APPENDIX

APPENDIX 1 MEMBER LIST OF THE STUDY TEAM

1-1 First Field Survey

Name	Position	Affiliation
Dr. Yuji MARUO	Leader	Senior Technical Advisor Japan International Cooperation Agency (JICA)
Mr. Masanori KURISU	Project Coordinator	First Project Management Division Grant Aid Management Department JICA
Mr. Shoji FUJII	Chief Consultant/ Water Supply Planning	Japan Techno Co., Ltd.
Ms. Kiyoko TAKAMIZAWA	Water Supply/Sanitation Facilities Planning/Design	Japan Techno Co., Ltd.
Mr. Shoichi YOKOGI	Hydrogeological Survey	Japan Techno Co., Ltd.
Mr. David ESCOBAR	Geophysical Survey	Japan Techno Co., Ltd.
Mr. Masahiko SUGINAGA	Socio-Economic Survey	Japan Techno Co., Ltd.
Mr. Shoji TAKAMATSU	Cost Estimation/ Procurement	Japan Techno Co., Ltd.
Mr. Akira SATO	Hydrogeology Adviser	Japan Techno Co., Ltd.
Mr. Akinori MIYOSHI	Consultant Coordinator	Japan Techno Co., Ltd.

1-2 Second Field Survey

Name	Position	Affiliation
Dr. Yuji MARUO	Leader	Senior Technical Advisor Japan International Cooperation Agency (JICA)
Mr. Takahisa FURUICHI	Project Coordinator	Planning Division Grant Aid Management Department JICA
Mr. Shoji FUJII	Chief Consultant/ Water Supply Planning	Japan Techno Co., Ltd.
Ms. Kiyoko TAKAMIZAWA	Water Supply/Sanitation Facilities Planning/Design	Japan Techno Co., Ltd.
Mr. Shoichi YOKOGI	Hydrogeological Survey	Japan Techno Co., Ltd.
Mr. Shoji TAKAMATSU	Cost Estimation/ Procurement	Japan Techno Co., Ltd.

1-3 Explanation of Draft Final Report

Name	Position	Affiliation
Mr. Shozo MATSUURA	Leader	Manager Grant Aid Management Department JICA
Dr. Yuji MARUO	Technical Advisor	Senior Technical Advisor Japan International Cooperation Agency (JICA)
Mr. Shigeki MIYAKE	Project Coordinator	First Project Management Division Grant Aid Management Department JICA
Mr. Shoji FUJII	Chief Consultant/ Water Supply Planning	Japan Techno Co., Ltd.
Ms. Kiyoko TAKAMIZAWA	Water Supply/Sanitation Facilities Planning/Design	Japan Techno Co., Ltd.
Mr. Shoji TAKAMATSU	Cost Estimation/ Procurement	Japan Techno Co., Ltd.

APPENDIX 2 SURVEY SCHEDULE

2-1 Itinerary for First Field Survey

No.	Date	Day	Maruo	Kurisu	Fujii	Takamizawa	Sato	Miyoshi	Suginaga	Yokogi	Escobar
1	4/7	Sat	Ar. Johannesburg		Leave Tokyo						
2	4/8	Sun			Arrive Johannesburg						
			Team meeting								
3	4/9	Mon	Courtesy call to JICA, EOJ; Courtesy call and explanation of Inception Report to DWAF; Meeting with EU; Move to East London								
4	4/10	Tue	*Meeting with DWAF Eastern Cape; Move to Umtata*								
5	4/11	Wed	Meeting with DWAF Umtata								
6	4/12	Thu	Explanation of Inception Report to DWAF Eastern Cape								
7	4/13	Fri	Site Survey								
8	4/14	Sat	Site Survey							Leave Tokyo	
9	4/15	Sun	Data Organization							Ar. JNB; To Umtata	
			Team meeting								
10	4/16	Mon	Move to East London		Site Survey				Prep Survey	To EL	Site Surv
11	4/17	Tue	*Discuss Minutes w/DWAF*		*Site Survey*			*To Pretoria*	*Prep Survey*	*Loc.Cont*	*Site Surv*
12	4/18	Wed	Finalize Minutes		Site Survey			Info Collect	Prep Survey	Loc.Cont	Site Surv
13	4/19	Thu	Sign Minutes; To JNB		Site Survey			To Umtata	Prep Survey	To Umt	Site Surv
14	4/20	Fri	Report DWAF, JICA, EOJ		Site Survey				Prep Survey	Site Survey	
15	4/21	Sat		Lv JNB	To Umt	Data Compilation			Prep Survey	Preparation for survey	
					Site Survey						
16	4/22	Sun		Ar TYO	Team meeting, Survey preparation						
17	4/23	Mon			Site Survey		Hydrogeo	Site Survey	Social Survey	Hydrogeo	Geophys
18	4/24	Tue			*Site Survey*		*Hydrogeo*	*Site Survey*	*Social Survey*	*Hydrogeo*	*Geophys*
19	4/25	Wed			Site Survey		Hydrogeo	Site Survey	Social Survey	Hydrogeo	Geophys
20	4/26	Thu			Site Survey		Hydrogeo	Site Survey	Social Survey	Hydrogeo	Geophys
21	4/27	Fri			Site Survey		Hydrogeo	Site Survey	Social Survey	Hydrogeo	Geophys
22	4/28	Sat			Site Survey		Hydrogeological surv		Social Survey	Hydrogeo	Geophys
23	4/29	Sun			Site Survey		Hydrogeological surv		Data Compil	Hydrogeo	Geophys
24	4/30	Mon			Meeting w/DWAF; Site Survey		Hydrogeological surv		Social Survey	Hydrogeo	Geophys
25	5/1	Tue			Site Survey		Hydrogeological surv		Social Survey	Hydrogeo	Geophys
26	5/2	Wed			Site Survey		Hydrogeological surv		Social Survey	Hydrogeo	Geophys
27	5/3	Thu			Site Survey		Hydrogeological surv		Social Survey	Hydrogeo	Geophys
28	5/4	Fri			*EU Site Survey*		Hydrogeological surv		*EU Site Surv.*	Hydrogeo	Geophys
29	5/5	Sat			Site Survey		Hydrogeological surv		Data Compil.	Hydrogeo	Geophys
30	5/6	Sun			Data Compilation		Hydrogeological surv		Data Compil.	Hydrogeo	Geophys
					Team meeting						
31	5/7	Mon			Mtg w/DWAF Umt		Hydrogeo	Mtg DWAF	EU Site Surv.	Hydrogeo	Geophys
32	5/8	Tue			Mtg w/Dist. Munic.		Hydrogeo	Mtg w/Dist.	Municipality	Hydrogeo	Geophys
33	5/9	Wed			Move to EL		Hydrogeological surv		Move to EL	Hydrogeo	Geophys
34	5/10	Thu			Meeting with EU, DWAF EC		Hydrogeological surv		Mtg w/EU, DWAF EC	Hydrogeo	Geophys
35	5/11	Fri			Meeting with DWAF East Cape		Hydrogeological surv		Mtg w/DWAF EC	Hydrogeo	Geophys
36	5/12	Sat			*Move to JNB*		*Data Compilation*		*Move to Umt*	*Hydrogeo*	*Geophys*
37	5/13	Sun			Data Compilation		Move to JNB		Data Compilation	Hydrogeo	Geophys
					Team meeting						
38	5/14	Mon			Report to JICA, DWAF				Social Survey	Test Drill	Geophys
39	5/15	Tue			Leave Johannesburg				Social Survey	Test Drill	Geophys
40	5/16	Wed			Arrive Tokyo				Social Survey	Test Drill	Geophys
41	5/17	Thu							Social Survey	Test Drill	Geophys
42	5/18	Fri							Social Survey	Test Drill	Geophys
43	5/19	Sat							*Move to JNB*	*Test Drill*	*Geophys*
44	5/20	Sun							Lv. JNB	Test Drill	Geophys
45	5/21	Mon							Ar. Tokyo	Test Drill	Geophys
46	5/22	Tue								Test Drill	Geophys
47	5/23	Wed								Test Drill	Geophys
48	5/24	Thu								Test Drill	Geophys
49	5/25	Fri								Test Drill	Data Com
50	5/26	Sat								Move to JNB	
51	5/27	Sun								*Lv. Johannesburg*	
52	5/28	Mon								Ar. Tokyo	

2-2 Itinerary for Second Field Survey

(1) Water Source Survey

No.	Date	Day	Yokogi (Hydrogeology)
1	8/1	Wed	Leave Tokyo
2	8/2	Thu	Ar. Johannesburg, CC/report to JICA, Move to Umtata
3	8/3	Fri	Meeting with DWAF Umtata, Test boring site survey
4	8/4	Sat	Test boring site survey
5	8/5	Sun	Test boring site survey
6	8/6	Mon	Meeting with subcontractor
7	8/7	Tue	Test boring site transfer
8	8/8	Wed	Test boring site transfer
9	8/9	Thu	Supervision of test drilling
10	8/10	Fri	Supervision of test drilling
11	8/11	Sat	Supervision of test drilling
12	8/12	Sun	Supervision of test drilling
13	8/13	Mon	Supervision of test drilling
14	8/14	Tue	Supervision of test drilling
15	8/15	Wed	Supervision of test drilling
16	8/16	Thu	Supervision of test drilling
17	8/17	Fri	Supervision of test drilling
18	8/18	Sat	Supervision of test drilling
19	8/19	Sun	Supervision of test drilling
20	8/20	Mon	Supervision of test drilling
21	8/21	Tue	Report to DWAF Umtata
22	8/22	Wed	Move to Pretoria, Procurement survey
23	8/23	Thu	Procurement survey
24	8/24	Fri	Report to JICA, Leave Johannesburg
25	8/25	Sat	Arrive in Tokyo

(2) Main Survey

No.	Date	Day	Leader: Maruo	Coordinator: Furuichi	Chief Consultant: Fujii	Facilities Plan: Takamizawa	Cost Est./Procure.: Takamatsu
1	10/1	Mon		Leave Tokyo			
2	10/2	Tue		Arrive in Johannesburg			
			Courtesy call and report to JICA/Embassy of Japan, Meeting with DWAF				
3	10/3	Wed	Data collection, Meeting with DWAF, Meeting with JICA				
4	10/4	Thu	Meeting with Magalies Water Board, Meeting w/ KameelboomVWC and survey of water scheme				
5	10/5	Fri	Move to Umtata				
6	10/6	Sat	Observation of Umtata peri-urban (Fairfield village) water scheme and demonstration toilets (with Cuban delegation), Survey of study villages in Umtata and NgqeliniDistricts				
7	10/7	Sun	Move to East London			Preparation for topo survey	Move to East London
8	10/8	Mon	Presentation of Interim Report and discussions with concerned members				
9	10/9	Tue	Discussion on Minutes			Supervision topo survey	Cost/procurement survey, Move to JNB
10	10/10	Wed	*Finalize Minutes, Move to Pretoria*			Supervision topo survey	Cost/procurement survey
11	10/11	Thu	Signing of Minutes, Report to JICA			Supervision topo survey	Cost/procurement survey
12	10/12	Fri		Lv. JNB	Move to Umtata	Supervision topo survey	Cost/procurement survey
13	10/13	Sat		Transit	Mat'ls/equipment survey	Supervision topo survey	Cost/procurement survey
14	10/14	Sun		Ar. Tokyo	Mat'ls/equipment survey	Supervision topo survey	Cost/procurement survey
15	10/15	Mon			Site survey	Supervision topo survey	Cost/procurement survey
16	10/16	Tue			Meeting with Dep of Education	Supervision geosoil survey	Cost/procurement survey
17	10/17	Wed			Meeting with LM (Ntabankulu, Mhlontlo)	Supervision geosoil survey	Cost/procurement survey
18	10/18	Thu			Meeting with LM (Nyandeni, KSD)	Supervision topo survey	Cost/procurement survey
19	10/19	Fri			Mtg with DWAF Umtata/DM	Supervision topo survey	Cost/procurement survey, Report JICA
20	10/20	Sat			Mtg with DWAF Umtata, Mtg w/DoE	Supervision topo survey	Leave Johannesburg
21	10/21	Sun			Meeting with DWAF Umtata	Supervision topo survey	Arrive Tokyo
22	10/22	Mon			Site survey	Supervision topo survey	
23	10/23	Tue			Mtg w/ O. R. Tambo DM, Move to EL	Supervision topo survey	
24	10/24	Wed			Report to DWAF EC, Move to Pretoria, Report to JICA	Supervision topo survey	
25	10/25	Thu			Report to DWAF, Lv. Johannesburg	Supervision topo survey	
26	10/26	Fri			Arrive in Tokyo	Supervision topo survey	
27	10/27	Sat				Procure survey	
28	10/28	Sun				Move to JNB	
29	10/29	Mon				Procure survey, Lv. JNB	
30	10/30	Tue				Ar. Tokyo	

2-3 Itinerary for Draft Report Explanation

	Date	Day	Leader: Matsuura	Tech Adviser: Maruo	Coordinator: Miyake	Chief Consult: Fujii	Facilities Plan: Takamizawa	Cost Est./Procure.: Takamatsu
1	1/28	Mon			Lv. Tokyo			
2	1/29	Tue			Ar. Johannesburg			
				C.C. & meeting with JICA, Embassy of Japan				
3	1/30	Wed		Lv. Johannesburg, Ar. East London Meeting with DWAF Eastern Cape				Procurement Survey
4	1/31	Thu		Workshop on Draft Report				Procurement Survey
5	2/1	Fri		Discussion on M/D; Move to Umtata; Site Survey				Procurement Survey
6	2/2	Sat	Lv. Tokyo	Site Survey				Procurement Survey
				Move to East London			Survey Prep	
7	2/3	Sun	Ar. East London	Team meeting; Preparation of M/D			Facilities Plan Survey	Lv. JHB, Ar. EL; Team meeting
8	2/4	Mon	Finalization and signing of M/D				Facilities Plan Survey	Final. & sign M/D
9	2/5	Tue	Lv. East London, Ar. Johannesburg, Move to Pretoria Report to JICA and Embassy of Japan				Facilities Plan Survey; Lv. UTA, Ar. JHB	Lv. EL, Ar. JHB; Procurement Survey
10	2/6	Wed	Meeting with DWAF; Meeting with EU				Procurement Survey	
11	2/7	Thu	Lv. JHB		Lv. JHB	Procurement Survey; Lv. Johannesburg, Ar. Umtata		Lv. JHB
12	2/8	Fri	Other Project		Transit	Meeting with DWAF; Meeting with OR Tambo DM		Ar. Tokyo
13	2/9	Sat	Transit		Ar. Tokyo	Survey on Facilities Plan and Procurement		
14	2/10	Sun	Transit			Site Survey		
15	2/11	Mon	Ar. Tokyo			Water Source Survey; Lv. UTA, Ar. JHB		
16	2/12	Tue				Procurement Survey		
17	2/13	Wed				Lv. Johannesburg		
18	2/14	Thu				Ar. Tokyo		

APPENDIX 3 LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

Department of Water Affairs and Forestry (DWAF)

Mr. *Junior Potloane*	*Deputy Director-General*
	Regional Operations and Water Services
Ms. Tamie Mpotulo	Chief Director, Water Services

Directorate: International Liaison

Mr. Mmamautswa Ngoatje	Director
Mr. Leo Van Den Berg	Senior Specialist Engineer
Mrs. Jean Kou	Assistant Director, Overseas Liaison Officer

Directorate: Geohydrology

Mr. Eberhard Braune	Director
Mr. Boniface Aleobua	Deputy Director

Directorate: Legal Services

Ms. Nivashnee Naraindath	Legal Officer

DWAF Eastern Cape

Mr. Trevor Balzer	Former Chief Director

Directorate: Planning Development and Implementation

Ms. Thandeka Mbassa	Director (Acting Chief Director)
Mr. Rogers Jack	Deputy Director, Planning & Implementation West
Mr. Z. Seti	Assistant Director, Institutional and Social Development West
Ms. Portia Makhanya	Expert, Monitoring and Evaluation, Information Services
Ms. Malebo Makgabo	Geographer, GIS, Information Services

Directorate: Water Resource Management

Ms. Lerato Mokoena	Deputy Director, Geohydrology
Mr. Wandile Nomquphu	Assistant Director, Geohydrology
Ms. Nosisa Gwegwana	Hydrologist, Geohydrology

Directorate: Operation and Maintenance

Mr. Dewald Coetzee	Director

European Union Support Programme

Mr. Uli Glatz	Assistant Programme Manager

DWAF Umtata Office

Sub-Directorate: Planning and Implementation East

Mr. Galelo Mbambisa	Deputy Director, Chief Engineer
Mr. Nkosinati Gule	Chief Technician
Mr. Mzamo Vonco	Technician
Ms. Nombasa Ndamase	Technician

Water Resources Management

Ms. Pacifica Sekoateng	Principal Hydrologist

Sub-Directorate: Institutional and Social Development East

Mr. Lufefe Ngedle	Assistant Director
Mr. Gezani Mabunda	Former Deputy Director
Mr. Bongani Matomela	Principal Community Development Officer

Oliver R. Tambo District Municipality

Ms. Nombulelo Mngoma	Permanent Councillor, Health & Welfare, Water, Sanitation and Environment

Sub-Directorate: Water and Sanitation

Ms. S. Skenjana	Secretary
Mr. O. N. Hlazo	Assistant Director, Planning and Implementation Section
Mr. Mawetu Mtengwane	Technician, Planning and Implementation Section
Mr. Alexander Mkondo	Assistant Director, Sanitation section
Mr. Sisa Mfithi	Former Assistant Director, Water Section
Mr. Mzi Mankazana	Former Staff
Mr. Sharewell Matshaya	Director, Finance Department
Mr. Viwe Mpekula	Finance Section

Ntabankulu Local Municipality

Mr. P. S. Matshoba	PR Councillor
Ms. J. N. Ruleni Mpompoze	PR Councillor
Ms. A. N. Ntamo	Ward Councillor
Mr. Tota Pikwa	PR Councillor
Ms. N. Mazwi	Municipal Manager

Mhlontlo Local Municipality

Mr. M. Socikwa	Speaker

King Sabata Dalindyebo Local Municipality

Mr. Mgudlwa	Mayor

Nyandeni Local Muncipality

Mr. M. R. Mtobela	Technical and Infrastructure
Mr. Matyunjwa	Works Manager
Mr. T. A. Thunzi	Technical and Infrastructure
Ms. F. Mqwedane	Youth, Gender and Disabled

European Union (EU)

Dr. Charles Reeve	Project Officer, water and Sanitation
Mr. Wout Soer	Former Project Officer
Ms. Nicoletta Merlo	Former First Secretary (Development)

Embassy of Japan, South Africa

Mr. Hayato Ishizuka	First Secretary
Ms. Yoko Doi	Special Assistant for Development, Development Assistance Section

Japan International Cooperation Agency (JICA) South Africa Office

Mr. Yoshiyuki Takahashi	Resident Representative
Mr. Yoshihiro Imamura	Assistant Resident Representative

APPENDIX 4 COST ESTIMATION BORNE BY THE RECIPIENT COUNTRY

The estimation of costs of the main items to be borne by the South African side as an obligation of the project is presented below.

1. Cost for Power Line Extensions

The cost for power line extensions from existing grids of commercial supply lines within 1 km from the Project power stations (6 sites) and 3-phase connections to Project water schemes will be as follows. Extensions and connections for the remaining 9 sites will be borne by the Japanese side.

a. Power Extension Cost: ZAR 2,600/extension × 6 schemes
= ZAR 15,600

b. Cost for 3-Phase Connection: ZAR 55,000/km × 2.02km
= ZAR 111,100

c. Total Cost: ZAR 126,700

2. Cost for Operation and Maintenance of Water Supply Facilities

The required costs for operation and maintenance of the completed 15 water schemes as explained in Chapter 4 are summarized below.

a. Annual O&M Cost: ZAR 565,901/yr

b. Monthly O&M Cost: ZAR 47,158/mon

c. Average Monthly per Household Payment (assuming 50% collection rate): ZAR 18/mon/HH

3. Shared Cost of Institutional and Social Development Program

The funding for the ISD intervention program for this project will be shared between the South African government and Japanese government. The Japanese side will fund the activities centered on formation and capacity building of PSC and VWSC to be conducted during the pre-construction and construction stages. The costs required by the South African side will include the following.

a. Program cost for assisting O. R. Tambo DM to properly function as the WSA

ISWIP:	ZAR 57,558
Interim Institutional Support Initiative:	ZAR 243,978
MAAP:	ZAR 5,795,400 (conditional)
Sub-Total Cost:	ZAR 6,096,936

b. Cost for implementing the mentorship activities during the post-construction period which include creation and training of WSP, as well as monitoring and evaluation.

Sub-Total Cost: ZAR 1,130,000 (rough estimate)

c. Salaries and incremental costs of ISD staff of DWAF for supervision requirements of ISD intervention: These costs should be estimated by the South African side

d. Total Cost (excluding c.): ZAR 7,226,936

4. Grand Total Cost to be borne by the South African Side (including conditional as well as rough estimate figures)

Grand Total: **ZAR 7,353,636**

and **ZAR 565,901/yr Running Cost**

APPENDIX 5 MINUTES OF DISCUSSIONS / TECHNICAL NOTE

MINUTES OF DISCUSSIONS
THE BASIC DESIGN STUDY
ON
THE PROJECT FOR RURAL WATER SUPPLY AND PROVISION OF SANITATION
IN EASTERN CAPE,
THE REPUBLIC OF SOUTH AFRICA

In response to a request from the Government of the Republic of South Africa (hereinafter referred to as "South Africa"), the Government of Japan decided to conduct a Basic Design Study on the Project for Water Supply and Provision of Sanitation in Eastern Cape (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the South Africa the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Dr. Yuji Maruo, Senior Technical Advisor, JICA, and is scheduled to stay in the country from 7 April to 27 May 2001.

The Team held discussions with the officials concerned of the Government of South Africa and conducted a field survey at the study area.

In the course of discussions and field survey, both parties noted the main items described on the attached sheets. The Team will proceed to further works and prepare the Interim Basic Design Study Report.

King William's Town, 19 April, 2001

丸尾祐治

Dr. Yuji Maruo
Leader
Basic Design Study Team
Japan International Cooperation Agency
(JICA)

Trevor Balzer

Mr. Trevor Balzer
Chief Director, Eastern Cape Region
Department of Water Affairs and Forestry
(DWAF)

ATTACHMENT

1. Objective of the Project
   The objective of the Project is to improve the conditions in water supply and sanitation in the Province of the Eastern Cape through the provision of adequate water supply and sanitation facilities.
2. Project site
   The Project sites are located in two District Municipalities of Eastern Cape, as shown in Annex-1.
3. Responsible and Implementing Agency
   The responsible organization is Department of Water Affairs and Forestry (hereinafter referred to as "DWAF"). The implementing organization is Department of Water Affairs and Forestry Eastern Cape.
4. Items requested by the Government of South Africa
   Construction of adequate water supply facilities and demonstration toilets in 30 villages which are shown in Annex-2.
5. Japan's Grant Aid Scheme

5.1. The South African side understands the Japan's Grant Aid Scheme explained by the Team, as described in Annex-3.

5.2. The South African side takes note of and agrees in principle to take the necessary steps to comply with the measures, as described in Annex-3, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented. Both sides agree that the measures as described in Paragraphs 6 ,7 and 9 of Annex-3 will be further discussed during the period that the Field Survey is conducted. The financial implications of the undertakings will also be determined during this stage.

6. Schedule of the Study

6.1. The consultants will proceed to further studies in South Africa until 27 May 2001.

6.2. This basic design study consists of two stages: Stage I and Stage II, each containing a field survey and a home study. At the end of Stage I, the Team will submit the Interim Report around September, 2001. Successively, the Team will explain the contents of the report and a session of discussion will be held at the beginning of Stage II. At the end of Stage II, the team will submit the Draft Final Report based on which discussion will be made between the two parties around January, 2002.

7. Other relevant issues

7.1. Study Target Villages
   Both sides recognized that 30 villages listed in Annex-2 are the target sites for the Stage I of the Basic Design Study.

7.2. Prioritization on the Target Villages
   During the Stage I study, priorities will be made on the 30 target villages by applying various criteria as follows: groundwater potential, existing facilities, preparedness and awareness of the community, affordability of the residents, cost-effectiveness and others. The financial viability of schemes will also be determined during the course of the study. The Team takes note of the strategy being developed by Government for the provision of free basic water supply.

7.3. Selection for Design
   As a result of Stage I study, adequate number of the candidate sites will be selected for the design work which will be conducted during the Stage II study.

7.4. Test Drilling Work
   To estimate the groundwater potential to meet the water demand for each of the

identified schemes, test drillings and pumping tests will be conducted at 6 selected sites during the Stage I. In case the groundwater potential at the particular sites cannot be fully confirmed, some additional test drilling works will be carried out at a later time. In this case, the submission of the Interim Report may be duly delayed.

7.5. Conformity of facilities to RDP Standards

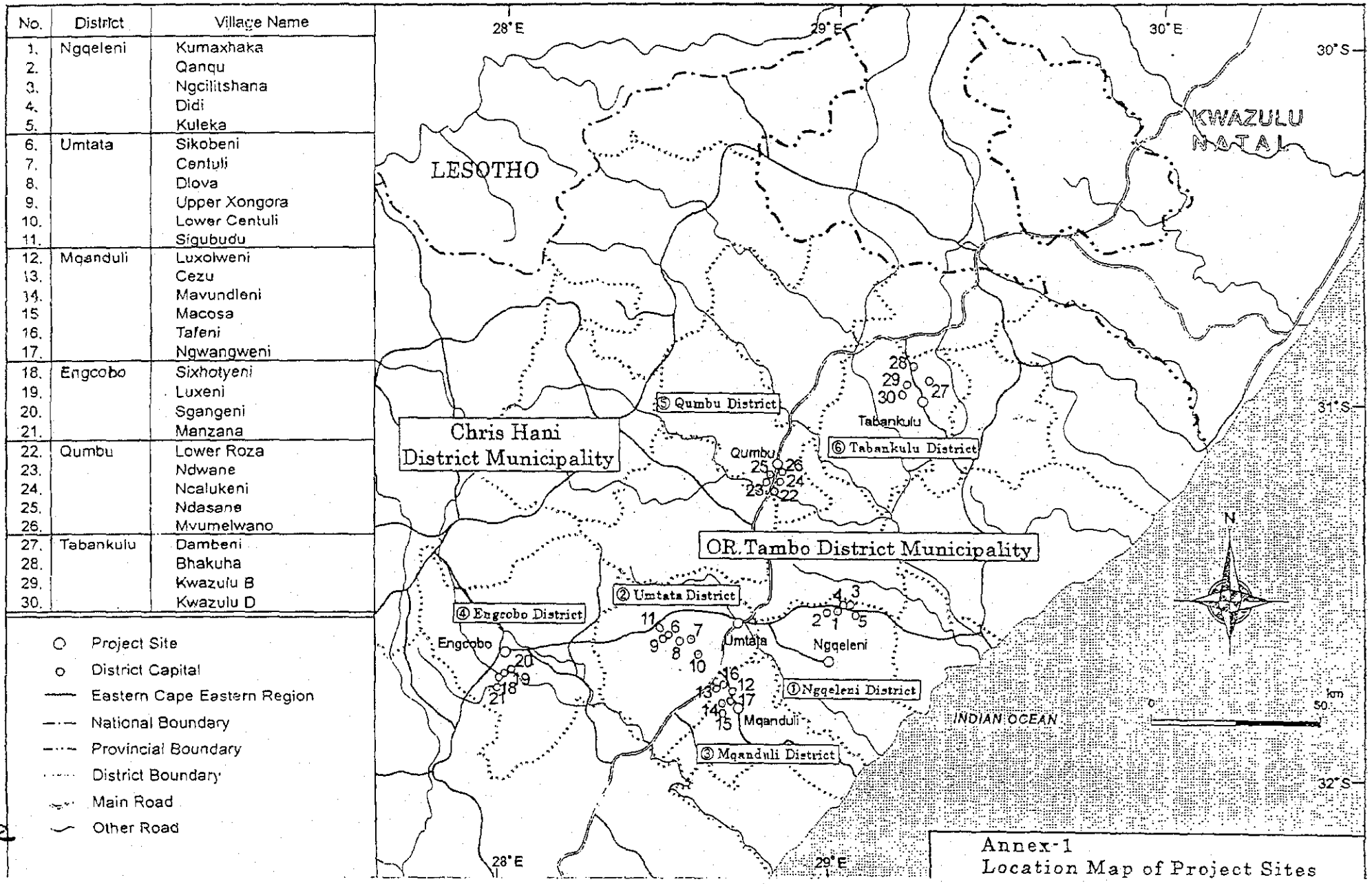
The water supply facilities shall be in conformity with the RDP standards with certain allowances for modifications wherever conditions require.

7.6. Lump-sum contract for Implementation

The South African side expressed their concern for the maximum utilization of local resources. In this regard, the Team explained the contract for implementation of the project would be awarded to the selected prime contractor on a lump-sum cost basis according to Japan's grant assistance guidelines. The South African side understood the explanation.

7.7. Both sides take note that the relevant District Municipalities will be involved in the project and that on completion, projects will be transferred to the responsible District Municipality.

No.	District	Village Name
1.	Ngqeleni	Kumaxhaka
2.		Qanqu
3.		Ngcilitshana
4.		Didi
5.		Kuleka
6.	Umtata	Sikobeni
7.		Centuli
8.		Dlova
9.		Upper Xongora
10.		Lower Centuli
11.		Sigubudu
12.	Mqanduli	Luxolweni
13.		Cezu
14.		Mavundleni
15		Macosa
16.		Tafeni
17.		Ngwangweni
18.	Engcobo	Sixhotyeni
19.		Luxeni
20.		Sgangeni
21.		Manzana
22.	Qumbu	Lower Roza
23.		Ndwane
24.		Ncalukeni
25.		Ndasane
26.		Mvumelwano
27.	Tabankulu	Dambeni
28.		Bhakuha
29.		Kwazulu B
30.		Kwazulu D



Annex-1
Location Map of Project Sites

Annex-2

List of Project Sites

Province	District Municipality	Magisterial District	Village			Population*[1]
			Name		Number	
Eastern Cape	Oliver Tambo	Ngqeleni	1.	Kumaxhaka	5	1,293
			2.	Qanqu		1,260
			3.	Ngcilitshana		1,048
			4.	Didi		1,260
			5.	Kuleka		873
		Umtata	6.	Sikobeni	6	798
			7.	Centuli		980
			8.	Dlova		5,588
			9.	Upper Xongora		1,969
			10.	Lowe□ Centuli		2,349
			11.	Sigubudu		910
		Mqanduli	12.	Luxolweni	6	353
			13.	Cezu		2,493
			14.	Mavundleni		1,694
			15.	Macosa		830
			16.	Tafeni		750
			17.	Ngwangweni		460
	Chris Hani	Engcobo	18.	Sixhotyeni	4	615
			19.	Luxeni		57
			20.	Sigangeni		293
			21.	Manzana		4,730
	Oliver Tambo	Qumbu	22.	Lower Roza	5	2,636
			23.	Ndwane		1,330
			24.	Ncalukeni		1,838
			25.	Ndasane		1,265
			26.	Mvumelwano*2		1,648
		Tabankulu	27.	Dambeni	4	3,820
			28.	Bhakuba		1,068
			29.	Kwazulu B		1,569
			30.	Kwazulu D*2		400
	Total				30	46,177

N.B.: *[1] The population figures listed here were supplied by DWAF Eastern Cape office.

*[2] These villages were requested as substitutes for Kubhonxa and Mpisini villages of Tabankulu because the two originally requested villages are already being implemented.

Annex-3

Japan's Grant Aid Procedures

1. Procedures of Grant Aid

1) Japan's Grant Aid Programme is executed through the following procedures.

Application:	(Request made by a recipient country)
Study:	(Basic Design Study conducted by JICA)
Appraisal & Approval:	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation:	(The Notes exchanged between the Governments of Japan and the recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraise the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the result are then submitted to the Cabinet for approval.

Fourthly, the Project, once approved by the Cabinet, with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the Project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study, conducted by JICA on a requested project is to provide basic document necessary for the appraisal of the project by the Japanese Government. The contents of the Study are as follows:

a) Confirmation of items agreed on by both parties concerning the basic concept of

the project.

b) Evaluation of the appropriateness of the project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the project.

d) Preparation of a basic design of the Project.

e) Estimation of the costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid Project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations in the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For the smooth implementation of the study, JICA uses (a) registered consultant firm(s). JICA selects (a) firms(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out the Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

The consulting firm(s) used for the study is (are) recommended by JICA to the recipient country to also work on the project's implementation after the Exchange of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

3. Japan's Grant Aid Scheme

1) What is Grant Aid ?

The Grant Aid Program provides a recipient country with non-reimbursable funds needed to procure the facilities, equipment, services (engineering services and transportation of the products, etc.) for economic and social development the country under the principals in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes Exchanged by the two Governments concerned, in which the objectives of the project, period of execution,

conditions and amount of the Grant, etc., are confirmed.

3) "The period of the Grant" means the one fiscal year in which the Cabinet approves the project for. Within the fiscal year, all procedure such as exchanging of Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed.

However in case of delays in delivery, installation or construction due to unforeseen factor such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Government.

4) Under the Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When both Governments deem it necessary, the Grant may be used for the purchase of the products or services of the third country.

However the prime contractors, namely, consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality

5) Necessity of "Verification"
The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required of the Government of recipient country
In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as the follows:

a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.
b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.
c) To secure buildings prior to the procurement in case the installation of the equipment.
d) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of products purchased under the Grant.
e) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies

which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

f) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their works.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign the necessary staff for operation and maintenance of them as well as to bear all the expenses other than those covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid shall not be re-exported from recipient country.

9) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan(hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

Minutes of Discussions
The Basic Design Study
on
The Project for Rural Water Supply and Provision of Sanitation in Eastern Cape, The Republic of South Africa
(The Second Field Survey)

In response to a grant aid request from the Government of the Republic of South Africa (hereinafter referred to as "South Africa"), the Government of Japan decided to conduct a Basic Design Study on the Project for Rural Water Supply and Provision of Sanitation in Eastern Cape (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA") .

JICA sent to the South Africa the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Dr. Yuji Maruo, Senior Technical Advisor, JICA. The first field survey was conducted from 8 April to 27 May, 2001, and the second field survey started from 2 October, 2001 and is scheduled to continue until 29 October, 2001.

The Team held discussions with the officials concerned of the Government of South Africa and conducted a field survey in the study area.

In the course of discussions on the Interim Basic Design Study Report and the field survey, both parties have confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Draft Final Basic Design Study Report.

Pretoria, 11 October, 2001

九尾祐治

Dr. Yuji Maruo
Leader
Basic Design Study Team
Japan International Cooperation Agency
(JICA)

11/10/2001

Mr. Dewald Coetzee
Acting Chief Director
Eastern Cape Region
Department of Water Affairs and Forestry
(DWAF)

ATTACHMENT

1. Screening of the Project Site

The number of villages requested by South African side is 30 in two District Municipalities, which are the target of the first field survey. Based on the information collected in the first field survey, the 30 villages are put through a screening process applying various criteria shown in Annex-1. As a result of this screening, 8 villages are deleted from further study due to the reasons stated in Annex-2, and 22 villages remained as shown in Annex-3.

2. Prioritization of Candidate Project Site

The remaining 22 villages are prioritized according to the criteria shown in Annex-1 due to limitations in budget for implementation. Tentative priorities are shown in Annex-3 and these could be revised in the Draft Final Report based on further studies.

3. Design Concept of Water Supply Schemes

3-1. Water supply schemes will be designed according to "Reconstruction and Development Programme (RDP)" standards.

3-2. There are a few villages where no public power line is available. However, the South African side stressed that public power supply should be regarded as the power source for the water supply scheme of the present project instead of diesel engine in taking the view of much lower costs for operation and maintenance. In this connection, the Japanese side explained that cost of the extension of the power line to those villages must be borne by the South African side.

4. Sanitation

South African side emphasized that due consideration should be paid on the investment in the field of sanitation in order to alleviate waterborne diseases such as cholera. Both sides agreed that VIP latrines should be constructed in primary schools where there is no latrine, where there are latrines but are not functioning, and where the number of the latrines are inadequate compared to the number of children. Japanese side explained that the adequacy of existing toilets at the primary schools of the 22 candidate project villages would be further surveyed.

5. Institutional Arrangement of District Municipality

According to Water Service Act (Act No.108, 1997), Municipal Infrastructures Act (Act No.117, 1998), Ammendment of Municipal Infrastructures Act (2001), and Municipal Systems Act (Act No.32, 2000), District Municipality will be responsible for operation and maintenance of the facilities and take up the role of water services authority. South African side will take necessary measures to strengthen the institutional capacity in operation and maintenance of the relevant District Municipality. Rural water services infrastructure presently operated by DWAF will be transferred to the District Municipality. Staff presently operating infrastructure will be also transferred to the District Municipality thereby enhancing their operation and maintenance capacity. Prior to initiating the Project, DWAF will enter into agreement with the District Municipality whereby the District Municipality will accept full responsibility, financial and otherwise, for the sustained operation and maintenance of the Project.

6. Budgetary Arrangement for Operation and Maintenance

South African side shall make every effort to ensure enough budget as estimated by Japanese side to operate and maintain the facilities and equipment after the completion of the project, in light of the Free Basic Water Policy. South African side confirmed that the necessary budget would be provided for the Local Municipality for operation and maintenance of the Project facilities from the fiscal year starting April 2003. Presently, the Equitable Share (a grant in terms of the Division of Revenue Act, Act No.1, 2001, to Local Municipality) for households with income less than R800/month is about R80/household/month and the portion which is supposed to be spent for operation and maintenance of water supply facilities is R30/household/month.

7. Free Basic Water Policy

The Government of South Africa developed an implementation plan for "Free Basic Water Policy", which would enable people to get 6,000 liters of free water per household per month. The starting date for implementation by local government structures was 1 July, 2001. Free basic water is to be funded using a combination of the Equitable Share of revenue of local government and internal cross-subsidies from appropriately structured water tariffs in a manner which best reflects the specific situation in the respective local government area. According to the implementation plan, consumers should continue to pay for water until they are informed by their municipalities on the actual date of implementation in their respective areas.

8. Institutional and Social Development (ISD) Issues

South African side requested assistance to ISD activities for communities in the target villages for upgrading sustainability of operation and maintenance of the facilities. South African side noted that the standard program for ISD being used by DWAF could be developed for the present project. Japanese side would consider the request and possibility of assistance to part of the activities.

9. Necessary Measures to be taken by South African Side

9-1. South African side agrees in principle to take the necessary steps, which includes the discussion with O.R. Tambo District Municipality, to comply with the measures, as described in Annex-4, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

9-2. Japanese side explained those items described in Annex-4 are some of basic principles of Japanese Grant Aid Scheme.

9-3. South African side, however, made proposals on the contents of paragraphs 1, 2, 3, and 9 of Annex-4 as follows:

- Paragraph 1: Land necessary for the site does usually not have to be purchased in the rural tribal areas. Levelling of the site should be done by the main contractor. The sentence should be amended as "to facilitate access to land and agreements with local authorities necessary to construct the facilities".
- Paragraph 2: The word "drainage" should be deleted as this should also be done by the main contractor.
- Paragraph 3: Expenses mentioned in the paragraph should be planned two years before the implementation, so that Japanese side should inform to South African

side the amount of cost necessary for the items mentioned in the paragraph.

- Paragraph 9: The expression "all the expenses other than those" should be clarified in more detail.

9-4. Both side agree that the measures as described in paragraphs 1, 2, 3, and 9 of Annex-4 will be further discussed during the period of forthcoming mission of Explanation of Draft Final Report.

9-5. South African side promised to exempt Japanese juridical and physical nationals engaged in the Project from customs duties, internal taxes including VAT and other fiscal levies which may be imposed in South Africa with respect to the supply of the products and services under the verified contracts. South African side shall duly take procedure necessary to be responsible for payment of taxes mentioned above.

10. Schedule of the Study

10-1. During the second field survey, the Team submitted the Interim Report to South African side, explained the contents of the report, and had discussions about the report. South African side basically agreed on the contents of the Interim Report.

10-2. The consultants will proceed to further studies in South Africa until 29 October, 2001, as the second field survey of the Basic Design Study.

10-3. After compiling the results of the first and second field surveys, the team will submit the Draft Final Report around January, 2002.

END

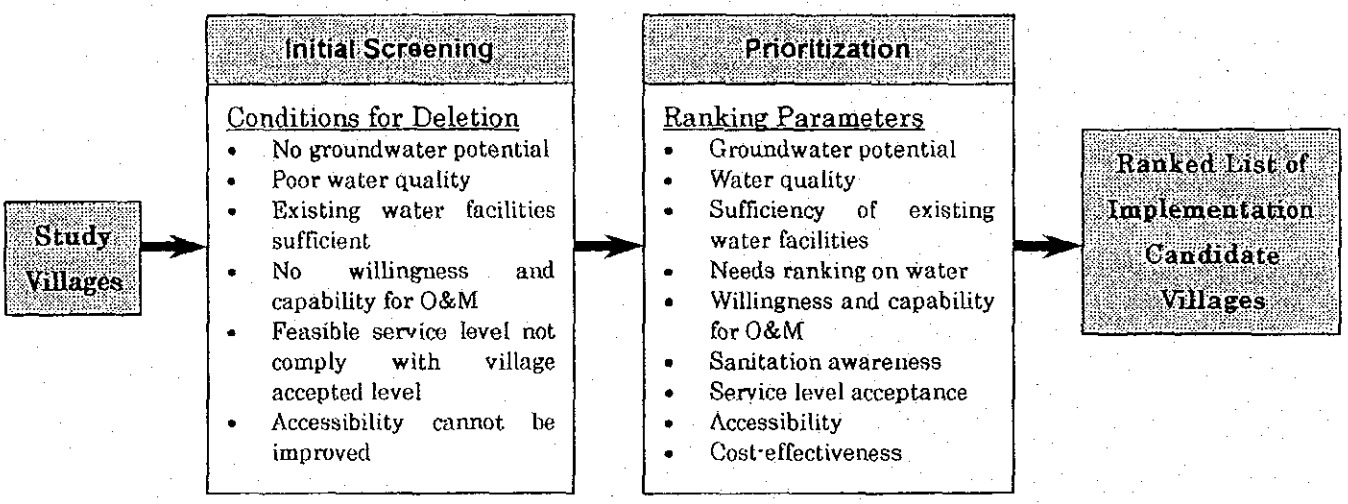
Annex-1 Criteria for Screening and Prioritizing the Project Site (Water supply)

Annex-2 Villages Excluded from Project Site (Water Supply)

Annex-3 Revised Project Site with Priority (Water Supply)

Annex-4 Necessary Measures to be taken by South African Side

Annex-1 Criteria for Screening and Prioritizing the Project Site (Water Supply)



Annex-2

Villages Excluded from Project Site (Water Supply)

Local Municipality	Village	Reason for Exclusion
KSD (King Sabata Dalindyebo)	Lower Centuli	Water quality is detrimental to health (Fluoride: 1.87 mg/l). No willingness or capability for operation and maintenance, and very low level of ownership.
	Macosa	Existing water facilities can meet demand of population (tap number is sufficient, but not to RDP standard of within 200 m). Needs for water is low.
	Ngwangweni	Groundwater potential is very low. Site having relatively higher potential is located at the bottom of a very steep valley where water fetching would be extremely difficult.
Engcobo	Sixhotyeni, Luxeni, Sigangeni, Manzana	Existing water supply system covering the target villages as well as other non-targeted villages can meet demand of all villages if the pump engine is repaired. If new system to cover only target villages is constructed, many problems can arise.
Ntabankulu	Kwazulu D	Water quality is detrimental to health (Arsenic: 0.069 mg/l).

Annex-3

Revised Project Site with Tentative Priority (Water Supply)

Province	District Municipality	Local Municipality	Village	Priority
Eastern Cape	Oliver Tambo	Nyandeni	Kumaxhaka	1
			Qanqu	9
			Ngcilitshana	2
			Didi	2
			Kuleka	7
		KSD (King Sabata Dalindyebo)	Sikobeni	2
			Centuli	8
			Dlova	6
			Upper Xongora	4
			Sigubudu	3
			Luxolweni	10
			Cezu	5
			Mavundleni	5
			Tafeni	10
		Mhlontlo	Lower Roza	11
			Ndwane	11
			Ncalukeni	11
			Ndasane	12
			Mvumelwano	12
		Ntabankulu	Dambeni	5
			Bhakuba	5
			Kwazulu B	7
			Total : 22 villages	

Note: Villages of some priority receive same evaluation ranking.
For some cases, villages of same priority share one water supply scheme.

Annex-4

Necessary Measures to be taken by South African side

In the implementation of the Japanese Grant Aid Project, the government of the recipient country is required to undertake such necessary measures as follows:

1. To provide land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

2. To provide facilities for the distribution of electricity up to the constructed facilities, and drainage and other incidental facilities in and around the sites as necessary.

3. To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of products purchased under the Grant in case products are imported.

4. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

5. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their works.

6. To maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign the necessary staff for operation and maintenance of them.

7. To provide full police security at any sites requiring such measures to assure the safety of the said Japanese nationals.

8. To bear the advising commission for an Authorization to Pay (A/P) and the payment commission to the Japanese foreign exchange bank for the banking services based upon the banking arrangement (B/A).

9. To bear all the expenses other than those covered by the Grant Aid.

The Project for Rural Water Supply and Provision of Sanitation in Eastern Cape of the Republic of South Africa
Technical Note for Second Field Survey

The second field survey of the JICA Study Team for the above-captioned project is scheduled to continue until the 29th October 2001. The present status of the field survey is summarized below for confirmation by both sides.

1. Confirmation of Study Target Villages
   - During the first field survey, discrepancies in the names of the target villages could not be clarified. Therefore upon clarification and confirmation with relevant municipalities during the second field survey, the names of study villages will be fixed by the end of the second field survey so that these names can be used throughout the period of the project.
   - The villages that are planned for implementation through other funding will be deleted from the list. These villages will be confirmed by DWAF before the end of the second field survey.

2. Confirmation on Present Status of Relevant District Municipality and Local Municipalities on Water Services Functions
   - O.R. Tambo District Municipality is the District Municipality (DM) responsible for operation and maintenance of the project facilities after their completion, and would function as the water services authority.
   - The District Municipality will structure a plan for effective management, operation and maintenance of the project facilities before December 2001.
   - Four Local Municipalities (KSD, Nyandeni, Mhlontlo and Ntabankulu) cover the 22 candidate project villages. Each of the Local Municipalities (LM) have differing capabilities and budget allocations, but all are stating that they are not receiving enough budget (including the equitable share) to properly operate and maintain the water supply facilities. However, Ntabankulu seems to have the highest capability of the four LMs, while Nyandeni seems to have the least.
   - All municipalities confirmed that Free Basic Water could not be implemented for quite some time and that they are ready to collect fees from the villagers to cover the expenses for operation and maintenance. Further, the municipalities said they would expend their best efforts to convince the villagers to contribute to the operation and maintenance procedures.
   - The present structure of the municipalities showed that many of them require capacity building to provide proper water services for the project villages.

3. Request for ISD assistance
   - Both sides agreed that an effective ISD program is needed for institutional strengthening and capacity building of WSA, WSP and CBO.
   - ISWIP and MAAP programs will assist O. R. Tambo District Municipality in capacitating them to function as WSA.
   - As discussed during the presentation of the Interim Report, the implementation of the proposed ISD program will be shared between both sides.
   - DWAF has agreed to identify the portion to be implemented by the South African side and to submit a request to the Japanese government for implementation of the remaining portion of the program which cannot be covered by the South African side.
   - Both sides agreed that if any portion of the program cannot be implemented by either side, then the project itself cannot be implemented.

4. Selection of Villages for Provision of Sanitation
   - As a result of the discussions held during the presentation of the Interim Report, both sides agreed that provision of toilets would be focused on primary schools of the 22 project candidate villages upon further considerations through additional survey of existing toilets in the schools.
   - The toilets as well as the tapstands to be installed in schools would be maintained by the schools as confirmed by the Office of Education. However, DWAF agreed to hold an interdepartmental meeting between the Department of Education and DWAF to confirm the construction of facilities in the school.
   - The selection process will be modified from the procedure explained in the Interim Report. The schools having no toilets and those having broken or non-functioning toilets will be given highest consideration for implementation. The schools having insufficient toilets would be given further consideration for implementation depending on their degree of necessity for additions.
   - The selection will be done in Japan upon analyzing the survey results from the second field survey.

Both sides confirmed the above-mentioned items.

Umtata, 19 October 2001

Mbambisa 19/10/01

Mr. Galelo Mbambisa
Deputy Director, Planning & Implementation
DWAF Umtata

19/10/01

Mr. Shoji Fujii
Chief Consultant
JICA Study Team

MINUTES OF DISCUSSIONS
ON BASIC DESIGN STUDY
ON
THE PROJECT FOR RURAL WATER SUPPLY AND PROVISION OF SANITATION
IN EASTERN CAPE, THE REPUBLIC OF SOUTH AFRICA
(EXPLANATION ON DRAFT FINAL REPORT)

In April 2001, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study Team on the Project for Rural Water Supply and Provision of Sanitation in Eastern Cape (hereinafter referred to as "the Project") to the Republic of South Africa, and since then the Team have conducted the study through discussion, field survey, and technical examination of the study results in Japan, and JICA prepared a draft final report of the study in February 2002.

In order to explain and to discuss with officials of the Government of South Africa on the contents of the draft final report, JICA sent a Final Report Explanation Team (hereinafter referred as to "the Team"), which is headed by Mr. Shozo Matsuura, Managing Director, Grant Aid Management Department, JICA, from January 29th to February 12th, 2002.

As a result of discussions, both parties confirmed the main items of the discussion described on the attached sheets.

King William's Town, February 4th, 2002

Mr. Shozo Matsuura
Leader
Draft Report Explanation Team
Japan International Cooperation Agency
(JICA)

Ms. Thandeka Mbassa
Acting Chief Director, Eastern Cape Region
Department of Water Affairs and Forestry (DWAF)

ATTACHMENT

1. The Project Formulation

The South African side accepted in principle the project formulation (Basic Design) described in the draft final report explained by the Team.

2. Japan's Grant Aid Scheme

The South African side reconfirmed and understood mechanism of Japan's Grant Aid Scheme applied to the Project (See Annex-3 of Minutes of Discussions signed by both sides on April 19th 2001).

3. Schedule of the Study

JICA will finalize the report based on the result of discussions and forward it to the Government of South Africa around May 2002.

4. Project Site

As the result of Basic Design (Ⅱ), twenty one (21) villages in Oliver R. Tambo District Municipality listed in Annex-1 are selected as Project site.

5. Free Basic Water Policy and the Project

Both sides reconfirmed that free basic water policy (See clause 7 in ATTACHMENT of the Minutes of Discussions signed by both sides on October 11th 2001) would not be introduced into the project sites for the time being until the District Municipality becomes fully capable of managing water services in terms of financial viability and institutional capacity.

6. Notification of Water Service Jurisdictional Transfer

DWAF will notify the Embassy of Japan and JICA South Africa office accordingly when jurisdictional transfer of water service agreement (See clause 5 in ATTACHMENT of the Minutes of Discussions signed by both sides on October 11th 2001) will come into effect.

7. Institutional and Social Development (ISD)

Both side agreed to share the responsibility in implementation of ISD programme (See clause 8 in ATTACHMENT of the Minutes of Discussions signed by both sides on October 11th 2001), which is itemized in Annex-3.

8. Electric Power Line Extension

The South African side will extend the power line and make available for 3-phase 380V motor pump operation in the case where existing grids are within one (1) kilometer from the project pump stations. Power extension of more than one (1) km will be responsibility of Japanese side. The extension work of each site must be completed by the time of installation of pump.

9. Sanitation and Confirmation of Department of Education

As the result of basic design study, four (4) schools in four (4) villages which are included in the twenty one (21) villages are finally selected for the site of sanitation facilities construction (See Annex-2). DWAF has agreed to submit to the Team the letter issued by Department of Education. This letter should confirm that Department of Education agrees with the construction plan and taking responsibility for maintenance of sanitation facilities in the primary schools. The letter should be made available before February 12th. If it is not available by the time, the provision of sanitation will be excluded from the project.

10. Necessary Measures to be taken by the South African Side

The Japanese side explained that the items described in Annex-4 are the basic principles of the Japanese grant aid scheme. The South African side agreed to take the necessary steps to comply with the measures described in Annex-4 for smooth implementation of the project, as a condition for the Japanese grant aid to be implemented.

Annex-1

List of Project Target Villages

Province	District Municipality	Local Municipality	Village Name	
Eastern Cape	Oliver R. Tambo	Nyandeni	1.	Kumaxhaka
			2.	Qanqu
			3.	Didi
			4.	Ezinkozweni
		KSD (King Sabata Dalindyebo)	5.	Sikobeni
			6.	Centuli
			7.	Dlova
			8.	Upper Xongora
			9.	Gubevu
			10.	Luxolweni
			11.	Cezu
			12.	Mavundleni
			13.	Tafeni
		Mhlontlo	14.	Lower Roza
			15.	Ndwane
			16.	Ncalukeni
			17.	Ndasane
			18.	Mvumelwano
		Ntabankulu	19.	Dambeni
			20.	Bhakuba
			21.	Kwazulu

Annex-2

List of Target Villages for Provision of Sanitation

Local Municipality	Selected Village Name	
KSD	1.	Centuli
	2.	Gubevu
Mhlontlo	3.	Mvumelwano
Ntabankulu	4.	Kwazulu

Annex-3

Responsibilities of Both Sides on ISD Intervention

Responsibility of Japanese Side	Responsibility of South African Side
• Formation and capacity building of PSC and VWSC • Awareness building to strengthen sense of ownership of villagers • Health education and hygiene promotion • Formation of and preparatory support to WSP • Program supervision	• Institutional strengthening and capacity building of WSA • Mentoring activities including capacity building of WSP • Program supervision

Annex-4 Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	South African side
1	To secure land necessary for the construction of facilities and clear the sites		○
2	To provide facilities for the distribution of electricity. (Power line extension is within one kilometer from the project pump station to existing grid)		○
	To provide facilities for the distribution of electricity. (Power line extension is more than one kilometer from the project pump station to existing grid)	○	
3	To bear the following commissions to bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P		○
	2) Payment commission		○
4	To ensure prompt unloading and customs clearance at the port of disembarkation in South Africa.		
	1) Marine (Air) transportation of the products from Japan to South Africa.	○	
	2) Tax exemption and custom clearance of the products at the port of disembarkation.		○
	3) Internal transportation from the port of disembarkation to the project site.	○	
5	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into South Africa and stay therein for the performance of their work.		○
6	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in South Africa with respect to the supply of the products and services under the verified contract.		○
7	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid.		○
8	To provide full police security at any sites requiring such measures to assure the safety of the said Japanese nationals.		○
9	To bear miscellaneous expenses, other than those to be borne by the Grant Aid, necessary for construction of facilities as well as for transportation and installation of the equipment		○

APPENDIX 6 OTHER RELEVANT DATA/INFORMATION

A6-1 Results of Baseline Survey

A6-1-1 Survey Procedure

This basic design survey consisted of two field surveys as follows.

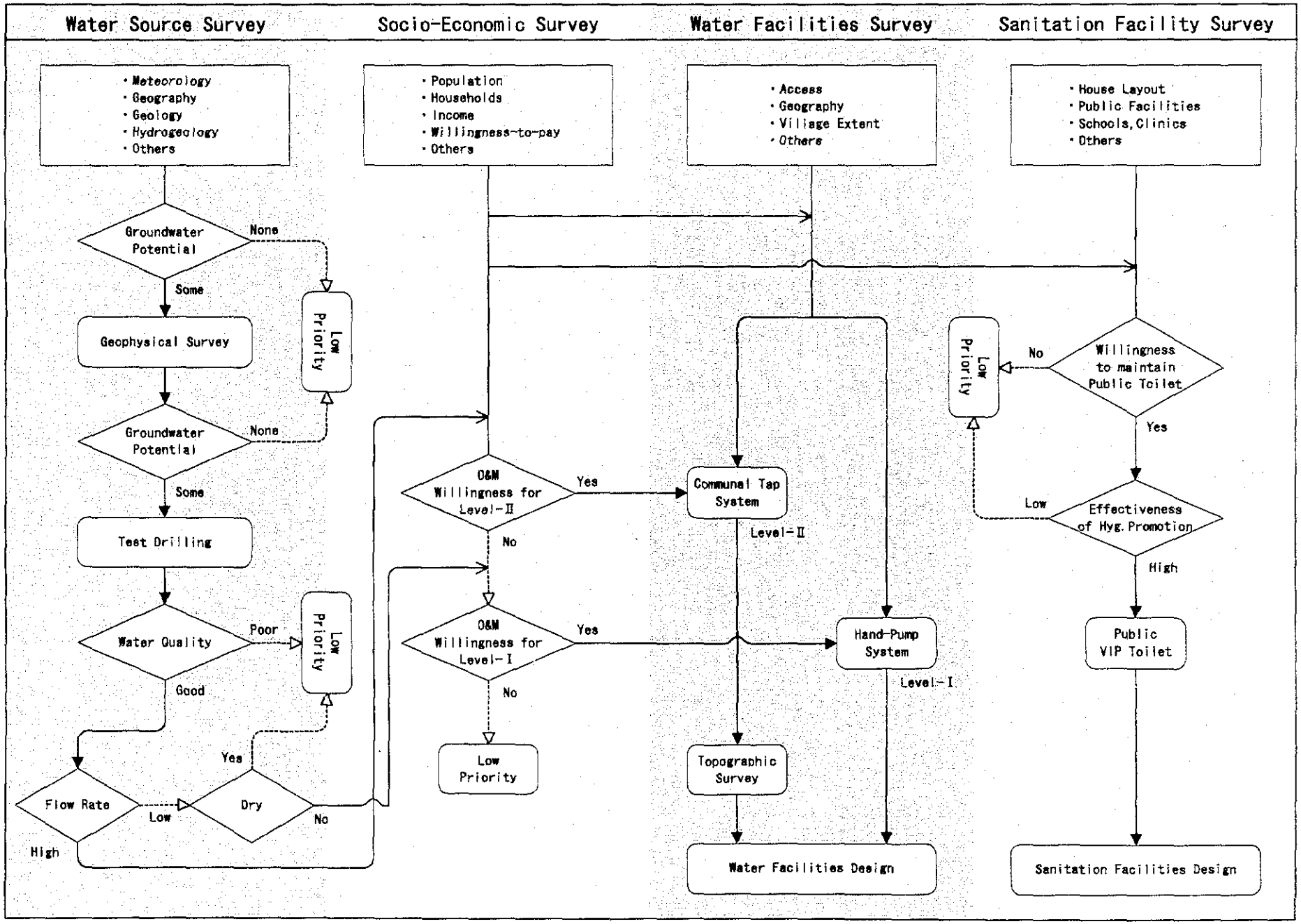
Field Survey	Period	Description
First	8 April to 27 May 2001	Baseline survey (water source survey, socio-economic survey, facilities planning survey)
Second	2 August to 24 August 2001	Water source survey including additional test drillings
	2 October to 29 October 2001	Facilities design survey; procurement and cost estimation survey

As shown in the flow chart in the following page, the field surveys consisted basically of 3 surveys including water source survey, socio-economic survey and facilities survey. The results focused on the baseline survey are presented below.

A6-1-2 General Information

Difficulties were encountered in determining the correct number of population. The figures given in the request and those obtained through the socio-economic survey had definite differences. The uncertainties in the request counts probably result from calculations from the population census using average growth rates, and so these will be used as reference. Therefore, the number of assumed households from aerophotos taken during the survey were counted and the population extrapolated using the number of persons per household as obtained from the socio-economic survey. The population counts from the aerophotos were compared with the request population and socio-economic survey figures. As a result of analyzing the ratios of the population figures, if the comparison is reasonably similar, then the surveyed figures are used. However, if the difference is unreasonably great, then the aerophoto-counted numbers will be employed. The household counts are taken from those corresponding with the determined population numbers. From these results, the average household size is about 7.7 persons per household for the study villages. The population and household counts are indicated in the following table.

Flow Chart of Field Survey



Determination of Population Counts

District	Village Name	Request Popul.	Soc-Econ Survey		Aerophoto		Decided Population	Decided No. of HH
			Popul.	HH	Popul.	HH		
Ngqeleni	Kumaxhaka	1,293	1,669	231	1,262	175	1,262	175
	Qanqu	1,260	967	122	1,827	231	1,827	231
	Didi	1,048	1,234	153	1,416	175	1,234	153
	Ezinkozweni	1,260	1,199	138	1,770	203	1,770	203
	Kuleka	873	782	118	2,128	320	2,128	320
Umtata	Sikobeni	798	1,467	183	1,784	223	1,784	223
	Centuli	980	1,810	221	2,184	267	2,184	267
	Dlova	5,588	981	124	2,356	299	2,356	299
	Upper Xongora	1,969	457	52	730	83	730	83
	Lower Centuli	2,349	749	89	1,960	233	1,960	233
	Gubevu	910	563	81	995	143	995	143
Mqanduli	Luxolweni	353	1,033	130	960	121	1,033	130
	Cezu	2,493	711	84	850	101	711	84
	Mavundleni	1,694	355	51	634	91	634	91
	Macosa	830	637	87	695	95	637	87
	Tafeni	750	1,696	229	1,754	237	1,696	229
	Ngwangweni	460	589	74	656	82	589	74
Engcobo	Sixhotyeni	615	159	20	203	26	203	26
	Luxeni	57	217	29	129	17	129	17
	Sigangeni	293	310	33	274	36	310	33
	Manzana	4,730	4,572	494	6,778	732	6,778	732
Qumbu	Lower Roza	2,636	1,885	267	1,998	283	1,885	267
	Ndwane	1,330	1,889	271	3,675	528	3,675	528
	Ncalukeni	1,838	905	123	1,935	264	1,935	264
	Ndasane	1,265	676	96	819	116	819	116
	Mvumelwano	1,648	1,036	167	1,407	227	1,407	227
Tabankulu	Dambeni	3,820	2,102	290	4,250	587	4,250	587
	Bhakuba	1,068	4,831	587	4,173	507	4,831	587
	Kwazulu B	1,569	1609	219	1,798	245	1,609	219
	Kwazulu D	400	402	55	367	50	402	55
Total		46,177	37,492	4,818	51,767	6,697	51,763	6,683
Average		1,539	1,250	161	1,726	223	1,725	223
Average Household Size			7.78 pers/HH		7.73 pers/HH		7.75 pers/HH	

General information concerning the study villages as obtained from the field surveys are summarized in the table shown below. The population figures and number of households are those decided in the above table and these will be used for water supply planning of this project.

General Information of Study Sites

District	Village Name	Pop.	HH	Elect.	School	Present Water Supply	Existing Latrine	
							School	Private
Ngqeleni	Kumaxhaka	1,262	175	Yes	Yes	Spring	VIP	Some pit
	Qanqu	1,827	231	Yes	Yes	Dam water to reservoirs, supplied thru tapstands	VIP	Some pit
	Didi	1,234	153	Yes	Yes	Spring	VIP	Some pit
	Ezinkozweni	1,770	203	Yes	Yes	Spring	VIP	Some pit
	Kuleka	2,128	320	Yes	Yes	Stream	VIP	Some pit
Umtata	Sikobeni	1,784	223	Yes	Yes	Stream	VIP	Some pit
	Centuli	2,184	267	No	Yes	Stream	Pit	Some pit
	Dlova	2,356	299	Yes	Yes	Stream	Broken	Few
	Upper Xongora	730	83	Yes	Yes	Stream	VIP	Some pit
	Lower Centuli	1,960	233	No	Yes	Stream, spring, handpump	VIP	Shared
	Gubevu	995	143	No	Yes	Stream	Broken	Some pit
Mqanduli	Luxolweni	1,033	130	Yes	No	Spring	—	Some pit
	Cezu	711	84	Yes	Yes	Spring	VIP	Some pit
	Mavundleni	634	91	Yes	No	Stream	—	None
	Macosa	637	87	Yes	Yes	From borehole to elevated tanks; supplied thru tapstands	Broken	Flush and pit
	Tafeni	1,696	229	Yes	Yes	Handpump. spring	VIP	Some pit
	Ngwangweni	589	74	Yes	No	Spring	—	Some pit
Engcobo	Sixhotyeni	203	26	Yes	No	Spring and dam water to reservoirs, supplied thru tapstands	—	Few
	Luxeni	129	17	Yes	No		—	Some pit
	Sigangeni	310	33	Yes	No		—	Some pit
	Manzana	6,778	732	Yes	Yes		VIP	Some pit
Qumbu	Lower Roza	1,885	267	Yes	Yes	Spring, stream	VIP	Some pit
	Ndwane	3,675	528	Yes	Yes	Spring	VIP	Some VIP
	Ncalukeni	1,935	264	Yes	No	Handpump, spring	—	Some VIP
	Ndasane	819	116	Yes	Yes	Spring	VIP	Some pit
	Mvumelwano	1,407	227	Yes	Yes	Spring, stream	Broken	Some pit
Tabankulu	Dambeni	4,250	587	No	Yes	Stream	VIP	Some pit
	Bhakuba	4,831	587	Yes	Yes	Handpump, stream	Broken	Some pit
	Kwazulu B	1,609	219	No	Yes	Handpump, stream	Pit	Some pit
	Kwazulu D	402	55	No	No	Stream	—	Some pit
Total		51,763	6,683					

A6-1-3 Water Source Survey

1) General

(1) Survey Procedures

The main objective of the water source survey is to search for the appropriate points for drilling to determine the water source which can supply the target villages. The hydrogeology team surveyed geological formations and existing water sources around the study villages to select points and lines for geophysical measurements. Upon siting these points and lines, the geophysical team using local consultants progressively made magnetic surveys, followed by horizontal and vertical electric prospecting. The results of the water source survey are described below.

(2) Hydrogeology of Eastern Cape

Eastern Cape has over 10,000 existing boreholes. These boreholes draw groundwater found in fractures formed in sedimentary rocks of the Karoo sequence, or fissures in dykes or sheets of dolerite intruded in the Karoo sequence. Many of the boreholes have depths less than 100 m with an average yield of 1.5 l/sec/well, and those giving more than 10l/sec/well are rare. The boreholes using the fissures of dolerite is believed to give higher yield than that of the sedimentary rocks of the Karoo formation. (In Eastern Cape Province, those yielding more than 0.1 l/sec is taken to be a successful well). The success rate of the existing boreholes in the dolerite is 80%, while that for the sedimentary rocks of the Karoo sequence is lower at 55 to 70%.

The fractures formed by the Cape orogeny run northwest and southwest. However, the northwest direction fractures are more eminent, and fractures in the dolerite dykes running northwest are also more noticeable. Therefore, the conclusion that groundwater flows in the fissures directed northwest is reasonable.

The significant differences in area-wise characteristics of groundwater yields can be attributed to the hydrogeological structure of this region. Therefore, new drilling points must be selected at hydrogeologically favorable locations. Groundwater development in the target area has potential, but the success of boreholes will depend on proper selection of drilling points. Yields and depths of new drillings can only be determined upon analyzing the results of the field surveys.

(3) Drilling Depth and Expected Yield of Project Borehole

i. Drilling Depth

According to "An Explanation of the 1:500,000 General Hydrological Map", Queenstown 3126 (M. C. Smart, 1998), since the potential to find fissure water decreases as the depth increases, the appropriate drilling depth is said to be 50 m. However, the fissures formed by the Cape orogeny in the intruded dykes and sheets of dolerite are believed to extend to deeper layers.

ii. Expected Yield

As mentioned before, the yields of existing boreholes reveal extreme areal characteristics resulting from the peculiar hydrogeological structure. However, the conditions of dolerite layers are much better than that of the sedimentary rocks of the Karoo group formations. The average yield in the target area is about 2.9 l/sec/well.

2) Hydrogeology of Target Area and Proposed Water Sources

(1) Ngqelini District

i. Kumaxhaka

This village is located about 1 km west of Qanqu, another study village. The village is situated between the tributaries of the west flowing Mtakatye river on a hill at 760 to 820 m above sea level. The south side of the village has a

steep slope with a height difference of 100 m making access by a drilling rig very difficult, but the north side has a gentle slope of 20 to 30 m height difference. The hill is composed of dolerite, but whether it is a dyke or sheet is not clear. The Mtakatye river bed to the south shows outcrops of mudstone of the Karoo group, giving possibility of it being a sheet. Two test drillings were conducted upstream of the village entrance from the National road which crosses the stream. The first drilling yielded only 0.1 l/sec, so the drilling was stopped at 50 m, and a second hole was drilled about 100 m upstream of the first point. The second well was drilled down to 101.05 m, giving a static water level of 1.02 m, drawdown of 5.85 m and a yield of 2.06 l/sec. Therefore, this can later be reamed and completed into a production borehole to be used as a project water source.

ii. Qanqu

This village is located on a hill with a maximum altitude of 902 m on the right banks of the upstream of the Mtakatye river. The height difference from the river bed to the village is about 170 m, and with a 1/4 steep slope, the accessibility for a drilling rig becomes very difficult. A dolerite dyke runs in the 10° NE direction, but most of the riverbed is outcrops of mudstone of the Karoo formation. The geophysical survey was carried out at the bottom of a valley located to the north of the national road where the accessibility for a drilling rig is possible. However, the results showed that the area is composed of a mudstone dominant layer of the Karoo sequence (layered with 30 to 50 cm of sandstone), and this gave reason to determine that a sufficient yield from a borehole drilled in this area cannot be expected. As expected, the test drilling in this area yielded 0.8 l/sec, which is not enough to supply water to this village.

At the present time, a dam located about 40 km away supplies water to this village through a reservoir and communal tapstands, but the facilities are not to RDP standards. The present water supply facilities can be rehabilitated by the South African side to supply the whole village.

iii. Ngcilitchana

This village lies between the Mgwenyana and Mkunjazana rivers upon a hill extending north-south of 830 to 880 m altitude. The geology consists of alternating layers of mudstone and sandstone of the Karoo sequence, but along the eastern valley, a dolerite dyke is found in the 30° NE direction. A 20° to 30° NE fissure is developed in the dyke, and a small spring is found near the leg of the upstream portion of the dyke (right bank) where the villagers come to fetch water from this spring as well as the stream. A borehole should be drilled in the dolerite dyke, and although the catchment does not seem to be sufficiently large, the test drilling yielded an amount sufficient to supply this village.

iv. Ezinkozweni

This village extends north-south upon a hill along the right banks of the Mgwenyana river. The altitude of the north end is 875m and goes down to 824m at the south end. The hills consist of mudstone dominant Karoo formation (with a thin layer of sandstone) and dolerite dyke running NE direction was found. But even though the development of fissures in the contact zone is very weak, the test borehole gave a yield sufficient to supply the population of this village.

v. Kuleka

This village is located on a hill of 760 to 800 m altitude along the St. Johns road. The St. Bamamas hospital is situated in the eastern part of the village. To the south of the village, the Dakodala river flows south along a deep V-shaped valley having an 1/3 steep slope. A drilling rig cannot enter this south valley, but the valley to the north is gentle enough for rig access. Alternating layers of mudstone and sandstone of the Karoo sequence make up this area, but a dolerite dyke in the 40° NE direction with developed fissures is found near the junction of the Mgwenyana and Mkunjazana rivers. A test drilling was conducted at this point to a depth of 121.33 m and gave a yield of about 3.0 l/sec, and this can be used as the water source to supply this village.

(2) Umtata District

i. *Sikobeni*

This village is located on a gentle slope having altitudes of 920 to 1,00 m along the left bank of the Sikobeni river. This area consists of alternating layers of mudstone and sandstone of the Karoo sequence with no dolerite formation. A borehole which used to be pumped by a windmill exists at the northwest end of the village, but is now abandoned. The abandoned borehole had a depth of 104 m, a static water level of 33 m and yield of 0.36 l/sec. The fracture developed in the sandstone layer in the 10° to 20° NE direction, outcropped along the Sikobeni river flowing east in the northern part of the village, was selected as the test drilling site. The result of the first test well was 0.2 lit/sec, which is insufficient for the target village. The second test hole was selected 120m west of the first, where was found a dolerite dyke. This gave sufficient yield (2.3 lit/sec) enough to supply the population.

ii. Centuli

This village is situated on a hill having altitudes from 780 to 820 m extending east-west on the left banks of the Mpunguhana river. The triangulation station #281 (832.7 m high) located in the eastern part of the village and a 918 m high mountain to the west of the village are composed of dolerite formations. The low altitude portions consist of alternating layers of mudstone and sandstone of the Karoo sequence.

Two existing boreholes are found, one in the southwestern part of the village and the other at about 1 km to the south near the bridge over the Centuli river. The abandoned well near the bridge recorded a yield of 0.1 l/sec giving rise not to use this well. The other borehole in the southwestern part is recorded to have a depth of 69 m with a yield of 1.6 l/sec, and a windmill was installed to pump water, but now the windmill pump is broken and the well is abandoned. Since the latter well is very old, difficulties would arise in using it. Therefore, drilling a new borehole next to this one was anticipated as having possibility for using it as the water source for the village. However, the test drilling resulted in giving a dry well. A second test drilling was tried near the Centuli stream, south direction from the village, and the yield obtained was sufficient to supply the target village.

iii. Dlova

The village is located upon a mountainous hill of 860 to 1,040 m altitude extending east-west along the left banks of the upstream of the Centuli river. The villagers are presently using rainwater and stream water. The mountainous area along the right banks of the Centuli river is composed of dolerite and a number of dolerite dykes of about 10 m widths are found in the western edge of the village. Most of the hills is composed of alternating layers of mudstone and sandstone of the Karoo group formation, but in the southeastern part of the village, a wide distribution of dolerite is found. Whether this dolerite layer is a sheet or a dyke is not certain, but the vertical electric prospecting results clearly showed a wide high-resistivity layer at depths below 10 m which can be concluded as a dolerite layer. In the outcrops of this dolerite layer, fissures were found in the 60° NE and 30° NW directions, and so the test drilling was conducted in this area. A test well of 165mm diameter was drilled down to 91 m and yielded 5 l/sec (Pumping test: Q = 2.5 l/sec, s = 25.2 m). The results of the step drawdown test confirmed that 3 l/sec at s = 30.0 m is possible, and therefore this well can be used as the water source for this village.

iv. Upper Xongora

Located on the other side of the road of Sikobeni, this village is situated on a hill of 900 to 1,000 m altitude along the right banks of the Xongora river. The mountainous area on the Xongora right banks has a steep 1/9 slope and the residences are built along the gentle slope on the mountain top. The villagers are using small streams and dams in the village for their water supply. The village area is composed of alternating layers of mudstone and sandstone of the Karoo sequence, but solidified sandstone is dominant near the Xongora river bed with no dolerite formations. The sufficiently developed fracture running in the 50° NE direction was selected as the point for the proposed water source. As the candidate area is considered as a very difficult place for groundwater development, more detailed geophysical survey was done. According to the survey result, the possible drilling area is very limited, and the test drilling done at that area yielded 1.4 l/sec, which is sufficient for the target village.

Near the stream located southeast of the village (about 700 m from the school), a 70 m deep borehole was drilled in 1988 yielding 1.8 l/sec with a static water level of 11.0 m, but is now abandoned. A borehole drilled near this abandoned well gave a yield enough to supply the village.

v. Lower Centuli

This village is located on a gently sloping hill of altitude 780 to 840 m between the Xugxwala river and its tributary, the Gwegwe river. The hilltop slopes at a gradient of 1/42 in the north-east direction. A 923.3 m high mountain (triangulation station #212) at the south-west end of the village is a dolerite formation which extends further west. The main portion of the hill is composed of alternating sandstone and mudstone of the Karoo sequence and large fissures are developed in the sandstone from 70° NE to EW. The dolerite which composes the south-west end mountain is judged to be a sheet. A dolerite dyke is found in the northwestern part of the village, but the poorly developed fissures cannot bear much water and so this would not be appropriate as a water source. Near the Gwegwe river (having minimal surface flow), which flows north-east at the southeast side of the village, a borehole was drilled aiming for the sandstone fracture (yield: 0.3 l/sec) and a windmill pump was installed to pump water up to the reservoir on top of the hill. However, after the windmill broke down, a handpump was installed and is still being used now. Moreover, about 2 km west of the village on a hillside, a spring (Field survey results: yield = about 2 l/sec, electric conductivity = 679 μ S/cm, temp. = 20 °C) from the dolerite fissure is protected by a concrete intake. This spring was once planned as the water source for Lower Centuli village, but since then the plan was abolished.

Although the existing borehole was drilled at a hydrogeologically excellent location, the yield is not sufficient to supply the whole village. The result of the test drilling done at the west side of the village gave 0.8 l/sec and several water quality analyses items were out of the stipulated standards. Therefore, this borehole should not be used for drinking purposes.

vi. Gubevu

Situated on a 600 m width hill extending east-west, this village is bound between the Sikobeni main stream and its tributary. The height difference between the river bed and the top of the hill is 30 to 40 m, and the hillsides are gently sloped. Mudstone and sandstone of the Karoo sequence are alternating and a small scale anticline is seen in the north valley with highly developed fissures along the river. The villagers are using water from the stream to the north (elect. cond. = 220 μ S/cm, temp. = 27 °C).

A test drilling was carried out at the mentioned small scale anticline north of the village down to 100 m. The formation was an alternation of sandstone and mudstone down to 53 m and dolerite down to 100m. The yield was 5.5 lit/sec.

(3) Mqanduli District

i. Luxolweni, Cezu, Tafeni

These villages are scattered around the hilltops on both sides of the Cezu river. The highest point of 973.9 m (triangulation station #215) is at the north-west end of Tafeni. The main parts of the hills are composed of alternating layers of mudstone and sandstone of the Karoo sequence, and a dolerite layer is found at the south-east foot of Tafeni. An artesian well exists near the confluence of the Cezu river and its tributary, Kupetshe river. Since the abundant outflow caused difficulties in drilling, another well was drilled about 5 m away (still flowing out) with an estimated yield of about 15 l/sec. This amount is enough to supply the 3 villages of Luxolweni, Cezu and Tafeni, and a pumping test was scheduled to be performed to confirm its present yield. However, DWAF used this well for training newly recruited staff on conducting a pumping test, and during the training, the borehole collapsed so the well had to be abandoned. As a consequence, a pumping test was held for an existing borehole in Tafeni, but the yield was too low to be used as water source for these villages. Therefore, a new borehole needs to be drilled near the collapsed artesian well or a new site for drilling needs to be found to supply the villages.

ii. Mavundleni

This village is situated upon a hill extending from northwest to southeast in the south of Cezu. The hill slopes down to the southeast with altitudes from 880 to 820 m. To the south of the village, the Macosa river flows south-east. Alternating layers of mudstone and sandstone of the Karoo sequence are found, but a dolerite dyke extending almost east-west outcrops near the confluence of the Macosa and Zadungeni rivers and this area is proposed as candidate for the water source. The existing borehole has drilled into the

dyke with a depth of 157 m and yielding 0.2 l/sec. The borehole used as the water source for Macosa is located about 1 km downstream of this borehole with a depth of 91 m, static water level of 6.4 m and yield of 2.3 l/sec. At a neighboring village of Kusigiba, 2 boreholes were drilled with one being dry and the other one with depth of 105 m and yield of 0.5 l/sec was operated 9 hours daily, but due to the lack of fuel, presently it is operated only during high necessity periods. A new borehole was drilled in this area which gave enough yield to supply Mavundleni as well as Cezu.

iii. Macosa

The village is located on a hill of 780 to 850 m altitude extending east-west between the Macosa and Kundingaba rivers. Outcrops of alternating layers of mudstone and sandstone of the Karoo formation are found in the Macosa river. The existing borehole was drilled into the 20° NE direction fissure developed in these layers (well depth: 91 m, SWL: 6.4 m, yield: 2.3 l/sec). A vertical turbine pump is installed to pump water to elevated tanks and supply water to the villagers through 8 communal tapstands located around the village (elect. cond. = 460 μ S/cm). The pump is operated once every 3 days to sufficiently supply the village.

iv. Ngwangweni

Bound between the Kunokana and Ngqwara rivers, the village is located on a narrow hill of widths from 100 to 200 m. The Kunokana and Ngqwara rivers form deep V-shaped valleys with steep hillsides making access by a drilling rig very difficult. The Mgwenyane river flowing south-east near the center of the village also creates a deep V-shaped valley with steep hillsides, and at the steep slope located about 10 m above the river bed, seepage flows out from a dolerite fracture which the villagers are collecting as their water source. At the east end of the village in the gently sloping area, a water source is sought to be used for a handpump scheme, but two test drillings resulted in both being dry. If a borehole is drilled down in the steep valley, the villagers would have great difficulties to fetch water.

(4) Engcobo District

i. Sixhotyeni, Luxeni, Sigangeni

These 3 neighboring villages are located on slopes along the left bank of the Manzana river. Along the north side of the villages are the Kunyana mountains ranging southeast from Engcobo. The rugged Kunyana mountains are composed of dolerite formations and steep cliffs of 100 m height differences make up the northern slopes. The southern slopes are also steep, and at the head of the north-south dissected valley between Sigangeni and Luxeni is a cliff called Kuhamile. These 3 villages fall in the contact zone of the dolerite and Karoo sequence (mudstone dominant), and therefore, finding groundwater is difficult. At about 3.5 km southwest of Engcobo to the west side of National Route 61, in the river basin of the south flowing Cefane river, small scale river terraces are developed where a small quantity of underflow may be available.

The existing water supply system uses the spring found in the mountaintop to the north of Luxeni and the surface water from the Sigangeni river stored in a dam (elec. cond. = 70.5 μ S/cm, temp. = 17.6 °C, pH = 7.05) between Luxeni and Sigangeni. The water from these 2 sources are stored in concrete reservoirs to be supplied to a number of villages including the 3 villages as well as Manzana through tapstands located in each village. At the time of the field survey, the pump engine to pump water from the dam to the reservoir was removed for repairing, and so only the spring water was being supplied. When the pump engine is repaired, the system will be sufficient to supply water to satisfy the area.

ii. Manzana

This village is located on the gentle hill extending north-west along the right banks of the Manzana river. The area is composed of mudstone dominant Karoo sequence where groundwater development is difficult. This village receives water from the same system mentioned above. When the pump engine becomes operational, the villagers will have enough water.

(5) Qumbu District

i. Lower Roza

This village is situated on a hill east side of National road No. 2 about 7 km south of Qumbu. Alternating layers of sandstone and mudstone of the Karoo sequence are found across the village, but a dolerite peak runs east-west in the southwestern part. Near the stream running in the southwestern part of the village at about 1 km from the village entrance, an existing artesian well was drilled into the 40° NW direction fissure of the sandstone from the Karoo sequence. The water from this borehole was pumped up to a reservoir in the village, but after the pump broke down, it is not being used. Since the pumping equipment is still installed inside the borehole, difficulties would arise in using this well.

ii. Ndwane, Ncalukeni, Ndasane, Mvumelwano

These villages are located on both sides of National Route No. 2 to the south of Qumbu town and north of Lower Roza. On the west side of the village, the Mzike river flows to the west and on the east side, the Mhlangwe river flows to the south. The Ndakeni river forms a boundary. A 1,067.4 m peak (triangulation station #265) is found in the northern part of Mvumelwano, and another peak of 1,031.9 m (triangulation station #246) rises in the southern part of Ndasane. Most of the area is composed of alternating layers of mudstone and sandstone of the Karoo formation, but the mountains in the southern part of Ndasane is dolerite and a dolerite dyke extends east-west from here.

Three boreholes in Ncalukeni (one using a windmill and two with handpumps), one artesian well in Ndasane (having 3 l/sec yield, this is used as the water source for the villagers), one well in Ndwane, and one borehole in Mvumelwano are existing, but other than the well in Ndasane, all are abandoned. The water source for Qumbu town, which is located to the north of this area, is a borehole (depth: 60 m, diamter: 165mm, yield: 22 l/sec) drilled into the dolerite dyke along the Mzike river about 900 m west of the town. Actually 4 boreholes were drilled but 3 yielded less than 1 l/sec and were unsuccessful while the fourth one was successful.

From the layout of the villages, a water scheme using one source is thought to be more efficient. A test drilling was conducted in the dolerite dyke of the Ndakeni river to a depth of 150 m, but due to the poor development of the fracture, the well was dry. Then, at the beginning of the second field survey, two test drillings were conducted, one in the multi-fissure portion of the dolerite dyke near the dry test drilling site, and another in the dolerite dyke crossing the Mhkangwe river to the east of Ndwane. However, these boreholes can supply only some of the target villages in this area. Therefore, further drillings are necessary to supply all of the villages.

(6) Tabankulu District

i. Dambeni

Located about 3.5 km north of Tabankulu town, this village lies on top of a hill extruding out to the east. The village covers a wide area of about 5.5 km east-west and about 5 km north-south. The Kunggubane river flows in the south side and the Mzintlava river flows in the east side. Both of these rivers flow down in deep V-shaped valleys forming 1/2 grade steep sides where accessibility by drilling rigs is impossible. Near the center of the village, the Dambeni river flows east and the river basin forms a wide fan-shaped, gentle sloping area. The village does not have any boreholes and so the villagers are using the stream as their water source. The Tabankulu road runs along the western edge of the village. The highest point is the triangulation station #143 at 1,304 m and small mountains about 50 m high are scattered around the village all ranging to the Kwababa mountain (triangulation station #168 of 1,065.8 m height) located centrally in the village. The central area is dominantly mudstone of the Karoo sequence, but all of the small mountains are dolerite sheets. The low hill north of the Dambeni river is a dolerite formation and a dolerite dyke crosses the river. A test borehole was drilled into this dyke and yielded 16 l/sec. When the test well is reamed and completed into a production well, this can become the water source to supply both Dambeni and Bhakuba.

ii. Bhakuba

Along the Tabankulu road, this village is situated adjacent to Dambeni to the north. Along the gentle slopes, small mountains of dolerite are scattered, but the main portions of the village are alternating layers of sandstone and mudstone of the Karoo formation. Existing boreholes are found, one at an altitude of 1,140 m along the Siqokoqweni river and another at an altitude of 1,140 m along the Dambeni river. The former well was drilled into the small fissure of the alternating layers of sandstone and mudstone of the Karoo sequence and fitted with a handpump but this is now broken and not used. The latter well aimed the dolerite dyke and a windmill pump was installed but since it broke down, the well is presently used with a handpump. Nevertheless, these do not give sufficient yields for a level 2 scheme, and so a test well was drilled down to 150 m into the dolerite dyke crossing the Siqokoqweni river (from the fracture of this dyke, a small spring emerges where the villagers use this as their water source). During the test drilling, a small fissure was hit at 72 m to yield 0.5 l/sec, but gradually the yield decreased down to 0.1 l/sec, and the concentration of fluorine was analyzed to be a little high at 1.3 mg/l. Consequently, the water source for this village should use the test well drilled at the adjacent village of Dambeni.

iii. Kwazulu B

This village is situated about 4 km west of Tabankulu on top of a gently sloping area along the right banks of the Caba river tributary. To the north of the village, the Kubhonxa mountain rises up to 1,373.7 m. Alternating layers of sandstone and mudstone of the Karoo sequence make up the area but a small dolerite mountain is formed in the south of the village, and the dyke crossing the Caba river ranges to the 1,227 m dolerite peak in the northeastern part. Two boreholes fitted with handpumps along the Caba river are presently used by the villagers. The dyke crossing the Caba river was selected as the site for test drilling. The result gave a yield sufficient to supply the village population.

iv. Kwazulu D

This small village is located on a steep slope along the left bank of the Caba river. The geology is composed of alternating layers of sandstone and mudstone of the Karoo sequence, but the eastern half of the village is dolerite and outcrops in the bed of the Caba river. The access road from Kwazulu B is very bad to create difficulties for bringing in a drilling rig. A test well was drilled near the eastern entrance of the village with sufficient yield, but with water quality out of standard. It can be difficult to consider as a drinking water.

3) Geophysical Survey

In order to select the optimum drilling points and well depths, geophysical surveys were conducted in the target area. The results can contribute to proper knowledge of the geological structures and determine the groundwater potential which can be reflected upon the proper water source design.

The methods used in this study and the number of measurements are as follows.

- Magnetic prospecting: Proton-Precession method
  Measurements: Total 59 linear measurements
- Electrical prospecting (Horizontal prospecting):Wenner method
  Electrode arrangement (for a = 40 m and a = 60 m)
  Measurements: a = 40 m x 21,440 m
  a = 60m x 19,895 m
- Electrical prospecting (Vertical prospecting): Wenner method
  Measurements: 80 points x 150 m depth

See Appendix 6-4 for details of the geophysical survey.

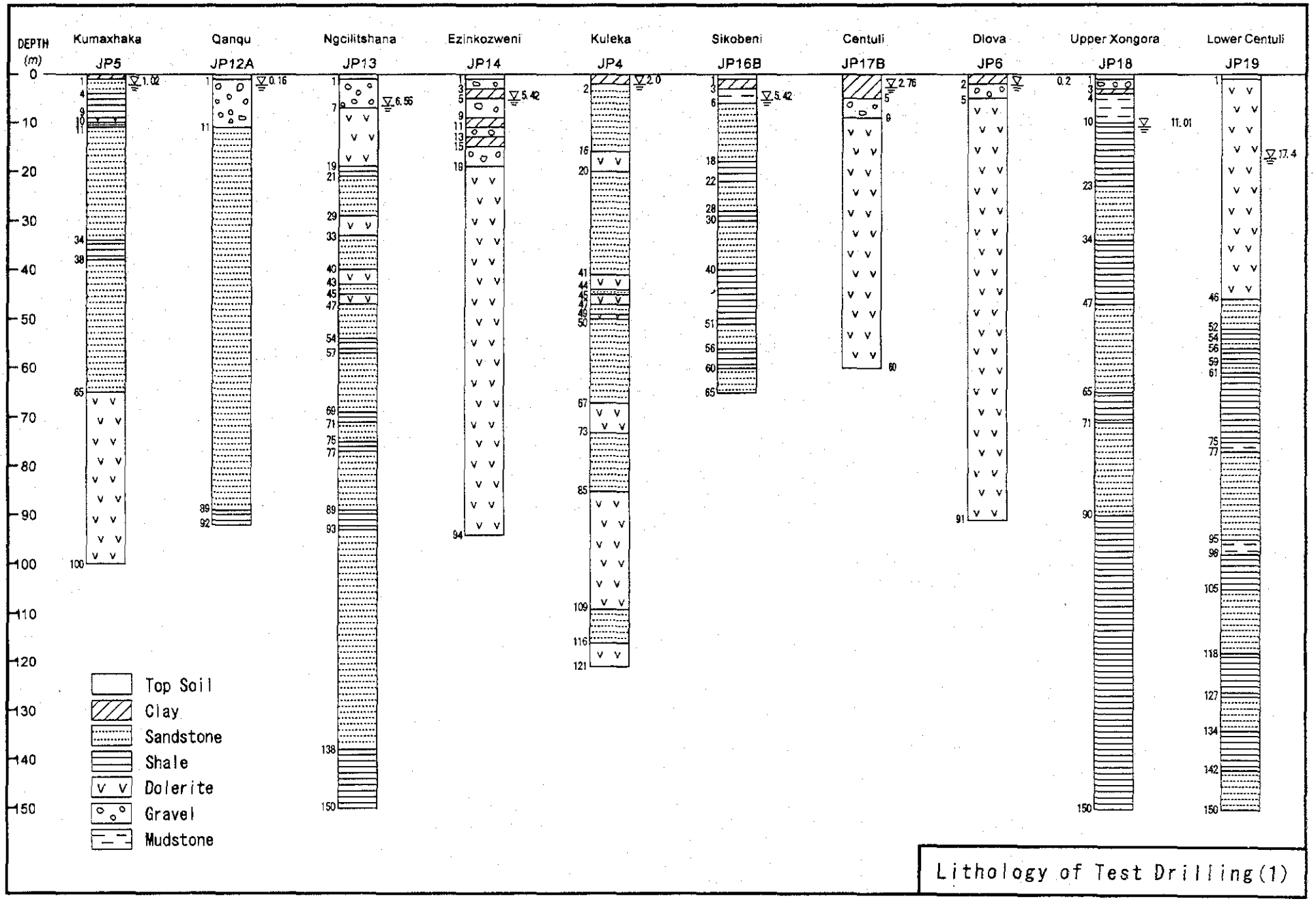
4) Test Drilling

As a result of the hydrogeological and geophysical surveys, test drillings were carried out at selected points where groundwater potentials were questionable. During the first field survey, six test drillings were conducted, with 4 out of the 6 having sufficient pumping rates to supply the target villages. From the results of the first test drillings and questionable conditions of the other target water sources, further test drillings were made at 14 sites at the beginning of the second field survey. The wells were temporarily finished so that casing pipes and screens can later be inserted into the well. The test drilling results are listed in the following table and the lithologies of the test boreholes are shown thereafter.

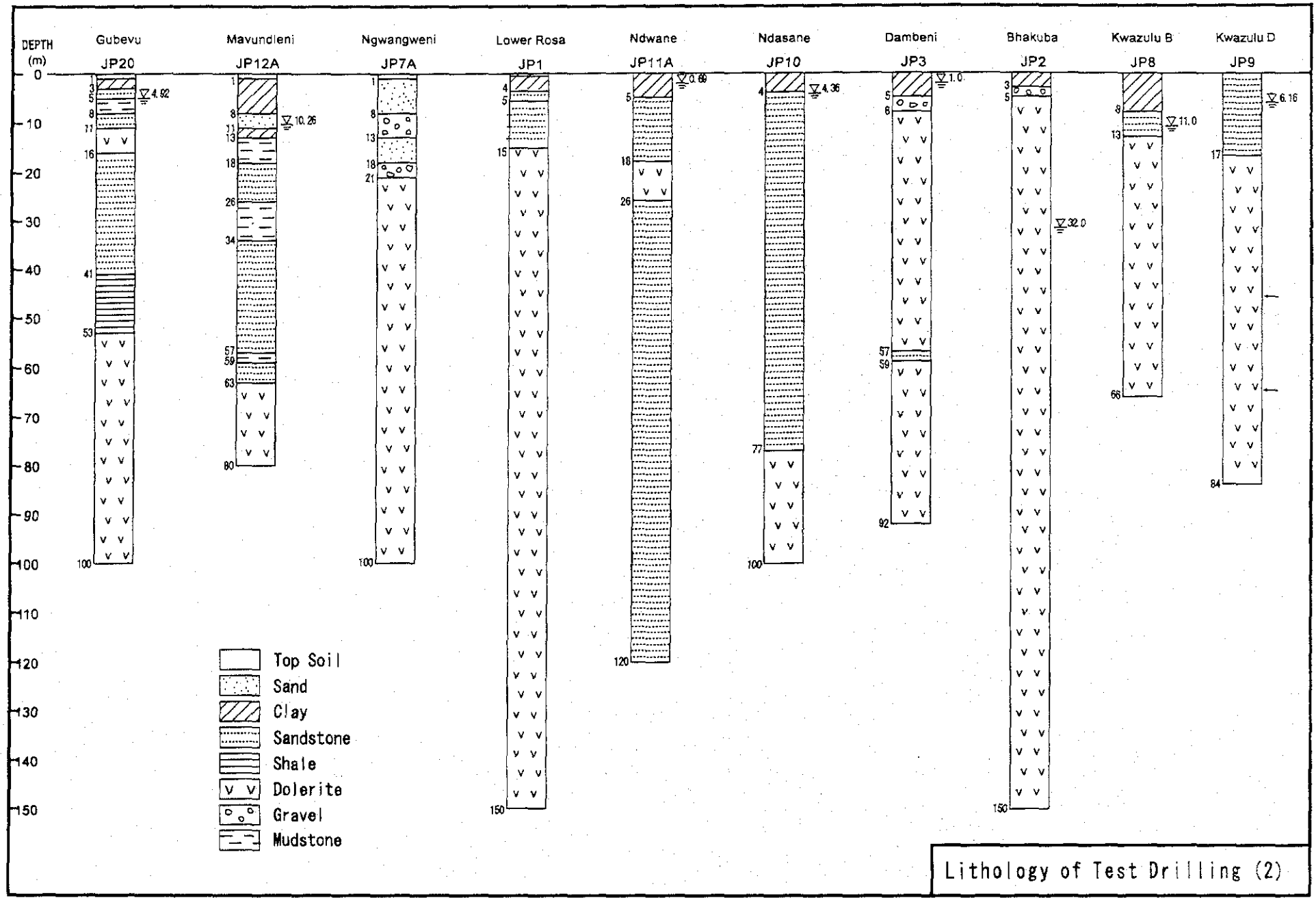
Results of Test Drillings

Site Name	Code No.	Diam. (mm)	Depth (m)	SWL (m)	PWL (m)	Draw-down (m)	Pumping Rate (l/sec)	Specific Capacity (l/sec/m)	Comments
Kumaxhaka*	—	165	50.0	—	—	—	<0.10	—	Abandoned
	JP5	165	101.1	1.02	3.42	2.40	2.00	0.08	Source for Kumaxhaka
Qanqu	JP12	165	92.8	0.16	17.52	17.36	0.65	0.04	Insufficient to supply Qanqu
Didi	JP13	165	149.6	6.55	15.55	9.00	1.50	0.17	Source for Didi
Ezinkozweni	JP14	165	94.2	5.42	19.42	14.00	1.80	0.13	Source for Ezinkozweni
Kuleka*	JP4	165	121.3	2.00	5.90	3.90	3.00	0.77	Source for Kuleka
Sikobeni	—	165	85.0	—	—	—	0.20	—	Abandoned
	JP16	165	66.6	5.42	10.42	5.00	2.30	0.46	Source for Sikobeni
Centuli	—	165	98.0	Dry					Abandoned
	JP17	165	61.6	2.76	19.54	16.78	2.21	0.13	Source for Centuli
Dlova*	JP6	165	91.0	0.20	13.20	13.00	2.30	0.18	Source for Dlova
Upper Xongora	JP18	165	150.0	11.01	15.81	4.80	1.40	0.29	Source for Upper Xongora
Lower Centuli	JP19	165	150.6	17.40	35.40	18.00	0.80	0.04	Source for Lower Centuli (L1)
Gubevu	JP20	165	100.0	4.92	9.40	4.48	5.50	1.23	Source for Gubevu
Tafeni**	Exist Bore	165	70.7	16.35	25.49	9.14	0.53	0.06	Insufficent for Level 2 service
Mavundleni	JP15	165	80.0	10.26	21.76	11.50	2.00	0.17	Source for Cezu and Mavundleni
Ngwangweni	—	165	100.0	Dry					Abandoned
	JP7	165	71.0	Dry					Abandoned
Qumbu 1 (Lower Roza)*	JP1	165	150.0	Dry					Abandoned.
Qumbu 2 (Ncalukeni)	JP10	165	118.8	4.36	9.11	4.75	5.00	1.05	Source for Lower Roza, Ndasane and Ncalukeni
Qumbu 3 (Ndwane)	JP11	165	120.0	0.69	10.69	10.00	3.00	0.30	Source for Ndwane and Mvumelwano
Dambeni*	JP3	165	92.0	0.30	16.38	16.08	16.00	1.00	Source for Dambeni and Bhakuba
Bhakuba*	JP2	165	151.2	7.29	71.2	63.91	0.10	0.002	Abandoned
Kwazulu B	JP8	165	64.5	6.16	32.48	26.32	12.04	0.46	Source for Kwazulu B
Kwazulu D	JP9	165	85.4	36.95	40.36	3.41	7.09	2.08	Water quality not to standard

N.B.: *These sites were drilled during the first field survey.
The other sites were drilled at the beginning of the second field survey.
**Pumping test was conducted in the existing borehole.



Lithology of Test Drilling(1)



Lithology of Test Drilling (2)

5) Water Quality Analyses

Water quality analyses were made during the field survey for various existing water sources of the target villages, as well as from the newly drilled test boreholes. The analyses results are shown in the tables in the following pages. The water quality standards adopted by DWAF are listed below along with the standards of WHO and Japan.

Drinking Water Quality Standards

Indicator		Unit	DWAF (Class I)	WHO	Japan
Electrical Conductivity		mS/m	150	–	–
Total Dissolved Salts (TDS)		mg/l	1,000	–	500
Total Coliforms		Counts/100 ml	10	0	0
Faecal Coliforms		Counts/100 ml	1	0	0
pH		–	5.0 – 9.5	6.5 – 8.5	5.8 – 8.6
Turbidity		NTU	1.0	5.0	2.0
Ammonia		mg/l	1	–	–
Nitrate/Nitrite	as N	mg/l	10	–	10
	as NO_3	mg/l	44	50	–
Fluoride		mg/l	1.0	1.5	0.8
Sulphate		mg/l	400	200	200
Chloride		mg/l	200	250	200
Arsenic		mg/l	0.05	0.01	0.01
Cadmium		mg/l	0.005	0.003	0.01
Copper		mg/l	1.0	2.0	1.0
Manganese		mg/l	0.1	0.5	0.05
Zinc		mg/l	5.0	3.0	1.0
Iron		mg/l	0.2	0.3	0.3
Potassium		mg/l	50	–	–
Sodium		mg/l	200	200	200
Magnesium as $CaCO_3$		mg/l	70	–	–
Calcium as $CaCO_3$		mg/l	80	–	–
Total Hardness as $CaCO_3$		mg/l	150	500	300

Water Quality of Study Village Water Sources

District	Village Name	Sampling Point	pH	TDS	Conductivity	Turbidity	Alkalinity (as $CaCO_3$)	Chloride (as Cl)	Sulphate (as SO_4)	Ammonia (as NH_3)	Nitrate (as NO_3)	Sodium (as Na)	Calcium (as Ca)	Calcium (as $CaCO_3$)	Magnesium (as Mg)	Magnesium (as $CaCO_3$)	Total Hardness (as $CaCO_3$)	Potassium (as K)	Manganese (as Mn)	Arsenic (as As)	Fluoride (as F)	Iron (as Fe)	Zinc (as Zn)	Cadmium (as Cd)
DWAF Standard (Class 1)			5.0-9.5	1,000	150	1		200	400	1	44	200		80		70	150	50	100	50	1.0	0.2	5.0	5
WHO Standard			6.5-8.5			5		250	200		50	200					500		500	10	1.5	0.3	3.0	3
Japanese Standard			5.8-8.6	500		2		200	200			200					300		50	10	0.8	0.3	1.0	10
Unit			—	mg/l	mS/m	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/ l	mg/l	mg/l	µg/l	µg/l	mg/l	mg/l	mg/l	µg/l
Ngqeleni	Kumaxhaka	Spring	7.74	222	44	15.0	138.9	40.1	<3.0	<0.1	4.5	26.9	32.3	80.7	18.0	74.1	154.8	0.3	147	0.8	<0.1	0.46	<0.01	<10
		Borehole Outside Village	7.95	1,030	205	1.0	280.6	462.6	7.7	<0.1	2.5	169.2	123.0	307.1	75.1	309.3	616.4	3.2	70	2.9	0.3	0.05	0.93	<10
		Borehole	7.49	311	62	0.2	125.2	55.1	9.4	<0.1	6.0	38.2	42.5	106.1	25.2	103.8	209.9	0.6	<10	1.8	0.1	<0.01	0.34	<10
	Didi	Spring	7.26	171	34	1.0	70.7	35.7	2.9	<0.1	<0.1	24.4	11.8	29.5	6.8	28.0	57.5	0.8	63	3.0	<0.1	0.02	0.01	<10
	Kuleka	Stream	7.84	197	40	13.4	106.8	46.5	27.4	<0.1	0.5	31.8	23.6	58.9	11.9	49.0	107.9	1.5	108	0.6	0.1	0.81	0.02	<10
		Borehole	7.85	338	68	0.1	177.0	91.8	9.3	<0.1	1.1	66.3	46.4	115.9	18.2	74.9	190.8	0.8	58	7.7	0.6	0.02	0.17	<10
Umtata	Centuli	Stream	7.91	197	39	6.5	146.6	34.2	<3.0	<0.1	1.1	29.7	29.9	74.7	14.9	61.4	136.1	0.5	138	<0.3	<0.1	0.16	<0.01	<10
	Dlova	Borehole	7.96	68.9	345	0.8	202.4	70.2	100.7	<0.1	0.3	45.7	56.9	142.3	28.9	118.0	261.3	1.5	18	1.7	0.1	<0.01	0.18	<10
	Lower Centuli	Borehole	7.25	602	121	0.7	252.0	165.8	31.1	<0.1	8.8	92.3	105.5	263.4	36.7	151.1	414.5	4.3	132	2.0	0.2	0.07	0.03	<10
		Stream	8.14	633	126	1.6	243.9	217.7	4.7	<0.1	3.3	129.9	65.2	162.8	40.9	168.4	331.2	2.8	138	1.3	<0.1	0.07	<0.01	<10
	Viedgesville	Borehole	7.84	469	94	0.1	201.9	116.4	19.0	<0.1	10.3	57.1	99.9	249.5	28.4	117.0	366.5	3.3	136	<0.3	<0.1	0.04	0.06	<10
Mqanduli	Luxolweni	Borehole	7.29	171	34	0.1	110.4	24.0	29.7	<0.1	3.4	23.9	24.9	62.2	12.0	49.4	111.6	0.2	127	4.6	0.2	0.01	<0.01	<10
	Mavundleni	Stream	7.94	162	33	6.0	87.4	30.9	<3.0	<0.1	2.9	26.9	15.9	39.7	12.0	49.4	89.1	0.7	<10	1.4	<0.1	0.04	0.02	<10
	Macosa	Borehole	7.14	246	49	3.7	172.6	39.4	6.0	<0.1	4.2	40.9	38.7	96.6	14.5	59.7	156.3	0.8	24	4.3	0.3	<0.01	1.78	<10
Engcobo	Sixotyeni	Spring	7.64	35	7	3.0	14.7	<4	<3.0	<0.1	0.5	3.0	5.3	13.2	3.0	12.4	25.6	0.0	123	<0.3	<0.1	0.09	0.02	<10
	Sigangeni	Spring	7.54	40	9	3.1	23.4	4.4	<3.0	<0.1	<0.1	4.3	6.5	16.2	3.8	15.6	31.8	0.0	125	0.5	<0.1	0.11	<0.01	<10
	Manzana	Spring	8.00	56	11	2.1	36.7	<4	<3.0	<0.1	<0.1	4.2	8.7	21.7	4.7	19.4	41.1	0.0	118	0.4	<0.1	0.08	0.03	<10
Qumbu	Lower Roza	Borehole	8.10	322	65	0.5	169.6	49.6	6.0	<0.1	4.3	35.3	30.7	76.7	20.8	85.7	162.4	1.1	63	4.7	<0.1	0.02	0.06	<10
	Ncalukeni	Spring	7.21	173	35	8.6	64.9	30.8	5.3	<0.1	7.3	29.0	18.7	46.7	10.9	44.9	91.6	1.5	127	0.5	1.4	0.19	0.02	<10
Tabankulu	Dambeni	Stream	8.27	378	76	0.4	278.7	21.0	4.0	<0.1	1.1	45.0	55.6	138.8	38.0	156.5	295.3	0.9	111	1.3	0.2	0.02	<0.01	<10
		Spring	8.15	619	124	0.4	304.7	167.3	5.6	<0.1	3.0	69.5	105.5	263.4	64.5	265.6	529.0	1.0	113	1.9	0.1	0.02	0.01	<10
		Borehole	7.60	361	72	1.0	210.0	94.1	13.9	<0.1	<0.1	66.7	40.1	100.1	34.5	142.1	242.2	1.0	<10	10.5	0.7	0.06	0.02	<10
	Bhakuba	Spring 1	8.23	138	27	1.5	131.2	9.4	3.9	0.2	0.2	7.3	7.7	19.2	21.7	89.4	108.6	0.2	58	4.6	<0.1	0.05	<0.01	<10
		Spring 2	7.71	283	56	0.3	210.9	32.3	<3.0	<0.1	5.5	26.5	44.1	110.1	29.6	121.9	232.0	0.8	108	12.2	<0.1	0.02	<0.01	<10
		Borehole 1	8.51	259	52	1.1	191.8	91.3	15.2	0.2	0.5	39.0	36.5	91.1	14.0	57.7	148.8	0.5	57	36.4	0.2	0.04	0.23	<10
		Borehole 2	8.34	119	24	5.3	99.0	13.0	6.9	<0.1	0.1	35.9	6.4	16.0	4.2	17.3	33.3	1.2	<10	8.9	1.3	0.02	0.57	<10
	Kwazulu-B	Stream	8.21	209	42	1.3	164.5	21.0	4.6	<0.1	2.8	25.0	34.1	85.1	17.3	71.2	156.3	0.5	115	1.1	0.2	0.04	<0.01	<10
		Borehole 1	8.31	217	43	0.3	171.6	21.3	4.9	<0.1	0.2	31.8	30.1	75.2	15.6	64.2	139.4	0.8	58	9.8	0.3	0.07	0.07	<10
		Borehole 2	8.31	318	63	1.0	149.4	70.0	7.5	<0.1	1.4	42.0	29.7	74.2	25.8	106.2	180.4	1.5	60	3.4	<0.1	0.04	0.02	<10
	Kwazulu-D	Stream	8.19	216	43	2.5	106.2	17.1	5.6	<0.1	1.5	22.2	32.8	81.4	21.6	88.9	170.3	0.8	120	1.2	<0.1	0.09	<0.01	<10

Water Quality of Test Boreholes

District	Village Name	pH	Conductivity	Turbidity	Alkalinity ($CaCO_3$)	Chloride (Cl)	Sulphate (SO_4)	Ammonia (NH_3)	Nitrate (NO_3)	Sodium (Na)	Calcium ($CaCO_3$)	Magnesium ($CaCO_3$)	Total Hardness ($CaCO_3$)	Potassium (K)	Copper (Cu)	Manganese (Mn)	Arsenic (As)	Fluoride (F)	Iron (Fe)	Zinc (Zn)	Cadmium (Cd)
DWAF Standard(Class 1)		5.0-9.5	150	1		200	400	1	44	200	80	70	150	50	1.0	0.1	0.05	1.0	0.2	5.0	0.005
WHO Standard		6.5-8.5		5		250	200		50	200			500		2.0	0.5	0.01	1.5	0.3	3.0	0.003
Japanese Standard		5.8-8.6		2		200	200			200			300		1.0	0.05	0.01	0.8	0.3	1.0	0.010
Unit		—	mS/m	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Ngqeleni	Kumaxhaka	7.49	62.0	0.2	125	55.1	9.4	<0.1	6.0	38.2	106.1	103.8	209.9	0.6	—	<0.01	0.0018	0.1	<0.01	0.34	0.005
	Qanqu	6.72	43.5	1.0	144	34.0	6.2	<0.1	1.8	23.0	74.9	57.7	132.6	0.6	<0.01	<0.01	0.0046	0.23	0.10	<0.01	0.005
	Didi	6.22	29.7	0.5	89	19.0	3.2	<0.1	1.2	18.8	38.0	32.9	70.9	0.45	<0.01	<0.01	0.0015	0.25	0.17	<0.01	0.005
	Ezinkozweni	6.83	45.3	0.4	170	24.0	3.4	<0.1	1.1	35.0	54.9	49.4	104.4	0.6	<0.01	<0.01	0.0056	0.18	0.16	0.14	0.005
	Kuleka	7.85	68.0	0.1	177	91.8	9.3	<0.1	1.1	66.3	115.9	74.9	190.8	0.8	—	0.06	0.0077	0.6	0.02	0.17	0.005
Umtata	Sikobeni	8.27	48.0	3.5	163	45.0	7.9	<0.1	0.2	65.0	57.0	38.0	96.0	2.8	<0.01	<0.01	0.0170	0.2	0.31	<0.01	0.005
	Centuli	6.74	72.6	1.5	273	51.0	12.0	<0.1	0.5	55.0	114.9	90.6	205.5	0.6	<0.01	<0.01	0.0011	0.12	0.46	<0.01	0.005
	Dlova	7.96	345.0	0.8	202	70.2	100.7	<0.1	0.3	45.7	142.3	119.0	261.3	1.5	—	0.02	0.0017	0.1	<0.01	0.18	0.005
	Upper Xongora	6.76	69.6	1.4	171	81.0	5.6	<0.1	0.4	55.2	98.4	55.2	153.6	0.8	0.01	<0.01	0.0026	<0.1	0.16	0.03	0.005
	Lower Centuli	7.71	90.4	1.2	144	139	4.5	<0.1	0.3	118.8	47.2	24.7	71.9	0.7	<0.01	<0.01	0.0022	1.87	0.27	0.17	0.005
	Gubevu	7.22	42.0	53.3	152	26.0	3.6	<0.1	0.6	31.0	75.0	70.0	145.0	0.9	<0.01	<0.01	0.0005	0.4	0.50	0.21	0.005
Mqanduli	Mavundleni	6.97	52.6	5.0	190	28.0	7.5	0.5	0.5	36.4	54.7	52.7	107.4	0.4	<0.01	<0.01	0.0009	0.05	0.12	3.45	0.005
	Tafeni*	7.04	73.9	5.4	212	76.0	6.7	<0.1	1.1	37.0	139.6	86.5	226.3	0.7	<0.01	0.55	0.0017	0.12	0.26	<0.01	0.005
	Ngwangweni	Dry Well																			
Qumbu	Lower Roza	Dry Well																			
	Ncalukeni	6.55	55.0	12.8	186	36.0	4.2	<0.1	1.3	46.0	87.4	57.7	145.0	1.0	<0.01	<0.01	0.0050	0.32	0.46	<0.01	0.005
	Ndwane	6.57	56.6	3.7	194	37.0	5.5	<0.1	2.5	34.0	102.4	82.4	184.7	0.9	<0.01	<0.01	0.0028	0.09	0.03	<0.01	0.005
Tabankulu	Dambeni	7.60	72.0	1.0	210	94.1	13.9	<0.1	<0.1	66.7	100.1	142.1	242.2	1.0	—	<0.01	0.0105	0.7	0.06	0.02	0.005
	Bhakuba	8.34	24.0	5.3	99	13.0	6.9	<0.1	0.1	35.9	16.0	17.3	33.3	1.2	—	<0.01	0.0089	1.3	0.02	0.57	0.005
	Kwazulu-B	8.46	43.6	12.4	148	40.0	7.2	<0.1	0.3	36.0	70.0	70.0	140.0	0.7	<0.01	<0.01	0.0006	0.1	0.43	<0.01	0.005
	Kwazulu-D	7.59	67.4	5.5	266	49.0	11.0	<0.1	<0.1	37.0	80.0	185.0	265.0	2.7	<0.01	0.10	0.0690	0.3	0.06	<0.01	0.005

N.B.: * Pumping test conducted in existing borehole

The values which do not conform to the drinking water standards of DWAF are shaded in the tables and these are summarized as follows.

- Turbidity is generally high for samples from streams and springs, as well as some borehole samples.
- The sample from the existing borehole of Tafeni gave a Manganese concentration of 0.55 mg/l (550 μ g/l) which is above the WHO guidelines and over 5 times the standard of DWAF and over 10 times the standard of Japan. This concentration can have slight health risks to sensitive groups as well as increased taste and color with moderate staining of clothes. Therefore, precaution is needed to use this source, especially for drinking purposes.
- Manganese concentration in half of the samples, and the iron content of a few samples showed values above the DWAF standard. These may contribute to some taste or odor and slight staining of white clothes, but should not present a significant problem to the health.
- Total hardness for over half of the samples as well as corresponding values of Magnesium and Calcium indicate values above the standard. Total hardness values above 300 mg/l can have effects in health and taste, as well as severely impair lathering and scaling of kettles. Values above 25 mg/l up to 300 mg/l can affect lathering and scaling of kettles, but has insignificant health effects.
- The sample from the new test borehole at Lower Centuli gave a fluoride concentration of 1.87 mg/l which does not meet the standards of DWAF, WHO and Japan, and can have possible health effects. Therefore this borehole should not be used for drinking purposes.
- A spring in Ncalukeni and the test drilled borehole in Bhakuba revealed fluoride contents above the DWAF standard, but are below the WHO standard of 1.5 mg/l. These sources can have some effects in sensitive groups and tooth staining.
- The sample from the test borehole at Kwazulu D revealed an Arsenic concentration of 0.069 mg/l which does not comply with standards of either DWAF, WHO or Japan. This value can be detrimental to the health, and therefore use of this source should be avoided for drinking purposes.
- Some samples from the Tabankulu area show Arsenic values which are below the DWAF standard, but are above the standards of WHO and Japan. Care should be taken when consuming water from these sources and when developing new water sources around this area.