Urban Groundwater Management and Sustainability

NATO Science Series

A Series presenting the results of scientific meetings supported under the NATO Science Programme.

The Series is published by IOS Press, Amsterdam, and Springer in conjunction with the NATO Public Diplomacy Division

Sub-Series

I. Life and Behavioural Sciences	IOS Press
II. Mathematics, Physics and Chemistry	Springer
III. Computer and Systems Science	IOS Press
IV. Earth and Environmental Sciences	Springer

The NATO Science Series continues the series of books published formerly as the NATO ASI Series.

The NATO Science Programme offers support for collaboration in civil science between scientists of countries of the Euro-Atlantic Partnership Council. The types of scientific meeting generally supported are "Advanced Study Institutes" and "Advanced Research Workshops", and the NATO Science Series collects together the results of these meetings. The meetings are co-organized by scientists from NATO countries and scientists from NATO's Partner countries – countries of the CIS and Central and Eastern Europe.

Advanced Study Institutes are high-level tutorial courses offering in-depth study of latest advances in a field.

Advanced Research Workshops are expert meetings aimed at critical assessment of a field, and identification of directions for future action.

As a consequence of the restructuring of the NATO Science Programme in 1999, the NATO Science Series was re-organised to the four sub-series noted above. Please consult the following web sites for information on previous volumes published in the Series.

<http://www.nato.int/science>

<http://www.springer.com>

<http://www.iospress.nl>

Series IV: Earth and Environmental Sciences – Vol. 74

Urban Groundwater Management and Sustainability

edited by

John H. Tellam

Earth Sciences, School of Geography, Earth and Environmental Sciences,
University of Birmingham, U.K.

Michael O. Rivett

Earth Sciences, School of Geography, Earth and Environmental Sciences,
University of Birmingham, U.K.

and

Rauf G. Israfilov

Geology Institute, Azerbaijan National Academy of Sciences,
Baku, Azerbaijan

Technical Editor

Liam G. Herringshaw

Earth Sciences, School of Geography, Earth and Environmental Sciences,
University of Birmingham, U.K.

Published in cooperation with NATO Public Diplomacy Division

Proceedings of the NATO Advanced Study Institute on
Management and Sustainable Development of Urban Groundwater Systems
Baku, Azerbaijan
6–15 August 2004

A C.I.P. Catalogue record for this book is available from the Library of Congress.

ISBN-10 1-4020-5174-3 (PB)
ISBN-13 978-1-4020-5174-6 (PB)
ISBN-10 1-4020-5173-5 (HB)
ISBN-13 978-1-4020-5173-9 (HB)
ISBN-10 1-4020-5175-1 (e-book)
ISBN-13 978-1-4020-5175-3 (e-book)

Published by Springer,
P.O. Box 17, 3300 AA Dordrecht, The Netherlands.

www.springer.com

Printed on acid-free paper

All Rights Reserved
© 2006 Springer

No part of this work may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission from the Publisher, with the exception of any material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work.

TABLE OF CONTENTS

PREFACE	xiii
PARTICIPANTS AND CONTRIBUTORS	xv
SECTION I: Introduction	
1 TOWARDS MANAGEMENT AND SUSTAINABLE DEVELOPMENT OF URBAN GROUNDWATER SYSTEMS: An Introduction	1
John H. Tellam, Michael O. Rivett, and Rauf G. Israfilov	
SECTION II: Regional Overviews	
2 ANTHROPOGENIC CHANGES TO HYDROGEOLOGICAL CONDITIONS IN URBAN AREAS: New Perspectives from Azerbaijan	11
R.G. Israfilov	
3 DEMANDS ON, CONDITION, AND ENVIRONMENTAL PROBLEMS OF THE BAKU MUNICIPAL WATER SUPPLY	29
M.A. Mammadova and Sh.I. Pashayeva	
4 GEOENVIRONMENTAL PROBLEMS IN AZERBAIJAN	39
Adishirin B. Alekperov, Ruslan Ch. Agamirzayev, and Ramil A. Alekperov	
5 SOURCES OF GROUNDWATER SUPPLY TO URBANIZED AREAS IN AZERBAIJAN: National Development of Groundwater Resources	59
F.Sh. Aliyev and F.S. Askerov	
6 OPTIMIZATION OF GROUNDWATER USAGE FOR URBANIZED RURAL SETTLEMENT SUPPLY IN AZERBAIJAN	79
Yu.H. Israfilov, M.A. Asadov, and T.M. Rashidov	

7	URBAN GROUNDWATER POLLUTION IN TURKEY: A National Review of Urban Groundwater Quality Issues Alper Baba and Onder Ayyildiz	93
8	GROUNDWATER POTENTIAL AND HYDROGEOLOGICAL CHARACTERISTICS OF ÇORLU, TURKEY: A Case of Over-abstraction of Good Quality Groundwater Resources I. Feda Aral	111
9	EVALUATION OF GROUNDWATER OVER- ABSTRACTION BY INDUSTRIAL ACTIVITIES IN THE TRAKYA REGION, TURKEY: A Case of Urban Groundwater Resource Over-abstraction Atakan Öngen and Esra Tinmaz	117
10	A LONG-TERM PERSPECTIVE ON THE SUSTAINABLE DEVELOPMENT OF URBAN GROUNDWATER RESOURCES IN ROMANIA Liviu – Daniel Galatchi	129

SECTION III: Groundwater Flow

11	INTEGRATED HYDROLOGICAL MODELLING FOR SUSTAINABLE DEVELOPMENT AND MANAGEMENT OF URBAN WATER SUPPLIES E. Zia Hosseinipour	137
12	ESTIMATING EVAPOTRANSPIRATION IN URBAN ENVIRONMENTS Ken Trout and Mark Ross	157
13	RELIABILITY IN ESTIMATING URBAN GROUNDWATER RECHARGE THROUGH THE VADOSE ZONE: Managing Sustainable Development in Arid and Semiarid Regions Michael J. Friedel	169

14	URBAN WELL-FIELD CAPTURE ZONES DELINEATED USING FLOW STRUCTURE MODELLING	183
	Danila Kuznetsov	

SECTION IV: Chemical Water Quality

15	IMPACTS OF SEWER LEAKAGE ON URBAN GROUNDWATER: Review of a Case study in Germany	189
	Inka Held, Leif Wolf, Matthias Eiswirth, and Heinz Hötzl	
16	CONTAMINATION AND DEGRADATION OF DE-ICING CHEMICALS IN THE UNSATURATED AND SATURATED ZONES AT OSLO AIRPORT, GARDERMOEN, NORWAY	205
	Bente Wejden and Jarl Øvstedal	
17	AROMATIC HYDROCARBON CONTAMINATION OF CLAY STRATA BELOW A PETROCHEMICAL SITE, UK: Organic Contaminant Migration in Clay Aquitards	219
	Rachel A. White, Michael O. Rivett, and John H. Tellam	
18	BASELINE GROUNDWATER QUALITY IN THE COASTAL AQUIFER OF ST. LUCIA, SOUTH AFRICA	233
	Marianne Simonsen Bjørkenes, Sylvi Haldorsen, Jan Mulder, Bruce Kelbe, and Fred Ellery	
19	HYDROCHEMICAL QUALITY OF GROUNDWATER IN URBAN AREAS OF SOUTH PORTUGAL	241
	Antonio Chambel, Jorge Duque, and M. Manuel Madeira	
20	ISSUES OF RADIOACTIVITY AND SUSTAINABLE DEVELOPMENT WITHIN URBAN GROUNDWATER SYSTEMS IN RUSSIA	251
	Liliya M. Rogachevskaya	

21	RISKS POSED BY UNSANITARY LANDFILL LEACHATE TO GROUNDWATER QUALITY: Çorlu (Trakya), Turkey	259
	Esra Tinmaz and Atakan Ongen	
22	AGRICULTURAL INFLUENCES ON GROUNDWATER USED FOR WATER SUPPLY IN THE CAUCASUS MINERAL WATER REGION	269
	Olga A. Karimova	
23	ENVIRONMENTAL PROBLEMS ASSOCIATED WITH UTILIZATION OF MINERAL WATERS IN URBANIZED AREAS OF AZERBAIJAN	279
	Mehriban M. Ismailova	
24	CONCLUSIONS FROM A NEGATIVE TRACER TEST IN THE URBAN THERMAL KARST AREA, BUDAPEST, HUNGARY	289
	Anita Eröss, Judit Mádl-Szőnyi, Andrea Mindszenty and Imre Müller	

SECTION V: Biological Water Quality

25	MONITORING AND MANAGING THE EXTENT OF MICROBIOLOGICAL POLLUTION IN URBAN GROUNDWATER SYSTEMS IN DEVELOPED AND DEVELOPING COUNTRIES	299
	A.A. Cronin, J. Rueedi, E. Joyce and S. Pedley	
26	MICROBIAL POLLUTION OF GROUNDWATER IN THE TOWN OF WALKERTON, CANADA: Implications for the Development of Appropriate Aquifer Protection Strategies	315
	Ken W.F. Howard	

27	EFFECTS OF ARTIFICIAL STORMWATER INFILTRATION ON URBAN GROUNDWATER ECOSYSTEMS: Ecological Issues in Urban Groundwater	331
	Thibault Datry, Florian Malard, and Janine Gibert	

SECTION VI: Remediation

28	ORGANIC CONTAMINANT REMEDIATION IN URBAN GROUNDWATER: A Review of Groundwater Remediation Technology Development	347
	Michael O. Rivett	
29	RECENT APPROACHES FOR URBAN GROUNDWATER POLLUTION PREVENTION AND REMEDIATION: Analysis and Recommendations	357
	Detlef Klaffke	
30	REDUCING THE GROUNDWATER POLLUTION RISK IN THE MINING AND INDUSTRIAL REGIONS OF CHIATURA AND KAZRETI, GEORGIA: Remediation of Mine-related Tailings and Wastes	375
	Sh. Petriashvili and D. Chutkerashvili	
31	THE REMOVAL OF NITRATE AND PESTICIDES FROM CONTAMINATED WATER	381
	Sukru Aslan and Aysen Turkman	

SECTION VII: Engineering

32	CHEMICAL AND GEOTECHNICAL PROBLEMS ASSOCIATED WITH THE TBILISI WATER STORAGE RESERVOIR, GEORGIA	393
	G. Buachidze and T. Tevzadze	
33	HYDROGEOLOGY AND ENGINEERING GEOLOGY OF THE ‘SLEEPING DISTRICT’ (VARKETILI) OF TBILISI, GEORGIA	401
	Gocha Gelashvili	

34	AN INTEGRATED EVALUATION PROGRAM FOR THE ASSESSMENT OF VARIATIONS IN URBAN GROUNDWATER LEVEL	409
	Nikolai Bobylev	
35	THE HYDROTHERMAL SYSTEM OF TBILISI, GEORGIA	417
	G. Buntebarth, T. Chelidze, and G. Melikadze	
36	ESTIMATING THE BASIC MATERIAL AND TECHNICAL RESOURCE NEEDS FOR THE OPERATION OF WELL DRAINAGE SYSTEMS IN URBAN AREAS WITH HIGH WATER TABLES	427
	Sh. Yakubov and Sh. Usmanov	
37	HYDROGEOLOGICAL CONDITIONS IN URBAN AREAS IN THE GEORGIAN BLACK SEA COASTAL ZONE: Case Studies of the Towns of Poti and Batumi	441
	T. Iashvili	

SECTION VIII: Socio-Economics

38	GROUNDWATER INSTITUTIONS AND MANAGEMENT PROBLEMS IN THE DEVELOPING WORLD	447
	Kai Wegerich	
39	THE ROLE OF GROUNDWATER IN DELHI'S WATER SUPPLY: Interaction Between Formal and Informal Development of the Water System, and Possible Scenarios of Evolution	459
	Augustin Maria	
40	WATER SUPPLY AND SANITATION SECTOR ANALYSIS OF THE SECONDARY TOWNS OF AZERBAIJAN: Does Groundwater Play a Role?	471
	Shammy Puri and Tanya Romanenko	

41	GROUNDWATER UTILIZATION AS ADAPTIVE CAPACITY TO PUBLIC WATER SUPPLY SHORTAGES: Case Study of Two Cities in Khorezm, Uzbekistan	479
	Kai Wegerich	

PREFACE

With increasing awareness of environmental issues and the rapid expansion of urbanized areas, interest in urban groundwater has developed greatly over the last two decades. A number of meetings have been held on urban groundwater issues, for example the International Association of Hydrogeologists (IAH) Congress in 1997 (Chilton et al., 1997), and the urban groundwater session of the Geological Congress of 2004. The IAH has a commission on Urban Hydrogeology, and UNESCO has an Urban Water Management focal area under its IHP VI programme. Concomitantly, there has been a great interest in the wider development of the concepts of sustainability (e.g. Hiscock et al., 2002), including as applied to urban systems. It was in this context that a NATO Advanced Studies Institute (ASI) was held in Baku, Azerbaijan, in August 2004, following a very successful NATO Advanced Research Workshop at the same venue in 2001 (Howard and Israfilov, 2001). The ASI brought together, over a period of 10 days, a very diverse group of researchers from a wide range of countries interested in the whole gamut of urban groundwater issues. The aim was to share experiences and ideas, and to explore the commonality of urban groundwater problems, working towards methods for managing urban hydrological systems in ways that would minimize adverse impacts. This book is one product of the meeting. It covers all the main aspects of urban groundwater issues, from flow systems, through chemical and biological contamination, to engineering and socio-economic impacts, with evidence being drawn from many different countries and hydrogeological/socio-economic environments. It also includes, importantly, overviews which demonstrate how the different processes and impacts coexist and interact within any one city system.

We would like to thank NATO, and in particular Dr Alain Jubier and Dr Deniz Beten, for support and funding of both the ASI and the book. In the running of the ASI, the 'Baku team' and the staff of the Geology Institute of the Azerbaijan National Academy of Sciences provided much needed infrastructural support. We would particularly like to recognize the contributions of Rafiq Hanifazade and Tofiq Rashidov. The book would not have been possible without the extremely able editing of Dr Liam Herringshaw. Our publishers were very understanding, and in particular we would like to thank Mrs Wil Bruins for her support. Vanessa Chesterton and Kevin Burkhill undertook much of the metadata compilation and re-drafting of figures. Finally, we would like to thank all the contributors for their interesting ideas and lively discussions during the ASI, and later for their helpful response to our many editing queries.

- Chilton, P.J. et al. (eds), 1997. *Groundwater in the Urban Environment, Vol. 1*. A.A. Balkema, Rotterdam, 682pp.
- Hiscock, K.M., Rivett, M.O., Davison, R.M. (eds), 2002. *Sustainable groundwater development*. Geological Society, London, Special Publication 193, 352pp.
- Howard, K.W.F., and Israfilov, I.G. (eds), 2001. *Current problems of hydrogeology in urban areas, urban agglomerates and industrial centres*. NATO Science Series IV: Earth and Environmental Sciences, Vol.8, Kluwer Academic Publishers, Dordrecht, 500 pp.

PARTICIPANTS AND CONTRIBUTORS

Ruslan Ch. AGAMIRZAYEV

*Ministry of Ecology and Natural Resources, Balajar, Natavan st. 16, Az-1117,
Baku,
AZERBAIJAN*

Ramil A. ALEKPEROV

*Ministry of Ecology and Natural Resources, Balajar, Natavan st. 16, Az-1117,
Baku,
AZERBAIJAN*

F. Sh. ALIYEV (now deceased)

*Institute of Geology, National Academy of Sciences, H.Javid Av. 29A, Baku-
AZ1143,
AZERBAIJAN*

F. ARAL

*Department of Civil Engineering, Engineering Faculty, Trakya University, 59860,
Çorlu, Tekirdağ,
TURKEY*

M. A. ASADOV

*Institute of Water Problems, Tbilisi av, 69a, 370012, Baku,
AZERBAIJAN*

F. S. ASKEROV

*BP Oil Company, Baku,
AZERBAIJAN*

Sukru ASLAN

*Cumhuriyet University, Department of Environmental Engineering, 58140, Sivas,
TURKEY*

Onder AYYILDIZ

*Geological Engineering Department, Engineering and Architecture Faculty,
Çanakkale Onsekiz Mart University, 17100 Canakkale,
TURKEY*

Alper BABA

*Geological Engineering Department, Engineering and Architecture Faculty,
Çanakkale Onsekiz Mart University, 17100, Canakkale,
TURKEY*

Marianne BJORKENES

*Dept. of Plant and Environmental Sciences, Agricultural University of Norway,
Box 5003, 1432 Ås,
NORWAY*

Nikolai BOBYLEV

*St. Petersburg State Polytechnic University,
RUSSIA*

G. BUACHIDZE

*Institute of Hydrogeology and Engineering Geology, Georgian Academy of
Sciences, 31 Rustaveli Ave, 380008, Tbilisi,
GEORGIA*

G. BUNTEBARTH

*Geophysikalisch-Technisches Büro, Burgstaetter Str. 6, D-38678 Clausthal-
Zellerfeld,
GERMANY*

Antonio CHAMBEL

*Department of Geosciences, University of Évora, Apartado 94, 7002-554, Évora,
PORTUGAL*

T. CHELIDZE

*Institute of Geophysics, Aleksidze Str. 1, 0193, Tbilisi,
GEORGIA*

D. CHUTKERASHVILI

*Institute of Hydrogeology and Engineering Geology, Academy of Sciences, Tbilisi,
GEORGIA*

Aidan A. CRONIN

*Robens Centre for Public and Environmental Health, The University of Surrey,
Guildford, GU2 7XH,
UK*

Thibault DATRY

*University Claude Bernard - Lyon 1 - Bat. Forel (403), UMR CNRS 5023, 43 Bd
du 11 Novembre 1918, F-69622 Villeurbanne Cedex,
FRANCE*

Jorge DUQUE

*Department of Geology, Faculty of Sciences, University of Lisbon, Edificio C2,
Campo Grande, Lisbon,
PORTUGAL*

Matthias EISWIRTH (now deceased)

*Department of Applied Geology, University of Karlsruhe,
GERMANY*

Fred ELLERY

*University of Natal, Durban,
SOUTH AFRICA*

Anita ERŐSS

Dept. of Applied and Environmental Geology, Institute of Geography and Earth Sciences, Eötvös Loránd University, Pázmány P. sétány 1/c, 1117, Budapest, HUNGARY

Michael J. FRIEDEL

Department of Water Resources Science, University of Minnesota, 55108, St Paul, Minnesota, USA

Daniel GALATCHI

Ovidius University, Department of Ecology and Environmental Protection, Mamaia Boulevard 124, 900241, Constanta - 3, ROMANIA

Gocha GELASHVILI

Institute of Hydrogeology and Engineering Geology, Academy of Sciences, 31 Rustaveli Ave, 380008, Tbilisi, GEORGIA

Janine GIBERT

University Claude Bernard - Lyon 1 - Bat. Forel (403), UMR CNRS 5023, 43 Bd du 11 Novembre 1918, F-69622 Villeurbanne Cedex, FRANCE

Sylvi HALDORSEN

Dept. of Plant and Environmental Sciences, Agricultural University of Norway, Box 5003, 1432 Ås, NORWAY

Inka HELD

Department of Applied Geology, University of Karlsruhe, GERMANY

E. Zia HOSSEINIPOUR

DHI Water and Environment, 311 South Brevard Ave., 33606, Tampa, Florida, USA

Heinz HÖTZL

Department of Applied Geology, University of Karlsruhe, GERMANY

Ken W. F. HOWARD

Groundwater Research Group, University of Toronto at Scarborough, 1265 Military Trail, M1C 1A4, Toronto, Ontario, CANADA

T. IASHVILI

Institute of Hydrogeology and Engineering Geology, Academy of Sciences, 31 Rustaveli Ave, 380008, Tbilisi, GEORGIA

Aydin IBRAHIMOV

*Department of Geography, Faculty of Art and Literature, University of Çanakkale
Onsekiz Mart, 17100, Çanakkale,
TURKEY*

Mehriban M. ISMAILOVA

*Hydrogeology Department, Azerbaijan State Oil Academy, 20 Azadlig Ave, Az
1001, Baku,
AZERBAIJAN*

Rauf G. ISRAFILOV

*Geology Institute, National Academy of Sciences, H.Javid Av. 29A, Baku AZ1143,
AZERBAIJAN*

Yu. H. ISRAFILOV

*Institute of Water Problems, Tbilisi av 69a, 370012, Baku,
AZERBAIJAN*

E. JOYCE

*Robens Centre for Public and Environmental Health, The University of Surrey,
Guildford GU2 7XH,
UK*

Olga A. KARIMOVA

*Water Problems Institute, Russian Academy of Sciences, 3 Gubkina str. GSP-1,
119991, Moscow,
RUSSIA*

Bruce KELBE

*University of Zululand,
SOUTH AFRICA*

Detlef KLAFFKE

*The International Association of Hydrogeologists, Heedheide 8, 58553, Halver,
GERMANY*

Talat KOC

*Department of Geography, Faculty of Art and Literature, University of Çanakkale
Onsekiz Mart 17100, Çanakkale
TURKEY*

Danila KUZNETSOV

*Geolink Consulting
Warshavskoe shosse 39a, Moscow,
RUSSIA*

Judit MÁDL-SZÖNYI

*Dept. of Applied and Environmental Geology, Institute of Geography and Earth
Sciences, Eötvös Loránd University, Pázmány P. sétány 1/c, 1117 Budapest,
HUNGARY*

M. Manuel MADEIRA

*SULPLANO, R. da Sfuap A/E, Laranjeiro, 2890-510 Almada,
PORTUGAL*

Florian MALARD

*University Claude Bernard - Lyon 1 - Bat. Forel (403), UMR CNRS 5023, 43 Bd
du 11 Novembre 1918, F-69622 Villeurbanne Cedex,
FRANCE*

Ramez Yu. MAMMEDOV

*Institute of Hydraulic Design, Landau str. 16, AZ1073, Baku,
AZERBAIJAN*

M. MAMMADOVA

*Baku State University, 23 Zaid Khalilov street, AZ1073, Baku,
AZERBAIJAN*

Augustin MARIA

*CERNA - ENSMP, Ecole Nationale Supérieure des Mines de Paris, 60 Bd St
Michel, 75006, Paris,
FRANCE*

G. MELIKADZE

*Seismohydrogeodynamic Research Centre, Mosashvili Str. 24, 0162, Tbilisi,
GEORGIA*

Andrea MINDSZENTY

*Dept. of Applied and Environmental Geology, Institute of Geography and Earth
Sciences, Eötvös Loránd University, Pázmány P. sétány 1/c, 1117 Budapest,
HUNGARY*

Jan MULDER

*Dept. of Plant and Environmental Sciences, Agricultural University of Norway,
Box 5003, 1432 Ås,
NORWAY*

Imre MÜLLER

*Dept. of Applied and Environmental Geology, Institute of Geography and Earth
Sciences, Eötvös Loránd University, Pázmány P. sétány 1/c, 1117 Budapest,
HUNGARY*

Kirami ÖLGEN

*Department of Geography, Ege University, Bornova-Izmir 35100,
TURKEY*

Atakan ONGEN

*Department of Environmental Engineering, Engineering Faculty, Trakya
University, 59860, Çorlu, Tekirdağ,
TURKEY*

Jarl ØVSTEDAL

*Oslo Airport, P.O. Box 100, 2061 Gardermoen,
NORWAY*

Sh. PASHAYEVA

*Geology Institute, National Academy of Sciences, H.Javid ave. 29^a, AZ1143, Baku,
AZERBAIJAN*

S. PEDLEY

*Robens Centre for Public and Environmental Health, The University of Surrey,
Guildford GU2 7XH,
UK*

Sh. PETRIASHVILI

*Institute of Hydrogeology and Engineering Geology, Academy of Sciences, 31
Rustaveli Ave, 380008, Tbilisi,
GEORGIA*

Shammy PURI

*Scott Wilson Kirkpatrick, The Brook House, Drayton Rd, Dorchester on Thames,
OX10 7PJ Oxon,
UK
(Now at Puri Resources International – Sustainable Solutions)*

Nizamidin R. RAHIMOV

*Central Asian Research Institute for Irrigation (SANIIRI), Karasu-4/11, Tashkent
700187,
UZBEKISTAN*

T. M. RASHIDOV

*Geology Institute, National Academy of Sciences, H.Javid av. 29a, AZ1143, Baku,
AZERBAIJAN*

Michael RIVETT

*Earth Sciences, School of Geography, Earth and Environmental Sciences,
University of Birmingham, Birmingham B15 2TT,
UK*

Liliya M. ROGACHEVSKAYA

*Water Problems Institute, Russian Academy of Sciences, Gubkina str., 3, 119991,
Moscow,
RUSSIA*

Tanya ROMANENKO

*Scott Wilson Kirkpatrick, The Brook House, Drayton Rd, Dorchester on Thames,
OX10 7PJ Oxon,
UK*

Mark ROSS

*Dept. of Civil and Environmental Engineering, University of South Florida, 4202
E. Fowler Ave., Tampa, Florida, 33620,
USA*

J. RUEEDI

*Robens Centre for Public and Environmental Health, The University of Surrey,
Guildford GU2 7XH,
UK*

Rustam R. SAIDOV

*“SUGORISH” Research Centre, Karasu-4/11, Tashkent 700187, (UMRP),
UZBEKISTAN*

Bernd SCHREIBER

*Dresden University of Technology, Institute of Water Chemistry, 01062 Dresden,
GERMANY*

John TELLAM

*Earth Sciences, School of Geography, Earth and Environmental Sciences,
University of Birmingham, Birmingham B15 2TT,
UK*

T. TEVZADZE

*Institute of Hydrogeology and Engineering Geology, Academy of Sciences,
31 Rustaveli Ave, 380008, Tbilisi,
GEORGIA*

Esra TINMAZ

*Department of Environmental Engineering, Engineering Faculty, Trakya
University, 59860, Çorlu, Tekirdağ,
TURKEY*

Kenneth TROUT

*University of South Florida, Dept. of Civil and Environmental Engineering, 4202
E. Fowler Ave., 33620, Tampa, Florida,
USA*

Aysen TURKMAN

*Department of Environmental Engineering, Dokuz Eylul University, 35160 Buca
Izmir,
TURKEY*

Sh. USMANOV

*SPA SANIIRI, Karasu-4/11, 700187, Tashkent,
UZBEKISTAN*

Kai WEGERICH

*Irrigation and Water Engineering Group, Wageningen University, Nieuwe Kanaal
11, 6709 PA, Wageningen,
THE NETHERLANDS*

Bente WEJDEN

*Oslo Lufthavn AS, P.O.Box 100, 2061, Gardermoen,
NORWAY*

Rachel WHITE

*Earth Sciences, School of Geography, Earth and Environmental Sciences,
University of Birmingham, Birmingham B15 2TT,
UK*

Leif WOLF

*Department of Applied Geology, University of Karlsruhe,
GERMANY*

Sh. YAKUBOV

*SPA SANIIRI, Karasu-4/11, 700187, Tashkent,
UZBEKISTAN*

Sh. YUSUPOV

*Central Asian Research Institute for Irrigation (SANIIRI), Karasu-4/11, Tashkent
700187,
UZBEKISTAN*

Ucha ZVIADADZE

*Department of Hydrogeology and Engineering Geology, Georgian Technical
University, 1 Cavchavadze Ave, Tbilisi, 380028,
GEORGIA*