
EMERGENCY WATER SOURCES

GUIDELINES FOR SELECTION AND TREATMENT

Sarah House and Bob Reed

Water, Engineering and Development Centre (WEDC)
Loughborough University UK



Published by
WEDC
Loughborough University
Leicestershire
LE11 3TU UK

© WEDC Loughborough University 2004
(Third edition)

First edition printed in 1997

Any part of this publication, including the illustrations (except items taken from other publications where the authors do not hold copyright) may be copied, reproduced or adapted to meet local needs, without permission from the authors or publisher, provided the parts reproduced are distributed free, or at cost and not for commercial ends, and the source is fully acknowledged as given below. The publisher and authors would appreciate being sent copies of any materials in which text or illustrations have been used.

House, S.J. and Reed, R.A. (2004) *Emergency Water Sources: Guidelines for selection and treatment (Third edition)*, Water, Engineering and Development Centre (WEDC), Loughborough.

ISBN 1 84380 069 1

Designed by Rod Shaw
Layout by Helen Batteson
Editorial support by Kimberly Clarke
Additional illustrations by Robin Borrett
and Jeremy Thistlethwaite

ABOUT THE AUTHORS

Sarah House is a civil / public health engineer who has experience of training for, and implementation of, labour-based construction for peri-urban areas of sub-Saharan Africa. She also has experience of emergency water supply and a specific interest in water and wastewater treatment process selection, design and evaluation. Her other major interests include gender and other people issues in engineering projects and the problems related to homelessness and mental health.

Bob Reed is a Programme and Project Manager at the Water, Engineering and Development Centre. He specializes in water supply and sanitation for rural areas, low-income urban communities and refugees. He has considerable experience of training, design and project implementation in the Pacific, the Caribbean, Asia and Africa. In recent years he has focused on the provision of improved and sustainable water supply and sanitation systems for displaced populations.

The authors would like to hear from anyone who uses the guidelines in the field with comments on their usefulness and areas which require adaptation or improvement. Please forward comments or suggestions to Bob Reed at the address given overleaf.

ABOUT WEDC

The Water, Engineering and Development Centre (WEDC) is one of the world's leading institutions concerned with education, training, research and consultancy for the planning, provision and management of physical infrastructure for development in low- and middle-income countries.

WEDC is devoted to activities that improve the health and well-being of people living in both rural areas and urban communities. We encourage the integration of technological, environmental, social, economic and management inputs for effective and sustainable development.



Water, Engineering and Development Centre
Loughborough University
Leicestershire
LE11 3TU UK

Phone: +44 1509 222885
Fax: +44 1509 211079
Email: WEDC@lboro.ac.uk
<http://www.lboro.ac.uk/wedc/>

COLLABORATORS

The 'Rapid Assessment of Emergency Water Sources' project (R 6256A) has been funded by the Department for International Development (DFID) of the British Government.

The following organisations have acted as peer reviewers for this research contract. They have reviewed draft documents, provided access to staff for interview, provided information and have been involved in and provided support for the field trials.

Opinions noted within these documents do not necessarily represent those of DFID or the collaborators, but are solely those of the authors.



INTERNATIONAL COMMITTEE OF THE RED CROSS



International Federation
of Red Cross and Red Crescent Societies



Many individuals have made useful contributions and are acknowledged in Section 1.

OVERVIEW

Section 1	Introduction and instructions for use	1
Section 2	Survival supply	11
	Procedures; selection; checklists and survey sheets	
Section 3	Longer term supply	35
	Procedures; selection; checklists and survey sheets	
Section 4	Supporting information	101
Section 5	Equipment and addresses	255

CONTENTS

Acronyms	xvi
----------	-----

Section 1	Introduction and instructions for use	1
------------------	--	----------

About these guidelines	1
What is an 'emergency'?	2
Socio-political, legal, cultural and security issues	2
Approach	3
Application	4
Guideline user group	4
Relationship between source selection with other activities	4
Completeness of surveys	5
Record keeping	5
Photographs and sketches	5
Time targets for assessments	6
Instructions for use	6
Acknowledgements	7

Section 2	Survival supply	11
Procedures and selection		13
Flowchart S1:	Steps for assessing survival supply	13
Flowchart S2:	Source and water treatment process selection for survival supply	14
Checklists		15
Checklist S1:	Background information gathering and identification of working environment before departure and in-field	15
	■ Background information gathering before departure and in-field	15
	■ Identification of working environment	16
Checklist S2:	Reconnaissance of the area (including existing water usage situation, features of the source, requirements for development, constraints and impacts)	17
	■ Regional orientation	17
	■ Settlement orientation	17
	■ Demographics, water usage and water demands	18
	■ Availability of resources / logistics	18
	■ Physical features including yield and quantity	19
	■ Management, legal, security, socio-political and cultural issues	19
	■ Requirements for development	20
	■ Impacts of development	20
Survey sheets		21
Survey sheet S1:	Conversations / observations log (2 pages)	21
Survey sheet S2:	Addresses (2 pages)	23
Survey sheet S3:	Published information log (2 pages)	25
Survey sheet S4:	Resources log (2 pages)	27
Survey sheet S5:	Reconnaissance of area (including existing water usage situation, features of the source, requirements for development, constraints and impacts) (6 pages)	29
	■ Regional orientation	29
	■ Settlement orientation	30
	■ Demographics, water usage and water demands	31
	■ Logistics	32
	■ Physical features including yield and quality	33
	■ Management, legal, security, socio-political and cultural issues	33
	■ Requirements for development	34
	■ Impacts of development	34

Section 3	Longer term supply	35
Procedures and selection		37
Flowchart L1:	Steps for assessing longer term supply	37
Flowchart L2:	Pre-selection of sources for further investigation	38
	Water treatment process selection for longer term supply	39
	■ Introduction	39
	■ How to use this section	40
	■ Water treatment process selection tools for longer term supply	44
	Source selection for longer term supply	46
	■ How to use this section	46
	■ Source comparison tool for longer term supply	49
Checklists		53
Checklist L1	Background information gathering and identification of working environment before departure and in-field	53
	■ Background information gathering before departure and in-field	53
	■ Identification of working environment	54
Checklist L2	Reconnaissance of the area (including existing water usage situation, logistics and resources)	55
	■ Regional orientation	55
	■ Settlement orientation	55
	■ Demographics, present water usage and water demands	56
	■ Availability of resources / logistics	57
Checklist L3	Features of the source (excluding water quality)	59
	■ Physical features including yield	59
	■ Management, legal, security, socio-political and cultural issues	59
Checklist L4	Features of the source (water quality)	60
	■ Water quality assessment	60
Checklist L5	Requirements for development and impacts summary	61
	■ Physical requirements	61
	■ Impacts of development	62
Checklist L6	Confirmation of assumptions made during the selection process	63
	■ Resources, logistics, legal, security, social-political and cultural issues	63

Checklist L7	Groundwater investigation	64
Checklist L8	Rainwater investigation	66
Checklist L9	National government / local government / NGO / international organization	68
	■ National or local government	68
	■ Non-governmental organizations and international organizations	69
Checklist L10	Affected population / local population issues	70
Checklist L11	Water treatment works and urban water supply systems	72
	■ Urban water supply system inventory	72
	■ Resources / spares checklist	74
	■ Water treatment works operational checklist	74
Survey sheets		79
Survey sheet L1	Conversations / observations log	79
Survey sheet L2	Addresses	81
Survey sheet L3	Published information log	83
Survey sheet L4	Resources log	85
Survey sheet L5	Reconnaissance of area (including existing water use situation, logistics and resources)	87
	■ Regional orientation	87
	■ Settlement orientation	88
	■ Demographics, present water usage and water demands	89
	■ Logistics	90
Survey sheet L6	Features of the source (excluding water quality)	91
	■ Physical features including yield	91
	■ Management, legal, security, socio-political and cultural issues	94
Survey sheet L7	Features of the source (water quality)	95
	■ Water quality assessment summary	95
	■ Water quality analysis	96
	■ Treatability tests	97
	■ Industrial pollution laboratory analysis	97
Survey sheet L8	Requirements for development and impacts summary	98
	■ Technical and O & M requirements and time of set up	98
	■ Resources and costs	99
	■ Impacts of development	100

Section 4	Supporting information	101
Guidance on undertaking assessments and report writing		103
■ Assessments		103
■ Report writing		104
Management, legal, security, socio-political and cultural issues with case studies		108
■ Management, legal, security, socio-political and cultural issues		108
■ Case studies		111
Typical water source features		125
Requirements for development		131
■ Technical		131
■ Resources / logistics		131
■ Time of set-up		131
■ Operation and maintenance (O&M)		132
■ Costs		132
Impacts of development		136
Water quantities		141
Measurement of yield and water levels		143
■ Groundwater - wells and boreholes		143
■ Groundwater - springs		145
■ Surface water - streams & rivers		146
■ Surface water - lakes and ponds		146
Water quality assessment routines		148
■ Introduction		148
■ Catchment mapping		148
■ Local knowledge including local medical information		149
■ Sanitary investigation / observation		149
■ Water quality analysis routine		151
■ Biological surveys		153
Catchment mapping: Maps and symbols		154
■ Catchment mapping: regional		154
■ Catchment mapping: local		156
■ Camp mapping		158
■ Detailed sketch of source		159
■ Mapping symbols		160

Catchment mapping: Surveying	161
■ Trigonometry	161
■ Pacing and using the vehicle mileage meter	162
■ Compass traverse	162
■ Measuring inaccessible distances	163
■ Using an aneroid barometer or an altimeter	164
■ Using a clinometer or Abney level	164
■ Using the Global Positioning Systems (GPS)	167
Water quality analysis	169
■ Introduction to physical, chemical and microbiological analyses	169
■ Water quality parameter summary tables	170
■ Water sampling	174
■ Treatability tests	176
■ Industrial pollution	181
■ Industries and activities and associated pollutants	185
■ Recommended water sample preservation techniques	193
■ Draft letter to laboratory requesting assessment	195
■ Draft letter to interpreting organisation	196
■ Organisations which may be able to interpret industrial pollution data	197
■ WHO drinking-water guideline values	198
Biological survey	204
■ Introduction	204
■ Small water animals	204
■ Other water animals, plants and algae	206
Water treatment: Treatment processes and health and safety	214
■ Features of treatment processes	214
■ Health and safety information	224
Background to groundwater and aquifers	230
■ Soils and rocks	230
■ Hydrological cycle	230
■ Water in soils and rocks	231
■ Groundwater	234
■ Aquifer characteristics	235
Rock and soil identification	235
■ Identification of rocks and aquifers	236
■ Aquifer properties	237
■ Unconsolidated sediments (soil) identification and infiltration rates	238
Groundwater investigation	249
■ Groundwater levels and interaction between water sources	249
■ Indicators of the presence of groundwater	252
Rainwater harvesting	253

Section 5	Equipment and addresses	255
Glossary		257
Water quality analysis and surveying equipment		261
■ General equipment (surveying, yield measurement etc.)		261
■ Makes and suppliers of general equipment		261
■ Water quality analysis equipment		262
■ Makes and suppliers of water quality testing equipment		269
■ Equipment selection		277
■ Example total kit list		277
Water treatment: Mobile treatment units and modular kits		283
■ Details		283
Useful addresses		285
■ Organisations which may be able to interpret industrial pollution data		285
■ Equipment manufacturers and suppliers		286
■ General		289
Bibliography		291

ACRONYMS

ARRA	Administration of Refugee and Returnee Affairs (Ethiopia)
CEU	Construction Enterprise Unit
DFID	Department for International Development
GPS	Global positioning system
HCR	Shortened version of UNHCR
ICRC	International Committee of the Red Cross
IFRC	International Federation of the Red Cross and Red Crescent Societies
MSF	Médecins sans Frontières
NGO	Non-governmental organisation
NTU	Nephelometric Turbidity Units
O&M	Operation and maintenance
RAEWS	Rapid Assessment of Emergency Water Sources
REDR	Register of Engineers for Disaster Relief
RSF	Rapid sand filtration
SRS	Sanitary risk score
SSF	Slow sand filtration
THM	Trihalomethane
TU	Turbidity Units
TDS	Total dissolved solids
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNPROFOR	United Nations Protection Force
UNIDO	United Nations Industrial Development Organization
UTM	Universal Transverse Mercator
WEDC	Water, Engineering and Development Centre
WHO	World Health Organization

S. House



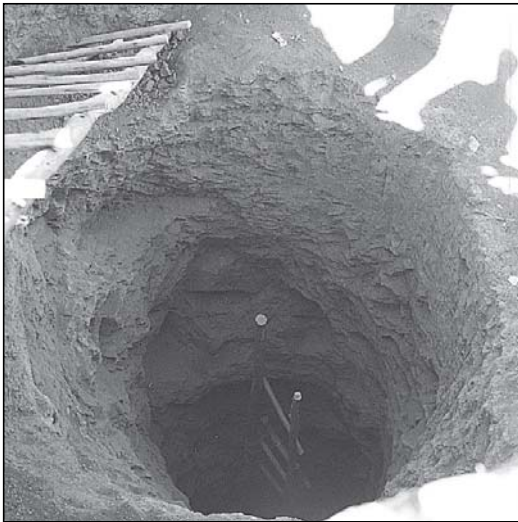
Lungutu River, Eastern Zaire

S. House



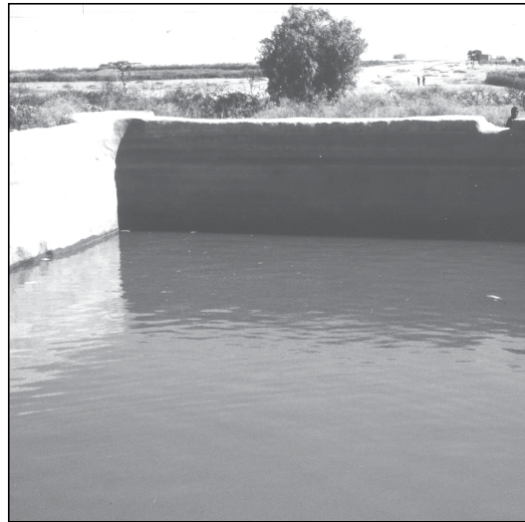
Shallow groundwater, Teferi Ber, Eastern Ethiopia

S. House



Shallow well under construction, Teferi Ber, Eastern Ethiopia

S. House



Rainwater stored in *birka*, Kebri Beyah, Eastern Ethiopia

Water sources

