Chapter 3

Existing Water Supply System

3 Existing Water Supply System

3.1 General

In order to secure safe water of water supply, the Ministry of Water generally recommends the technology of water supply, such as piped scheme, wells with hand pump, and protected spring. Actually, as there are not many types of water supply system which MoW recommends in study area, the existing water supply system needs to be surveyed.

3.2 General Condition of Water Supply

3.2.1 Nationwide Water Supply Condition

Based on 2004 NRWSSP (Draft) by data source of Dec.2003, the nationwide water supply rate for rural areas grew to 53.5%. The water supply coverage is still 49% (data of 2004, by NRWSSP, Jan. 2006) in Mwanza region and 45% (same source with Mwanza region) in Mara region. The both regions are less than the nationwide average of 53.5%. Out of 21 regions, Mwanza is ranked 15th and Mara 17th.

3.2.2 Water Supply Condition in Study Area

Water supply coverage to access to clean and safe water in each district of the Mwanza and Mara regions is shown in the Table 3.2-1.

Table 3.2-1: Water Supply Coverage (source: NRWSSP Final,2006)

Mwanza		Mara	
District	coverage(%)	District	coverage(%)
Misungwi	37	Bunda	55
Sengerema	57	Musoma（R)	24
Kwimba	52	Tarime	49
Magu	62	Serengeti	53
Geita	51		
Ukerewe	42		
Ilemela	43		

The main water sources of 515 villages for well inventory survey are shown in Figure 3.2-1and Figure 3.2-2.

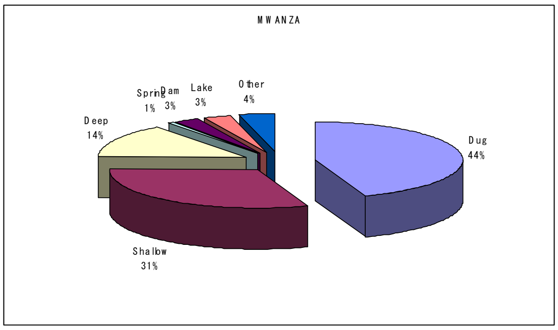

Figure 3.2-1: Water Source in Mwanza

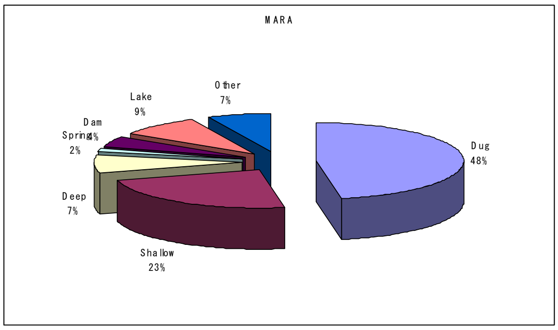

Figure 3.2-2: Water Source in Mara

The main water sources in the 515 villages in the two regions are traditional dug wells and shallow wells, accounting for more than 70% of all water sources. The proportion of the deep wells indicates 14% in Mwanza, and 7% in Mara. Lake water accounts for a proportion in

Mara of 9%, and that in Mwanza of 3%. About 63% of the 57 piped scheme facilities which are used as sources of lake water in the study area are not functional. So it is indicated that the usage rate of lake water sources is not so high compared with other resources (refer to the Table 3.2-2).

Table 3.2-2: Condition of the Piped Scheme

Condition	Functioning	Partially Functioning	Not Functioning	Total
Number	9	12	36	57
%	15.8	21.0	63.2	100%

3.3 Piped Scheme for Water Supply

The piped schemes, which were included in the water supply plan of the 57 existing piped schemes, were selected out of 110 existing piped schemes submitted by MoW, and were carried out the field survey. Based on the result of the 57 existing piped schemes, the current conditions of existing piped schemes were executed in the field survey.

3.3.1 Current Condition of Existing Piped Scheme

As a result of the study on the 57 existing piped schemes, the overall current status is summarized in Table 3.3-1 and the condition of the 57 existing piped schemes is shown in Table 3.3-2: Condition of 57 Existing Piped Schemes . Lake Victoria water for the water sources are utilized in about 57% of the 57 existing piped schemes, 28% of those use boreholes, and the rest rely on other sources, such as dams and springs. The construction of about 68% of the existing piped schemes was completed in the 1970s, and around 22% were built in the 1960s or before. It means that about 90% were constructed in the 1970s or before.

Table 3.3-1: Summary of the Existing Piped Schemes

District	Target schemes	Types of sources					Status of function			Year of completion			
		Lake	Wells	Springs	Dams	Others	Function	Partially function	Not function	Before 1969	1970s	1980s	Since 1990
Nyamagana & Ilemela	-	-	-	-	-	-	-	-	-	-	-	-	-
Missungi	5	3	2	0	0	0	2	0	3	3	2	0	0
Kwimba	6	0	6	0	0	0	0	1	5	3	3	0	0
Sengerema	7	6	0	0	1	0	3	0	4	3	4	0	0
Magu	7	5	0	0	0	2	1	2	4	1	5	1	0
Geita	4	3	1	0	0	0	0	0	4	0	3	1	0
Ukerewe	8	7	0	1	0	0	0	2	6	1	7	0	0
Sub total	**37**	**24**	**9**	**1**	**1**	**2**	**6**	**5**	**26**	**11**	**24**	**2**	**0**
		64.9 %	**24.3 %**	**2.7 %**	**2.7 %**	**5.4 %**	**16.2 %**	**13.5 %**	**70.3 %**	**29.7 %**	**64.9 %**	**5.4 %**	**0.0 %**
Bunda	4	4	0	0	0	0	2	1	1	0	4	0	0
Musoma (R)	5	3	2	0	0	0	0	2	3	1	2	2	0
Tarime	9	3	5	1	0	0	1	2	6	1	8	0	0
Serengeti	2	0	1	1	0	0	0	2	0	0	1	0	1
Sub total	**20**	**10**	**8**	**2**	**0**	**0**	**3**	**7**	**10**	**2**	**15**	**2**	**1**
		50.0 %	**40.0 %**	**10.0 %**	**0.0 %**	**0.0 %**	**15.0 %**	**35.0 %**	**50.0 %**	**10.0 %**	**75.0 %**	**10.0 %**	**5.0 %**
Total	**57**	**34**	**17**	**3**	**1**	**2**	**9**	**12**	**36**	**13**	**39**	**4**	**1**
		59.6 %	**29.8 %**	**5.3 %**	**1.8 %**	**3.5 %**	**15.8 %**	**21.1 %**	**63.2 %**	**22.8 %**	**68.4 %**	**7.0 %**	**1.8 %**

Table 3.3-2: Condition of 57 Existing Piped Schemes (1/4)

No.	ID No.	Name of scheme	Present population (2004)		% of Service pop.	Water source		No. of Service Connections (as of 2004)			General condition of facilitily	Year of completion	Year of suspension
			Each village	Total		Types	Nos. of sources	House or yard	Institution	Stand Post (Inc. Kiosk)			
Mwanza Region													
Missungwi District													
1	MwPM-1	Usagara	2,403	2,403	25.0	BH	1	19	0	4	Not Functioning	1961	
2	MwPM-2	Mbarika	2,816	2,816	-	Lake		20	2	12	Functioning	1971	
3	MwPM-3	Kasololo / Igongwa	4,463 3,948 3,538 2,136 4,257 2,142	20,484	-	Lake		0	3	26	Functioning	1976	
4	MwPM-4	Ukiriguru	3,346 1,969 2,929 3,474	11,718	34.1	Lake		180	0	20	Not Functioning	1961	2004
5	MwPM-5	Misasi	3,324	3,324	-	Borehole	1	19	1	1	Not Functioning	1968	2004
Sengerema District													
6	MwPS-1	Nyamazugo / Sengerema	17,235 4,894 9,407 5,250 2,788 3,676 2,929 2,304 6,060	54,543	33.0	Lake		1530	37	0	Functioning	1975	
7	MwPS-2	Katunguru	5,559 2,733 4,416	12,708	43.3	Lake		5	3	26	Functioning	1962	
8	MwPS-3	Lumeya / Kalebezo	3,809 5,506 11,225	20,540	22.4	Lake		7	4	24	Functioning	1973	
9	MwPS-4	Sima	5,338	5,338	14.1	Dam		0	2	8	Not Functioning	1967	1987
10	MwPS-5	Luchili	6,264 5,477 3,561	15,302	22.9	Lake		0	2	21	Not Functioning	1973	2000
11	MwPS-6	Busisi	3,358	3,358	443.8	Lake		0	1	6	Not Functioning	1975	1987
12	MwPS-7	Lugasa	7,901	7,901	8.2	Lake		8	1	3	Not Functioning	1968	1978
Kwimba District													
13	MwPK-1	Ngudu	11,317 675 332 490 3,429	16,243	40.6	Borehole	6	240	7	4	Partially Functioning	1955	
14	MwPK-2	Mantare	895 3,364	4,259	37.6	Borehole	1	0	0	4	Not Functioning	1977	2004
15	MwPK-3	Ilula	2,932 3,399 2,505	8,836	8.1	Borehole	1	2	4	3	Not Functioning	1967	1998
16	MwPK-4	Kadashi	4,436 3,659 2,413 3,555 1,686	15,749	-	Borehole	1	1	0	5	Not Functioning	1964	2004

Table 3.3-2: Condition of 57 Existing Piped Schemes (2/4)

No.	ID No.	Name of scheme	Present population (2004)		% of Service pop.	Water source		No. of Service Connections (as of 2004)			General condition of facilitily	Year of completion	Year of suspension
			Each village	Total		Types	Nos. of sources	House or yard	Institution	Stand Post (Inc. Kiosk)			
17	MwPK-5	Mwamashimba	3,147	48,151	85.1	Borehole	6	0	0	50	Not Functioning	1975	2001
			3,167										
			2,075										
			3,117										
			3,932										
			2,512										
			2,350										
			1,963										
			5,492										
			4,601										
			2,166										
			1,923										
			2,001										
			2,243										
			2,842										
			1,788										
			2,832										
18	MwPK-6	Ilumba	2,213	2,213	-	Borehole	1	0	0	2	Not Functioning	1974	1996
Magu District													
19	MwPMa-1	Kabila-Ndagalu	4,954	8,302	37.9	others	1	15	5	10	Not Functioning	1974	1985
			3,348										
20	MwPMa-2	Magu	2,189	13,542	44.3	Lake		914	47	38	Partially Functioning	1984	
			3,521										
			742										
			762										
			2,922										
			3,406										
21	MwPMa-3	Kalemela/Mkula	5,470	30,011	15.0	Lake		31	14	26	Partially Functioning	1973	
			5,927										
			2,359										
			1,756										
			1,082										
			5,273										
			2,395										
			2,800										
			2,949										
22	MwPMa-4	Kisesa	4,104	8,429	3.8	others	1	65	5	25	Not Functioning	1975	2005
			2,362										
			1,963										
23	MwPMa-5	Ilumya	2,755	8,694	13.8	Lake		12	4	8	Not Functioning	1971	1988
			3,041										
			2,898										
24	MwPMa-6	Nassa	2,526	14,173	5.6	Lake		15	4	8	Not Functioning	1975	2003
			5,455										
			3,339										
			2,853										
25	MwPMa-7	Kiloleli	2,755	5,464	5.5	Lake		21	4	4	Functioning	1963	
			2,709										

Table 3.3-2: Condition of 57 Existing Piped Schemes (3/4)

No.	ID No.	Name of scheme	Present population (2004)		% of Service pop.	Water source		No. of Service Connections (as of 2004)			General condition of facilitily	Year of completion	Year of suspension
			Each village	Total		Types	Nos. of sources	House or yard	Institution	Stand Post (Inc. Kiosk)			
Geita District													
26	MwPG-1	Karumwa / Msalala	2,709 675 4,647 2,218 1,331 2,175 2,717 2,551 5,361 2,709	27,093	67.5	Lake		10	8	25	Not Functioning	1973	2000
27	MwPG-2	Nzera	6,852	6,852	13.1	Lake		0	2	4	Not Functioning	1978	1988
28	MwPG-3	Nyang'wale	3,320 2,199	5,519	47.5	Borehole	1	0	4	6	Not Functioning	1980	2004
29	MwPG-4	Nyakagomba	3,630 4,732 3,990 4,285 1,384 3,630 2,162 5,231	29,044	63.2	Lake		0	3	6	Not Functioning	1973	1973
Ukerewe District													
30	MwPU-1	Gallu	3,994	3,994	60.8	Lake		0	0	17	Not Functioning	1971	1985
31	MwPU-2	Muriti	2,405 2,394	4,799	142.8	Lake		0	0	15	Not Functioning	1976	1986
32	MwPU-3	Kazilankanda	2,671 2,985 3,082 3,706 2,736 2,057 3,975 2,560 4,419 3,208	31,399	85.3	Lake		0	9	51	Not Functioning	1977	2005
33	MwPU-4	Murutunguru	4,737	4,737	172.4	Lake & Spring	1	0	0	9	Partially Functioning	1972	
34	MwPU-5	Nansio	6,412 5,927 528 3,706 4,558	21,131	12.5	Lake		141	20	104	Partially Functioning	1974	
35	MwPU-6	Kagunguli / Bukindo	1,444 5,987	7,431	73.6	Lake		0	3	10	Not Functioning	1968	2002
36	MwPU-7	Bukonyo	1,557	1,557	80.7	Lake		0	0	3	Not Functioning	1973	1982
37	MwPU-8	Irugwa	3,072 2,870	5,942	61.7	Lake		0	0	17	Not Functioning	1978	1985

Table 3.3-2: Condition of 57 Existing Piped Schemes (4/4)

No.	ID No.	Name of scheme	Present population (2004)		% of Service pop.	Water source		No. of Service Connections (as of 2004)			General condition of facilitily	Year of completion	Year of suspension
			Each village	Total		Types	Nos. of sources	House or yard	Institution	Stand Post (Inc. Kiosk)			
Mara Region													
Bunda District													
38	MPB-1	Bunda	26,482 4,587 2,737 1,726 2,092 7,984 3,012 1,659 2,144	52,423	57.2	Lake		422	26	80	Partially Functioning	1973	
39	MPB-2	Kasahunga	3,416 2,139 930	6,485	18.5	Lake		0	4	20	Functioning	1975	
40	MPB-3	Kibara	6,339 3,718	10,057	6.0	Lake		13	2	25	Functioning	1973	
41	MPB-4	Iramba	1,797 3,518 1,452 1,584 2,948	11,299	67.3	Lake		4	5	37	Not Functioning	1978	1980
Musoma (R) District													
42	MPMr-1	Masurura	3,237	3,237	103.2	Borehole	2	3	4	8	Not Functioning	1982	2005
43	MPMr-2	Itaro	5,692	5,692	155.1			2	0	9	Not Functioning	1975	2004
44	MPMr-3	Murangi	4,097	4,097	101.3	Lake		0	3	3	Partially Functioning	1962	
45	MPMr-4	Kyankoma	3,884	3,884	15.4		1	0	2	0	Not Functioning	1988	1988
46	MPMr-5	Mugango / Butiama (TR)	3,674 1,877 2,106 4,429 4,927 5,568 3,816 3,074 4,266 3,008	36,745	43.5	Lake		237	8	1	Partially Functioning	1975	
Tarime District													
47	MPT-1	Komuge (TR. No.2)	2,111 1,362 3,405 3,265 3,093 3,338	16,574	-	Lake		62	5	65	Partially Functioning	1977	
48	MPT-2	Shirati (TR. No.1)	4,363 1,686 2,704 3,373 2,704 1,773	16,603	-	Lake		75	7	50	Partially Functioning	1979	
49	MPT-3	Marasibora	2,064 2,419	4,483	83.8	Borehole	2	4	5	19	Not Functioning	1978	1996
50	MPT-4	Ochuna	1,289	1,289	99.6	Borehole	1	0	1	8	Not Functioning	1968	1994
51	MPT-5	Nyarwana	3,790	3,790	-	Borehole	1	0	1	5	Not Functioning	1976	1980
52	MPT-6	Changuge	4,335	4,335	100.4	Shallow Well	1	3	3	10	Not Functioning	1979	1984
53	MPT-7	Nyamagaro	4,596 4,596	9,192	43.5	Borehole	1	0	2	5	Not Functioning	1971	2005
54	MPT-8	Kyangasaga	4,396	4,396	-	Lake		0	0	5	Not Functioning	1972	1985
55	MPT-9	Nyanduga	2,523	2,523	182.3	Borehole	1	0	2	17	Functioning	1979	
Serengeti District													
56	MPS-1	Mugumu	12,549	12,549	-	Borehole	9	185	23	13	Partially Functioning	1974	
57	MPS-2	Musati Gravity Scheme	2,409	2,409	307.2	Spring	2	0	2	11	Partially Functioning	1992	

3.3.2 Types of Existing Piped Schemes

The typical facilities of existing piped schemes are composed of water sources, intake facilities, pump facilities, transmission pipes, service reservoirs and distribution pipes. The facilities of existing piped schemes are roughly classified by about the seven types based on the form of intake and transmission as shown in Figure 3.3-1. Type C, which is shown in Figure 3.3-1 is the most abundant type and accounts for about 57% of the 57 piped schemes. This type is a relatively simple structured facility which can provide water without any treatment (Chlorination only for some of the piped schemes) from the water source to the service area through a reservoir that stores raw water directly down from the water source.

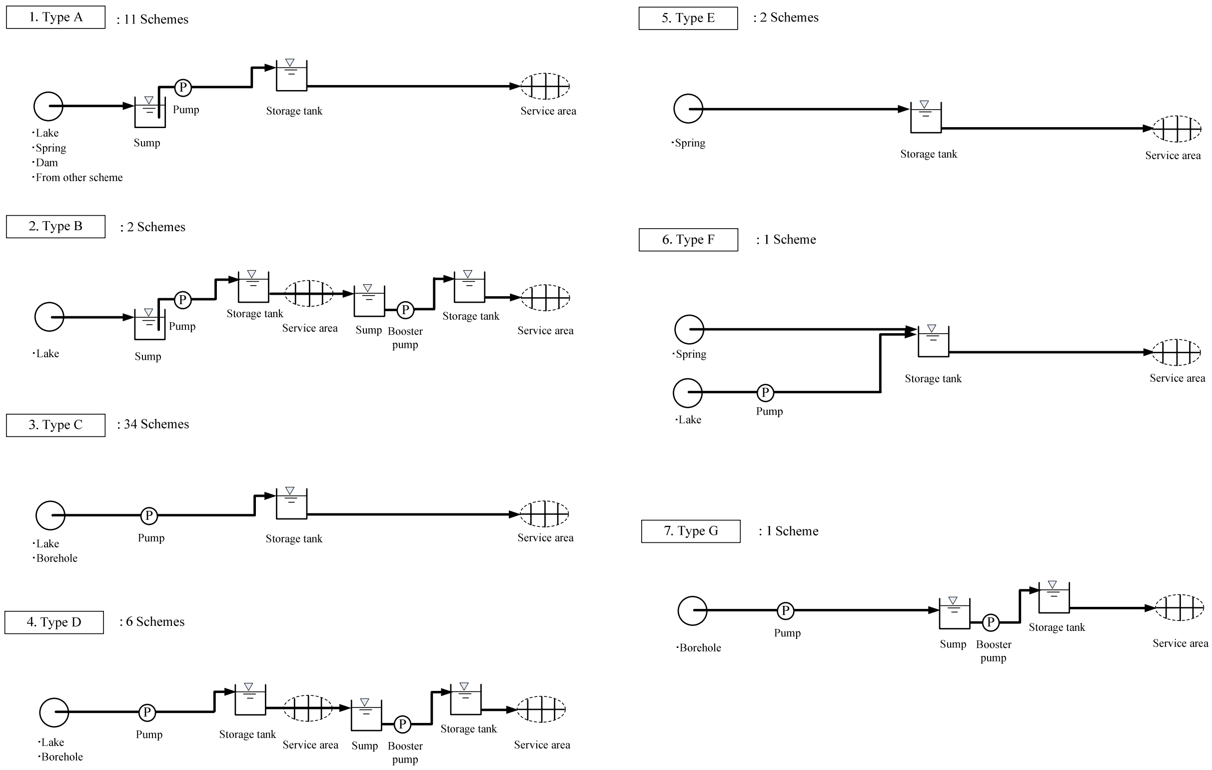

Figure 3.3-1: Facility Types of the Existing Piped Scheme

3.3.3 Problems of Existing Piped Scheme

The piped schemes have not been repaired for 30-40 years and their operations have been suspended. The conditions of various facility items and main problems are as follows;

Table 3.3-3: Current Facility Problems

Function of Facilities		Main Problems
Water Sources		• Decrease of Water Level • Lack of Capacity for the Water Source
Intake Facilities	Pipes	• Disconnection • Damage or Deterioration of Pipes

	Pump Units	• Damage, Breaking, Wearing out of Pump Units • Theft of Pump Units
Rising & Booster Pump Facilities	Pipes	• Disconnection • Damage or Deterioration of Pipes
	Booster Pump Units	• Damage, Breaking, Wearing out of Pump Units
Distribution Facilities	Service Reservoir	• Deterioration such as Cracks on Tank Structure • Leakage
	Pipes	• Disconnection Damage or Deterioration of Pipes

Most of the existing piped schemes were completed in the 1970s, and 68% of the 57 piped schemes. About 90% of the suspended piped schemes are facilities which were completed in the 1970s, the 1960s or before. Also the main causes for the suspension of the facilities are at pump facilities which make up 78%, and especially suspended pump facilities, which are concentrated in piped schemes completed in the 1970s. The main causes for the suspension of the facilities by the year of completion are shown in Table 3.3-4.

Table 3.3-4: Number of Suspended Facilities

The facilities which caused suspension	Water sources	Pipes	Pump Units	Others※	Total
1960s or before	0	0	9	0	**9**
1970s	5	1	17	1	**24**
1980s	0	1	2	0	**3**
1990s	0	0	0	0	**0**
2000s	0	0	0	0	**0**
Total	**5**	**2**	**28**	**1**	**36**
%	**13.9**	**5.6**	**77.8**	**2.7**	**100.0**

※Financial problem with fuel or power supply

3.4 Current Institutional Situation of Operation and Maintenance for Water Supply System

3.4.1 The Current Institutional Framework for Rural Water Supply

The present institutional arrangement for rural water supply is as depicted in Figure 3.4-1. As the figure shows there are in fact two major lines to facilitate for rural water supply activities. One is the technical line from the MoW and the other is the institutional and budgetary arrangement along with the decentralization policies following the Local Government Reform Programme (LGRP). As for the technical matters, it is supposed that command comes down from the MoW, through the Basin Water Office (supposed to be) to the District Water Engineer Office.

The concepts of the institutional reforms for rural water supply along with the 2002 NAWAPO and the RWSSP are acknowledged by the relevant authorities such as RAS (Regional Administrative Secretariat) and District Councils, the institutional reforms are still on the way and in transitional periods, and thus there are wide gaps between what the policies intended and the actual practices in the Study area. Although the concepts are aware of the government offices, in general the institutional reorganization has been on the progress and not been completed in the Study area.

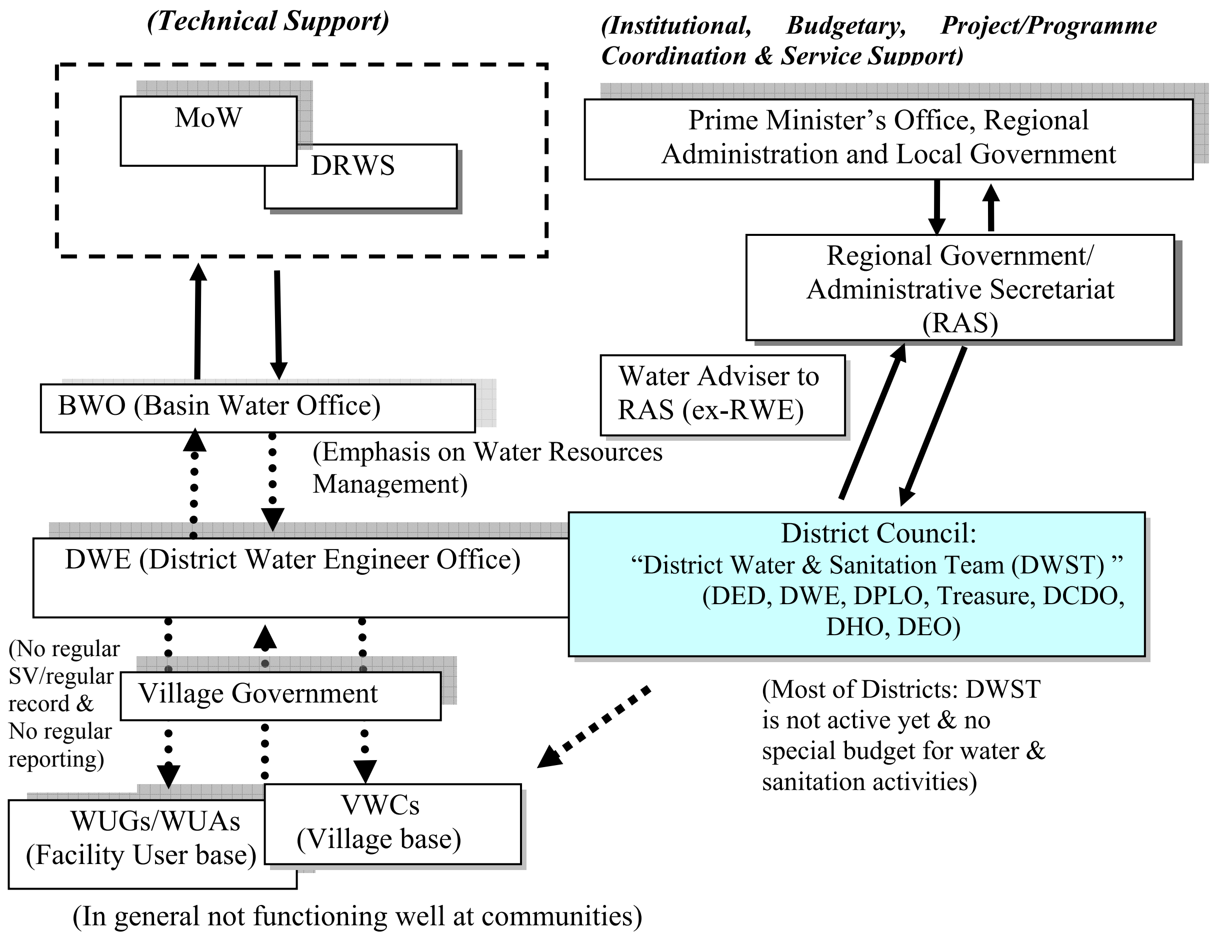

Figure 3.4-1: Institutional Arrangement between MoW, RAS, Basin Water Office, District Council, District Water Department, VWCs and WUGs/WUAs

Current organizational problems are summarized below (refer to Table 3.4-1).

(1) Inadequate coordination and undefined demarcation between government offices led to weak planning and performance in such areas as budget based planning and activities.
(2) Lack of coordination roles to standardize the water supply activities and human resource deployment among districts deteriorated to keep balanced development of water supply status in the region.
(3) Low priority for monitoring and supervision of community based facility management led to deterioration of water facility
(4) Shortage of skilled technicians in DWE offices led to ineffective and untimely management of water supply.

(5) Lack or deterioration of VWCs and user groups for facility management led to poor maintenance of water facility.
(6) Poor knowledge of technical maintenance and financial management led to weak sustainability of water facility.

Table 3.4-1: Current Organizational Problems and O&M Status

Key Institutions		Organizational Problems	Major Influences to the Present O&M Status
Regional	**Basin Water Office (BWO)**	・Expected roles, in particular district support, are not fulfilled due to shortage of human and financial resources	・Inadequate coordination and undefined demarcation between government offices led to weak planning and performances of such as budget based planning and activities.
Regional	**Regional Administrative Secretariats (RAS)** **Regional Administration and Local Government (PMO-RALG)**	・Weak support to the districts	・Lack of supervisory roles to standardize the water supply activities and human resource deployment among districts deteriorated to keep balanced development of water supply status in the region.
District	**District Councils (DCs)**	・Insufficient budget allocation for monitoring and supervision for community based facility management	・Low priority for monitoring and supervision of community based facility management led to deterioration of water facility.
District	**District Water and Sanitation Team (DWST)**	・Unidentified tasks and roles of the DWSTs	
District	**District Water Department (District Water Engineer Office)**	・Shortages of skilled human resources (technical) ・Inadequate supervision and monitoring activities to communities	・Shortage of skilled technicians led to ineffective and untimely management of water supply.
Village	**(Village Council)** **Village Water Committee (VWC)** **VWC/Village HESAWA Committee (VWC/VHC)**	・Weak leadership skills for community mobilization	・Poor knowledge of technical maintenance and financial management led to weak sustainability of water facility.
Village	**(User Groups)** **Water User Group (WUG)** **Water User Association (WUA)**	・Insufficient knowledge on minor technical maintenance of water facility ・Insufficient knowledge of financial management for water facility	

3.4.2 Current Activities for Water Supply at Community

a. Current Activities at Community Level

The current organization arrangement for water supply at community by types of technologies and water sources is summarized in Table 3.4-2.

Mainly there are 4 types of water supply sources or facilities:

1) unprotected traditional water sources,
2) protected traditional water sources,

3) hand pump and
4) piped scheme

The above are further divided by varieties of different water sources such as shallow wells, boreholes and lake water.

Types of community based management organizations for water facilities include:

i) water board for piped scheme;
ii) water user association (WUA) for piped scheme;
iii) VWC for piped scheme, hand pump operation, and other type of operation; and
iv) water user group (WUG) mainly for hand pump operation.

(Refer to Supporting Report for the detailed description on organizational structure and functions of water supply entities.)

Table 3.4-2: Current Activities of Water Supply Organizations at Community

	Type of technology	Water source	Type of organization	Activities
1	Unprotected traditional water sources	Spring, pond, lake, river, etc.	n.a.(lake and river)	✧ Cleaning (spring and pond)
2	Protected traditional water sources	Spring, ring well, etc.	VWC or WUG	✧ Protection ✧ Cleaning ✧ Security
3	Hand pump	Shallow well	VWC or WUG	✧ Cleaning ✧ Security ✧ Collection of water fee ✧ Minor repair works
4	Hand pump	Borehole	VWC or WUG	
5	Piped scheme	Borehole	Water Board, WUA or VWC	✧ Security ✧ Collection of water fee ✧ Minor repair works
6	Piped scheme	Lake Victoria	Water Board, WUA or VWC	

b. Water Board

The Water Board is a management body under Authority for urban and town water supply through piped schemes. All members of the Board are appointed by the Ministry of Water. In the Study area, water fee collection for urban water supplies is done by the District Water Office, and in general the collection is still very low to cover the running costs. For instance, in the case of the Bunda Water Supply Scheme, it is estimated that 76 % of the estimated running costs are covered by national subsidy allocated every quarter.

c. Water Users Association (WUA)

The Water Users Association (WUA) is officially defined as the lowest appropriate level of water resources management entity at local level (NAWAPO 2002). A WUA is a legal entity registered under the Water Rights Act Amendments (No. 8 of 1997).

In terms of rural water supply, the WUAs are considered to be a kind of water users group responsible for management of point source facility (hand pump) or piped water system.

There are three types of WUAs in the Study area: (i) a group of WUGs; (ii) associations for the management of piped schemes; and (iii) associations similar to water user groups.

Formation of WUAs for the water supply schemes is not complete due to the following reasons:

- a majority of the piped schemes are not functioning
- insufficient and irregular O&M support from the DWE to the communities, and
- insufficient cost recovery from water users due to low willingness to pay

d. Village Water Committee

The village water committee (VWC) falls under the social services committee of a village government. It is elected by the community, has 6 to 12 members, and all represent their sub-villages. The roles and duties of VWCs are to: (i) submit monthly and quarterly reports to the village government; (ii) audit income and expenditures; (iii) assist in security at domestic points; (iv) enforce by-laws on the use and protection of the water system; and (v) advise on issues relating to the operation of the water system.

In terms of water fee collection, activities of the VWCs are not found active due to the lack of necessary guidance from the DWE office at present. The VWCs result in being less autonomous from the village government without legal entities. However, some active villages without any improved water supply facilities established the VWCs to maintain their traditional water sources in the Study area.

e. Water User Group

A WUG is usually formed by voluntary membership in order to share a single water point.

Conventional organization for water supply system management was to establish water committees or tap committees under each VWC. However, several problems were identified in the traditional structure. For instance, the roles of the VWC were not clearly defined, and the village government leadership was often preoccupied with many local issues other than the management of water supply systems. In order to overcome these problems, the concept of the WUG has emerged. The WUGs have been established as “independent” water users` organizations in some projects such as the SIDA funded HESAWA project and Dutch funded Shinyanga project. The establishment of WUGs intended to avoid any intervention by the village government.

According to the survey in 2005, it is shown that the number of WUGs is 858 in Magu, 670 in Kwimba, 311 in Misungwi, 236 in Sengerema, 285 in Geita, and 291 in Ukerewe in the Mwanza region, while in the Mara region there are 222 in Musoma Rural, 381 in Bunda, and 411 in Serengeti. As for Tarime, there is no compiled information found at the DWEO.

Chapter 4

Water Sources Potential

4 Water Sources Potential

4.1 General

For the purpose of water supply planning, the water sources in the area are examined. The water source can be divided into two categories which are: Surface water and Groundwater.

The main concept of selecting the suitable water resources for the provision of water to the villages should satisfy the following items:

1) Sustainability for water use, 2) Availability throughout the year and 3) Safety of water quality

4.2 Potential and Prospects of Use of Surface Water

The most common water sources that supply water to the villages are traditional water sources such as hand dug wells and local springs; however, most sources run dry or have reduced discharge in the dry season.

There are also some artificial surface water resources by use of facilities; i.e. rainwater harvesting, charcoal dam, etc. However, these are not classified as surface water sources.

The potential and its prospects of use of surface water is limited to Lake Victoria and some rivers in this study, because most of the other artificial water sources are not available throughout the year and have problems with safety.

4.2.1 River Water Evaluation

The permanent rivers in the study area are the Mara and Simyu rivers and some of the rivers at the East and South Shore (Mori River). Except the Mara River, although some of the other rivers have water in the dry season, but the water level is minimal according to the discharge measurement in this Study.

a. Potential Amount of River Water Development

It is revealed that Mara River is the potential water source to be developed considering its constant discharge. As shown in the following table, the monthly average discharge of Mara River is 38.2 m^3/s and the minimum discharge is 16.0 m^3/s.

Table 4.2-1: River Discharge

	Monthly Average Discharge of the Main Rivers (m^3/s)												Year Total	Averages m^3/s
	January	February	March	April	May	June	July	August	September	October	November	December		
Mara	27.1	24.2	33.9	75.2	88.7	62.3	35.8	26.6	23.8	17.4	16.0	27.6	458.5	38.2
Grumeti	32.6	16.6	17.5	24.0	21.0	2.6	1.1	0.5	0.8	1.6	3.9	18.7	141.0	11.8
Mbalageti	5.4	4.5	6.6	12.9	9.1	2.0	0.6	0.4	0.4	0.8	3.2	6.3	52.1	4.3
E. Shore Streams	24.7	16.9	22.8	44.8	41.6	13.8	4.0	3.2	3.5	5.2	14.5	32.2	227.3	18.9
Simyu	64.7	45.0	62.5	84.5	54.9	22.1	15.3	12.4	10.7	9.8	26.1	69.2	477.2	39.8
Magogo-Moame	30.3	10.0	9.6	14.4	10.0	0.6	0.2	0.1	0.1	0.2	2.1	24.2	101.7	8.5
Nyashishi	3.8	1.7	1.7	2.2	2.9	0.2	0.0	0.0	0.0	0.0	0.3	7.1	19.8	1.7
Issanga	11.5	10.2	17.1	9.8	9.0	1.9	0.5	0.4	0.3	0.4	5.1	307.7	373.8	31.1
S. Shore Streams	29.0	23.6	19.5	38.6	43.9	4.0	0.5	0.4	0.4	0.4	9.9	142.6	312.8	26.1

** compiled by the LVEMP for the year of 1950 to 2000*

b. Water Quality of River Water

The water quality of river water is represented by high color, turbidity, Hg, Fe, BOD and NH_4^+. Coliform and bacteria are high in the dry season, but concentrations are reduced to a drinkable level in the wet season. Treatment and filtering are required for potable purposes.

Still, river water can be used as a general water source instead of for drinking and cooking. However, river water is not considered as a source of rural water supply in the study due to the following reasons:

1) High fluctuation of the river water level by season makes it difficult.

2) The water quality of the river is risky due to the content of toxic metal such as Hg and high bacteriological contamination.

3) Although permanent rivers such as the Mara River exist, a treatment and filtering plant is required. Additional works for the intake structure will also be required such as a river stream dividing to the canal or an infiltration gallery. The capital cost and maintenance costs would be quite high for a village water supply.

4.2.2 Lake Victoria Potential

Lake Victoria is the world's second largest freshwater lake, covering an area of 67850 sq km. The water level has varied within two meters in the past three decades but the fluctuation tends to retain the water level every ten years. Therefore, it could be categorized as a stable water source. The lake water is one of the highest potential surface water sources in the area.

a. Potential Amount of Lake Water Development

According to the data of the Lake Victoria Environmental Management Project (LVEMP), the total sum of lake water has a surplus of $33m^3/s$ in the short-term. This amount equals 2,851,200 m^3/day. The water demand in this study for planning the rural water supply from Lake Victoria is 32,435m^3/day in the year 2015, with a maximum intake of 46708m^3/day.This is 1.6% of the total water balance (positive value) of the lake.

b. Water Quality of Lake Victoria

The analysis revealed that the water is high in coliforms and general bacteria at the lake shore. The result also indicates high values of turbidity, color, BOD and NH_4^+ throughout the year. There are some areas high in Ba, Fe, and NO_2^-. These facts indicate that the water itself should be filtered and treated for potable purposes.

For the purpose of rural water supply in the study, the lake water shall be used for the scheme based water supply system, consisting of intake facilities, pump facilities, a processing plant, a storage tank and a distribution pipe. The harmful substances from the lake shall be treated and processed. The cost effectiveness shall be carefully examined with the borehole distribution (Level II) system for the actual use of the water for the rural area.

4.2.3 Examination of Surface Water Development

The potential surface water distribution covers a wide portion of the study area. However, in the inland area, the ponds and rivers are not suitable for use as potable water sources due to the seasonal effect, water quality and cost of facility construction. Lake water is considered as a potential source of water for the villages within some 9 km from the lake.

However, the necessity of a treatment and filtering plant requires higher costs in terms of construction and operation and maintenance. Operation and maintenance will be an important factor for facilities with a treatment system.

River water is not considered for use as a rural water supply because of its unreliability due to seasonal variations in water volume, risks for the water quality and the high cost of the water supply facility.

4.3 Groundwater Potential

In general, the two groundwater sources identified in the area are stratum aquifers and fissure water. Stratum aquifers can be divided into two categories: shallow aquifers and medium aquifers.

4.3.1 Classification of Aquifer Unit

The groundwater in the study area can be classified into three forms:

1) **Stratum aquifer**: unconfined aquifer within 10m below ground surface (bgsl) in the Neocene alluvial, lacustrine, terrestrial, fluvatile and marine deposits

2) **Stratum aquifer**: unconfined, semi-confined aquifer at a depth range of 20-50m bgsl in the decomposed (weathered) or secondary deposited Precambrian hard rocks (mainly granite)

3) **Fissure water**: semi-confined, confined aquifer at a depth range of 20–150m bgsl in the fractures and fissures distributed in the hard rocks (mainly granite).

The major water to be extracted from the ground will be water from medium stratum aquifers and fissure water. There are also shallow stratum aquifers in the area, but most of them dry up or the discharge is minimal in the dry season.

A geological map of the area is presented in Figure 2.3-4 as a reference of the distribution of the geological units.

a. Relationship between Well Depth and Yield (Discharge)

The high yielding (more than 70 liters/min) depth ranges from 30m to 180m, but holes at these depths include a lot of low yielding wells as well.

This is much due to its geological nature. The wells are highly affected by the existence of fissures and/or fractures as the aquifer, and the discharge (yield) depends on the storage capacity and continuity of the fissures and fractures.

b. Relationship between Aquifer (Geology Type) and Yield

Granite has the highest average yield at 53 l/min, followed by Nyanzan green rocks (38 l/min) and Decomposed Precambrian rocks (36 l/min). But the figures vary from less than 1 l/min to over 300 l/min. Because of the variation of the figure, the average itself is highly affected by the large numbers.

However, this fact indicates that potential aquifers exist in these rock units, and the potential for the development of water sources is relatively higher than other rock members.

Table 4.3-1: Aquifer and Yield, Depth

	Yield (litre/min)				Depth (GL-m)			
	sample no	maximum	minimum	average	sample no	maximum	minimum	average
Neocene	11	60.0	0.1	11.8	31	105.5	3.0	25.7
Secondary Deposits and Weathered portion of Pre Cambrian (Ngr)	53	267.8	0.1	28.7	106	195.3	4.0	35.5
Volcanics	1	2.4	2.4	2.4	6	91.0	7.0	33.8
Bukoban	0	0.0	0.0	–	4	86.0	7.0	32.5
Nyanzan (green rocks)	8	151.7	0.1	38.0	16	93.0	6.0	54.0
Nyanzan (banded ironstone)	8	11.9	0.3	4.4	14	90.2	6.0	49.7
Granite U	7	1.7	0.1	0.6	14	40.0	5.0	9.4
Granite	71	335.0	0.1	45.7	103	214.6	1.6	51.7

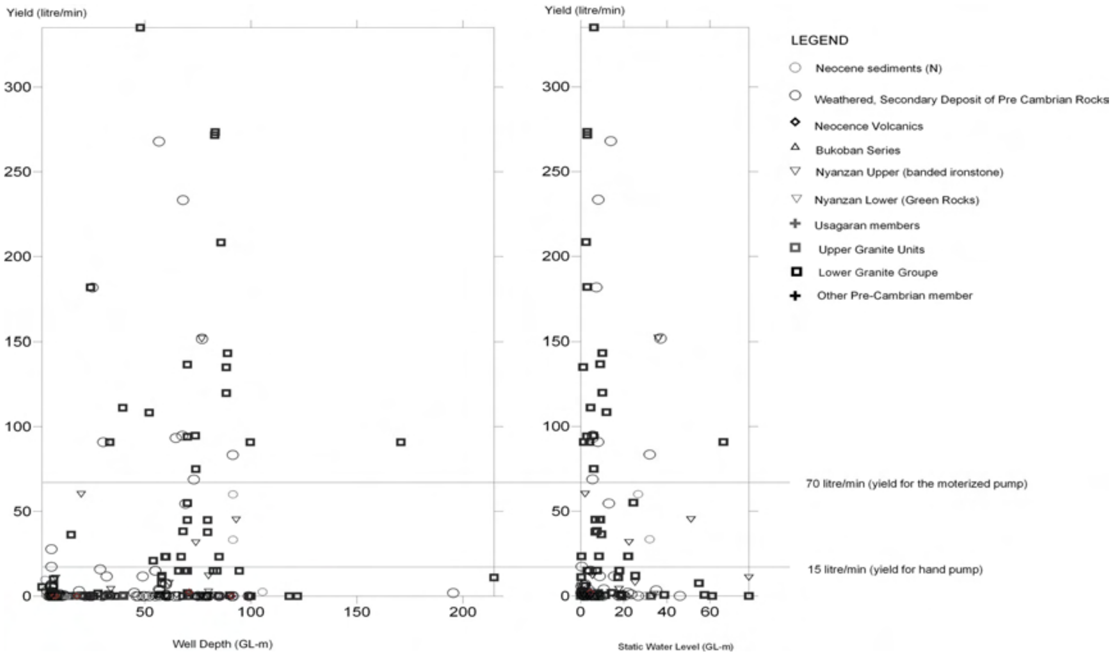

Figure 4.3-1: Relation between Yield (litres/min) and Well Depth, Static Water Level by Geology

The yield distribution map is indicated in Figure 4.3-2. The high yielding area is distributed from north to south of Kwimba, the lakeside of Musoma and west of the boundary between Sengerema and Geita.

c. Relationship between Well Depth and Water Level

The relationship between well depth and water level is examined in Figure 4.3-3.

There is a tendency for the static water level to be less than 10 meters until a depth of between 40 to 50 meters. The aquifer unit in this range is weathered Precambrian and granite members. This may indicate that unconfined – semi confined aquifers are present until a depth of around more or less 50 meters, and as the depth increases, the variation of yield increases.

It should be noted that the difference of massive rocks and the decomposed zone can hardly be identified from the surface. Therefore, from the depth of 30m to 80m bgsl, the two rock units interfuse.

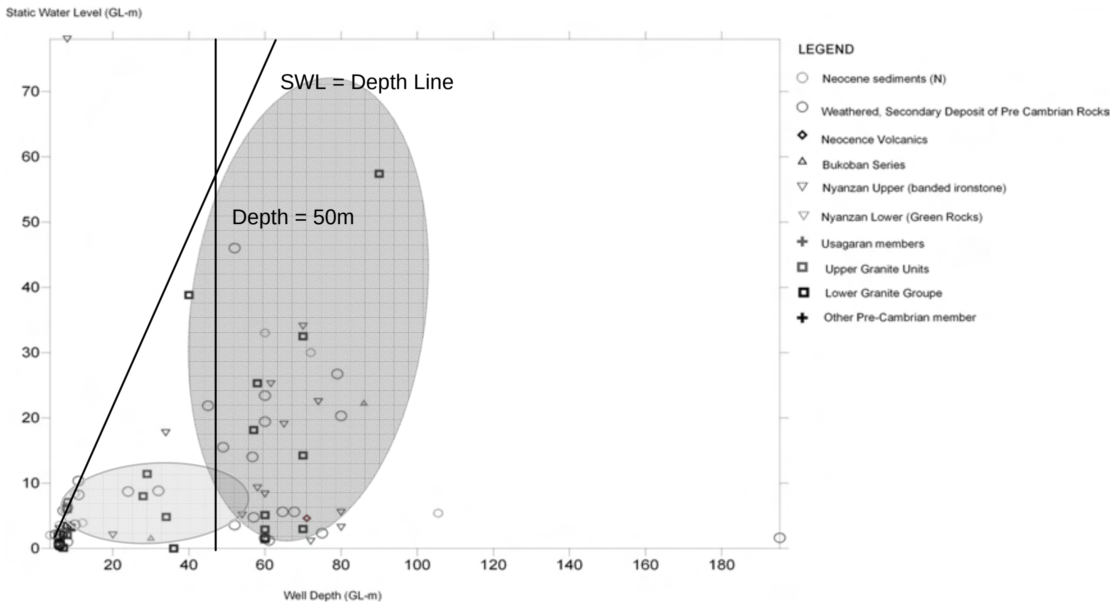

Figure 4.3-3: Well Depth and Static Water Level

4.3.2 Character of Aquifer Unit and Wells

In evaluating the existing data and survey data, the following points are revealed:

- Potential (productive) aquifers can be divided into two types: stratum aquifers in the weathered or secondary deposits of Precambrian rock units (mainly granite) and fracture type aquifers.
- High yield areas or aquifers are not identified as a zone, but some limited locations.
- There is quite a high variation of yield by depth and type of aquifer.
- Granite is the main fissure water source and productive aquifer in the area.
- The static water level varies even in aquifers of the same geology.

Considering these findings, the potential targets for groundwater development shall be limited to two types:

1) The granite and Nyanzanian meta-sedimentary rock distributed area for the fissure type aquifers (more than 45 meter in depth).

2) Medium aquifers in the decomposed Precambrian rocks (up to 50 m).

The difficulty of water source development in the area is also indicated in the SIDA Report, 1979. Only 31% of the total drilling holes could get a yield of more than 1 m^3/h, which is 17 l/min.

The hydrogeological analysis of aquifer parameters is described in the test drilling results, such as the specific capacity and transmissivity are indicated in the following Section. However, these parameters are not discussed in regard to the whole study area, as there is not sufficient information to discuss the results as representative aquifers.

a. Water Quality of the Groundwater

A series of water quality results have been achieved, and from the results, the nature of the groundwater can be summarized as follows:

Shallow Wells: large variation by area. The shallow well at Bunda (Tamau Borehole) is extracting water from an aquifer in the Neocene deposits; it has an extremely high concentration of Cl^-, SO_4^{2-}, Cd, Na^+, and K^+, and the EC value exceeds 40,000 μ S/m. The well shall not be used as a drinking water source. Shallow wells also have high contaminations of coliform and bacteria, and indicate a high EC value. This largely depends on the well structure and nature of the aquifer.

Deep – Medium wells: not so much affected by bacteria but contain a series of metal ions such as Fe, Pb, Cr, Se, Ba and F. Based on the water quality standards of Tanzania and WHO guideline, some of the parameters exceed the allowable value. The granite fissure type aquifer at Kwimba and Magu indicated a high content of Fluoride.

Geological map in relation with EC value is shown in Figure 4.3-4 as reference.

b. Geological Structure and the Groundwater

It was revealed that one of the potential aquifers is fissure water extracted in the fissures and fractures distributed in the Precambrian hard rock formations.

The interpretation of the maps, especially in reference to the yield, will provide the information on the potential water bearing structure.

Recognizing that the well inventory data is disorganized in the study area, more well inventory information will provide more accurate interpretation of the water bearing structure from the lineament maps. Lineament and structural map in relation with yield of the wells are presented in Figure 4.3-5 and Lineament density map with yield is shown in Figure 4.3-6

However, in reference to the SIDA report and our test drilling record, the possibility of intersecting the water bearing fissures and structures is low, even in areas which have high yield well records.

4.3.3 Aquifer Potential Evaluation

The potential area for groundwater development is examined. The potential water extracting zone (groundwater availability map) is shown in Figure 4.3-7.

Two types of aquifers are considered as potential groundwater sources based on the yield, geological structure and water quality.

a. Medium depth stratum aquifer

Type of Rock: Decomposed Precambrian rock units (mainly secondary deposits or weathered granite.

Target Depth: From 20m to 50m in depth from the surface

Distribution:

- Hillside of Geita, East Sengerema, West Misungwi, East Kwimba and Magu, Ukerewe Island in Mwanza Region

- Hillside of North Bunda, Central Tarime, South Tarime and West Serengeti in Mara Region

Estimated Yield: Between 5 to 15 l/min is most common. High values of more than 70 l/min can be achieved if it captures the coarse grained fissure zone.

Parameters from Test Wells

Specific Capacity (m2/day): ranges from 0.044 to 8.804
Transmissivity (m2/day): ranges from 0.0085 to 3.72

Remarks: The yield of the aquifer largely depends on the local topographical features (catchment area, valley). The lineaments are also targeted as additional potential for the aquifer. Coarse grained granite and other Precambrian rocks in the local area are an advantage.

Water Quality: Good in general. Some wells are sensitive to the rain and seasonal fluctuations of the quality can be observed.

b. Deep Depth Fissure Water

Type of Rock: Granite, Nyanzan rock units (Precambrian rock units)

Target Depth: From 20 m to 100m

Distribution:

- NNE-SSW, WNW-ESE lineaments in Sengerema and Geita
- NW-SE lineaments in Misungwi and Kwimba
- WNW-ESE lineaments in Bunda and Musoma
- NNW-SSE lineaments in Musoma, Serengeti and Tarime
- EW to WSW-ENE lineaments in Tarime

Estimated Yield: The only measure to estimate the yield is the inventory of surrounding wells. High values of more than 70 l/min can be achieved if it captures water bearing coarse grained fissure zone.

Parameters from Test Wells

Specific Capacity (m2/day): ranges from 0.224 to 3.226
Transmissivity (m2/day): ranges from 0.052 to 1.87

Remarks: Drilling target is narrow. It may not be possible to achieve 100% accuracy even if a resistivity sounding is conducted. Most of the lineaments in the valley are on the structural line of almost vertical, but some of them may vary their face angle. Although fissures or fractures exist, it is hard to predict the existence of water and its amount.

Water Quality: Characterized by high EC value and containing of various ions. Most of the values of substances are not more than the allowable limit of WHO, but some exceed the acceptable limit of Tanzania. Fluoride and NO_3^- concentrations are high in south Kwimba, Misungwi and Magu. This is also a trial and error process to obtain safer aquifers.

4.3.4 Examination of Groundwater Availability Map

The water availability map was made by the correlation between geology, yield of existing wells, lineaments and structures, and quality (EC value).

The potential for development of the water source is mainly concentrated at the granite area, with high density of the lineament.

The grey area is considered as the target area of stratum aquifer in relation with fissure water. The light grey area on the map is considered as a fissure water area. Therefore it is essential to examine the potential with the density or intensity of the lineaments. The yellowish area is defined as recent deposits which consist of loose materials such as sand, clay and gravel.

Although the recent deposit is defined as low potential for high yield, there is a possibility to intrude the basement rock area as actually found in the Kwimba District.

4.3.5 Potential Area for Groundwater Development

The high potential area is marked as an orange zone in the water availability map. The zone is defined as the area where;

1. High density lineament area
2. Existence of medium – high yielding well
3. Geological discontinuity such as fault and/or geological boundary

However, it is difficult to find out just the point to capture the good aquifer and fissures from past efforts and experiences made by the field survey. Therefore, additional investigation such as resistivity sounding is required for the further accuracy of drilling site.

An additional difficulty is how to predict the high yielding areas before drilling. It is confirmed that if the drilling site is close enough to a good yielding site, a better yield can be achieved.

As mentioned before, some Neocene deposits (alluvial, lacustrine, terrestrial, fluvatile and marine deposits) are concentrated with heavy metals as a placer. The minerals dissolved in the water are mainly due to the mineralization in the basement rocks experienced over the long term, not only as fissures in the basement but also as a placer.

In the southern to central area of Kwimba, a series of good yielding wells exist. The surface geology is Neocene deposit, but all the drill holes intrude into the granite under the Neocene deposit. No clear lineaments exist, but there may be some water bearing structure in the granite rock in a NW-SW direction from the topographical features.

Although the high potential area is revealed from the surveys and interpretation, the risk of drilling dry holes is relatively high due to the nature of the aquifers in the area.

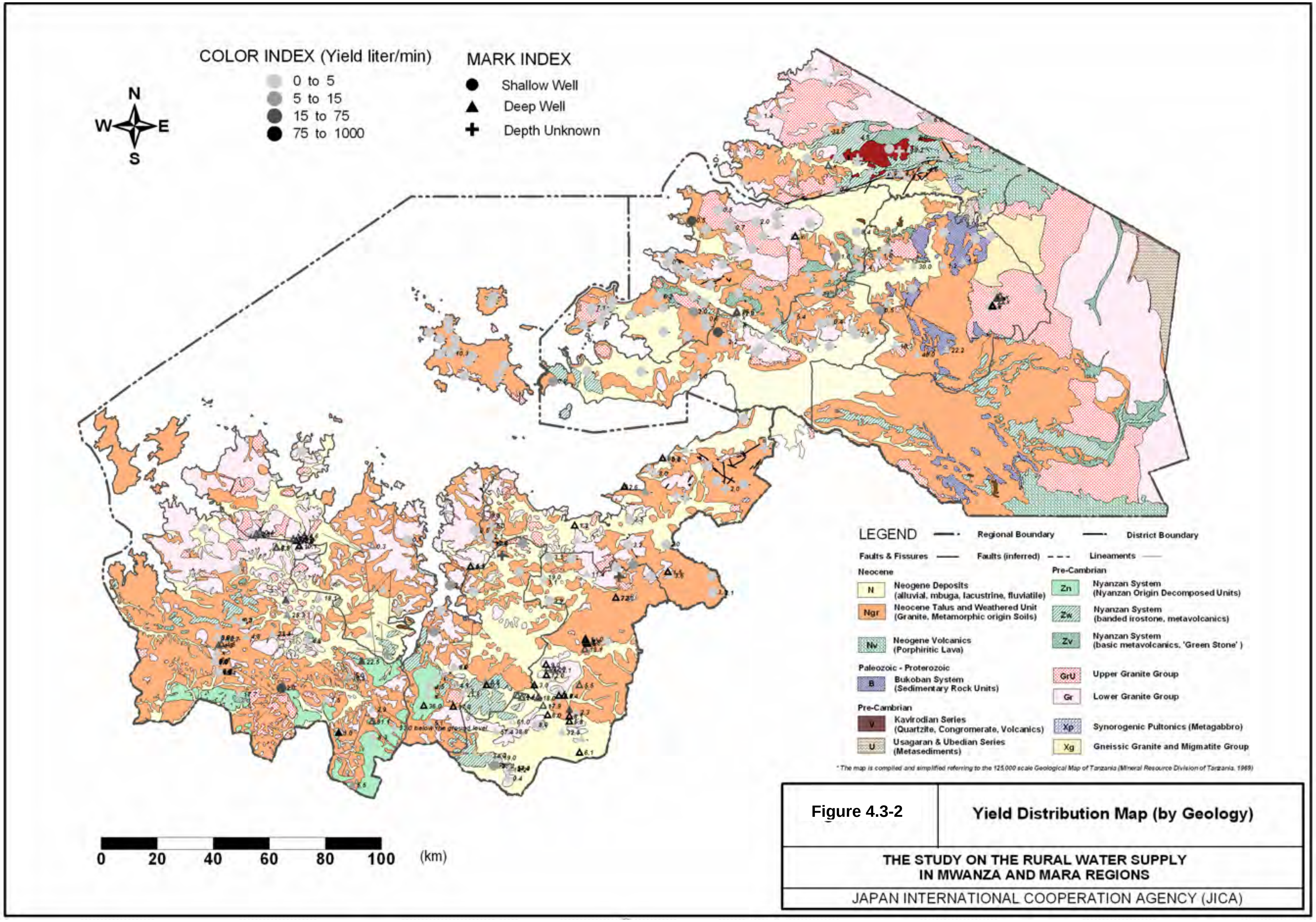

Figure 4.3-2 Yield Distribution Map (by Geology)

THE STUDY ON THE RURAL WATER SUPPLY IN MWANZA AND MARA REGIONS

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

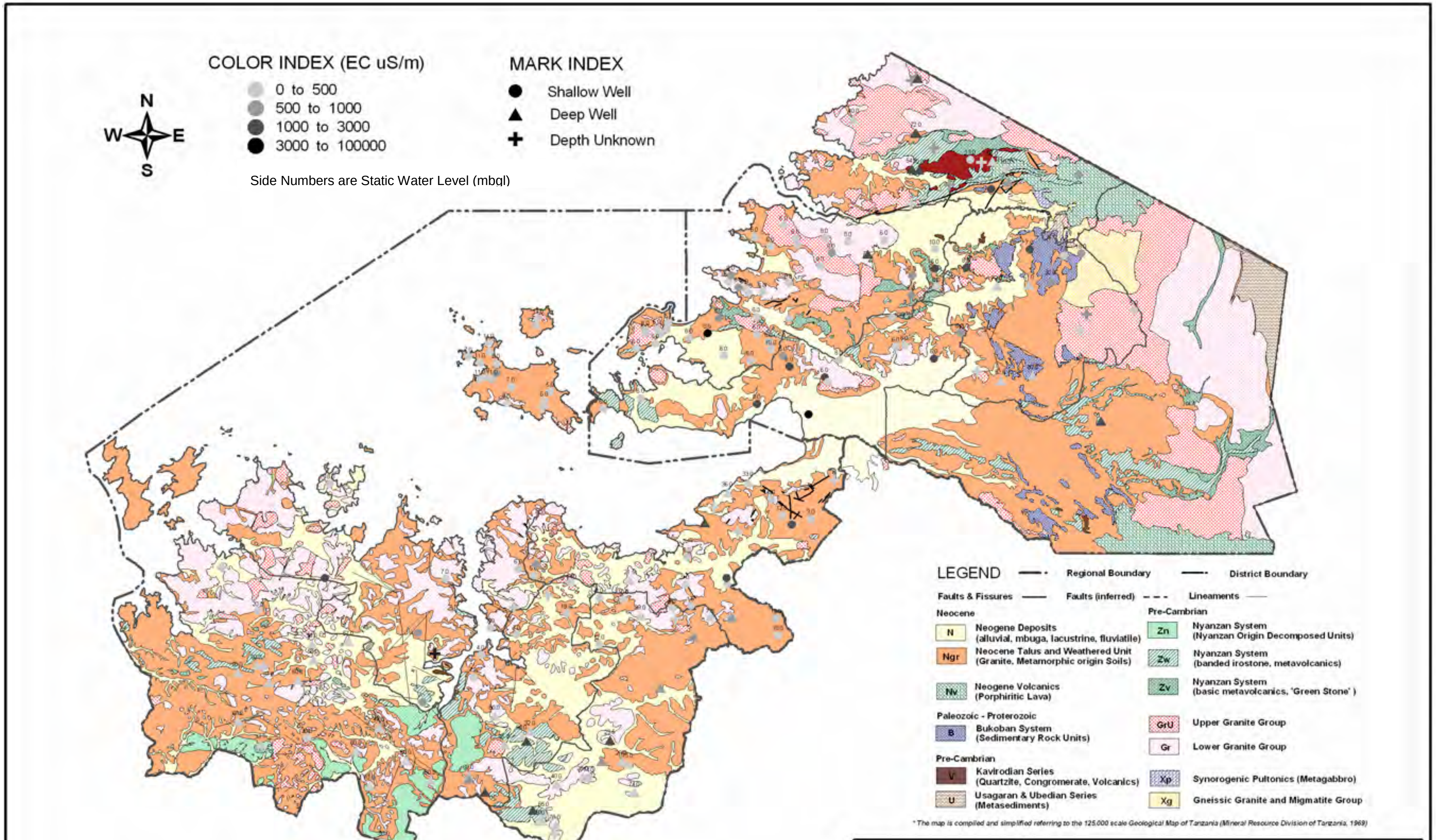

Figure 4.3-4	Geology and EC Value
THE STUDY ON THE RURAL WATER SUPPLY IN MWANZA AND MARA REGIONS	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

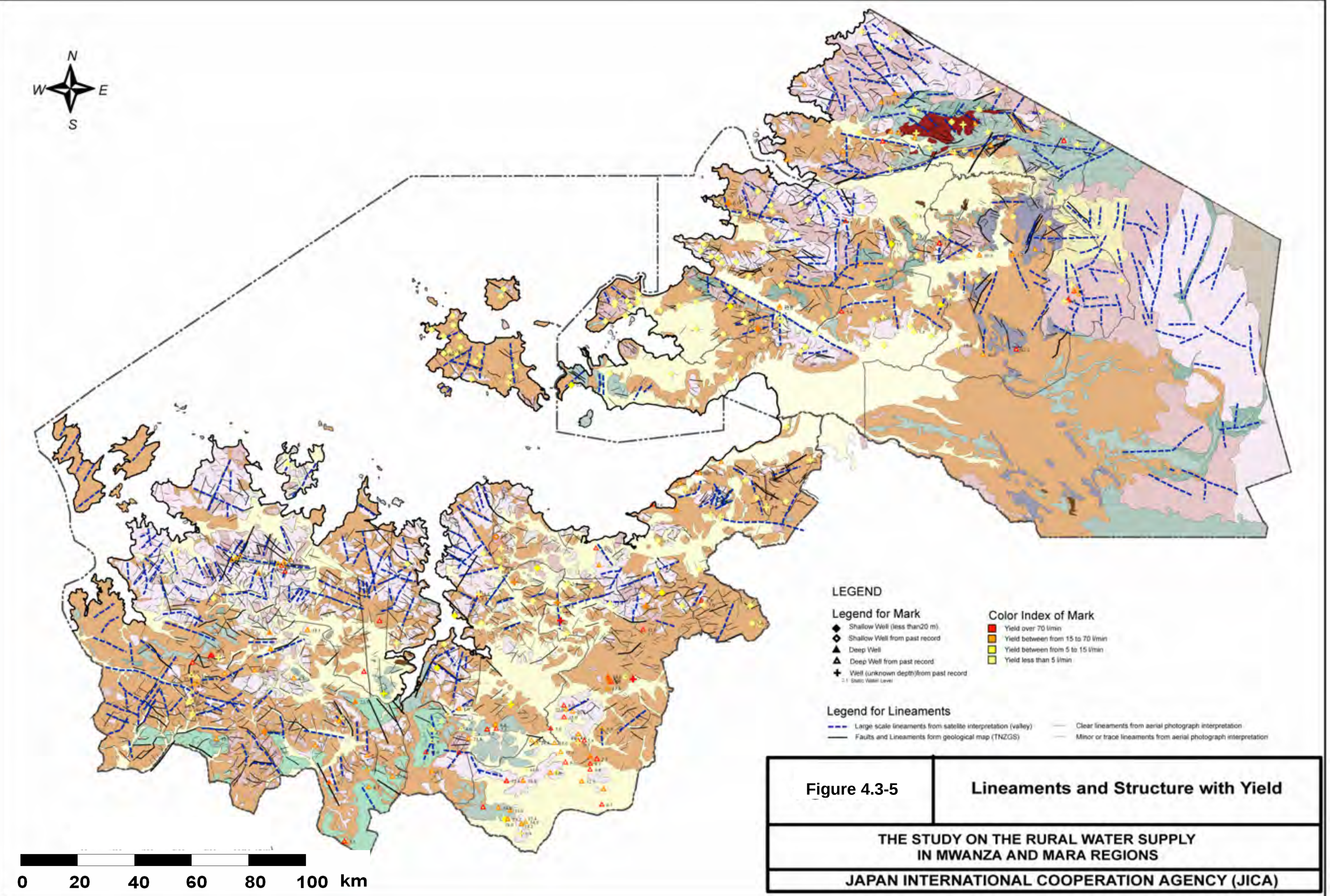

Figure 4.3-5	Lineaments and Structure with Yield

THE STUDY ON THE RURAL WATER SUPPLY
IN MWANZA AND MARA REGIONS

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

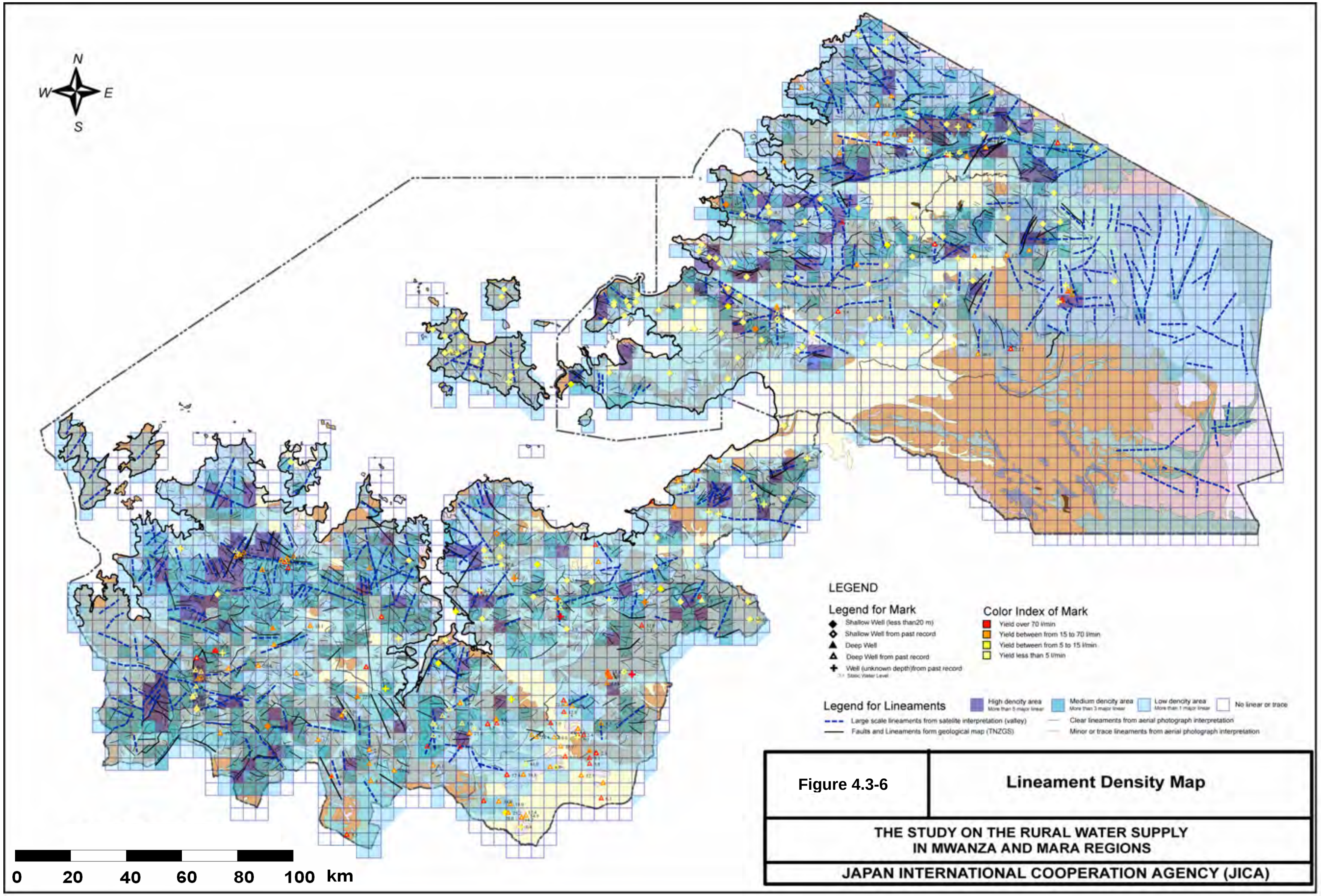

Figure 4.3-6 **Lineament Density Map**

THE STUDY ON THE RURAL WATER SUPPLY IN MWANZA AND MARA REGIONS

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)