# Subject Index

## A

**Absorption/adsorption**
- mechanisms of, 186–187

**Agriculture**

**Aquifers**
- carbonate, 442–457
- freshwater, 101–106
- glacial till, 62–63
- Karst, 445–446, 449–452
- oil field location, 358–359
- sandstone, 101–118
- sandy, 407–415, 416–428
- stratified, 407–415

**Areal mapping**, 77–84
- error analysis, 80–84

**ASTM Subcommittee D18.95 Information Retrieval and Data Automation**, 35–36

**Atterberg limits**, 402–403

**Audio-magnetotellurics (CSAMT)**, 101, 108–118

## B

**Bacteria**
- coli, 445–446

**Bailers**
- water samples/sampling procedures, 246, 248–249, 251, 260, 285–288, 438

**Bentonite**
- permeability of, 397–404

**Brine contamination**
- bromide/chloride ratio, 106
- oilfield source, 101–118

## C

**Cement solvents**
- leaching of, 189

**Chemicals**
- (see also Organic chemicals)
  - agricultural, 459–467
  - oil recovery, 358–368
  - sampling procedures for, 421–426
  - uranium tailing plumes, 421–428

**Chemistry**
- analytical tests, 235–238, 248–250
- EPA methods 601/602, 286
- methylene blue, 355
- purgeable organic compounds, 261–268
- sulfide, aqueous, 349–356
- bromide/chloride ratio, 106
- monitoring system selection, 221
- permeant, 339–342
- purging new wells, 232–239
- water sampling procedures protocol, 20, 25
- well stability, 235

**Chloride**
- pollution
  - freshwater aquifer, 101–106

**Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)**, 121–122

**Contamination**
- (see also Chemicals; Organic chemicals; Pollution)
  - bacterial, 445–446
  - brine, 101–118
  - cement solvents, 189
  - fertilizers, 453–455, 472
  - metals, trace, 423, 426, 466
  - nitrates, 445–446, 450–452, 455–457, 472
  - oil recovery chemicals, 358–368
  - organic chemicals (see Organic chemicals)
  - pesticides, 176–184, 382, 387–394
  - phosphate mining, 290–302
  - pyritic, 416–428
  - radioactive, 15–16, 290–302
  - uranium tailings, 416–428
  - wastewater sludge, 430–440, 459–467

**Core tests**, 359–368

## D

**D-C resistivity prospecting**, 43–56, 59
Data acquisition
flow-chart, 432
ground-water flow, 155–161
monitoring systems, 221–222
monitoring zones, 206–216
Data analysis, 439–440, 448, 457
Data bases
ground-water, 35–40
directory to, 37
Directory
Water Data Source, 37
Drilling, wells (see Well-drilling)
Dwell-time study
well casings, 172–184

E
Electrical prospecting, 43–56, 86–100
oilfields, 101–118
Electromagnetic conductivity, 44, 59–63
Electromagnetic prospecting, 43–56, 59–70, 73–80
Electroscan system, 86–100
Enteroviruses
diseases, 343–344
ground-water analysis, 343–348
sources of, 343–344
EPA (see U.S. Environmental Protection Agency)

F
Fertilizers, 443–455, 472
Fiber optics, 372–380
Filters, monitoring well, 128–129
Flow-pump
soil permeability, 331–342
Flowlines
fracture systems, 468–480
Flowmeters
heat-pulsing, 146, 152–158
Fluid flow apparatus, 359–363
Fluorimeter, 242–243, 373–375
Flux maps, 386–394
Fracture areas
effect on ground water, 468–480

G
Gene probe
enterovirus detection, 347–348
Geoelectrics (see also Electrical prospecting; Electromagnetic prospecting), 73–84

Geophysics (see also Hydrogeology), 32–33
contamination monitoring, 73–74, 86–100
monitoring well design and, 124–125
oil field surveys, 101–118
selection of well sites, 59, 63–69
Geostatistics, 73–84
Glacial till, 62–63
Graphics
Wenner technique versus impedance-computed tomography, 91–100
Ground-water measurements (see Monitoring, ground-water)
Ground-water monitoring (see Monitoring, ground-water)
Groutings
source of contamination, 223
Guidelines (see Standardization)

H
Hazardous waste (see Wastes, hazardous)
Heat-pulsing flowmeter, 146, 152–158
Hydraulic conductivity, 421, 436–437, 478
bentonite, 397–404
leachate versus tap water, 397–404
soils
clayey, 397–404
sandy, 407–415
Hydrogeology, 103, 383–384
agricultural land, 459–467, 468–480
data acquisition, 43–56, 69
variability of, 62–63, 64
fracture areas, 468–480
Karst areas, 443–445, 447–450
monitoring systems
selection of, 221
monitoring zones, 207–208
upland watersheds, 468–480
Hydrology, 17–26

I
IACWD (see Interagency Advisory committee on Water Data)
Imaging
subsurface pollution plumes, 86–100
Wenner technique versus impedance-computed tomography, 91–100
Impedance-computed tomography (ICT) (see Tomography, impedance-computed)
Information retrieval (see Data bases)
Injection oil wells
plugging of, 106–108
Interagency Advisory Committee on Water Data (IACWD), 7

K
Karst
pollution of, 442–457

L
Land treatment systems, 304–305
Landfills
ground-water contamination of, 65–69, 397–404
tomography of, 94–100
Leachates
cement solvents, 189
hydraulic conductivity of, 398–404
properties of, 397–404
soil permeability tests, 398–404
well-casing, 172–184, 185–197, 224, 227–228
Lysimeters, 126, 304–323
ceramic polytetrafluoroethylene, 310–312
installation of, 312, 317
literature review, 305

M
Metals, trace, 423, 465, 466
Methylene blue
precision of method, 355
Monitoring, ground-water
air pollution versus ground-water, 29–34
direct flow, 146, 147, 152–161
worksheet, 157
gеophysical, 73–74, 86–100, 124–125, 476
methods
audio-magnetotellurics, 101, 108–118
direct flow, 146, 147, 151–161
electrical prospecting, 43–56, 86–100, 101–118
electromagnetic prospecting, 43–56, 59–70, 73–80
fiber spectroscopy, 371–372, 380
radar, ground-penetrating, 476
reference and equivalent, 31–32

in situ time-series measurements, 58–70
tomography, impedance-computed, 87–100
network design, 18–20
nonpoint source pollution, 430–440, 442–457, 458–467
packing material and, 151–152, 162–63
systems
classification of, 122–124
design of (see also Wells, monitoring, design of), 432–440
hermetically sealed, 274–289
objectives of, 138
scope of, 125–126, 127–128
surface, 476
variable head permeability, 164–170
water quality, 18–20
zones, 207–210
vadose, 123, 305, 388, 394
Monitoring, soil contamination, 370–380
static collector, 381–396
Muds, drilling, 222–223, 410, 413

N
NASA Kennedy Space Center
monitoring wells, 1
Nitrates, 445–446, 450–452, 455–457, 472

O
Observation network, 75
Observation wells (see Wells, monitoring)
Office of Water Data Coordination (OWDC), 36
Oil recovery chemicals
cation exchange capacity, 364–365
degradation of, 358–368
ion exchange analysis, 364–365
stability/degradability of, 358, 366–368
surfactants, 364, 366–368
Oil refinery
organic chemical wastes, 321
Oil wells
plugging of, 106–108
Oilfield
waterfloods, 101–118
Optics (see Fiber optics)
Organic chemicals (see also Chemistry)
agricultural, 459–467
chlorides, 371
leachates
epoxy-fiber casings, 172–182
fluoroplastic casings, 194–197
stainless steel casings, 194–197
thermoplastic casings, 194–197
tubing, 224, 227–228
well casing materials, 224
oil recovery
degradation of, 358–368
pesticides, 176–184, 387–394, 451–452, 455, 457
refinery wastes, 321
trace chemicals, 253
loss of in sampling procedures, 241, 253–257, 318–322

Osmosis
soil, 341

Permeability, soil (see Soil permeability)
Permeant chemistry, 339–342
Pesticides, 451–452, 455, 457
contamination, 382, 387–394
well casing leachates, 176–184
Phosphate mining, 290–302
Piezometers, 162–170, 210–212, 476–478
accuracy of measurements, 164–170, 210–212
design of, 417–422, 427–428
installation of, 417–421, 427–428
number required, 209
types of, 212
Pollution (see also Contamination)
areal mapping of, 77–84
casing leachate, 172–184, 192–197
chemicals
detection levels, 18–19
nonpoint source, 430–440, 442–457, 458–467
oilwells, improperly plugged, 101–118
Polonium, radioactive, 290–302
Pore fluid
movement in soil, 331–342
Purgeable organic chemicals (see Organic chemicals, VOCs)
Pyritic contamination, 416–428

Q
Quality assurance
Environmental Protection Agency (EPA) guidelines, 28, 30–34, 121–122, 304–305
water samples, 462–464

R
Radar, ground-penetrating, 476
Radiation, gross-alpha, 290–302
Radioactive waste, 290–302
Nuclear Regulatory Commission regulations, 15–16
Radon, 291, 300
Recharge wells, 291–293
Remote fiber spectroscopy (see Spectrometry, fiber)
Resource Conservation and Recovery Act (RCRA), 121–122, 305
Rock cores, 474–476

S
Sampling procedures (see Water samples/sampling procedures)
Sand
well packing, 151
Sandstone
cation exchange behavior, 365
Screens
piezometer, 427
well, 22, 130–131, 147–152, 149
deformation of, 202–204
fluid pressures, 215
Seismic refraction survey, 476
Silica flours
lysimeter packing, 306–307
Sinkholes, 442–457
Site investigations, 30, 64–69
  Clayton County, Iowa, 442–457
  Dade County, Florida, 65–70, 459–467
  Denver, Colorado, 382–394
  Florida, 290–302
  John F. Kennedy Space Center, 139
  Lincoln County, Oklahoma, 101–118
  Lucas County, Ohio, 51–56
  Manitoba, Canada, 94–100
  Mobile, Alabama, 407–415
  Ontario, Canada, 416–428
  Pennsylvania, 468–480
  Riverside County, California, 44–50
  South Dakota, 430–440
  Temperance, Michigan, 49–51
Sludges
  wastewater, 460
Soil conservation, 453–455
Soil contamination
  monitoring of, 370–380
Soil gas, 377, 381, 385, 387–394
Soil permeability
  clayey soils, 397, 398, 401
  infiltration/percolation, 442–457
  laboratory measurement
    flow-pump method, 331–342
    triaxial cell permeameters, 397–404
Spectrometry
  Curie-point desorption mass, 381–382, 384–386
  fiber, 372–380
Stagnant water (see also Purging monitoring wells), 223–224, 235, 240–245
Standardization
  EPA, 11, 27–34, 121–122, 304–305
  Federal agencies and, 7–16, 28
  new well preparation, 232–233
  Nuclear Regulatory commission, 15–16
  sampling procedures, 9, 10–11
  U.S. Department of Agriculture, 12–14
  well-digging materials, 32
Standpipe, 162
Static trapping
  VOCs, 381–396
Sulfide, aqueous
  field analysis
    contaminated water, 349–356
    ground-water, 349–356
Surface measurement techniques (see Electrical prospecting; Electromagnetic pros-
Viruses
enteroviruses, 344–348
ground-water analysis, 344–348
sources of, 343–344

Volatile organic chemicals (see Organic chemicals, VOCs)

W
Wastes (see also Chemicals; Organic chemicals disposal of), 58–70, 94–100, 342, 387–394, 416–428, 459–467
hazardous
chlorides, 371
organic compounds in, 253, 318, 321
radioactive, 15–16, 290–302
oil, 20, 101–118, 321, 358–368
drilling techniques, 20
Wastewater sludges
agricultural use, 460
effect on ground water, 460
Water chemistry (see Chemistry)
Water quality (see Monitoring, ground-water; Quality assurance)
Water samples/sampling procedures
chemical analysis of (see Chemistry, analytical tests)
chemical stability of, 232–239, 261
contamination of (see Leachates)
decision-tree diagram, 24
degradation of, 210, 211
devices for, 225, 226, 246, 248, 254–272, 274–289
error sources, 210–212, 221–230
hermetically sealed system, 274–289
multilevel, 206–216, 407–410, 421–428
pore water, 305
preservation of, 210, 274–289, 294, 297
protocols, 25, 438–440
pump, 246, 248–249, 251
purge/sampling procedures mechanism
decision tree diagram, 24
radiation analysis, 290–302
recharge wells, 290–302
representative samples, 9–11, 300
solid sampling procedures, 426–427
standardization of, 9–11, 27–34
U.S. Geological Survey methods, 9–11
Watersheds, 468–480
Well casings
epoxy
dwell-time study, 172–184
fiberglass reinforced epoxy, 172, 178–182
fluoroplastic, 191–192
leachate tests, 172–184, 185–197, 224, 227–228
polyvinyl chloride, 130–131, 172–175, 176–178, 180–181, 185–197, 224
slotted versus solid, 410–415
stainless steel, 130–131, 190, 191, 224
corrosion of, 224
Teflon, 199–204
compressive strength, 200–203
flexibility, 200–203
installation of, 204
sorption, 203–204
tetrafluoroethylene, 130–131
thermoplastic, 191
Well-drilling, 121–206
methods of, 151, 222–223
hollow-stem auger, 127, 131–133, 433
rotary, 132–133, 137–145
solid-stem auger, 127, 131–133, 433
muds, 222–223, 410–413
water sampling procedures, 20–25
decision tree diagram, 21
well casings/screens
decision tree diagram, 22
well materials, 32
wet versus dry methods, 138
Wells, monitoring (see also Well casings; Well-drilling)
chemical stability of, 235
classification of, 122, 208
definitions, 162
development, 233–235
filters, 128–129
gROUTlNGs, 223
multilevel, 206–216, 407, 410–415
recharge, 291–293
screens, 130–131, 147–152, 202–204
decision trees, 22

Z
Zones of monitoring (see Monitoring, groundwater, zones)