CHAPTER 5 THE PROPOSED PROJECT

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5 - 1 Monduli Water Supply Project

5 - 1 - 1 Water Supply System

(1) Existing Water Sources

At present, Monduli town receives its water supply from three springs which are located in the Monduli Mountains lying behind the Town at Kilimani, Rasharasha and Rekisilititi, of which only the Kilimani spring is capable of supplying the town with water up to the target year of 2014.

In addition to the above, water is also distributed by the TMA Pipelines via a booster pump to the MCE. When the elevated water tank of the MCE is full, the runoff water is channelled to a water storage tank at the Monduli Demonstration Primary School via a spillway pipe. The runoff water from this school tank is then distributed to those households located in the lower part of Monduli town. In recent years, however, very little water has been supplied to households in the Town due to the electricity supply shortage and the difficulty of diverting water from the TMA Pipelines to the MCE.

As the water supplies by the above-mentioned sources cannot meet the water demand of the town's residents as well as that of various facilities in full, the town's water supplies are rotated. As a result, the residents find it necessary to buy bottled water.

(2) New Water Sources

As the existing water sources cannot provide Monduli town with the required volume of water, it is necessary to find/construct new water sources to ensure an adequate water supply throughout the project years. The water sources which can realistically be used to supply Monduli town with water are as follows:

i) Pumping of groundwater from Engare Olmotoni and its supply to the Town

ii) Pumping of spring water near Mfereji village and its gravity supply to the Town

iii) Supply from the dam reservoir to be constructed at Olong Oswa downstream from Monduli town

(3) Optimum Water Supply System

Various water supply systems were compared for detailed analysis, taking the water volume available for use at the existing water sources, the water supply capacity of new sources and the required water volume of Monduli town in the target years into consideration. It is concluded that the extraction of groundwater from Engare Olmotoni is the most advantageous new water source. Accordingly, the optimum water supply system for Monduli town consists of the following components.

i) Gravity supply from the Kilimani spring
ii) Pumped supply of diverted water from the TMA
iii) Pumped supply of groundwater from Engare Olmotoni

5 - 1 - 2 Water Source Capacities

The capacities of the water sources in the above-mentioned optimum water supply system are examined below (Figure 5 - 1):

(1) Kilimani Spring

As the Kilimani spring is the only existing water source among the three springs which is capable of supplying water all year round, its scanty water discharge is adopted as the design water supply capacity. Based on past observation data, this scanty water discharge is put at 130 m^3/day.

During the Phase I survey period, discharge observation was conducted at the water tank into which water from both the Kilimani spring and Rasharasha spring is sent and an inflow of 216 m^3/day from the Kilimani pipeline was observed. The fact that no spring water loss at the intake for the Kilimani pipeline due to overflow to the lower stream of the intake was observed, is proof that all water from the Kilimani spring is currently channelled to the pipeline, meaning that the pipeline is at least capable of

sending 216 m^3 of water per day. No specific problem was found with regard to the structure and function of the intake. The pipeline itself is judged to be sound with no problems such as deterioration and leaking joints. As far as the water conveyance system from the Kilimani spring is concerned, there appears to be no specific need for immediate improvement. Based on the above analysis, the design water supply volume of the Kilimani spring is set at 130 m^3/day.

(2) Diversion from TMA Pipelines

Due to the difficulties concerning the electricity supply in the Monduli area and water diversion from the TMA Pipelines, the booster pump is not fully fulfilling its capability. Based on the past operation performance, the daily diversion of water from the TMA Pipelines is set at 45 m^3.

(3) Pumping of Groundwater at Engare Olmotoni

The test boring data and data obtained from the existing wells at Engare Olmotoni suggest that the feasible water yield from a borehole (deep well) is 30 - 90 m^3/hr or an average of 60 m^3/hr.

5 - 1 - 3 Water Supply Plan

(1) Planning Criteria

The adopted design criteria for the water supply plan are as follows.

Item		Specifications, etc.
- Target Year	:	2014
- Design Population	:	34,854
- Water Supply System	:	additional supply to existing water supply system
- Unit Water Supply	:	per person: 30 litres/person/day per schoolchild: 10 litres/schollchild/day hospital: 88 litres/bed/day public facility (office, etc.):10 litres/person/day commercial facility (hotel & restaurant, etc.): 70 litres/person/day
- Daily Maximum Water Supply Coefficient	:	1.1 due to little fluctuation of mean annual temperature
- Hourly Maximum Coefficient	:	1.65 (general recommendation, ranging between 1.5 and 2.0)
- Water Supply Ratio for miscellaneous Purposes:		5 %
- Water Loss	:	15 %

(2) Designed Water Demand

The following average daily water supply volumes are estimated based on the above-mentioned design conditions and the criteria. Monduli town water supplies.

Item		Water Supply Volume
- Resident Supply	:	34,854 persons x 30 litres/person/day = 1,046 m^3
- School Supply	:	645 schoolchildren x 10 litres/schoolchild/day = 6 m^3
- Hospital Supply	:	840 persons x 88 litres/bed/day = 74 m^3
- Public Facilities Supply	:	382 persons x 10 litres/person/day = 4 m^3
- Commercial Facilities Supply	:	386 persons x 70 litres/person/day = 27 m^3
- Miscellaneous Water	:	(sum of the above) x 0.05 = 58 m^3
- Water Loss	:	(sum of the above) x 0.15 = 182 m^3
Total		1,397 m^3

(3) Supplemental Water Sources Capacities

To meet the designed water requirements for Monduli town described in (2) above, 130 m^3/day and 45 m^3/day will be forthcoming from the existing Kilimani spring and TMA pipelines respectively, leaving 1,222 m^3/day to be supplied by the new source.

The required design source capacities are calculated at 1,344 m^3/day; 1,222×1.1 m^3/day.

5-1-4 Facilities Plan

Based on the design criteria, the contents of the new facilities at the new water source are described here and their rough distribution is illustrated in Figure 5-2.

(1) Intake Facilities

a) Numbers of Boreholes

More than one borehole will be constructed at Engare Olmotoni for pumping groundwater. Given the feasible well yield of a borehole of 60 m^3/hr or, 600 m^3/day, as described earlier, the number of boreholes required to meet the demand comes to two. Due to the crucial importance of these boreholes, a

standby borehole will also be constructed to minimize the adverse impacts of a reduced water supply during times of breakdown of any of the regular boreholes thus totaling three boreholes (Figure 5-3).

b) Borehole Design

Because of the need for mechanical drilling to reach the deep-lying aquifer, the planned well diameter is 200 mm. The depth of each borehole will be 150 m based on boring data and the depth of existing boreholes in the area. The casing will be made of FRP in view of easy handling, good workability, satisfactory strength and lower vulnerability to weather conditions.

c) Water Pump

Given the required pumping volume of 60 m^3/hr and the total head of approximately 110m, the submerged water pump to be installed at each borehole will have the following specifications.

- Pipe diameter : 80 mm
- Shaft power : 22 KW
- Nos. : 2 plus one (for standby borehole)

d) Independent Power Generator

Due to the poor electricity supply in the area, each borehole pump will be operated by an independent power generator instead of commercial power. The generator capacity will be 35 KVA to supply the design shaft power of 22 KW.

e) Water Pipeline

The planned three boreholes will be constructed with at least 1 km between each of them to prevent an undesirable drop in pumping water volume due to mutual interference during pumping. It will be necessary to lay water pipes to convey the pumped water from the two boreholes to the water tank of the water pumping station to be located near the remaining well. These pipes will be made of FRP in view of FRP's strong resistance to both internal and external pressure and its good workability, etc. The pipe diameter will be 150

mm using Hazen-Williams' formula based on such factors as the pumping volume of 60 m^3/hr and the pipe material, etc. The above water conveyance system is illustrated in Figure 5-4.

(2) Water Storage Facilities

While it is practically impossible for the pumping of water to respond flexibly at all times to the fluctuations of the borehole pumping volume, pumping station feeding volume and Monduli town's consumption volume, etc., water storage tanks will be constructed where necessary to ensure smooth pumping vis-a-vis the hydraulic fluctuations described above.

For the present purpose, two water storage tanks are planned. One will be located in the middle of the configuration of the three boreholes while the other will be located at the relay pumping station to be constructed at the halfway point of the water pipeline between the pumping station and Monduli town.

The required storage tank capacity is calculated below assuming an equivalence to eight hours supply based on the daily maximum water supply volume:

$$QT = \frac{1,344 \times 8}{24} = 448\ m^3$$

(3) Water Conveyance Facilities

a) Water Pipeline

The construction of a water pipeline is planned to convey the water pumped from the three boreholes at Engare Olmotoni to the existing water storage tank in Monduli town.

Pipeline Route

The distance from the pumping station, to be located at the center of the borehole configuration, to the water storage tank in Monduli town is approximately 23 km, following the contour line on the topographical map

(scale: 1:50,000). The elevation of the likely site for the pumping station on the topographical map is 1,460 m while the elevation of the water storage tank in Monduli town is 1,630 m, indicating an elevation difference of approximately 170 m.

Type of Pipes

Given the longitudinal shape of the pipeline, the planned pipeline will be subject to strong internal pressure depending on the actual pumping conditions. Ductile pipes will be used for the pipeline in view of safety vis-a-vis the said pressure, environmental considerations and workability of the pipes, etc.

Pipe Diameter

The optimum pipe diameter is calculated to be 200 mm using the Hazen-Williams' formula, taking the longitudinal shape of the pipeline, pipe type and maximum hourly water supply volume into consideration.

b) Water Conveyance Pumps

Pump Size

Using the popularly used pump size calculation formula, the required pipe diameter of the water conveyance pump for the design maximum daily water supply volume of 1,344 m^3/day (0.93 m^3/min) is 100 mm.

Total Head

The total head affecting the water conveyance pump will be extremely large if the water is directly conveyed from the pumping station located in the configuration of the three boreholes to the existing storage tank in Monduli Town. A relay pumping station will, therefore, be constructed at the halfway point of the pipeline to enable the use of common pumps to create a two-tier conveyance system. Because of this relay pumping station, the total head for each tier will be approximately 215 m.

Shaft Power

Based on the pumping volume of 0.93 m^3/min, the total head of 215 m and pumping efficiency of 65%, the required shaft power will be 55 KW.

Number of Pumps

Although one pump will be sufficient to convey the design maximum daily water supply, two pumps with the same capacity will be installed at each of the two planned pumping stations to maintain the operation of these key water supply facilities. Switching over between these two pumps at certain intervals will be appropriate to ensure even wear and tear on the machinery.

Independent Power Generators

The underlying reason for the installation of an independent power generator for each borehole also applies to the case of the pumps installed at the two pumping stations. The capacity of these generators at the pumping stations will be 75 KVA.

5 - 2 Village Water Supply Project

While the type of current water supply at 18 villages differs from village to village, dams are the main water supply facilities. As groundwater potentials are limited in the Study Area, the main measures for improving water supplies would be to secure the amount of water necessary by storing water in dams. Therefore, this measure will be examined with emphasis on dams while grasping the present capacity of water supply facilities for each village.

5 - 2 - 1 Water Balance of Existing Reservoirs

Prior to the preliminary design of dams, water balance examinations of the existing reservoirs were made in order to understand the behavior of water storage that may present useful information on planning dams and reservoirs; no observation data on inflow and outflow are available for the existing reservoirs.

(1) Inflow

The mean monthly rainfall data recorded at Monduli District office over a period of 62 years are employed to estimate the mean inflow to the reservoirs. The mean annual rainfall amounts to 812 mm (Table 5-1).

The portion of rainfall does not contribute to stream flow; the water is lost by interception, depression storage and soil moisture. It is assumed that there is less rainfall and consequently less runoff for a period of five months from June to October; the effective runoff can be expected for a seven-month period from November to May. As no observed data are available with respect to river runoff in the Study Area, the monthly inflow to the reservoirs is calculated by multiplying the mean monthly rainfall by a mean monthly runoff coefficient. The mean monthly runoff coefficient is arbitrarily estimated at 15 percent in view of the topography and vegetation cover of the catchment area, resulting in an annual inflow of 115,050 m^3 per km^2 of the catchment area (Table 5-1).

(2) Evaporation Loss

The storage water is partially lost through evaporation from reservoir surface. The evaporation loss is assumed to be 70 percent of pan- evaporation rates. The evaporation records at Arusha Air Field station is used to calculate the evaporation loss for the study. The annual evaporation loss amounts to 1,483 mm (Table 5-1).

(3) Water Demand

Villages are dependent on water from the dams for both domestic and livestock use. As livestock are a valuable asset for the villagers, securing their drinking water is an important matter. Therefore, the storage water is not used for cultivation of crops. Cultivation of crops is done under rainfed conditions. For this reason, the dam water in this case is limited to domestic use and livestock use.

Assuming that the amount of water currently consumed as domestic water is 20 lit/person/day, the present population and overall amount of water consumption will be as shown in Table 5-2.

The amount of water currently consumed by livestock is estimated based on the results from an oral survey that was conducted locally, and the following values are used.

Cattle	:	30 lit/head/day
Goat	:	10 lit/head/day
Sheep	:	10 lit/head/day
Donkey	:	20 lit/head/days

Total amount of water demand by livestock for each village obtained according to the number of livestock in each village is as shown in Table 5-2.

(4) Water Balance

The water balance of the existing reservoirs is preliminarily examined based on the several assumptions mentioned. Out of 14 villages which are provided with storage dams, only one village, Moita Bwawani, despite having two reservoirs with a total storage capacity of 71,000 m^3, could not supply water to cover the demand for the villagers as summarized in Table 5-3. Details of water balance studies are presented in the Supporting Report.

A question may be posed regarding the obvious difference between the results of water balance studies and the present situation of reservoirs; however, the water balance studies may imply that the existing dams could meet the water demand if well-designed structures like intake facilities and spillways are provided and proper water management is practiced.

5 - 2 - 2 Water Balance of Proposed Reservoirs

The construction of small-scale dams is proposed as a main water source for village water supplies. In order to estimate the numbers and scales of dams necessary for storing water to meet the water demand of the villagers, water balance studies are made on a village basis.

(1) Inflow

In the planning of the reservoir capacities, it is proposed to provide capacities sufficient to meet the water demand under drought runoff conditions

with a return period of ten years. The rainfall in 1950 observed at Monduli District Office is closely corresponding to the minimum annual rainfall with the return period of 10 years. Monthly rainfall is converted into the monthly inflow into the proposed reservoirs in the manner explained earlier (Table 5-4).

(2) Evaporation Loss

Evaporation loss from the reservoir surface is estimated to be 70 percent of pan-evaporatin observed at Arusha Air Field station (Table 5-4).

(3) Water Demand

The estimated total water demand in the year 2014, the planning year for this project, for village water supplies includes water for domestic use and livestock use, and five percent of allowance. Table 5-5 presents the total water demand and the water demand to be supplied from reservoirs which is obtained by deducting the available source capacities other than reservoirs from the total water demand. Out of the total water demand of 5,533 m^3/day, water demand of 4,900 m^3/day, or 89 percent of the demand must rely on reservoirs, or in other words, the village water supply project needs to construct dams with total supply capacities of 4,900 m^3/day to attain 100 percent of service coverage.

The water demand for domestic use is estimated based on the projected population in 2014 and the proposed demand of 30 ℓ per person per day, while the water demand for livestock use is based on the population of livestock in 1995 and the proposed demand of 25 ℓ per livestock unit per day. One livestock unit is equal to one head of cattle, or five goats, or five sheep, or two donkeys.

5 - 2 - 3 Description of Village Water Supply Projects

(1) Village Project

Lendikinya Village

The storage capacities of the existing Arkatan dam and Murandawa dam will be reduced to 111,000m^3 and 9,000m^3 due to sedimentation by the end of the planning period. According to the water balance studies, total live storage capacities are 191,000m^3 to meet the village water demand; thus, an additional

71,000m^3 of live storage capacities must be provided. Construction of two new dams is proposed, as follows:

Dam No.1	Live storage	:	35,500m^3	Catchment area: 30km^2
	Dead storage	:	31,500m^3	
	Total		67,000m^3	
	Dam length	:	120 m, Dam height : 6.0 m	
Dam No.2	Live storage	:	35,500m^3	Catchment area: 30km^2
	Dead storage	:	31,500m^3	
	Total		67,000m^3	
	Dam length	:	120 m, Dam height : 6.0 m	

Enguik Village

The existing Enguik dam will be silted up within the planning period. The total live storage capacities are 113,000m^3 to meet the estimated village water demand. Construction of two new dams is proposed, as follows:

Dam No.1	Live storage	:	56,500m^3	Catchment area: 6.4km^2
	Dead storage	:	35,500m^3	
	Total		92,000m^3	
	Dam length	:	150 m, Dam height : 4.0 m	
Dam No.2	Live storage	:	56,500m^3	Catchment area: 6.4km^2
	Dead storage	:	35,500m^3	
	Total		92,000m^3	

Arkatan Village

The aggregated storage capacities of the existing five dams are sufficient to supply the villagers with domestic and livestock water when reservoirs are properly operated.

Lossimingori Village

The embankment of Rasha Rasha dam will be renovated up to a length of 25 m with a height of 5.0 m.

The water balance shows that the total live storage capacities of 184,000m^3 are needed, of which 24,000m^3 are provided by the existing Lossimingori dam, resulting in 160,000m^3 of total live storage capacities to be newly provided by the Project. Construction of two new dams is proposed to meet the village water demand.

Dam No.1	Live storage	:	80,000m^3	Catchment area: 21m^3
	Dead storage	:	22,000m^3	
	Total		102,000 m^3	
	Dam Length	:	150 m,	Dam Height : 4.0 m
Dam No.2	Live storage	:	80,000m^3	Catchment area: 21km^2
	Dead storage	:	22,000m^3	
	Total		102,000m^3	
	Dam Length	:	150 m,	Dam Height : 4.0 m

Lepurko Village

The total live storage capacities amount to 290,000m^3 to meet the estimated village water demand according to the water balance, of which 143,000m^3 will be shared by the existing Lepurko dam. The required live storage capacity is fixed at 147,000m^3, nearly the same capacity as Lepurko dam. The Project proposes to construct one dam as follows:

Dam No.1	Live storage	:	147,000m^3	Catchment area : 4km^2
	Dead storage	:	44,000m^3	
	Total		191,000m^3	
	Dam length	:	250 m,	Dam height : 6.0 m

Meserani Juu Village

An increase of diversion water from the TMA pipelines is not expected. The existing Ngoi Kumen reservoir will be silted up within the planning period. The required live storage capacity is 106,000 m^3 to meet the estimated village water demand. Construction of two new dams is proposed in view of the topographic conditions of the village as follows:

Dam No.1	Live storage	:	53,000m^3	Catchment area : 15km^2
	Dead storage	:	5,500m^3	

	Total		58,500m³	
	Dam length	:	120 m,	Dam height : 6.0 m
Dam No.2	Live storage	:	53,000m³	Catchment area : 15km²
	Dead storage	:	5,500m³	
	Total		58,500m³	
	Dam length	:	120 m,	Dam height : 6.0 m

Nengung Village

Increase of diversion water from TMA pipelines is not expected. The live storage capacities of the three existing reservoirs will be reduced to 115,000m³. Under this situation, the live storage capacity is estimated at 51,000m³ to provide year-round water supplies for the villagers. The Project proposes to build one dam with the following capacity:

Dam No.1	Live storage	:	51,000m³	Catchment area : 3km²
	Dead storage	:	33,000m³	
	Total		84,000m³	
	Dam length	:	150 m,	Dam height : 4.0 m

Moita Kiloriti Village

The live storage capacities of the existing reservoirs will decrease to 142,000m³ due to sedimentation within the planning period. According to the water balance the village needs to build reservoirs with live storage capacities of 284,000m³ after subtracting the 142,000m³ of live capacities of the existing three reservoirs. In consideration of topography, construction of two new dams is proposed as follows:

Dam No.1	Live storage	:	142,000m³	Catchment area : 15km²
Dam No.2	Dead storage	:	16,000m³	
	Total		158,000m³	
	Dam length	:	150 m,	Dam height : 4.0 m

Moita Bwawani Village

The storage capacity of Ndulele dam will decrease to 14,000m³ and Kilimantinde reservoir will lose its function due to sedimentation within the

planning period. In order to meet the estimated village water demand, 312,000m^3 of live storage capacities are to be provided. After consideration of topographic conditions of the village, it is proposed to construct three new dams with live storage capacities of 104,000m^3.

Live storage	:	104,000m^3	Catchment area : 37km^2
Dead storage	:	26,000m^3	
Total		130,000m^3	
Dam length	:	210 m,	Dam height : 6.0 m

Meserani Bwawani Village

The storage capacities of the two existing dams will become zero due to sedimentation within the planning period. Meserani dam with an effective storage capacity of 750,000m^3 is not working at present owing to failure of the dam embankment. Therefore, it is proposed to renovate the dam to make better use of the storage capacity. The sediment volume of the dam is estimated at 135,000m^3 for the planning period. With the rehabilitation of Meserani dam, 615,000m^3 of live storage capacity will be provided, which is enough to meet the estimated village water demand of 623,000m^3.

Mbuyuni Village

Out of the two existing dams, Mbuyuni No.2 dam will be silted up within the planning period, whereas the effective storage capacity of Mbuyuni No.1 dam will decrease to 58,000m^3. The water balance study reveals that the required total live storage capacities amount to 358,000m^3. Accordingly the Project proposes to construct two dams with total live storage capacities of 300,000m^3.

Dam No.1	Live storage	:	150,000m^3	Catchment area : 21km^2
	Dead storage	:	22,000m^3	
	Total		172,000m^3	
	Dam length	:	250 m,	Dam height : 6.0 m
Dam No.2	Live storage	:	150,000m^3	Catchment area : 21km^2
	Dead storage	:	22,000m^3	
	Total		172,000m^3	
	Dam length	:	250 m,	Dam height : 6.0 m

Lolkisale Village

The existing water sources of two springs and one dug well are not taken into account in the project planning because of their unstable water sources. Construction of new dams is proposed instead. According to the water balance study, the required total live storage capacities are 709,000m^3. In consideration of the village topography, provision of two dams is proposed as given below:

Dam No.1	Live storage	:	354,500m^3	Catchment area : 15km^2
	Dead storage	:	16,000m^3	
	Total		370,500m^3	
	Dam length	:	165 m,	Dam height : 6.0 m
Dam No.2	Live storage	:	354,500m^3	Catchment area : 15km^2
	Dead storage	:	16,000m^3	
	Total		370,500m^3	
	Dam length	:	165 m,	Dam height : 6.0 m

Tukusi Village

In addition to the existing water sources of one spring and dug wells, construction of new dams is proposed to meet the village water demand. The estimated live storage capacities of 116,000m^3 will be provided with two dams as given below:

Dam No.1	Live storage	:	58,000m^3	Catchment area : 5km^2
	Dead storage	:	28,000m^3	
	Total		86,000m^3	
	Dam length	:	150 m,	Dam height : 4.0 m
Dam No.2	Live storage	:	58,000m^3	Catchment area : 5km^2
	Dead storage	:	28,000m^3	
	Total		86,000m^3	
	Dam length	:	150 m,	Dam height : 4.0 m

Makuyuni Village

The source capacity of the existing borehole is sufficient to meet the demand for domestic use; however, the pump installed in 1989 needs to be

replaced. The following renovation works are proposed with respect to the existing borehole:

Replacement of pump	:	130m³/day
Rehabilitation of water pipes	:	GS pipe, 4", 4.1 km long
Construction of water tank	:	91m³

There are five dams, four of which are in operation. Rehabilitation of JKT No.3, currently unused, is proposed. Due to sedimentation in the reservoirs, the total live storage capacities of the existing reservoirs will decrease to 31,000m³ within the planning period. The required water storage for livestock use is 161,000m³ according to the water balance. Accordingly it is proposed to construct two dams with total live storage capacities of 130,000m³ for livestock purposes:

Rehabilitation of JKT No.3 dam : Dam height-3.0 m

Dam No.1	Live storage	:	65,000m³	Catchment area : 15km²
	Dead storage	:	16,000m³	
	Total		81,000m³	
	Dam length	:	150 m,	Dam height : 4.0 m
Dam No.2	Live storage	:	65,000m³	Catchment area : 15km²
	Dead storage	:	16,000m³	
	Total		81,000m³	
	Dam length	:	150 m,	Dam height : 4.0 m

Naitolia Sub-Village

Two dams are currently in use for water supplies; however, the dams will lose their function due to sedimentation within the planning period. The required water capacities are estimated at 200,000m³ to meet the village water demand. It is proposed to build two dams as follows:

Dam No.1	Live storage	:	100,000m³	Catchment area : 8km²
	Dead storage	:	44,000m³	
	Total		144,000m³	
	Dam length	:	300 m,	Dam height : 4.0 m
Dam No.2	Live storage	:	100,000m³	Catchment area : 8km²

Dead storage	:	44,000m^3
Total		144,000m^3

Oltukai Sub-Village

Dug wells are the only available water sources, whereas Oltukai dam with a reservoir capacity of 264,000m^3 is not operated because dam bodies have collapsed due to seepage through the embankments. Rehabilitation of the existing Oltukai dam is proposed. With the rehabilitation works, Oltukai reservoir will be able to provide water for the village to meet a water demand of 141,000m^3.

Rehabilitation of Oltukai dam : Dam length : 250 m
Dam height : 4.0 m
Dam width : 4.0 m

Mswakini Village

The Mswakini borehole with a capacity of 75 m^3/day is the only water source available for domestic use; however, pumping of groundwater is being carried out by a private company at its own cost. Construction of two boreholes is proposed to supply water for domestic use as follows:

Construction of Boreholes	:	2 boreholes	:	75m^3/day×2
Pump and Engine	:	2 units of	:	7.5m^3/hr capacity
Water Pipes	:	GS pipe, 3", 4.5 km×2 lines		
Elevated tanks	:	91m^3×2 locations		

There are two dams; but neither is being used. Rehabilitation of these dams is proposed. The required water storage is estimated at 165,000m^3 to meet the water demand for livestock use. In consideration of the village topography, construction of two new dams is also proposed as follows:

Rehabilitation of Dams	:	Mswakini No.1 dam Dam length-370 m, Dam height-2.0 m Mswakini No.2 dam Dam length-330 m, Dam height-4.0 m

Dam No.1	Live storage	:	82,500m^3	Catchment area : 15km^2
	Dead storage	:	16,000m^3	
	Total		98,500m^3	
	Dam length	:	150 m,	Dam height : 4.0 m
Dam No.2	Live storage	:	82,500m^3	Catchment area : 15km^2
	Dead storage	:	16,000m^3	
	Total		98,500m^3	
	Dam length	:	150 m,	Dam height : 4.0 m

Emairete Village

The exploratory well EX-7 will be converted into a production well with a yield of 12m^3/day. In addition, one borehole will be constructed; water yield is estimated at 36 m^3/day. Both the two boreholes are used for domestic purposes.

Conversion of Well EX-7	:	Water yield of 12m^3/day 1 unit of pump and engine: 0.2m^3/minute Storage tank: 45m^3
Construction of Borehole	:	Water yield of 36m^3/day Drilling depth of 150 m 1 unit of pump and engine: 0.6m^3/minute Water pipe, 2 km in length

The live storage capacities of the existing three dams will decrease to 225,000m^3 due to sedimentation within the planning period. The required live storage capacities come to 293,000m^3. Therefore, the Project proposes to construct one dam with a live storage capacity of 68,000m^3 after consideration of the live storage capacities of the three existing dams as follows:

Dam No.1	Live storage	:	68,000m^3	Catchment area : 4km^2
	Dead storage	:	44,000m^3	
	Total		112,000m^3	
	Dam length	:	150 m,	Dam height : 4.0 m

(2) Water Treatment

Regarding surface water resources development for domestic use, care should be devoted to turbidity of water. In many reservoirs, water is turbid mainly owing to the encroachment of livestock on reservoirs as evidenced by the water quality analyses made during the course of the Study. The project proposes to provide easy-to-operate filtration facilities for turbidity control.

The filtration facilities will be built at appropriate locations just downstream from the intake structures attached to the dams so that raw water for domestic use flows into the filtration facilities by gravity. Filtrated water is lifted to storage tanks by manual pumps.

The standard filtration speed generally ranges from four to five meters per day. The average speed of 4.5 meters per day is applied to design of facilities. The daily amount of water to be treated for each facility averages 37 m^3 on condition that two treatment facilities are provided for one reservoir for domestic use. A total of 116 of filtration facilities will be provided for 67 reservoirs including the existing reservoirs.

5 - 3 Priority Projects

Within the framework of the water supply program for Monduli town and the surrounding villages as proposed earlier, the following projects are warranted as the priority projects for early implementation:

5 - 3 - 1 Monduli Water Supply Project

The Monduli water supply project has a history of more than 20 years; current problems are basic shortage of water source capacities and the resultant low rates of water charge collection. Under this situation, quick returns from the proposed project can be expected.

Monduli town is the center of administration and economic activities in the District, and its proximity to Arusha city has attracted many people to settle in the Town. Implementation of the proposed project will therefore encourage the improvement in quality of life and economic activities which in turn will

have a profound knock-on effect throughout the District. Accordingly top priority is given to the Monduli Water Supply Project.

5 - 3 - 2 Priority Village Water Supply Projects

Priority is given to the villages where groundwater is currently used, or groundwater development is available and to the villages which seriously suffer from a shortage of water sources, thus leading to the selection of the following village projects:

Makuyuni Water Supply Project:

- Rehabilitation of Makuyuni borehole

Mswakini Water Supply Project:

- Construction of two boreholes

Emairete Water Supply Project:

- Converstion of well EX-7 into production well
- Construction of one borehole

Oltukai Water Supply Project:

- Rehabilitation of Oltukai dam

Moita Bwawani Water Supply Project:

- Construction of three dams

5 - 4 Sanitary Education Programme for Monduli Town

5 - 4 - 1 Need for Sanitary Education Programme

Development efforts in providing clean and safe water have been given strong emphasis in accordance with the national water policy. However, past experiences have shown that provision of water alone was not enough to assist in improvement of health of beneficiaries, because sanitary conditions remained poor and lack of sanitary education facilitated health problems. Health benefits are less obvious and immediate. It is not clear that rural populations think much about the relationships between water and health. Therefore, the integration of health and water is a positive approach to effective communication of water resources for improved quality of life.

An improvement in the rural water supply will result in a measurable increase in public health. The effect on community health of providing safe water supply depends on the extent to which the community makes use of the supply, and this in turn depends on social customs, an understanding of health implications, and on the level of service provided. Sanitary education should be continuously given to rural populations in all phases of planning, implementing and maintains new water supply systems.

5 - 4 - 2 Project Objectives

The objective of the proposed sanitary education programme for Monduli town, which is scheduled to be implemented in succession to the education trials made during this study period, is to raise villagers' senses of sanitary improvements. To this end, the proposed programme will include the following services:

Primary School

- Introduction of improved sanitary education curricula.
- Provision of education materials and aids.
- Improvement of pupils' personal hygiene.

Community

- Campaign for enlightment of sanitary improvement.

- Provision of materials for campaign.
- Promotion of installation of sanitary facilities.

5 - 4 - 3 Sectoral Roles and Responsibilities

(a) District Education Department

District Education Department has a central role in coordinating sanitary education activities in schools, as well as promoting and monitoring the health of school children. The Department is responsible for implementation of the following programme:

- to prepare guidelines for promoting sanitary education in primary schools including environmental sanitation.
- to train teachers with respect to sanitary education.
- to provide materials and aids for sanitary education.

(b) District Department of Community Development

District Department of Community Development has a key role in mobilizing communities to participate in self-reliance activities. The Department is responsible for implementation of the following activities:

- to sensitize communities so as to raise their awareness about sanitary education and environmental sanitation.
- to mobilize communities to build pit-latrines and other sanitary facilities in their homes.
- to assist communities in organizing villagers' groups for sanitary improvement.

(c) Primary Schools

Primary schools are responsible for implementation of the following activities:

- to give effective sanitary education to pupils.
- to maintain cleanliness of school compound.

- to maintain health records of each pupil during the period of schooling.
- to convene meetings with village leadership or parents in order to discuss school sanitary/health problems and work out solutions.

(d) Communities

Communities will participate fully in the sanitary education programme and try to attain self-enlightment regarding sanitary improvement.

5 - 4 - 4 Implementation and Operation of the Programme

(a) Executing Agency

Monduli District Executive Directorate will be the executive agency responsible for implementing the proposed Sanitary Education Programme for Monduli Town. The Directorate will organize a steering committee composed of officials concerned in order to facilitate the programme.

(b) Plan of Approach

Monduli District Executive Directorate will employ consultants who shall assist the department in implementing the sanitary education programme, as follows:

- to prepare educational materials and aids for use of teachers, pupils,village leaders and villagers.
- to conduct seminars for teachers of two primary schools in Monduli town (about three days for each school).
- to carry out education trials for pupils in the two primary schools (about five days for each school).
- to conduct sensitization seminars for village governments' leaders, members of villages' health committees, traditional leaders and traditional birth attendants.
- to conduct sensitization seminars and workshops for community members who will be divided into 15 administrative units.

Seminars for community members will be participatory and introductory in the sense that facilitators will be tapping the experiences of the participants, and in the process give them tasks to be performed at their homes. Thereafter, workshops will be held to determine how much the participants have been performed at their homes.

The consultants will use village leaders and traditional leaders to penetrate the communities and mobilize the community members to attend seminars and workshops. In order to maintain continuity, the consultants will make follow-up visits to homes/households of community members to conduct an on-the spot assessment of their surroundings and personal hygiene.

Table 5-1 DESIGNED INFLOW AND EVAPORATION LOSS FOR ALL EXISTING RESERVOIRS

Month	Rainfall (mm)	Inflow (m^3/km^2)	Evaporation Loss (mm)
Nov.	84	12,600	137
Dec.	97	14,550	110
Jan.	66	9,900	141
Feb.	75	11,250	114
Mar.	143	21,450	116
Apr.	219	32,850	109
May	83	12,450	97
Jun.	13	0	99
Jul.	3	0	95
Aug.	5	0	134
Sep.	5	0	176
Oct.	19	0	155
Total	812	115,050	1,483

Table 5-2 WATER CONSUMPTIVE USE AND DEPEND ON DAM (PRESENT CONDITION)

S. No.	Name of Village	Population					Water Consumptive Use (m^3/day)		
		People (1994)	Livestock				People	Livestock	Depend on Dam
			Cattle	Goats	Sheep	Donkeys			
1	Lendikinya	2,873	3,482	6,188	2,728	473	57.5	203.1	260.6
2	Enguik	4,090	1,280	1,950	975	141	81.8	70.5	86.3
3	Arkatan	1,895	4,585	2,676	1,340	139	37.9	180.5	218.4
4	Lossimingori	1,720	3,078	6,706	3,150	218	34.4	195.3	229.7
5	Lepurko	3,042	5,456	11,920	5,601	432	60.8	347.5	408.3
6	Meserani Juu	2,985	4,978	1,677	899	123	59.7	177.6	177.6
7	Nengungu	1,586	1,430	950	338	146	31.8	58.7	82.5
8	Moita Kiloriti	1,685	4,266	4,130	2,725	205	33.7	200.6	234.3
9	Moita Bwawani	3,934	9,703	4,835	2,320	230	78.7	367.2	445.9
10	Meserani Bwawani	1,151	3,228	1,119	539	135	23.0	116.1	139.1
11	Mbuyuni	3,700	1,224	3,880	1,060	35	74.0	86.6	160.6
12	Lolkisale	4,397	7,305	3,772	858	42	87.9	266.3	No dam
13	Tukusi	1,541	1,026	417	191	22	30.8	39.4	No dam
14	Makuyuni	3,604	3,739	9,104	2,742	208	72.1	234.8	234.8
15	Naitolia Sub-Village	1,259	3,452	3,225	1,262	128	25.2	151.0	176.2
16	Oltukai Sub-Village	691	4,153	3,113	1,649	158	13.8	175.6	Dam breached
17	Mswakini	2,391	6,944	4,068	1,325	78	47.8	163.8	Dam breached
18	Emairete	4,674	3,828	2,925	1,262	265	93.5	162.0	162.0
Total		65,428	76,086	41,038	33,223	3,245	-	-	-

Table 5-3 SUMMARY OF WATER BALANCE OF EXISTING RESERVOIRS

Village	(1) Water Demand	Nos. of Reservoirs	(2) Effective Storage	(2)/(1) (%)
Lendikinya	95	2	95	1.00
Enguik	31	1	31	1.00
Arkatan	80	5	80	1.00
Lossimingori	84	1	84	1.00
Lepurko	149	2	149	1.00
Meserani Juu	65	1	65	1.00
Nengungu	30	3	30	1.00
Moita Kiloriti	85	3	85	1.00
Moita Bwawani	163	2	136	0.83
Meserani Bwawani	51	2	51	1.00
Mbuyuni	59	2	59	1.00
Makuyuni	86	4	86	1.00
Naitolia Sub-Village	64	2	64	1.00
Emairete	59	3	59	1.00
Total	1,101	33	1,074	0.98

Note: Details of calculation are given in the Supporting Report.

Table 5-4 DESIGNED INFLOW AND EVAPORATION LOSS FOR PROPOSED RESERVOIRS

Month	Rainfall (mm)	Inflow (m^3/km^2)	Evaporation Loss (mm)
Nov.	0	0	137
Dec.	17	0	110
Jan.	15	0	141
Feb.	28	0	114
Mar.	208	31,200	116
Apr.	250	37,500	109
May	0	0	97
Jun.	5	0	99
Jul.	7	0	95
Aug.	0	0	134
Sep.	0	0	176
Oct.	0	0	155
Total	530	68,700	1,483

Table 5-5 VILLAGE WATER DEMAND IN 2014

(Unit: m^3/day)

Village	Water Demand				Demand Relying on Reservoirs
	Domestic	Livestock	Others	Total	
Lendikinya	189	138	16	343	343
Enguik	268	48	16	332	267
Arkatan	114	137	13	264	264
Lossimingori	113	129	12	254	254
Lepurko	200	229	22	451	451
Meserani Juu	196	139	17	352	186
Nengungu	91	44	7	142	121
Moita Kiloriti	111	144	13	268	268
Moita Bwawani	259	281	27	567	567
Meserani Bwawani	76	91	8	175	175
Mbuyuni	243	56	15	314	314
Lolkisale	289	206	12	507	467
Tukusi	101	31	7	139	128
Makuyuni	124	155	8	287	163
Naitolia Sub-Village	43	110	8	161	161
Oltukai Sub-Village	22	130	8	160	160
Mswakini	157	202	10	369	212
Emairete	307	120	21	448	399
Total	2,903	2,390	240	5,533	4,900

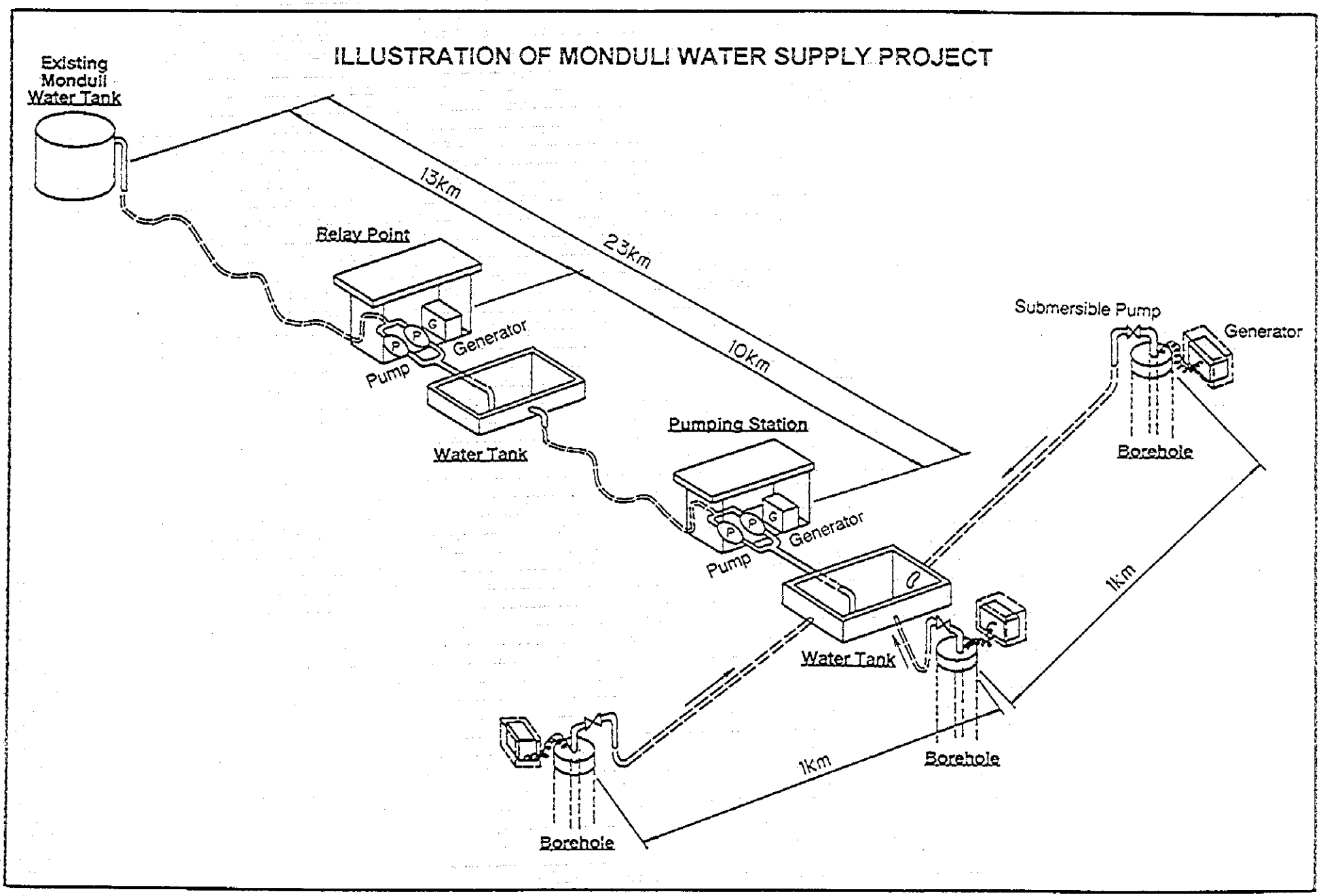


ILLUSTRATION OF MONDULI WATER SUPPLY PROJECT
Existing Monduli Water Tank
13km
23km
10km
Relay Point
Pump
Generator
Water Tank
Pumping Station
Pump
Generator
Water Tank
Submersible Pump
Generator
Borehole
1km
Borehole
1km
Borehole

Figure 5 - 1 EXISTING MONDULI WATER SUPPLY

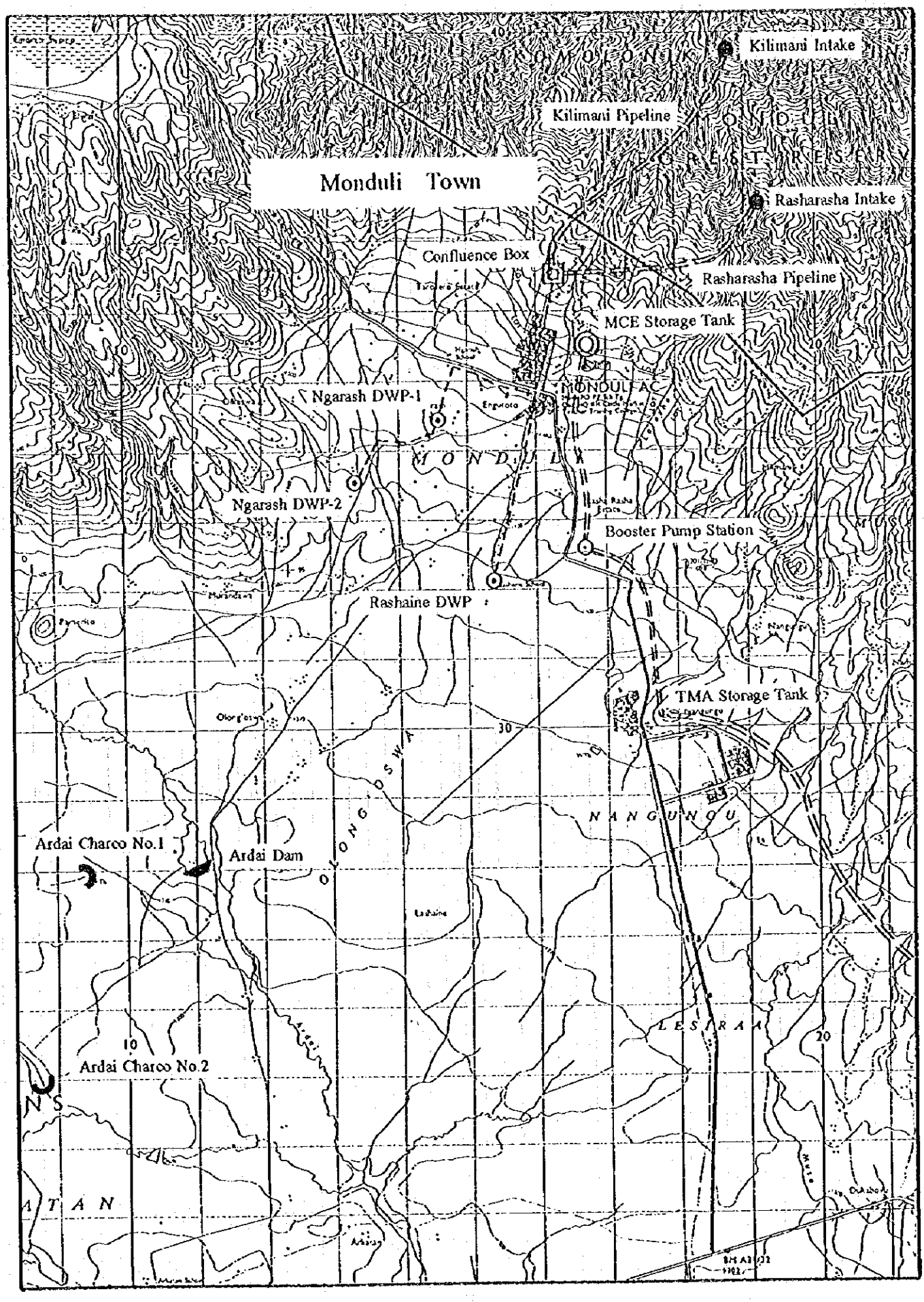


Figure 5 - 2 LAYOUT OF PROPOSED MONDULI WATER SUPPLY PROJECT

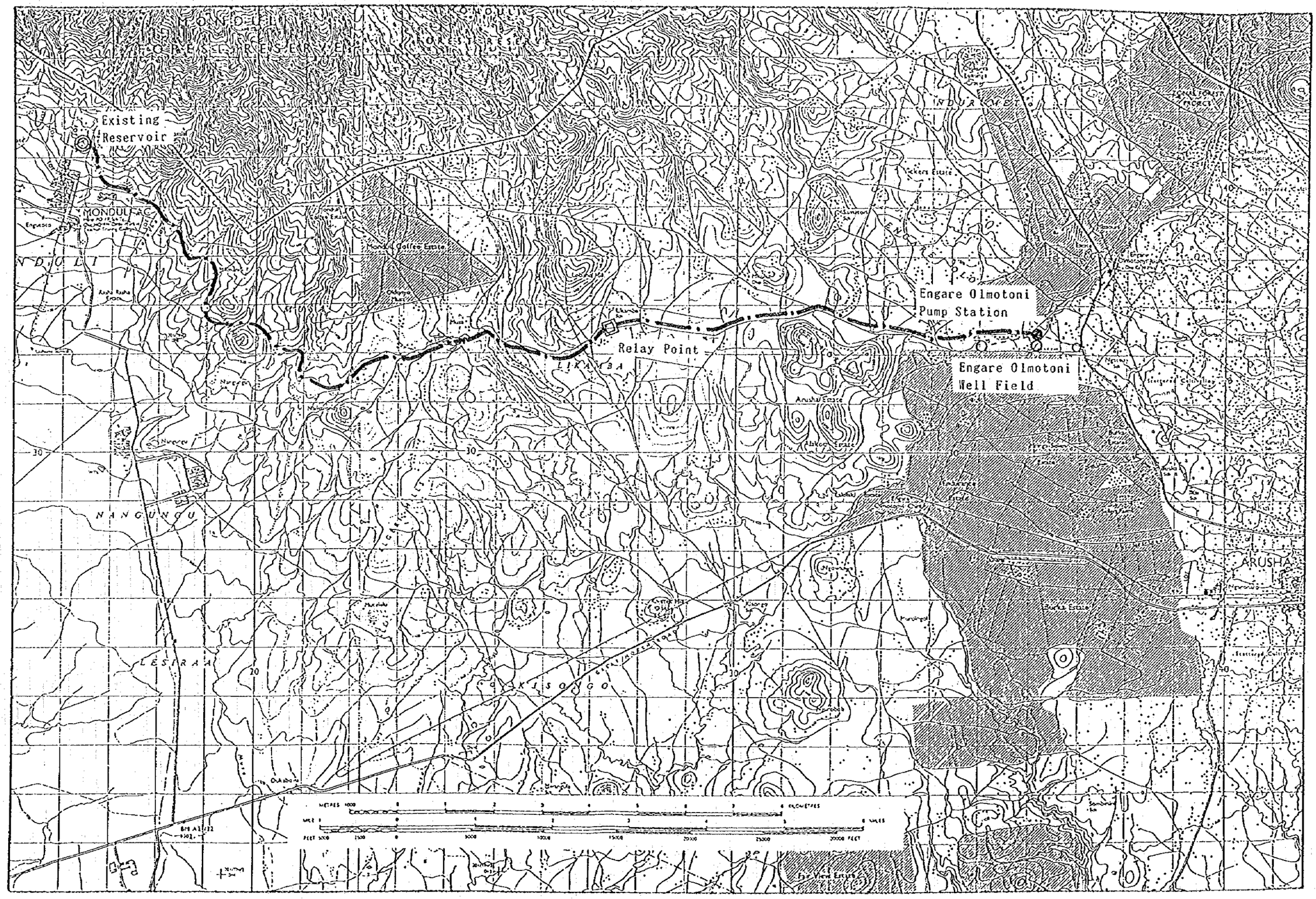


Figure 5 - 3 PROPOSED DEEP WELLS IN ENGARE OLMOTONI

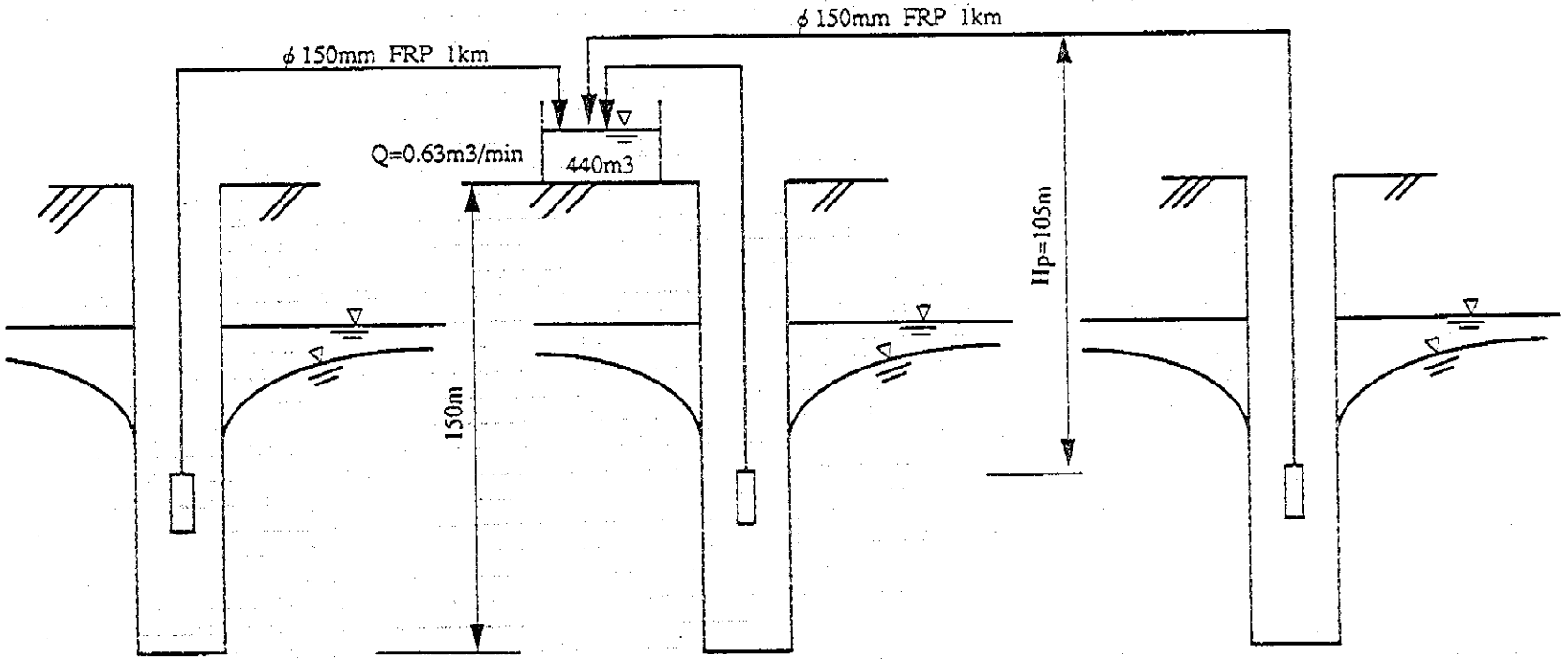


Figure 5-4 MONDULI WATER SUPPLY SYSTEM

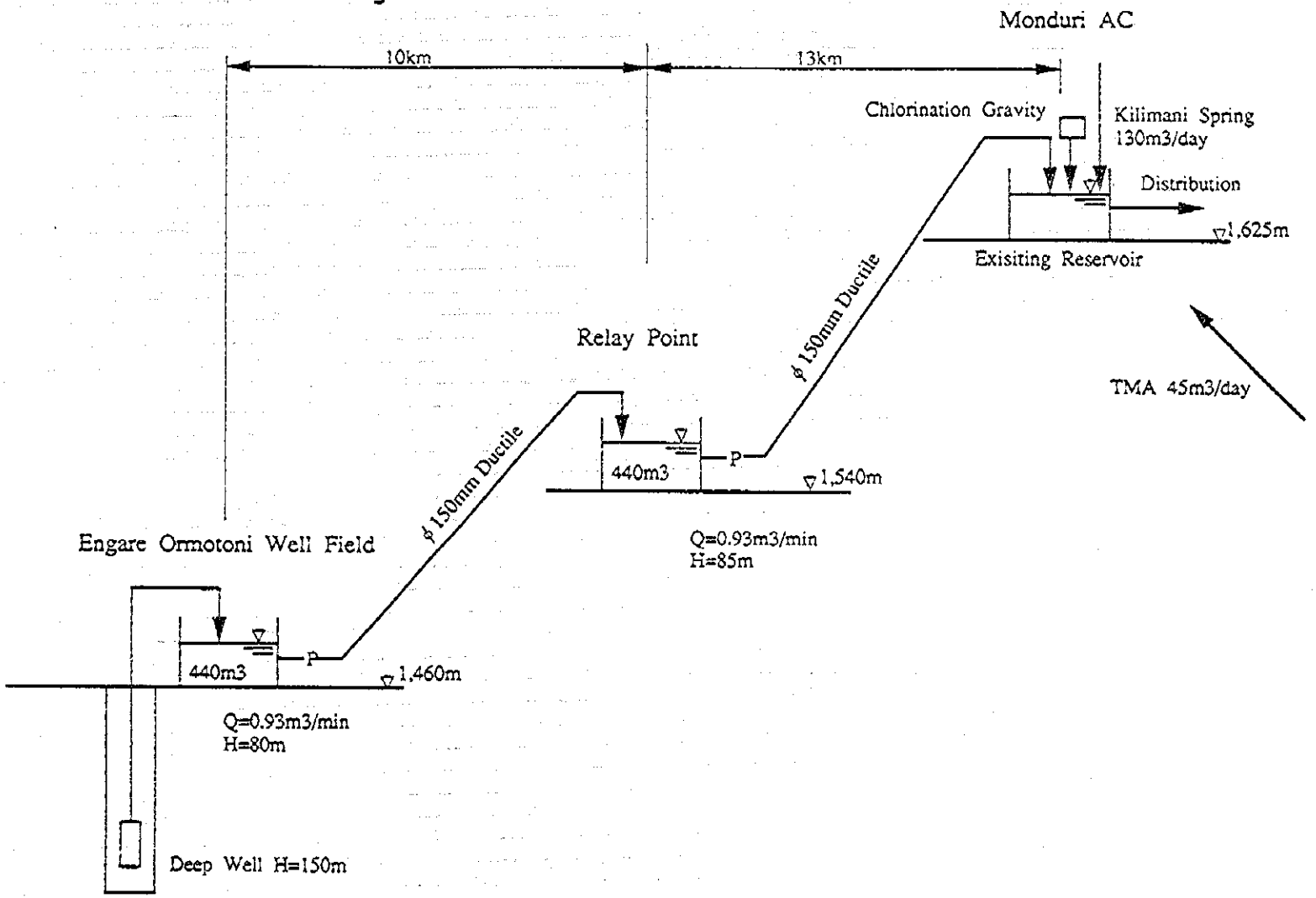
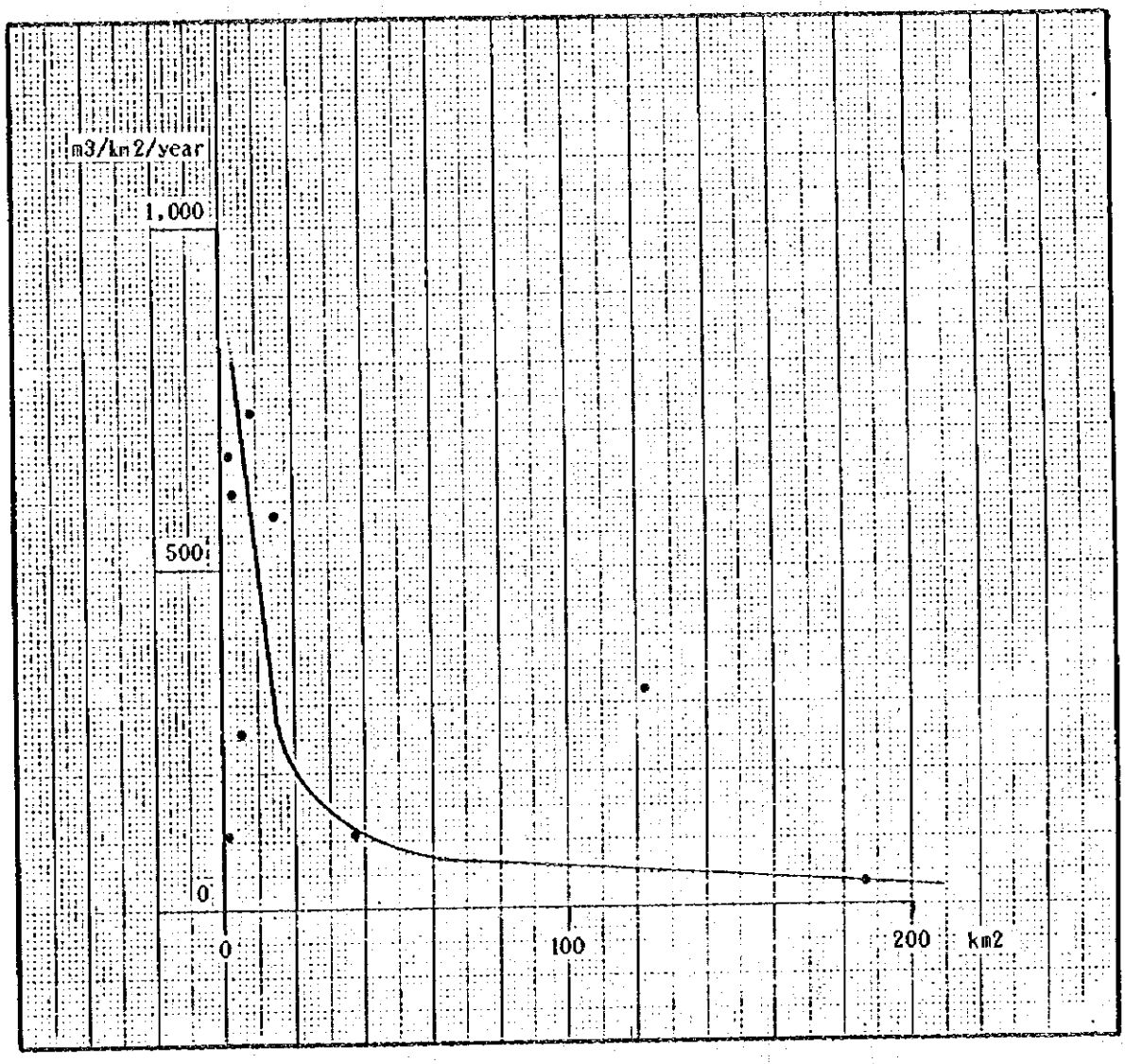


Figure 5 - 5 CATCHMENT AREA ~ SEDIMENT RATES



CHAPTER 6 IMPLEMENTATION AND OPERATION OF THE PROJECT

CHAPTER 6 IMPLEMENTATION AND OPERATION OF THE PROJECT

6 - 1 Implementation Program

6 - 1 - 1 Executing Agency

The Regional Water Department of Arusha (RWD) will be the executing agency responsible for implementing the Monduli Water Supply Project with the assistance and cooperation by the Monduli District Water Department (DWD) and the village governments concerned in their respective fields, whereas the Monduli District Water Department will be responsible for implementation of the Village Water Supply Projects.

6 - 1 - 2 Implementation Schedule

The proposed projects will be implemented as a package project in two phases; phase I project includes Monduli Water Supply Project and selected five Priority Village Water Supply Projects; phase II of the project includes 13 other Village Water Supply Projects.

(1) Phase I Project

Monduli Water Supply Project will be implemented in two stages. The stage 1 implementation program includes construction of two boreholes in Engare Olmotoni area and procurement of four water trucks with a tank capacity of 10 cubic meters each; the total well yields of 60 cubic meters per hour and four water trucks are enough to meet the increasing water demand of the residents till the year 2005. The economic lifespan of the water truck is estimated at five years from 1998 to 2002. The stage 2 implementation program is composed of construction of a water booster pumping station and conveyance pipelines with a length of 23 kilometers to connect the boreholes and the existing water tanks in Monduli town, and construction of an additional borehole to meet the water demand after the year 2005.

Regarding village water supplies, the selected five Priority Village Water Supply Projects will be implemented at the stage 1; they are Makuyuni, Mswakini, Oltukai, Emairete and Moita Bwawani, all of which are warranted

for early implementation of the projects. The construction of the five Priority Village Water Supply Projects will be completed in 1997.

(2) Phase II Project

The phase II project will address the 13 Village Water Supply Projects of 18 villages other than the five Priority Village Water Supply Projects. The project will be implemented over a four-year construction period starting in 1998 to be completed in 2001 so as to meet the objectives of the national water policy. Table 6.1 gives the proposed implementation schedule.

6 - 2 Operation and Maintenance

6 - 2 - 1 Responsibility

(1) Principles

As stated in the National Water Policy, with respect to supervision and operation of rural water supply projects emphasis will be placed on the involvement of beneficiaries so that users construct and operate water projects in their areas. However, there will be some water projects too big to be handled at village level due to the big capital investment and expertise involved. Therefore, the National Water Policy has categorized rural water supply projects into three levels: small-scale water supply projects, medium-size water supply projects and large-scale water supply projects.

(2) Monduli Water Supply Project

The proposed Monduli Water Supply Project is a large-scale water supply project for its beneficiaries of 18,000 people. Monduli District Water Department will be responsible for looking after the project under the supervision of Regional Water Department. However, the community and the village governments will be responsible for the security and protection of water supply points within their village through the establishment of village water committees.

(3) Village Water Supply Projects

The proposed village water supply projects are categorized as small-scale water supply projects. The community will participate in the process of conserving, safeguarding and maintaining, protecting and operating the project through the establishment of village water committees.

6-2-2 Organization

For the successful implementation and operation of the Project, Arusha Regional Water Department (RWD) will appoint a project director to be responsible for the promotion and coordination of projects under the supervision of the Regional Water Engineer. For operation and maintenance of the proposed Monduli Water Supply Project, Monduli District Water Department (DWD) will strengthen manpower resources as shown in Figure 6-1.

The village water committees are responsible for operation and maintenance of their village water supply projects. The members of these committees are selected among the villagers and do not necessarily have sufficient knowledge and or skills to operate and maintain the project facilities. Accordingly, DWD needs to supervise them.

For the efficient functioning of the proposed organization, the following is recommended:

- Monduli District Water Department will organize seminars to transfer the necessary knowledge and skills to the members of the village water committees who are assigned to take charge of operation and maintenance of the project facilities.

- The present organizational structure of the O&M section of Monduli District Water Department does not station anyone in charge of the reservoirs. For the sake of importance of reservoirs as water sources for rural water supplies, DWD should appoint a staff member(s) at the O&M section to take charge of planning and operation of reservoirs.

6 - 2 - 3 Operation and Maintenance of Water Facilities

The proposed main water supply facilities include deep wells, pumping equipment and storage dams. The following guidelines are proposed in order to maintain the water facilities in good working order:

(1) Deep Well

- To keep the area surrounding the deep well clean so as not to form pools of muddy water which could cause contamination of well water.
- To periodically observe the water quality and the size of soil particles contained in the pumped-up water.
- To operate deep wells, rotating among two main wells and one standby well at regular intervals to keep the flow capacities of aquifers around the well strainer.

(2) Pumping Equipment

Submersible Pump

- To read and record the ammeter once a day to check if the value is within the range of the specified value.
- To measure the insulation resistance value of the submersible motor once a month and confirm whether or not substantial drops in value occur.

Conveyance Pump

- To check the motor for unusual noises and excess vibration.
- To change the oil of oil-lubricated bearings after 5,000 to 8,000 operating hours.
- To measure the insulation resistance value.

Diesel Generator

- To check the lube oil level, cooling water level and fuel oil level, and make sure that the V-belt is tight.
- To read the oil pressure gauge, water temperature gauge, charging ammeter to confirm their normal indication.

- To confirm that there is no abnormal vibration, striking or rubbing noise and oil, water or fuel leakage.
- To use genuine oil, fuel and pure water.

(3) Storage Dam

- To make regular inspection of the dam twice a month during the rainy season and once a month during the dry season. The following items should be checked:
  - conditions of dam embankment
  - silting and trash in the reservoir
  - soil conditions around the abutment
  - scouring of the spillway
- To observe the water level of the reservoir and estimate the effective water storage in the reservoir, for which the gauging staff be installed and the relationship of water levels to water storage volumes be established.
- To check the filtration structure with respect to the quality of filtered water, filtration rates and working conditions of hand pumps.

6 - 3 Additional Survey

6 - 3 - 1 Monduli Water Supply Project

The construction plan of the conveyance pipelines between the proposed boreholes at Engare Olmotoni and the existing water tank at Monduli town was based on the topographic maps with a scale of 1/50,000. It is, therefore, necessary to conduct detailed topographic surveys to prepare detailed facilities plans and cost estimates. The survey shall include plane survey, longitudinal survey and cross-sectional survey.

6 - 3 - 2 Village Water Supply Project

Topographic surveys for the sections between the boreholes and elevated tanks should be carried out regarding the three village water supply

projects of Makuyuni, Mswakini and Emairete where rehabilitation of pumping facilities for boreholes is proposed.

The required storage capacities of the proposed reservoirs were predetermined preliminarily for each village based on topographic maps with the scale of 1/50,000, based on which selection of dam sites be carried out. In selecting possible dam sites, useful information on topography and river runoff may be obtained from the villagers.

6 - 4 Water Charge Collection

6 - 4 - 1 Current Situation

The existing water supply system in Monduli town consists of house connections and public taps. Only some 1,000 people living in Monduli town center receive direct supplies and six public taps serve some 25,000 people. The water charge through house connections is Tsh 200/month for each household and Tsh 400/month for commercial use. No charge is made for water supply through the public taps.

The collection rate of the water charge from house connection system is reported to be approximately 70 percent for commercial uses and 40 percent for households. Given the small number of households with house connections, the supplied water volume carrying a water charge which is duly paid is extremely small vis-a-vis the total water supply volume. The above low water charge collection efficiency is attributed to the frequent stoppage of water supplies, mainly caused by a decline of water availability at water sources and power cuts. Notwithstanding these adverse conditions, the existing water supply system has survived due to the following reasons:

- Fairly reliable water intake from the main sources, i.e. Kilimani spring at Mt. Monduli.
- Low operation costs due to use of the gravity water conveyance system.
- Subsidy provided by the local administration for the maintenance costs.

When a water shortage occurs, particularly water cuts during the dry season, local inhabitants buy water from merchants at a cost of Tsh five per liter. As the national water policy dictates that rural water supply systems must be run on the benefit principle, the current water supply operation and maintenance system in Monduli town requires radical changes.

6 - 4 - 2 Water Charge Collection Plan

(a) General

In order to provide the necessary water supply for Monduli town, a proposal is made under the Project to pump up groundwater from the boreholes to be constructed at Engare Olmotoni. The pumped water is conveyed to the existing water storage tank in Monduli. The proper operation and maintenance of the proposed system require the introduction of a reasonable water charge and the establishment of an efficient water charge collection system to meet the operation and maintenance cost. The attached table gives the analysis results on feasible measures relating to the water charge collection system, taking the present local conditions into consideration. Based on the results, the following proposals are made in regard to water charge collection.

(b) Water Distribution System

The proposed Monduli Water Supply Project envisages the development of new water sources and the construction of a water conveyance system. The existing water distribution system will be preserved, however. This means that there will be no extension of the present house connection system and no increase of the number of public taps. The reason for this is that the most urgent task is to secure water supply sources given the present low water consumption and income levels. In the future, however, extension of the house connection system and an increase of the number of public taps may become necessary depending on the extent of the progress of economically viable water supply operation.

(c) Water Charge System

Water charge collection is necessary to provide a source of funding for the maintenance of the water supply facilities after completion of the project

and also as a funding source for improvements of the facilities which will be required in the future in accordance with the socioeconomic development of Monduli town. A PR campaign designed to raise the awareness of local inhabitants of the principle that beneficiaries are required to pay water charge, corresponding to the cost of the water supply services received, should be implemented.

1) House Connection System

At present, the water charge is collected at a monthly flat rate. The introduction of metering (or measuring by other means) may be an option in view of the principle of a water charge based on water volume consumed. The advantages and disadvantages of metering are shown in the attached table. While a flat rate system and metered charge system both have advantages and disadvantages, the introduction of a metered charge system in this project may prove problematic in terms of the maintenance and repair of meters. Adoption of the current flat rate system is, therefore, deemed appropriate for Monduli town for the supply of domestic water in view of the current low water consumption level. In the case of water supplies for commercial purposes, however, the water consumption level varies from one type of business to another, implying that the introduction of a metered charge system is feasible.

In short, adoption of the present flat rate system without the use of meters is proposed under the project although new flat rates will be set for the house connection system depending on the number of family members, type of business and number of employees.

2) Public Taps

The introduction of either a flat rate system or metered charge system is possible for each public tap. While a flat rate system is more convenient in terms of charge collection or payment, it has the following possible problems:

- Excessive consumption taking advantage of the fixed charge.
- Increase of ineffective water.

In contrast, a metered (measured) charge system is likely to result in local habitants reducing their water consumption in order to save their payment. Therefore, the adoption of a metered (measured) charge system is proposed to reduce wasteful water consumption and to prevent the emergence of a feeling of unfairness among local habitants who communally use the public water taps.

(d) Water Charge Collection System

The basic principles of a desirable water charge collection system are i) the participation of local inhabitants in recovering the maintenance cost of the water supply facilities, ii) prevention of any feeling of unfairness among local inhabitants in regard to water charge payment and iii) a clearly visible relationship between the water charge collected and volume of water supplied.

1) House Connection System

Water Charge Payment System

The scope of the current house connection system is limited to domestic households, commercial facilities and public facilities, all of which are located in the Monduli town center. The beneficiaries will pay a monthly water charge, set by the village water committee, directly to the secretariat of the Committee. The water volume conveyed from the water sources, water volume supplied and water charge collected will be recorded by the Committee. The collected water charges will be later paid to the Monduli District Water Department which is responsible for the operation and maintenance of the Project.

Measures to Deal with Delayed or Non-Payment

The proposed measures to deal with delayed payment or non-payment of the water charge should be taken. As the identities of the beneficiaries of the house connection system are clearly established, the village water committee issues a monthly bill to the beneficiaries, requesting prompt payment. If payment is delayed for two months, for example, a reminder should be issued. A water supply rule should be introduced that non-payment of the water charge for three months, for example, without a justifiable reason will result in the

stoppage of water supply, reminding all beneficiaries of the importance of prompt payment.

Delay in payment could result in disruption of the maintenance of the entire facilities in general and shortage of working capital to operate pumps in particular. Tolerance in regard to non-payment could anger regular and prompt payers and could also lead to a decline of the water charge payment rate. It is, therefore, essential that the village water committee be extremely firm when dealing with non-payment.

Illegal Use

The use of water through the house connection system for purpose other than consumption by the registered household members, taking advantage of the fixed water charge system, will adversely affect proper water supply operation. Provisions should be made, including the suspension of water supply, penalizing those who misuse the system.

2) Public Taps

One way of collecting the water charge is to supply water in direct exchange for payment at the site of the water tap. However, this method may be liable to confusion or cheating in regard to payment of the collected water charges to the village water committee. Water supplies and water charge collection may be contracted to a third party but the possible disadvantages of this system are a much higher water charge and deterioration of the awareness of local inhabitants of the need to properly use and maintain vital facilities. This system is inappropriate at the initial stage of water supply services. It is, therefore, proposed to collect the water charge for the public tap system based on metered consumption by means of water tickets using the system described below:

- The village water committee will appoint two operators for each tap from among local inhabitants living near the taps in question. The recruitment of local inhabitants is intended to make local inhabitants aware of the preciousness of water as well as the importance of water supply services.

- The public tap operators will receive a predetermined number of water ticket booklets from the water committee prior to the commencement of water supplies.

- At the site of the public water tap, one operator will detach tickets from the booklet depending on the size of containers used for water collection and will hand over the tickets in exchange for payment. As the size of containers used by local inhabitants in the project area is practically uniform, measuring of the water supplied should not prove too difficult.

- The other operator will receive the tickets and will supply the water determined by the number of tickets received.

- At the end of water supply hours, the operators will check the number of tickets issued and the amount of cash received and will submit both the remaining booklets and cash to the village water committee after confirming that the number of issued tickets matches the amount of cash received.

Comparison Table of Water Charge Collection Systems

(1) Charge System for Direct Supply to Households, etc.

	Existing Fixed Charge	Metered Charge
· Relationship between water consumption and water charge level	Not very clear (△)	Clear (○)
· Determination of water volume consumed	Not very easy (△)	Easy and accurate (○)
· Cost of instruments	No (○)	Yes (△)
· Maintenance of instruments	No (○)	Yes (△ technical difficulty)
Overall Judgement	No (○)	Less advantageous (△)

(2) Charge System for Communal Water Plugs

	Fixed Charge	Measured Charge
· Charge collection	Easy (○)	Charge based on consumption volume (△)
· Handling of payment	Trouble-free when paid to the secretariat (○)	Careful handing required (△)
· Special measure vis-a-vis non-payment	Required (△)	Not required (○)
· Relationship between excessive use and planned water supply	Decline of service population due to excessive use (△)	Planned water supply highly feasible (○)
· Water wastage	Yes (△)	Unlikely to occur (○)
Overall Judgement	Less advantageous (△)	Advantageous (○)

(3) Water Charge Collection Method

	Advance Purchase of Water Ticket	On-Site Purchase of Water Ticket	Direct Cash Payment
· Payment	Lump sum payment in advance (△)	Payment for required volume on the day (○)	Payment for required volume on the day (○)
· Loss of ticket	High financial risk (△)	Small financial risk (○)	Irrelevant (○)
· Water supply process	Simple (○)	Time-consuming (△)	Simple (○)
· Possible cheating vis-a-vis collected money	None (○)	None (○)	Highly possible (△)
Overall Judgement	Slightly advantageous (○)	Advantageous(○)	Disadvantageous (△)

(4) Type of Water Supply Operator

	Local Official	Contracted Third Party	Representative of Local Inhabitants
· Personnel cost	High (△)	Medium (△)	Low (○)
· Business speed	Fair (△)	Fast (○)	Fair (△)
· Awareness of importance of water	Fair (△)	Little (△)	Strong (○)
Overall Judgement	Disadvantageous (△)	Less advantageous (△)	Advantageous (○)

Table 6-1 IMPLEMENTATION SCHEDULE OF PROPOSED WATER SUPPLY PROJECTS

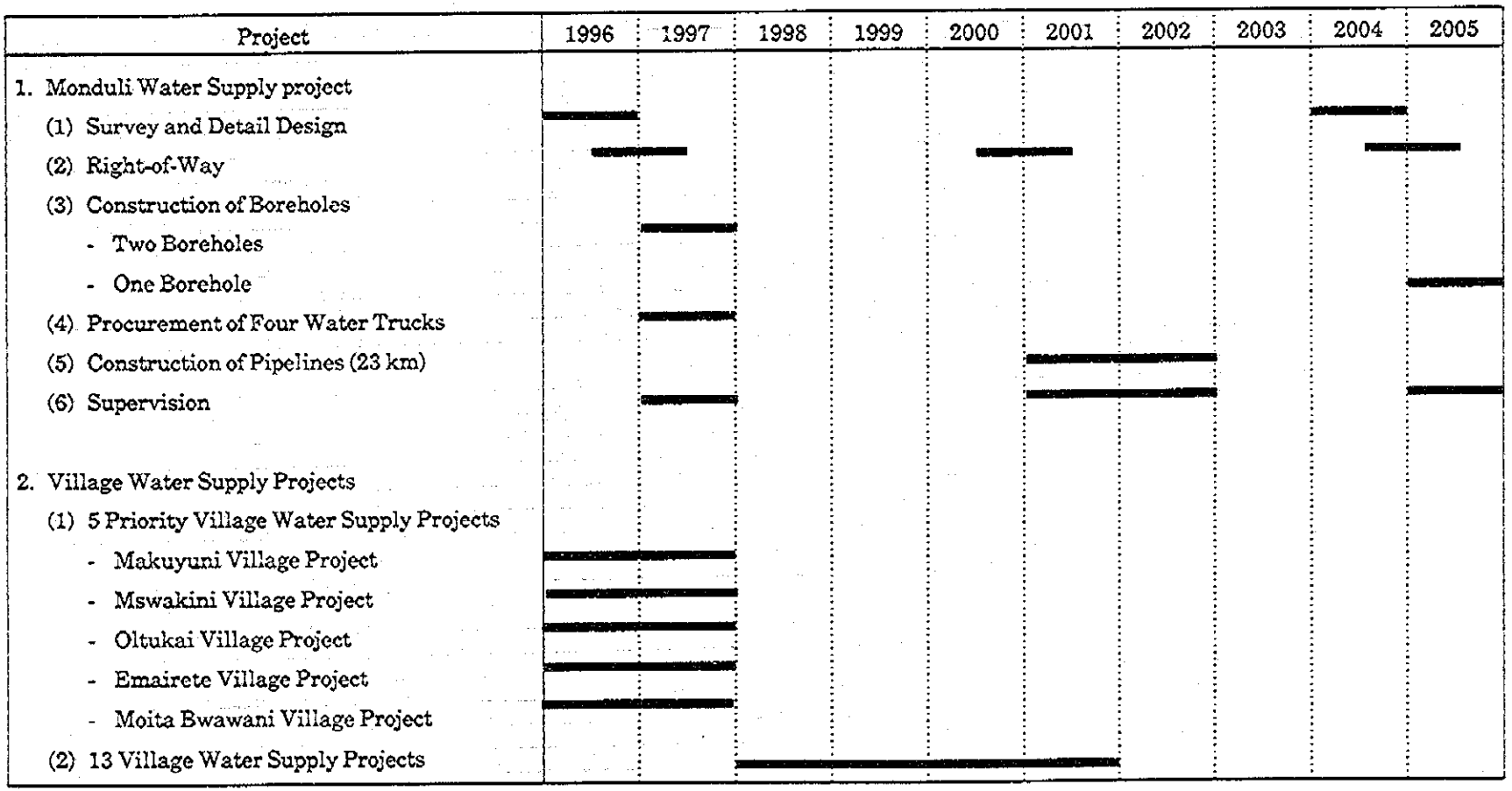
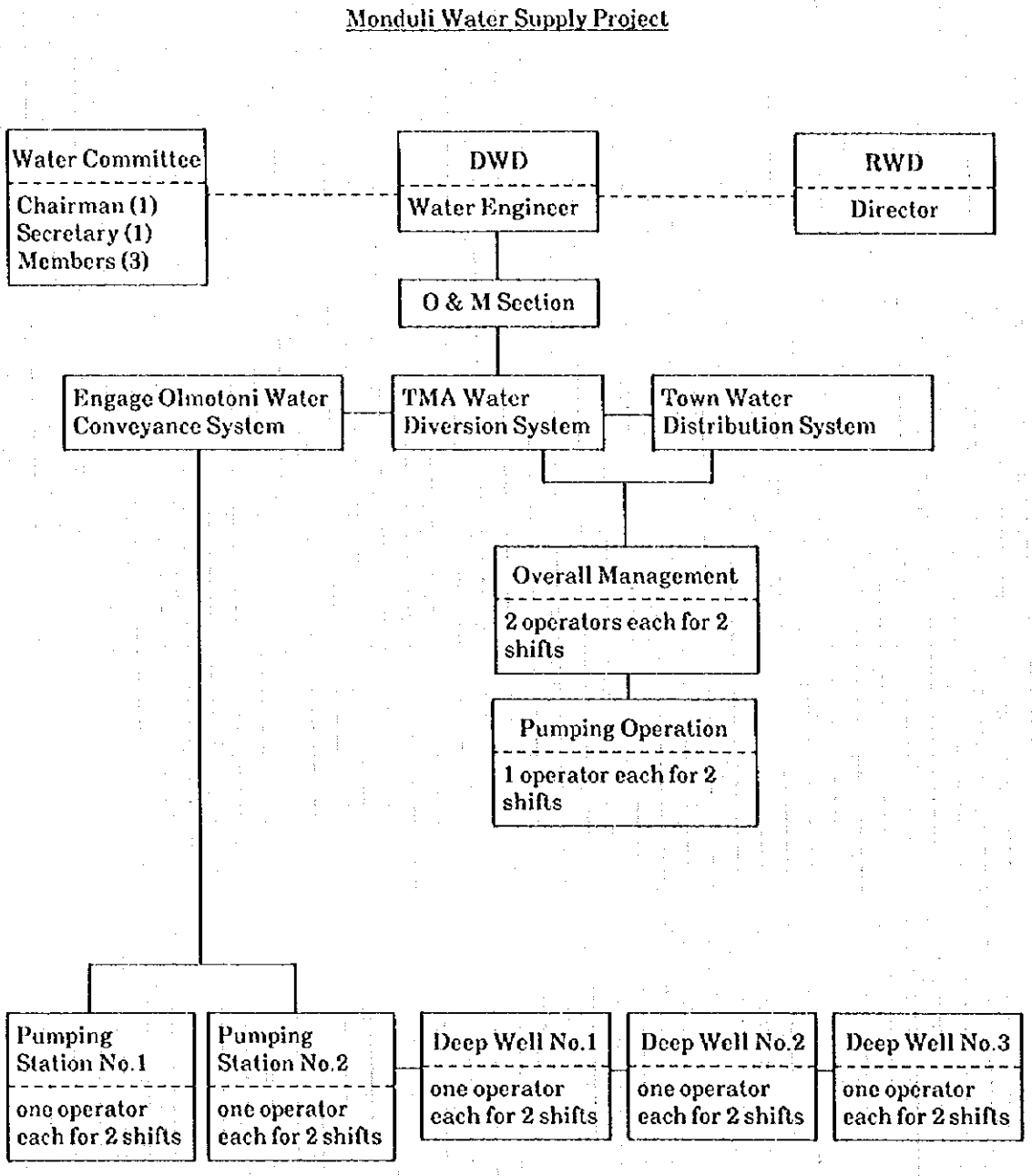


Figure 6 - 1 PROPOSED ORGANIZATION



CHAPTER 7 PROJECT COST

CHAPTER 7 PROJECT COST

7 - 1 Construction Cost

The construction works will be implemented on a contract basis under the supervision of Arusha Regional Water Department (RWD) for the Monduli Water Supply Project and Monduli District Water Department (DWD) for the Village Water Supply Project.

The construction costs are estimated based on the work quantity, current unit rates employed in RWD projects and the proposed implementation schedule. The construction costs include the costs for engineering services of detail design and supervision of construction works, construction of engineering facilities, procurement of water tank trucks. 10 percent of physical contingencies are added. Price escalation contingencies are calculated at rates of two percent per year for the foreign currency components and 14.7 percent per year for the local currency portion.

The construction costs are divided into two components of foreign currency and local currency. The foreign currency component is the amount of the costs required for procurement of machinery, equipment, spare parts and materials to be imported, and parts of costs.

The total construction costs of Monduli Water Supply Project amount to 3,814 million Tanzania Shilling (Tsh) and the total construction costs of Village Water Supply Project amount to 6,205 million Tsh at 1995 price levels exclusive of price contingencies (Table 7-1 to 7-4). The Summary of construction costs is given below:

Summary of Construction Costs

-Unit: Tsh Million-

Cost Item	Monduli Water Supply	Village Water Supply	Total
Right-of-Way	1.3	33.4	34.7
Construction	2,532.5	4,877.3	7,409.8
Water Tank Trucks	404.9	-	404.9
Engineering Services	529.0	730.2	1,259.2
Physical Contingencies	346.7	564.0	910.7
Base Cost	3,814.4	6,204.9	10,019.3
Price Contingencies	505.3	1,586.5	2,091.8
Total	4,319.7	7,791.4	12,111.1

Table 7-5 gives the annual disbursement schedule of Monduli Water Supply Projects, summarized as follows:

Monduli Water Supply Project

-Unit: Tsh Million-

Year	Enginrng. Services	land	Wells	Water Trucks	Pipe-lines	Physical Contgcy.	Total Base Cost
1996	337.1	-	-	-	-	33.7	370.8
1997	54.9	0.1	431.7	404.9	-	89.1	980.7
1998	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-
2001	41.6	1.2	-	-	778.4	82.1	903.3
2002	62.5	-	-	-	1,167.7	123.0	1,353.2
2003	-	-	-	-	-	-	-
2004	23.0	-	-	-	-	2.3	25.3
2005	9.9	0.0	154.7	-	-	16.5	191.1
Total	529.0	1.3	586.4	404.9	1,946.1	346.7	3.814.4

7 - 2 Operation and Maintenance Costs

The operation and maintenance costs of Monduli Water Supply Project cover the following three components: the existing intake facilities from the three springs of Kilimani, Rasharasha and Rekisilititi, pumping diversion from TMA pipelines through the existing booster pump, and water supplies from the proposed three boreholes at Emairete Olmotoni. Annual costs are estimated as follows:

(1) The Existing Water Intake and Distribution Facilities

- Administration and materials		Tsh	1,500,000
- Chlorine for disinfection		Tsh	137,000
- Labor		Tsh	973,000
	Total	Tsh	2,610,000

(2) TMA Diversion

- Pump operators	: 2 persons	Tsh	324,000
- Watchman	: 2 persons	Tsh	324,000
- Electricity		Tsh	240,000
	Total	Tsh	888,000

(3) Water Supply from the Proposed Three Boreholes

- Administration		Tsh	700,800
- Operators	: 10 persons	Tsh	1,620,000
- Fuel	: 3 wells and 2 stations	Tsh	35,550,000
- Repair and materials		Tsh	7,574,200
	Total	Tsh	45,445,000

(4) Water Tank Truck

- 4 nos. of truck, 4x40 m^3/day			
- Drivers and assistants: 8 persons		Tsh	1,632,000
- Fuel		Tsh	20,736,000
- Car maintenance		Tsh	6,912,000
	Total	Tsh	29,280,000

Table 7-1 CONSTRUCTION COST OF MONDULI WATER SUPPLY PROJECT

Unit : Tsh 1,000

Cost Item	Local Currency	Foreign Currency	Total
1. Right-of-way	1,350	0	1,350
2. Construction			
1) Boreholes			
- Wells : 3 nos.	78,105	63,906	142,011
- Pumps & generators	25,598	145,061	170,659
- Storage tank & pipes	47,313	189,252	236,565
- Technical Supervision	0	37,203	37,203
Sub-Total	151,016	435,422	586,438
2) Water Conveyance Works			
- Pumps and generators	26,131	104,522	130,653
- Pump house	33,705	3,745	37,450
- Pipelines : 23 km	261,116	1,479,657	1,740,773
- Technical supervision	0	37,198	37,198
Sub-Total	320,952	1,625,122	1,946,074
3. Water Tank Trucks			
- Water trucks : 4 nos.	57,752	288,756	346,508
- Garage	58,365	0	58,365
Sub-Total	116,117	288,756	404,873
4. Engineering Services			
- Survey	2,233	151,411	153,644
- Detail design	2,456	203,968	206,424
- Supervision	2,009	166,883	168,892
Sub-Total	6,698	522,262	528,960
5. Physical Contingencies	59,613	287,156	346,769
Base Cost (1 ~ 5)	655,746	3,158,718	3,814,464
6. Price Contingencies	60,400	444,920	505,320
Total Construction Cost	716,146	3,603,638	4,319784

Table 7-2 CONSTRUCTION COST OF VILLAGE WATER SUPPLY PROJECT

Unit : Tsh 1,000

Cost Item	Local Currency	Foreign Currency	Total
1. Construction			
1) Lendikinya	23,848	243,188	267,036
2) Enguik	17,882	181,854	199,736
3) Arkatan	27,500	240,625	268,125
4) Lossimingori	23,720	239,444	263,164
5) Lepruko	17,909	178,807	196,716
6) Meserani Juu	18,348	195,063	213,411
7) Nengungu	22,691	211,240	233,931
8) Moita Kiloriti	29,917	305,856	335,773
9) Moita Bwawani	31,467	341,800	373,267
10) Meserani Bwawani	17,705	177,432	195,137
11) Mbuyuni	24,988	267,320	292,308
12) Lolkisale	25,029	269,936	294,965
13) Tukusi	12,382	133,729	146,111
14) Makuyuni	5,378	242,560	247,938
15) Naitolia	24,295	250,914	275,209
16) Oltukai	6,789	84,160	90,949
17) Mswakini	13,153	554,254	567,407
18) Emairete	27,652	388,464	416,116
Sub-Total	370,653	4,506,646	4,877,299
2. Right-of-way	33,400	0	33,400
3. Engineering Services	54,162	675,997	730,159
4. Physical Contingencies	45,722	518,264	564,086
Base Cost (1 ~ 4)	504,037	5,700,907	6,204,944
5. Price Contingencies	338,543	1,247,966	1,586,509
Total Construction Cost	842,580	6,948,873	7,791,453

Table 7-3 BREAKDOWN OF CONSTRUCTION COSTS OF VILLAGE WATER SUPPLY PROJECT (1)

Unit : Tsh 1,000

Item	Local Currency	Foreign Currency	Total Cost
1. Land Compensation	33,400	0	33,400
- Priority Project	8,610	0	8,610
- Other Villages	24,790	0	24,790
2. Construction Cost	370,653	4,506,646	4,877,299
- Priority Project	84,439	1,611,238	1,695,677
- Other Villages	286,214	2,895,408	3,181,622
3. Engineering Services	54,162	675,997	730,159
- Priority Project	12,666	241,686	254,352
- Other Villages	41,496	434,311	475,807
4. Physical Contingency	45,822	518,264	564,086
- Priority Project	10,572	185,292	195,864
- Other Villages	35,250	332,972	368,222
5. Base Cost	504,037	5,700,907	6,204,944
- Priority Project	116,287	2,038,216	2,154,503
- Other Villages	387,750	3,662,691	4,050,441
6. Price Contignecy	338,543	1,247,966	1,586,509
- Priority Project	25,482	59,509	87,991
- Other Villages	313,061	1,188,457	1,501,518
7. Construction Cost	842,580	6,948,873	7,791,453
- Priority Project	141,769	2,097,725	2,239,494
- Other Villages	700,811	4,851,148	5,551,959

Table 7 - 4 BREAKDOWN OF CONSTRUCTION COSTS OF VILLAGE WATER SUPPLY PROJECT (2)

Unit : Tsh 1,000

Village	Item	Q'ty	LC	FC	Total
Lendikinya	Dam Const.	2 nos	1,680	46,080	47,760
	Filter	8 nos	20,000	175,000	195,000
	Others		2,168	22,108	24,276
	Sub Total		23,848	243,188	267,036
Enguik	Dam Const.	2 nos	1,256	34,072	35,328
	Filter	6 nos	15,000	131,250	146,250
	Others		1,626	16,532	18,158
	Sub Total		17,882	181,854	199,736
Arkatan	Filter	10 nos	25,000	218,750	243,750
	Others		2,500	21,875	24,375
	Sub Total		27,500	240,625	268,125
Lossimingori	Dam Const.	2 nos	1,408	39,488	40,896
	Dam Rehabili.	1 no	156	3,188	3,344
	Filter	8 nos	20,000	175,000	195,000
	Others		2,156	21,768	23,924
	Sub Total		23,720	239,444	263,164
Lepurko	Dam Const.	1 no	1,281	31,302	32,583
	Filter	6 nos	15,000	131,250	146,250
	Others		1,628	16,255	17,883
	Sub Total		17,909	178,807	196,716
Meserani Juu	Dam Const.	2 nos	1,680	46,080	47,760
	Filter	6 nos	15,000	131,250	146,250
	Others		1,668	17,733	19,401
	Sub Total		18,348	195,063	213,411
Nengungu	Dam Const.	1 no	628	17,036	17,664
	Filter	8 nos	20,000	175,000	195,000
	Others		2,063	19,204	21,267
	Sub Total		22,691	211,240	233,931
Moita Kiloriti	Dam Const.	2 nos	2,197	59,301	61,498
	Filter	10 nos	25,000	218,750	243,750
	Others		2,720	27,805	30,525
	Sub Total		29,917	305,856	335,773
Moita Bwawani	Dam Const.	3 nos	3,606	91,977	95,583
	Filter	10 nos	25,000	218,750	243,750
	Others		2,861	31,073	33,934
	Sub Total		31,467	341,800	373,267
Meserani Bwawani	Dam Const.	1 no	1,095	30,052	31,147
	Filter	6 nos	15,000	131,250	146,250
	Others		1,610	16,130	17,740
	Sub Total		17,705	177,432	195,137

Village	Item	Q'ty	LC	FC	Total
Mbuyuni	Dam Const.	2 nos	2,716	68,018	70,734
	Filter	8 nos	20,000	175,000	195,000
	Others		2,272	24,302	26,574
	Sub Total		24,988	267,320	292,308
Lolkisale	Dam Const.	2 nos	2,754	70,396	73,150
	Filter	8 nos	20,000	175,000	195,000
	Others		2,275	24,540	26,815
	Sub Total		25,029	269,936	294,965
Tukusi	Dam Const.	2 nos	1,256	34,072	35,328
	Filter	4 nos	10,000	87,500	97,500
	Others		1,126	12,157	13,283
	Sub Total		12,382	133,729	146,111
Makuyuni	Dam Const.	2 nos	1,408	39,488	40,896
	Dam Rehabili.	1 no	17	297	314
	Pipes	4.1 km	1,164	115,099	116,263
	Pump	1 no	-	3,125	3,125
	Reserv. Tank	1 no	2,300	62,500	64,800
	Others		489	22,051	22,540
	Sub Total		5,378	242,560	247,938
Naitolia	Dam Const.	2 nos	2,086	53,104	55,190
	Filter	8 nos	20,000	175,000	195,000
	Others		2,209	22,810	25,019
	Sub Total		24,295	250,914	275,209
Oltukai	Dam Rihabili.	1 no	1,172	32,759	33,931
	Filter	2 nos	5,000	43,750	48,750
	Others		617	7,651	8,268
	Sub Total		6,789	84,160	90,949
Mswakini	Dam Const.	2 nos	1,408	39,488	40,896
	Dam Rehabili	2 nos	100	1,978	2,078
	Deep Well	2 nos	3,278	85,088	88,366
	Pipes	9.0 km	2,571	252,313	254,884
	Reserv. Tank	2 nos	4,600	125,000	129,600
	Others		1,196	50,387	54,071
	Sub Total		13,153	554,254	567,407
Emairete	Dam Rehabili.	1 no	628	17,036	17,664
	Filter	8 nos	20,000	175,000	195,000
	Deep Well	1 no	1,639	42,544	44,183
	Pipes	L. S.	571	56,069	56,640
	Reserv. Tank	1 no	2,300	62,500	64,800
	Others		2,514	35,315	37,829
	Sub Total		27,652	388,464	416,116
Total			370,653	4,506,646	4,877,299

Table 7 - 5 ANNUAL DISBURSEMENT SCHEDULE OF MONDULI WATER SUPPLY PROJECT

[Well; 3nos.]
[Truck; 4 nos.]
[Pipeline; 23 km]
Unit; Tsh 1,000

Year		1	2	3	4	5	6	7	8	9	10	Total
		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
1. Survey & D/D												
	(LC)	4,368								321		4,689
	(FC)	332,672								22,707		355,379
2. Land Compensation												
	(LC)		100				1,200				50	1,350
	(FC)		0				0				0	0
3. Supervision												
	(LC)		606				506	760			137	2,009
	(FC)		64,297				41,142	61,712			9,732	166,883
4. Construction of Wells												
	(LC)		123,092								27,924	151,019
	(FC)		308,618								126,804	435,422
5. Water Tank Truck												
	(LC)		116,117									116,117
	(FC)		288,756									288,756
6. Construction of Pipeline												
	(LC)						128,376	192,576				320,952
	(FC)						650,049	975,073				1,625,122
7. Physical Contingency	(LC)	437	23,992	0	0	0	13,008	19,334	0	32	2,811	56,614
	(FC)	33,267	65,167	0	0	0	69,119	103,679	0	2,271	13,654	287,157
Base Cost	(LC)	4,805	263,907	0	0	0	143,090	212,670	0	353	30,922	655,747
	(FC)	365,939	716,838	0	0	0	760,310	1,140,464	0	24,978	150,190	3,158,719
8. Price Contingency	(LC)	642	4,464				16,545	28,429		782	9,538	60,400
	(FC)	6,653	50,436				120,381	213,532		4,428	49,490	444,920
Total	LC	5,447	268,371	0	0	0	159,635	241,099	0	1,135	40,460	716,147
	FC	372,592	767,274	0	0	0	880,691	1,353,996	0	29,406	199,680	3,603,639

CHAPTER 8 PROJECT EVALUATION

CHAPTER 8 PROJECT EVALUATION

8 - 1 Economic Evaluation

The proposed project is the Monduli Water Supply Project in Arusha Region, Tanzania, providing supplemental groundwater for the existing Monduli water supply system and its surrounding 18 villages. The project aims to provide water and water facilities, thereby increasing economic activities and raising the standard of living in the Town. The Monduli town has been selected as a high priority area with greater potential development in the near future.

8 - 1 - 1 Method of Economic Evaluation

The method of economic evaluation is as follows;

1) Economic benefits and costs of the project are expressed in monetary terms.

2) The project life is assumed to be 20-years starting from 1995 with three years of project implementation. Project benefits will be realized at the end of the 3rd year.

3) The benefits were evaluated with incremental value on the basis of the difference in value between "without project" and "with project". And also sanitation and disease reduction benefits are taking into account in the evaluation.

4) Economic prices were estimated on the basis of data gathered from the local and national sources, using the standard conversion factor of 0.75, for construction works and 0.6 for a water tank truck, the ratio to be used to convert financial prices into shadow or economic prices.

5) Economic and financial internal rates of return(EIRR and FIRR) were estimated to be used as the main indicator of economic and financial evaluation.

6) The foreign exchange rate of US$1.00 = Tsh 600 has been used to convert foreign costs into local currency terms, as of October 1, 1995 in Dar Es Salaam, Tanzania.

7) The foreign exchange rate of US$1.00 = ¥ 102.25 as of October 1, 1995, (Bank of Tokyo) has been used.

8) Shadow price was applied to the labor component of civil work of construction. In an economy with a high unemployment rate of over 10%, particularly for the 20 and to 30s age group, the minimum day wage rate of 10,000 Tsh would equal to 454 Tsh per day [10,000/22 days/month]. Any amount in excess of 10,000 Tsh a month would be considered as a premium in determining shadow price. For skilled and professional workers, the prevailing wage/salary rates would be considered competitive and the same as the financial wage/salary rate.

8 - 1 - 2 Project Concept

There are two projects, one is for Monduli and the other is for the 18 Villages. The Monduli Water Supply Project alone will be discussed in this chapter.

The Monduli Project was designed to provide a water supply system for Monduli with a 1994 population of 18,210, increasing to 34,854 by the year 2014. The average water consumption per capita per day is 10 to 15 liters, but that figure would be expected to increase to 30 litres per person per day (LPD), or equivalent to a monthly consumption of 5.4 cubic meters (m^3) for every household of six persons.

At present, the daily average water supply in Monduli is estimated at 175 m^3/day, or only 24% of daily water requirement. The water supply situation will deteriorate toward the year 2014 with a population of 34,854. The water shortage becomes acute during the dry season between June and October. People have to buy water at a cost of 100 Tsh/20 liters or 5,000 Tsh/m^3.

To provide sufficient and dependable water for the entire year, the Monduli Water Supply Project was conceived as a feasible solution. This

chapter deals with a proposed plan in some detail for economic and financial evaluation accompanied by financial statements and water tariff determination.

8 - 1 - 3 Two Implementation Cases of Water Supply Compared

The project begins with the detail design in 1996 which provides three boreholes (1,344 m^3/day) in Engare Olmotoni and the conveyance pipelines with a length of 23 kilometers to connect the boreholes with the existing water tank at Monduli town. In view of increasing water demand toward the planning year of 2014, two boreholes will be constructed in 1997 and one borehole in 2005 in conformity with the water demand. Further consideration was given to pipeline installation that needs large capital investment at the initial stage of project implementation with the smaller water demand, thus selecting the following two alternative cases of the project implementation: case 1 deals with installation of pipelines in 1997-1998, and case 2 deals with transportation of water by water tank trucks for five years and then installation of pipelines in 2001-2002.

Two Alternative Cases

Particulars	Case 1	Case 2
Boreholes		
2 borcholes	1997	1997
1 borehole	2005	2005
Pipelines - 23 km	1997-98	2001-02
Water truck - 4 nos.	-	1997
Base Cost (Tsh 10^6)	3,369	3,814

Two cases have been compared by means of Economic Internal Rate of Return (EIRR). As a result, the EIRR of case 1 turned out to be 9.9 percent, while case 2 indicated that the EIRR had increased to 12.2 percent. Thus, case 2 became the better choice on economic grounds. Therefore, this project has proposed to employ the case 2 implementation schedule.

8 - 1 - 4 Economic Benefits

Table 8-1 shows an EIRR of 12.2%, compared with 9.9% in Table 8-2. Case 2, a combination of water tank truck and pipeline, has a higher EIRR and

can be justified on economic grounds. In the calculation, economic benefit was derived from willingness to pay at Tsh 5,000 a month per household of six. While EIRR is not so high as the social opportunity cost of, say, 15%, the project itself has a greater merit on humanitarian grounds. Water is indispensable for survival and without it, no social and economic development will be possible. Furthermore, provision of water is in accordance with national water policy in Tanzania, as indicated in the National Water Policy of 1991.

Case 2 (proposed project) has one definite advantage over case 1. Up to 15 LPD of water would become available in 1997 by water truck. A full delivery system would begin in 2002 and thereafter 30 LPD of water would be supplied.

Case 2 deliberately excludes other potential economic benefits. These are (1) economic value of domestic work reduction attributable to hours reduced in transporting water from a distant water distribution point or place to homes, and (2) to reduce of water-borne diseases and sickness.

8 - 2 Financial Evaluation

8 - 2 - 1 Method of Evaluation

Following is a summary of overall financial evaluation:

1) Cash flows over the expected project life of 20 years are evaluated.

2) The rate of inflation, whether it be measured by consumer price index(CPI), GDP deflator, the rate of increase in rate of foreign exchange, or an increase in the broadest definition of monetary supply, (known as M3), will be taken into account in evaluating financial cash flows for the project.

   The current inflation rate runs somewhere around 35% and 28% per annum during the period from 1985 to 1995 and between 1990 and 1995 on the basis of CPI, respectively.

3) The expected water revenues attributable to water collection fees and tariff structure will be assessed in comparison to operations and

maintenance costs. To be realistic on the basis of water revenue collection efficiency in other water projects in Tanzania, an 80% rate of revenue collection efficiency will be employed as a guideline.

4) Partial cost sharing on the part of local or regional government in terms of subsidy or development assistance, if available, will be assessed.

5) Affordability and self sustainability will be the key to the water project. Average household monthly income will be employed to assess affordability in terms of percentage.

6) Should the project not be sustainable, a way of resolving the financial issue will require financial management and daily operation and maintenance.

7) Organizational setting, legal entity, technical capability, and financial sustainability will be needed for the project to be successful.

8 - 2 - 2 Financial Cash Flow Benefit

Project contribution to the Monduli Water Supply Project was computed as the difference in net benefit between without project and with project. To be more specific, the differences in O&M cost between without project and with project, and in revenue between without project and with project were computed. Then net cash flow, the difference in cash flow between with project and without project was derived. Details of project contribution to Monduli is shown in Table 8-3. Net financial cash flow is indicated in column H where people contribute 350Tsh/m^3.

Column H shows that cash flow would be negative for the first seven years. However, cash flow changes to positive after the project's year eigth and thereafter.

8 - 2 - 3 FIRR of Net Cash Flow and Affordability

The net financial cash flow was derived from the difference in net financial benefit, i.e., financial benefit with project minus financial benefit without project. The financial revenue indicates that water revenue is collected on the basis of water tariff. We have employed 350 Tsh/m^3 as a water tariff for Monduli. This put a household burden of 6.23% of monthly household income. The FIRR of net cash flow became 33.13%. The figure would be appropriate since the recent interest rate charged by city banks ranges from between 29 and 31% for the five years between 1990 and 1995. Any figure below 30% would incur financial risk that cannot be covered should funds shortage occur during day-to-day financial management. Another serious risk is the revenue collection efficiency, defined as the ratio between water bills collected and water bills to be collected. We have used an 80% criterion. A sharp drop in FIRR would create a potential financial hazard should a funds shortage occur. Financial solvency would become a problem. Thus, the local water committee for management should keep water revenue collection efficiency as high as possible as one of the major management tasks.

8 - 2 - 4 Inflation and Standard Conversion Factor

This water tariff was not adjusted for price escalation. Macro economic data indicate that the rate of inflation during the period between 1990 and 1995 was 25% by official foreign exchange rate between US dollar and Tanzanian Shilling, 28% by CPI(consumer price index), and 24% by money supply of M3(Currency + Demand deposit + Time deposit + Security Deposit + Foreign Currency). On the other hand, real GDP increased at the annual rate of 3.8% between 1985 and 1994. From a statistical point of view, the social opportunity cost would be in the neighborhood of 20%(24% - 3.8%). In fact, bank lending rate in early 1990 was 31%, housing mortgage rate was 29%. Discount rate of 27% was stable between 1987 and 1993, but jumped to 46% in 1995 due to a budget crisis.

From the financial data, it appears reasonable that the social opportunity cost is 20% or 15% at a minimum for project justification.

Still another adjustment is needed. A shadow price conversion factor of 0.5 for domestic works and of 0.6 for foreign costs (water tank trucks and

other equipment) is needed. Capital goods conversion factor was computed on the basis of export of capital goods (exports - imports + import tax on capital goods). The figure ranged between 0.24 in 1991 and 0.27 in 1990. Standard conversion factor, defined as 1- exports (exports + imports - import taxes) turned out to be 0.74 for the period between 1990 and 1994. Imported tariff schedule for capital goods such as machinery and equipment was 30 to 40% on CIF value. It appears reasonable that SCF(standard conversion factor) is somewhere between 0.7 and 0.6.

8 - 2 - 5 Financial Sensitivity Analysis Under Four Scenarios

The financial and economic environment will be subject to change over time. Factors affecting financial conditions are revenue and cost. Without taking into account inflationary pressures, a water revenue collection efficiency of 100% cannot be maintained over time. Drop in revenue collection efficiency is a financial risk that should be covered as one of the contingencies. In scenario 1, it was assumed that revenue collection drops by 10%. Then another contingency is the risk of the increase in O&M cost. In scenario 2, it was assumed that there had been 10% increase in O&M cost. Still another scenario was a two-year delay of the project. And finally, if not the last, the contingency was 20% drop of revenue collection efficiency.

These four representative scenarios are summarized in Table 8-4. A summary of four scenarios affecting financial rates of internal return is shown below:

Financial Rates of Return (O&M Cost only)		(%)
Base Condition		33.13
Water Revenue	10%Down	28.05
O&M Cost	10% Up	28.60
2 Year Delay		32.95
Water Revenue	20% Down	22.68

The figures indicate that the project would be able to withstand the above contingencies should they occur during the project duration. Price escalation clauses become very important in hedging against inflation and/or revenue protection measures should an O&M funds shortage be anticipated.

Unexpected contingencies of more than a 10% change or more would make the project sustainability at stake.

8 - 2 - 6 Financial Statements

Financial statements that will be dealt with are (1) Profit and Loss Statement or more precisely, project contribution to net cash flow, (2) Cash Flow Analysis, (3) Capital Funds with Revenue Collection Efficiency, and (4) Balance Sheet in project year 1 and project year 20.

Overall cash flow is shown in Table 8-3, showing net contribution of the water supply project to Monduli under two different water tariffs, one for water revenue generated at 350 Tsh/m^3, the other at 330 Tsh/m^3.

FIRR with 350Tsh/m^3 amounted to 33.13%, compared with 30.25% at 330Tsh/m^3. Approximately 30% level of FIRR is needed in view of two digit inflation and high loan rate charged by financial institutions in Tanzania. Any figure below 30% appears to indicate a great financial risk in management. Financial difficulty would lead to a failure of the project itself. This spirit is consistent with National Water Policy, the pay as you go principle, or self sustainability concept.

Cash flow for 20 years is shown in columns H and I of Table 8-3 respectively. Negative cash flow continues until the end of project year 7, or calendar year 2001. Cash flow will turn positive in the year 2002 and thereafter.

In covering negative cash flows, Monduli Water Supply Project would be advised to obtain a loan, short term or medium term, either from federal or foreign sources, preferably at 15% interest or less. Cash flows with different rates of loan is shown in Table 8-5. Here interest payment is indicated with 15% loan, 20% loan, and 30% loan rate respectively.

Should a federal loan subsidy become available for local government or organization of public entity, it is highly recommended to be considered. Other funding could come from foreign sources, such as the World Bank or foreign government funds at lower loan rates.

Still another real risk is revenue collection efficiency. Table 8-6 deals with cash flow position with 100% revenue collection efficiency and with 80% revenue collection efficiency. Serious and continued efforts would be rewarded financially should water revenue collection efficiency be maintained as high as possible. For example, in project year 10, or calendar year 2004, the difference in revenue between 100% and 80% collection efficiency will amount to 19 million Tsh.

Finally, the balance sheets of project year 1 and project year 20 are shown in Table 8-7. In project year 1, cash was 10.923 million with loans and assets of 4 trucks at 562 million Tsh. In project year 20, the asset value of the water supply system would have 60% of deep wells, 50% of pumps and generators, 100% of pump houses, and 60% of pipe works with a total value of 1,499 million Tsh, and cash value of 113 million Tsh.

8-2-7 Determination of Affordable Water Tariff

Water tariff should have two criteria, one for financial self sutainability for operation and management, and the other for affordability on the part of water users.

As indicated at the beginning of section 8-2-6 above, a 30% level of FIRR is required in taking care of O&M cost and of usual financial risks such as a drop in revenue collection efficiency, an increase of O&M cost, as well as daily contingencies. Table 8-4 shows that FIRR drops from 33% to 28% when revenue drops by 10%, and further decreases to 22% with 20% drop in revenue collection efficiency. With 20% drop in revenue collection, FIRR drops by 11% from 33 to 22%. This would create a financial problem for management. On the other hand, should revenue collection efficiency be as high as, say 90%, if not 100%, FIRR could be maintained closer to 30%.

The other side of the story is the financial burden on the part of users. Monduli used to charge a flat rate of 200 Tsh per house connection, and 400 Tsh per commercial connection. This type of practice should be changed to a self-sustainable level of water charge. We have examined both 350 Tsh/m^3, or equivalent of 1,890 Tsh a month per household, producing FIRR at 33%. Should the rate drop to 330 Tsh/m^3, FIRR would be reduced to 30%, a minimum level of financial self sustainability.

350 Tsh/m^3 is a basic minimum rate for both parties, both provider and user group. 330 Tsh/m^3 is not recommended because 100% revenue collection efficiency cannot be guaranteed under any conditions.

The above water tariff is higher than that of Hai Water District Project. They charge between 100 and 150 Tsh/m^3. This is because water is strictly provided by gravity. No deep wells, no pumps and generators, no long distance water pipe works were involved. The Monduli case requires deep wells, a long distance pipeline, and a delivery system.

In view of high initial investment and O&M costs, 350 Tsh/m^3 appears very reasonable for both parties in Monduli. It has to be clearly stated that 350 Tsh/m^3 would cover O&M cost only, and excludes the initial huge construction costs.

8 - 3 Organizational Setting

8 - 3 - 1 General

The proposed setup for operation and maintenance should be approved by the Steering Committee of the Water User Committee. The proposal is aimed at the maximum participation of water users in O&M which is reflected in the proposed composition of the Board of Water User Committee in Monduli. The Board of the Water User Committee is designed as the overall legislative body for the future independent water supply entity.

The socio-economic survey in Monduli and its surrounding 18 villages has confirmed that the beneficiaries are quite aware of the necessity to contribute to the O&M of their water supply system. Approximately two-thirds of the households stated that they understand the need to contribute to O&M cost and more than half are willing to pay according to their financial capability, somewhere between 500 and 600 Tsh per month for a family of six.

A program to support the institutional build-up of the water supply entity is recommended to be conducted in parallel and supplementary to the construction works, as stated in the following:

1) Initial assignment of an expert for organizational build-up of water supply organizations

2) Advice and guidance in the formation of the entity

3) Identification of training requirements for the assigned staff of the entity and elaboration of training manuals and a training program in cooperation with an expert for understanding

4) Execution of the training program to facilitate the staff

8 - 3 - 2 Legal Setting of the Water Supply Entity

The selection of the most appropriate legal setting under the given circumstances for the water supply entity is decisive for its future smooth operation and management. An acceptable proposal must meet the undermentioned objectives of the project, as stated below:

1) To furnish an adequate clean domestic water supply to the Town and village community mainly through public taps.

2) To ensure that the facility is continuous, reliable, affordable, and self financing through consumer contributing to revenue in covering the cost of operation and maintenance.

3) To ensure conformity with the prevailing water policy.
The organization to be proposed must conform to the following criteria:

- It must be an autonomous entity for water supply operation and maintenance. The entity must be free to set its own policy, determine its own tariff, manage its own funds and hire/fire its own employees acting through its own governing board.

- It must be non-profit and thereafter not subject to taxation.

- It must be grassroots-oriented in ownership and management.

- It must be operative within the existing organizational setup involving:
  - village water user committees as "owners" with representatives from villages/towns, district/regional water engineering office.
  - An executive committee charged with the day-to-day management function.

8 - 4 Self Sustainability

Sustainability has three dimensions, first, organizational identity should clearly be established. Second, financial cost recovery, and third, technical capability of operation and maintenance.

8 - 4 - 1 Organizational Self Identity

Water Committees must be formed in villages where inhabitants benefit from water in informing the public that water costs must be shared equitably and that water facilities should be maintained safe, clean, and functional at all times. People in charge are technically capable and administratively responsive, managerially efficient and cost effective. These people must be trained in such a way that they can perform their duties and responsibilities for providing water, and collecting water bills as promptly as possible. Technical and administrative assistance should also be available from local water authorities in due course should the need arise. Close communication between a local water point and Monduli Water Engineering Office should be maintained in executing daily routines.

People who are in charge of water revenue collection must legally be binding in posting and depositing the money collected. Monthly or quarterly financial reports should be made available to all the water users in a village in the sense that each water beneficiary should have a sense of direct participation in the water committees.

Any major agenda such as problems, new repairs, new replacement, management, administrative tasks, etc. should be shared and discussed in the village water committee to find amicable solutions to those who are concerned and directly affected by the decisions the committee makes.

8 - 4 - 2 Financial Sustainability

Financially, the committee should be completely independent. It has to be self managing and self sustaining. Financial analysis should be made in such a way that cash flow analysis will be enough to cover not only recurrent expenditures but also future repairs and replacement costs, salaries and wages. Furthermore, the financial internal rate of return (FIRR) should be high enough to cover the social opportunity costs of financial capital costs, say, 15% per year. A water tariff should also be designed in such a way to meet two criteria, one is cost recovery, and the other, affordability, say, within 3% of household income of 21,210 Tsh per household per month in a village, and of 30,300 Tsh in Monduli town.

8 - 4 - 3 Technical Sustainability

People in charge should be technically trained in such a way that water facilities can be maintained and managed throughout the entire year. Technical assistance and cooperation should be made available from local authorities where and when needed. Monduli Water Engineering Office will be contacted for technical assistance.

Major technical issues are (1) functional maintenance of equipment, (2) maintenance of water quality, (3) cleanliness of water point facilities, (4) cleanliness of cattle trough areas from contamination, (5) water bill collection (6) bookkeeping of revenues (7) agenda to be discussed in the next available committee meeting and (8) other relevant matters of mutual interest to those who are concerned and are directly affected by any decision made by the committee.

8 - 5 Environmental Impacts

8 - 5 - 1 General

(1) Environmental Administration

In Tanzania, the Ministry of Tourism, Natural Resources and Environment conducts all the environment administration. The following laws

and regulations can only cover the environment issues in the country, and the regulations on environmental impact assessment have been imposed as duty only to development works in the National Parks.

- National Parks Ordinance
- Forest Ordinance
- Grassland and Fire Ordinance
- Natural Resources Ordinance
- Wildlife Conservation Act

(2) Entry to International Organizations and Treaties on Environmental Issues

Tanzania is signatory to the following international treaties. The country is currently preparing to ratify the Ramsar Convention for the Manyara Lake.

- Convention on International Trade in Endangered Species of Wild Fauna and Flora
- Convention for the Protection of the World Cultural and Natural Heritage
- Particular Areas Officially Protected

Tanzania has designated the following areas as Particular Areas Officially Protected, and about thirty percent(30%) of the national land area has been adopted as protected areas.

a) National Parks
b) Forest Reserves
c) Game Reserves
d) Game Controlled Areas

8 - 5 - 2 Initial Environmental Examination (IEE)

(1) Objective of IEE

More than half of the Study Area is restricted and under protection due to the fauna and flora found therein. Under the circumstances, IEE aims to

deepen the knowledge through study of the area so as to confirm the necessity of the environmental impact assessment.

(2) Results of Initial Environmental Survey

a) Proposals to study and development works in the Project Area

National Parks

Three national parks are situated in the Study Area and its neighborhood. They are Tarangire, Lake Manyara, and Arusha.

Since, the proposed plan does not aim to develop the areas in the natural parks or their vicinities, there are no factors concerning the parks within the Study Area

Forest Reserves

The Study Area includes three forest reserves, Monduli, Burko, and Lossimingori. In the forest reserves of Burko and Lossimingori, there will be no environmental impacts due to the development, but contrarily, in the Monduli forest reserve, careful attention should be paid to development of well digging and providing the related water distribution facilities in consideration of the proximity of Monduli town.

Game Reserves

The proposed work will have no environmental impacts on the game reserves, although Mount Meru game reserve is situated in the neighborhood.

Game Controlled Areas

The Study Area contains Mto Wa Mbu and Simanjiro Game Controlled Areas, the total land area of which covers more than half the Study Area.

No special restriction is imposed on entrance into the Game Controlled Areas except that permission by the authorities concerned is required for fire use. Under such conditions, application should be made to the authorities for permission beforehand, if the necessity arises for fire use during the development work.

b) Impacts on existing wells

In the Study Area, there are several villages depending for their water supply sources upon wells and the well-digging in the vicinity to the existing wells may have adverse effects on the water level of the existing wells. In this respect, planning and designing of wells in such sites should be made paying careful attention and consideration so as not to lower the water levels of the wells.

c) Effect on water rights

The right of water utilization is vested in the Government, at the Ministry of Water, Energy and Minerals. Water utilization anywhere in Tanzania is according to the legal basis of water rights as follows:

Water Law (Ordinances)

1. Act No. 42 of 1974 - Water Utilization
   (Control and Regulation Act 1974)
2. Act No. 10 of 1981 - Water Utilization
   (Amendment of Control and Regulation Act 1981; to be read as the principal act)
3. Act No. 17 of 1989 - Written Law
   (Miscellaneous Amendments No. 2)

Main Features of Acts

1. Act No. 42 of 1974

   Section 8: All water in Tanganyika (Main Land Tanzania) is vested in the United Republic (i. e. water is public property)

   Section 14: Subject to the provisions of this part and to the provision of Section 53 of Mining Ordinance, no person shall divert, dam, store, abstract or use water for any such purpose or construct or maintain any works, except in accordance with the existing right or with prior water rights granted.

2. Act No. 10 of 1981
   Section 15A: Discharge of effluent
   Section 18A: Wells and boreholes

As many water spruces such as wells, springs and dams exist in the Study Area, the planning and designing of the wells should be carried out with careful attention and consideration to the water rights of the existing water sources by means of thorough surveys and studies.

d) Impacts on ecological system

Tanzania has designated protected animals as follows:

Following CITES ratification, killing of the following wild animals is strictly prohibited anywhere in Tanzania:

- Cheetah
- Pangolin
- Rhino
- Black & White Colored Monkey
- Red Colobus Monkey
- Wild Dog
- Bush Baby
- Giraffe

Following CITES ratification the birds which are prohibited to be killed anywhere in Tanzania are as follows:

- Love Bird (Yellow collared love bird)
- African Gray Parrot
- Whale Headed Stock

The following is a list of endangered species in Tanzania and, in view of this, a local ban or prohibition of killing has been enacted:

- Bustards
- Gown Crane
- Saddle Bill Stock

- Secretary Bird
- Gotah Heron
- Peregrine Falcon

And furthermore, most of the Study Area has been designated as a fauna protection area, and some of the above designated animals are living in the Area, although the official records are unavailable. Therefore, careful consideration should be give to environmental impacts on the eco-system in the Area.

e) Impacts on the social environment

Since the Study Area faces difficulty in securing potable water, it is not expected that the proposed water resources development will have adverse effects on the social environment.

However, in land acquisition for pipeline construction as water distribution facilities, special attention should be paid to the following social system for successful realization of the work:

Land belongs to the government. Land users should pay a nominal fee of rent of one Tsh per acre for pure agriculture and 1.5 Tsh per acre for agriculture and livestock. Traditional landowners do not pay rent to the government. Rent is only applicable to land occupants and release.

When a piece of land is dedicated to public use such as a public road, public water or power/communication lines, landowners/occupants who are affected by public use of land will be subject to compensation on the basis of loss of crop, and loss of privileged use of land. An agreement must be reached between people who will be affected by public use of land and the project's responsible party, whether it be association, local government, or any other legal entity. Regional Commission's Land Survey and Evaluation Division will be in charge of determining loss or damage attributable to a piece of land dedicated for public use. When the appropriate loss or damage is determined, compensation procedures and time schedule will be negotiated between both parties. In any case, the project's responsible party will be recommended to contact the Land Survey and Evaluation Division of the Regional Planning Commission for detailed information prior to the project's initiation.

f) Effects on cultural heritage and historical remains

The below listed cultural heritage sites can be found in the Study Area and its vicinity, but there will be no fear of adverse effects on these sites because the development work will not be implemented in their proximity.

- Engaruka : historic site
- Lashaine : cultural location
- Oldonyo-Lengai : cultural location

These places are not officially alienated or leased by the Government. However, the case of the historic site, Engaruka is known for being among the oldest towns in the country and there are remains of old buildings.

Two cultural locations of Lashaine and Oldonyo-Lengai are popular for the annual Masai traditional activities or visits in the area.

8 - 5 - 3 Environmental Impact Assessment (EIA)

According to the results of IEE, the study of environmental impacts has been carried out to include the environmental impacts assessment (EIA). Since, however, further survey and study are required, the final environmental assessment will be made on the basis of the result of the final design study. For information, the major results obtained from the current environmental study can be shown as follows.

(1) Environmental Impact Assessment in Monduli Town

a) Effects of well digging

The proposed well-digging site is found on a narrow land area surrounded by coffee plantations, and there have been many wells excavated in the vicinity.

In such conditions, new well digging may have an adverse effect in lowering the water level of the well existing nearby. The foundation is in pyroclastic rock, so that there will be no fear of ground settlement as a result of the pumping of groundwater.

The proposed site is a narrow extension surrounded by coffee plantations, so that there may be no direct adverse effects given on the inhabitants apart from some pumping noise pollution in their living environment.

b) Effect of provision of the pipeline system

The planned route of the pipelines for water conveyance between the well at Engare Olmotoni and Monduli Town will run through expansive Savanna, with little fear of adverse effects from pipeline operation on the living environment of the local people.

The proposed pipeline route extends through those areas outside of such protected areas as forest reserves, game reserves, etc. No special attention is required for these designated protected areas.

For the Study Area, however, the records and data on animal habitats are not available and there maybe a possibility of adverse effects on those animals in their living environment, if any are existing in the Area.

(2) Environmental Impacts on the 18 Villages

a) Effects from rehabilitation of the existing pumping stations

In replacing the time-worn pumping units, some noise pollution may result for the local people from the pumping operation, if any inhabitants are in the vicinity.

b) Effects by rehabilitation of existing dams

There will be no negative effects on the living environment and eco-system in the Area from rehabilitation works on the damaged or destroyed embankments of the dams.

8 - 5 - 4 Environment Conservation Plan

An environmental conservation plan is proposed according to the environmental impact assessment. The proposed plan is composed of three

stages: Final Design Stage, Implementation Stage, and Operation and Management Stage.

(1) Planning Stage

It is most important that the most comprehensive plan and design should be prepared, paying careful attention and consideration to the environmental impacts resulting from the works.

a) Notices to well site selection

The site of the proposed wells should be selected taking into account that the new well excavation must not generate adverse effects such as lowering the water level of the existing wells with thorough survey and study of the locations and lifting capacity of the existing wells.

b) Selection of the type of pumping units

As frequent blackouts happen in the Area, the type of pump unit must be one working with engine so as to enable operation during blackouts. And also, possibly a low-noise type of engine for the pumps must be selected so as to avoid noise pollution in or near residential areas.

c) Compensation plan

Appropriate compensation should be paid to those farmers or land owners who have farming land, earmarked for land acquisition as land for pipeline construction.

d) Consideration of the ecosystem

Adequate surveys should be made on the fauna and flora in the proposed pipeline construction areas, and the pipeline plan must be prepared so as to minimize adverse effects on those fauna and flora, if any protection designated species are found in the areas.

(2) Implementation Stage

An implementation program should be prepared so that the related construction work can be controlled to minimize the adverse effects on the environment.

a) Consideration of buried cultural artifacts

So far no cultural artifacts have been found in the proposed area. Construction works, however, must be carried out paying close attention to discovering buried cultural artifacts.

b) Close watch of construction works for successful environmental conservation in implementation

While implementing the construction work, careful attention and consideration must be given to clean environmental control from noise and dust, together with safety management for laborers in the sites. Fully responsible working systems should be firmly established through close supervision and/or monitoring.

(3) Operation and Maintenance Stage

An adequate operation and maintenance plan (O & M plan) should be prepared so as to promote continuous and smooth development in the area.

a) Groundwater development control

It is necessary to establish an appropriate system for controlling and restricting the groundwater development in the area. Restriction control imposed on groundwater development will be able to prevent irregular development so that groundwater utilization in the area can be sustained while maintaining the existing water levels of the current wells.

b) Restriction of groundwater pollution

For controlling groundwater pollution which may result from excessive dosing of fertilizers, chemical sewage, etc. it is necessary to impose restrictions

on application and drainage of these materials. Such restrictions will not only enable long-lasting groundwater utilization but also ensure successful environmental conservation.

8 - 6 Social Aspects

8 - 6 - 1 Women in Development (WID)

Women in Development is an approach to programming within the Third World development context. Taking its impetus from the strength of the women's movements in European/North American and the United Nations' Women's Conferences in Mexico, Nairobi (Kenya), Dakar (Senegal) and Beijing (China), the WID movement has gained considerable momentum and influence. WID movement was a reaction to the oppressive policies and social arrangements which blocked the participation of women, and thus subordinated women in ways in which they had never experienced before (Nancy M. Drost, 1993).

In the majority of cases women played no role in decision making, thus giving male household heads the power to dictate what should be done; although women were the ones who shouldered heavy burdens in the household domestic chores and economic activities. For example, the following conditions prevail in many countries:

- The woman works throughout the day and has very little time to rest.
- The woman's work is tedious.
- The woman works to support the whole family.
- All the maintenance activities of the family are performed by the woman.
- The man's reproductive activities are mainly for the man's comfort.

The development planners representing international donor agencies and Non governmental Organizations (NGOs) introduced projects which did not alleviate the plight of women; but rather increased women's workload and jeopardized their health and that of their children. The projects which were

initiated by the donor agencies and NGOs included transfer of technology, small income-generating activities, milling machines, food processing, tree nurseries and provision of small loans to run businesses. The main purpose was to bring about equality between men and women without considering the implications involved. The income generating projects were considered to be able to encourage women to engage in increased productive activity.

Women's rights have been discussed explicitly by former President of Tanzania, Mr. Julius K. Nyerere:

> It is impossible to deny that women did, and still do more than their fair share of the work in the field and in the homes. This is certainly inconsistent with our socialist conception of the equality of all human beings and the right of all to live in... security and freedom... If we want our country to make full and quick progress now, it is essential that our women live in terms of full equality with their fellow citizens who are men.

This issue of inequality has been recognized nationally in the sense that employed women receive equal pay with men, get the same benefit and generous maternity leave of three months with full pay. The Marriage Act of 1971 ensured the equality of women in marriage and specified the right of wives to keep their union monogamous; and stipulated the minimum age of marriage. It also made some provision for inheritance by widows (Liz Wiley, 1989).

However, from the discussion above, it can be concluded with certainty that Women in Development approaches have been women-centered; but with little success.

Drost has summarized the WID concept as having ignored the fact that the category of "man" is static and that men's roles are unchangeable. Whereas women were struggling to change; the social structures that subjugated them continue to thrive and seek to exploit them further. The WID programmes did not consider the consequences for femininities and masculinities in cultures where there are not only strict divisions of labour and power; but rules about how men and women communicate and bond to bring about a peaceable household (Nancy M. Drost, 1993).

The major factor to be taken into serious consideration is that there is friction which is a result of the struggle between women (who are struggling to assume the roles being exercised by men) and men (who are resisting this kind of change).

Barbara Rogers illustrates this point in a clear and fashionable manner when she writes:

> In the development process, the division of labour is increasingly a matter of men abandoning their traditional obligations and women being forced to take over their work in the struggle for subsistence. Control of the family is becoming concentrated in the hands of men because they have so much more time, mobility, education, access to land and other resources, particularly the most important of all being cash. Increasingly, there are indications that as families become involved in development, the men are showing contempt for women and a more directly hostile and oppressive attitude

8 - 6 - 2 Development Programmes and Gender Relations

(1) Gender

Martha Umbulla and Rehema Shemkunde (Report on Gender Sensitization, Saying and Credit Mobilization in Monduli District, 1993) say that the word GENDER is a new version in contemporary development. The word 'gender' is used to describe the socio-cultural aspects of sex. It is a dynamic concept in which males and females are differentiated and ordered in society. It differs from one culture to another depending on class or social divisions within a culture. As a consequence, each member of the society behaves in conformity with the culturally determined expectations.

(2) Gender Roles

Martha Umbulla and Rehema Shemkunde have further stated that gender roles are socially and the culturally determined roles men and women have in a society, i.e. in terms of rights, duties, obligations, etc. As an example of a gender role in Masai society, women are supposed to perform all domestic duties, care for children, build huts, etc. ; while men are involved in tending

livestock and heading households. Due to socio-cultural attitudes and defined gender roles, the division of labour between men and women in rural Monduli district is still very sharp. Women carry double loads of both domestic and economically productive engagements. One Masai woman lamentedly told the authors that she had no other friends apart from a donkey.

Also, due to an imbalance of gender roles, Masai men have higher degree of access to and control of family resources. All family property is controlled by men (like in any other African culture); despite the fact that the effort to get it is a contribution from both, i.e. husband and wife or wives.

(3) Gender and Development

There is need to eliminate the socio-cultural barriers which draw a distinct demarcation line between men and women, especially in the Masai cultural heritage. All this needs confidence, trust and tenacity of purpose and cannot be achieved without education, availability of information and, for women, facilities to sustain their normal family responsibilities. All these matters may appear unnecessarily exacting to those thinking of assisting in the development of women, often illiterate and living in areas quite remote from cities and governments, or in urban districts where poverty is rife (Muriel Russell, 1988).

(4) Socio-Cultural Barriers

Men and women are initiated into their roles and responsibilities from childhood. The traditions, norms, and beliefs have gone to the extent of instilling fear and lack of confidence in women on one hand, and pride and overconfidence in men on the other. For example, a Masai woman is not allowed to stand up and speak in public meetings otherwise her husband will die.

(5) Sexual Differences

The biologically determined sexual roles of women have contributed to limited access to various opportunities apart from sociological factors for example, in Masai culture, a woman is not allowed to travel long distances and neither is she allowed to conduct businesses or trade.

(6) Access to Information and Educational Opportunities

From the strong and well-set gender roles, chances for women to be incorporated in the information network are very much limited.

Although the standard/level of education in rural Monduli district is poor for both men and women; the women are more disadvantaged because they are not allowed to attend even informal gatherings such as agricultural field days, or extension training. In this respect they also do not have access to credit facilities.

8 - 6 - 3 Women Initiatives and Participation in Development

(1) Present Situation

Marjorie Mbilinyi has this to say: Women in Tanzania, as elsewhere, have traditionally been allocated tasks that are low-paying, insecure and temporary, whether in wage labour, petty commodity production or self-employment. At the same time women are increasingly responsible for the provision of family requirements such as food, clothing and school fees. In addition, they face constraints due to their position as wives or daughters.

Women's group activities and cooperatives have developed as a way to acquire more power, if not more income. The village political structure has also created a forum in which different interest groups, including women's groups, have begun to identify themselves and organize in order to promote their own, often conflicting interests.

In early 1981, the Arusha Planning and Village Development Programme, with the cooperation of the United States Agency for International Development (USAID), carried out a short investigation to determine how rural women were being involved in the project. The project was initiated in 1979. The survey indicated that men thought women rarely attended the village meetings because:

- Women are still shy to attend public meetings.
- Women are too busy at home;

- It is not the women's job to roam and survey the village and attend things like meetings; her job is to watch the house;
- Women cannot speak Kiswahili;
- Women are uneducated;
- Women cannot follow discussions;
- It is difficult for a woman to get permission to leave the house and attend a meeting; and normally only one person from the household is supposed to attend, so it is always the man;
- Women don't need to attend meetings because the men would tell them what transpired;
- Women are not used to sitting together with men.
- There are still some men who don't like to see women in meetings.

Women, on the other hand, spoke about being engaged mostly with domestic chores, taking care of children and attending to the fields. Furthermore, they complained that representation and participation in village communities affairs were of less importance because:

- Women cannot complain in meetings otherwise their husbands can still beat them;
- Women are still the same because the money is controlled by husbands;
- Men can still refuse to give women what is due to them because they own everything.
- Men drink women's money and they have no way to get more;
- Women are not equal with men. Men can refuse to do anything, even to buy food for the children (Liz Wiley, 1989).

Marjorie Mbilinyi comments underscore the results of the above-mentioned survey as follows:

One of the main specific constraints is male attitudes. These include restrictions on mobility of women; negative attitudes towards women holding cash; fear of women's increasing power if they gain economic strength, and that women will reject marriage; competition in starting projects and getting employment; and resistance to women's independent ownership of land or other

resources. Male leaders have even taken over women's projects that have proved successful.

(2) Gender Awareness in Development Programmes

Gender awareness gives an insight into the identification of the different gender roles and their impact on social development. Identification of these roles enables gender planning. Apart from the roles of men and women being separated, gender concept helps to optimally combine these roles toward labour-force maximization which is very important to social development. Gender awareness brings about social equality and justice which is the cornerstone to social development.

(3) Existing Programmes and Gender Awareness

Most programmes have to look for strategies in order to formulate policies on how best all the beneficiaries men and women could be involved fully in order to achieve maximum success. A number of strategies have therefore been formulated and undertaken to involve women in development programmes. They do this by considering:

(i) Equal Participation

- Decision making
- Planning of activities, e.g. allocation of resources.

(ii) Human Resources Development

- Sustainability needs, e.g. improvement of skills at the village level.

(iii) Special Support

- Several programmes give support to women's activities by creating an enabling environment for their active involvement and advancement.