese Government's Grant Aid Cooperation. The remaining facilities which can not be constructed during this construction period under the grant aid cooperation shall be constructed later on by the Philippines side using the equipment provided and the transferred technology.

Grant Aid Cooperation Project:

. MPR-PMO will be the Project implementation agency. The project implementation shall be effectively undertaken based on the rules of the Japanese grant aid cooperation.

. Construction schedule and work organization shall be planned to be practical and efficient by taking into consideration the equipment procurement, transportation means, construction period, signing period of the Exchange of Notes, and technology transfer.

. The roles of the Japanese engineers includes providing technical advice and guidance, technical transfer, and construction supervision during the Project implementation. The staffing plan shall be prepared according to the above aspects.

. The rainy season in the Project areas is from June to October. Average monthly rainfall during the said season exceeds 500 mm. Construction work is extremely difficult during the rainy season. Thus, special attention must be paid on construction schedule over this period.

. When preparing the construction schedule, the Philippines job classification rule, local workers' skill and technical level should be considered.

. The project areas are widely scattered in 8 sites of 3 provinces and includes various types of work. Thus, it would be desirable to contract with one contractor who will manage the entire Project work, including equipment and material procurement, and facility construction. The rules for the contractor selection shall be decided through the discussions with DPWH during the contract document preparation.

. DPWH shall procure the required tanks for the Project facility construction prior to commencing the construction, based on the boundaries of work to be borne by the Philippines side and the Japanese side and the facility design drawings.

2) Quantity of Project Work

The quantity of Project work is listed in Table 4.13

Table 4.13 Quantity of Construction Work

	Under Grant Aid	After Grant Aid
Hand pump well	64 wells	802 wells
Piped Water Supply System	3 sites	5 sites
Project area		
. Resettlement Areas	8 sites	5 sites
. Barangays		369

3) Implementation Schedule of the Water Supply Overall Plan

The implementation schedule of the Overall Planwhich requires 8 years from commencement to completion was examined by MPR-PMO, as mentioned in Chapter 4. The schedule is divided into two sub-plans: Initial stage -the Japanese Grant Aid Project and following stage - Philippino Project conducted by DPWH, as shown below.

Initial Stage: Japanese Grant Aid Project

- Construction and procurement under the Japanese Grant Aid
  - Preparation (0.5 year)
  - Construction period (1.5 years)

Following Stage: Philippino Project

- Construction to be conducted by DPWH
  - Construction period including turn over of the
  - Equipment (7.0 years)

4) Construction Implementation System

As shown in Fig. 4.6, the construction implementation system can be classified into 6 sections necessary for the construction of hand pump wells and piped water supply systems. For efficient performance, each section shall be specialized to suit the type of work to be performed. If required, each section can possess its own independent work groups.

The responsibilities of each section and group are described in the Staffing Plan.

The six sections are as follows:

- Project Management Section
- Construction Supervising Section
- Construction Management Section
- Well Construction Management Section
- Piped Water Supply facilities' Construction Section
- Warehouse Management and Equipment Repair, Maintenance, and Management Section

After two years from the Project commencement, the project operation will be carried out by DPWH itself. Therefore, the transfer of techniques to the Philippines staff should be carried out during the Phase I construction period.

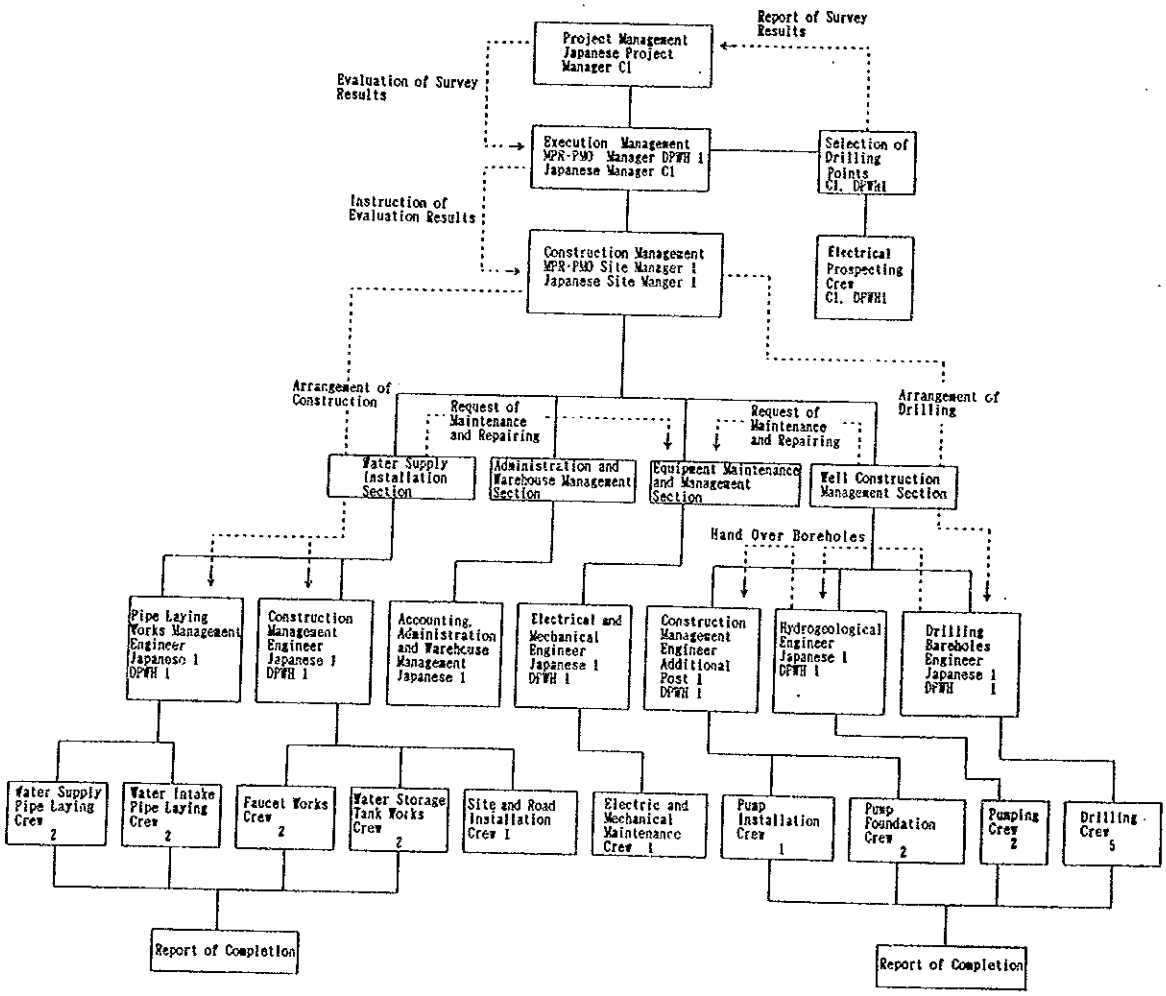


Fig. 4.6 Project Implementation System

5) Work Procedures

It is necessary to understand the work procedures and the contents of each type of work in order to examine the construction schedule. The work procedures and work contents are summarized below :

- Hand pump Wells
  - Selection of drilling points
    - Examination of population distribution in the Site
    - Examination of topography, geology and ground water hydrology
    - Electrical prospecting

  - Drilling bore holes
    - Preparation
    - Drilling
    - Borehole logging, appreciation of aquifer
    - Decision of depth for screen, installation of casing & screen

  - Pumping test and pump installation
    - Pumping test, water quality test
    - Foundation of hand pump, concrete slab
    - Installation of hand pump

- Piped water supply systems
  - Confirmation of distribution system
    - Examination of population distribution in the site
    - Examination of topography and geology

  - Preparation
  - Construction of intake facilities
  - Construction of transmission facilities
  - Construction of reservoir tank
  - Construction of distribution pipeline
  - Construction of water service facilities

Temporary work includes base camp construction, access road improvement, and site preparation. All access roads from major roads to the Project's resettlement areas are in very poor conditions; unpaved, narrow, steep and sloppy. Their lengths are 8 to 18 km.

As the construction equipment and materials can not be transported through the present roads, they must be improved by using a bulldozer and grader. Further, the resettlement areas are sloped; drilling machinery and its associated equipment cannot be placed. Hence reclamation shall be carried out in these areas.

The base camp shall be constructed in San Fernando. Mobil camps shall be set up on Iba and Olongapo as shown in Table 4.14.

Table 4.14 Location of Camps and Their Charging Sites

Location	Project Site	Piped Water Supply Facilities	Wells	Geology
Base Camp	Camies	-	8 wells	Volcanic Sediments
(San Fernando)	Kalangitan	-	15 wells	"
	Dompay Salasa	1 site	-	Hard Basal Rocks
Mobile Camp	Loob-Bunga	-	13 wells	"
(Iba)	Baquilan	-	8 wells	"
Mobile Camp	Cawag		20 wells	"
(Olongapo)	Iram	1 site	-	Volcanic Sediments
	Dueg*	1 site	-	Hard Basal Rocks

6) Construction Schedule Plan Under the Grant Aid Programme

The first step in the construction schedule is the signing of the Exchange of Notes. The second step is the preparation of detailed design by consultants. Then, after selecting a contractor by bidding, the construction work will start. It would be very dangerous to do the construction work in the mountainous resettlement areas during rainy seasons. Thus, it would be appropriate to assume 9 months construction period in a year. The total construction period would be over 15 months.

By taking into account the Project's total work amount and the rules of the Japanese Government's grant aid cooperation, it would be most appropriate to implement the Project in two phases. Work schedule during each phase is outlined below:

Phase I Period

Depending on the time when the Exchange of Notes will be signed, the equipment and material procurement and construction period during the Phase I will be approximately 8 to 9 months by taking account of the period necessary for detailed design, tendering work and the rainy season. Procurement of boring equipment will require about four months. Equipment shipping, customs clearance, staff training, and site study will require one to two months. Thus, the actual well construction period will be two to three months.

On the other hand, four to five months may be spent for the construction of spring water use facilities. In conclusion, the field work period of Phase I will be about two months of well construction and about four to five months of spring water use facility construction.

Phase II Period

The remaining work shall be completed during Phase II period. The maximum period for the field work will be 9 months.

In view of the above considerations, the schedule to construct water supply facilities under the Japanese Government's grant aid cooperation was examined as shown below :

Number of Workdays:

The number of workdays for the Project construction was calculated based on the Philippines' work conditions as follows:

Working hour: 8:00 to 17:00, 8 hours a day

Workdays were calculated for the rainy and the dry seasons as follows:

. Dry Season:

During the dry season, from October to July, the non workdays such as sundays, ordinary holidays, Christmas, and Easter are 18 days (average of 6 days a month). Thus, the average monthly workdays are 23 days.

. Rainy Season:

Possible workdays during the rainy season are approximately one half of a month. Thus, the average workdays per month are 14 days including some sundays and holidays.

. Average Yearly Workdays:

By averaging the monthly workdays during the dry season (8 months a year) and the rainy season (4 months a year), the average yearly workdays will be as follows:

23 days/month x 2/3 + 14 days/month x 1/3 = 20 days/month

Number of Days Required for Construction Work:

Number of workdays required for construction work was examined in accordance with the construction work process and by referring to the data and information obtained as shown below :

. Temporary Work:

. The number of workdays required for temporary work such as the field office set up, site preparation work, and access road improvement work was estimated based on the data from the past projects.

. Based on the Well Construction Standard Work Rate Manual of the Japan Well Construction Association and considering the possibility of dry holes, the number of workdays required for well construction work including drilling work and pumping test was calculated by increasing the estimated work amount by 10%.

Civil Work, Such as Pipe, Earth, and Concrete Work

. Number of workdays required for civil work was calculated based on the Japanese Ministry of Construction's Civil Work Standard Work Rate Manual, data on similar projects in the Philippines, and the results of hearing surveys conducted at DPWH and field surveys.

a) Temporary Work:

. Base Camp Set Up (in San Fernando):

Thirty (30) days will be needed for setting up the office, equipment management and maintenance, and material storage.

. Mobil Camp Set Up (in Iba and Olongapo):

Each camp will manage two or three construction sites. The camps must have a field office, equipment management and maintenance, and material storage functions.

Total of 7 days will be needed.

. Access Road Improvement and Site Reclamation (2.5 days)

Bulldozers and graders shall be used for the work.

They shall be moved from Manila. The access roads are 1 to 18 km long with an average of 7.8 km. The workdays required at each site are as follows:

. Access road improvement work (2.5 days):

By assuring a grading work rate of 5 areas/hour and that 30% of 4 m wide road be graded, 3.3km of road will be improved in a 8-hour workday.

Thus, Average road length 7.8 km - 3.3 km/day = 2.35; say 2.5days per road

. Site Reclaiming Work: One day per site

. Transporting equipment (round trip between Manila and site): 2 days

b) Required Workdays for Borehole Drilling

The workdays include the time required for providing the technical guidance, and transportation.

- Mobilization

Mobilization from site to site, including transportation and preparation in the Project Area. ..... 4.0 days

- Drilling work

a.	Transporting, assembling, and preparation work within the site	1.0 days
b.	Drilling (9 m/day)	9.0
c.	Borehole logging and casing installation:	1.0
d.	Casing finishing work:	1.0
e.	Repair and drilling trouble times:	0.5
	Total	12.5 days

It was determined to use 12.5 days/borehole.

- Pumping test

Long-term pumping test is not required because of the well equipped hand pump.

a.	Preparation, assembling and disassembling	1.5 days
b.	Pumping test	3.0 days
	Total	4.5 days

- Hand pump installation

a.	Foundation and concrete works	4.0 days
b.	Pump installation	2.5 days
	Total	6.5 days

The standard schedule of well construction is examined and the results are shown in Fig. 4.7.

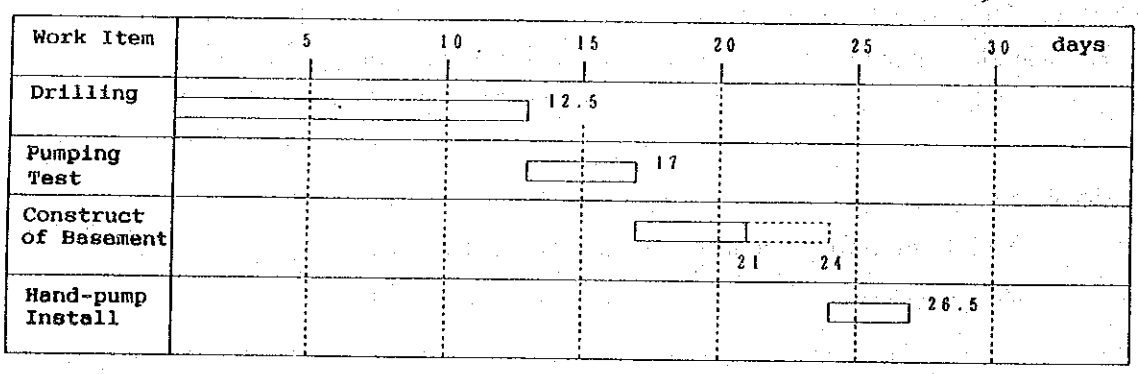


Fig. 4.7 The Standard Construction Schedule of Hand pump Well

c) Piped water supply system

Required workdays for each construction work are estimated, referring to Japan's standard of required workdays of construction, as follows:

- Mobilization (same as that of well construction work) 4 days
- Construction of intake facilities 30 days
- Construction of transmission pipeline 20 days/km
- Construction of reservoir tank 30 days
- Construction of distribution pipeline 30 days
- Construction of public faucet 3 days/faucet
- Relative construction work (2% of workdays for distribution pipeline)

Since the average length of transmission pipeline and distribution pipeline are 2.38k m and 4.86 km respectively and the average number of public faucets is 15.7, the standard required workdays for a piped water supply system are estimated as shown below:

- Transmission pipeline (48 days)
- Distribution pipeline (97 days)
- Public faucet (47 days)
- Relative facilities (20 days)

Hence, 30 workdays are required for intake facilities and reservoir tank construction. Therefore, approximately 1.5 month is considered to be the standard required construction workdays of piped water supply system construction, including rainy days and holidays.

d) Examination of the Construction Schedule

The overall construction schedule is examined based on the standard required workdays of the works.The standard required workdays are outlined in the following Table.

Summary of Workdays for Each Work

Work Type	Required Workdays per Site	No. of Site	Total Work-days Required
Temporary Work:			
Base camp setup	30	1	30
Mobil camp setup	7	2	14
Access road improvement and site reclamation	5.5	8	44
Well Construction Work:			
Well drilling	12.5	64	800
Pumping test	4.5	64	288
Hand pump foundation work	4	64	256
Hand pump installation	2.5	64	160
Water Supply Facility Construction Work:			
Intake basin construction	30	3	90
Conveyance pipeline work	48	3	144
Reservoir tank con-struction	30	3	90
Distribution pipeline work	48	3	144
Installation of public standpipe & associated facility	47	3	141

Construction of spring water use facilities can be started prior to the arrival of drilling equipment at the Project sites or can be conducted simultaneously with well construction work.

Thus, the entire construction schedule can be determined by the number of workdays required for well construction work.

Since the construction work will be undertaken during the dry season, the necessary work month for well construction can be calculated by dividing the workdays required for well construction by average monthly workdays as shown below :

800 days ÷ 23 days/month = 34.8 months

When fire drilling equipment units are used;

34.8 months ÷ 5 = 7.0 months

By adding one month for pumping tests, hand pump installation, and equipment delivery, the total required well construction period will be 8 months.

The overall construction period including the 8 months of equipment procurement, shipping, and temporary work for Phase I and II will be 16 months.

Based on the above examination results, entire construction schedule within two phases will be as shown in Fig. 4.8 and the amount of work can be divided into two phases as shown below :

Phase I Period:

- Procurement of boring equipment
- Construction of 15 to 20 wells equipped with hand pumps
- Construction of spring water use facilities in two areas

Phase II Period:

- Construction of 45 wells equipped with hand pumps
- Construction of spring water use facility in one area

e) Examination of Construction Order and Project Construction Schedule

By examining the construction areas of each phase in accordance with the above-mentioned conditions, it was thought to be appropriate to proceed with the construction in the following order:

Phase I:

- Base camp set up in San Fernando,
  - Construction of 8 wells in Camies and
  - Construction of spring water use facilities in
  - Dueg

- Mobil camp set up in Iba,
  - . Construction of 8 wells in Baquilan and
  - . Construction of 16 wells and one spring water use facility (at two locations)
    in Dampay and Salasa

Phase II:

- By using the base camp,
  - . Construction of 15 wells in Kalangitan and
- By using the mobil camp in Iba,
  - . Construction of 13 wells in Loob Bunga
- Mobil camp set up in Olongapo,
  - . Construction of 20 wells in Cawag, and
  - . Construction of 48 wells and one spring water use facility in Iram.

4.4.5 Staffing Plan

1) Philippines Side Staffing Plan

In accordance with the construction schedule, and the construction implementation system, the major duties of each work section and group required for Project implementation were established as follows:

a) Project Management (one work group):

- Coordination with administrative agencies concerned
- Coordination with rural offices concerned
- Management of the Project's overall implementa-tion schedule
- Overall supervision of construction sections
- Selection of borehole drilling sites
- Evaluation of successful bore holes
- Recording of the Project's implementation work
- Management of Project personnel
- Management of unused equipment and materials and the inventory management of spare parts
- Accounting management
- Other pertinent works

b) Construction Management (one work group):

- Management of base camps
- Management of borehole sites
- Coordination of construction sections
- Inventory management of construction equipment and materials
- Procurement of materials at local markets and its supply to construction sites
- Management of construction section personnel
- Management of well construction
- Preparation of work schedules for electrical prospecting teams, pump installation teams, and drilling teams
- Inspection of completed wells.

c) Hydrogeology (one work group):

- Evaluation of selected borehole sites
- Analysis of geophysical exploration
- Evaluation of proposed well sites and reporting of results to the project manager
- Analysis of borehole logging

- Evaluation of screen pipe locations and reporting of results to the well manager

d) Site Selection (one work group):

- Assisting hydrogeologists
- Management of electrical prospecting

e) Electrical Prospecting (one work group):

- Conducting electrical prospecting at proposed well sites
- Reporting prospecting data to hydrogeologists

f) Drilling (five work groups)

- Conducting drilling work
- Installation of well casings

g) Pumping Test and Pump Installation (two work groups)

- Installation of hand pumps after borehole logging
- Installation of screen and casing pipes
- Conducting pumping tests
- Installation of hand pumps
- Installation of appurtenant concrete facilities
- Removal and land cleaning work after well completion

h) Management of Civil Work of Piped Water Supply System(5 work groups)

- Faucet construction
- Intake and reservoir tank facilities construction
- Inspection of completed facilities

i) Management of Pipeline Work (eight work groups)

- Distribution pipeline construction
- Transmission pipeline construction

j) Administration (one work group):

- Clarification of construction work diaries
- Preparation of reports
- Preparation of related documents concerned with the Project
- Accounting and administrative work
- Inventory management of unused equipment and spare parts at DWA's Monze Office's warehouse
- Preparation of monthly inventory reports

k) Equipment Repair, Maintenance, and Management (one work group):

- Daily management and maintenance of drilling machines, supporting equipment, and vehicles
- Repair of damaged drilling machines, supporting equipment, and vehicles

Table 4.15 Required Members of Philippine Side

Position, Kind of Occupation	Working Group											
	Project Managing	Adaini-stration	Equipaent Repair, Mainte. & Manage.	Civil Work	Hydro-geology	Site Selection	Electrical Prospec-ting	Drilling	Pumping Test and Instal.	Water Supply Facilities	Pipeline Work	Total
Project Manager	1											1
Construc. Manager				1								1
Site Engineer										1	1	2
Accountant		1										1
Typist		(1)										1
Material Control		1										1
Hydro-geologist					1							1
Assistant						1						1
Soil Engineer							1					1
Driller								5				5
Driller Assistant								5				5
Plumber											2	2
Logging Engineer									2			2
Civil Engineer									2	2		4
Mechanic			2									2
Common Labour							4	10	4			18
Driver	1		1	1	1		1	5	2	2	2	16
Watchman		1						2				3
Total	3	3	3	2	2	1	6	27	10	5	5	67

Phillinine personnels from DPWH

Personnels of the Consultants

Others shall be employed by contractor

A minimum of 67 Philippino personnel (60 to be assigned to construction sites) will be required to cover all of the above work sections for the Project implementation as shown in Table4.16.The expenditures for personnel of management and material control sections and drilling engineer must be borne by DPWH(see Table 4.15).

2) Engineers' Dispatch Plan

Japanese engineers shall be dispatched to assist the Philippino personnel for the implementation of the Project. The dispatched Japanese engineers will provide technical advice to the Phlippino personnel. They will cooperate with the Philippino team for the smooth implementation of the project. During the Project implementation they will also conduct the transfer of techniques, particularly in the following areas:

a) Project management
b) Selection of new borehole drilling sites
c) Design of deep wells
d) Construction management of well and piped water system
e) Borehole drilling technique
f) Borehole tests
g) Management of wells' rehabilitation work
h) Repair, maintenance, and management of drilling machines and supporting equipment, and vehicles
i) Inventory management of equipment and materials
j) Assembling of hand pumps and their maintenance & management, and monitoring technique of facility conditionsn

The Japanese side shall dispatch the following engineers to accomplish the above objectives as shown in Table 4.16.

Table 4.16 J apanese Personnel Dispatched for the Construction Works (Required Engineers Dispatched from Japan)

Items	Designation	Assignment	Numbers
Consulting Section	Managing engineer	Project Management and Site Selection, and evaluation of Hydrological Conditions	1
	Execution Manager	Execution Management	1
Subtotal			2
Construction Management & On-The-Job Technology Transfer Section	Construction Manager	Construction Management	1
	Hydrogeologist	Site Selection, Borehole Test and Drilling Report	1
	Civil Work Manager	Civil Work Management	1
	Pipe Work Manager	Management of Pipeline Construction	1
	Drilling Expert	Drilling Technology	5
Subtotal			9
Total			11

The responsibilities of the Japanese to be dispatched to the Philippines are as follows:

Design Management Section (consultant):

a) Project Manager (leader of the Japanese Team):
- Conferring with, and reporting to DPWH,MPR-PMO and JICA
- Supervision of management of Japanese team members
- Overall management of the transfer of techniques
- Technical advice, cooperation, and the transfer of techniques to the Philippinnes personnels

project manager related to the following work:

- Coordination with related administrative agencies and rural communities concerned with the Project
- Management of the Project implementation schedule
- Supervision of construction sections
- Selection of borehole drilling sites
- Conducting geophysical exploration and analysis of exploration data
- Evaluation of proposed borehole drilling sites and preparation of the evaluation report
- Evaluation and selection of access road to the site
- Instruction of access road improvement
- Evaluation of successful bore holes
- Management of Project personnel
- Other pertinent matters

b) Construction Execution Manager
- Technical advice, cooperation, and the transfer of techniques related to the following work to the Philippino construction supervisor as well as supervising the Project work are to be borne by the Japanese side:

- Designing bore holes and piped water supply facilities
- Supervision of borehole tests and pipeline test
- Supervision of bore holes' appurtenant facility construction, hand pump installation work and piped water facilities construction

Construction Cooperation Section

a) Construction management engineer:

- Control and management of Japanese construction engineers
- Control accounting, management, record keeping, and the preparation of reports related to the construction work to be borne by the Japanese side
- Providing technical advice, cooperation, and the transfer of techniques to the Philippino construction supervisor related to the following works:
  - Management of base camp
  - Management of borehole sites
  - Coordination of construction sections
  - Inventory management of construction materials
  - Procurement of construction materials at the local markets and their supply to construction sites
  - Management of construction sections' personnel
  - Preparation of construction records and report presentation

b) Hydrogeologist

- Providing technical advice, cooperation, and the transfer of techniques related to the following work to Philippino personnel:
  - Pumping tests and their analysis
  - Hand pump installation
  - Construction of appurtenant concrete facilities
  - Supporting Japanese construction engineers

c) Borehole Drilling Engineer

Providing technical advice, cooperation, and the transfer of techniques to Philippino personnel related to the following work:

- Operation of drilling machines and supporting equipment
- Borehole drilling
- Casing installation and gravel placing
- Borehole cleaning
- Pumping test
- Water quality test

d) Civil Work Manager

- Providing technical advice, cooperation and the transfer of techniques to Philippino personnel related to the following civil works:

- Intake, reservoir tank and public faucet facilities' construction
- Construction of transmission and distribution facilities
- Inventory management of construction materials
- Procurement of construction materials at local markets and their supply to the sites

e) Pipe Work Manager

- Providing technical advice, cooperation, and the transfer of techniques related to the following rehabilitation works to the Philippino personnel
  - Construction of transmission pipeline
  - Construction of distribution pipeline
  - Construction of appurtenant concrete facilities

4.4.6 Procurement Plan

Procurement manner of equipment and materials which shall be necessary for appropriate implementation of whole water supply project in whole affected area consisting of more than 850 wells construction and this grant project is studied in this chapter.

There are four ways, as explained below, for the Procurement of equipment and materials;

1) Supply by grant based on the request and considering essential for the implementation.

Equipment and materials which are difficult to procure in the Philippines and essential for well constructions and maintenance are grouped here. Besides items requested by Philippines, supporting vehicles such as cargo truck with crane ,water tank lorry, fuel tank lorry and others are added to provide continuous groundwater development by the newly organized implementing agency (MPR-PMO).

2) Procured in Japan, by contractor to be selected for the implementation of grant project, are the construction materials.

Here are grouped the materials which shall be exported from Japan to the Philippines (longer delivery delays).

3) Equipment material procured in the Philippines

Equipment and materials owned by DPWH or easily available in the Philippines are grouped in this category.

4) Construction material (including rental equipment) procured in the Philippines

The results of the consideration are outlined in Table 4.17.

Table 4.17 Required Equipment and Procurement Method

ITEMS	① from Japan (equipment)	②from Japan (materials)	③in Philippines (materials)	④in Philippines (equipment)
(1) Well drilling rig	5			
(200 m drilling capacity)				(R):Rental
St'd accessories				
Operating tools for mud rotary				
DTH Tools	3			
(2) Vehicles				
1) Maintenance service truck, st'd body	3			
2) - do -, long body	5			
3) Small cargo truck w/1 ton crance	3			1(R)
4) Dump truck				2(R)
5) Pick up light vehicle	5			2(R)
6) Station wagon				5(R)
7) Low body trailer				1(R)
8) Water tank lorry	3			
9) Fuel tank lorry	2			
(3) Construction Equipment				
Bulldozer				1(R)
Grader				1(R)
(4) Borehoke Testing Equipment				
1) Borehole logger	2			
2) Pumping test equipment	2			
3) Water level indicator	5			
4) Water analysis equipment	5			
(5) Casing and Screen		1lot		
(6) Mud Agent		1lot		
(7) Hand Pump Set			70 units	
(8) Materials for Pipe line				
1) SGP steel pipe				
2) PVC pipe			1,330	
3) Panel water tank		3lots		
4) Fausets			3,589	
5) Valves, fittings			93	
(9) General Materials			1lot	
(10)Maintenance Workshop Tools				
Portable lathe	1 set			
Electric tools	1 set			
Mechanic tools	1 set			
Tools for pipe-works	1 set			
Diesel generator	1 set			
Diesel welder	3 sets			

4.4.7 Implementation Schedule

The commencement of the Project will start when the Government of Japan and the Government of Philippines sign the Exchange of Notes of the Project's grant aid cooperation agreement.

After the signing of the Exchange of Notes, DPWH and a Japanese consultant company will make a contract concerning with the Project's design management services. After making the contract agreement, the Consultant will prepare the detailed design and tender documents. After the approval of the detailed design and tender documents by the Japanese and Philippino governments, the consultant will conduct the tendering of the Project to contractors for the Government of the Philippines, and will evaluate the tender documents.

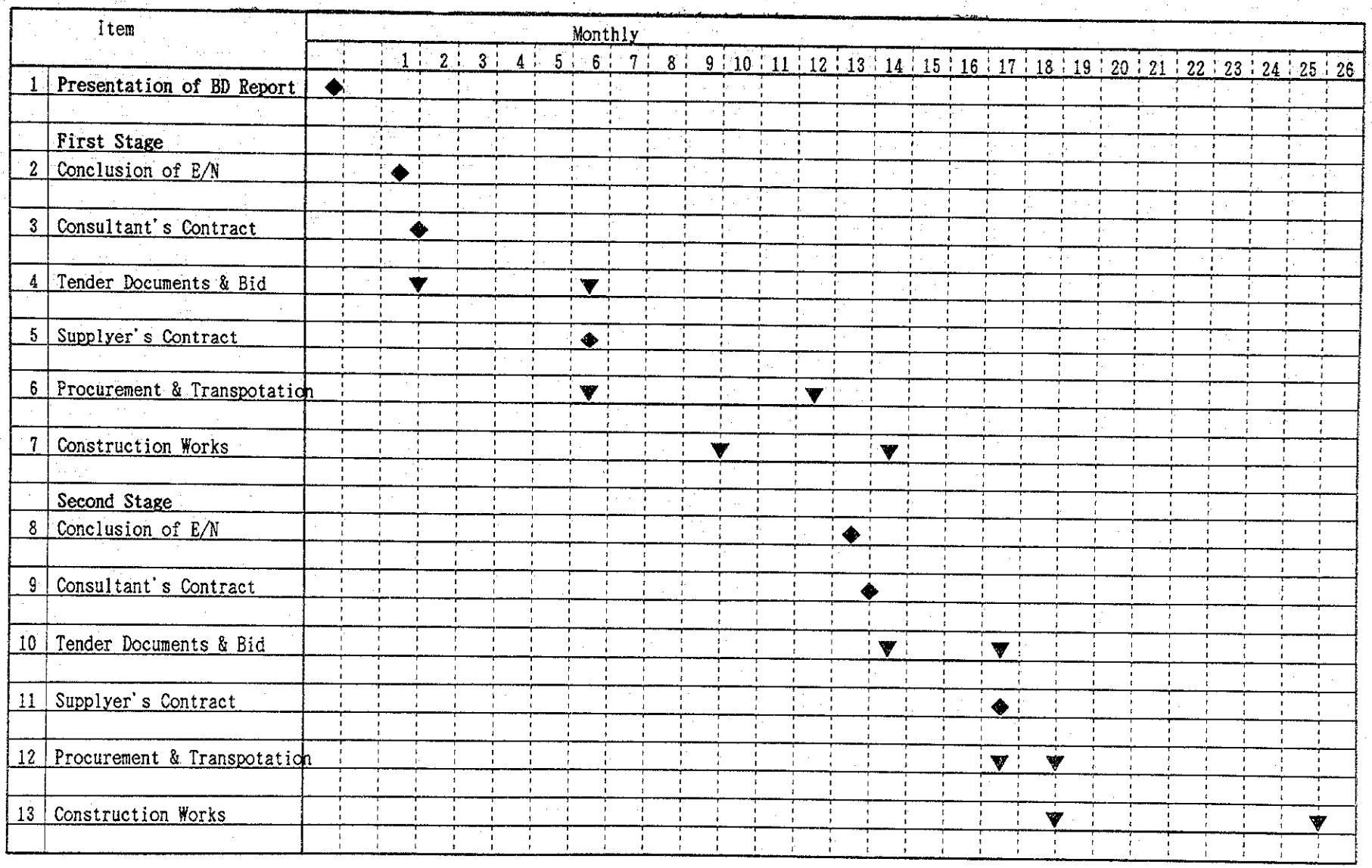
It will take approximately five months to reach the contract agreement after the signing of the Exchange of Notes.

After the contract agreement, the contractor will procure the equipment and materials necessary for the Project. It may take from two to five months to manufacture, procure, and pack the new drilling machine. Further, it will take approximately one month for the sea transportation of the equipment and materials.
Thus, it will take three to six months before the commencement of the Project construction.

The construction works under Japanese Grant Aid will be divided into two stages, and construction is not recommended during the rainy season (Jun. to Oct.). After completion of construction cooperation, Phase II will be conducted by DPWH.

The project implementation plan is shown in Fig. 4.8

Fig. 4.8 Project Implementation Plan



CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

Chapter 5 Project Evaluation and Conclusion

5.1 Project Evaluation

The main purpose of the Project is the reconstruction and restoration of Mt. Pinatubo eruption disaster areas and stabilization of standard of living of the residents by providing safe drinking water in the resettlement areas and damaged barangays. The project aims at constructing deep wells equipped with hand pumps and spring water use facilities to supply safe, and reliable drinking water.

The Project will be implemented as a part of the domestic infrastructure improvement project of the Mt. Pinatubo eruption disaster areas reconstruction and restoration plan; an urgent program by the Philippines Government.

The main point of the plan is to construct 866 wells equipped with hand pumps and Level I water supply facilities at 8 places during the 8 year period starting from 1993.

The Project under Japanese Grant Aid Programme which is a initial stage of the Plan, is to construct 64 wells equipped with hand pumps and spring water use facilities at 3 places during the two phases project period of around 2 yearsand provide well construction equipment which will be used for the entire plan.

Once the overall plan is completed during the 8 year period more than one quarter million the 12 resettlement areas and 369 barangays in 46 municipalities of the suffered 5 provinces (Zambales, Pampanga, Tarlac, Bataan and Nueva Ecija) will benefit from the total implementation of the Plan. and around 42 thousand residents will benefit from the Project.

The expected beneficial effects by the Project implementation are as follows :

1) Reduction of mortality rate and diseases caused by inappropriate drinking water under poor living conditions in disaster areas by supplying safe, reliable drinking water throughout the year:

   The most common diseases caused by unsanitary drinking water is diarrhea. According to the data obtained between September to December 1991, the occurrence rate of the diarrhoea among all the diseases was approximately 10 %. About 1,000 out of every 100,000 patients die due to diarrhea.

2) Improvement of living conditions during dry seasons:

Rainfall during the dry season becomes often smaller than the average rainfall of the past 30-years period. The average rainfall during the dry season is in the range of 0 to 10 mm a month.

The surface water and small springs which are used in the disaster areas often dry up. Thus, the living conditions of the residents during the dry seasons will be greatly improved by urgently implementing the Project .

3) Hard labor of fetching drinking water from far-away water sources will be greatly reduced:

Many of the water sources dry up during dry seasons and residents have to expend hard labor to fetch the drinking water from far-away sources. Once the water supply facilities are constructed, the residents can reduce their household work greatly.

4) Poor living conditions in the disaster areas may be improved by securing safe drinking water throughout the year and stable development of barangays and resettlement areas may be attained through the improvement of the residents' living and social conditions.

The indirect beneficial effects are as follows :

5) Stabilization of residents standard of living, improvement of social conditions, improvement of farming production, and expansion of local economy will be accomplished.

6) As water supply points will be installed at community centers and public facilities, residents will be able to communicate with each other around the facilities and their social solidarity may be strengthened.

When the construction equipment to be procured by the Japanese Government's grant aid cooperation is sufficiently maintained and the equipment's spare parts and materials are supplied, even after completing the construction cooperation, the Philippines side can continue the rural water supply project by constructing deep wells using the equipment. In order to continue the rural water supply project after completing the construction cooperation, technology transfer to be provided during the construction cooperation is extremely important.

In view of the points mentioned above, it is evaluated that the implementation of the Project under the Japanese Government's grant aid cooperation will be extremely important. Further, the relationship between Japan and the Philippines will be strengthened through the Project implementation. Thus, the Project implementation is considered to be worthwhile and appropriate.

5.2 Conclusions

The following conclusions are made based on the results of the field surveys, discussions with officials concerned of the Philippines Government, and the analyses made in Japan:

1) Mt. Pinatubo eruption disaster areas' overall water supply development Plan is to construct 866 wells equipped with hand pumps and spring water use facilities in 8 areas. The Project under Japanese Government's grant aid cooperation will provide the construction cooperation for the initial part of the overall project and procurement of well drilling equipment.

2) The prime objective of the Project is to contribute to the area restoration and stabilization of living conditions by providing safe reliable drinking water in the resettlement areas and damaged barangays and to the public facilities. By providing safe drinking water, it will be possible to reduce water-borne diseases such as diarrhea.

3) Rainfall in the Project areas during rainy seasons is very small. The water supply facilities in the areas were either destroyed or severely damaged. Surface water and springs which are presently used for drinking water supply often dry up.

4) 64 wells equipped with hand pumps and 3 spring water use water supply facilities will be constructed by the Project under the Japanese Government's grant aid cooperation. within the priority sites of affected areas by Mt. Pinatubo eruption. These facilities will provide safe, reliable drinking water to 7,541 families of approximately 42,000 people in the project areas. Furthermore, as existing water supply facilities in the surrounding areas dry up during dry seasons, people living in those areas will also benefit from these facilities.

5) As the Project will contribute for the restoration of domestic infrastructure, stabilization of the residents' livelihood, reduction of diseases caused by unsanitary drinking water, the Project's urgency and necessity were confirmed.

6) As the common expenditure rate of the total budget of DPWH and MPR-PMO which are responsible for the Project is quite high, the request for foreign aid is inevitable to implement the overall water supply project. A total of 2 billion pesos in foreign aid is expected for the overall Project.

7) The contents of the Project were examined in view of the above background, and the following results were obtained:

o DPWH is responsible for the Project implementation. MPR-PMO which was established within DPWH in September 1992 to manage Mt. Pinatubo disaster areas' overall reconstruction and restoration project will undertake the Project implementation.

o The Project is consisted of the following two works in order to supply safe and reliable drinking water throughout the year in the disaster areas:

- Procurement of well drilling equipment for the disaster areas' overall water supply development project which will be implemented during the 8-year period.
- Construction of water supply facility as the first stage of the overall water supply development project:

Number of wells equipped with hand pumps	: 64
Average well depth	: 80m
Spring water use water supply facility	: 3locations
Total water conveyance pipeline length:	Approximately 7km
Total water distribution pipeline length:	Approximately15km

o Project construction will be conducted by using new equipment to be procured under the Project. Required equipment units are as follows :

- For well drilling:

Well boring machine	5each
(With standard accessories and slurry rotary drilling tools)	
DTH drilling equipment	3 each
High-pressure air compressor:	
Low-pressure air compressor:	

o Supporting vehicles:

Crane truck of medium payload	3 each
Crane truck, long body	5 each
Crane truck of small payload	3 each
Pick-up	5 each
Water-tank truck	3 each
Fuel-tank truck	2 each

o Testing equipment:

Borehole logger	2 sets
Submersible pump with a generator for pumping tests	2 sets
Water level measurement instrument	5 sets
Water quality analyses kit	5 sets

o Boring machine repair workshop: 1 set

- Small lathe
- Electrical tool set
- Machine tool set
- Pipe installation tool set
- Diesel generator
- Electrical welder with a generator

o Expendable materials (to be procured):

Casing	1,127 each
Screen	282 each
Slurry material	1 set
Hand pump	70 sets

- Pipeline materials

SGP zinc plated steel pipe	1,330 each
FRP storage tank (20 - 50 m^3)	3 sets
PVC pipe	3,589 each
Faucet for public stand pipe	93 each
Valves and fittings	one complete set
Common materials	one complete set

- The Japanese side will dispatch engineers. They will provide technical advice, construction cooperation, and technology transfer for Project construction.

8) Project implementation will have the following beneficial effects :

Direct Effects :

- Improvement of living conditions and reduction of diseases caused by unsanitary drinking water in disaster areas.
- Stabilization of water supply during dry seasons and reduction of labor for fetching water from far-away sources.
- Stabilization of standard of living and improvement of social conditions.

Indirect Effects:

- Expansion of production activities as the results of the direct effects, and activation of local economy.
- Strengthening of residents' social solidarity.

Other Effects:

- After completing the Project construction, the equipment procured and the transferred technologies during the Project construction will enable continuous construction of disaster areas' overall water

supply development project and the overall project's initial objectives can be achieved.

- o Contribution to the reconstruction and restoration of disaster areas and strengthening of friendly relationship between Japan and the Philippines.

In view of the points outlined above, the implementation of the Project under the Japanese Government's grant aid cooperation is considered to be appropriate.

5.3 Recommendations

The recommendations for Project implementation are as follows :

(1) Boundary of Work

Approximately two years is required for the Project implementation starting from signing of the Exchange of Notes and ending with construction completion. But, according to the rules of the Japanese Government's Grant Aid Cooperation, the P roject shall be divided into two stages and total implementation period is approximately 18 months. Tendering, signing of contract, equipment manufacturing, equipment and material procurement and shipping, and site preparation may require 8 months. Thus, the actual Project construction of two stages should be completed within the remaining 10-months period.

Technical advice, guidance, transfer of technology, construction supervision by Japanese engineers will be conducted during the 8-months period. During this period, construction of 64 wells equipped with hand pumps and 3 spring water use water supply facilities will be undertaken.

After the Project period, the remaining 802 wells equipped with hand pumps and 5 spring water use water supply facilities shall be constructed entirely by the Philippines side within 6 years. The necessary budget amount and staff required for the Philippines side should be clarified. Further, it should be confirmed that the equipment and materials procured under the Project will be used only for the construction of disaster areas' water supply development project.

(2) Equipment

In view of the obtainable spare parts in the Philippines, and easiness of operation and maintenance, it would be desirable to procure the type of equipment which is most commonly used in the Philippines. Amount of spare parts to be provided should be sufficient for 2-year use after completing the Project construction under the Japanese grant aid cooperation.

It is highly desired that the Philippines side will secure its own budgetary amount to establish a spare parts supply system during this 2-year period and will continue the construction of the disaster areas' overall water supply development project by efficiently using the provided equipment and transferred technology.

(3) Technology Transfer

As MPR-PMO is newly established within DPWH for Project implementation, it does not have enough experience in well drilling and water supply facility construction. Therefore, it is extremely important to provide technology transfer under the Project to upgrade MPR-PMO's technical level.

At the Philippines' well drilling sites, suspension of work due to equipment malfunctioning caused by inadequate skills or inappropriate equipment operation is often seen. Thus, it is important to transfer not only the well drilling technologies but also equipment repairs and maintenance technologies to Philippines mechanics.

(4) Operation and Maintenance of the Water Supply Facilities

Many unusable wells due to mechanical failures were found during the field survey. Facilities inappropriately repaired or maintained were also found. Facility maintenance is presently a big problem. Maintenance work will largely affect the water supply facility equipped with a hand pump. Thus, it is extremely important to thoroughly notify facility users of the necessity of adequate operation and repair skills and appropriate repair and maintenance works.

As the facility maintenance vehicles will be provided under the Project, MPR-

PMO should establish a facility maintenance organization and conduct a periodical inspection and appropriate repairs. Further, the management and maintenance of Project facilities may be entrusted to the resettlement areas or barangay residents in the future. Thus, resident education program including public health education should be established. Further, it is highly desired that the operation and maintenance plan described in Chapter 7 should be established.

(5) Requests to the Philippine Government

The items confirmed in the Minutes of Discussions and the items requested in this Study Report shall be surely undertaken without delay by the Philippines Government for the success of the Project.

After completing water supply facility construction under the Japanese grant aid cooperation, the Philippines side should continuously construct additional 802 wells equipped with hand pumps and 5 level II water supply facilities to accomplish the initial objectives of the overall water supply development plan.