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MINISTRY OF WATER RESOURCES

No. 22

THE STUDY
ON
ELEVEN CENTERS WATER SUPPLY AND SANITATION
IN
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

FEASIBILITY REPORT
DEBRE TABOR

(Volume II-VI)

FEBRUARY, 1996

SANYU CONSULTANTS INC.
KYOWA ENGINEERING CONSULTANTS CO., LTD.

GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
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PREFACE

This is the Feasibility Study Report for Debre Tabor presenting the results of the Study on Eleven Centers Water Supply and Sanitation (the Study) carried out in accordance with the Scope of Work agreed upon between the Government of Federal Democratic Republic of Ethiopia (GOE) through the Water Supply and Sewerage Agency (WSSA) of the Ministry of Natural Resources Development and Environmental Protection (MNRDEP), which was recently reorganized Water Supply and Sewerage Service Department (WSSD) under Ministry of Water Resources (MWR), on the one part and the Government of Japan (GOJ) through the Japan International Cooperation Agency (JICA) on the other part dated April 8, 1994.

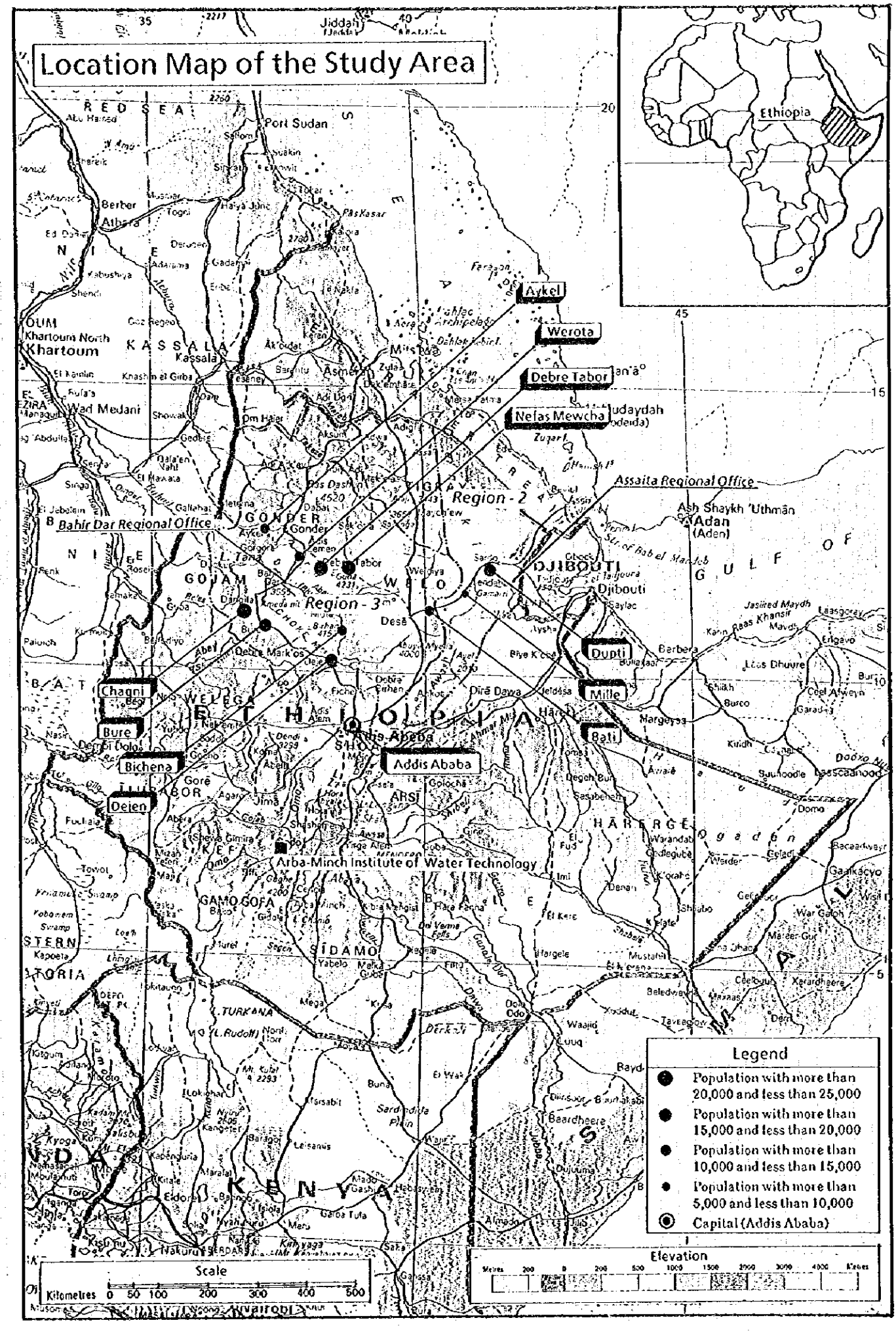
The major objectives of this Study are 1) to conduct a feasibility study on the water supply system in order to improve living condition of the population in the Study area by enhancing the level of the water supply services in terms of water quantity, water quality and its accessibility, 2) to formulate a plan for sanitary education and the diffusion of sanitary facilities in order to raise peoples' awareness on hygiene and improve environmental sanitation, which will be able to prevent the contamination of water source(s) and to secure safe water supply, and 3) to transfer technologies to the Ethiopian counterpart personnel in order to strengthen the managerial aspects of water supply services.

The Study had been conducted over a two (2) Japanese fiscal year-period from 1994/95 to 1995/96 and divided into two (2) phases. The Phase I study was conducted between December 1994 and March 1995, and Phase II was conducted between May 1995 and February 1996, for a total study period of 15 months during which three (3) times of visit to Ethiopia were made.

The survey items and major activities are meteo-hydrological survey, geo-electric prospecting (GEP) survey, water quality, water use condition, sanitary and health condition and people's awareness, social background, socio-economy, initial environmental examination (IEE), environmental impact assessment (EIA), sanitary education practice, and existing pump investigation.

With the survey and the study, this report presents the formulation of the Project of the water supply system with the implementation program, improvement plan of sanitary facilities with the diffusion program, set-up and strengthening of organization, and strengthening of operation and management.

The Study Team extends heartiest thanks to WSSD especially those assigned counterparts for their close cooperation and hard work in both office and the field, and the officers of related agencies of Japan.


Location Map of the Study Area
Ethiopia
Aykel
Werota
Debre Tabor
Nefas Mewcha
Assaita Regional Office
Bahir Dar Regional Office
Region - 2
Region - 3
Addis Ababa
Arba-Minch Institute of Water Technology
Dupti
Mille
Bati
Djibouti
Bure
Bichena
Deien
Chagni
Legend
Population with more than 20,000 and less than 25,000
Population with more than 15,000 and less than 20,000
Population with more than 10,000 and less than 15,000
Population with more than 5,000 and less than 10,000
Capital (Addis Ababa)
Scale
Kilometres 0 50 100 200 300 400 500
Elevation
Metres 200 0 200 500 1000 1500 2000 3000 4000 Metres

General Description of Current Condition in Debre Tabor

Items	Description
Administration	Amhara Region, South Gonder, No. of Kebele : 9
Residents	Total population : 25,575 (4.3 persons/ha) Average family size : 5.7 persons Amhara : 100% Christians : 95% (6 churches) : % Moslems : 5% (1 mosque) : %
Educational Conditions	Kinder garden / Elementary school / Junior high s. / Senior high s. No. of school 1 / 5 / 1 / 1 No. of teachers 3 / 195 / 28 / 52 No. of students 143 / 5008 / 1065 / 1734
Medical Conditions	Hospital : 1 Doctor : 7 Health center : 1 Nurse : 15 Health clinic : -
Economic Conditions	Hotels/restaurants : 574 Shops : 1053 Cottage industry : 43 Filling Stations: 2 Average monthly household income : 248 birr
Water Supply Condition	The source of WSS : Borehole (2) Major other sources : Hand dug well & spring Domestic consumption : 31.5 cum/day (3.7 lpcd) Other consumption : 23.2 cum/day (total 54.7) Water service coverage : 34% House connection : 16.0 lpcd (0%, 1.0 birr/cum) Yard connection : 14.1 lpcd (4%, 1.0 birr/cum) Neighbors : 2.3 lpcd (18%, 1.0(3.1) birr/cum) Public fountain : 2.3 lpcd (11%, 1.0(1.3) birr/cum)
Sanitary Condition	Septic toilet : 1/100HH Dry pit toilet : 57/100HH Community toilet : 5/100HH Open field : 37/100HH Toilet condition : Ill-maintained and constructed. Sullage disposal site : No allocated and vacuum track is required. Drainage facilities : No existed except along main road, poorly maintained.
People's Health Awareness and Needs	Group awareness : 75% Diarrhea awareness : 69% ORS awareness : 50% Sanitary behaviors score : 887/1600 (55%) Needs : Adequate Water, Improvement of waste disposal
Remarks	1. Water charge in bracket is actually paid. 2. HH means "household". 3. ORS means Oral Rehydration Solution. 4. Faecal coliforms found in samples from connections and household containers.

Project Description of Debre Tabor

Items	Description
Project Title	Eleven Centers Water Supply and Sanitation
Executing Agency	Water Supply and Sewerage Service Department(WSSD)
Objectives	To supply domestic water which meets people's demand and to improve sanitary condition in the center.
Population Projected	In 1995: 25,575 (4.5%) / 2000: 31,871 (4.0%) / 2005: 38,776 (3.5%) / 2010: 46,054
Water Demand Projected in cum/day	in 1995*: Domestic 32; Non Domestic 23; Losses 51; Total 106 2000: Domestic 425; Non Domestic 323; Losses 83; Total 831 2005: Domestic 777; Non Domestic 441; Losses 166; Total 1,384 2010: Domestic 1,358; Non Domestic 591; Losses 344; Total 2,293
Dimensions of Water Supply System	Target Service Coverage: 75% (34% at present) Target Year of 2005 Deep Wells : 6 (626m) Rising Main : ϕ200(0.25km), ϕ150(8.96km), ϕ75(3.50km), Booster of Rising : ϕ150mm,Q=0.43m^3/min,H=100m ϕ150mm,Q=1.03m^3/min,H=70m ϕ150mm,Q=0.17m^3/min,H=70m Reservoir : 400m^3(200×2) 0.17 Distribution : ϕ300(315m),ϕ250(190m),ϕ200(750m), ϕ150(5,680m),ϕ75(8,580m), ϕ50(16,310m) Booster of Dist'n : ϕ300mm,Q=1.9m^3/min,H=17m Target Year of 2010 Deep Wells : 4 (480m) Rising Main : ϕ100(3.23km), ϕ50(1.10km)
Water Tariff Structure & Accounting System	Introduction of Progressive Water Tariff** HC: 3.67 birr/m^3,YC: 2.23 birr/m^3,PF: 1.66 birr/m^3 Introduction of Double Accounting System
Plan of Sanitary Facilities Improvement	Construction of 3 public toilets and facilitation of other type toilets. Provision of toilet emptying system. Maintenance of main drainage and construction of supplemental drainages. Facilitation of waste water disposal pit and dry solid waste disposal system.
Plan of Sanitary Education and Implementation Program	Utilization of sanitary education manual and video. Application of sanitary education priorities(see report). Set-up of Sanitary/Health Committee. Assignment of Community Participation Promoter.
Organization Set-up	Strengthening of Planning & Project Department of MWR and relationship among central, regional and town. WSS to be composed of Administration, Financial, Technical and Sanitary Service, and manpower to be 46 in 2005 and 57 in 2010.
Remarks	* Actual Consumption ** Water Tariff for industry and institution is same as HCs'.

Composition of the Report

Report
- Executive Summary
- Main Report (Volume I)
- Feasibility Report (Volume II-I to II-XI)
- Appendixes (Volume III-I to III-XI)

Others
- Operation and Maintenance Manual
- Sanitary Education Manual
- Sanitary Education Video (titled Simple Steps... for Better Health)

Table of Contents

ABBREVIATIONS

[ORGANIZATION]

AfDB or ADB	- African Development Bank
AfDF or ADF	- African Development Fund
AWTI	- Arba-Minch Water Technology Institute
CIDA	- Canadian International Development Agency
CPPS	- Community Participation Promotion Services
CSA	- Central Statistical Authority
EELPA	- Ethiopian Electric Light and Power Authority
EIGS	- Ethiopian Institute for Geological Survey
EMA	- Ethiopian Mapping Authority
EPD	- Environmental Protection Department
GOE or TGE	- Transitional Government of Ethiopia
GOJ	- Government of Japan
IBRD	- International Bank for Reconstruction Development (The World Bank)
JICA	- Japan International Cooperation Agency
KFW	- Kreditanstalt fur Wiederaufbau
MEDP	- Ministry of Economic Development Planning
MEEC	- Ministry of External Economic Cooperation
MNRDEP	- Ministry of Natural Resources Development and Environmental Protection
MOA	- Ministry of Agriculture
MOH	- Ministry of Health
MPI	- Master Plan Institute
MPWUDH	- Ministry of Public Works and Urban Development and Housing
MWR	- Ministry of Water Resources
NMA	- National Meteorological Authority
NMSA	- National Meteorological Service Agency
NGO	- Non-Governmental Organization
NRDPEPB	- Natural Resources Development & Environmental Protection Bureau
PWUDB	- Public Works and Urban Development Bureau
REA	- Regional Education Authority
REWA	- Revolutional Ethiopian Women Association
RRC	- Relief and Rehabilitation Commission
UN	- United Nations
UNDP	- United Nations Development Program
UNICEF	- United Nations Children's Fund
TADE	- Tendaho Agricultural Development Enterprise
WAB	- Women's Affairs Bureau
WHO	- World Health Organization
WRDA	- Water Resources Development Authority
WSS	- Water Supply Service
WSSA	- Water Supply and Sewerage Agency
WSSD	- Water Supply and Sewerage Service Department (former WSSA)
WWCE	- Water Works Construction Enterprise
WWDE	- Water Well Drilling Enterprise

[OTHERS]

BOP	-	Balance of Payment
CPP	-	Community Participation Promoters
DCI	-	Ductile Cast Iron
Dia	-	Diameter
DWL	-	Dynamic Water Level
EB	-	Ethiopian Birr (Birr or birr)
E.C.	-	Ethiopian Calender
ERRP	-	Ethiopian Relief and Rehabilitation Programme
EIA	-	Environmental Impact Assessment
EIRR	-	Economic Internal Rate of Return
FIRR	-	Financial Internal Rate of Return
FRP	-	Fiberglass Reinforced Plastic
GDP	-	Gross Domestic Product
GNP	-	Gross National Product
GS	-	Galvanized Steel
HC	-	Household Connection
IEE	-	Initial Environmental Examination
lpcd	-	liters per capita per day
l/s	-	liters per second
m.asl	-	meters above mean sea level
mg/l	-	milligram per liter
ND or DN	-	nominal diameter
NP or PN	-	nominal pressure
O & M	-	Operation and Maintenance
pa	-	per annum
PC	-	Private Connection
PF or P.F.	-	Public Fountain
pm	-	per month
PCM	-	Project Cycle Management
PDM	-	Project Design Matrix
PVC	-	polyvinyl chloride
SWL	-	Static Water Level
TB	-	Tuberculosis
TOR	-	Terms of Reference
USD	-	United States Dollar
VES	-	Vertical Electric Sounding
WID	-	Women in Development
YC	-	Yard Connection

Exchange Rate

1 US Dollar = 6.3 Birr

1 US Dollar = 94.5 Yen

1 Birr = 15.0 Yen

GLOSSARY

Belg	- Short & moderate rain in spring, autumn or winter
Birr, Br	- Ethiopian currency unit
Debo	- Small association in rural area to work collectively in farm
Eder	- Community organization for social occasions & social problems
Kebele	- Smallest unit of administration
Keremt	- long & heavy rain in summer
Kilil	- Region (a group of zones)
Shet	- Stream
Wenz	- River
Woreda	- An administrative sub-district (also referred to as Wereda)
Zone	- A group of Weredas

Note: There is, as yet, no standardized spelling of Ethiopian words written in Roman Letters and based on English phonetics. Consequently, different spellings of the same word may be encountered in the report, particularly on the EMA maps.

List of Tables

List of Figures

Chapter 1 Introduction

1.1 Background

Most of the Ethiopian population do not have adequate and safe access to potable water supplies or sanitation facilities, leaving people vulnerable to water-borne and sanitation-related infectious diseases.

In 1994, only 26 % of the total population and 18 % of the rural population were estimated to have access to potable water. Consequently, the majority of the population is exposed to polluted water and thus to water-borne diseases. It is also estimated that less than 12 % of the total population uses latrines. An estimated 1 % only of the rural population have access to adequate refuse disposal systems.

Surveys of morbidity patterns and levels have pointed the consequence to the effects of poor water supply and hygiene practice, and unsanitary excreta disposal. Addressing health problems through water supply and sanitation activities is evident.

In Debre Tabor, water service coverage is 34 % only, and the water consumption per capita per day is extremely low with the amount of 3.7 lpcd in average. Although water quality of the sources is acceptable with reference to WHO drinking water guideline in terms of physico-chemical aspects, many faecal coliforms have been detected in samples collected from connections and household containers. This suggests that contamination is expected in such way through cross-connection, leaking and back-siphoning associated with aged facilities.

Although toilet coverage is 63 %, which is relatively high, those toilets are mostly ill-maintained and poorly designed/constructed in terms of ventilation and emptying, thus the majority of the population dispose off their body waste in open field. Also, sullage disposal sites are not prepared, making difficult to dispose of emptied ones. Drainage facilities are not well constructed except ones along main road, constructed by road authority. And, even the drainage along main road is not well maintained, accompanying blockade by garbage or refuse disposal.

In view of the above situation, the Government of Ethiopia (GOE) put priority on the Eleven Centers Water Supply and Sanitation among 230 rural centers listed in the National Development Plan (ERRP 1993-95). Debre Tabor is the one, located in Amhara Region, among the Eleven Centers along with Dupti, Mille, Bati, Nefas Mewcha, Aykel, Werota, Chagni, Bure, Bichena and Dejen as shown on the attached Location Map.

1.2 Overall Progress of the Study

The Team arrived in Ethiopia on January 5, 1995 and submitted the Inception Report to Water Supply and Sewerage Service Department (WSSD). Both parties had discussed and confirmed the plan of approach, plan of operation, schedule of the Study, undertakings of the both parties and other related matters. Following the confirmation, the Team immediately commenced the Phase I survey/study.

The Team had collected and reviewed the existing data and information related to the Study. After reviewing the data and information gathered, reconnaissance survey covering all Eleven Centers had been carried out throughout the month of January by the Team members and their counterparts. The survey was conducted to recognize the overall situation of the centers, give common understandings among the members, and identify the centers to be studied in Phase I and Phase II respectively. Debre Tabor was selected for the detailed survey during Phase II. The survey items and major activities are described below:

Meteorological and hydrological survey had been conducted through the aerial photographs, topographical maps, related rainfall/river discharge data collected, and further field observation in order to understand the drainage and recharge systems of the Study area.

For the geological part, geo-electric prospecting (GEP) survey had been conducted to identify the hydrogeological condition to be required for designing water supply systems. The 16 points at each center had been prospected with a maximum depth of 150 meters.

Water quality of the existing water sources and surface water had been examined in terms of physico-chemical characteristics. The analysis items and procedure were made in accordance with WHO drinking water quality guidelines. Also water samples had been undertaken for bacteriological tests, which were collected from the water sources, public fountains, private connections and household containers in order to identify the place of contamination.

Topographic survey had been made along the existing water supply transmission lines and distribution lines through the reservoirs. Also, proposed water supply distribution lines, which start at prospective water source(s) identified by GEP, had been surveyed.

Survey on water use condition had been conducted by filling-out questionnaire form(s) at 100 households as well as schools, institutions, industries, hotels and restaurants in each center. A census for water consumption had also been carried out in all areas being supplied with piped water. These surveys have clarified the water supply quantity and service rate as well as people's demand for water both in quantitative and qualitative aspects.

Survey of sanitary and health condition had been also carried out together with the above water use condition survey. Interviews had been conducted at the above 100 households, and sanitary facilities such as the type of toilet, condition of facility and utilization, treatment of dejecta/excretion and situation of solid wastes disposal had been observed.

Survey of social background aims at minimizing the possible negative effects which may be expected on the society and the people. The survey had been carried out by the same 100-household-interviews, questioning key informants such as Wereda, Kebele, school teachers, health workers and other community leaders, and meetings with various focused groups.

Socio-economic survey had been conducted with 100-household-interviews as well as questioning key organizations and institutions. This survey clarifies household level

economy and financial condition of those organizations/institutions, contributing to introduction of affordable water tariff system and sound account of WSS.

Initial environmental examination (IEE) had been carried out on all Eleven Centers during reconnaissance and Phase I surveys. As a result of IEE conducted in Phase I, detailed environmental survey had been carried out during Phase II survey in accordance with the terms of reference made on IEE. Based on the result of IEE and the detailed environmental survey, environmental impact assessment (EIA) for each center had been made in parallel with the project formulation.

Besides the surveys mentioned above, a sanitary education video titled "Simple Steps.....for Better Health" was firstly produced in this water & health sector of Ethiopia with different languages as Amharic, Afar and English.

With the completion of those surveys mentioned above, comprehensive evaluation and understanding of problems had been made based on the present situation. Then, concept and basic strategy of the Project had been formulated at the end of field survey in Phase II, and presented in the Interim Report.

After returning to Japan, the Team started Home Work in Japan to finalize the project formulation based on the concept mentioned in the Interim Report and agreed by WSSD through discussions. Those outcomes are presented in this report together with operation and maintenance manual and sanitary education manual.

Chapter 2 Natural Condition

2.1 Meteorology and Hydrology

Debre Tabor is located at the hilly plateau in the west of Mt. Guna on Werota-Woldia road. The area is surrounded by deep gorges of the tributaries of Rib river to the north and the tributaries of Gumara river to the south. All drain to Lake Tana. Streams around the town are Zufil, Selamko, Mero, Janmeda, Imbera, Alem and Gibr Wiha. All are originated from the town area. The area is entirely occupied by weathered basalts.

Debre Tabor has a meteorological station of NMSA in the town and a river gauging station of WRDA on Zufil river which has the watershed area of 3.03 km^2.

Table 2.1.1 shows the long term monthly mean values of precipitation, potential evapotranspiration and air temperature obtained from NMSA.

Table 2.1.1 Long Term Monthly Mean Values of Precipitation, Potential Evapotranspiration and Air Temperature

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P(mm)	6.4	9.2	32.3	35.2	68.8	180.9	463.7	464.4	188.9	99.6	32.4	7.9	1,589.7
ETo(mm)	139	143	141	138	135	136	135	136	135	134	134	136	1,642
A.Temp.(°C)	16.7	16.9	17.7	17.9	17.7	16.2	14.2	13.9	14.6	14.8	14.9	15.1	15.9

The monthly precipitation is distributed with a peak in the rainy season "Keremt" in July and August. It ranges from 6.4 mm in January to 464.4 mm in August. The annual precipitation amounts to 1,589.7 mm. The monthly potential evapotranspiration does not vary much ranging from 134 mm in October and November to 143 mm in February. The monthly air temperature does not vary much either ranging from 13.9°C in August to 17.9°C in April.

The water balance sheet of an average year for assessing ground water recharge in the watershed area of Zufil river is prepared as shown in Table 2.1.2. The precipitation data is prepared from the 25 year record between 1952 and 1993. The runoff data is provided by the simulation using a Tank model for the years in which precipitation data is available but not runoff data. The model was calibrated with the runoff record and the precipitation record of 1987 and 1988. The potential evapotranspiration is assumed to be same as the long term one and the crop factor for the reference crop evapotranspiration to be 0.7.

Table 2.1.2 Water Balance Sheet of the Ground Water Recharge, Zufil River, Debre Tabor

Unit : mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	7.8	9.2	37.2	36.6	86.6	177.5	457.5	458.6	194.4	93.0	34.4	8.5	1,601.3
Q	16.7	12.8	10.2	8.6	9.9	35.4	172.5	192.3	131.8	61.0	29.5	19.9	700.6
P-Q	*	*	27.0	28.0	76.7	142.1	285.0	266.3	62.6	32.0	4.9	*	—
ETo	139	143	141	138	135	136	135	136	135	134	134	136	1,642
ETcrop	97.3	100.1	98.7	96.6	64.5	65.2	64.6	95.2	94.5	93.8	93.8	95.2	1,149.4
ETa	—	—	27.0	28.0	76.7	95.2	94.6	95.2	62.6	32.0	4.9	—	—
ΔS	—	—	0	0	0	46.9	190.5	171.1	0	0	0	—	408.5

Note: P = Precipitation
Q = Runoff
ETo = Potential Evapotranspiration
ETcrop = Reference Crop Evapotranspiration
ETa = Actual Evapotranspiration
ΔS = Recharge
* = Distorted Data
— = Not calculated due to distorted data

According to this sheet, the recharge takes place only in June, July and August, which amounts to 408.5 mm in an average year. The proposed sites for new wells and the sites of existing wells are mostly located in the watershed areas of Zufil river, Selamko river and Mero river. Since some of these wells exist in the very small watershed areas, it must be checked if there is a sufficient recharge for the wells.

Yearly water balance sheets of Zufil river were prepared for the 25 years between 1952 and 1993 as shown in Appendices. The monthly recharge of each year is shown in Table 2.1.3.

Applying the probability analysis for the annual recharge using log-normal two parameter distribution function, 5-year recharge and 10-year recharge of dry years are resulted at 294.5 mm and 256.0 mm respectively.

Table 2.1.3 Monthly Recharge Estimated by Means of Surface Water Balance Analysis, Zufil River, Debre Tabor

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1952	—	—	—	0	0	103.5	127.4	149.2	0	—	—	0	380.1
1954	—	—	—	—	—	80.0	209.0	162.7	0	—	—	—	451.7
1956	—	—	—	—	—	64.6	257.0	112.6	0	4.1	—	—	438.3
1957	—	—	9.5	0	12.7	26.1	29.1	199.7	—	0	—	—	449.0
1958	—	—	—	0	0	11.4	255.4	109.6	0	—	0	0	476.4
1959	—	0	0	0	0	0	243.5	182.1	22.8	0	—	—	448.4
1960	0	0	0	—	52.5	0	211.9	111.7	0	—	—	—	376.1
1961	—	0	0	0	0	47.4	317.5	181.8	0	—	—	—	546.7
1974	—	—	—	—	—	14.8	186.3	91.1	0	—	—	—	292.2
1975	0	—	—	0	0	108.5	148.0	165.4	0	—	—	—	421.9
1976	—	—	0	—	—	19.3	108.6	124.9	0	0	0	—	252.8
1977	—	—	0	—	25.5	107.2	246.7	148.8	0	9.3	—	—	379.4
1978	—	—	—	0	0	231.0	197.4	56.4	0	—	0	—	484.8
1979	—	—	—	—	15.7	23.6	246.4	123.6	0	0	—	—	409.3
1980	—	—	—	6.9	0	57.9	269.7	146.4	0	0	0	—	480.9
1981	—	—	—	—	0	37.2	206.1	151.7	1.2	0	0	—	396.2
1982	—	—	0	—	0	0	112.6	300.5	0	0	0	—	413.1
1983	—	—	—	0	0	—	180.2	188.7	0	0	0	—	368.9
1985	0	0	0	—	0	20.9	139.9	73.6	0	—	0	0	234.4
1986	0	0	0	0	0	182.0	159.0	113.8	0	—	—	0	454.8
1987	0	—	0	—	76.1	13.6	76.3	109.2	0	0	0	—	275.2
1988	—	—	—	0	0	58.6	287.0	105.3	0	0	—	0	450.9
1989	0	—	0	0	0	0	48.7	108.3	0	0	—	—	157.0
1992	—	—	—	1.5	0	19.9	148.7	122.9	0	—	0	—	293.0
1993	—	—	0	0	77.9	16.2	179.7	52.2	8.2	0	0	—	334.2

Note: — = not calculated due to missing data or distorted data

In quantity wise for the watershed area of Zufil river;

5-year recharge $0.2945 \times 3.03 \times 10^6 = 0.892 \times 10^6$ m^3/year
10-year recharge $0.2560 \times 3.03 \times 10^6 = 0.776 \times 10^6$ m^3/year

These are equivalent to 2,443 m^3/day and 2,126 m^3/day respectively, which are applicable for WSS Well No. 2. If it is allowed to apply this method for the watershed areas of WSS Well No. 1 and WSS Well No. 3, the quantity of recharge is estimated;

For the watershed area of WSS Well No. 1 (A = 0.54 km^2);

5-year recharge $0.2945 \times 0.54 \times 10^6 = 0.159 \times 10^6$ m^3/year
10-year recharge $0.2560 \times 0.54 \times 10^6 = 0.138 \times 10^6$ m^3/year

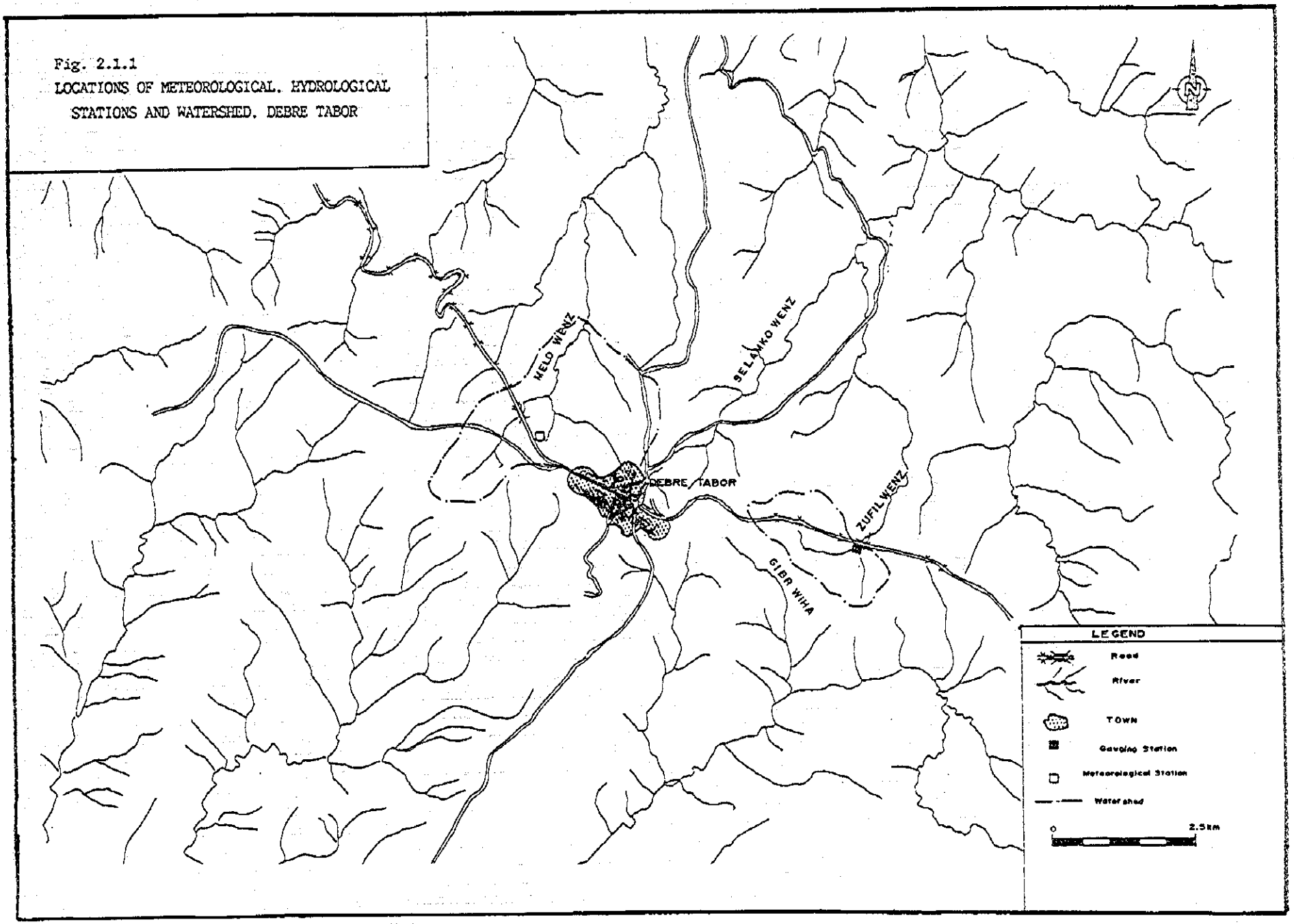
These are equivalent to 436 m^3/day and 378 m^3/day respectively.

For the watershed area of WSS Well No. 3 (A = 0.78 km^2);

5-year recharge $0.2945 \times 0.78 \times 10^6 = 0.230 \times 10^6$ m^3/year
10-year recharge $0.2560 \times 0.78 \times 10^6 = 0.200 \times 10^6$ m^3/year

These are equivalent to 630 m^3/day and 548 m^3/day respectively.

Fig. 2.1.1
LOCATIONS OF METEOROLOGICAL. HYDROLOGICAL
STATIONS AND WATERSHED. DEBRE TABOR



2.2 Hydrogeology

2.2.1 Geology

Debre Tabor is located on a small plateau, at an elevation of about 2,600 m.asl, which forms a promontory of mountains extending southwestward from Mt. Guna (4,231 m.asl). The plateau consists of alkaline basalt, tuff which belong to the Ashangi Group of Paleocene - Miocene. A number of minor cones, apparently the remains of more recent volcanic activity, are scattered over the area, some of which are distributed in a NW-SE direction.

The undulating surface of the plateau is covered with clayey soil originating from decomposition of the weathered volcanic rocks. The surface is quite fertile because of the comparatively high rainfall and most of the land surrounding the town is cultivated. Major alluvial deposits are not present.

2.2.2 Hydrogeology

(1) Groundwater

The clayey soil covered on the surface of the plateau stores shallow ground water which is exploited by the town people by means of hand dug wells. The wells frequently dry up, especially during the dry season.

There are three boreholes in this area. Borehole No.1 is located at the inside of the town area but no data of this borehole could be obtained. According to our field measurement on June 1, the yield is 1.4 l/s.

Borehole No.2 is located at about 4 km east of the town center, near the crossing point of the Werota - Weldiya highway and the Zufil River. This borehole was drilled to 122 m depth by WWDA in 1979. According to the lithological log of this borehole, the subsurface within 4 m depth is occupied by dark clay and sandy soil, and is underlain by the basalt which is partly fresh and massive, partly vesicular. It is differently weathered and is struck with intercalation of lateritic layers. The hydrogeological characteristics of this borehole are shown as below.

Static Water Level	2.6 m
Dynamic Water Level	42.6 m
Maximum Yield	4.0 l/s
Safe Yield	3.2 l/s
Transmissivity	$3.15 \times 10\text{-}5$ m²/s
Permeability	$1.60 \times 10\text{-}7$ m/s

Borehole No3. which is located at about 4 km northeast of the town center was drilled to 117 m depth by EWWCA in 1992. This is the newest one and not productive yet because a submersible pump and a generator are not prepared in spite of completion of the pipe line installation. In this borehole, clay with sand and silt overlies at the subsurface with the thickness of about 8 m. Basalt which intercalates with weathered and/or fractured layers

and clayey layers underlines the subsurface clay. The static water level was 2.35 m below the ground surface in April, 1993 when the pumping test was carried out, and the yield by air lifting during the borehole construction was 3 l/s.

Besides the above boreholes, geological log data of two other boreholes, Borehole No.4 and No.5 which were abandoned due to the borehole collapse and the damage of the drilling bit, are obtained. Their location, however, are not known because of absence of a location map.

The fact that Debre Tabor area stand on the plateau, creates hydrological conditions that are unfavorable for ground water recharge. The plateau is drained by slopes to the north and south, so that most of the precipitation in the various small catchment areas is lost through rapid run-off. Infiltration is expected to be poor because of the soil cover which apparently has a low permeability. Therefore, selecting the best positions for drilling, to exploit the aquifers which have been the basalt layers created by successive lava flows, will be not easy. According to the borehole records and lithological logs, ground water is struck in fissured and weathered basalt layers in the deep parts, so that the points along the fissured or faulted zone is often known as a lineament useful for selecting the drilling points.

(2) Other Water Source

The nearest perennial river would be the Irb River and the Gumara River about 8 and 10 km from the town respectively. However, the use of these rivers as sources would involve treatment, long pipelines, and high lifts. The streams flowing in the vicinity of the town such as the Selamko, Zufil, Melo and Janmeda could not be considered, because mostly their catchment areas are small and they originate from the town area which creates pollution problems.

Chapter 3 Present Social, Water Supply and Sanitation Condition

3.1 Result of Water Quality Analysis

Water quality analysis has been made in both physico-chemical and bacterio-logical aspects, using calorimetric, volumetric analysis and filtration technique methods respectively. In the operational procedure and application of guideline value, "WHO Guidelines for Drinking-Water Quality 1993" has been referred to. The results are shown in Appendix-2 "Result of Water Quality Test" of Appendixes (Volume III).

3.1.1 Physico-chemical aspects

There are two (2) boreholes which are the main source of water for the center. Two (2) samples were tested, one (1) of which was from Borehole No.1 and the other was the mixture of the boreholes because it was inconvenient technically to collect the sample from Borehole No.2. The both sampled waters are fit for drinking purpose according to WHO drinking water quality guideline.

Besides the main sources, other two (2) samples were analyzed. The sample collected at Chagnwuha Spring was found to be acceptable for drinking, but another sample collected at a hand dug well showed that color, turbidity and nitrate concentrations were above the guideline values. The nitrate concentration is 114.40 mg/l, while the WHO guideline recommends the value of 50 mg/l. Since the well is located within the town, it is expected that the well is probably contaminated with sewerage and/or body disposal discharged from the residential area. When nitrate present in excessive amounts in water, it indicates that the pollution occurred could not have been recent since nitrate is the final oxidation product of the element nitrogen which is usually present in sewerage. Excessive amount of nitrate in drinking water causes methaemoglobinaemia in bottle-fed infants in most cases and occasionally in some adults. Although no such report is heard at present, it is recommended that the well be abandoned for drinking purpose and the well users be introduced into the service of WSS water.

3.1.2 Bacteriological Aspects

Thirty two (32) samples were undertaken. The water supplied by WSS showed free from faecal coliform regarding the two (2) boreholes, one (1) public fountain and one (1) private connection. However, considerable number of faecal coliform was detected for the samples collected from household container as well as from hand dug well.

The result taken from the household containers suggests that the contamination of the potable water from the source takes place mostly through improper handling of the household containers used for storing water.

There is an indication that spring water is of very susceptible to change. Chagnwuha spring, which is relatively well protected, presented just 10 number of faecal coliforms on June 6th, but the result carried out one (1) week later showed too-many-to-count coliforms. Since the latter test was done after heavy rainfall, it is conjectured that the spring became contaminated with the consequence.

3.2 Current Water Consumption and Demand

3.2.1 Current Water Production and Consumption

The data of the production and the billed consumption for past 2 years were collected by the Team and summarized in Table 3.2.1. However, the production for 12 months was not recorded, and the total consumption for past two years 20,210 m^3. According to the consumption data, the monthly consumption rate decreases in rainy season.

3.2.2 Water Users

According to the water consumption census conducted by the Team, the total population served by the water supply is about 8,600, which is accounted for about 34% of the total population. The water supply is limited to the eastern half of the center. Domestic, institutional, commercial, industrial and agricultural consumption are estimated based on the consumption records of May, 1995 and the census data. Domestic consumption is subdivided into house connection, yard connection, public fountains and those who buy and borrow water from neighbors (vendors), considering the mode of services. Table 3.2.2 shows the results of the data processing.

Table 3.2.2 Water Consumption and Demand

Categories	No. of Customers	Population served		Day Consumption		Day Demand	
		Population	(%)	(m^3)	(LPCD)	(m^3)	(LPCD)
Domestic	1791	8578	(100)	31.5	(12.3)	163.6	(19.1)
House Connection	4	78	(0.9)	1.2	(16.0)	2.4	(30.9)
Yard Connection	121	912	(10.6)	12.9	(14.1)	26.1	(28.6)
Public Fountain	656	2905	(33.9)	6.6	(2.3)	70.9	(24.4)
Neighbors	1010	4683	(54.6)	10.8	(2.3)	127.8	(27.3)
Institutional	16			20.0			
Commercial	171			1.9			
Industrial	4			0.3			
Agriculture	8			1.0			
Total	1990			54.7			

There are only four (4) connections with house connection, i.e., the hospital and one (1) coffee bar. The hospital has 24 residential houses in the compound in which 11 houses are equipped with house connections. Although those houses with connections are not metered, the domestic lpcd of the house connection customers is estimated at 16.0 from the census data of those houses in the hospital. With this lpcd and the population served accounted at 78, the domestic consumption is calculated at 1.2 m^3/day. The consumption of the institutional houses in a total of 24 hours is estimated at 10.5 m^3/day. The commercial consumption of the coffee bar is minimal.

Those who have yard connections are accounted at 120 households and 13 institutions. There are only 17 households which use water for their businesses. The domestic lpcd of the yard connection customers is calculated at 15.2 from the census data. Taking into consideration that the consumption of the health assistant school is domestic, the lpcd becomes 14.1. With this lpcd and the population served accounted at 912, the domestic

consumption is calculated at 12.9 m^3/day. The institutional consumption is 4.7 m^3/day excluding the health assistant school. The large consumers are the army camp, the zone administration office and the senior secondary school. Their consumption is 2.7 m^3/day in total. The commercial consumption is estimated at 0.7 m^3/day excluding their domestic consumption estimated at the rate of 15.2 lpcd. There is no industrial customer with yard connection. Instead, there are three (3) agricultural customers (cattle breeders). Their agricultural consumption is estimated at 1.0m3/day excluding their domestic consumption estimated at the rate of 15.2 lpcd.

Public fountain users are accounted for 656 households with the population of 2,905. They are served by only (1) PF, i.e., PF1. Since the lpcd of the PF users engaged in businesses is low, their consumption for business is considered negligible.

The majority of the water users are those who borrow and buy water from neighbors (vendors). There are 1,010 households and two (2) institutions. Their domestic lpcd is calculated at 2.3 from the census data. With the lpcd and the population served accounted at 4,683, the domestic consumption is calculated at 10.8 m^3/day. The two (2) institution are the culture and sport dept. office and a clinic. Their consumption for building is estimated at 0.3 m^3/day and it is sorted to industrial consumption. There is one (1) cattle breeder, however, the consumption is minimal.

3.2.3 Current Water Demand

The water required by the users of different mode of services for different domestic purposes was surveyed and the result is shown in Table 2.4.6. In the study, five (5) major categories of the users are identified including Traditional source Users (TSU). Six (6) sample households of each category are selected from those which do not give or sell water to neighbors and do not engage any businesses either.

Most of the samples are located in the eastern half of the center, i.e., Kebele 01, 05 and 06 where piped water and shallow wells (hand dug wells) are available.

In comparison with the current demand and consumption, it can be said that the water supply does not satisfy the demand of any user category. In order to calculate the domestic day demand, the lpcd of demand surveyed is applied to all user categories except for public fountain users. This is because there are many shallow wells and springs, and the public fountain users will take the water except for drinking purpose. The domestic demand of the users with different mode of services is shown in Table 3.2.2. With the new water supply system presently being constructed, there will be a significant increment in water consumption and number of water users upon completion.

Table 3.2.1 Water Production and Consumption in Debre Tabor

	Consumption (m3)						Production (m3)			Unaccounted Losses	
					Sub	Grand	Well				
	IC	PF1	PF2	PF5	Total	Total	No.1	No.2	Total	(m3)	(%)
Jul-93	637	113	9		122	759			0		
Aug-93	486	40	8		48	534			0		
Sep-93	627	40	5		45	672			0		
Oct-93	343	39	29		68	411			0		
Nov-93	508	154	56		210	718			0		
Dec-93	486	70	27		97	583			0		
Jan-94	538	239	52		291	829			0		
Feb-94	515	111	17		128	643			0		
Mar-94	436	182	53		235	671			0		
Apr-94	456	78			78	534			0		
May-94	493	100			100	593			0		
Jun-94	864	100	21		121	985			0		
Jul-94	696	200		26	226	922	2,248		2,248	1,326	58
Aug-94	601	119		56	175	776	2,254		2,254	1,478	65
Sep-94	814				0	814	2,961	155	3,116	2,302	73
Oct-94	1,161	281			281	1,442	2,687	234	2,921	1,479	50
Nov-94	543	255			255	798	2,425	373	2,798	2,000	71
Dec-94	1,603	226		12	238	1,841	2,186	431	2,617	776	29
Jan-95	1,604	218		8	226	1,830	2,056	370	2,426	596	24
Feb-95	1,677	247		7	254	1,931	2,316	639	2,955	1,024	34
Mar-95	1,678	246			246	1,924	1,731	453	2,184	260	11
Total	16,766				3,444	20,210	20,864	2,655	23,519	11,241	47
Average						962			2,613		
Maximum						1,931					

*Unaccounted losses is sumed up from July '94 to April 95

* Recorded in Ethiopian Calendar

IC: Individual Connection PF: Public Fountain

3.3 Water Supply Facilities Condition

3.3.1 General

Water source in this town is groundwater, and water supply is served by the piped water system. Existing water supply system consists of two boreholes, transmission facilities and distribution facilities.

In addition, an additional borehole together with a rising main and boosting station was constructed last year and connected to the existing reservoir. However, it is not operating until to date, because there are no submersible pump, boosting pump, and generators, which is yet to be purchased at this moment.

3.3.2 Water Source

No.1 Borehole is equipped with a flow meter, check valve, gate valve, and a pressure gauge. The pumping rate and the pressure are quantified at the rates of 2.8 l/s and 9.5 kg/cm^2. It is reported that the existing submersible pump for No.1 Borehole is being operated in the morning, afternoon, and evening. However, the existing submersible pump stops automatically within 30 minutes after switching on due to the drawdown of groundwater. Although the hydroelectricity is available, the existing submersible pump is driven by Indian-made generator with a capacity of 25 KVA.

No.2 Borehole is equipped with a flow meter, check valve, and two gate valves. The pumping rate is quantified at about 1.1 l/s. The existing submersible pump is driven by the hydroelectric power. It is reported that the existing submersible pump for No.2 Borehole is operated for about thirteen hours continuously.

3.3.3 Transmission and Distribution Facilities

Groundwater is delivered from the borehole to the service reservoir directly and supplied to the town by gravity. There are some connections between the rising main.

Existing service reservoir is rectangular R.C. reservoir with a capacity of 70m3, and no leakage was observed. No measurement appurtenance was also provided.

The existing distribution network is the branched system with galvanized steel pipes. The diameters of the pipes range from DN 25 to DN 80. The lengths of pipelines including rising main are summarized as follows:

Table 3.3.1 Existing pipeline data

Diameter (mm)	Length (m)	Material
25	250	G.S.
40	1560	-do-
50	1880	-do-
65	340	-do-
80	7960	-do-

3.3.4 Service Level

Water service level is divided into two modes: individual connection and public fountain. There are 320 individual connections, and the individual connection is subdivided into 4 categories: private(256), commercial(32), governmental institution(23), and public institution(7). Individual connection is about 83% of the total consumption, and public fountain about 17 %.

There are 5 public fountains, and 3 operational public fountains. Six faucets per public fountain are provided.

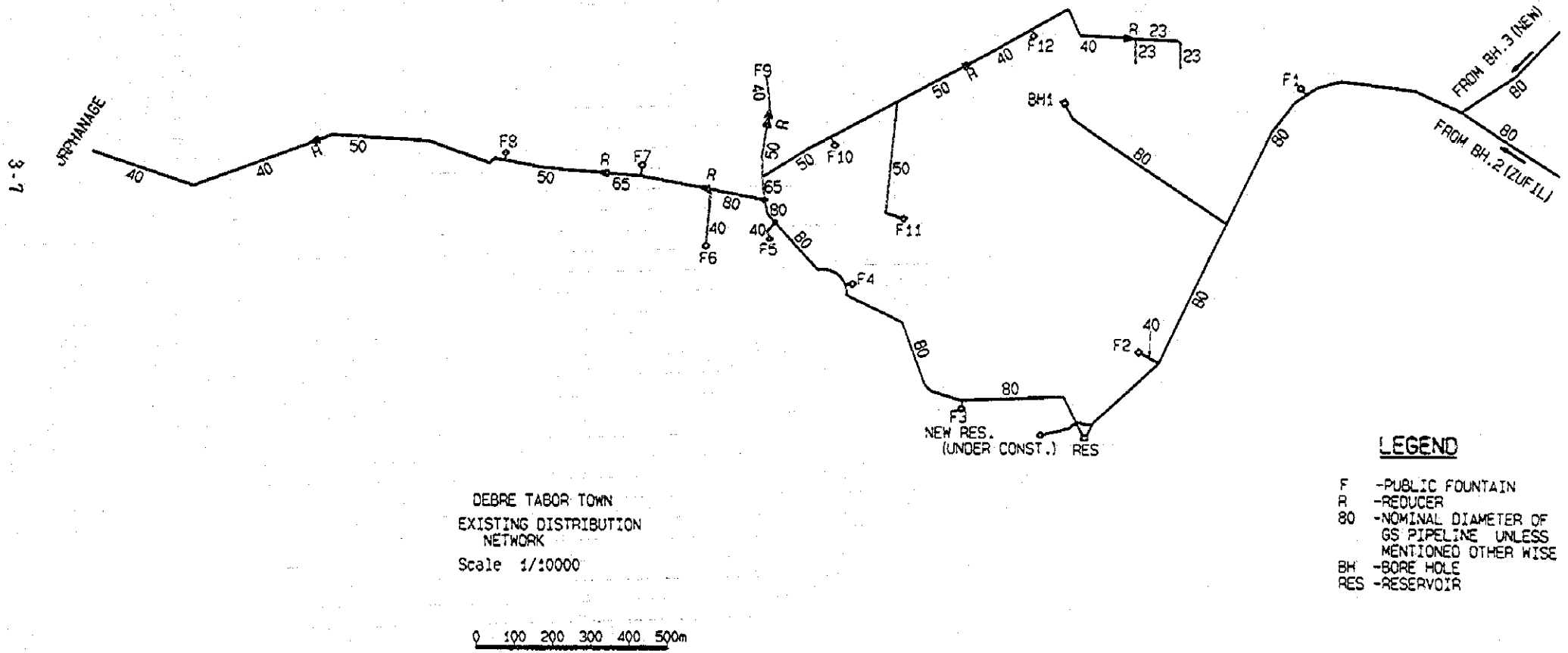
3.3.5 Disinfection

There is no disinfection facility in existing water supply system. It is reported that no disinfection is being performed.

3.3.6 O & M

Debre Tabor is classified as urban town, and the waterworks is under the control of the Regional Office in Amhara Region. This office manages one satellite town. Debre Tabor office is managing not only financial works but also maintenance works such as replacement of valve and meter. Any regular check up for the maintenance was not made except yearly inspection tour by the regional office.

Figure 3.3.1 Schematic layout of Existing Facilities (No scale)



3.4 Sanitary Facilities Condition

3.4.1 Toilet Facilities

It has been reported that Debre Tabor has 1,729 pit latrines and 562 water wells at present. Based on the survey made in 1993 by the town itself, 61% of the population of the town get their water from wells, 24% from springs, 9% from piped water and 6% from rivers. Because the large percentage of the population uses well water, positions of pit latrines in relation with location of water wells are not well observed to avoid contamination of water.

The survey of the Population and Housing Centers of 1984 as updated in 1993 has reported the following regarding sanitation facilities.

Table 3.4.1 Distribution of Housing Units by Type of Toilet Facilities in Debre Tabor

Number and percentage	Type of Toilet Facility						Total
	Flush		Dry pit		None i.e. (open-) field	Other	
	Private	Shared	Private	Shared			
• Number	27	1	770	381	2,033	17	3,229
• Percentage (%)	0.8	0.1	23.9	11.8	63.0	0.5	100.0

As can be seen from Table 3.4.1, 63% of the population of Debre Tabor do not have toilet facilities, 30% have dry pit latrines both private and shared, and only a little less than 10% have flush toilets.

The survey of 100 households carried out by the Team has come out with the following results pertaining to sanitation facilities.

Table 3.4.2 Distribution of Households by Type of Toilet Facilities Used

Percentage	Type of Toilet Facility				
	Septic Tank	Dry Pit Latrine	Community Toilet	Open field	Total
%	1	57	5	37	100

The tabulation above indicates that 57 households out of 100 have dry pit latrines for toilet facilities, 37 households do not have any toilet facility and they use open-field for disposing excreta. Only one household has been indicated as having septic tank out of the hundred.

From the survey of the construction material, out of which the walls, roofs and floors of housing units including toilet superstructures, it has been reported that 88% of walls are made of wood and mud, 85% of roofs of corrugated iron sheets and 92% of the floors are of earth and mud. Many pit latrines have cement foot rest, and practically all of them do not

have covers. The maintenance of many of toilet facilities is not only poor but totally neglected.

When the traditional pit latrines get filled-up, they will be emptied by having vacuum truck from Bahir Dar or Gonder if the owners have the capacity to pay. Those who cannot pay, dig new pit latrines if they have space; otherwise they resort to the use of open-field for excreta disposal. Debre Tabor does not have proper dumping sites for sludge that has been taken out from the pit latrines. Consequently, the sludge dumping is creating environmental pollution and contamination of water bodies.

Debre Tabor used to have public toilet; but it does not operate now because it was filled-up and has not been emptied. Many people use the center of the town areas near the Shell Fuel Station, and the Bus Terminal for open-field excreta disposal.

3.4.2 Other Sanitary Facilities

From the survey made by the Project regarding dry solid wastes disposal, the following results have been obtained.

- 70% of the households throw dry solid wastes anywhere;
- 18% of the households use open pit to damp their refuse;
- 3% place their refuse in cover pits; and
- Only 9% of the households burn their refuse.

The dumping of any solid wastes in open-field has created environmental pollution, water contamination and health hazards specially to children.

Survey of disposal of sullages of 100 household showed that 84% of the households dump their sullage anywhere, 8% in drains and 7% in pits. This situation has aggravated the sanitation condition of the area of dumping and also increased the threat to health.

Debre Tabor has an abattoir which is well-built and kept clean. But the waste materials is dumped into a creek that keeps polluting the downstream areas.

3.5 Organization and Management

It is advised to refer to Tables 1 and 2 of Appendix-5 when you read this section.

The number of personnel for the Water Supply Service of Debre Tabor is 18, which is a medium size among the 11 towns. Its breakdown by position/function is shown below.

Table 3.5.1 Number of Personnel and Positions/Functions

Positions/Functions	Gender		Type of Employment		
	M	F	Permanent	Contract	Temporary
1. Head, WSS	1	0	1	0	0
2. Administration					
Store keeper	1	0	1	0	0
Guards	4	0	4	0	0
Janitor	0	1	1	0	0
Sub-total	5	1	6	0	0
3. Finance					
Accountant	1	0	1	0	0
Cashier	0	1	1	0	0
Bill collector	1	0	1	0	0
Meter reader	1	0	1	0	0
Water sellers	1	3	4	0	0
Sub-total	4	4	8	0	0
4. Technical					
Motor operators	2	0	2	0	0
Plumber	1	0	1	0	0
Sub-total	3	0	3	0	0
Total	13	5	18	0	0

As the table shows, there are only permanent workers. Female workers are 5 in number or 28%. It is nearly equal to 27%, which is the average percentage of female workers in 11 towns. When one classifies the functions into administrative, financial and technical ones, the head of WSS being included in technical functions, their respective shares work out to 33%, 45% and 22%. On the other hand, their 11 town averages are 37%, 41% and 22%. It means that the share of administrative functions is a little lower and that of financial functions is a little higher compared to their respective 11 town averages.

Annual water production per worker, which is the broadest labor productivity indicator is calculated at 663 m^3. It is very much the lowest among the 11 towns. The monthly remuneration per worker is 173 birr, which is rather on the high side.

It follows from the above that both the participation rate of female workers and the functional composition of workers are more or less standard ones, but there is a serious problem, that is, the absolute shortage of water production. Because of it under the existing circumstances both the number of personnel and the level of remuneration might be not commensurate with the level of water production.

3.6 Financial Condition of WSS

It is advised to refer to Tables 1 and 2 1 in Appendix-5 when you read this section.

The price of water is 1 birr per m^3 for all clients.

Production and consumption of water in the last fiscal year (Jul. 1993 to Jun. 1994) were 11,930 m^3 and 9,773 m^3 respectively. Leakage ratio works out to 18.1%, which is at a medium level. The daily water consumption as divided by population comes to 1.0 liter. This is by far the lowest among the 11 towns.

Debre Tabor suffers from a severe shortage of water supply.

Income for the last year was 31,337 birr. The major sources of income are water sales (26.5%), service charge (21.7%), public fountains (7.8%) and water meters (6.2%). Income per m^3 of water consumed works out to 3.21 birr, which is the second highest, following the estimated 5.00 birr in Aykel. WSS seems to desperately look for income sources other than water supply itself. Bill collection rate is 67.8%, which is by far the worst among the 11 towns. This state of affairs appears to have something to do with the limited service resulting from the dire scarcity of water.

Expenditures for the same year were 78,328 birr. Major items of expenditures were salaries (47.8%), fuel and electricity. Expenditures per m^3 of water produced work out to 6.57 birr, which is very much the highest among the towns concerned. The income-expenditure ratio comes to 40%. This is very much the lowest.

The number of personnel is 18. It is a medium size among the 11 towns. Annual water production per worker is calculated at 663 m^3, which is by far the lowest. Annual income per worker is 1,741 birr, which is the second lowest, following 1,735 birr for Bichena. Annual expenditures per worker are 4,352 birr, which is on the high side. Average monthly salaries are 173 birr. It is rather on a high side.

It follows from the above that the financial status of the water supply organization in Debre Tabor is the worst among the 11 towns. Although the central factor for it will be the absolute shortage of water supply, there can be other factors such as the size of workforce and the level of remuneration per worker.

3.7 Social Background and People's Awareness

3.7.1 Population and Social Composition

At the time of the field survey the population of Debre Tabor was about 25,575, divided into 9 Kebeles. According to the household survey, the population are all Amhara and have Amharic as their first language. The religious mix was 95% Christian and 5% Muslim. The survey also revealed a high level (42%) of female headed households with the average household size of 5.75 people, and of the six households with and income of less than 50 Birr each month all were female headed households. Land ownership among respondents was 40%. The Muslim population live in one small section of the town near to the Mosque. The town has a number of social organizations (EDER's), but these are mostly concerned with financing and organizing funerals and other social events.

3.7.2 Sanitary Condition

Most private connection users had latrines while only some public fountain users had latrines. Some people in the town did not have latrines and practiced open defecation (35% according to the household survey), especially the poor and those in rented housing. They did not have latrines due to lack of affordability and possibly some lack of motivation. Lack of land did not seem to be a major constraint but in some areas the land needs to be allocated for sanitary purposes by the authorities. In general people seemed to be aware of water and sanitation related disease prevention. Groups were in favor of community latrines and most were prepared to help in the construction and management but felt that they would need some support and even enforcement from appropriate officials. All groups thought that they would be able to keep the latrines clean. More groups preferred to share the facility shared by groups of families, rather than by sex. Groups felt that the authorities should finance desludging of the latrines once they are filled up. There did not seem to be any cultural reason why manual desluding of latrine compost could not be considered. The household survey indicated that 61% of respondents would like a loan for latrine construction or improvement, including septic tanks and dry pit latrines.

The prison latrine was causing a nuisance to nearby residents and also contaminating one spring water source. The latrine needed to be rehabilitated or reconstructed elsewhere. There was also a need for a public latrine near the bus station to serve that area of town and the bus travelers. There was a public shower in the town, which had developed a reputation for being expensive and for having insufficient water.

3.7.3 Water Situation

Water was considered to be the priority need by most of the people. Only those with private connections did not seem to be suffering from lack of adequate quantities of safe water. There were a large number of hand-dug wells in Debre Tabor, but the quality of the well water was not considered good and people preferred water from the public supply or from springs. There was one functional public fountain but the supply from it was insufficient for demand. Some people were selling water from their private connections.

The majority of town people were using spring water. The public water supply system only covers part of Kebele 1. According to the household survey, mostly women and some girls were collecting water from the public fountain. Girls were more involved with collection water from other sources. Boys also helped to fetch water from wells and men and boys fetch water from springs. There were reported to be long queues at the springs. Laundry was undertaken by both men and women by the springs or the river. Well water was used in times of spring water shortage, but the water from both spring and wells was reported to be insufficient during the dry season (March-April).

Three public wells were originally constructed by the Municipality, and these were being rehabilitated by the Red Cross at the time of the field study. These public wells were to have handpumps installed on them. People were concerned that the handpumps would break within weeks and would be more trouble than they were worth. Households using these wells were paying 50 cents each month for a well guard/caretaker. In one area

people (Group 1) reported lack of ability to pay more than this per month and that if they were provided with a public fountain, they would be still have to use well water. In all other areas people wanted to have public fountains and all but one of these groups were prepared to help in the construction and management of them. Protection of springs for contingencies was also reflected as a priority. A few householders preferred private connections, particularly some in the Muslim and business areas. Not all private well owners were positive about improvements to the public water supply system. In Group 10, considerable tension over these differences were voiced.

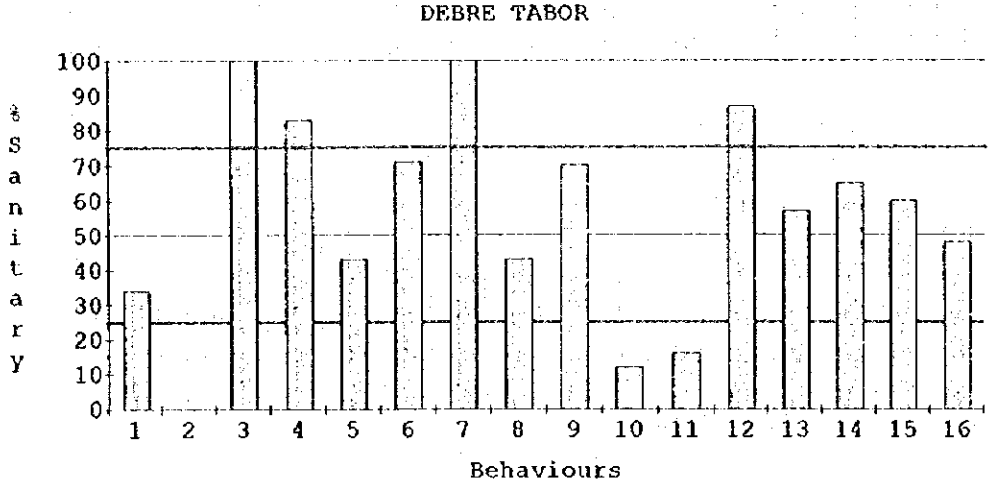
The price of water varies with demand and shortage. Spring water generally being free. Private well water vendors were selling water at 20 cents per clay pot or at 2 Birr for two pots each day for one month. Most people were prepared to pay more for a better water supply service. Among some well water vendors there was a desire not to see improvements to the existing piped water supply system.

3.7.4 Health Indicators

There is a hospital and a Health Center in Debre Tabor. These are not managed by the same administration. The Health Center is managed by the Woreda in an experimental scheme. The Woreda activities are all planned by the Woreda in an attempt to directly answer the needs of the population. Thus the Ministry of Health has an indirect line to the Health Center but has direct command of the Hospital. The Hospital concentrates on curative aspects of health while the Health Center also covers prevention work. Both Hospital and Health Center keep good records and undertake health education for outpatients, but no analysis of the impact of this work has been studied. Each have one Sanitarian, but the work of the hospital sanitarian is only within the hospital compound while the Health Center Sanitarian is responsible for the whole Woreda. The sanitation programs have had serious problems due to financial constraints. Despite this most people were aware of the health education program being carried out at the health center and hospital. The school has had inputs from the health center for the Anti-AIDS and Red Cross Clubs.

The morbidity statistics were different for the hospital and health center, but diarrhea, intestinal worms, skin and eye diseases were common at both establishments last year. Health staff considered that lack of adequate quantities of safe water have been the major cause of ill health in the town. This was thought to be worst in areas relying on handdug wells.

The level of health awareness in the town was relatively high compared with other towns in the Study. The responses to the household survey indicated that 70% of households were aware of the cause of diarrhea and 52% were able to prepare ORS correctly. Food and water were stored covered in 100% of households. Responses regarding handwashing with soap after defecation suggested a low level at 43% while handwashing with soap after handling children's stools was higher at 71% of the households with small children. 14% of respondents requested sanitary education as part of any sanitation program.



No.	SANITARY BEHAVIOURS	%Sanitary
1	Access to piped water	34
2	Use piped water supply always	0
3	Covered water container	100
4	Water scoop kept off the floor	83
5	Handwashing with soap after defecating	43
6	" after handling childrens stools*	71
7	Covering cooked food during storage	100
8	Not eating raw unwashed fruit and vegetables	43
9	Kitchen utensils stored off the floor	70
10	Rubbish burried or burned	12
11	Wastewater disposed in pit/drain/veg. garden	16
12	No animals kept in the house	87
13	Home not infested with flies	57
14	Latrine in use by household	65
15	Latrine in use by all household members	60
16	Infant's excreta disposed of in latrine*	46
TOTAL SCORE FOR SANITARY BEHAVIOURS		887

* As proportion of households with young children

Figure 3.7.1 Indicator Sanitary Behaviours

There are too few Muslims to pick up any variations in behaviors between the two represented religious groups. There are some differences related with income. Sanitary behaviors seem to be slightly worse in lower income groups, particularly relating to the handling of children's excreta and handwashing with soap. However in Debre Tabor the above situation is overriding. The highest priority areas are use of piped water always and sanitary disposal of solid waste and waste water. The high-middle priorities for sanitary behavior improvement are access to piped water, handwashing with soap after defecation and sanitary disposal of infant's excreta. The low-middle sanitary behaviors for improvement are handwashing after handling children's stools, keeping kitchen utensils off the floor, fly control, latrine access and latrine use by all family members.

3.7.5 Education

Debre Tabor had one high school. There were 1,670 pupils attending this school (933 boys and 737 girls) during the field survey. Girls had a higher drop out rate from school and generally perform less well. The reasons for this had not been studied but the Headmaster thought that it may be related to the early marriages for girls and that parents expect boys to do better academically than girls.

The school had a health/Anti AIDS and a Red Cross Club, supported by the Ministry of Health. Training and advice were given to students at flag ceremonies. Students expressed a willingness to be involved in giving out health messages, not just receiving them.

There was a public fountain at the school which worked daily. There was one latrine in the school but it was only used by boys. Girls in Debre Tabor and especially rural girls do not want to be seen while they are going to a latrine or using open field sites for excreting.

3.7.6 Religious Institutions

The Orthodox Church has already been involved with HIV/AIDS education, but not sanitary education work. The Priests were using spring water brought to them by deacons and trainees at the time of the field survey. They had no latrines but used open fields some distance from the Church. The leader of Madhanealem Church felt that the poor sanitary and health conditions in the town were a reflection of the poor economic status of the town and probably also from ignorance. It was also felt that education and motivational activities were required, but that income generation was the greatest need. Without adequate financial resources, people would not be able to benefit from additional health knowledge. The Priests felt that community latrines would be a good option in the town but that people need some income generation activities in order to maximize on their existing health knowledge. Madhanealem Church had already started income generating forestry activities to help with poverty alleviation. Leaders of Jesus Church were more willing to consider involvement in health education activities as part of the Sunday teaching programs. For this they would require support from the Health Center staff.

The Mosque had not been involved in health education before, but was willing to get involved if given support from the health center. The Mosque had a private well and was giving water to people living nearby. The Mosque had a latrine but there were no other latrines in the area. The Muslim leaders considered that this was due to laziness or lack of motivation for building latrines.

3.8 Socio-Economy

It is advised to refer to Tables 3 and 4 in Appendix-5 when you read this section.

3.8.1 Administrative Conditions

Debre Tabor which was once the capital of the Ethiopian monarchy perform the dual role of Weroda town and Zonal town.

Because the zonal administration is located there, it has a greater number of governmental offices. There are 30 governmental organizations excluding schools dealing with general administration, finance, education, health, water supply and sanitation, communications, police, justice, water resources development, agriculture, commerce, electricity supply, mass media, labor & social affairs, town planning, economic development, industry & handicraft, relief, culture & sports, road construction and municipal affairs.

The number of government employees is 1,674. It is by far the greatest among the 11 towns. The number of them per 1,000 population works out to 65, which is the second biggest, next to 86 in Mille. Their average monthly salaries are 397 birr, which is the second highest, after 407 birr in Dejen.

This town has nine Kebele. There is no NGO.

Debre Tabor is characterized as a big administrative town.

3.8.2 Population

The population of the town is estimated at 25,575 based on the results of the cartographic census conducted by Central Statistical Authority in 1993. It is the second biggest, next to 26,823 for Chagni among the 11 towns. Ethnically, Amhara occupy a virtually 100 percent of population with a handful of Tigre and Oromo. Religion-wise, 95% of the population is Christians and 5% Moslems. There are 6 churches and 1 mosque.

This is an Amhara and Christian town.

The average family size is 5.7 persons. This is on the small side among the towns concerned. The area of the town is 1,402 ha. It is the second largest, next to the estimated 1,600 ha in Dupti. The population density is calculated at 18.2 persons/ha. This is one of the lowest.

3.8.3 Educational Conditions

There are 1 kindergarten, 5 elementary schools, 1 junior high school and 1 senior high school. The total number of pupils/students is 7,950. It is the largest among the 11 towns. The number of pupils/students per 100 population is calculated at 31, which is the second highest, next to 34 in Aykel.

Literacy ratio and primary school enrollment ratio were 73.8% and 74.5% respectively according to the 1984 population census. Each figure is one of the highest among the towns concerned.

The above tells that Debre Tabor is an educational town.

3.8.4 Medical Conditions

There are 1 hospital and 1 health center. Also, there are 5 pharmacies. The total number of medical personnel in the medical institutions comes to 81, which is by far the largest among the 11 towns. It means that there are 3.2 medical personnel for every 1,000 population. It is at the highest level.

The types of diseases people suffer most are water-borne and sanitation-related diseases such as TB, intestinal parasite, eye diseases and diarrhea, and lower/upper respiratory tract infection. The number of top ten disease cases treated in the medical institutions in 1993/94 was 21,318, which is the second largest, next to 22,002 in Nefas Mewcha.

The estimated total number of cases treated last year in the hospital was divided by the estimated service population. It came to 25.0%, which is at a medium level.

Under 5 mortality rate and life expectancy were 72.6/1,000 and 63.7 years respectively according to the 1984 population census. The former is the lowest and the latter is the highest among the 11 towns.

Ratio of households more or less using septic tanks and pit latrines is 65%. This is one of the highest among the 4 towns.

It follows from the above that medical/sanitary conditions of the town are one of the best among the towns concerned. However, the incidence of diseases per unit population is not necessary low, and it is suspected that there lies a scarcity of water supply behind it.

3.8.5 Economic Conditions

The number of hotels and restaurants is 574 (34.3%), that of shops 1,053 (63.0%), that of cottage industry 43 (2.6%) and that of others 2 (0.1%), adding up to 1,672 (100.0%). This total number of commercial/industrial establishments is by far the largest among the 11 towns. The total number per 1,000 population comes to 65, which is the second highest, next to 75 in Dupti. The number of hotels and restaurants per 1,000 population is 22, which is the second highest, following 42 in Mille.

The above proves that the town is characterized as a commercial hub.

Major occupations in the town are trade, government employees, day laborers and animal husbandry.

Major products are grain powder, edible oil and metal. Major marketable items are agricultural products such as tef, barley, wheat, beans, peas and chick peas, livestock such as oxes, cows, sheep, goats, donkeys, mules and chickens, household items, etc.

Monday is the market day on which 20,000 people are said to gather to the town.

The average monthly household income is 247.8 birr. This is at a medium level.

3.9 Town Planning and Development

The master plan for town planning has been formulated in the era of the Imperial government. According to the field survey, it is expected that seventy percent of the current master plan has been completed as shown in Figure 3.9.1.

The electric power is now supplied to the Centers by the hydroelectric power by EELPA, but the existing water supply facilities is operated by the on-site generators. The future water supply facilities at the target year of 2005 and 2010 will be also operated by the hydroelectric power.

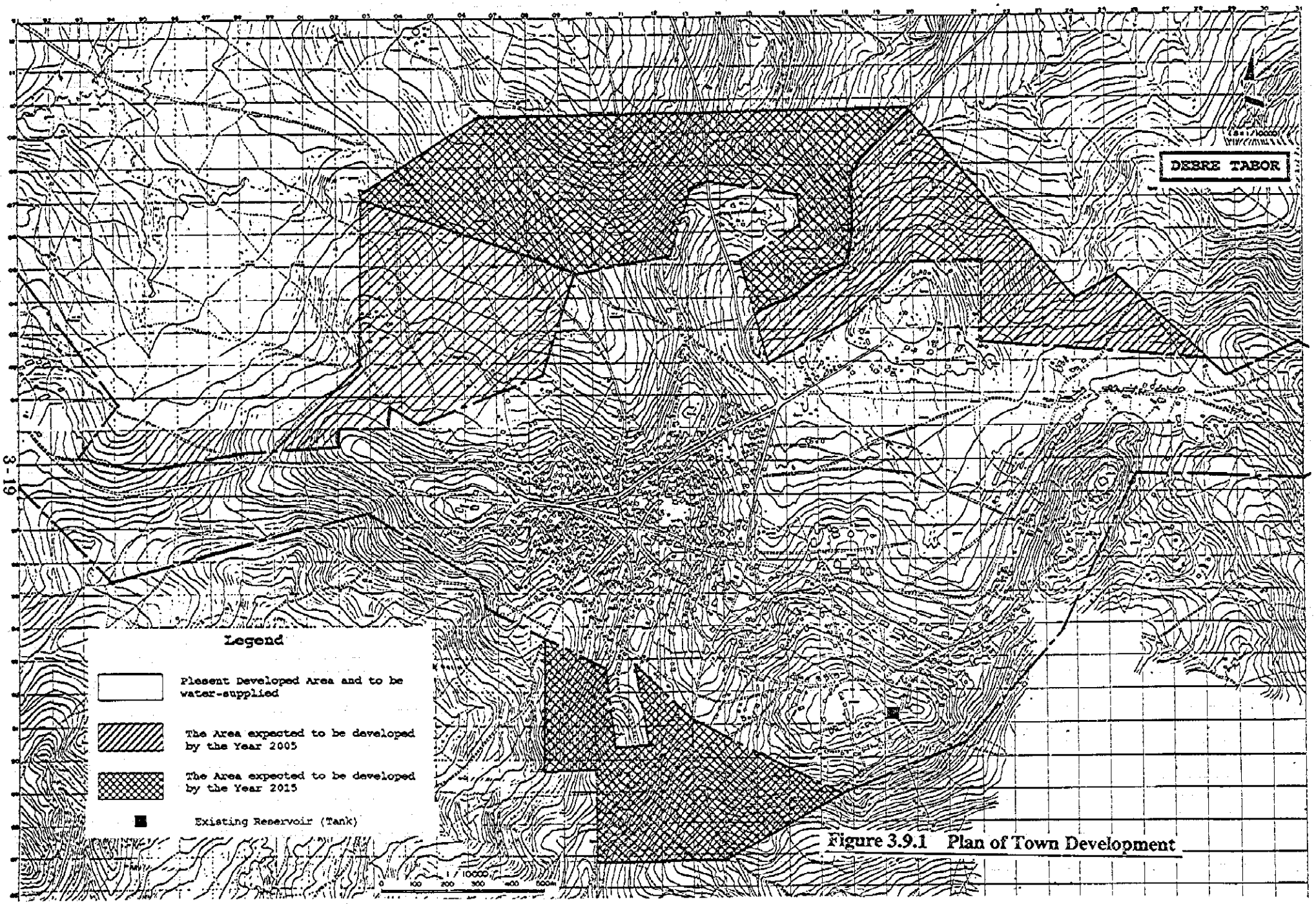


Figure 3.9.1 Plan of Town Development

Chapter 4 Plan of Water Supply System

4.1 Water Demand Projection

4.1.1 Population Projection

The population of Debre Tabor was 15,226 in 1984 according to the results of the 1984 Population Census. The census is the first one the Ethiopian government has ever took.

Before 1984 no established population figures are available. However, Central Statistical Authority (CSA) published 1974 population estimates for those towns whose population was supposed to be more than 2,000. Also, it had similar 1972 and 1973 estimates.

According to CSA estimates, 1974 population for the town was 10,600. Similarly, 1972 and 1973 population was 9,340 and 9,950 respectively. When one adopts CSA estimates, the average annual population growth rate during the 10 years 1974 to 1984 is calculated at 3.69%.

Since 1984 also CSA published its own estimates of population. According to them population of the town in 1992 and 1993 was 27,780 and 29,609 respectively.

In 1993 to 1994 CSA conducted the Cartographic Census for all the towns over the nation, using its own staff just before the 1994 Population Census. CSA says the results of the former is dependable, even more than those of the latter.

According to the Cartographic Census the population of the town was 23,273 in 1993. When one uses the figures, the average annual population growth rate during the 9 years from 1984 to 1993 works out to 4.83%. The JICA Study Team projected future population of the town based on the rate.

In October, 1994 the second Population Census was carried out. The results are not yet published. There was no way for the team to get even the preliminary figures of the census for Debre Tabor. Therefore, the team projected the 1995 population using the 1984 to 1993 average annual growth rate. It came to 25,575.

Weroda people consider that economic growth of the town hinges upon industrial development such as dairy, soap factory and oil factory utilizing hydro-electric power. The town is covered by the National Grid.

As the average annual population growth rate 1995 to 2000 4.5% was adopted based on the average annual population growth rate 1984 to 1993. The more a projection is long-term, the more the incertainty increases regarding the projection. Therefore, one should be more cautious and conservative for a longer-term projection. In line with this reasoning the average annual population growth rates 2000 to 2005 and 2005 to 2010 were projected to be 4.0% and 3.5% respectively.

As a result the projected population of the town for 2000, 2005 and 2010 works out to 31,871, 38,776 and 46,054 respectively (Refer to Table 4.1.1).

Table 4.1.1 Population of Debre Tabor

1. Past Population

1974 Estimates by CSA	1984 Population Census	Average Annual Growth Rate 1974 to 1984
10,600	15,226	3.69%
1984 Population Census	1993 Cartographic Census	Average Annual Growth Rate 1984 to 1993
15,226	23,273	4.83%

2. Population Projection

1995	2000	Average Annual Growth Rate 1995 to 2000
25,575	31,871	4.5%
2000	2005	Average Annual Growth Rate 2000 to 2005
31,871	38,776	4.0%
2005	2010	Average Annual Growth Rate 2005 to 2010
38,776	46,054	3.5%

4.1.2 Water Demand Projection

(1) Domestic Water Demand

a) Population Projection by Service Modes

Based on the current population data by service modes, the population at the target years by modes is projected and estimated in the Table 4.1.2.

75% of the population is targeted at the year of 2010 to be served by the piped water system, and the ratio served by the traditional water source is estimated at 25%, considering the current ration of the population served. Based on the the ratio of the households who are payable for the mode-wise water charge, Target ratio of the sum of house and yard connections (YC) at the year of 2010 is 61%, and 18% of this ratio is house connection (HC).

Table 4.1.2 Population Forecast by Service Modes

	Population (%)							
	1995		2000		2005		2010	
HC	78	(0.3)	1051	(3.3)	3567	(9.2)	8290	(18.0)
YC	5595	(21.9)	8095	(25.4)	12563	(32.4)	19803	(43.0)
PF	2905	(11.4)	7798	(24.4)	9537	(24.6)	6448	(14.0)
Sub total	8578	(33.6)	16944	(53.1)	25667	(66.2)	34541	(75.0)
TSU	16997	66.4	14927	46.9	13109	33.8	11513	25.0
Total	25575	100.0	31871	100.0	38776	100.0	46054	100.0

b) Projection of Domestic Water Demand

Water demand figure by service modes formulated by WSSA is applied for the projection, i.e, House Connection 60 lpcd, Yard Connection 35 lpcd, Public Fountain 15 lpcd. In addition, these figures multiply by 0.9, considering the natural condition (annual mean rainfall is more than 900 mm). Based on these conditions, the domestic water demands at the years of 2000, 2005 and 2010 are obtained as follows:

Table 4.1.3 Domestic Water Demand by Modes

	m^3/day (lpcd)							
	1995		2000		2005		2010	
HC	1.2	(16.0)	56.8	(54)	206.9	(58)	522.3	(63)
YC	23.5	(4.2)	259.0	(32)	427.1	(34)	732.7	(37)
PF	6.7	(2.3)	109.2	(14)	143.1	(15)	103.2	(16)
Total	31.4		425.0		777.1		1358.1	
Average	10.5	(3.7)	141.7	(25)	259.0	(30)	452.7	(39)

(2) Non Domestic Water Demand

a) Current Non Domestic Water Demand

As a result of field survey, the following current non domestic water demand is obtained.

Table 4.1.4 Non Domestic Water Demand in 1995

Item	Unit	Nos.	Demand (m^3/day)	Remarks
School	5 l/person	7950	39.8	
Hospital	20 l/staff	83	1.7	
Hotel	100 l/bed	990	99.0	6 beds/place × 165 places = 990 beds
Bar...	200 l/bar	409	81.8	
Mosque	5 l/visitor	200	1.0	200 visitors/place × 1 place = 200
Offices	5 l/person	1674	8.4	
Total			231.7	

b) Non Domestic Water Demand in Target Years

The public and institutional water demand increase in a geometric ratio of population growth, and the commercial water demand increases in a geometric ratio of population growth plus 3%. Non domestic water demands in the target years are estimated as follows:

Table 4.1.5 Total Non Domestic Water Demand in Target Years

Item	Demand (m^3/day)				Remarks
	1995	2000	2005	2010	
School	39.8	49.6	60.3	71.6	Population growth rate
Hospital	1.7	2.1	2.6	3.1	-do-
Hotel	99.0	142.1	199.3	273.1	Population growth rate +3%
Bar, Tea shop	81.8	117.4	164.7	225.7	-do-
Mosques	1.0	1.2	1.5	1.8	Population growth rate
Offices	8.4	10.5	12.8	15.2	-do-
Total	232	323	441	591	

(3) Total Water Demand

Total water demand at the target years including the accounted losses are estimated as follows:

Table 4.1.6 Total Water Demand in Target Years (m^3/day)

	1995*	2000	2005	2010
Domestic	32	425	777	1358
Non Domestic	23	323	441	591
Losses	51	83	166	344
Total	106	831	1384	2293

* Actual consumption

(4) Maximum Day Demand and Peak Day Demand

Taking the seasonal difference into account, the factor 1.2 is adopted for the projection of maximum day demand. Furthermore, the factor 1.6 is adopted for the projection of peak day demand. The maximum day demand and peak day demand at the target years are obtained as follows:

Table 4.1.7 Maximum Day Demand Peak Day Demand

Item	Factor	1995	2000	2005	2010
Average Water Demand (m^3/day)		106	831	1384	2293
Maximum Day Demand (m^3/day)	1.2	127	997	1661	2752
Peak Day Demand (m^3/hour)	1.6	8	66	111	183

4.2 Water Resources Development

4.2.1 Evaluation of Water Resources

Debre Tabor has annual precipitation of 1,589.7 mm and annual ground water recharge of 408.5 mm in an average year. In the area, there are many head waters of the tributaries such as Zufil river, Selamko river, Mero river, etc. Their flow becomes very little in the mid dry season and some of them dry up in dry years. Yields of springs and shallow wells become unstable in the dry seasons. The use of these water resources as sources of the water supply will result in unreliable supply.

Ground water might be feasible because of the large ground water recharge which takes place in the rainy season. The WSS has three deep wells with the depths of more than 100 m. Among them, BH No.3 is not operated yet but the yield was tested. According to the report, the yield is 2.5-3.0 l/s.

The geology is basalts and tuffs of Ashangi group which are dissected by the linearments according to the aerial photograph interpretation. The primary permeability of volcanic rocks is low but it could be increased with secondary prosity caused by faults and fracture openings. It is expected that the rocks are fractured and weathered along the linearments as favorable as for ground water exploitation.

Geoelectrical survey was conducted at 16 points in total in the area except for the south as shown in Drawing including the sites of the WSSś boreholes. The apparent resistivity curves of the borehole sites show bumpy shapes and their apparent resistivity values range from 10 to 30 ohm-m. The other points except for the northern area where Station No.1 and No.2 are have similar shapes and almost same range of apparent resistivity. The curves of the northern area show smooth shapes and their values are generally high ranging from 50 to 800 ohm-m. The results of VES are shown in Appendices.

Considering the lineation, the result of VES and the watershed area, borehole sites are selected at Station No.3, No.4, No.7, No.11, No.13 and No.15 and the points where linearments intersect i.e. No.17 No. 18 and No.19 totally ten (10) sites. Station No.6, No.11, No.17 and No.18 are located along Zufil river and its tributary. Station No.4, No.7 and No.19 are along Selamko river and its tributary. Station No.3, No.13 and No.16 are along Mero river and its tributary. Station No.15 is in the watershed area of Janmeda river.

Since the watershed area of WSS BH No.1 is very small i.e. 0.54 km^2, the 5-year annual recharge of dry years is checked. It is estimated to be equivalent to 436 m^3/day.

4.2.2 Strategy of Water Resources Development

The characteristics of the major aquifers of the existing deep wells and the proposed well sites are shown in 4.2.1.

Table 4.2.1 Characteristics of Aquifers

Well No.	Locations	Depths of Major Aquifers (GL-m)	Lithology of the Aquifers	Total Thickness of the Aquifers (m)	Permeabilities (m/day)	Remarks
1	VES St.8	76 - 104※	Weathered and Fractured Basalt	28	1	WSS BH No.1
2	VES St.10	51 - 56 62 - 74 100 - 106 108 - 112	Slightly Weathered Basalt Vesicular Basalt River Sand and Pebbles Slightly Weathered Basalt	27	1	WSS BH No.2
3	VES St.6	74 - 87 105 - 112	Highly Weathered and Fractured Basalt Gravel with Sand	20	1	WSS BH No.3
4	VES St.3	30 - 60 60 - 100※	Weathered and Fractured Basalt Weathered and Fractured Basalt	17.5	1	New Well
5	VES St.4	28 - 100※	Highly Weathered and Fractured Basalt	18	1	-Ditto-
6	VES St.7	2 - 24 61 - 90 90 - 100※	Highly Weathered and Fractured Basalt Weathered and Fractured Basalt Highly Weathered and Fractured Basalt	21	1	-Ditto-
7	VES St.11	4 - 28 28 - 100※	Weathered and Fractured Basalt Highly Weathered and Fractured Basalt	24	1	-Ditto-
8	VES St.13	20 - 50 50 - 65 65 - 100※	Slightly Weathered and Fractured Basalt Weathered and Fractured Basalt Highly Weathered and Fractured Basalt	20	1	-Ditto-
9	St.19	1 - 100※	Highly Weathered and Fractured Basalt	25	1	-Ditto-
10	VES St.15	5 - 56 56 - 100※	Weathered and Fractured Basalt Highly Weathered and Fractured Basalt	24	1	-Ditto-
11	VES St.16	50 - 100※	Slightly Weathered and Fractured Basalt	12.5	1	-Ditto-
12	St.17	1 - 100※	Highly Weathered and Fractured Basalt	25	1	-Ditto-
13	St.18	1 - 100※	Highly Weathered and Fractured Basalt	25	1	-Ditto-

Note: ※ = The aquifer bottom is probably deeper than the figure.

The depths of the major aquifers of WSS BH No.2 and No.3 are obtained from the geological logs. The others are detected by the geoelectrical survey. Excluding the existing boreholes, the thickness of major aquifers is reduced into a quarter because most of basalts are highly weathered and may become clayish.

For the sites where the geoelectrical survey was not done, the aquifer of highly weathered and fractured basalt is expected to be existing below the soil cover because they are located at the intersection of linearments.

The permeabilities are assumed at 1 m/day according to the design criteria. The optimal yields of the wells are estimated with the formula listed in the design criteria with a drawdown of 20m and the diameters of wells to be 200mm. The well efficiency of WSS BH No.3 is assumed at 0.8 because this is a new well.

Table 4.2.2 Optimal Yields and Water Levels of the Wells

Well No.	Optimal Yield (m^3/day)	Static Water Level (GL-m)	Dynamic Water Level (GL-m)	Remarks
1	85	0	20	WSS BH No.1
2	82	2.6	22.6	WSS BH No.2
3	121	2.35	22.35	WSS BH No.3
4	212	0	20	New Well for Year 2005
5	218	0	20	- Ditto -
6	254	0	20	- Ditto -
7	291	4	24	- Ditto -
8	242	5	25	- Ditto -
9	303	0	20	- Ditto -
10	291	0	20	New Well for Year 2010
11	151	0	20	- Ditto -
12	303	0	20	- Ditto -
13	303	0	20	- Ditto -

The optimal yield of Well No.1 to Well No.9 totaling to 1,808 m^3/day covers the demands of year 2005. The total yield of all the wells will cover the demands of year 2010. It is recommended to drill six (6) wells i.e. Well No.4 to Well No.9 before year 2005 because they are located nearer to the town.

4.2.3 Design of Water Source Facilities

The new deep wells are designed as follows.

(1) Casing

Fiber Reinforced Plastic (FRP) pipe is adopted considering its elasticity for the case that the drilled hole is not straight. The diameter of casing is decided at 200 mm, taking into consideration the outer diameter of the submersible pump (standard 80 - 140 mm) and the allowance. The length of the pipe is six (6) m long per piece.

(2) Screen

Corresponding with the casing, FRP screen is adopted. The opening ratio is 12% and the length is four (4) m long per piece. The total screen length is longer than the calculated by the following formula.

$$Ls = \frac{\alpha \cdot Q}{10 \cdot A \cdot N \cdot V}$$

where
- Ls: Length of screen (m)
- Q: Pumping rate (l/s) (assumed equal to the optimal yield)
- A: Surface area of screen 0.66 m^2/m
- N: Opening ratio 0.12
- V: Inflow velocity 0.5 cm/s (assumed)
- α: Safety factor 3

The dimensions of the wells are summarized as shown in Table 4.2.3.

Table 4.2.3 Dimensions of Wells

Well No.		4	5	6	7	8	9	10	11	12	13
Pumping Rate	(m^3/day)	212	218	254	291	242	303	291	151	303	303
	(l/s)	(2.5)	(2.5)	(2.9)	(3.4)	(2.8)	(3.5)	(3.4)	(1.7)	(3.5)	(3.5)
Diameter of Well	(mm)	200	200	200	200	200	200	200	200	200	200
Casing Length	(m)	78	78	72	66	78	66	66	84	66	66
Screen Length	(m)	28	28	32	36	28	36	36	18	36	36
Well Depth	(m)	106	106	104	102	106	102	102	102	102	102
Drilling Diameter	(mm)	300	300	300	300	300	300	300	300	300	300

4.3 Plan of Water Supply System

The water supply system proposed for the center of Debre Tabor would be implemented in two phases: first phase (target year 2005) and second phase (target year 2010).

The water supply system, which is composed of intake facilities, rising mains and distribution facilities, is proposed in the first phase to meet the water demand.

The water supply system, which is composed of additional intake facilities and transmission facilities, is planned in the second phase to meet the water demand at the target year of 2010.

4.3.1 Water Supply System in 2005

(1) Boreholes

There are ten potential sites for borehole as stated in chapter 4.2. Among these proposed sites, six boreholes will be constructed in the first phase. The groundwater pumped up is transferred to the new reservoir directly or by boosting pump. The production rate planned is summarized as follows.

W1 (Existing Well)	85 m^3/day
W2 (Existing Well)	82 m^3/day
W3 (Existing Well)	121 m^3/day
W4 (proposed)	212 m^3/day
W5 (proposed)	218 m^3/day
W6 (proposed)	254 m^3/day
W7 (proposed)	291 m^3/day
W8 (proposed)	242 m^3/day
W9 (proposed)	303 m^3/day
Total	1,808 m^3/day

(2) Borehole Pumps

Each borehole will be equipped with a submersible motor pump. The characteristics of the pumps to be installed are assumed as follows:

W1 ~ W3 Q = 0.08 m^3/min., H = 70 m, P = 3 kW, Dia = 80 mm 3 set
W4 ~ W9 Q = 0.21 m^3/min., H = 100 m, P = 5 kW, Dia = 140 mm 6 set

(3) Boosting Facility and Rising Mains

The booster pumps with following capacities will be installed to transfer the water to reservoir. And the collecting chamber with following capacities will be constructed as well.

BP1 ϕ150 mm Q = 0.83 m^3/min., H = 100 m, P = 30 kW
BP2 ϕ100 mm Q = 0.34 m^3/min., H = 70 m, P = 22 kW

Rising mains will range from 75 mm to 200 mm and transferred water to the new reservoir. The total length is about 12,460 m.

(4) Reservoir

The existing reservoirs is used, therefore, the additional capacity of the reservoir is required to meet the water demand at the year of 2005, and the required capacity is about 400m^3 including reserve for fire fighting.

(5) Distribution Network

The distribution network is designed for the peak hour demand and fire fighting case, according to the design criteria.

The layout of the network follows the existing roads. The pipe with Dia. 75 mm is adopted as the minimum dia., and the pipe with dia. 50 mm is automatically adopted for the small distribution zone. Existing galvanized steel pipes will be replaced, if necessary.

The layout of distribution network for the target year of 2005 is prepared and attached in the Drawings. The main pipelines planned are shown as follows:

Table 4.3.1 Distribution pipelines

DN (mm)	Length (m)
300	315
250	190
200	750
150	5,680
75	8,580
50	16,310

(6) Disinfection

Disinfection will be performed by the injection system directly into the outlet of the reservoirs. Daily consumption ratio of chemical will be estimated at about 1.9 kg and necessary more than 0.11 PPM at the end of distribution pipe.

(7) Administration Building

In order to manage daily basis waterworks such as operation works, bill collecting, a building is required to be built by the year of 2005. The building is preferable to be built in the center of the town, and it has a store room and warehouse.

4.3.2 Water Supply System in 2010

(1) Borehole

Four boreholes will be additionally constructed in the second phase to meet the water demand at the year of 2010. The production rate planned is summarized as follows.

W10 (proposed)	291 m^3/day
W11 (proposed)	151 m^3/day
W12 (proposed)	303 m^3/day
W13 (proposed)	303 m^3/day
Total	1,048 m^3/day

(2) Borehole Pumps

The boreholes will be equipped with submersible motor pumps. The characteristics of the pumps to be installed are assumed as follows:

Q = 0.21 m^3/min., H = 100 m, 4 set

(3) Distribution Network

The layout of distribution network for the year of 2010 is not prepared in this Study. It is needed to revise the current master plan of town planning to match up to current situation. It is, therefore, preferable to design a layout plan after revision of master plan.

(4) Disinfection

Disinfection will be performed by the injection system directly into the reservoirs. Daily consumption ratio of chemical will be estimated at about 3.2 kg and necessary more than 0.11 PPM at the end of distribution pipe.

4.4 Implementation Schedule and Cost Estimation

4.4.1 Executing and Responsible Agencies

The executive agency of this Project is to be the Water, Mine and Energy Bureau of the Amhara National Regional Government, while the Ministry of Water Resources is to be responsible to coordinate and facilitate the implementation of the Project.

WSSD is to be responsible for the close coordination with the agencies concerned on the project approval, finance and project implementation. The Project would be required to be of great importance in the coordination of activities among the departments in the Ministry and between the central and regional offices concerned.

Prior to the implementation of the Project, the Project Manager is to be appointed under WSSD, who rests with the day-to-day works. Under the manager, aiming at the smooth implementation, coordination be maintained among such departments/services as Planning & Project, Administration & Finance, Contract Administration, Design and WSSD. The Project Manager be also required to keep close relationship with regional and town offices concerned.

4.4.2 Construction Schedule

The construction works for pipeline and reservoir related to water supply works have been carried out mostly by manual labor in Ethiopia. However, it would be recommended to introduce certain number of construction machines and lightweight materials used specially for pipe and reservoir works in order to speed up the construction works.

As this Project requires urgent intermediation to counteract the current deteriorating water supply condition, the aforementioned measures shall be employed for the purpose of keeping-up smooth execution of the construction works.

The construction schedule is divided into two stages; namely, 1) preparation of finance including the foreign currency portion and detail design accompanied with tender document, and 2) implementation of the Project. The schedule is proposed in the following, taking into consideration the above two stages and the construction amount.

First stage : Preparation in 1996
Second stage : Implementation after 1996 with reference to the priority among Eleven Centers

4.4.3 Project Construction Cost

The Project cost is estimated with both local currency and foreign currency. The unit price is estimated with reference to the standard unit price specified in Guideline for Preparation of Project, WSSA, July 1991. The unit price in this Project is price-escalated from the guideline prices based on the inflation rate shown in Economic Sensus between

1991 and 1995. WSSD's overhead, design and supervision fees and physical contingency are estimated according to the guideline.

In respect of foreign currency portion, the cost is required for the preparation of construction equipment and machinery, and procurement of such equipment and material as pump and pipe. Also, fuel, cement and other local materials made of imported row material are partly counted into foreign currency portion.

Engineering staff will be required for the detail design work and the implementation of the Project, since the Project is relatively large in the scale comparing to those existing water supply system. Consultant will also be employed by WSSD, MWR and be responsible for the all necessary work to be required and cooperate together with the WSSD's engineers.

Total project costs regarding water supply in years of 2005 and 2010 are summarized in Table 4.4.1.

Table 4.4.1 Total Project Cost of Water Supply in Thousand Birr

Year	F.C.	L.C.	Total
2005	21,303	11,213	32,516
2010			13,673

Note: Transportation Cost for Construction Equipment, Vehicles and Office Equipment are not included.

In this Study, sanitary improvement was also designed and required costs are summarized in Table 4.4.2. The costs are composed of 1) toilet facilities to be constructed in schools, medical institutions and public, 2) vacuum track, 3) refuse disposal track, 4) sludge dumping site, 5) refuse disposing site and 6) refuse collecting bins. Household sanitary facilities such as toilet (including community type) and waste water disposal pit shall be managed by the individuals or otherwise subsidized. Although drainage facilities are important, those are to be managed by Municipality and community participation in coordination with WSS. Therefore, the cost does not include the drainage facilities.

Table 4.4.2 Total Project Cost of Sanitary Facilities in Thousand Birr

Year	Cost
2005	1,968
2010	450

4.5 Financial Analysis

4.5.1 Financial Plan

(1) Estimation of Revenues

(a) Determination of Water Tariff

It was decided that there will be three water prices. One will be applied to house connection owners and non-domestic clients. The second and the last will be applied to yard connection users and public fountain users respectively.

The water tariff was so constructed that house connection owners and non-domestic clients will cross-subsidize yard connection and public fountain users, and yard connection users will, in turn, cross-subsidize public fountain users.

The tariff was determined in such a way that house connection owners, yard connection users and public fountain users will pay 4%, 4% and 2% of their income for water respectively in the target year of 2010.

Eventually, it is recommended that the following tariff will be applied from 1999 onward:

Clients	Water Price (birr/m^3)
1. House Connection Owners and Non-Domestic Clients	3.67
2. Yard Connection Users	2.23
3. Public Fountain Users	1.66

Important information concerned such as average monthly household income, share of households, water consumption per household per month, payment for water supply per household per month and ratio of water payment to income by type of clients and by the target year is shown in Table 4.5.1.

(b) Projection of Revenues

The major income source of water supply services is as every one knows revenue from water charge.

It is calculated by (No. of households by year by type of clients) × (annual water consumption per household by year by type of clients) × (water price by type of clients) × (bill collection rate).

The number of households was estimated based on the service population projection in the other chapter.

Annual water consumption was estimated based on the water demand projection in the other chapter.

Water price is already mentioned above.

The bill collection rate in the future was assumed as 95%.

There is the second revenue source. It is the revenue from technical service charge. This is the installation charge of connections. They say that the charge is 40% of the material and transportation cost actually incurred.

The revenue is calculated by (No. of connections to be newly installed by year) × (average technical service charge per connection).

The number of connections to be newly installed every year is estimated based on the projected number of house/yard connection owners.

According to the field surveys conducted by JICA, the average technical service charge per connection worked out to 195 birr although the charge varies depending on the diameter and length of the pipe, distance, etc.

The third revenue source is the the revenue from meter rent. For every new connection installed a water meter will be rented. The rental fee is 1 birr per month.

There are other revenues such as those from material sales, contract fee, connection fee, road crossing, etc. They are assumed to be 2% of the sum total of the preceding three revenues.

Projected revenues by source are shown in Table 4.5.2.

(2) Estimation of Cost

There are two types of cost. One is capital cost and the other is operation and maintenance (O & M) cost.

Capital cost is required to construct and replace water supply facilities. O & M cost is an recurrent cost daily required for the proper functioning of water supply facilities.

(a) O & M Cost

Seven types of O & M cost can be identified.

The first is electricity cost. It is estimated that 162 birr, 270 birr and 447 birr will be daily required in 2000, 2005 and 2010 respectively.

The second is fuel cost. It will not be required as there will be sufficient electricity so far as Debre Tabor is concerned.

The third is disinfection cost. It is estimated that 12 birr, 20 birr and 34 birr will be daily required in 2000, 2005 and 2010 respectively.

The fourth cost is personnel cost. It is estimated that 39, 46 and 57 employees will be required for WSS in 2000, 2005 and 2010 respectively. It is recommended that the average monthly remuneration per employee will be 481 birr. It was worked out based on the standard salaries the authorities are now proposing for each type/position of personnel comprizing WSS.

The fifth is installation cost of connections. It is projected that 99, 200 and 342 connections will be annually newly installed from 1999 to 2004, from 2005 to 2009 and from 2010 onward respectively. Installation cost per connection is estimated at 488 birr on average.

The sixth is the purchase cost of water meters. For each connection to be newly installed one water meter will be required. The purchase price of a water meter widely varies depending on the diameter of the pipe and the country from which it was imported. It was assumed that it will be 276 birr based on the bulk purchase price of Indian imports.

The last is other cost including office supplies, uniform, per diem and travel, postage & telephone, transport, maintenance of office, motor house, etc. , insurance, cleaning items, etc.

It was assumed that the cost will be 10% of the six preceding cost combined.

(b) Capital Cost

Capital cost can be classified into initial cost and replacement cost. The former is required at the time of initial investment and the latter at the time of investment for replacement.

So far as the Project is concerned, replacement cost will be required every 15 years for water purification units only. The average life of other equipment and facilities is assumed to be 30 years, which is the assumed life of the Project.

The summary of the estimated initial cost is as follows:

(Unit : thousand birr)

Item	Foreign Components	Local Components	Total
1. Phase 1			
1) Construction Cost	16,360	6,807	23,167
2) Engineering Cost (12% of 1))	2,780		2,780
3) Contingency (5% of 1) + 2))	957	341	1,298
Sub-Total	20,097	7,148	27,245
4) Buildings		2,830	2,830
5) WSSD's Management Cost (2% of 1) + 2) + 3) + 4))		601	601
Sub-Total		3,431	3,431
Total	20,097	10,579	30,676
6) Water Purification Units (included in total)	10	15	25
2. Phase 2			
1) Construction Cost			7,958
2) Engineering Cost (10% of 1))			796
3) Contingency (10% of 1) + 2))			875
Total			9,629
Grand-Total			40,305

The Phase 1 Project will start in 1996 and end in 1998, while the Phase 2 Project will start in 2007 and end in 2009. The first year of project implementation is for detail design, and the second and third years are for the construction of facilities. The progress of construction work was assumed to be 50% for 1997/2008 and the remaining 50% for 1998/2009.

4.5.2 Financial Analysis

Financial statements (income statement and fund statement) were projected for 30 years starting in 1996.

In doing so, the following conditions were assumed:

1. External Loan for Initial Cost

   Ratio of Loan : 100%
   Grace Period : 10 years
   Repayment Period : 30 years
   Interest Rate : 1%

2. Governmental Subsidy to WSS

   55% of Initial Cost

It is to be noted that the cost related to the construction of accommodation facilities as well as WSSD's management is not included in the above initial cost. Such cost will be borne by the Ethiopian government and WSS will pay it back on the same repayment terms as in the case of external loan.

Also, it was assumed that the existing corporate income tax system will be applied, including 40% tax rate on the before-tax income in case the income is over 50 thousand birr.

Further, inflation was not considered.

The results are shown in Table 4.5.3.

As it shows, WSS will be financially sound and stable in terms of earnings as well as solvency in the years to come except initial years, if all the above mentioned conditions, estimates and assumptions are met.

As representative managerial indicators, the weighted averages of the ratio of revenues to expenditures and the ratio of working capital to revenues for the 30 years from 1996 to 2025 work out to the following:

Revenues/Expenditures = 148.3%
Working Capital/Revenues = 34.7%

Generally, it will be all right if the ratio of revenues to expenditures is equal to or more than 100%, or preferable 110%. Also, it will be all right if the ratio of working capital to revenues is equal to or more than 10%.

It is to be noted that the above values exceed the required levels by a thick margin.

Table 4.5.1 Water Price and Ratio of Water Payment to Income

Item	1995	2000	2005	2010
1. Average Monthly Household Income (birr)				
1) House Connection Owners	-	1,144	1,051	987
2) Yard Connection Users	581	535	455	353
3) Public Fountain Users	287	244	217	227
2. Share of Households (%)				
1) House Connection Owners	0.3	3.3	9.2	18.0
2) Yard Connection Users	21.9	25.4	32.4	43.0
3) Public Fountain Users	11.4	24.4	24.6	14.0
3. Water Consumption/Household/Month (m^3)				
1) House Connection Owners	2.7	9.2	9.9	10.8
2) Yard Connection Users	0.7	5.5	5.8	6.3
3) Public Fountain Users	0.4	2.4	2.6	2.7
4. Water Price (birr/m^3)				
1) House Connection Owners	1.00	3.67	3.67	3.67
2) Yard Connection Users	1.00	2.23	2.23	2.23
3) Public Fountain Users	1.00	1.66	1.66	1.66
5. Payment for Water Supply/Household/Month (birr)				
1) House Connection Owners	2.7	33.9	36.4	39.5
2) Yard Connection Users	0.7	12.2	13.0	14.1
3) Public Fountain Users	0.4	4.0	4.3	4.5
6. Ratio of Water Payment to Income (%)				
1) House Connection Owners	-	3.0	3.5	4.0
2) Yard Connection Users	0.1	2.3	2.9	4.0
3) Public Fountain Users	0.1	1.6	2.0	2.0

Source: JICA

Table 4.5.2 Planning of Revenues

(Unit: birr)

Year	H./Y. Connec.	Public Founta.	Non-Domest.	Techni. Servic.	Meter Rent	Other Revenue	Total
1996	4,379	2,492	4,078	6,791	1,996	12,007	31,744
1997	4,467	2,542	4,160	6,791	2,036	12,164	32,160
1998	4,556	2,593	4,243	6,791	2,077	12,325	32,585
1999	155,388	35,739	234,281	19,350	14,488	32,078	491,324
2000	272,555	62,856	411,041	19,350	15,679	39,074	820,554
2001	336,754	66,759	441,074	38,911	18,073	45,079	946,649
2002	400,953	70,661	471,106	38,911	20,468	50,105	1,052,205
2003	465,153	74,564	501,139	38,911	22,862	55,131	1,157,760
2004	529,352	78,466	531,172	38,911	25,257	60,158	1,263,316
2005	593,551	82,369	561,205	38,911	27,651	65,184	1,368,872
2006	721,086	77,776	599,382	66,651	31,753	74,832	1,571,480
2007	848,622	73,182	637,559	66,651	35,855	83,093	1,744,962
2008	976,157	68,589	675,736	66,651	39,956	91,354	1,918,444
2009	1,103,692	63,996	713,913	66,651	44,058	99,615	2,091,925
2010	1,231,227	59,402	752,090	66,651	48,159	107,877	2,265,407
2011	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2012	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2013	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2014	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2015	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2016	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2017	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2018	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2019	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2020	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2021	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2022	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2023	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2024	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423
2025	1,231,227	59,402	752,090	0	48,159	104,544	2,195,423

Note: H./Y. Connec. = House/Yard Connection
Public Founta. = Public Fountain
Non-Domest. = Non-Domestic
Techni. Servic. = Technical Service

Table 4.5.3(1) Financial Statement

(Unit: thousand birr)

No.	1	2	3	4	5	6	7	8	9	10
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Income Statement										
Revenue	32	32	33	491	821	947	1052	1158	1263	1369
Operation and Maintenance	80	81	83	362	401	504	522	540	558	577
Depreciation	0	230	460	460	460	460	460	460	460	460
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	80	311	543	821	860	963	982	1000	1018	1036
Profit before Tax	-48	-279	-510	-330	-40	-17	71	158	245	333
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	-48	-279	-510	-330	-40	-17	71	158	245	333
Funds Statement										
Profit after Tax	-48	-279	-510	-330	-40	-17	71	158	245	333
Loans	1314	7189	7189	0	0	0	0	0	0	0
Subsidies	1605	6690	6690	0	0	0	0	0	0	0
Depreciation	0	230	460	460	460	460	460	460	460	460
Sources	2871	13829	13828	129	420	443	530	618	705	792
Capital Works	2919	12163	12163	0	0	0	0	0	0	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	-48	1666	1665	129	420	443	530	618	705	792
Applications	2871	13829	13828	129	420	443	530	618	705	792
Loan Liabilities	1327	8601	15947	16107	16268	16431	16595	16761	16929	17098
Cash Balance	-95	1571	3236	3365	3785	4228	4758	5376	6081	6873

Source: JICA

Table 4.5.3(2) Financial Statement

(Unit: thousand birr)

No.	11	12	13	14	15	16	17	18	19	20
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Income Statement										
Revenue	1571	1745	1918	2092	2265	2195	2195	2195	2195	2195
Operation and Maintenance	725	755	784	813	842	555	555	555	555	555
Depreciation	460	460	525	591	591	591	591	591	591	591
Payment of Interest	15	93	168	160	152	144	136	128	120	111
Expenditure	1199	1307	1478	1565	1586	1290	1282	1274	1266	1257
Profit before Tax	372	438	441	527	680	905	913	921	930	938
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	372	438	441	527	680	905	913	921	930	938
Funds Statement										
Profit after Tax	372	438	441	527	680	905	913	921	930	938
Loans	0	394	1970	1970	0	0	0	0	0	0
Subsidies	0	482	2407	2407	0	0	0	0	0	0
Depreciation	460	460	525	591	591	591	591	591	591	591
Sources	832	1773	5343	5495	1270	1496	1504	1512	1521	1529
Capital Works	0	876	4377	4377	0	0	13	13	0	0
Payment of Principal	66	427	792	800	808	816	824	833	841	849
Working Capital	766	470	174	318	462	680	667	667	680	680
Applications	832	1773	5343	5495	1270	1496	1504	1512	1521	1529
Loan Liabilities	17188	17238	18439	19652	18888	18116	17337	16550	15755	14952
Cash Balance	7639	8109	8283	8602	9064	9744	10411	11078	11758	12438

Source: JICA

Table 4.5.3(3) Financial Statement

(Unit: thousand birr)

No.	21	22	23	24	25	26	27	28	29	30
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Income Statement										
Revenue	2195	2195	2195	2195	2195	2195	2195	2195	2195	2195
Operation and Maintenance	555	555	555	555	555	555	555	555	555	555
Depreciation	591	591	591	591	591	591	591	591	591	591
Payment of Interest	103	99	111	123	112	101	90	78	67	55
Expenditure	1249	1245	1257	1269	1258	1247	1236	1224	1213	1201
Profit before Tax	947	951	938	926	937	948	960	971	982	994
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	947	951	938	926	937	948	960	971	982	994
Funds Statement										
Profit after Tax	947	951	938	926	937	948	960	971	982	994
Loans	0	0	0	0	0	0	0	0	0	0
Subsidies	0	0	0	0	0	0	0	0	0	0
Depreciation	591	591	591	591	591	591	591	591	591	591
Sources	1538	1542	1529	1517	1528	1539	1550	1562	1573	1585
Capital Works	0	0	0	0	0	0	0	0	0	0
Payment of Principal	858	886	994	1102	1114	1125	1136	1147	1159	1170
Working Capital	680	656	535	415	415	415	415	415	415	415
Applications	1538	1542	1529	1517	1528	1539	1550	1562	1573	1585
Loan Liabilities	14141	13298	12325	11223	10109	8985	7849	6702	5543	4373
Cash Balance	13118	13774	14309	14723	15138	15553	15967	16382	16796	17211

Source: JICA

Chapter 5 Improvement of Health and Sanitation

5.1 Plan for Sanitary Facilities

Debre Tabor's sanitation situation is very poor. The critical shortage of water supply aggravates even more the sanitary condition. The general use of open-area for defecation, the filled-up traditional pit latrines, the indiscriminate dumping of sullage and refuse have created environmental pollution and serious health hazards. The traditional pit latrines that are being used at present are not properly designed and constructed; and when they are filled up and emptied practically all of them cave-in and collapse.

Waste water production in liters per capita per day was estimated using water demand data for each type of water supply service.

Table 5.1.1 Water Demand in lpcd and Waste Water Production in lpcd for Debre Tabor

Item	HC			YC			PF		
	1995	2005	2010	1995	2005	2010	1995	2005	2010
• Water demand (lpcd)	16	58	63	4.2	34	37	2.3	15	17
• Waste water generation rate (%)	63	74	75	60	67	68	60	63	64
• Waste water production (lpcd)	10	43	47	2	23	25	1	9	11

From the water demand and waste water production per capita per day for Debre Tabor, as seen in Table 5.1.1, introduction of conventional sewerage system cannot be justified in any of the target years due to blockage of the system when the total water use is less than about 75 liters per capita per day. Therefore, the sanitary technologies proposed for Debre Tabor are those that are on-site technologies such as drainage and waste water disposal pit.

5.1.1 Plan of Toilet Facilities

The sanitary technologies envisaged for Debre Tabor are grouped into four major categories.

- Improved Traditional Pit Latrines
- VIP Latrines
- Compost Toilets
- Flush Toilets

These technologies are related to the types of water supply services; and the proposed toilet facilities are considered for residential or domestic households as well as for non-domestic households taking the water supply services of HC, YC and PF into account.

Table 5.1.2 Proposed Sanitation System in Relation to Types of Water Supply Services for Domestic Households

Types of Water Supply Services	Proposed Sanitary System for Domestic Households
1. Traditional Water Sources + Public Fountain (PF)	• Improved traditional pit latrine • VIP latrine, single-pit or double-pit • Soakaway pit for sullage
2. Yard Connection (YC)	• VIP latrine, single-pit or double-pit • Compost latrine • Pour-flush toilet with simple water seal and on-site pit • Pour-flush latrine + soakaway pit • Soakaway pit for sullage
3. House Connection (HC)	• Pour-flush toilet + soakaway pit • Cistern-flush toilet + soakaway pit • Pour-flush or cistern-flush toilet + septic tank • Soakaway pit for sludge

In each category, the first sanitation technology is generally the simplest and the cheapest. Those that can afford more can build the subsequent ones depending on their choices and paying capacity.

For communities, schools, bus, terminals, market areas, health facilities, government offices, hotels, restaurants, bakeries, pastries, bars, tej and tella drinking houses etc. the sanitation technologies proposed are indicated in Table 5.1.3.

Table 5.1.3 Proposed Sanitation Technologies for Communities and Non-domestic Households

Category	Proposed Sanitation System
1. Communities	• VIP community latrine with washbasin
2. Schools & training centers	• VIP collective toilet with washbasin
3. Market & bus terminals	• VIP public toilet with washbasin or shower
4. Government institutions	• VIP latrine with washbasin • Cistern-flush toilet + soakaway pit • Cistern-flush toilet + septic tank
5. Commercials	• VIP latrine with washbasin • Pour-flush or cistern-flush toilet + soakaway pit • Pour-flush or cistern-flush toilet + septic tank
6. Hotels, restaurants, drinking place, etc.	• Collective VIP latrine with washbasin • Pour-flush toilet with washbasin + soakaway pit • Cistern-flush toilet with washbasin + septic tank • Soakaway pit for sullage
7. Hospitals, health centers, clinics	• Collective VIP latrine with washbasin • Pour-flush toilet with washbasin + soakaway pit • Cistern-flush toilet with washbasin + septic tank • Soakaway pit for sullage

5.1.2 Plan of Sullage, Dry Solid Waste and Drainage

(1) Sullage

Sullage is the waste water which does not contain excreta but comes out from each household. Sullage always contains some pathogens though the concentration is much lower than that in sewage. In Debre Tabor, sullage is presently being dumped in front of the households or along the streets. This poses a health risk if it is allowed to continue to be dumped everywhere.

The plan considers sullage soakaway pits of various sizes depending on the size and type of households for its disposal. The sullage soakaway pits need to be properly lined with stone, adobe, and other local materials with open joints for the major posts of the depth leaving about 30 cm from the top for pointed lining. If the waste water or sullage is too much for the soakaway pits to handle, then drainage field channels should be used.

(2) Dry Solid Waste

Most of the dry solid wastes in Debre Tabor are being dumped indiscriminately everywhere. In order to curtail this and reduce environmental pollution and water contamination, five specific sites are proposed for dumping dry solid wastes, those of which are located on the north, south, east, west and south-east side of the town.

Collecting bins need to be located at the strategic places with the consent of the Municipality, Kebeles and communities so that members of the community should not walk long distances to place their refuse in the bins. The contents of the bins should be transported to the refuse disposing sites either by refuse disposal truck or animal-drawn cart. The Municipality should take the responsibility to follow up and supervise the burning of the refuse at regular intervals in close coordination of WSS.

(3) Drainage

Two types of drainage are considered here. The first is the use of drainage field channels for the areas where the soakaway pits have become ineffective due to excess of sullage or waste water. The sizes and numbers of the drainage field channels depend on the quantity of waste water to be drained after close follow up of the working of the soakaway pits. The second type of drainage is draining the storm water. Most of the drainage facilities that were prepared during the construction of the main roads have been blocked by outside rubbishes that have been dumped on them. The first action required is to open-up the blocked drainage facilities and maintain them regularly to remain open. This would considerably help to reduce the formation of stagnant water, and thereby reducing or eliminating the sources for breeding of insects and flies. There are roads within Debre Tabor that do not have any means of drainage facilities. These roads should have side ditches and cross drainages to drain the water whenever storm (rainfall) occurs. Proposed drainage facilities are indicated on Debre Tabor Map or City Plan.

5.2 Financial Plan for Sanitary Facilities

To estimate both the capital cost of building the sanitary facilities and the annual operation and maintenance cost, based on the 1995 prices, the following assumptions have been made.

- The calculated waste water flows for Debre Tabor are too low to justify the installation of conventional sewerage system in Debre Tabor. On account of this, the sanitary facilities proposed for Debre Tabor are on-site sanitary technologies.
- Those households that do not have any toilet facilities in Debre Tabor at present are assumed to have one type of toilet facility by the year 2010.
- Sanitary technologies that are new to the culture of the people living in Debre Tabor are to be introduced gradually and with proper prior education as to the benefits and usefulness of the new technologies. Social acceptability of the new technology has to be confirmed prior to its introduction.
- Proposals for the appropriate sanitary technologies are drawn up based on the types of water services rendered in Debre Tabor.
- The households in the same water service category can have toilets of the standard they can afford to pay for.

5.2.1 Households

From projected population of Debre Tabor for target years of 2005 and 2010, households have been estimated using the family size for each type of water services.

Table 5.2.1 Households in Debre Tabor for Target Years of 2005 & 2010 by Type of Water Services

Target Year	Households		
	HC	YC	PF
• 2005	630	2,200	1,670
• 2010	1,450	3,470	1,130

5.2.2 Estimate of Costs

(1) Capital Costs per Unit

For each type of toilet facility that is considered appropriate for Debre Tabor and some equipment required, indicative costs for constructing each type of sanitary facilities and for purchasing the equipment are estimated as follows.

Table 5.2.2 Indicative Cost of a Type of Sanitary Facility or Equipment

Type of Sanitary Facility or Equipment	Indicative Cost of One Facility or Equipment (Birr)
1. Improved traditional pit latrine	1,000
2. VIP toilet, single pit	1,500
3. VIP toilet, double pit	2,000
4. VIP toilet, shared	15,000
5. VIP toilet, community	45,000
6. VIP toilet, collective (e.g. schools)	65,000
7. VIP toilet, public (e.g. market)	95,000
8. Compost latrine	2,500
9. Pour-flush + soakaway pit	3,000
10. Pour-flush + septic tank + soakaway pit	7,500
11. Cistern-flush + soakaway pit	4,000
12. Cistern-flush + septic tank + soakaway pit	8,500
13. Sullage soakaway pit	800
14. Drain field channel	4,000
15. Medium size vacuum truck	250,000
16. Medium size refuse collection and disposal truck	180,000
17. Animal-drawn cart	12,000
18. Refuse collection bin	250
19. Sludge dumping site	10,000
20. Refuse disposing and burning site	6,500

(2) Annual Operating and Maintenance Costs per Unit

The annual operating and maintenance cost is based on the assumption that most of the work is going to be done by labor only. For the equipment both running and maintenance costs are included.

Table 5.2.3 Annual Operating and Maintenance Cost per Unit

Type of Sanitary Facility or Equipment	Annual Operating and Maintenance Cost (Birr)
1. Improved traditional pit latrine	200
2. VIP toilet, single pit	250
3. VIP toilet, double pit	300
4. VIP toilet, shared	400
5. VIP toilet, community	700
6. VIP toilet, collective (e.g. schools)	800
7. VIP toilet, public (e.g. market)	3,000
8. Compost latrine	750
9. Pour-flush + soakaway pit	1,000
10. Pour-flush + septic tank + soakaway pit	1,250
11. Cistern-flush + soakaway pit	1,200
12. Cistern-flush + septic tank + soakaway pit	1,400
13. Sullage soakaway pit	100
14. Drain field channel	800
15. Vacuum truck	7,500
16. Refuse collection and disposal truck	8,500
17. Animal-drawn cart	3,000
18. Refuse collection bin	50
19. Sludge dumping site	2,000
20. Refuse disposing and burning site	2,500

(3) Assumptions for Estimating the number of Toilets to be Implemented in Debre Tabor by the Year 2005 and 2010

To find the number of toilets to be implemented in Debre Tabor by the year 2005 and 2010, the following assumptions have been made.

- By the year 2005

  - All schools in Debre Tabor will have, at least, VIP collective toilets.
  - The Debre Tabor Hospital toilet facilities will be rehabilitated; and the clinic and possibly a health center will have VIP collective toilets.
  - Debre Tabor market area and bus terminal will have VIP public toilet.
  - 100% of households that have house water supply connections (HC) will have some kind of flush toilet.
  - 75% of the households that have yard water supply connections (YC) will have VIP or higher toilets.
  - 75% of households that use public fountain (PF) as a source of water supply will have improved traditional toilets or VIP toilets.

- By the year 2010

  - 50% of households that have HC water supply will have some kind of flush toilets.
  - 50% of households that have YC will have VIP or higher toilets.
  - 100% of household that use PF will have improved traditional latrine or VIP latrine or higher grade toilets.

- In each category (HC,YC,PF), those that can afford more can have higher standard of toilets of their choices.

- All equipment will be replaced by this time.

(4) Total Capital Cost

Indicative capital costs for sanitary facilities for Debre Tabor based on 1995 prices are shown in Table 5.2.4 for the year 2005 and in Table 5.2.5 for the year 2010.

Table 5.2.4 Capital Costs of Sanitary Facilities for Debre Tabor for Year 2005

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• VIP collective toilets for schools	12	65,000	780
• VIP collective toilets for clinics and health centers	6	65,000	390
• VIP public toilet for market area and bus terminal	3	95,000	285
• 100% households with HC to have PF toilets	630	7,500	4,725*
• 75% households with YC to have VIP shared toilets or higher	1,650	15,000	24,750*
• 75% households with PF to have VIP toilets	1,253	2,000	2,506*
• Vacuum truck	1	250,000	250
• Refuse disposal truck	1	180,000	180
• Sludge dumping site	3	10,000	30
• Refuse disposing site	5	6,500	33
• Refuse collecting bins	80	250	20
Total			33,949
Excluding Households' (*)			1,968

Table 5.2.5 Capital Costs of Sanitary Facilities for Debre Tabor for the Year 2010

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• 50% of households with HC to have flush toilets	725	7,500	5,438*
• 50% of households with YC to have VIP toilets or higher	1,735	3,000	5,205*
• 100% households with PF to have VIP toilets	1,130	2,000	2,260*
• Replacement of vacuum truck	1	250,000	250
• Replacement of refuse disposal truck	1	180,000	180
• Replacement of refuse collecting bin	80	250	20
Total			13,353
Excluding Households' (*)			450

(5) Total Operating and Maintenance Cost

Indicative operating and maintenance cost for sanitary facilities for Debre Tabor are shown in Tables 5.2.6 and 5.2.7 for the years of 2005 and 2010 each.

Table 5.2.6 Annual Operating & Maintenance Costs for the Year 2005

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• VIP collective toilets for schools	12	800	9.60
• VIP collective toilets for clinics and health centers	6	800	4.80
• VIP public toilet for market area and bus terminal	3	3,000	9.00
• Flush toilets for households with HC	630	1,250	787.50*
• VIP shared toilet for households with YC	1,650	400	660.00*
• VIP toilets for households using PF	1,253	300	375.90*
• Vacuum truck	1	7,500	7.50
• Refuse disposal truck	1	8,500	8.50
• Sludge dumping site	2	2,000	6.00
• Refuse disposing site	5	2,500	12.50
• Refuse collecting bins	80	50	4.00
Total			1,885.30
Excluding Households' (*)			61.90

Table 5.2.7 Annual Operating & Maintenance Costs by the Year 2010

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• Flush toilets for households with HC	725	1,250	906.25*
• VIP or higher toilets for households with YC	1,735	1,000	1,735.00*
• VIP toilets for households using PF	1,130	300	339.00*
• Vacuum truck	1	7,500	7.50
• Refuse disposal truck	1	8,500	8.50
• Refuse collecting bins	80	50	4.00
Total			3,000.25
Excluding Households' (*)			20.00

(6) Summary of Costs

- Capital Costs

Year	Cost in 1,000 Birr (Total)	Excluding Households'
2005	33,949	1,968
2010	13,353	450
Total	47,302	2,418

- Annual Operating & Maintenance Costs

Year	Cost in 1,000 Birr (Total)	Excluding Households'
2005	1,885.30	61.90
2010	3,000.25	20.00
Total	4,885.55	81.90

5.3 Application of Sanitary Education Program

In line with the approach detailed in the Main Report, the suggestions in Table 5.3.1 are made with reference to sanitary education in Debre Tabor. These take into account the findings of the field survey.

Special attention must be made to target the poor particularly the poorest women headed households and also the minority groups like the Muslim community through the sanitary education program.

Table 5.3.1 Sanitary Education Priorities in Debre Tabor

Priority level	Type of Behavior	Blocks to Improved Practice
High	Piped water used always	Piped water not always available in sufficient quantities (WSS), not available when required by people (WSS), at sites convenient for collection (WSS) People (women/girls) to be encouraged to use piped water always for drinking (CPP)
High	Solid waste disposal in covered pits or burned	Sites not allocated for public waste disposal sites or not managed strictly (Municipality/ Woreda) Individuals (women) must be informed of where (Municipality/ Woreda) and how to dispose of waste (CPP/ all)
High	Waste water disposal in pits, drains or vegetable gardens	Drainage insufficient and disposal into drains not strictly managed (Municipality/Woreda) Individuals (women) must be informed of where to dispose waste water (Municipality/Woreda) and shown simple sanitary disposal techniques, inc. veg gardens (CPP/all)
Medium -High	Access to Piped water	Improved access and level of piped water supply (WSS role) All use water but this depends mostly on opening times, location of supply sources and to a lesser extent to price (women/girls/(boys))
Medium -High	Handwashing after defecation	Personal hygiene (all) made more easy by making access to water and soap/ash nearer to the latrine (women's role) and by improving the status of the improved behavior (all)
Medium -High	Not eating unwashed fruit or vegetables	Domestic hygiene (women's role in home but individual's role outside home) Individuals (mostly women) must be shown methods of washing such food and be motivated to wash raw fruit and vegetables before eating (CPP role)
Medium -High	Sanitary disposal of children's excreta	Small children should be encouraged to use the latrine as soon as they are able (all family members) Clearing up of children's excreta (women/girls) to be encouraged, information about health risks of children's excreta provided (CPP/all)
Medium -Low	Handwashing after handling children's stools	Personal hygiene (women/boys/girls roles) made easier by improving access to water and soap/ ash nearer to latrine (women) and improving the status of such behavior (all)
Medium -Low	Kitchen utensils kept off the floor	Domestic hygiene (women) although facilitated by shelf or similar available in kitchen to keep utensils off floor (women/ men) Construction of such shelves to be promoted (CPP)
Medium -Low	Fly Control	Related to solid and liquid waste disposal and excreta disposal (Municipality/Woreda /All role) Behaviors like covering of food and water pots during storage should be maintained (CPP/All)
Medium -Low	Latrine coverage for all households	Latrines to be built and maintained (Public - Municipality/Woreda and Community/private latrines -WSS/CPP/All (made easier with examples of low cost latrines and loans (WSS)
Medium -Low	Latrine use by all members of household	Where there is a latrine, not all (children) of the household members use it. Use by all family members should be encouraged and status of latrine users promoted (CPP/all)

Chapter 6 Reinforcement of Organization

It is advised to refer to Table 6.1.1 and Figure 6.1.1 when you read this section.

6.1 Comprehensive Organization and Management

The production of water will increase markedly under the proposed plan from 106 m^3/day in 1995 to 831 m^3/day in 2000, 1,384 m^3/day in 2005 and 2,293 m^3/day in 2010.

In line with it, the organizational structure will be enlarged, new functions will be added and the number of employees will be increased.

Basically the number of employees in the target years was estimated dividing water production by water production per employee. In estimating water production per employee, labor efficiency resulting from a greater production was assumed. It is proposed that sanitation functions be introduced in the organization of WSS from 2000 on. It means that more manpower will be required.

In adding sanitation functions to WSS the full name of WSS will be changed to Water Supply and Sanitation Service. But, the abbreviated name will be WSS as has been the case.

Considering the above factors, it is proposed that the number of employees will increase from 18 in 1995 to 39 in 2000, 46 in 2005 and 57 in 2010.

The organizational structure will get enlarged and more diversified. The ultimate organizational structure of WSS to be realized in the last target year of 2010 is shown in Figure 6.1.1.

As it shows, the organizational structure of WSS will be basically composed of 7 elements: Manager, Internal Audit, Customer Services, Administration Service, Financial Service, Technical Service and Sanitary Service. These are a skeletal structure or fundamental requirements of water supply and sanitation services. The functions of the last four big Services will get more diversified as years go by in accordance with greater water production.

6.2 Organization and Management of Water Supply

The number of personnel for water supply functions of WSS will be 37, 42 and 52 in 2000, 2005 and 2010 respectively.

Personnel for Administration, Financial and Technical Services will be basically distributed in such a way that their respective shares will be 30%, 35% and 35%.

A brief explanation on the ultimate organizational structure and functions will be given below:

The objectives of water supply functions of WSS are to supply sufficient piped water on one hand and to financially stand on its own feet. In this regard Customer Services and Internal Audit are typical functions of WSS. Besides them there will be three major Services.

Administration Service is composed of General Administration. Personnel, Storage and Legal Sections. General Administration Section will be in charge of secretarial/clerical work. Guards and sweepers also belong to this section. Personnel Section will be in charge of recruitment, assignment and training of personnel, and remuneration. Storage and purchasing of materials and supplies will be done in Storage Section. Such matters as complaints and penalties can be taken care of by Legal Section.

Financial Service controls Budgeting, Accounting, Financial Management and Operation Sections. Annual and monthly budget of income and expenditures will be prepared in Budgeting Section. Monthly and annual accounting of expenditures and income will be performed in Accounting Section. Financial Management Section makes analysis and evaluation of financial performances. Operation Section is in charge of meter reading, billing and collection, and cash water selling.

Technical Service covers Technical Records, Operation and Maintenance, Inspection and Work Sections, and Workshop. Records of equipment and supplies such as acquired dates, number, plans, dimension, breakdowns and repairs will be kept in Technical Records Section. Operation and maintenance of pumping stations, reservoirs, pipelines, public fountains, etc. will be taken care of by the section of the same name. Inspection of the above-mentioned facilities will be regularly done by the section of the same name. Repairing and manufacturing belong to Workshop. Works Section is in charge of rehabilitation/replacement/construction of facilities.

The number of personnel to be assigned by position/function in 2000, 2005 and 2010 is shown in the latter half of Table 6.1.1.

6.3 Organization and Management of Sanitation

The number of personnel for sanitation functions of WSS will be 2, 4 and 5 in 2000, 2005 and 2010 respectively.

A brief explanation on the ultimate organizational structure and functions will be given below:

An independent department called Sanitation Service will be introduced. The Service will be comprized of Public Relations, Loan Service and Maintenance Sections.

Public Relations Section will be in charge of the provision of information and public relations services to help people to install septic tank toilets and dry pit latrines. Loan Service Section will provide loan/subsidy to clients for the installation of septic tank toilets and keep related records. Maintenance Section will have a vacuum truck to regularly empty toilets and will regularly clean and maintain drainages.

The number of personnel to be assigned by position/function in 2000, 2005 and 2010 is shown in the latter half of Table 6.1.1.

Table 6.1.1 Personnel Requirements

1. Total No. of Personnel

Item	1995	2000	2005	2010
1. Total Production of Water (m^3/day)	106	831	1,384	2,293
2. Water Production per Worker (m^3/day/worker)	5.9	20	30	40
3. Coefficient	1	0.9	0.9	0.9
4. No. of Personnel	18	37	42	52
5. Additional Personnel for Sanitation	0	2	4	5
6. Final No. of Personnel	18	39	46	57

2. Breakdown of Personnel by Position/Function

Positions/Functions	1995	2000	2005	2010
1. Manager	1	1	1	1
2. Customer Services	0	0	0	1
3. Internal Audit	0	1	1	1
4. Administration Service				
1) Head	0	1	1	1
2) General Administration Section	4	6	7	8
Secretaries/Typists/Clerks	1	1	1	1
Guards				
Sweepers/Janitors	1	1	1	1
Drivers	0	0	0	1
Sub-Total	5	8	9	11
3) Personnel Section				
Recruitment and Assignment	0	1	1	1
Training	0	0	0	0
Remuneration	0	0	0	0
Sub-Total	0	1	1	1
4) Storage Section				
Store Keepers	1	1	1	1
Purchase of Materials/Supplies	0	0	0	0
Sub-Total	1	1	1	1
5) Legal Section	0	0	0	1
Total	6	11	12	15

2. Breakdown of Personnel by Position/Function (Continued)

Positions/Functions	1995	2000	2005	2010
5. Financial Service				
1) Head	0	1	1	1
2) Budgeting Section	0	1	1	1
3) Accounting Section				
Accountants	1	1	1	1
Cashiers/Treasurers	1	1	1	2
Sub-Total	2	2	2	3
4) Financial Management Section				
Financial Analysts	0	1	1	1
5) Operation Section				
Meter Readers	1	2	2	3
Bill Distributors/Collectors	1	1	1	3
Water Sellers	4	5	6	5
Sub-Total	6	8	9	11
Total	8	13	14	17
6. Technical Service				
1) Head	0	1	1	1
2) Technical Records Section	0	1	1	1
3) Operation and Maintenance Section				
Mechanics	0	1	1	1
Electricians	0	1	1	2
Motor Operators	2	4	4	4
Plumbers	1	2	2	2
Sub-Total	3	8	8	9
4) Inspection Section				
Water Meter Technicians	0	1	1	1
Leakage Detectors	0	0	1	1
Water Quality Analysts	0	0	0	1
Sub-Total	0	1	2	3
5) Workshop	0	0	1	2
6) Works Section				
Contracting	0	0	1	1
Designing/Drafting	0	0	0	0
Sub-Total	0	0	1	1
Total	3	11	14	17
7. Sanitary Service				
1) Public Relations Section	0	1	1	1
2) Loan Service Section	0	1	1	1

2. Breakdown of Personnel by Position/Function (Continued)

Positions/Functions	1995	2000	2005	2010
3) Maintenance Section				
Technicians	0	0	1	2
Drivers	0	0	1	1
Sub-Total	0	0	2	3
Total	0	2	4	5
Grand-Total	18	39	46	57

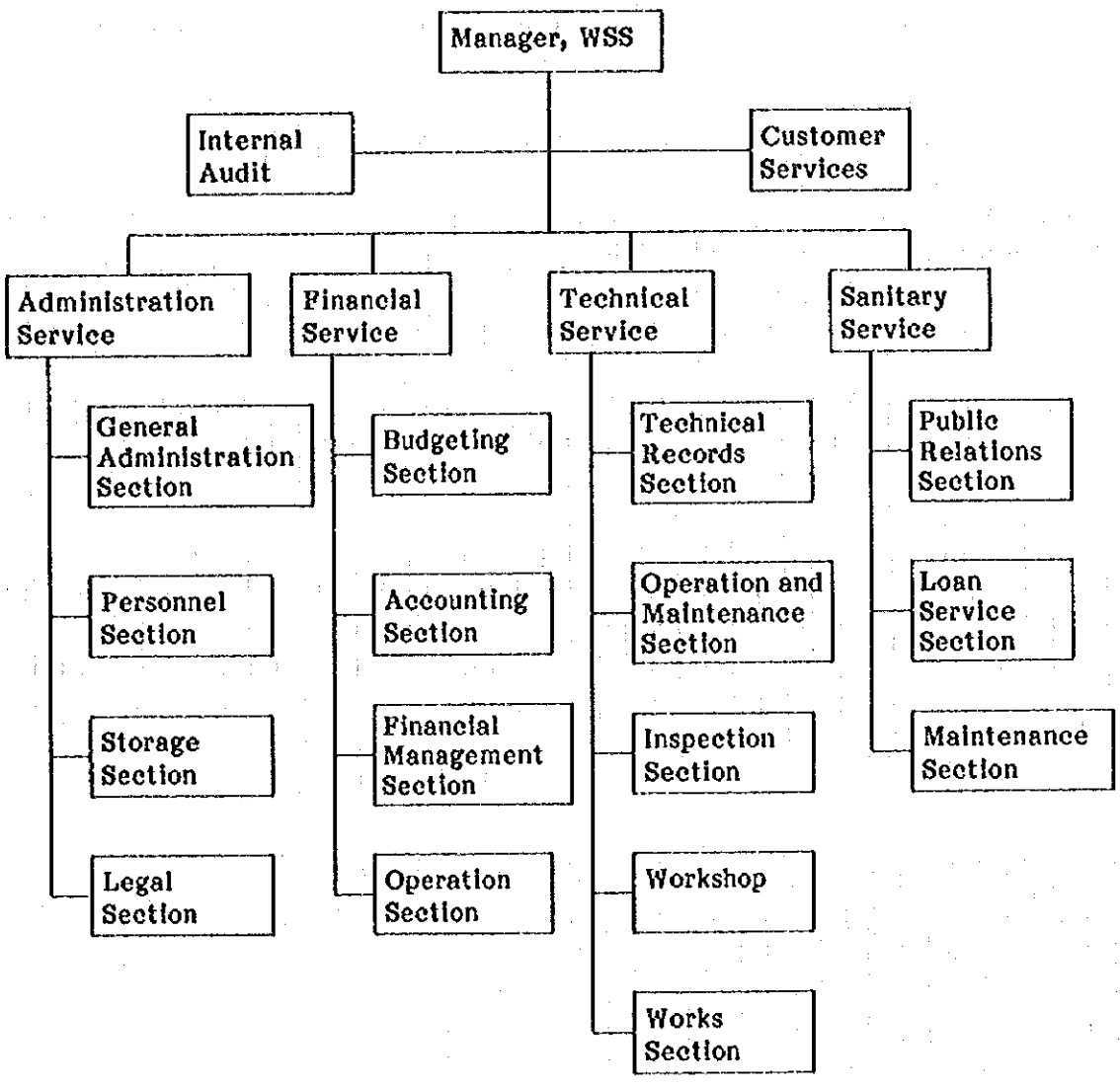


Figure 6.1.1 Proposed Model Organization Set-up of WSS

6.4 Community Building / Participation and WID

Based on the approach outlined in the Main Report, the following details are recommendations specifically for Debre Tabor based on the field survey.

- The water supply situation in Debre Tabor was serious at the time of the field survey. The problem is at it's worst in the dry season. Most people buying water from wells or people using springs wanted public fountains and were prepared to be involved in their construction and management.

- Some people, particularly the lowest income groups of which there are more women headed households, may not be able to afford water from these public fountains. Efforts to assist these groups in particular with income generation activities should be made. Other options include discount prices for water for these households.

- Some people (men and women) are paid to collect water which is a source of income for them. Well vendors do not want water supply improvements and are opposed to increased numbers of public fountains. These two groups of people in particular need to be involved and considered carefully in the planning and implementation of the water supply improvement program.

- Most people do not have latrines, but practice open defecation. Those with latrines have problems due to filling up of the latrines and no reliable emptying system. There is no habit of composting excreta but no perceived problems with it either. At present people simply close full latrines and either dig new ones next to them or resort to using open fields again.

- Sanitary education should part of the program including integration with religious teaching sessions. This would require additional support from the health center, who may require budget and resources for these activities. The health center is keen to use videos and dramas in their health education sessions but lack the materials.

- Income generation activities are also included in the Church program, and they may provide valuable assistance in this matter.