

Protecting Groundwater for Health

Managing the Quality of Drinking-water Sources

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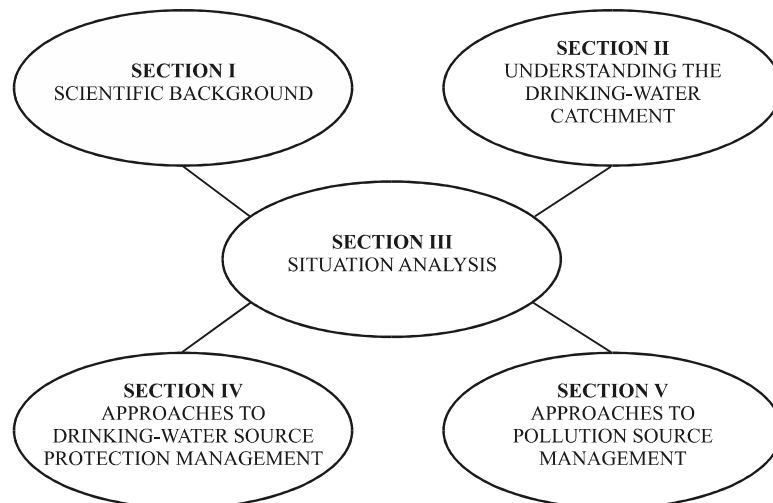
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Structure of this book

This book is a tool for developing strategies to protect groundwater for health by managing the quality of drinking-water sources. For this purpose it provides different points of entry. As illustrated in the Figure below, the book consists of five sections.



Structure of Protecting Groundwater for Health

Section I covers the scientific background needed to understand which pathogens and chemicals are relevant to human health, how they are transported in the underground and how they may be reduced, removed or retarded (Chapters 3 and 4). The criteria for inclusion of agents in this overview are their relevance to human health and their relevance in groundwater. Further the concept of groundwater recharge areas is introduced in Chapter 2, and basic hydrological and hydrogeological background information is provided. The section is concluded by Chapter 5 which introduces socio-economic and institutional considerations relevant to developing the protection of groundwater resources.

Section II provides background information for characterizing and understanding the drinking-water catchment. The chapters in this section explain how conditions and human activities in the catchment may lead to the occurrence of pathogens or hazardous substances in groundwater. The section begins with general guidance on collecting information (Chapter 6). Chapter 7 discusses assessing the socio-economic and institutional setting as a necessary basis for choosing and implementing feasible management actions. Chapter 8 outlines the background and information required for understanding the hydrogeological conditions determining the likelihood of pollutants to reach aquifers. Chapters 9-13 address the range of human activities potentially releasing pollutants to the underground, i.e. agriculture, sanitation practices, industry, mining, military sites, waste disposal and traffic. These chapters end with checklists highlighting the type of information needed about the setting and the human activities in it for assessing health hazards potentially affecting groundwater.

Section III provides conceptual guidance on prioritizing both hazards and management responses. Chapter 14 describes how information on the hydrogeological conditions, particularly on aquifer vulnerability, can be related to human activities in the drinking-water catchment area in order to assess the potential for pollutants emitted from these activities to reach the aquifer. Chapter 15 discusses how to prioritize pollutants according to their public health burden as well as to their likelihood of long-term accumulation in the aquifer. It also addresses the need to consider the socio-economic context in choosing feasible options from the range of technically appropriate management responses for protection, control or remediation.

Section IV provides an overview of the potential management actions that may be taken to protect drinking-water sources. These begin with their integration into a comprehensive Water Safety Plan that covers all supply steps from catchment to consumer (Chapter 16). Two chapters specifically cover protection of the drinking-water source: Chapter 17 at the scale of designating and managing groundwater protection zones in the catchment and Chapter 18 at the scale of protecting wellheads. Lastly, Chapter 19 addresses the management of groundwater abstraction in order to avoid impacts upon quality and quantity and thus on human health.

Section V provides an overview of control measures to prevent pollution from human activities in the catchment, beginning with the overarching issues of policy, land-use planning and implementation of management options for protecting groundwater (Chapter 20). Chapters 21-25 follow with overviews of the specific management approaches that help avoid groundwater pollution from the range of human activities in the catchment, i.e. agriculture, sanitation practices, industry, mining, military sites, waste disposal and traffic.

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Acronyms and abbreviations

ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	acid sulphate soils
BAT	best available technology
BC MAFF	British Columbia Ministry for Agriculture, Fisheries & Forestries, Canada
BGS	British Geological Survey
BMP(s)	best management practice(s)
BOD	biochemical oxygen demand
BTEX	benzene, toluene, ethylbenzene, xylene
C&D	construction and demolition
CCTV	close circuit television
cDCE	cis-dichloroethene
cf	contamination factor
CJD	Creutzfeldt-Jakob disease
COD	chemical oxygen demand
CSOs	combined sewer overflows
CTC	carbon tetrachloride/tetrachloromethane
CVM	contingent valuation methodologies
CW	chemical warfare
2,4-D	(2,4-dichlorophenoxy)acetic acid
DALY	Disability Affected Life Years
2,4-DB	(2,4-dichlorophenoxy)butyric acid
1,2-DCA	1,2-dichloroethane

1,2-DCB	1,2-dichlorobenzene
1,4-DCB	1,4-dichlorobenzene
1,1-DCE	1,1-dichloroethene
DCM	dichloromethane
DDT	dichlorodiphenyltrichloroethane
DFID	Department for International Development, UK
DNAPL	dense non-aqueous phase liquid
DNB	dinitrobenzene
DNT	dinitrotoluene
DOC	dissolved organic carbon
DOE	Department of the Environment
DWI	Drinking Water Inspectorate
EA	Environment Agency
EDCs	endocrine disrupting chemicals/compounds
EDTA	ethylenediamine tetraacetic acid
EED	Environmental Engineering Division
EIA(S)	Environmental Impact Assessment (Study)
EU	European Union
FS	faecal streptococci
FAO	Food and Agriculture Organization
GIS	Geographical Information System
GDWQ	<i>Guidelines for Drinking-water Quality</i> , WHO
HACCP	Hazard Analysis and Critical Control Points
GV	guideline value
Hb	haemoglobin
HCB	hexachlorobenzene
HD	mustard gas
HIV	human immunodeficiency virus
HMX	High Melting Explosive cyclotetramethylenetetranitramine
IARC	International Agency for Research on Cancer
ICPE	International Commissions for the Protection of the Elbe
ICPR	International Commissions for the Protection of the Rhine
IDWSSD	International Drinking Water Supply and Sanitation Decade
ISL	in situ leaching
IUPAC	International Union of Pure Applied Chemistry
LNAPLs	light non-aqueous phase liquid
LWS	Lenzburg water supply
MCPA	(4-chloro-2-methylphenoxy)acetic acid
MCPP	2-(4-chloro-2-methylphenoxy)propanoic acid (mecoprop)
MDG	Millennium Development Goal
metHb	methaemoglobin
MNA	monitored natural attenuation
MSW	municipal solid waste
MTBE	methyl tertiary-butyl ether
NA	natural attenuation
NAPL	non aqueous phase liquid
NCRP	National Council on Radiation Protection Measurements, USA
NGOs	non-governmental organizations
NRC	National Research Council, USA

NSW	New South Wales, Australia
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	perchloroethylene/tetrachloroethene
PCP	pentachlorophenol
PCPs	personal care products
PCR	polymerase chain reaction
PHAST	participating hygiene and sanitation transformation
POPs	persistent organic pollutants
PPP	purchasing power parity
RDX	Royal Dutch Explosive cyclotrimethylenetetranitramine
REC	Regional Environmental Council
RNA	ribonucleic acid
SHI	Sanitary Hazard Index
SPA	Source Protection Areas
2,4,5-T	(2,4,5-trichlorophenoxy)acetic acid
TCA	trichloroethane
TCE	trichloroethene
TCM	trichloromethane
tDCE	trans-dichloroethene
TDS	total dissolved solids
TeCE	tetrachloroethene
TNT	trinitrotoluene
TON	total organic nitrogen
2,4,5-TP	(2,4,5-trichlorophenoxy)propanoic acid (fenoprop)
TTC	thermotolerant coliforms
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNICEF	United Nations International Children's Emergency Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSCEAR	United Nations Scientific Committee of Effects of Atomic Radiation
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VBNC	viable but non-culturable
VC	vinyl chloride
VFAs	volatile fatty acids
VOC	volatile organic compounds
WEDC	Water Engineering and Development Centre, University of Loughborough, United Kingdom
WHO	World Health Organization
WMO	World Meteorological Organization
WSP	Water Safety Plan
γ -HCH	1 α ,2 α ,3 β ,4 α ,5 α ,6 β -hexachlorocyclohexane (lindane)