

Index

A

access (tank) 9,53,55,56,57,109
 form for 102
 hatch 117
 lockable 52
 pressure-tight 56
 sealing 52
Acrylonitrile Butadiene Styrene (ABS) 94
ac (acre) 90
additives 39
aerator. See inlet aerator
aesthetics 31
afy (acre-feet per year) 90
agricultural chemicals 23
air, displaced 8
airlock 9
air gap 55
air pressure level gauge 70–89
air vent. See vent, air
alarm 35,71
algae 9,22,27,65,76
aluminum 43
animal droppings 9
anti-seep collars 25
apartment 88–89
appropriate technology 3
aquaculture 21,23
aquatic plants 21,27
aquifers 16–20,76,88
 artesian 18
 confined 18
 contamination 17
 fissured 18
 gravity 18
 high 22
 increasing water in 19–20
 injection wells 19
 overdrafting 19,83
 perched 18,83
 protecting quality 20
 recharge 7,19,21
 saltwater intrusion 18,19,20
 subartesian 18
 types 18
architectural guidelines 52
area, formulas for 90
Arizona desert 88
armature (for ferrocement) 95,107,114,117
atm (atmosphere) 90
attrition (of pathogens) 2,10,11

B

bacteria 5,9. See also pathogens
 anaerobic 10
 a health problem? 11
 fecal 7
 indicator 13
bacteria, beneficial 72
bacterial regrowth 11,12,76
baked enamel. See porcelain-bonded carbon steel
ball valve. See valves, ball
bathing 7
bathtubs 7
beavers 27
bedrock, fissured
 and ponds 23
bending force 91,92,93
bentonite clay 24,61,109
biological hazards. See pathogens
birds 22
bisphenol-A 94
boilers 11
bore. See wells
Branched Drain Greywater Systems 124
brass 41,42
brass fittings 56,114
break pressure tanks 54
brick (tank material) 44

bucket 56
Builder's Greywater Guide 124
building department 52
bulkhead fitting 45,87
buried storage 31,38,44,47,49,65,74
 collapse of 32
burning brush 79

C

calcium, precipitation 11
capillary connection 16
cedar 45
cement 6
cement mixer 38
cheap and easy 8
check valve. See valves, check
chicken wire 117
chlorination 9,10,12,27,67,76
cigar shape 32
circumference of a circle 90
clarified septic effluent 10
clay (material for storage) 22,44
clear tube (as level indicator) 70–89
climate 20
cold joints (in concrete) 107
coliforms. See bacteria
coliscan plate 11
color coat 106
combined drain/outlet. See drain, combined with outlet
components
 overview 28
 spreadsheet 28
compound curves. See curves, compound
compression force 92,93
concrete 11,22,32,44
 fly ash in 39
 forms 96–107
conduction 54
confining layers 18
conical floor. See floor, conical
conjunctive use 19
conservation
 in emergency 35
contact time 12
contamination. See toxins
context 3,14,95
convection 54
conversions 90
copper 42–43
 pipe 54
corks 62
corrosion. See rust
cost 5,8,16,22,24,27,50–51
 ponds 21
 really cheap storage 50
cost-benefit 4
Costa Rica 88
CPVC 54
crayfish 27
Create an Oasis with Greywater 124
creeks 14,18
creek direct. See source direct
critter-proofing 8,50,63,64,65
crud 8
Cuba 54,58
curing 96
 too fast 100
curves 71
 compound 93,116,117
 simple 93
cut 48

D

dams 20
dead storage 55
decorative ponds 75
deflocculation 10
demand. See water design
design
 contexts 6
 ecological 3
 life 7
 principles 3–8
 trade-offs 4
disaster 1

 sizing storage for 35
disinfection 11
byproducts 10,12
decay 12
dissolved oxygen. See oxygen
distribution system 10
diversions 23,25,83,85
dobies 108,113
 size 115
drain 58–62
 capped 59,60
 center 111
 combined with outlet 45,58,60
 construction details 61,109
 extension 71
 for buried tanks 31
 for pond 24,25
 in wood tank 45
 location 59–65
 low tech 61
 options 61
 retrofit
 plastic tank 60–65
 steel tank 58,59
 size 62
 sump 60–65,104
drainage 48
dredging 27
drinking water 7,88
 emergency 76
 separate system 6
drought 19
drowning hazard 9,27,53
drums 6,50,76,89

E

earthquake 2,35,53,77–89,89
earthquake loads 91
ecological design. See design, ecological
economics. See cost
Eden 88
electricity 1
 dependence 89
 electric heater 74
 electrolytic corrosion 42,43
 electronic level indicator 70–89
embankment 26
emergency
 reserve 35,52,56,73
 storage 75–89
energy
 consumption 6
 thermal 2
engineer's stamp 52
engineering 53,77
EPDM 22,23,24,46,94
epoxy-coated rebar 57
epoxy-coated steel 47,94
erosion 24
Ethylene Propylene Diene Monomer. See EPDM
Evans, Ianto 13
evaporation 2,16,20,23,23–24,27
 swimming pool 27
evapotranspiration, vs precipitation 20
excavation 101–107
expanded metal lath 92,113,114,117

F

failure 8
fecal matter 11,12. See also bacteria, pathogens
fences 78
ferrocement tanks 41,57
 construction 95–120
 experimental improvements 96
 forms for 96
 heavy-duty 107–120
 light-duty 101–103
 medium-duty 104
 skill required 95–107
 spherical 96
 tank shape 38
 ultra-light-duty 100–101
fiberglass (glass fiber-reinforced poly-

ester) 32,46–47
 footings for 49
fill capacity 15,16
fill 48,60
fillet 92
filtration 10,66,124
fire 1,2,124
 department 52
 fighting 52,78–81
 hoses 1,79–89
 hydrant 2,35,52,55,73,79,80,81,83
 reserve 34,56
 resistant storage 77–89
 safety 21
 sprinklers 2,80–89,89
 trucks 81–89
fish 21,22,24
 in ponds 26
 nuisance 27
floating solids 8,62
float (level indicator) 69–89
float switch 71
float valve. See valve, float
flooding 2,24,25,53
 hazard 52
 plains 21
 reduction 16
floor 48–49,55
 concrete 38
 conical 92,112
 construction 105,109
 disshed 92,112
 finishing 116
 flexible 91
 options 61
 pouring 115–116
 pumping 115
 shape innovations 112
 slab 113,115
 sloped 60
 stiff 91
 strain 49
 Thai jar 97–107
flow. See water/flow
foam injection 36,79,81–89
footings 48–49,102–107
 Thai jar 96–107
forms. See concrete, forms
fossil fuels 3
foundation. See footings
fountain
 hydroelectric 29
freeze protection 1,2,73–75
 by burial 31
 pond depth 24
frost heave 32,91
ft³/sec (cubic feet per second) 90
fungicides 39

G

gallons per inch 70–89
galvanized steel 8,41–42,56
 corrosion. See rust
 welded tank 64
 with plastic membrane 47–48
galvanizing paint 56
gal (gallon) 90
Gambusia. See mosquito fish
garden hose 79
gasoline 78
gasses, dissolved 11
gate valves. See valves, gate
generator 79
geology 18
glass 39
glass reinforced polyester (GRP).
 See fiberglass (glass fiber-reinforced polyester)
goals 1,4,5
goat bladders 48–50
gpm (gallons per minute) 90
grading 105
gravel (as footing) 48
gravity
 flow 29,55,66
 loads 91
gravity flow water systems 120

Greenpeace 45
greywater
 storage 6
greywater systems
 for runoff harvesting 16
grid 111
groundwater. See aquifers
gauge. See pressure gauge
gutters 42,65,80

H

hardness 12
hardware cloth 92,114,117
hazards 52–53
 biological. See pathogens
 liability. See liability
ha (hectare) 90
HDPE 46,76
 cast into masonry 61
 taste 46
 toxicity/leaching 46
health department 52
heating
 effects 10–11
heat loss 54
high density polyethylene. See HDPE
hilltops 31
hog-ring pliers 107
 pneumatic 107,117
homeowners' association 52
hoops 113
 spacing 114
 stress 92–96,113
hot springs 54
 drain 62
hot tubs 75,81
hot water storage 54,75
Huehucoyotl Eco Village 11,16,25,83–84
hurricanes 2,77–89
hydrant. See fire hydrant
hydroelectric 14,16,83–84
 battery 2
 pressure for 29
hydrogen sulfide 67

I

ice-skating 21
ice loads 91
indoor supply plumbing
 copper 42
infiltration 15
 basins 7,19,21
 coefficient 19
 galley 87
inlet 12,55,55–56,58
 aerator 10,67
 combined with outlet 66–67,67
 diffuser 67–68
 float 73
 float valve. See valves, float
 hidden 104
 in roof 56
 welded 56
insulation 74
insurance 52
Intermediate Technology Development Group 96,101
iron 12,67
irrigation 6,7,16
 covering peaks 34
 drip 7
 storage in soil for 15–16

K

Kemnitzer, Paul 107,120
kitchen sinks 30
kPa (kilopascal) 90

L

ladder 9,53,56,57
 built-in 117
Lake Cachuma 24
landslides 31,53
lath. See expanded metal lath
laundry 7,75
leaching. See toxins, leaching

lead 39
 based paint 9
 glaze 44
leaks 9,23,27,56,61,68
 in wood tanks 45
leather 48–50
legal requirements 1,2,5,52,67
 firefighting 36,78
levees 22,24,25
 construction 25
 cross section 26
level indicators 69–71
lexan. See polycarbonate/ lexan (PC #7-other)
liability 5,21,53
lid 9
 removable 27
lifestyle accommodation 4
lightning 77
lights 115
lime 12
livestock 7,21,24,26
loads. See structural loads
locks 78
long-term storage 76
Los Angeles 89
Low-Density Polyethylene (LDPE #4) 94
low pressure. See pressure, low
lpm (liters per minute) 90
L (liter) 90

M

m³/day (cubic meters per day) 90
m³ (cubic meter) 90
manganese 67
manhole. See access (tank)
marine plywood 45
market culture 3,5
Maruata 16–18
masonry 60
masonry in and over plastic 47
materials 28,39–48
 efficiency 36,38
 toxicity 12
 to avoid 39
membrane 92
meter 66
Mexico 83,93
microclimate 21,74
mold. See concrete, forms
mold-release agents 39
mosquito
 screened 55
mosquitoes 9,22,27,52,63,65
 fish 27,124
 trap 52
multiple tanks 7,72
 plumbing options 73
muskrats 25,27
m (meter) 90

N

Nalgene bottles 94
National Drinking Water Clearing-house 120
National Fire Protection Association 120
National Testing Laboratories 120
natural pools 27
natural resources
 waste 33
natural swimming pools 120
New York City 88–89
Nil 102
nitrates 20,23
non-modulating float valve 120
NSF 61 certified 39,46,47
 cement 41
 sealers 41
NTU 90
nutrients
 and algae 27
 in water 65

O

oak 45

odor 12
organic mater 9
outlet 9,12,35,56
 curves 71
 float 68
 for pond 24
 screen 68
overflow 9,25,52,55,62–65,71,73
 critical 64
 for pond 24
 line 63
 size 62
 uncontrolled 9
oxygen 67
 for fish 26
ozonation 2,10,71,76

P

paint 12
 reflective 65
 with zinc 41
pallet wrap 108
pasteurization 10,11
pathogens 10,12,13,53,72. See also bacteria
pebble tech 27
perched aquifer 18
perfectionism 109
performance standard 4,5
 inflation 4
permeation 11,53,76,78–89
permit. See legal requirements
pesticides 13
 in aquifers 18
PETE. See Polyethylene Terephthalate (PETE or PET #1)
pH 12,26
pipe 29
 abandoned 12
 nipples 8
 size 1
 supply
 size 32
 wrap 109
planes 93
plants. See irrigation
plaster 113
 color 119
 curing 119
 in tension 92
 mixer 108,118
plasticizers 39
plastics 65
 American Plastic Council 45
 health & ecological issues 94
 membranes, coatings and bladders 48
tanks
 drain retrofit 60–65
 footings for 49
 tank material 45–46
 tank shape 38
 taste 46,76
plumbing 11
 code 52
 for easy changes 8
point loads 91. See loads, point
polyamide epoxy. See epoxy
Polycarbonate/ Lexan (PC #7-other) 76,94
polyethylene 54
 septic tanks 32
Polyethylene Terephthalate (PETE or PET #1) 46,76,94
Polypropylene (PP #5) 94
ponds 20–27,81
 clay core 25
 combination 22
 cost 25
 depth 24
 duck 6
 embankment 22
 excavated 22
 failure 22,25
 liners 24
 living 21,22
 locating 21

runoff harvesting 21,22
shape 24
size 24
storage 21,22,23
turn over 24
types 21
wall slope 24
weeds 24
Popocatepetl 93
population 7
pot growers 51
power outage 35
pressure 6,8,29,36,91
 for different applications 30
 gauge 66
 as remote level indicator 70–89
inward, from burial 32
loss in tank 33
low 29
maximum 29
spike 69
switch 71
tanks 29,30,38,54
very low 87–88
Principles of Ecological Design 124
progress, true 3
psi (pounds per square inch) 90
pump 30,56,88,89
 buried tanks 31
 for fire 79
 for pressure tank 54
pumping 1,2,3,6,15,19,20
 downhill (pet peeve) 32
 energy use 30
pump control 71
purification. See treatment
PVC 8,45,46,51
 in sunlight 9,39
 pipe 14

R

raccoons 76
radial with hoops 111,116
radio links 29,71
rainwater 7,27,76
 cistern under an office 64
 fate of 15
 gutters. See gutters
 harvesting 12,72,83,88,96
 Huehucoyotl 83
 tank for 101
infiltration 16
Rainwater Catchment Systems for Domestic Supply (book) 120
Rainwater Harvesting & Runoff Management 7,15,19,21,50,84,124. See also runoff
rats 9,65,76
rebar 92,113
 hickey 107
 joining 114
 overlap 114
 spacing and size 92
 welding 114
recycling 8
redwood 27,45,77,92
red cedar 39
regulations i
 reliability 8
 repair 8
 reserve. See emergency, reserve
 resource use 3
riprap 25
river 81
rocks 11
 tank shape 38
rock and mortar. See stone tanks
roofs 50,116–117
 cave-in 118
 center pole 117
 conical 38,50,57,92
 domed 38,50,91,92,93,116
 construction 102–107
 flat 50
 grid 117
 hexagonal 50
 water harvesting 50

roots 49,77–89
 as pumps 15
 rope 53
 runoff 7,15,20,21,23,25,56,83
 rust 41,48,58,63

S

sacred spots 31
 safety factor 92
 salt
 flushing 7
 sand
 filter 72,86
 silica 119
 sand filters 120
 San Juan Island 72
 screed 116
 security 31
 and tank size 32,33
 standard 4
 sediment 9
 septic conditions 12
 septic tank 10,44
 outlets 63
 plastic 32
 set-aside. See reserve; See also emergency, reserve
 settleable solids 86
 settling 2,8,10,11,73
 inlet diffuser for 67
 sewage 10
 in aquifers 18
 shade 65
 shape 36–38
 for burial 32
 graphical overview 36
 rectangular 9,36
 rock-like 117
 sphere 32,36,38
 square 36
 structural effect 93
 shear force 92,113
 shower 1
 shut-off valve. See valve/shut-off
 silver solder 54
 sinkholes 19
 siphon 55
 site
 prep 109
 walk-in only 109
 siting 28–32
 size
 structural effect 93–96
 sizing 32–36,44
 for firefighting 36
 for intermittent production 35
 for interruptions in supply 35
 for limited supply 34
 skimmer 27
 skinny-dipping 78
 slab. See floors, slab
 slope
 stability 29,31
 steep 53
 sludge 58
 small containers 76
 smell 12
 snow load 93
 soil
 loads 91
 report 52
 storage in 15–16,25
 vs aquifers 15
 solar
 greenhouse 2
 heaters 75
 source direct 14–15,85,85–87
 specific heat 2
 spillways 25,64
 spill point 55
 springs 1,2,9,12,14,16,18,22,23,34,6
 6,85
 stainless steel 42,54
 standpipes 79
 steel
 reinforcing 95
 tanks 48

tank shape 38
 Stinson Beach 15
 stone tanks 43
 storage ponds. See ponds, storage
 stress
 uniform 93
 structural loads 53,91–93,91–96
 buried 31
 collapse 53
 considerations 91–93
 efficiency 36
 point 116
 stucco. See plaster
 subsurface irrigation. See irrigation/
 subsurface
 suburban house 89
 sulphur 12
 sun, on tanks 9
 sunscreen 47,65
 by burial 31
 supply 66. See water/supply
 surface area, formulas for 90
 Surface Water Treatment Rule 120
 suspended solids. See turbidity; See
 also floating solids; See also
 settleable solids
 swamp coolers 2
 swimming 22,124
 holes 11
 pools 27,75,81,89
 aboveground 27,51
 variable level 27
 swing joint 80
 system modes 28

T

tanks
 cleaning 58,59,60
 coatings
 toxins in 39
 cost. See cost
 forces on. See structural loads
 galvanized. See galvanized steel
 multiple. See multiple tanks
 on roof 29
 open 27
 painting. See paint
 shape. See shape
 siting. See siting
 sizing. See sizing
 Tank Talk Newsletter 120
 tannins 22
 tap station 98
 taste 12
 temperature 12,65
 of buried storage 31
 tension force 92,93
 Thai jar 96–98
 thermal mass. See specific heat
 thermal storage 1,2
 thermos 54
 Thoroughseal 106,116,119
 toilet 7
 flushing 7
 tank 75
 tools 107–108
 torque block 59
 tote bins 51
 tower. See water, towers
 toxins 7,9,53,78
 leaching 11,12,53,76
 PVC 39
 threat to aquifers 20
 transporting water 54–58
 trash cans 39
 treatment 2,73,124
 biological 27
 residual 10
 trees 77–89
 triangles 93
 trihalomethanes 9,10
 tunnel vision 3,5
 turbidity 7,12,67. See also floating
 solids; See also settleable solids
 and fish 26
 turbulence 71

U

ultraviolet light 10
 underground river 17–18
 union 56
 units. See measurements

V

vacuum breaker 25
 valves
 ball 62
 check 55,56,63
 float 55,66,71
 gate 69
 shut-off 55,56,61
 vandalism 78
 variable height outlet 68
 vector control 52
 vent 55,65
 vermin 27
 vernal pools 22
 volume, formulas for 90

W

walls 91,102–107
 floor joint to 113
 structural loads 92
 thickness 92
 washing machine 7
 water
 age 12
 bottled, survey 12
 color 12
 corrosive 12
 demand
 forecast 7
 flow 1
 hazards. See hazards
 level 105,107
 pressure. See pressure
 protecting 77
 quality 1,2,4,12,16,83
 changes 9–13
 guidelines for different uses 7
 improving 10
 of ponds 20,23
 separate handling 6–7
 testing 12–16
 quantity 5
 running 6
 security 1,1–2
 shortage 1,19
 softness 7,12
 stagnant 12
 still 6
 stored energy 2
 supply chain 1
 taste 7
 temperature 12
 towers 29,38,53,54,66,77
 safety 30
 use
 covering peaks 33–34
 hourly 34
 peaks 1
 per capita 6
 waterbed bladder 39,48
 Watermaster 120
 watershed 16,18,20,25
 area for ponds 23
 water age 120
 water hammer air cushions 68,69
 Water Quality Testing Procedures and
 Information Packet 124
 Water Storage Extras 124
 weather station data 120
 welded steel 60
 wire mesh 109
 wells 9,17,18,55,66,82. See also aquifers
 artesian 16,18
 contamination 55
 horizontal 16,87
 low yield 34
 wildlife 22
 and ponds 26
 habitat 21

Willard 107
 wind. See hurricanes
 wind loads 91
 wings (for rain harvesting) 116
 wood (tank material) 45

Y

yucca stalk 61

Z

zinc 42
 zoning 52