

Index

Note: Page numbers in *italic* refer to illustrations, those in **bold** type to tables.

- abstraction
 - and groundwater flow 141
 - Jaffna 186
 - Meherpur **149**
 - periodic 215
 - redistribution 97
 - and river flows 199–210, 211–233
 - see also* groundwater abstraction
- abstraction quotas 67, 70
- abstraction reduction, targeted 97
- adsorbable organic halogens 279, 283, 286–287, 287
- advection-dispersion equation 256, 263
- aflaj systems 70
- Agenda 21 3–4, 12
- agriculture
 - efficiency 76
 - High Plains 103, 112
 - Jaffna 181–182
 - and water resources 64, 80
- alachlor 113, 114, 251
- algal blooms, and CO₂ capture 311
- Amarillo 110
- analytical solutions, river-aquifer interactions 216–220, 228
- Andean basins, groundwater development 133–144
- Anoia Unit, Catalunya 307–308
- aquicludes 20
- aquifer
 - heads, and river stage 212–213
 - management 86
 - models 305
 - remediation, Ploiesti **299**
 - sensitivity, climate change 303–323
 - simulation 308–309
 - storativity 37, 212, 306, 330
 - vulnerability 255, 294
 - see also* groundwater vulnerability
- aquifers
 - Bangladesh 167
 - carbonate 9
 - confined 203
 - fissures 216
 - flow zones 327
 - fractured 126
 - leaky 135
 - parameters 55
 - pumping response 212
 - temporary over-exploitation 1
- aquitards 20, 21, 162
- Arabian Peninsula 11, 63
 - groundwater management 63–74
- Arabian Sea 184
- arid regions 12
- Arikaree Formation 106
- Arkansas River 105
- arsenic
 - depth profiles *158*
 - desorption 155
 - hydrochemical relationships *155*
 - hydrochemistry 153–156
 - measuring 149
- arsenic in groundwater 11
 - conceptual model 159–160, *161*, *165*, *166*, *167*
 - Meherpur 149–157
 - sedimentological control 176
 - source 167, 170, 177
 - changes with time 158–159, *172*
 - depth distribution 157–159, *157*, *160*
 - depth–time relationship *175*
 - monitoring 177
 - numerical models 165–179
 - spatial distribution 146, 156–157, *156*, 159–160, 165
 - tubewells 173
- arsenic concentrations, equilibrium 174
- arsenic content, Ujjalpur core **153**
- arsenic mobilization 146
- arsenic removal 161, 177
- arsenic in sediments 158
- arsenic transport, modelling 170–172
- arsenic-bearing aquifers, Bangladesh 145–163, 165–179
- arsenic–iron relationship *159*
- Astra refinery 300
- atrazine 113, 114
 - distribution 249, 250, *251*
- Avon, River 18
- Avon Gorge 18, 28
 - cold springs in 31
- Avon-Solent Fracture Zone 42
- Avrovez 282, 283
- BALDOS model 308–309
- Bangladesh
 - anoxic aquifer 153
 - arsenic-bearing aquifers 145–163, 165–179
 - bicarbonate values 155
 - deep aquifers 162–163
 - groundwater 11
 - groundwater schemes 66
 - hydraulic properties 168–169
 - study area *146*
- bank storage 213
- Barcelona 307
- baseflow depletion 229
- baseflow separation 54
- baseflow volumes, and climate change 339, *340*, **341**
- Basford 272
- Bath
 - depth to Carboniferous Limestone *50*
 - landslips 41
 - location map *42*
- Bath Hot Springs 9, 15–40
 - annual flow 30
 - Carboniferous Limestone aquifer 18, 19
 - circulation depth 18, 26
 - conceptual model *19*
 - geophysics 41–52
 - groundwater head lowering 36
 - protection 37–38
 - recharge area 26
 - source 41, 51
 - sustainability and protection 36–38
 - water chemistry 35
- Bath Spa
 - Bouguer gravity map 47–49, *48*
 - seismic surveys 43, *45*
- Bath thermal aquifer, groundwater modelling 29–35, *29*
- Bathing Waters Directive 79
- Batinah 70
- Bay of Bengal 184
- Bayesian statistics 247–248, 250
- Beacon Hill 26
- Bengal basin, arsenic concentrations 145, 165
- benzene
 - biodegradation 273
 - probability distribution 273, 274
- Bhairab, River 148, 157
- biodegradation 272, 273, 280–281, 285, 297
 - anaerobic 298
- biofilms 281
- biological diversity, wetlands 61
- Birds and Habitats Directives 9
- Birmingham 9
- Birmingham Groundwater scheme 95, 96, 98
- Blaney-Criddle formula 314
- bleaching and dyeing 274
- Blue Lias 21
- borehole vulnerability 247, **250**, 252, 253
- boreholes
 - groundwater vulnerability 245–254
 - location 59
 - Meherpur 147, *148*
 - Nottingham 272
 - production 7, 57
 - responses 199
 - and rivers 213
 - test pumping 55
 - wild 201, 203, 204–205
- Bouguer gravity anomalies 24
 - Bath area 43
- Bouguer gravity data, in seismic correlation 49–50
- Bouguer gravity map, Bath Spa 47–49, *48*
- boulder clay
 - Anglian region 328
 - Southern Lincolnshire 202
- boundary conditions, numerical modelling 169, 328–329, *329*
- brackish water, use in agriculture 70
- Brahmaputra, floodplain 146, 158
- Brazi refinery 293, 294, 296, 300
- Bristol, hot springs 18

- Bristol–Bath Basin 9
 cross-section 23
 geological map 16
 geological structure 21–28, 22
 geothermal gradient 26
 gravity anomaly map 24
 post-Variscan structures 25–26
 seismic reflection profiles 25
 stratigraphy and hydrogeology 17, 20–28
 thrust belt structure 21
 Variscan structures 21–25
- Broadfield Down 19, 20, 21, 29
- Brule Formation 106
- Brundtland Report 3
- BTEX pollution 266, 274, 297
- Burton Coggles 202
- calcium content, spring water 315
- caliche 102
- California
 groundwater 249
 irrigation 75–76
 pesticides 246
- California Department of Pesticide Regulation 247
- Canadian River 105
- Capellades 308
- carbonate aquifers
 and climate change 303–323
 Europe 306
 sensitivity 305–306
- carbonate rocks, dissolution 305
- Carboniferous Limestone 9, 18–20, 21
 connections at depth 26, 27
 depth 42, 50, 51
 hydraulic conductivity 32
 seismic velocity 43
 structure contours 24, 25
- Carmenellis Granite 42
- Carsington 91
- Catalan Prelittoral Range 307
- Catchment Abstraction Management Strategies 8, 11, 83, 89
- catchment models 267, 305
- catchment scale models 83
- CAVE model 308–309, 315
- cave systems 314
- celestite 20
- cesspits, leakage 129
- chalcedony 18
- Chalk aquifers
 groundwater modelling 9, 54
 Lincolnshire 57
 London Basin 75
 Norfolk 326
 south-east England 87
- Channel Islands 121
- Chaumohani 160, 162
- Cheddar Gorge 25
- Cheyenne 110
- Chile
 mining 133
 mining industry 2
- chloride
 Bangladesh 155
 and coastal proximity 192
 Jaffna 183, 189, 190–194, 190, 191, 194
 MNT aquifer 138
 and rainfall 191
- chlorofluorocarbons, Guernsey 129, 130
- Church Wilne 95
- Cimarron River 105
- climate, historic 336
- climate change 9
 aquifer sensitivity 303–323
 and groundwater levels 339–341, 339, 340, 341
 and hydrological parameters 335–339, 336, 338
 and hydrological systems 325, 326
 impact predictions 316, 317, 318
 seasonal factors 342
 and surface water 304
 and sustainability 80–81
 unpredictability 76
 and water resources 94, 95, 326
- climate change effects
 Anoia 319
 eastern England 325–344
 Gallusquelle 319
 Sa Costera 319
 Yorkshire Chalk aquifer 312
- climate change scenarios 311, 313, 332–335, 334
- Climate Impacts Link project 310
- climate sensitivity 311
- cloud seeding 65
- cluster analysis, chloride levels 192, 193
- CO₂ capture, algal blooms 311
- CO₂ changes, in GCMs 310
- CO₂ reservoirs 304
- Coal Measures 21, 24, 27, 28
 aquitard 36
 thickening 50
- coal mines, dewatering 36
- Coal Pit Heath 21, 26
- coastal wells, over-abstraction 11
- colmatage, and infiltration 237, 238
- colmatage layers 235, 236
- Colwick Formation 94
- Common Depth Point surveying 43, 44
- compensation discharges 93, 94
- conduit flow 309
- connectivity, hydraulic 7
- contaminant sources
 European Union 7
 modelling 171
- contaminated sites 6, 270
- coordination, in change management 71
- copper, mining 2, 135
- coral reefs, Jaffna 186
- core probe 239
- corn production
 nitrogen demand 112–113
 water demand 110
- cost-benefit analysis, abstraction 94
- Cotswold Hills 21, 41
- Crabble Mill 205
- crops, High Plains 104
- Cross Spring 18
- cyanazine 251
- Danube, River 293, 307
- data collection 9
- DBCP 246
- decentralisation 67
- deep wells, modelling 170, 173, 174–175, 176, 178
- Derby 96
- Derwent, River 97
- Derwent Valley 91
- deterministic theory 256
- development agencies 66
- Dhaka 158
- Dhamrai Formation 147
- disinfection by-products 285, 286, 287
- dispersivity 171
- dissolved organic carbon 279, 283, 284, 285, 286
- dissolved oxygen 129, 150, 153
- dissolved solids, Ogallala Formation 112, 114, 116
- distribution coefficient 256
- diuron 249
- Dodge City 102, 105
- dolines 309
- Dolomitic Conglomerate 20, 21, 28, 49
- domestic water use, national 77
- Dour catchment 205
- Dour River 206, 209
- Dove, River 91
- Dover 205
- Dover Beck 93
- DRASTIC methodology 245, 246
- drawdown 213, 217, 227
- drinking water
 arsenic in 145, 166
 Europe 4
 High Plains 110, 112
 quality 100
 St Petersburg 278
 Sjasstroj 286
 standards 273
- droughts
 Britain 76
 and groundwater storage 54
 High Plains 102
 and water quality 97
- dry valleys 306
- dry-year water demand 91
- dryland farming 117
- Dublin Principles 66, 69
- Dust Bowl 102
- dust storms 102
- Earth Summit *see* Rio Conference
- East Anglia
 geology 326
 hydrogeology 327–328
 hydrology 328
 map 327
- East Anglian region, groundwater resources 54
- East Glen River 202
- East Kent Chalk aquifer 201, 205–209
 conceptual models 206–209
 groundwater models 207
 map 208
 river flows 205–206
- East Midlands Resource Zone 9, 91, 93
 developments 96–97
 groundwater sustainability 91–98
- Eastern England
 climate change 325–344
 groundwater development 58

- groundwater resource management 53–62
- Easton Wood catchment 202
- ecological factors, and abstraction 55, 59
- economic aspects, water management 68
- economic prosperity, and water demand 77
- education programmes 12, 196
- Edwards Aquifer 304, 306
- effective porosity 171
- effluent discharge 55
- Elbe, River 241, 246, 281
- electrical conductivity 129, 190
- Elkhart 105
- Elkhorn River 106
- Environment Agency 8, 53, 83
- groundwater modelling 85–90
- modelling capability 89
- modelling programme 86–89
- Water Resources Plan 91
- environmental concerns 77
- costs of 79
- environmental protection 78–79
- Environmental Protection Act (UK) 274
- environmental requirements, for sustainability 139–140
- equilibrium GCMs 310
- erosion, Bath and Bristol 20
- Escondida mine 134–135
- estuarine sediments 147
- ethylbenzene 274
- European Union, sustainable groundwater use 4–8
- eutrophication, Lake Ladoga 277
- evaporation
- High Plains 102
- oceanic 319
- evaporites, Keuper Marl 20
- evapotranspiration
- East Anglia 327, 335
- and global warming 315, 337
- Guernsey 123, 124
- Jaffna 181
- evidential methods, risk assessment 278
- extreme weather events, High Plains 102
- Faridpur 161, 162
- Farnborough Fault Zone 25
- faults, Bath aquifer 51
- fertilizer application
- High Plains 113
- Jaffna 195
- fertilizers, leaching 129, 195
- fiscal factors 66
- flood risk 79, 80
- floods, run-off 213
- flow events 263
- flow lines 31, 32
- flow processes
- conceptual models 203
- seasonal 201
- fluoride, Jaffna 196
- fog, condensation 65
- Food and Agriculture Organization 66
- fossil aquifers
- depletion 64
- Libya 76
- fossil–fuel free energy future 311
- fracture–flow systems 305
- fractures
- Catalunya 308
- Jaffna 190
- freshwater depletion 4
- fulvic acids 286
- Gallusquelle aquifer 307
- climate change 315–319
- hardness changes 320
- model grid 313, 314
- Ganges
- floodplain 146, 158
- River 148
- Gault Clay 327
- general circulation models 304, 305, 306, 332
- Gallusquelle 319
- recharge scenarios 309–311
- geological structures, and groundwater modelling 32–35
- geophones 43
- geothermal gradient, Bristol and Bath 26
- Ghyben–Herzberg relationship 140
- GIS, parameters 268
- global circulation models *see* general circulation models
- Global Meteoric Water Line 138
- global warming 303, 304, 311
- and evapotranspiration 315
- Glover equation 140
- GLUE method 268
- gold mining 2
- governments, water resource management 71
- GRACE project 305, 308
- granite batholiths, as thermal source 42
- gravity anomaly map, Bristol–Bath Basin 24
- Great Ouse catchment, climate change 326
- Great Plains Conservation Program 102
- Great Plains Physiographic Province 101
- green revolution 10
- greenhouse gas forcing 333
- greenhouse gases, and hydrological systems 326
- Grenobles sand 259, 262
- grey water 79
- Grimsthorpe Brook 202
- groundwater
- availability 53–55
- Guernsey 124–128, 131
- High Plains Aquifer 106–110, 108
- irrigation demand 10
- over–abstraction 1
- and renewable water resources 64
- saline 100
- stagnant 149
- surface discharge 49
- groundwater abstraction
- Anglian region 329
- Arabian Peninsula 64
- impacts 212, 221, 223, 226, 228, 229
- licences 53, 211, 220–223
- modelling methodology 220, 222
- and river flows 220
- for river regulation 227
- total 5
- Groundwater Action Programme 7
- groundwater bodies, definition 84
- groundwater contamination 97
- High Plains 100
- Ploiesti 6, 293–301
- pulp and paper mill 8
- groundwater development
- Eastern England 58
- environmentally sustainable 61
- Ploiesti 300
- groundwater flooding 79
- groundwater flow 55
- Bangladesh 149
- contamination 297
- hydraulic properties 168
- measuring 240
- MNT aquifer 140–142
- modelled and measured 30
- modelling 140–142, 141, 168–170, 315
- simulations 170
- Sjastroj 281
- velocity vectors 169
- see also* groundwater throughflow
- groundwater flux, MNT aquifer 139
- groundwater heads 30
- contours 31
- and mine dewatering 36
- observed and modelled 142
- reduction 94
- groundwater levels
- and abstraction 93
- Anglian region 332, 334
- and climate change 339–341, 339, 340, 341
- Guernsey 123, 126
- Jaffna 186, 187
- groundwater management
- Arabian Peninsula 63–74
- national policy in 66–67
- Oman 69–71
- urban 265–276
- groundwater mining, Libya 76
- groundwater modelling 9
- abstractions 211–233
- alternative models 35–36
- Anglian Chalk aquifer 328–332
- aquifer–scale 54
- Bath thermal aquifer 29–35, 29
- calibration 330–331
- conceptual models 86
- Environment Agency 85–86
- and geological structures 32–35, 33, 34
- and mixing proportions 35
- regional 54
- and resource management 83–90
- groundwater models, locations 85
- groundwater over–exploitation, Europe 6
- groundwater overdraft 65, 117
- groundwater pumping 53
- impact assessment 55–57
- management 57–61
- seasonal 57
- groundwater quality
- High Plains Aquifer 99, 100, 110, 111, 115–116

- Jaffna 181
temporal variability 116
- Groundwater Resource Investigation
Areas 87, 88
timescales 89
- groundwater resource management,
Eastern England 53–62, 56
- groundwater resources
common pool 72, 73
East Anglian region 54
renewable 54
- groundwater sampling, Meherpur
150
- groundwater status 7
- groundwater throughflow, Tilopozo
143
- groundwater vulnerability, assess-
ment 245–254
- groundwater withdrawal, and renew-
al 65
- groundwater–surface water bound-
ary 7
- Guelph loam 259, 261, 262
- Guernsey
alluvium 124
aquifer 5
aquifer thickness 126
artesian conditions 127
geological map 122
geology 123–124
groundwater chemistry 127, 128–
131, 128
groundwater hydrograph 125
groundwater resources 121 133
loess 124
wells, boreholes and springs 124
- Gypsy race 54
- hard–rock aquifers, Guernsey 5, 121
- hardness
and climate change 319–320, 320
increase of 305
see also total hardness
- hazard quotient 8, 278, 289–290
- head gradient 239–240
- headroom, planning 92
- Helshaw Grange 226, 227–231, 227
abstraction rates 231
model parameters 228
- herbicides, High Plains 113
- Hetling Spring 18
- high flow regimes 80
- High Plains
agriculture 103
crops 104
depth to water 115
fertilizer application 113
irrigated lands 103
land use 102–104
manure disposal 113
pesticides 113
population 102–104
soils 102
streamflow 105
water budget 109
- High Plains Aquifer 1, 99–119
bedrock and hydrogeology 106
climate 101–102
future 116–117
groundwater 106–110, 108
hydrogeological units 107
hydrology 104
- irrigation 109
map 100
pumping 109
surface water 104–106
water level decline 99, 103, 109
- Himalaya, deglaciation 147
- Holderness Plain 306
- homesteads, Jaffna 184
- hot springs, Bath 9
- Hotwells Spring 18, 19, 28
- modelling 30
- Hull, River 307
- Humber Estuary 306
- hydraulic conductivity 137
Anglian region 330, 331
Bangladesh 147, 169
determination 238
Southern Lincolnshire 202, 203
- hydraulic continuity 28
- hydraulic head, distribution 213
- hydrocarbon loading 298
- hydrocarbon plumes 296
- hydrocarbons, contamination 293–
301
- hydrodynamic properties, modelling
171
- hydrological parameters, and climate
change 335–339, 336, 338
- hydrological systems, and climate
change 325, 326
- hydroponic culture 122
- hypothetical catchments 314
- IGARF programme 212, 231
- illnesses, arsenic–related 145
- impact assessment
groundwater pumping 55–57
wetlands 59
- Inferior Oolite 20
- infiltration
cumulative 261
High Plains 102
measurement 54, 238–240, 242
infiltration rates 237, 259
- inorganic constituents, analysis of
288–289
- institutional issues 65
- institutional options, water conserva-
tion 71
- integrated river basin management 11
- intensive farming, effects on ground-
water 2
- Inter–Governmental Panel on Cli-
mate Change 142, 311
- International Conference on Water
and the Environment 66
- International Gravity Standardisa-
tion Net 48
- International Year of Freshwater 4
- ionic analysis 280, 289
- ionic distribution maps, Meherpur
154
- Irnham 202
- iron content, Ujjalpur core 153
- iron oxyhydroxides 148
reductive dissolution 155, 158, 159
- iron removal 161
- irrigation
Anglian region 328, 342
Arabian Peninsula 11, 63–74
Bangladesh 149, 175
Britain 80
California 75–76
Europe 4
High Plains 2, 99, 109, 114, 116
institutional requirements 70
return flows 109
- irrigation demand, and groundwater
10, 55
- irrigation management, participatory
68, 70
- irrigation wells 170
- Islamic law 67, 69, 71
- isotope studies, High Plains Aquifer
112
- Jaffna Peninsula 10, 181–197
geology 184–186
hydrochemistry 188–190
physiography 183–190
water balance 188
see also Valigamam
- jointing, in limestone 186
- Jurassic, Bath and Bristol 20
- Kalundai 186
- karstic features, Jaffna 186
- karstic flow 30
- karstification, Catalunya 307
- Keeramalai 186
- Keuper Marl
as aquiclude 21
Catalunya 307
evaporites 20
spring in 30
- King's Spring 18, 51
- Kingswood Anticline 21, 26, 29
- Kulna 162
- Ladoga, Lake 277–291
- land subsidence, and groundwater
abstraction 76
- land use
and chloride levels 192, 193
Guernsey 122
High Plains 102–104
Nottingham 269
- landfills 6, 285
- landslips, Bath 41
- laterite, Jaffna 186
- latitudinal shift 305
- latosols 186
- latrine pits 196, 196
- leaching potential index 246
- leakage, Anglian Chalk 330
- leakage input 94
- Leen, River 266
- legal issues 66
- Lias Clay 21
- Libya
groundwater schemes 66
Man–Made River project 76
- light non–aqueous–phase liquid 293,
294, 295, 296, 297
recovery 298
removal costs 298
- limestone aquifer
Jaffna Peninsula 11, 184
- limit concentration factor 289
- lineaments, Jaffna 186, 190
- Little Ouse, River 329
- Lodes–Granta catchment 57
- London Basin
drying of springs and streams 2, 75

- use of groundwater 1, 75
- Loup River 106
- low flow regimes 79, 80, 93
 - alleviation 97
- Lower Coal Series 26
- LOWESS method 115
- Lowestoft Till 327
- Lubbock 110

- MAGICC climate model 311
- Magnesian Limestone
 - groundwater 87, 88
 - Lower 266
 - Mallorca 308
- management tools 266
- Manipay Idikundu 186
- Manning's formula 212
- manure disposal, High Plains 113
- marl bands 206, 208
- Maruthanamadam 186
- matrix flow 255
- meander, abandoned 160
- Mediterranean, groundwater use 303
- Meghna, floodplain 146
- Meherpur 146
 - geology 147–148
 - groundwater analyses **151, 152**
 - hydrogeology 148–149
 - lithological log, Meherpur 147
 - tubewell locations 150
- Mells, River 31
- Mells fault 28
- Mendip Hills 19, 21, 26
 - Carboniferous Limestone 41
 - limestone outcrops 29
 - quarrying 36
 - seismic sections 27
- Mendips Model 18–20
- Mercia Mudstone 92, 266
- Mere Fault 26
- metolachlor 113, 114, 251
- microbial reduction 158, 160
- Middle East and North Africa 64, 72
- mineralized water, leakage 112
- mining, Chile 133
- mining industry, demands on water 2
- MNT *see* Monturaqui–Negrillar–Tilopozo Aquifer
- model parameters 271
- model testing 35
- MODFLOW program 168, 220, 267, 296, 308–309, 328
- MODPATH 268
- monsoon
 - Jaffna 183
 - recharge 148
- Monte Carlo methods 263, 268
- Monturaqui wellfield 135, 138, 139, 142
- Monturaqui–Negrillar–Tilopozo Aquifer 133–139
 - groundwater volume 142
 - hydrogeology 135–139
 - location 134
 - modelling 137–138
 - stratigraphy **136**
 - sustainable groundwater 139–142
 - thickness 135
- MORECS system 329
- multi-reservoir aquifers 308
- Muschelkalk 307
 - Naegleria* 18
- Nar, River 327, 328, 330, 332, 339, 340, 341
- National Gravity Reference Net 48
- National Groundwater and Contaminated Land Centre 89
- national policy, in groundwater management 66–67, 69
- National Rivers Authority 79
- National Water Quality Assessment 100
- natural heads, Bath Hot Springs 20
- Negrillar 135
- Negrillar volcanics 139
- Neva, River 277
- nitrates 6
 - Bangladesh 155
 - Guernsey 121, 129
 - Jaffna Peninsula 11, 182, 195
 - Ogallala Formation 2, 112, 114, 115
 - Ontario 246
- nitrogen application, High Plains 113
- nitrogenous fertilizers 5
- Norfolk
 - Chalk aquifer 326
 - hydrogeological system 328
- North Hill 25
- North Muskam 96
- North Somerset coalfield 19
- Northern Plutonic Complex, Guernsey 124
- Nottingham 266
- Nottingham Industrial Archaeology Society 269
- Nottinghamshire aquifer 92–93
- Novaja Derevnja 282, 283

- oases 70
- Odessa (Texas) 110
- Office of Water Services (OFWAT) 95, 98
- Ogallala Formation 2, 106, 109, 110
 - salinization 112
- oil recovery, Ploiesti 299
- Old Red Sandstone, Bath 21
- Oman, groundwater management 69–71
- Onega, Lake 277

- paddy areas, Jaffna 184, 192
- palaeo-channel, Bangladesh 157, 160
- Palali 186
- Palma 308
- Panhandle, Texas 113, 116
- PCE 274
- Pechalevo 282, 283
- Pennant Sandstone 21, 36
- perched rivers 213
- percolation, limited 215
- permeability, Keuper Marl 307
- permeability profiles, Bangladesh 162
- pesticides 6
 - in boreholes 246, 252
 - High Plains 113, 114
 - leaching 247
- petroleum industry, privatization 6
- pH 129
- phenols 279, 287, 290
- phosphate–arsenic relationship 176
- piezometric heads
 - modelling 217
 - Southern Lincolnshire 203
- pipelines, leaks 296
- planning framework 37–38
- Platte River 105, 106, 110
- playas 101
- Ploiesti
 - aquifer 296
 - groundwater contamination 6, 293–301
 - hydrogeology 295–296
 - location map 294
- political issues 66
- pollutant transport 246
- pollutants 5
 - analytical methods 279, 280
 - model 284
- pollution, remediation 298–300
- pollution plumes, characteristics **297**
- pollution risk model 270–272, 270
 - parameters **272**
- pollution sources
 - pulp and paper mill 277–291
 - urban 265
- population
 - Anglian region 327–328
 - High Plains 102–104
 - Valigamam 184, 194
- porewater
 - arsenic profile 158
 - core sample 153
- porosity
 - multiple 256
 - see also* effective porosity
- potentiometric surfaces
 - Guernsey 126
 - lowering of 2
 - maps 86
- Prahova–Teleajen fan 295
- precipitation
 - and climate change 335, 337
 - High Plains 101
 - MNT basin 139
 - as recharge 112
 - see also* rainfall
- probabilistic methods, risk assessment 278
- probability distributions 248
- production wells 170
- proto-karstic systems 306
- Puig Major 308
- pulp and paper mill, groundwater
 - pollution 8, 277–291
- pulp production, methods 282, 290
- pumped storage reservoirs 91
- pumping regimes, Jaffna 188
- pumping stations, East Kent 205, 208
- pumping tests 135, 136
 - abstraction rate 226
 - evolution 226
 - model 137, 138, 217, 220, 225, 229, 230
 - Permo–Triassic Sandstone aquifer 227
- Punta Negra basin 138
- Puthur Nilavarai 186
- pyrite 148, 288

- quarrying
 - and dewatering 10, 20, 36, 37
 - Mendip Hills 36
- quartz, solubility 18
- quickflow 80

- radioactivity, measurements *240, 241*
radon isotopes *240–241, 241*
 depth profile *243*
Radstock Coalfield *36*
Radstock Slide Fault *25*
rainfall
 Channel Islands *125*
 East Anglia *327*
 extreme events *304*
 Guernsey *122, 123, 124*
 Jaffna *184, 191*
 predictability *76*
 Serra de Tramuntana *308*
 variability *319*
 see also precipitation
Rainworth Water *93*
recharge
 Anglian Chalk aquifer *328, 329–330*
 artificial *9, 65, 97*
 Bangladesh *148, 167*
 Bath Hot Springs *19*
 and climate change *94, 304, 337, 338, 342*
 estimation *54*
 Guernsey *124*
 High Plains *101*
 Jaffna *188*
 MNT aquifer *138, 139*
 modelling *309*
 Severn Trent area *92*
 Southern Lincolnshire *202*
 uncertainty *267*
Redgrave and Lopham Fen *59, 60*
redox potential *129*
reducing environment, Meherpur *148, 149*
Regional Meteoric Water Line *138*
remote sensing, and tubewell location *162*
renewable water, Arabian Peninsula *64*
renewable water resources, and groundwater *64*
Republican River *106*
reservoirs, East Midlands *91*
resin acids *279, 280, 283, 288, 288, 290*
resorption, arsenic *162*
resource assessment *84*
resource exploitation, and development *75*
resource management, and groundwater modelling *83–90*
resource protection *7*
retention dams *65*
Richards' equation *256*
Rio Conference *2–4*
risk assessment *8, 12*
 groundwater pollution *278*
 scheme *279*
risk models *267*
river augmentation *228, 231*
river banks
 in models *218*
 sediments *213*
river baseflow *231, 330*
 Anglian region *333*
 River Basin Districts *84*
 River Basin Management Plans *9, 84*
 river channel sediments *148*
 river flows
 and abstraction *199–210, 204, 211–233*
 depletion *215*
 River Dour *205*
 river stage
 and aquifer heads *212–213*
 groundwater response *229*
 river–aquifer interactions *7, 85, 211*
 analytical solutions *216–220*
 conceptual models *216, 218, 219*
 connections *212*
 river banks *212*
rivers
 augmentation *57*
 floodplain *55*
 penetrating *213, 218*
 reliability *55*
 road drainage *80*
 Rocky Mountains *101, 104*
 Roman Baths *18*
 Romania, petroleum refining *293*
 root zone *7*
 transport properties *256*
 travel time *258–259*
Rushall *327*
Sa Costera, climate change effects *319*
Sa Costera Spring *308*
sabkhas *76*
safe yield *2, 15*
St Petersburg, drinking water *278*
Salar de Atacama *2, 134, 140*
Salin Formation *135, 139*
saline intrusions
 conceptual model *191*
 Europe *5*
 Grimsby *59*
 and groundwater pumping *57–59*
 Jaffna *190–194*
 Oman *70*
salinization, by irrigation *114*
sample density, Bangladesh tubewells *146*
Sand Hills *109*
saturated depth
 East Kent Chalk aquifer *208*
 Southern Lincolnshire *203*
saturated flow *213*
screen depths, Bangladesh *176*
sea–level changes *304*
seasonal fluctuation
 river flows *205*
 water tables *54*
seawater
 desalination *65, 70*
 intrusion *182, 190, 304*
sediment samples, Ujjalpur *150*
sediment sampling *239*
sediments
 arsenic in *146*
 lake bed *285*
 stream bed *220*
seismic reflection, methodology *43–45*
seismic reflection profiles, Bristol and Bath *25*
seismic reflectors, Bath Spa survey *45–47, 50*
seismic sections
 Bath Spa survey *46, 47*
 Mendip Hills *27, 28*
 seismic studies, Bath *42*
 seismic surveys
 Bath Spa *43, 45*
 correlation with gravity data *49–50, 49*
 data processing *45*
 interpretation *45–47*
 seismic velocity, Carboniferous Limestone *43*
 semi-arid regions *12*
 Serra de Tramuntana *308*
 Severn Resource Zone *91*
 Severn Trent Water *91, 94, 95*
 Severn Trent Water Resource Zones *92*
sewage
 reuse *78*
 treatment *79*
Shardlow *96*
Sharia *67, 69*
Sherborne, spring *30*
Sherwood Sandstone
 abstraction *96, 97*
 aquifer *9*
 groundwater *87, 88*
 Nottingham *266*
Short Heath *96*
Shrewsbury *227*
Shropshire Groundwater Scheme *227*
simazine *114, 249*
Sjas, River *278, 282*
Sjasstroj *277–291*
 drinking water *283*
 map *278*
sludge, storage *283, 287*
soakaway pits *11, 80, 195*
Socompa *134*
soil moisture
 Anglian region *329*
 Guernsey *124*
 Jaffna *188*
 modelling *263*
 stored *54*
soil moisture deficit, and climate change *336*
soil profiles *256, 257–258*
soils
 High Plains *102*
 hydraulic properties **259**
solute concentration profiles *260*
solute transport *7, 255–264*
 analytical approach *259–263*
 contaminants *270*
 modelled *262*
solvents, pollution *266, 274*
sorption *171, 172*
 and arsenic transport *174, 175–176, 177*
 BTEX pollutants *297*
 reversible *167*
source protection *7*
Source Protection Zones *86*
source–pathway–target *see* target–pathways–sources
South Humber side *57*
Southern Igneous Complex, Guernsey *123*
Southern Lincolnshire Limestone aquifer *200, 201–205*
Southern Overthrust *25, 27, 28*
specific UV absorbance *286*

- specific yield 212
 Anglian region 331
 SPECTRE package 311
 spreadsheet tools, in modelling 222, 223, 224, 225, 271
 spring discharges, model 315
 springs 78
 Catalunya 308
 East Kent Chalk aquifer 208
 Gallusquelle aquifer 307
 groundwater-fed 2
 Jaffna 186
 Sri Lanka, dry zones 181
 stable isotope analysis
 Guernsey 129, 130
 MNT aquifer 138
 stakeholder participation 66, 68
 Stoke, Stafford and Telford Resource Zone 91
 storage coefficient 76
 Anglian region 331
 storage models 304
 storage systems, and climate change 319
 storage zones, in modelling 219
 storativity *see* aquifer storativity
 stream beds, sediments 220
 stream depletion
 and abstraction 215
 and groundwater pumping 55
 with time 217
 streamflow, High Plains 105, 106
 Stringside, River 327, 330, 332, 339, 340
 Strontium ratios, Bath Hot Springs 20, 37
 subsistence farming, and irrigation 68
 sulphate
 Bangladesh 155
 Jaffna 196
 sulphonic acids 280, 283, 287–288, 288
 superposition model 214, 217
 surface storage, Guernsey 121, 123
 surface water
 abstraction 97
 and climate change 304
 High Plains 104–106, 110
 Sjasstroj 281
 surface water flow, in irrigation 68
 surface water–groundwater interactions 235–243
 conceptual model 236
 exchange processes 237
 surfactants 290
 sustainability
 conceptual arguments 75–82
 time periods 76, 80
 sustainability appraisal 8
 sustainable development, principles 1
 sustainable groundwater development
 model 3
 Monturaqui–Negrillar–Tilopozo Aquifer 139–142
 sustainable groundwater use
 developing countries 10–11
 England and Wales 8–10
 European Union 4–8
 MNT aquifer 140
 Swabian Alb 307
 swallow holes 206
 SWIMv2 model 256, 259, 261
 target–pathways–sources model 266, 283
 TCA 274
 TCE 274
 Teleajen 296
 Tellipallai 186
 temperature changes, climate models 311, 335
 Tern, River 227, 228, 229
 test filters 283, 284, 285
 Texas–Oklahoma Panhandles 102
 textile industry 270
 thermal aquifer
 Bath Hot Springs 20
 Mendips 31
 thermal spas 18
 thermal springs, Bath 9, 15–40
 thermal water, origin 18–20
 Thet catchment 57
 thrust belt structure, Bristol–Bath Basin 21
 thrust faults
 and dewatering 10
 in groundwater models 32
 tidal wells 186
 Tilopozo wetland 2, 134, 139, 142
 Toft 202
 toluene 274
 total hardness
 Jaffna 183, 190, 194–195, 194
 model aquifers 315
 toxicity data 246
 toxicological index 8, 289, 290
 transfer functions 255
 transient GCMs 310
 transmissivity
 Bangladesh 148
 Chile 137
 East Kent Chalk aquifer 208
 Gallusquelle aquifer 307
 in modelling 30, 32, 35, 212
 Norfolk Chalk 327
 Southern Lincolnshire aquifer 201, 203
 Yorkshire Chalk 306
 transpiration 256, 259
see also evapotranspiration
 Trent, River 9, 95, 96, 266
 Triassic sandstone aquifer
 modelling 94
 Nottinghamshire 92, 93
 tritium, in thermal water 18
 tubewell age, and arsenic concentration 159
 tubewells 11
 arsenic in 162
 Bangladesh 145
 catchments 167
 hand-pumped 149, 150, 160, 167
 irrigation 169
 locating 161–162, 167, 176
 vertical flux 170
 Tucking Mill borehole 28
 Tucson, dissolved solvents 300
 Tunisia, water management schemes 72
 two-way travel time 43, 49
 UK Climate Change Impacts Programme 335
 UN Conference on Environment and Development *see* Rio Conference
 UNCED *see* Rio Conference
 unsaturated zones 7, 255
 upconing, saline water 191
 Upparu lagoon 186
 upward leakage 203
 uranium geochemistry, Bath Hot Springs 20, 37
 urban groundwater 265–276
 Vale of Pewsey Fault 26
 Valgomka, River 278, 282
 Valigamam 10, 181–197
 maps 182, 184
 Valukai aru 183, 184, 186, 190, 192, 193
 Variscan Orogeny 20
 Variscan structures, Bristol–Bath Basin 21–25
 Vasavilan 186
 Vibroseis units 43, 44
 virtual water 67, 70
 Wann complex 184
 waste water
 Sjasstroj 282, 283
 treated 65
 water
 in food imports 67
 importation 65
 as renewable resource 1
 reuse 80
 water abstractions, global 4
 Water Available For Use 91, 92, 97
 water balances
 catchment scale 216
 Jaffna Peninsula 188
 lumped 86
 water budget, High Plains 109
 water conservation
 institutional options 71
 participation schemes 72
 water demand
 Anglian region 327–328
 global 2–4, 76
 Water Framework Directive 7, 9, 11, 77, 84, 90
 water law 67–68
 water levels, declining 2
 water pricing 68–69
 water quality
 effect of pumping 54
see also groundwater quality
 water resources
 funding 95–96
 as source of conflict 11, 63
 water resources management, models for 305
 water rights
 and abstraction 54, 67
 trust holdings 68
 water storage 77
 water stress, national 2
 water tables
 Bangladesh 148
 carbonate aquifers 305
 seasonal fluctuation 54
 water treatment, Bangladesh 161, 177
 water use
 domestic 77, 78
 efficiency 110

- water users associations 69, 73
- water–rock interactions 11, 146
- Waveney, River 59
- weathering
 - and CO₂ consumption 304
 - depth of 126
 - rates of 305
 - Valigamam 186
- well functions 229
- wells
 - Chile 136
 - Oman 69
- Sri Lanka 186
- West Bengal, groundwater 11
- wetlands
 - biological diversity 61
 - conservation 57, 59–61
 - water tables 215
- wetting fronts 261
- Whatley Fault 28
- Wick 20, 21, 31, 36
- Winchester, sewage treatment 79
- Wissey, River 327, 328, 330, 332, 339, 340
- World Bank 66, 69
- World Water Forum, Second 66, 69
- xylene 274
- Yorkshire Chalk aquifer 306–307
 - climate change effects 312, 315
 - discharges 307
 - model flow patterns 314
 - reliability 307
- Zaldivar mine 135
- zone of depression 214