Abu Dhabi, Masdar, 54–55
accreditation, 276. See also certification; Leadership in Energy and Environmental Design (LEED); verification
acoustic leak-detection devices, 81
action plans, frameworks and, engineering design, 12
Addis Ababa, Ethiopia, 148
adsorption chiller, 179
advanced ecologically engineered system (AEES), 156–57
AECOM Design + Planning, 283–84
aggregates, paving selection criteria, 253
agriculture, 48. See also landscaping; land use
built form—ecology framework, 48
Ahwahnee Principles, 22, 72–73
air quality. See also pollution; water quality
automobile. See also streets; transportation
ergy demand reduction, 180, 181–83
San Francisco (California) Mission Streetscape Plan, 285–86
streets, 224–26, 227, 241
traffic calming, 228–29, 236
Ahtian Area Master Plan (Guangzhou, China), 11, 270–77
BedZED (Beddington Zero-Energy Development), 54–56. See also net-zero energy
Beijing, China, 189, 190
Berkeley (California) EcoHouse, graywater, 142
best management practices (BMPs), stormwater management, 124, 234, 317
Better Streets Plan (San Francisco, California), 282–83
bicycle, 227, 229–30, 233
bio-diesel fuel, 182–83
biogas, 191
biological diversity. See also wildlife
ecosystem services concept, 52–53
habituation, 51
One Planet Living framework, 55–56
biological inventory, site planning, 214–16
biological oxygen demand (BOD)
blackwater, 149, 152, 158
wastewater, 97
biological pathogens, wastewater, 97
biological treatment
blackwater, 149, 154–57
greywater, 136–37
biomass, 190
BioRegional, One Planet Living model, 54–56
bioremediation, built form—ecology framework, 53
bioswales. See swales
blackwater, 147–62. See also greywater; water use
Pearl Island, Panama, 304
reuse potential, 157–59
sources of, 147
treatment levels, 149–50
treatment technologies, 151–57
uses of, 148
wastewater, 98, 100–101
water balance modeling, 66–68
blueway mapping, site planning, 222
brackish water, 76
brick manufacturing, 259
Brisbane City Hall (San Mateo County, California), 111, 117, 338–40
Brooklyn, New York, Hollenback Community Garden, 152
brownfield development, built form—ecology framework, 47
Brambleton, Virginia, 86
Braun, Eron, 314
Braunfellner Area Master Plan (London, England), 264
brick manufacturing, 263
Brewers Hill Headworks (Baltimore, Maryland), 230
Brooklyn, New York, Hollenback Community Garden, 151
Brooklyn, New York, Hollenback Community Garden, 152
brownfield development, built form—ecology framework, 48
buckets, site planning, 223
building products, 246
building technologies, 49
built form—ecology framework, 48
nonpoint source pollution, 98
buffers
  site planning, 223–24
  streetscape design, 240–41
building envelope, energy demand reduction, 173
building factors, energy demand reduction, 170–71, 173
building-integrated sustainable agriculture (BISA), evapotranspiration, 82–83
Building Research Establishment Environmental Assessment Method (BREEAM), 9, 23, 24
building-scale design applications, 325–47
Brisbane City Hall (San Mateo County, California), 338–40
California Academy of Sciences (San Francisco, California), 327–31
Chartwell School (Monterey, California), 331–33
finance options, energy policy, 201 overview, 326
Pearl Island, Panama, 334–37
Pearl River Tower (Guangzhou, China), 344–47
Stanford University Green Dorm project, 341–43
Sustainable Sites Initiative, 337–38
builtform—ecology framework
  community design, 53–54
  ecosystem services concept, 52–53
  habitation and settlement, 48
  implementation of, 50–56
  industry, 48–49
  infrastructure frameworks, 22–23
  One Planet Living model, 54–56 overview, 47–48
Pearl Island, Panama, 296
recreation, 49–50
built systems inventory, site planning, 220–21
Butterfly Bay (New Zealand), 214, 215
Calgary, Alberta, Canada, Public Art Program, 290–91
California, 131, 143, 179
California Academy of Sciences (San Francisco, California), 327–31
type, 329
lighting, 330
materials, 329–30
site, 328
water use, 331
Calthorpe, Peter, 72
cap setting, energy policy, 199
carbon footprint measures, 192–95
carbon footprint reduction, 195–97
management plans, 197–99
One Planet Living model, 55
carbon sequestration, 195–96
Cattle Creek (Colorado) stormwater management, 315–20
Central Park (New York, New York), 40
Centre for the Environment (Oxford University, OUCE), 50
certification. See also accreditation; Leadership in Energy and Environmental Design (LEED); verification
construction methods, 261–62
renewable energy certificates, energy policy, 200
Cesar Chavez Green Street corridor (San Francisco, California), 286–87
changes, in-the-field, construction methods, 262–63
career concept, 14, 126–27
Chartwell School (Monterey, California), 13, 83, 89, 331–33
chemical disinfection
  blackwater treatment, 149–50
  graywater treatment, 138
Chernobyl, Ukraine nuclear disaster, 53
Chicago (Illinois) Green Alleys Program, 236–37
chicanes, traffic calming design, 229
chilled ceiling/chilled beam systems, energy use efficiency, 177–78
chip seal, paving selection criteria, 253
chlorine, graywater treatment, 138
cisterns. See also rainwater
  graywater systems, 138
  rainwater harvesting, 84–92
city-scale design applications, 267–91
Calgary, Alberta, Canada Public Art Program, 290–91
Guangzhou, China, 269–77
New York City (PlaNYC), 279–81
overview, 268–69
San Francisco (California) greening initiatives, 281–82
Better Streets Plan, 282–83
Cesar Chavez Green Street corridor, 286–87
Mission Streetscape Plan, 285–86
Old Mint Plaza, 287
Pavement to Parks (P2P) initiative, 288–89
stormwater management, 284–85
Urban Forest Master Plan, 283–84
San Francisco (California) Old Mint Plaza, 287
Tianjin Eco-City Master Plan, 277–79
Cities, infrastructure, site planning, 208
Clean Water Act of 1972, 98, 285
Cliff Garten Studio, 290–91
cclimate
  energy demand reduction, 172–73, 179
  graywater, 130–31
Pearl Island, Panama, 296
cclimate change, 192–99. See also greenhouse gas emission
builtform—ecology framework, 48
carbon footprint measures, 192–95
carbon footprint reduction, 195–97
carbon-neutrality management plans, 197–99
Guangzhou, China, 273
PlaNYC, 34
site planning, 218
cclimate regulation, builtform—ecology framework, 53
cclimatological analysis, site planning, 219
ccoal, carbon footprint measures, 193–94
ccoal power plants, pollution, 166–67
codes. See standards and codes
cCogeneration, energy demand reduction, 178–79
Colorado, 179
ccommissioning, engineering design implementation, 15
Committee on the Environment (COTE) Ten Measures of Sustainable Design (AIA), 4, 23, 46, 331
ccommunications, infrastructure frameworks, 25
community
- builtform—ecology framework, 53–54
- energy demand reduction, 178–80
- Great Wall of China resort (Jiankou, China), 32–33
- Pearl Island, Panama, 299, 300
- pillars of sustainability model, 27–29
- rainwater harvesting, 89–90
- streets, 225

Community Design + Architecture (CD+A), 283
- community-scale design applications, 293–324
- Cattle Creek (Colorado) stormwater management, 315–20
- Los Angeles State Historic Park, 321–24
- Pearl Island, Panama, 294–313
- standards, 313–15
- compact fluorescent bulbs (CFLs), 176
- complete streets concept, 226–33
- bicycles, 229–30
- emergency vehicle access (EVA), 230
- overview, 226–27
- road narrowing, 229
- shared streets (woonerfs), 229, 232
- smart-growth streets, 233
- traffic calming, 228–29, 230–31
- types and uses, 227
- composting, solid waste management, 264
- composting toilet, blackwater treatment, 151–52
- concept design, engineering design implementation, 15
- concrete structural materials, post-tensioned, 260
- conjunctive use, water supply, 82
- connectivity, site planning, synthesis, 223
- conservation
  - efficiency contrasted, 169–70
  - Pearl Island, Panama, 305
  - water supply strategies, 77–80
- constructed wetlands. see also wetlands
  - blackwater treatment, 155–56
  - graywater integration, 145
  - graywater treatment, 137
  - stormwater management, 118
- construction documents, engineering design implementation, 15
- construction methods, 261–63
- Chartwell School (Monterey, California), 333
- construction waste management, 263
- deconstruction, 261
- general contractor, 261
- green certification, 261–62
- in-the-field changes, 262–63
- project specification manual, 262
- construction process, engineering design implementation, 15
- construction waste management, 263
- contamination
  - rainwater harvesting, 90–91
  - wastewater, 97
- contextual background study, site planning, 210–21
- biological inventory, 214–16
- built systems inventory, 220–21
- climatological analysis, 219
- geological inventory, 211–12
- hydrological inventory, 212–14
- soils inventory, 212
- topography and land analysis, 216–18
- Copenhagen, Denmark, 230
- Corbett, Michael, 72
- costs
  - energy supply, 183, 309–10
  - low-impact development (LID) stormwater management, 106–7
  - net-zero energy, 171
  - photovoltaic technology, 185
  - rainwater harvesting, 87–88
  - stormwater management, 121
  - water treatment facilities, 161–62
  - credits and offsets, carbon emissions, 196–97
- Cubbison, Erin, 24, 277–79
- cultural heritage, builtform—ecology framework, One Planet Living framework, 56
- curb extensions
  - stormwater management, 113, 114
  - traffic calming design, 229
- curbs
  - emergency vehicle access (EVA), 230
  - green streets, 236
- curves, streetscape design, 240–41
- Daggett, California, Solar Two, 187
- dark graywater, 129
- daylighting
  - California Academy of Sciences (San Francisco, California), 330
  - energy demand reduction, 172, 176
  - deconstruction
    - Chartwell School (Monterey, California), 333
  - construction methods, 261
  - deforestation, carbon footprint measures, 192
  - demography, builtform—ecology framework, 48
  - density. see also scale-density framework
  - scale-density framework, 21–22, 36–37
  - desalination, water supply strategies, 92–93
  - desert dew harvesting, water supply, 82–83
  - design. see engineering design; sustainable design systems
  - design applications, 265–66. see also building-scale design applications; city-scale design applications; community-scale design applications
  - design development, engineering design implementation, 15
  - detention ponds, extended, stormwater management, 118–19
  - development type, infrastructure frameworks, 25–26
  - Devine, Robert, 29–33
  - DIG Cooperative, 142
  - disabilities, complete streets concept, 226
  - disinfection
    - blackwater treatment, 150
    - graywater treatment, 138
  - distribution components, graywater systems, 138–40
  - district cooling, energy demand reduction, 179
  - district heating, energy demand reduction, 178–79
  - drainage patterns, site planning, 243–45
drinking water. See also water use
blackwater reuse, 157–58
Guangzhou, China, 273, 275
importation of, 65
Pearl Island, Panama, 303–4, 305
water balance modeling, 66–68, 100
drivers concept, engineering design, 8–9
driveways, green streets, 235
drought, graywater integration system, 147
Duany, Andres, 22, 72
durability, materials assessment, 247
Dusenbury, Robert, 110
deathwork, grades and grading, 243–45
ecology and ecologist. See also
builtform—ecology framework
builtform—ecology framework, 22–23
design team dynamics, 6
Great Wall of China resort (Jiankou, China), 30–31
Pearl Island, Panama, 299, 300–302
pillars of sustainability model, 27–29
ecosystem approach, site planning, 209
ecosystem services concept, builtform—ecology framework, 52–53
eco-tourism, builtform—ecology framework, 47–48, 49–50
edges
site planning, synthesis, 223–24
streetscape design, 240–41
efficiency
conservation contrasted, 169–70
energy policy, incentives and requirements, 202
energy production, 167–68
EHDD Architecture, 341–43
electricity. See also energy
automobile, 182–83, 183
carbon footprint measures, 192–94
elevation, site planning, 217
emergency vehicle access (EVA), 230, 241
emission factor, carbon footprint measures, 192–94
employment, builtform—ecology framework, 56
end of life, materials assessment, 248
energy, 166–205
California Academy of Sciences (San Francisco, California), 329
Chartwell School (Monterey, California), 333
climate change, 192–99
carbon footprint measures, 192–95
carbon footprint reduction, 195–97
carbon-neutrality management plans, 197–99
consumption sectors, 170
consumption statistics, U.S., 168
defined, 166
demand reduction, 169–83
building factors, 170–71
efficient systems factors, 178–80
efficient use factors, 176–78
overview, 169–70
passive strategies, 171–76
transportation factors, 180–83
water system factors, 180, 181
distribution systems, inefficiency in, 167
Great Wall of China resort (Jiankou, China), 31
Guangzhou, China, 273
guidelines and standards, 202–3
Pearl Island, Panama, 299–300, 308–10, 334–37
Pearl River Tower (Guangzhou, China), 344–47
pillars of sustainability model, 27–29
planning—ecology framework, 27–29
PlaNYC, 34
policy measures, 199–202
building-scale financing options, 201
cap setting, 199
efficiency incentives and requirements, 202
green power programs, 200
incentive programs, 200–201
net metering, 199–200
regional power purchasing agreements, 201
renewable energy certificates, 200
utility profit decoupling strategies, 202
production modes, 169
rainwater harvesting, 87
scale-density framework, 35, 37–39
supply sustainability, 183–91
biogas, 191
biomass, 190
geo-thermal systems, 188–90
hydroelectric power, 191
overview, 183–84
solar power, 184–87
wind power, 187–88
transect model, 41, 43–45
water management plan, 65
Energy and Environment Program (Aspen Institute), 64
distributed energy distribution, inefficiency in, 167
Energy Star program, 9, 24
eengineer, architects’ relationship with, 4–5
engineering design, 3–18
drivers concept, 8–9
frameworks and action plans, 12
implementation, 13–18
outcome measurement, 10–12
paradigm for, 4–6
strategies, 12–13
team dynamics, 6–8
values and goal setting, 9–10
eenhanced geothermal systems (EGS), 189
enthalpy machines, 177
eventalmental impact evaluation, 246–52
Environmental Protection Agency (EPA, U.S.), 80, 96, 142, 166–67, 180, 232, 261, 304, 333
evaporation control
builtform—ecology framework, 53
materials for, 260
stormwater, 103
water supply strategies, 82–83
extended detention ponds, stormwater management, 118–19
fair trade, builtform—ecology framework,
One Planet Living framework, 56
farmers markets, streets, 227
farming. See agriculture
festivals, streets, 227
filtration, graywater treatment, 134–35
financing. See costs
Fisherville, Tennessee, 209
flood control
  builtform—ecology framework, ecosystem services concept, 52–53
rainwater harvesting, 88–89
flood irrigation, water conservation, 80
flood plains, site planning, 219
fly ash, coal power plants, 166–67
fog harvesting, water supply, 83
foods, One Planet Living model, 55
flood control
  graywater. See also blackwater; water use applications of system examples, 142–43
defined, 128
integration into master plan, 144–47
net-zero water, 74
Pearl Island, Panama, 304
potential uses of, 130–32
goals of, 132–33
quality characterization, 129–30
recommendations for, 140–41
reused systems, 132–40
uses of, 128–29
water balance modeling, 66–68, 69, 70
Great Depression, xii
Great Wall of China resort (Jiankou, China), 21, 29–33
Greenberg, Ellen, 233
green certification, construction methods, 261–62. See also accreditation; Leadership in Energy and Environmental Design (LEED)
Green Dorm project (Stanford University), 341–43
greenfield development
builtform—ecology framework, 47
transect model, 22
Green Globes program, 24
green gutters, stormwater management, 115–16
greenhouse gas emission. See also air quality; climate change
mitigation of, 198
sources of, 166, 197
transportation sector, 182
green power programs, energy policy, 200
green roof
  energy generation, PlaNYC, 34
  net-zero water, 74
  stormwater management, 116–17
  transect model, 43
green streets, 134–38. See also streets
  Chicago Green Alleys Program, 236–37
design factors, 235–36
  landscaping, 235
  Portland (Oregon) Green Streets Program, 238
  stormwater management, 234–35
swales, stormwater management, 110, 113, 338–40
greenway mapping, site planning, synthesis, 222–23
greywater. See graywater; water use applications of system examples, 129–30
grid orientation. See graywater; water use applications of system examples
mitigation of, 198
sources of, 166, 197
transportation sector, 182
inner water source, 74–75
Guangzhou, China, 11, 21, 269–77
Pearl River New Town project, 269
Pearl River Tower (Guangzhou, China), 344–47
Guerrero Park (San Francisco, California), 288, 289
guidelines, energy efficiency, 202–3
habitation, builtform—ecology framework, 48, 50–52, 56
Hamburg, Germany, 161
happiness, builtform—ecology framework, 56
Hargreaves + Associates, 269, 272, 321–24
Harrogate wind farm (United Kingdom), 188
Hart Howerton, 315–20, 334–37
health
builtform—ecology framework, 56
fossil fuels, 166–67
graywater, 129–30, 132
rainwater harvesting, 87, 90–92
wastewater, 97
heating, ventilation, and air-conditioning
California Academy of Sciences (San Francisco, California), 329
costs, net-zero energy, 171
design team dynamics, 9
district heating and cooling, 178–79
efficiency incentives and requirements, 202
energy use efficiency, 176, 177–78
Pearl Island, Panama, 305
Pearl River Tower (Guangzhou, China), 344–47
heat recovery systems, energy use efficiency, 177
Heid, Jim, 53–54
Heller Manus Architects, 269
Hollenback Community Garden (Brooklyn, New York), 152
hot water, solar thermal heating, 187–88
housing, builtform—ecology framework, 48, 50–52, 56
Howerton, Hart, 294–313
human development, stormwater management, 101–4
human runoff, wastewater, 100–101
hydroelectric power, energy supply, 191
hydrological inventory, site planning, 212–14
hydrologic cycle. See water cycle
hydrologist, design team dynamics, 8
implementation plans, Guangzhou, China, 276
incentive programs, energy policy, 200–201
industry, builtform—ecology framework, 48–49
industry standards. See standards inefficiency. See efficiency
infra red imaging leak detection, 81
infrastructure frameworks, 19–56
action plans and, engineering design, 12
builtform—ecology framework, 22–23, 47–56
design systems, 25
development type, 25–26
Guangzhou, China, 276
pillars of sustainability model, 26–34
scale-density framework, 35–39
selection of, 23–24
sustainability factors, 20–23
transect model, 22, 40–45
infrastructure improvement, water supply, 80–81
infrastructure mapping, Tehachapi, California, transect model, 45
inspections, stormwater management constraints, 125
insulation, energy demand reduction, 173
integrated water resource management (IWRM), 160
Intergovernment Panel on Climate Change (IPCC), 195
interior air exchange, energy use efficiency, 177
interlocking porous paving, stormwater management, 115
International Ecotourism Society, 49
intersections
Cesar Chavez Green Street corridor (San Francisco, California), 287
green streets, 236
traffic calming design, 229
in-the-field changes, construction methods, 262–63
iodine, graywater treatment, 138
irrigation
graywater, 70, 130, 131
net-zero water, 74
Pearl Island, Panama, 305
stormwater, 73, 123
water conservation, 79–80
Jacobsen, Brad, 341–43
Jamaica Bay Watershed Protection Plan (New York, New York), 281
Jencks, Rosey, 126–27
Jiankou, China, Great Wall of China resort, 21
Kilduff, Paul, 142
Kyoto Protocol, 268
Lake Merced (California), 213
lake water, 75
land analysis, site planning, 216–18
landscape architect, design team dynamics, 7
landscaping
carbon footprint measures, 195
Cesar Chavez Green Street corridor (San Francisco, California), 286–87
emergency vehicle access (EVA), 230
energy demand reduction, 175–76
engineering design, goal setting prioritization, 18
low-impact development (LID)
stormwater management, 106–9
Pearl Island, Panama, 306
San Francisco (California) Mission Streetscape Plan, 285–86
San Francisco (California) Urban Forest Master Plan, 283–84
site planning, 208
streets, 227, 234, 235, 236
streetscape design, 239–42
land use
automobile, 180–81
builtform—ecology framework, habitation, 52
PlaNYC, 33
scale-density framework, 37–39
site planning, synthesis, 224
streets, 225
transect model, 22, 40–45
laundry, ozone, graywater integration, 146–47
leachfield, 159
Leadership in Energy and Environmental Design (LEED), 9, 10. See also rating systems; U.S. Green Building Council (USBG)
American Society of Landscape Architects (ASLA), 338
gineering design, goal setting prioritization, 18
infrastructure frameworks, 23
Los Angeles State Historic Park, 323
San Francisco (California) greening initiatives, 284
water balance implementation, 68
leak-detection, 80–81
life-cycle assessment (LCA), environmental impact evaluation, 246–47
light-emitting diode (LED), 176
light graywater, 129. See also graywater
light imprint concept, 23
lighting
California Academy of Sciences (San Francisco, California), 330
energy use efficiency, 176
Living Building Challenge model, 9, 23, 73–74
living pool system, graywater integration, 146
living roof, graywater integration, 146.
See also green roof
Loreto Bay, Mexico, 259
Los Angeles State Historic Park, 321–24
Lovins, Amory, 170
low-emittance windows, 174
low-energy precision application (LEPA) spray irrigation, 80
low-impact development (LID) design.
See also stormwater and stormwater management
benefits of, stormwater management, 106–7
constraints and barriers to, 120–25
operations, stormwater management, 107–9, 234
principles, stormwater management, 104–6
San Francisco (California) greening initiatives, 285
maintenance and operations
engineering design implementation, 15
graywater systems, 141
materials assessment, 247
stormwater management constraints, 123, 125
malls, streets, 227
mapping, site planning, 221–23
markets, streets, 227
Masdar (Abu Dhabi), 54–55
masonry structural materials, selection criteria, 259
Massachusetts Institute of Technology (MIT), 189
materials. See also waste assessment of, 247–48
California Academy of Sciences (San Francisco, California), 329–30
carbon footprint measures, 194
construction methods, 261–63
construction waste management, 263
deconstruction, 261
general contractor, 261
green certification, 261–62
in-the-field changes, 262–63
project specification manual, 262
energy demand reduction, 170–71
environmental impact evaluation, 246–52
Great Wall of China resort (Jiankou, China), 31–32
One Planet Living model, 55
Pearl Island, Panama, 300, 310–13
pillars of sustainability model, 27–29
red list, 248
selection criteria, 252–60
erosion and sediment control materials, 260
paving and surfacing materials, 252–56
piping materials, 257
structural materials, 257–60
solid waste management, 263–64
transect model, 41, 43–45
McDonough, William, 48–49
McKinsey & Company, 170
mechanical, electrical, and plumbing (MEP) specialist, design team dynamics, 8
media filtration, graywater treatment, 134–35
medians, traffic calming design, 229
Melbourne Principles for Sustainable Cities, 23
membrane bioreactor (MBR), blackwater treatment, 154–55
membrane filtration, graywater treatment, 135
Merced, Lake (California), 213
metal structural materials, selection criteria, 257–58
methane, 191, 192
microclimates, energy demand reduction, 173
microirrigation, water conservation, 80
Mint Plaza, California. See Old Mint Plaza (San Francisco, California)
Mission Streetscape Plan (San Francisco, California), 285–86
modular pavement, selection criteria, 255–56
Moule, Elizabeth, 72
mulch basins, graywater treatment, 134
Native Americans, 47
native vegetation, site planning, 215–16
natural gas
carbon footprint measures, 194
transportation, 182–83
natural landscape
Pearl Island, Panama, 296
site planning, 209–10, 243–44
stormwater, 102–3
streetscape design, 239–41
natural pavement surfaces, 255
natural runoff, wastewater, 100–101
natural ventilation, energy demand reduction, 173
natural water treatment process, LID stormwater management, 108–9
Nelson, Carl, 85
net metering, energy policy, 199–200
net primary production, ecosystem services concept, 52
net-zero energy, 23
building factors, 171
Living Building Challenge model, 73–74
Pearl River Tower (Guangzhou, China), 344–47
Stanford University Green Dorm project, 341–43
Nevue Ngan Associates, 338–40
new development, infrastructure frameworks, 26
New Mexico, 131
Newtown Creek (New York, New York), 162
New Urbanist movement, 22
New York, New York, 179. See also PlaNYC (New York, New York)
bicycles, 229–30
blackwater, 148
Jamaica Bay Watershed Protection Plan, 281
Newtown Creek, 162
PlaNYC, 33–34
sustainable development, 268
transect model, 40
New York Times, 166–67
Ngan, Ben, 338–40
nonpoint source pollution, wastewater, 98
nuclear power, carbon footprint measures, 193
Obama, Barack, 176
Ocean Foundation, 313–15
oceans, builtform—ecology framework, 48
ocean thermal energy conversion (OTEC), energy supply, 191
Ohlone College (Newark, California), 177
oil. See petroleum
Old Mint Plaza (San Francisco, California), 16, 125–26, 287
Olympia, Washington, 114
One Planet Living model, 9, 23, 54–56
open space, site planning, 217–18
open water bodies, hydrological inventory, 213
operations and maintenance. See maintenance and operations
opportunities, infrastructure frameworks, 25
Orange County, California, 158
outcome measurement, engineering design, 10–12
Oxford University, Centre for the Environment (OUCE), 50
ozonation, blackwater treatment, 150
ozone laundry, graywater integration, 146–47
Pearl Island, Panama, 294–313
building-scale design applications, 334–37
community, 299, 300
ecology, 299, 300–302
energy, 308–10
framework, 299–300
master plan, 297–98
materials, 310–13
overview, 294–96
streets, 298, 299
unique factors, 296
water use, 299, 302–8
Pearl River New Town project (Guangzhou, China), 269
Pearl River Tower (Guangzhou, China), 344–47
pedestrians, 225, 227, 233
Pelican Court, Sea Ranch, California, 244
performance, materials assessment, 247
permaculture concept, 23
Perry, Kerry, 338–40
pervious paving, stormwater management, 114–15
pest control, builtform—ecology framework, 53
Petersen, Jacob, 321–24
petroleum. See also energy
automobile, 182–83
contemporary energy paradigm, 168
photovoltaic technology, 185, 300, 347
Piano, Renzo, 327
pillars of sustainability model described, 20–23
implementation of, 26–34
Pearl Island, Panama, 299–300
piping materials, selection criteria, 257
planner, design team dynamics, 7
planter boxes
Cesar Chavez Green Street corridor (San Francisco, California), 287
green streets, 236
stormwater management, 112, 113
planting strips, green streets, 236
plant products, ecosystem services concept, 52
PlaNYC (New York, New York)
pillars of sustainability model, 33–34
stormwater management, 279–81
water conservation, 78
Plater-Zyberk, Elizabeth, 72
pocket parks, green streets, 236
Poland, 193–94
politics. See also standards
city-scale design applications, 268
energy policy, 199–202
pollination, builtform—ecology framework, 52
pollution. See also air quality; water quality
builtform—ecology framework, ecosystem services concept, 53
fossil fuels, 166–67
graywater, 129–30, 141
green streets, 234
natural water treatment process, 109
rainwater harvesting, 90–91
stormwater, 102–3
streets, 225
wastewater, 97–100
water cycle, 60–61
Polyzoides, Stefanos, 72
ponds, surface water, 75
pool system, living, graywater integration, 146
population growth, builtform—ecology framework, 48
Portland, Oregon, 112, 121, 238
post-tensioned reinforcement, concrete structural materials, 260
potable water. See drinking water
Powell, John Wesley, 290
power plants, pollution, 166–67
power purchasing agreements, energy policy, 201
ppm (parts per million) standards, 97
precipitation. See also rainwater; water use
stormwater, 101–3
U.S., 88
priorities
goal setting, engineering design, 17–18
infrastructure frameworks, 25
production costs, materials assessment, 247
project planning, engineering design implementation, 14–15
project specification manual, construction methods, 262
propane, transportation, 182–83
property-assess clean energy (PACE) financing, energy policy, 201
protection, restoration vs., site planning, synthesis, 221–22
Public Art Program (Calgary, Alberta, Canada), 290–91
public transportation
streets, 225–26, 227
urban policy, 268
pumps
graywater systems, 138–40
water supply, 84
radiant barriers, energy demand reduction, 174–75
rainfall. See also rainwater; water use
stormwater, 101–3
U.S., 88
rain garden, stormwater management, 116, 117, 234–35
rainwater
builtform—ecology framework, 50
Chartwell School (Monterey, California), 331–33
harvesting, water supply strategies, 84–92
net-zero water, 74
Pearl Island, Panama, 304
water balance modeling, 66–68, 69, 70
water source, 75, 76
rating systems. See also Leadership in Energy and Environmental Design (LEED)
effects of, 24
infrastructure frameworks, 23–24
Realschule Friesenheim (Friesenheim, Germany), 186
recreation, builtform—ecology framework, 49–50
recycling
builtform—ecology framework, 49–50
graywater, 128, 132–40
solid waste management, 264
water management plan, 65
Reed, Bill, 47
reflective surfaces, energy demand reduction, 175
regenerative development concept, 23, 26
regional factors, materials assessment, 248
regional power purchasing agreements, energy policy, 201
reinforced gravel and grass paving, stormwater management, 115
renewable energy certificates, energy policy, 200. See also accreditation; certification; Leadership in Energy and Environmental Design (LEED)
reservoirs
graywater integration, 145
surface water, 75
resource systems, sustainability, 57. See also energy; materials; site resources; water use
restoration
Cattle Creek (Colorado) stormwater management, 315–20
infrastructure frameworks, 26
protection vs., site planning, synthesis, 221–22
retreat center
graywater integration system, 144–47
water balance, 68–71
riparian zones, hydrological inventory, site planning, 213–14
rivers, surface water, 75
road narrowing, streets, 229
roadways. See automobile; streets; transportation
roadway shoulders, emergency vehicle access (EVA), 230
Rocky Mountain Institute, 23, 170
Rohnert Park, California, Sonoma Mountain Village, One Planet Living, 54–56
rubberized asphalt, paving selection criteria, 253
runoff reduction, LID stormwater management, 107–8
rural nonpoint source pollution, wastewater, 98
salinity, brackish water, 76
sand filter, blackwater treatment, 152
San Diego Island, Midway Atoll, 159
San Francisco, California, 125–27, 264, 281–82
Better Streets Plan, 282–83
Mission Streetscape Plan, 285–86
Old Mint Plaza, 16, 125–26, 287
Pavement to Parks (P2P) initiative, 288–89
stormwater management, 284–85
Urban Forest Master Plan, 283–84
Sanlúcar la Mayor Solar Platform (Spain), 187–88
San Mateo County (California) stormwater management, 110, 111, 116, 117, 120
Santa Lucia Preserve (California), 50–52, 242, 243
Santa Monica (California) woonerfs, 232
scale-density framework implementation of, 35–39
infrastructure frameworks, 21–22
Sea Ranch, California, 244
seasonality, freshwater supplies, 63
seawater, water source, 76
sediment control materials, 260, 306
septic system
blackwater treatment, 151
nonpoint source pollution, 98
sequencing batch reactor (SBR), blackwater treatment, 152–54
settlement patterns, builtform—ecology framework, 48
Seville, Spain, 187–88
sewer(s)
Cesar Chavez Green Street corridor (San Francisco, California), 286
San Francisco (California) greening initiatives, 285
solid waste management, 263–64
wastewater, 97–100
sewer overflow, rainwater harvesting, 89
shade
Pearl Island, Panama buildings, 334–36
site planning, 219
shared streets (woonerfs), 229
Shell, Scott, 333
Sherwood Design Engineers, 270, 272, 274, 275, 294–313, 334–37
shoulders (roadway), emergency vehicle access (EVA), 230
sidewalk planters. See planter boxes
Singapore, 157–58
Sino-Singapore Eco-City Master Plan (Tianjin, China), 277–79
site planning, 208–64
Brisbane City Hall (San Mateo County, California), 338–40
California Academy of Sciences (San Francisco, California), 328
carbon footprint measures, 195
civil engineering, 208
contextual background study, 210–21
biological inventory, 214–16
built systems inventory, 220–21
climatological analysis, 219
geological inventory, 211–12
hydrological inventory, 212–14
soils inventory, 212
topography and land analysis, 216–18
ecosystem approach, 209
materials and waste flow, 246–64 (See also materials)
environmental impact evaluation, 246–52
selection criteria, 252–60
natural patterns, 209–10, 243–44
Pearl Island, Panama buildings, 334–37
San Francisco (California) Urban Forest Master Plan, 283–84
stormwater management, 121–22
streets, 224–42 (See also streets; transportation)
complete streets concept, 226–33
green streets, 234–38
overview, 224–26
Santa Lucia Preserve (California) street design, 242, 243
streetscape design, 239–42
synthesis, 221–24
Tianjin Eco-City Master Plan, 277–78
site resources
automobile, 180–81
builtform—ecology framework, 22–23
energy demand reduction, 171–76
engineering design outcome measurement, 10–12
graywater systems, 141
low-impact development (LID)
stormwater management, 107
Skidmore, Owings & Merrill LLP, 271, 274, 344–47
skylights, 174
slope maps, site planning, 216, 217
slopes. See also grades and grading
stormwater management constraints, 121–22
streetscape design, 240–41
SmartCode model, 9, 23
smart-growth streets, described, 233
smart irrigation controllers, water conservation, 80
smart meters/smart grids, energy demand reduction, 179–80
soil(s)
builtform—ecology framework, ecosystem services concept, 53
natural water treatment process, 109
site planning inventory, 212
stormwater management constraints, 122
solar orientation
Pearl Island, Panama buildings, 334–37
site planning, 217, 219
solar power
energy supply, 184–87
PlaNYC, 34
solar thermal power, 186–87
Solar Two (Daggett, California), 187
solid waste
ingeneration, PlaNYC, 34
management of, 263–64
scale-density framework, 35
SOM (architectural firm), 269, 344–47
Sonoma Mountain Village (Rohnert Park, California), One Planet Living model, 54–56
Southwestern United States project, scale-density framework, 37–39
space constraints, stormwater management, 121
Spalding, Mark J., 313–15
spray irrigation, water conservation, 80
stabilized soils, paving selection criteria, 255
stakeholders, engineering design, goal setting, 17–18
standards and codes
community-scale design applications, 313–15
energy efficiency, 202–3
engineering design outcome measurement, 10–12
Guangzhou, China, 275–76
materials assessment, 248
rainwater harvesting, 87, 90–91
wastewater, 97
Stanford University Green Dorm project, 341–43
Staten Island, New York, 123, 281
Steinbeck, John, xv
Stockholm, Sweden, 191
stormwater and stormwater management, 101–27
best management practices (BMPs), 124
Brisbane City Hall (San Mateo County, California), 338–40
builtform—ecology framework, 50
Cattle Creek (Colorado) project, 315–20
Cesar Chavez Green Street corridor (San Francisco, California), 287
constraints and barriers to, 120–25
drainage patterns, 243–45
green streets, 234–35
Guangzhou, China, 275
human development, 101–4
low-impact development (LID) design benefits, 106–7
operations, 107–9
principles, 104–6
net-zero water, 74
Old Mint Plaza, San Francisco (California), 287
Pearl Island, Panama, 305
PlaNYC, 279–81
San Francisco, California examples, 125–27, 284–85
scale-density framework, 37–39
suburban strategies, 118–19
transect model, 42
urban strategies, 110–17
wastewater, 100–101
water balance modeling, 66–68, 73
water source, 76–77
stormwater planters, stormwater management, 112, 113
streams, surface water, 75
street fairs, 227
streets, 224–45. See also automobile; transportation
automobile, 180–81
bicycles, 229–30
Cattle Creek (Colorado) stormwater management, 318–20
Cesar Chavez Green Street corridor (San Francisco, California), 286–87
Chicago Green Alleys Program, 236–37
complete streets concept, 226–33
design factors, 235–36
emergency vehicle access (EVA), 230
green streets concept, 134–38
landscaping, 235
overview, 226–27
Portland (Oregon) Green Streets Program, 238
road narrowing, 229
San Francisco (California) Better Streets Plan, 282–83
San Francisco (California) Mission Streetscape Plan, 285–86
San Francisco (California) Urban Forest Master Plan, 283–84
Santa Lucia Preserve (California) street design, 242, 243
shared streets (woonerfs), 229, 232
smart-growth streets, 233
stormwater management, 234–35
streetscape design, 239–42
swales, stormwater management, 338–40
traffic calming, 228–29, 230–31
types and uses, 227
width of, 241
streetscape design, 239–42
Cesar Chavez Green Street corridor (San Francisco, California), 286–87
San Francisco (California) Mission Streetscape Plan, 285–86
structural materials, selection criteria, 257–60
subsurface capillary irrigation, water conservation, 80
subsurface flow (SF) constructed wetlands, blackwater treatment, 155–56
suburban development builtform—ecology framework, 48
stormwater management, 118–19
surface water
rainwater harvesting, 89
site planning, hydrological inventory, 212–14
stormwater, 101–3
wastewater, 97–100
water source, 75
surfacing materials, selection criteria, materials and waste flow, 252–56
sustainability consultant, design team dynamics, 6
sustainability factors, infrastructure frameworks, 20–23
sustainable design systems, 1–56. See also engineering design
engineering design, 3–18
guidelines and standards, energy efficiency, 202–3
infrastructure frameworks, 25
overview, 1–2
team dynamics, 6–8
Sustainable Sites Initiative (American Society of Landscape Architects (ASLA)), 9, 23, 337–38
swales, stormwater management, 110, 113, 338–40
synergy, community design, builtform—ecology framework, 53–54
Taghazout, Morocco, 112
team dynamics, sustainable design team, 6–8
technology, smart meters/smart grids, 179–80
Tehachapi, California, transect model, 43–45
Ten Measures of Sustainable Design, Committee on the Environment (COTE, AIA), 4, 23, 46, 331
Terpeluk, Brett, 327–31
tertiary treated water, water balance modeling, 66–68
thermal mass, energy demand reduction, 174
thermal zoning, Pearl Island, Panama buildings, 335–36
third-party verification, Guangzhou, China, 276
Tianjin, China, Sino-Singapore Eco-City Master Plan, 277–79
tidal power, energy supply, 191
topography. See also site planning
traffic calming
green streets, 236
streets, 228–29
transect model
Cattle Creek (Colorado) stormwater management, 315–20
implementation of, 40–45
infrastructure frameworks, 22
transportation. See also automobile; streets
builtform—ecology framework, 53–54, 55
built systems inventory, site planning, 220
carbon footprint measures, 194
energy demand reduction, 180–83
greenhouse gas emission, 182
One Planet Living model, 55
PlaNYC, 34
transportation, continued
   public, 225–26, 227, 268
   streets, 227
   transect model, 41, 43, 45
   urban policy, 268
trash removal, stormwater management
   constraints, 125
tried water, water balance modeling,
   66–68
   built systems inventory, site planning,
   220–21
   stormwater management constraints,
   122–23
   utility profit decoupling strategies, 202
values, engineering design, 9–10
vegetated filter strips, stormwater manage-
   ment, 113
   Pearl Island, Panama buildings, 336–37
   verification, Guangzhou, China, 276. See
   also accreditation; certification; Leadership in Energy and Envi-
   ronmental Design (LEED)
   VIA Partnership, 290–91
views, site planning, 217
vision, engineering design, 9–10
vortex-induced vibration (VIV), energy
   supply, 191
warm mix asphalt, paving selection crite-
   ria, 253–54
Washington, D. C., Union Station, 174
   waste. See also materials
water balance
   Ahwahnee Principles, 72–73
   graywater integration, 144–47
   Living Building Challenge, 73–74
   modeling of, 66–68
   Pearl Island, Panama, 303
   retreat center implementation, 68–71
water cycle
described, 60–63
   energy demand reduction, 180, 181
   water management plan, 65
water quality. See also air quality;
   pollution
water treatment facilities, 61
   blackwater, 149–57
   conventional treatment paradigm,
   97–100
   costs, 161–62
   graywater, 133–38
   paradigm shift in, 159–62
   water use, 60–94. See also blackwater;
   graywater; stormwater management; wast-
   erwater
water supply strategies, 77–93
   conjunctive use, 82
   conservation, 77–80
   desalination, 92–93
   desert dew harvesting, 82–83
   evapotranspiration, 82–83
   fog harvesting, 83
   graywater integration, 144–47
   infrastructure improvement, 80–81
   management plans, 64–66
   pumps and transport, 84
   rainwater harvesting, 84–92
   water treatment facilities, 61
   blackwater, 149–57
   conventional treatment paradigm,
   97–100
   costs, 161–62
   graywater, 133–38
   paradigm shift in, 159–62
water use, 60–94. See also blackwater;
   graywater; stormwater management; wast-
   erwater
   builtform—ecology framework, 49–50
   carbon footprint measures, 195
   construction waste management,
   263
   One Planet Living model, 55
   Pearl Island, Panama, 313
   wastewater, 96–101. See also water use
   concept of, 96
   conventional treatment paradigm,
   97–100
   Guangzhou, China, 275
   infrastructure for, built systems inven-
   tory, site planning, 220–21
   net-zero water, 74
   paradigm shift in treatment, 159–62
   Pearl Island, Panama, 307–8
   redefinition of, 100–101
   scale-density framework, 35, 37–39
   transect model, 22, 40–45
   utility services
   builtform—ecology framework, 47–48
   stormwater management, 110–17
   Urban Forest Master Plan (San Francis-
   co, California), 283–84
   urban infill development, builtform—
   ecology framework, 47
   urban planning
   scale-density framework, 35–39
   streets, 225
   transect model, 22, 40–45
   ultraviolet (UV) irradiation
   blackwater treatment, 150
   graywater treatment, 138
   Uniform Plumbing Code (UPC), 87
   Union Station (Washington, D. C.), 174
   United Nations Human Development
   Index, 12
   United Nations Millennium Develop-
   ment Goals, 97
   U.S. Academy of Sciences, 167
   U.S. Census Bureau, 261
   U.S. Conference of Mayors Climate Pro-
   tection Agreement, 268
   U.S. Department of Energy, 166, 167, 187
   U.S. Energy Information Administration,
   166, 167, 168, 169, 170, 193
   U.S. Environmental Protection Agency
   (USEPA), 80, 96, 142, 166–67, 180, 233, 261, 304, 333
   U.S. Green Building Council (USBG),
   10, 24, 338. See also Leadership in Energy and Envi-
   ronmental Design (LEED)
   urban development. See also city-scale
   design applications
   builtform—ecology framework, 47–48
   stormwater management, 110–17
   Urban Forest Master Plan (San Francis-
   co, California), 283–84
   urban infill development, builtform—
   ecology framework, 47
   urban planning
   scale-density framework, 35–39
   streets, 225
   transect model, 22, 40–45
   ventilation
   energy demand reduction, 173
   energy use efficiency, 177
   Pearl Island, Panama buildings, 336–37
   verification, Guangzhou, China, 276. See
   also accreditation; certification; Leadership in Energy and Envi-
   ronmental Design (LEED)
engineering design, goal setting prioritization, 18
freshwater supplies and withdrawals of, 62
Great Wall of China resort (Jiankou, China), 31
Guangzhou, China, 273, 274, 275, 275
infrastructure for, built systems inventory, site planning, 220–21
Pearl Island, Panama, 299, 302–8
pillars of sustainability model, 27–29
PlaNYC, 33–34, 279–81
San Francisco (California) greening initiatives, 284–85
scale-density framework, 35–39
solar thermal heating, 187–88
sources, 74–77
supply strategies, 77–93
transect model, 41–45
water balance implementation, 68–74
water balance modeling, 66–68
water cycle, 60–63
water management plans, 64–66
water security, rainwater harvesting, 87
wave energy, energy supply, 191
weather, graywater integration system, 147
weir trash removal, 123
well water, graywater integration, 145
wetlands
graywater integration, 145
graywater treatment, 137
hydrological inventory, site planning, 212–13
stormwater management, 118
wet ponds, extended, stormwater management, 119, 120
white roof, energy demand reduction, 175
width, street width, 241
wildlife. See also biological diversity
ecosystem services concept, 52
habitation, 51
One Planet Living framework, 55–56
Pearl Island, Panama, 296
Wilson, Clark, 233
Wilson, E. O., 52
windows
low-emittance, energy demand reduction, 174
net-zero energy, 171
wind power
energy supply, 187–88
Pearl River Tower (Guangzhou, China), 344–47
Tehachapi, California, transect model, 44
winds, site planning, 219
wood structural materials, selection criteria, 258–59
woonerfs (shared streets), 229, 232
Works Progress Administration (WPA), xiii
World Health Organization (WHO), 61, 90
World Resources Institute (WRI), 52
World Wildlife Federation (WWF), One Planet Living model, 54–56
zero energy. See net-zero energy
Zoniro Panama, 294–313
Alternative Construction: Contemporary Natural Building Methods
by Lynne Elizabeth and Cassandra Adams

Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life
by Stephen R. Kellert, Judith Heerwagen, and Martin Mador

Cities People Planet: Liveable Cities for a Sustainable World
by Herbert Girardet

Contractors Guide to Green Building Construction: Management, Project Delivery, Documentation, and Risk Reduction
by Thomas E. Glavinich, Associated General Contractors

Design with Nature
by Ian L. McHarg

Ecodesign: A Manual for Ecological Design
by Ken Yeang

Green BIM: Successful Sustainable Design with Building Information Modeling
by Eddy Krygiel, Brad Nies, Steve McDowell (Foreword by)

by Ross Spiegel and Dru Meadows

Green Development: Integrating Ecology and Real Estate
by Rocky Mountain Institute

by Susan Weiler and Katrin Scholz-Barth

The HOK Guidebook to Sustainable Design, Second Edition
by Sandra Mendler, William O’Dell, and Mary Ann Lazarus

Land and Natural Development (Land) Code
by Diana Balmori and Gaboury Benoit

A Legal Guide to Urban and Sustainable Development for Planners, Developers, and Architects
by Daniel K. Slone and Doris S. Goldstein with W. Andrew Gowder

by James A. LaGro

Sustainable Construction: Green Building Design and Delivery
by Charles J. Kibert

Sustainable Commercial Interiors
by Penny Bonda and Katie Sosnowchik

Sustainable Design: Ecology, Architecture, and Planning
by Daniel Williams

Sustainable Design: The Science of Sustainability and Green Engineering
by Daniel A. Vallero and Chris Brasier

Sustainable Healthcare Architecture
by Robin Guenther and Gail Vittori

Sustainable Residential Interiors
by Associates III

Sustainable Urbanism: Urban Design With Nature
by Douglas Farr

Environmental Benefits Statement

This book is printed with soy-based inks on presses with VOC levels that are lower than the standard for the printing industry. The paper, Rolland Enviro 100, is manufactured by Cascades Fine Papers Group and is made from 100 percent post-consumer, de-inked fiber, without chlorine. According to the manufacturer, the use of every ton of Rolland Enviro100 Book paper, switched from virgin paper, helps the environment in the following ways:

<table>
<thead>
<tr>
<th>Mature trees saved</th>
<th>Waterborne waste not created</th>
<th>Waterflow saved</th>
<th>Atmospheric emissions eliminated</th>
<th>Solid wastes reduced</th>
<th>Natural gas saved by using biogas</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>6.9 lbs.</td>
<td>10,196 gals.</td>
<td>2,098 lbs.</td>
<td>1,081 lbs.</td>
<td>2,478 cubic feet</td>
</tr>
</tbody>
</table>