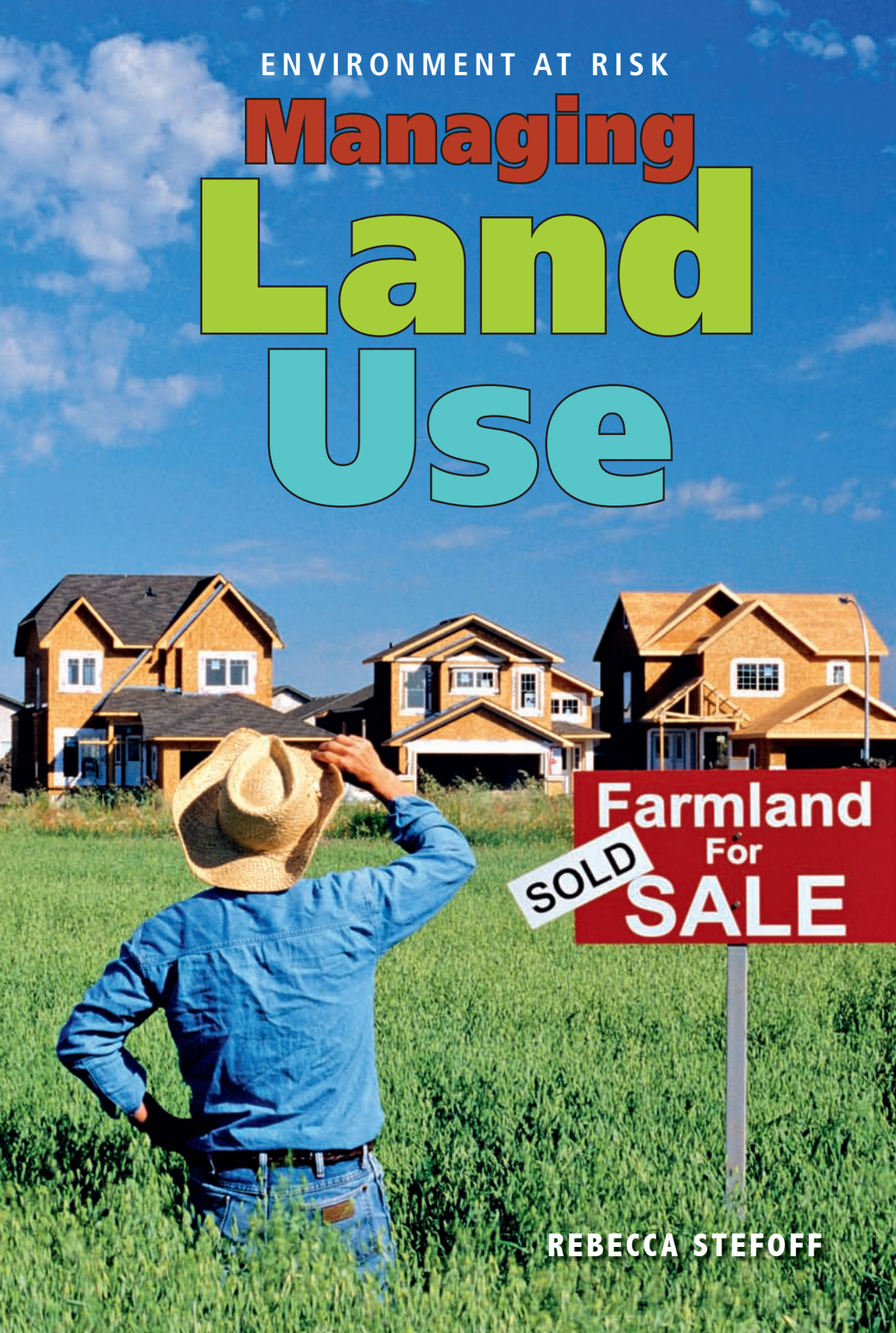
ENVIRONMENT AT RISK

Managing Land Use



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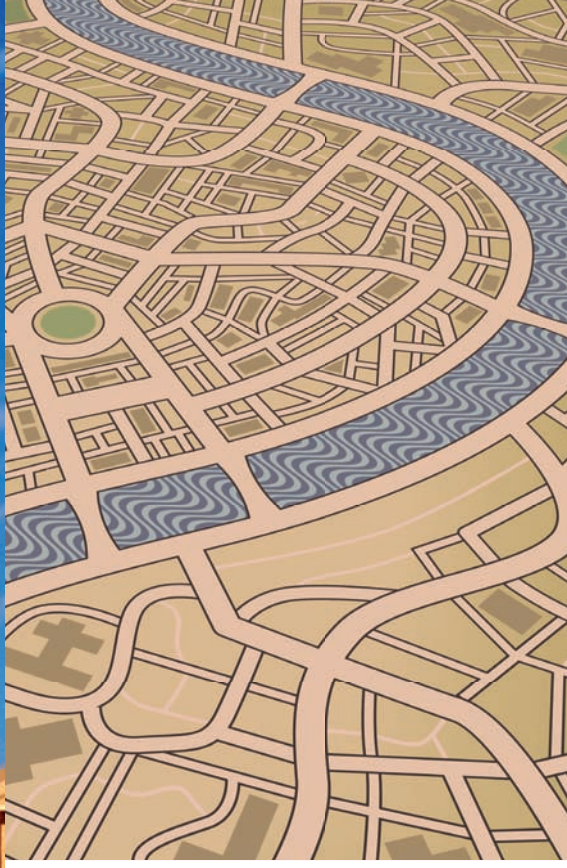

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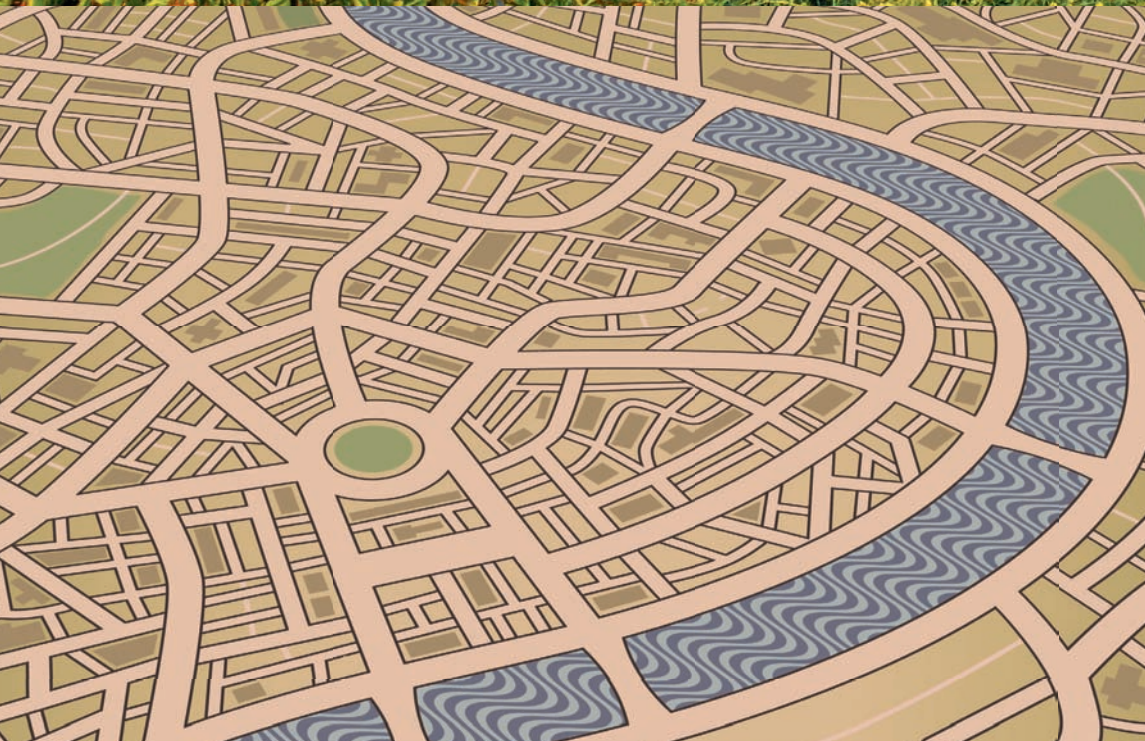

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Contents

One This Land Is Whose Land? 7

Two Down to Basics: Soil, Landforms, and Water 22

Three Misusing, Overusing, and Abusing the Land 33

Four The Human and Natural Landscapes 52

Five Tools of Land Management 70

Six Land Use Decisions 78

Notes 86

Further Information 99

Bibliography 102

Index 105

One
This Land Is Whose Land?

In 2010 the *Wisconsin State Journal* reported a battle brewing in Perry, a small rural town in Dane County, in the southern part of the state. The conflict concerned the land around a historic church. At the heart of the matter was a more general question: who has the right to decide how land will be used?

The answer may seem simple. In the United States, "[t]he property owner is the primary land use decision maker," wrote one scholar of land law in 2004. In practice, however, land use questions are often extremely complicated, whether they involve a small country church or a vast expanse of wilderness. In disputes over land use, the property owner may not be the only decision maker, or the final one.

Land use issues involve many interested parties, including property owners, the government, civic bodies, developers, and activists. In Fresno, California (left), prime farmland has been sold off to accommodate suburban housing.

Property Rights and Preservation in Perry

As many as a thousand people each year visit Perry's historic building, the Hauge Log Church. Dating from 1852, the church was the first built in western Wisconsin by the Norwegian Lutherans who settled the area. In 1974, in recognition of its significance, the National Park Service placed the Hauge Log Church on the National Register of Historic Places, a list of sites within the United States that deserve to be preserved, usually through a combination of government and private funds.

Preservation of the church, however, raised another issue: what would happen to the privately owned land around the church? The outcome was a tug-of-war between preservationists, who wanted to keep the land undeveloped as a setting for the church, and supporters of property rights, who viewed the preservationists as land grabbers.

The conflict started in 2000, when a man who owned land next to the historic church attempted to build a house and a barn on his property. Townspeople complained that the house and barn would lessen the appeal of the church, interfering with the scenic vistas of rolling farmland that form the building's setting. In 2001 the town's governing board responded to the citizens' concerns by declaring that 33 acres (13.4 hectares) of land around the church formed a "historic district," to be developed into a park.

That land, however, was privately owned. To buy it, the board raised money from state and county grants and from donations. With these funds the town was able to buy almost two-thirds of the land within the newly identified historic district. Unfortunately for the town's plans, the owner of 13 acres—the man who had planned to build the house and barn—refused to sell. In 2008 the town finally acquired his 13 acres through eminent domain, which is the right of government (federal, state, or local) to purchase a citizen's property without regard to the citizen's wish to sell.

When the town of Perry used eminent domain to acquire those 13 acres, it offered to pay the owner $74,000. The man

went to court to dispute the amount, and in 2009 a jury awarded him $312,500, an amount that is almost the town's entire yearly budget. Payment was put on hold while the court decided how much the town should also pay toward the lawyers' fees.

Meanwhile, the 33-acre parcel of land around the church had sparked another dispute. Perry's town board does not have the authority to pass zoning ordinances, the laws that define how particular pieces of land may be used. The town therefore asked the zoning committee of Dane County's governing board to designate the 33 acres as an official county historic district. This would make it easier for the county to block development around the church in the future. It might also pave the way for the entire district to be added to the National Register of Historic Places.

Legal recognition of the historic district would "create a sense of place in perpetuity," explains a member of the Perry town board, meaning that the character of the land around the church would remain unchanged into the future. One historian with the National Register says that although "the boundaries selected for a National Register property are [generally] confined to the limits of that historic property," there are exceptions. Another National Register historian suggests that the town could argue that the views are what make the site historic. A Wisconsin architecture writer points out that development has become a problem around many historic sites, such as Civil War battlefields. In his opinion, "you do want to prevent what's happening," and the county historic district sounds like a good idea.

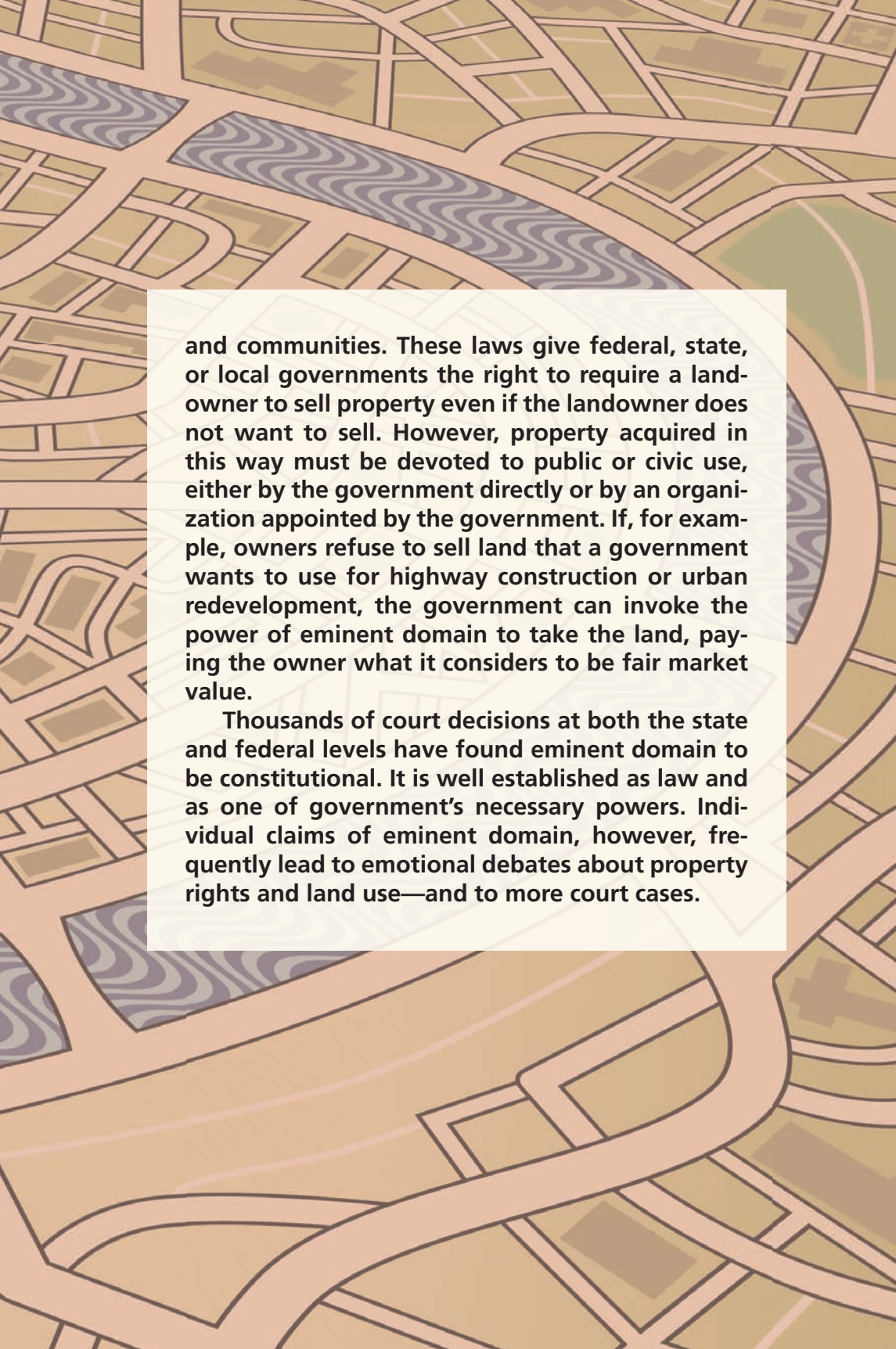
Not everyone agrees. One member of local government calls the proposed historic district "an abuse of power by Dane County." A spokesperson for an association of real estate brokers argues that "there is nothing in the state or county guidelines that makes this property historic" and says that the town of Perry and Dane County are using "a zoning weapon" against property rights.

Everyone agrees that the Hauge Log Church is a historic site worthy of protection. How far, though, should that protection extend? Was it right for community residents to keep a

Eminent Domain and the Law

Under certain circumstances, government can buy people's land from them even if they refuse to sell. This is a power of a government's legislative branch that is called eminent domain. At the federal level eminent domain is granted by the Fifth Amendment to the U.S. Constitution, part of the Bill of Rights. The final words of the amendment state that the government cannot take private property for public use without just compensation, which means that the government must pay a property owner a fair price for any property that is taken.

Over the years this part of the Fifth Amendment has come to be called the "takings clause." It is echoed in the constitutions of many states



and communities. These laws give federal, state, or local governments the right to require a landowner to sell property even if the landowner does not want to sell. However, property acquired in this way must be devoted to public or civic use, either by the government directly or by an organization appointed by the government. If, for example, owners refuse to sell land that a government wants to use for highway construction or urban redevelopment, the government can invoke the power of eminent domain to take the land, paying the owner what it considers to be fair market value.

Thousands of court decisions at both the state and federal levels have found eminent domain to be constitutional. It is well established as law and as one of government's necessary powers. Individual claims of eminent domain, however, frequently lead to emotional debates about property rights and land use—and to more court cases.

man from building a house and barn on land he owned near the church? Should the landowner have been allowed to build on his own land, even if it changed people's impressions of the old church? The dilemma of the Perry historic district is repeated every day around the world, in large cases and small ones, as people clash over the question of how land should be used, and who gets to decide.

Stakeholders

Questions or disputes about land use have stakeholders—individuals or groups with some stake in the outcome. Many land use issues are enmeshed in a web of multiple stakeholders. Typical stakeholders include the following:

Private property owners, especially neighbors

Government at any or all levels

Local civic bodies such as neighborhood associations and business groups

Developers, investors, bankers, and others with financial interests in the property or its future use

Organizations that promote various interests, such as wildlife conservation, recreation, resource use (mining, for example), or environmental protection

Activists who become directly involved and work to rally support for or against certain outcomes

Home ownership is a simple illustration of the stakeholder concept. Along with the rights of ownership come certain responsibilities. Homeowners must usually pay property taxes to cities, towns, or counties. They are also required to follow a number of local, state, and federal regulations, such as building and zoning codes, restrictions against eliminating wetlands, rules against burying hazardous or toxic materials on private property, and public nuisance laws that prevent people from, for example, using their yards as trash dumps. The owner is

In 2006 demonstrators in Los Angeles, California, were handcuffed after being arrested during a protest sparked by the eviction of urban farmers from land whose owner wanted to build a warehouse.

the primary stakeholder in decisions about how to use his or her property, but government bodies, environmentalists, and neighbors are stakeholders as well.

In the United States, federal and state regulations apply to some aspects of land use. Many everyday land use issues, however are governed by the local jurisdiction, whether it is a city, county, township, or municipality.

The city of Portland, Oregon, for example, has enacted many rules to protect urban trees and increase tree canopy, which is the total amount of tree coverage within the city. Trees provide shade, help clean the air, and are highly valued by many Portlanders for aesthetic reasons—in other words, they like the way the city looks with a lot of trees. Trees that grow on parking strips, between sidewalks, and along streets are covered by these rules, and so are some trees on private property. "Tree wars" occasionally break out in the city's neighborhoods when property owners want to cut down trees that other people think should be left alone, and people have been known to take to the streets to block tree-cutting equipment and wood chippers. A disagreement over a single tree may involve many stakeholders: the property owner, the owner's neighbors or community association, local environmental activists, and the Urban Forestry Division or another city agency that enforces tree regulations.

Ownership and Control

"Not all land is 'owned,'" writes Rutherford Platt, an expert in land use law. "Around the world, and in more traditional societies within the United States, land and the resources associated with it are held in some form of *common tenure*, that is, held by a cluster of families, a tribe, a village, or some other social group." Each society, however, has developed methods of regulating how people use the land, whether for building homes and businesses, cultivating crops, grazing livestock, or harvesting natural resources such as timber and minerals. Some of these methods are informal—use of the land is guided by custom, tradition, and "the way we do things." Other methods, like the rules of land tenure and zoning in the

The city of Portland, Oregon, protects its urban greenery through rules that affect some trees on private property.

United States, are highly structured, recognized by the state, and enforceable by law.

Land Tenure

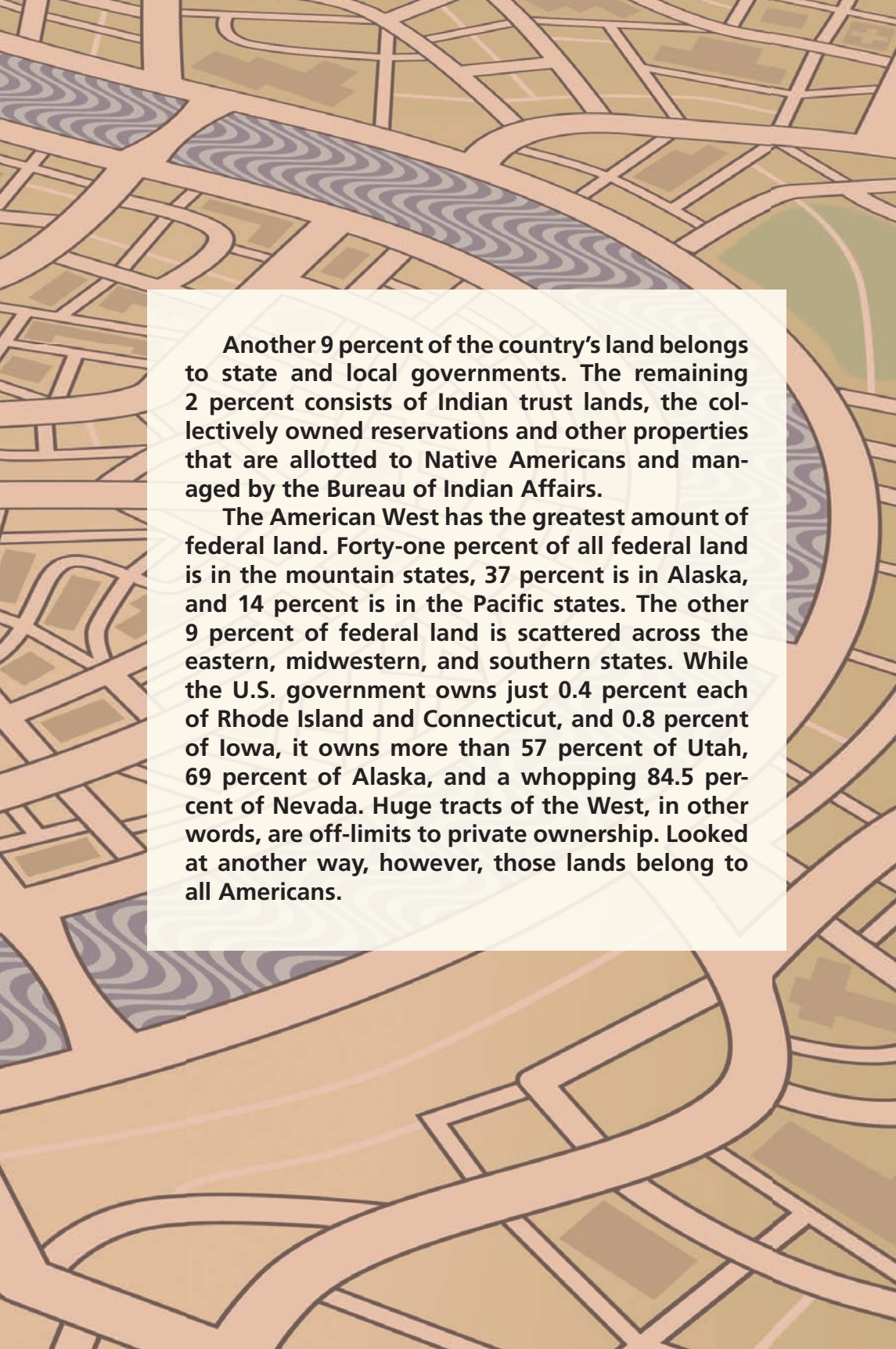
Land tenure, or people's rights with regard to land, can take many forms. The Food and Agriculture Organization (FAO) of the United Nations groups land rights into three categories: transfer, control, and use rights.

Transfer rights include the right to sell or mortgage the property, to give it to others, and to pass it to descendants through inheritance. Holders of transfer rights may exercise

Who Owns America?

More than 60 percent of the total land area in the United States is privately owned. Private property owners include individuals, businesses and corporations, and investors. Together they own nearly 1.4 billion acres (556,560 ha).

The rest of the United States is public land, owned by some level of government. The federal government is the nation's largest single landholder, with more than 28 percent of the land. (The proportion of federal land used to be larger, but since the 1990s the federal government has turned large tracts of public land in Alaska over to the state or to Native Alaskans.) Federal lands are managed by an array of agencies, including the Park Service, the Forest Service, and the Bureau of Land Management.



Another 9 percent of the country's land belongs to state and local governments. The remaining 2 percent consists of Indian trust lands, the collectively owned reservations and other properties that are allotted to Native Americans and managed by the Bureau of Indian Affairs.

The American West has the greatest amount of federal land. Forty-one percent of all federal land is in the mountain states, 37 percent is in Alaska, and 14 percent is in the Pacific states. The other 9 percent of federal land is scattered across the eastern, midwestern, and southern states. While the U.S. government owns just 0.4 percent each of Rhode Island and Connecticut, and 0.8 percent of Iowa, it owns more than 57 percent of Utah, 69 percent of Alaska, and a whopping 84.5 percent of Nevada. Huge tracts of the West, in other words, are off-limits to private ownership. Looked at another way, however, those lands belong to all Americans.

the other types of rights to the land, which are control rights and use rights, or they may assign those rights to others.

Control rights include the right to decide how the land is used and to benefit financially from its use. Use rights are much more limited. In many countries, for example, the poorer members of agricultural communities are allowed to grow crops to feed their families, to raise a few chickens or graze a few animals, and to gather fallen wood—all on property that is owned and controlled by others.

Property rights can also be divided into four types of access:

Private, owned by an individual or group

Communal, shared by the members of a specific community

Open access, owned by no one, able to be used by all

State or public, owned by some level of government

Within the United States, public lands such as national parks and state forests are owned by the government but can be used by all, within the limits defined by the government. Anyone can hike in a national forest, in other words; but cutting timber there requires a lease from the proper federal agency. Another example of blended rights is the privately developed subdivision, sometimes called a "gated community." Lots and houses within such a subdivision are privately owned by individuals; but the residents share communal rights to such features as tennis courts, clubhouses, and swimming pools, and no one outside the community can claim those rights. Combinations of various rights, both formally and informally, have given rise to a wide variety of land tenure arrangements around the world.

Zoning

State, county, and local governments in the United States regulate land use through zoning, which means designating

In the United States, the federal government owns national parks that are available to be used by all.

how people can and cannot use property within various zones, or districts, of a community. Many other countries have similar land use systems.

Depending upon the size and type of the community, zoning regulations may be fairly simple or mind-bogglingly complex. At a minimum, zoning specifies what types of uses are acceptable on each parcel of land. A lot may be zoned for residential, agricultural, commercial, or industrial use, for example, or for more than one potential use. In contrast, the zoning codes of New York City and other metropolitan areas with high population density go into elaborate detail about such things as the permitted height of roofs, the amount of landscaped or paved surface that is allowed or required, and the ratio of parking spaces to residential or office units.

Zoning codes for urban areas, such as New York City, regulate building height, ratio of parking spaces to residential units, as well as the amount of landscaped and paved areas.

The idea behind zoning is that similar kinds of land use should be grouped together, so that one type of use does not interfere with another. Zoning prevents homes from being sprinkled among industrial factories, for example, or office buildings from being plopped down in the middle of farmland. In reality, however, zoning can be quite flexible. Local governments may choose to lift or alter zoning restrictions to accomplish goals such as attracting new businesses, protecting wetlands, or encouraging development in run-down districts.

Individuals or corporations can ask zoning authorities for exceptions, called variances, to the zoning rules for a particular

property. Additionally, zoning codes have been challenged in court. Although courts occasionally overturn certain specific rules, the overall tendency is to rule that zoning is a constitutional and appropriate tool of city and town planning. The legal basis for zoning is the government's right and responsibility to protect the public health, safety, and general welfare, as the nation's courts have repeatedly recognized.

Land use laws are artificial, human creations. They are designed to help people, communities, and governments sort out their often-competing claims to the land. Such claims, however, are rooted in a physical reality—the ground beneath our feet. How we use the land, and whether we are successful or unsuccessful in our use of it, often depends on the nature of the land itself.

Two

Down to Basics: Soil, Landforms, and Water

Ancient warlords built their fortresses on hilltops so that they could see their enemies coming and defend themselves. Modern millionaires build mansions on hilltops to enjoy the view. In each case, the shape of the land has determined how people use it.

Topography, the scientific term for the shape of a landscape, is just one factor that affects land use. Water is another. Early cities, for example, arose in places with access to drinking water. Many were located on the shores of rivers or oceans that served as highways for transportation and trade.

The most basic factor in land use, though, is soil, the stuff of which land is made. Many types of soil exist, each with its own properties, which can make the difference between success and failure of a contemplated land use. When people build on land or cultivate it without considering the soil type, they are taking their chances.

The Soil Beneath Our Feet

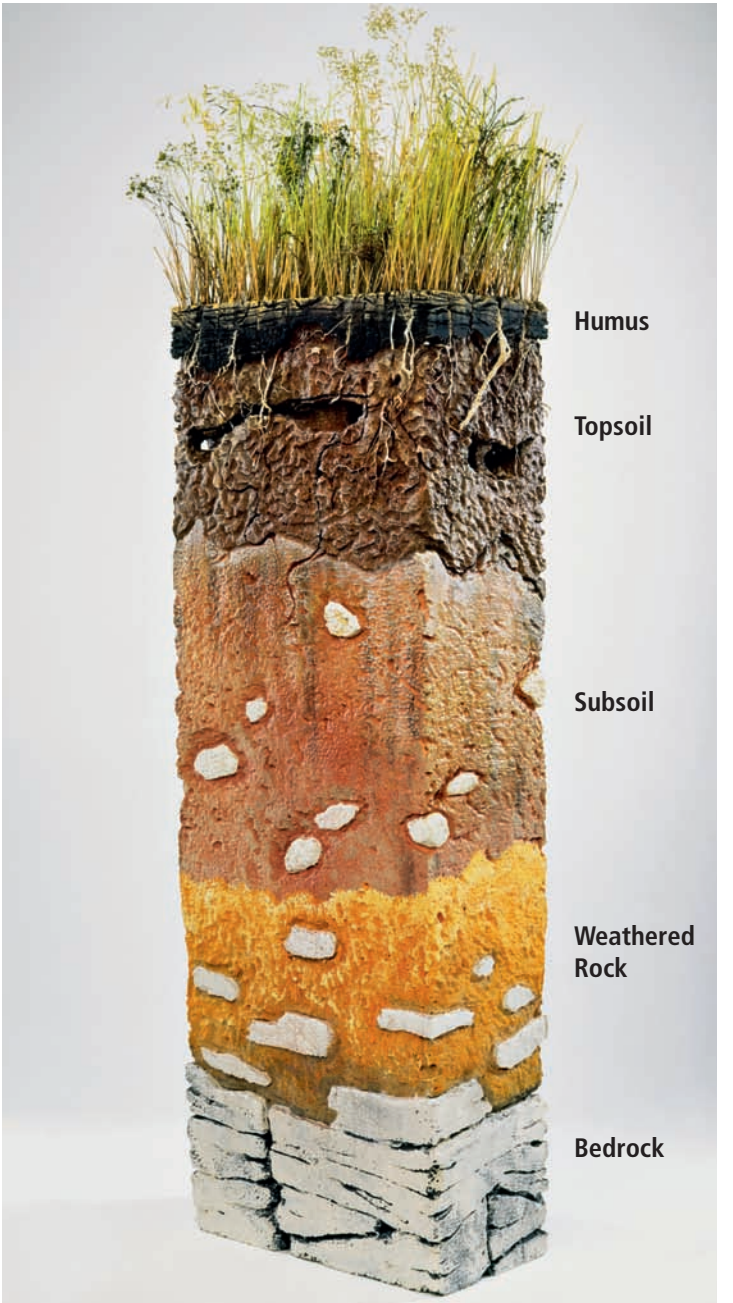
"To understand the natural processes of the land, and to plan land use in accord with them," writes a professor of environmental planning, "there is no more fundamental place to start than the soil." Whether it is called dirt, earth, or even mud, soil is the foundation for every use of the land.

Soil is made up of inorganic minerals mixed with organic material from decaying plants and animals. Soil also contains some air, as well as water that holds dissolved nutrients, such as nitrogen. Variations in the sizes and proportions of these ingredients create a wide range of soil types.

The organic, nutrient-rich part of soil is found in the upper layer, called topsoil. Soil's mineral structure, however, comes from the underlying rock. Over time, rock breaks down into particles because of weathering. The process of weathering can be physical, as when temperature changes cause rock to expand, contract, and split. Or it can be chemical, as when water dissolves minerals as it flows through cracks in the rock, changing the composition of the rock. Most soil results from both physical and chemical weathering.

Weathering produces mineral particles, but mineral particles alone do not make soil. Organic matter such as earthworm droppings and decaying leaves also form part of soil's upper layer. Because conditions across Earth's surface are highly variable, soil forms at various rates—but always slowly. It takes from one hundred to four hundred years for natural processes to create 0.39 inches (1 centimeter) of soil.

Pedologists, or soil scientists, classify the mineral particles produced by weathering according to their size. Cobbles—small rocks and pebbles—are larger than gravel. Sand particles are smaller than gravel, but still large enough that air and water can move freely through the pores, or spaces between particles. Silt is similar to sand, but smaller and finer, with smaller pores. The smallest and finest soil particles are clay, which has very small pores between the particles. Clay is sticky when wet because the particles swell with water and adhere to one another.



Soil covers much of the land on Earth. It is made up of layers: humus, topsoil, subsoil, weathered rock, and bedrock.

These broad categories can be divided into many subtypes, with different classification systems for different kinds of land use. In the case of farming, for example, the U.S. Department of Agriculture defines twelve soil types by their ratios of clay, sand, and silt. Clay is hard for plant roots to penetrate, sand does not hold water and nutrients well, but silt is suitable for growing crops. When planners consider the construction of buildings or highways, however, they use the Unified Soil Classification System, which divides soil into fifteen categories based on factors such as drainage, slippage, and the ability to bear weight.

The Shape of the Land

Earth's soil is not distributed evenly across a world of smooth landscapes. The planet's underlying rock surface forms mountains, rifts, and basins. Soil particles travel across this uneven surface, carried by many forces. Rivers and glaciers move pebbles, rocks, and boulders. Winds and streams carry sediment, which consists of loose particles of silt, sand, or dry clay.

All these materials are deposited into a variety of landforms, including sand dunes in deserts, deltas at river mouths, barrier islands along seacoasts, and talus cones (piles of loose soil and rock) at the base of cliffs or steep slopes. The volume of soil shifted by natural forces can be enormous, as the people of eastern Australia saw in September 2009, when a combination of drought and high winds produced a massive dust storm—a cloud of reddish airborne sediment that measured 310 miles by 620 miles. The storm deposited much of the sediment in the Pacific Ocean off Australia's coast.

The shape of the land often helps determine how it is used. A flat plain, for example, is an easier place to farm than a steep mountain slope—but if the slope has fertile soil, people can grow crops on it by creating terraces, small flat fields built up by packing soil behind a series of stone walls. Land use planners can evaluate the shape of the land by using the same tool that well-prepared hikers carry: a topographic map. Topography refers to measuring and mapping the contours of the land's surface. A topographic map, or topo, uses marks called

How to Analyze Soil

You don't need a science lab to do basic soil analysis. Dig a hole, scoop out an undisturbed shovelful of soil, then analyze it by following these steps from the federal government's Soil Science Basics website.

To start, examine a ped—one of the units in which your particular soil naturally occurs. If the soil is very dry and sandy, the ped may be a single grain. If the soil is wet and clayey, the ped may be a heavy clod. Between those extremes, peds may occur as small lumps like cookie crumbs, or chunks, sheets, or columns.

Moisten some soil slightly with water from a spray bottle, working the water through the sample. Rub a small amount of the damp soil between your thumb and forefinger. Sand feels gritty. Silt feels soft, like flour. Clay feels sticky. Many soils are made of up of two types of particles, but one type usually predominates.

If your sample feels both gritty and moist, and if you can easily form it into a loose ball and then crush the ball, you might have loam, a type of soil that is about 40 percent silt, 40 percent sand, and 20 percent clay. Try planting something—many experts consider loam ideal for gardening and farming.

A huge amount of sand and sediment engulfed eastern Australia in 2009. The city and harbor of Sydney were affected by the red dust storm.

contour lines to indicate the direction, steepness, and height of every slope.

Water Matters

The presence (or absence) of water affects how people use land. In turn, land use can have a significant effect on water. One example of this two-way influence is groundwater, which exists in large underground natural reservoirs called aquifers. A plentiful supply of groundwater that can be drawn to the surface in wells is an asset for both agriculture and urban growth.

Farmers in China terrace their sloping fields to grow rice.

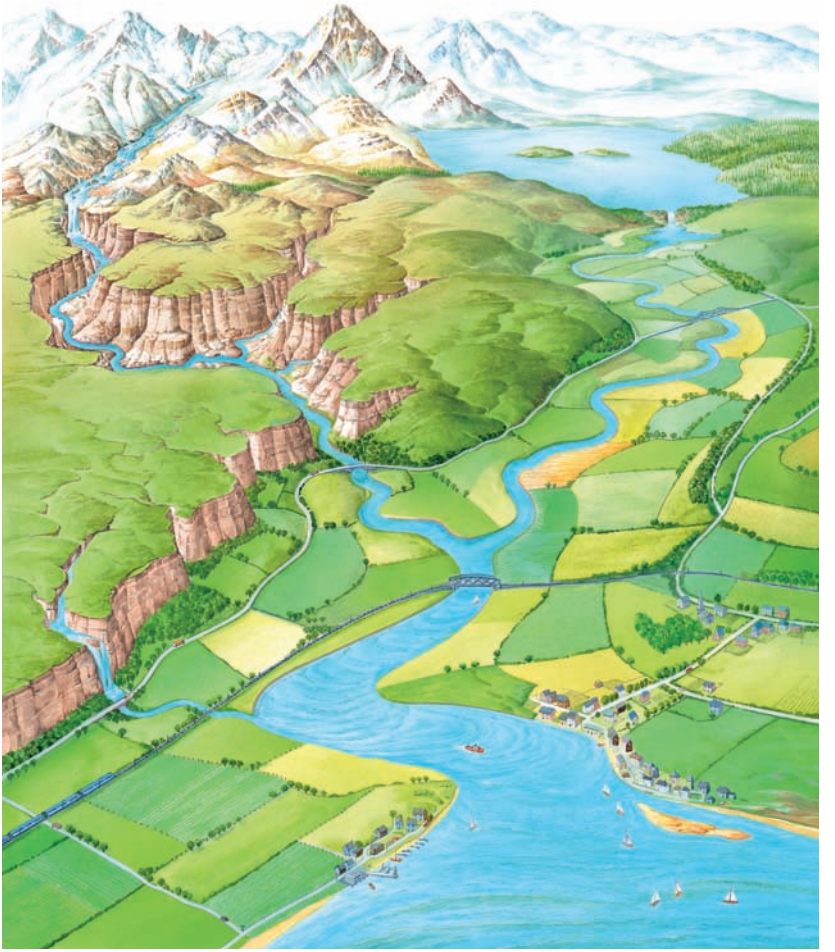
Human use of the land above the aquifer, however, may pollute the groundwater with agricultural chemicals such as fertilizer and pesticides, while overuse drains the aquifer faster than natural processes can restore it.

Aquifers fill with groundwater as part of the hydrologic cycle, which is "the continuous movement of water on, above, and below the surface of the Earth." Through the hydrologic cycle, also called the water cycle, water interacts constantly with land. At various points in the cycle, water can be a liquid, a vapor, or a solid (ice). It falls from the atmosphere onto land in the form of precipitation—rain and snow. Once water has fallen onto land, it may evaporate back into the atmosphere, infiltrate (seep into the soil), or run off along the surface until it flows into a stream, river, lake, or ocean. Hydrology is the study of these processes.

Topography determines how surface water will drain from a particular area of land. As a result of factors such as hills, valleys, and slopes, drainage occurs in natural patterns known as watersheds (sometimes called catchment basins). Within a watershed, all water drains ultimately into the same body of water. Small watersheds are contained within larger ones. A valley with a tiny creek trickling along its floor is a small, local watershed; the valley on the other side of the hill, with its own creek, is a separate watershed. On a larger scale, the Mississippi River watershed covers most of the United States east of the Continental Divide, an imaginary line that runs along the crest of the Rocky Mountains.

Certain types of watersheds require special attention from land managers and land use planners. These include watersheds in areas undergoing land development, watersheds that are prone to flooding, and watersheds that contain (or may contain in the future) reservoirs storing water for human use.

Another hydrologic feature of concern in land use planning is the wetland, a low-lying area where the soil is saturated with water at least part of the time. The pools, lakes, and marshes of wetlands provide critical nesting and feeding habitats for birds and other wildlife. Land use laws in many places prohibit the destruction of wetlands; alternatively,



This illustration depicts the drainage of a river into a drainage basin. It includes smaller rivers and streams and lakes that drain into a main river before reaching the sea.

developers may be required to create new wetlands or restore damaged ones.

Soil and the City

Soil isn't just for farms and gardens. It's everywhere, including towns and cities. Urban soil, however, often suffers from serious problems.

Impervious surfaces, which cannot be penetrated by water, are one problem. Every time a building is constructed or a street or parking lot is paved, that piece of land becomes impervious. Water cannot infiltrate the soil, so it pools and flows, creating puddles. When the drainage capacity of urban streams and storm drains is overloaded, during big storms or heavy rains, large-scale street flooding can occur.

Compaction is another problem. It happens when weight—even the weight of pedestrians walking along park paths—presses on soil, making it dense. Compacted soil drains poorly and prevents the growth of plant roots. Soil that is heavily compacted may act like an impervious surface and contribute to runoff and flooding.

Erosion or soil loss is a major concern, and not just in cities. When land development removes the natural vegetation cover, soil becomes vulnerable. It may dry out and be carried away on the wind, or it may be washed into streambeds by rain. Significant erosion on slopes can lead to mudslides, landslides, and the collapse of structures.

When soil erodes, major destruction can occur, as can be seen here. The backyards of these cliff homes have fallen into the sea in Pacifica, California.

Certain types of land use create the problem of soil contamination. Urban brownfields—abandoned or neglected industrial and commercial areas within cities—often have soil that contains the residue of waste dumping, fertilizer, pesticides, pollution carried in runoff water, and chemical spills. Expensive soil cleanup is needed before these areas can be redeveloped and made useful once again.

Land use is shaped by the interaction of soil, topography, and water, together with human development. With proper understanding of these factors and their interactions, planners and developers may be more likely to use the land wisely. Failure to achieve and act on such understanding, whether in cities or in the countryside, can have grim consequences.

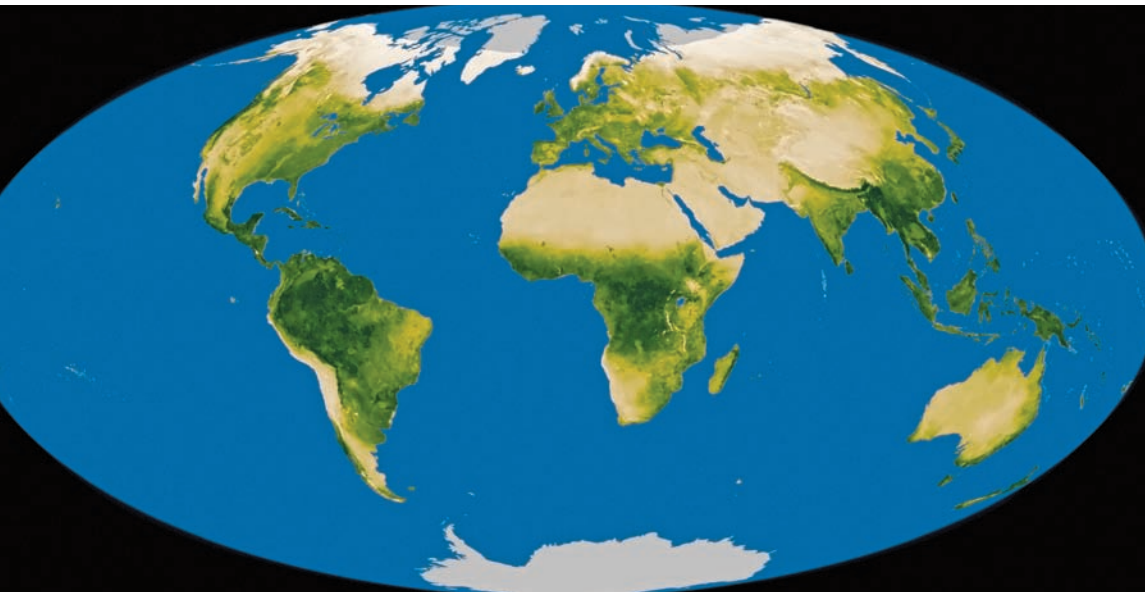
Three

Misusing, Overusing, and Abusing the Land

The resources of the land are vitally important to the human race. The land supports food crops and forests. It contains minerals. The surface of the land, where we live, build our cities, and work, is a resource, too—one that may become increasingly valuable as the world grows more crowded with people, all of whom require living space.

Oceans and other bodies of water cover nearly 71 percent of Earth's surface. The remaining 29 percent of the world is land. About 10.5 percent of that land is arable, which means that it can be used for growing crops that must be regularly replanted, such as wheat, corn, and rice. Permanent crops, such as fruit and nut trees and coffee bushes, are grown on another 1 percent of the land. Approximately 88 percent of Earth's land surface either is unusable (ice, deserts, mountain ranges) or is covered by forests, pastureland, and human constructions such as cities, roads, and factories.

A study published in 2008, using satellite images from 2000, reported that at the beginning of the twenty-first century 22 percent of Earth's ice-free land surface was being used



A 2007 satellite image of Earth illustrates the land areas that have high amounts of vegetation (dark green) and those that do not.

as pastureland, and 12 percent was used for growing crops. "On balance," said one of the study's authors, "the percentage of agricultural land looks set to increase."

Clearly, the human race must produce food, and people need places to live and work. Human needs, however, create pressure on the land. Population growth contributes to pressure—the more people there are, the more food and living space are needed. Technology can also be a source of pressure. For example, oil pipelines, which were first used in the late nineteenth century, allow people to send oil and natural gas over long distances more cheaply than the same fuels could be shipped by train. In addition, pipelines can carry the fuels through areas without railways. The technological advance of the pipeline brought new environmental problems, however, in the form of hundreds of spills, fires, and explosions along pipelines in many parts of the world.

Social changes can also bring new pressures to bear on the land. Between 1900 and 2000, for example, the United States

changed from a rural nation to an urban one. In 1900 slightly more than 60 percent of Americans lived in the country or in small towns, while slightly fewer than 40 percent lived in cities. By 2000 the balance had shifted: the U.S. population was 79 percent urban and 21 percent rural.

With the shift from rural to urban came changes in land use. Fewer people worked the land, yet they produced ever greater amounts of food by using new tools such as tractors, fertilizers, and pesticides, and advanced irrigation techniques. The shift to large-scale farming of a single crop, or monoculture, led to the rise of industrial agriculture. Intensive farming sometimes caused erosion, exhaustion of the nutrients in the soil (known as soil depletion), and the spread of pollution in the form of runoff from the fields. At the same time, as cities expanded to house their growing populations, extensive tracts of land were paved and developed.

Industrial agriculture arose to meet the need for increased food production as population grew and a rural nation became an urban one.

Land Degradation

When land is overused, or used inefficiently or shortsightedly, the result can be land degradation:

> Land degradation, a decline in land quality caused by human activities, has been a major global issue during the 20th century and will remain high on the international agenda in the 21st century. The importance of land degradation among global issues is enhanced because of its impact on world food security and quality of the environment. High population density is not necessarily related to land degradation; it is what a population does to the land that determines the extent of degradation. People can be a major asset in reversing a trend towards degradation. However, they need to be healthy and politically and economically motivated to care for the land, as subsistence agriculture, poverty, and illiteracy can be important causes of land and environmental degradation.

Degraded land becomes less productive or usable. Degradation can have many causes. One is erosion, the loss of soil through the action of wind or water. According to one estimate, worldwide soil loss due to erosion totals 75 billion tons a year. Three other major causes of land degradation are deforestation, desertification, and pollution.

Deforestation

If forests are cut down and not replaced by natural growth or tree planting, forested land becomes nonforested land, a result called deforestation. Human-caused deforestation occurs when forests are harvested for timber or cleared so that land can be used for crops, pasture, and building sites. Forest fires, destructive insects, and climate change also contribute to deforestation.

Forests currently cover about 9.8 billion acres (4 billion ha), or 31 percent of Earth's land area, according to the

Deforestation not only affects the land, it has negative impacts on the environment.

Cows on the Commons: Tragedy or Myth?

When many people use a resource but none of them owns it, what happens to the resource? In 1968 American ecologist Garrett Hardin answered that question in an influential and controversial article called "The Tragedy of the Commons."

Hardin's primary theme in "The Tragedy of the Commons" was the need to control the growth of the human population. He touched on topics ranging from parking meters and pollution to national parks and shopping malls. In each case, Hardin argued that individuals satisfy their own needs even when doing so is destructive to society.

The best-known example from Hardin's article involves "the commons"—a type of land use in which a piece of pasture is the common, or shared, property of a village or community. Everyone's cows can graze on the commons. For each cow that grazes, there is a benefit: nourishment to the cow, which will ultimately produce milk or meat. But each cow also damages the commons, trampling the soil, polluting the area with manure, and reducing the total available grass. Because all the benefit goes to the individual cow owners, while the damage is spread out among everyone who uses the commons, it is in each cow owner's best interest to graze more cows on the commons.

In this way, Hardin claimed, people will overuse or abuse a shared resource until its value is gone:

> Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

"The Tragedy of the Commons" has influenced environmentalists and policymakers who support laws and regulations to protect common resources such as air, water, and public land. At the same time, critics have pointed out flaws in Hardin's argument, even going so far as to call the "tragedy of the commons" a myth. According to some historians who have studied traditional land use practices, many communities have effectively managed the use of shared land through peer pressure or local councils.

Whether Hardin was right or wrong about the commons, his point was that individuals cannot be counted on to limit their own use of shared land, even when overuse of the land hurts everyone. Was he right about this central issue? Not everyone agrees with Hardin. Even those who do agree hold differing ideas about how best to protect our common resources. The practice of grazing cows on a commons may be disappearing from much of the modern world, but the debate over "The Tragedy of the Commons" lives on.

United Nations Food and Agriculture Organization. Based on a review of 233 countries, the FAO reported in 2010 that the world had lost more than 32 million acres (13 million ha) of forest each year since 2000. Total deforestation during the decade amounted to an area about the size of the Central American nation of Costa Rica.

Bad as that sounds, it has been worse. During the 1990s about 39.5 million acres (16 million ha) of land were deforested each year. One reason the rate of deforestation has slowed is that some nations, including China, Vietnam, the United States, and India, have carried out large-scale programs of reforestation, which is the planting of new trees. Some of these programs, however, are scheduled to end by 2020.

Other nations have reduced the amount of forest cut each year. Brazil and Indonesia had the highest rates of deforestation in the 1990s. Brazil has gone from an average of 7 million acres (2.9 million ha) of deforestation each year to 6.4 million (2.6 million) each year since 2000, and Indonesia has gone from 4.7 million acres (1.9 million ha) to 1.2 million (0.5 million ha). At the continental level, overall rates of deforestation have decreased in Asia and remained stable in North America and Europe. Deforestation rates have increased in Africa and South America.

Deforestation affects a wide range of environmental issues, including climate change and species biodiversity. It is also directly linked to land degradation. Deforestation can degrade the land by removing the leaf cover that shades soil, as well as the root systems that hold soil in place. Forested areas hold rainwater, which percolates downward through the soil. In deforested areas, especially on hillsides and slopes, rainwater becomes runoff, which washes away topsoil and may cause flash floods.

A practice called slash-and-burn agriculture is a leading cause of deforestation in tropical and developing nations. In this form of farming, people cut forests to clear land for growing crops, pasturing livestock, or both. The fallen trees are burned, enriching the soil with charcoal and released nutrients. Often, however, a few years of use are enough to drain

the soil of its nutrients, or cause it to erode. The agricultural people then move on to clear a new patch of land.

For years environmentalists criticized slash-and-burn agriculture as a wasteful practice that destroyed both forests and soil. Scientists are now finding that when practiced by indigenous forest-dwelling people who have used traditional methods for generations, this type of agriculture does not necessarily degrade the land. On a large scale, however, as when thousands of people migrate into the Amazon River basin and other tropical forests to carve out a living, slash-and-burn farming produces food in the short term but in the long term contributes to land degradation.

Desertification

Like deforestation, desertification is a change in the land's surface. It occurs when nondesert land becomes a desert, an arid place that receives very little precipitation. Deserts can be hot or cold, blanketed with sand like the Sahara or covered with low ground cover or shrubs. Desert and semidesert regions may support some grazing and even, with irrigation, some farming. Without extensive human manipulation, however, they are not productive landscapes.

Desertification turns land that is less suitable for human uses into land that is not suitable at all. It occurs when existing deserts spread and grow larger, either naturally or because of human activities. It also occurs when nondesert land in dry climates is altered by human activities, such as cutting trees for firewood, letting livestock overgraze the ground cover, or draining the groundwater through wells. These activities can create a degraded landscape, a human-made desert. Global climate change, whether caused naturally or by human activities such as burning fossil fuels, is another cause of desertification in various parts of the world.

Without vegetation, the soil of a desertified area becomes vulnerable to erosion by wind or sudden rainfall. The trampling hooves of livestock compact and harden the ground, decreasing its ability to absorb moisture and increasing runoff. As the land loses shade and ground cover, its soil temperature

Sand dunes threaten to engulf this desert oasis in the Sahel in Africa.

rises, causing water in the soil to evaporate more quickly, which in turn increases water loss even more. In addition, as water is drawn up through the soil to evaporate into the dry air, mineral salts that are normally distributed throughout many layers of soil are deposited near the surface, changing the chemical makeup of the soil—usually making it less fertile. As a result of these processes, often working together, land that was once fertile or productive becomes marginal, meaning that it barely supports human life and agriculture. Land that was once marginal, meanwhile, can become completely inhospitable through desertification.

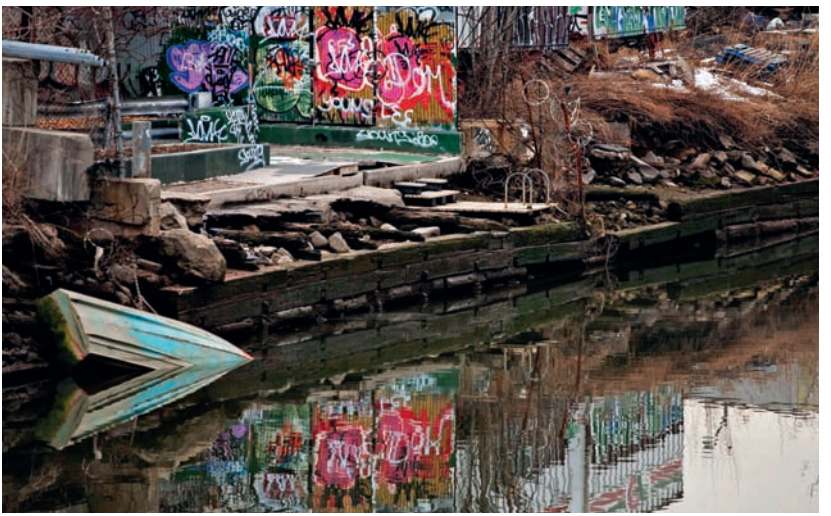
About one-third of Earth's land surface is vulnerable to desertification. Among the areas that have already experienced extensive desertification, and are at high risk for more of it, are

North Africa, inland China and central Asia, and India, Pakistan, and Afghanistan.

Pollution

The three main causes of land pollution are contamination, solid waste disposal, and air pollution. Contamination means that sewage, chemical elements such as lead and mercury, or other hazardous or toxic materials such as petroleum products, are present in the soil. (Such materials are often present in water, too, because they can enter soil through water, and vice versa.) Industrial spills, illegal waste dumping, and legal but ineffective waste disposal cause contamination. Everyday use of pesticides and other garden or agricultural chemicals, which find their way into water and soil, also contributes to contamination.

Within the United States, seriously contaminated land may be identified as a Superfund site by the Environmental Protection Agency (EPA). Such sites are off-limits to most uses. They are eligible to be cleaned up and restored to usefulness by the EPA, which uses money from a federal fund. Some of the Superfund money has been recovered from polluters.



In March 2010 the Environmental Protection Agency declared New York's Gowanus Canal one of the nation's newest Superfund sites.

Some Superfund sites are enormous and highly dangerous. The EPA has called the Hanford site in south-central Washington State, where plutonium was produced for nuclear weapons and reactors, "one of the largest and most complex cleanup projects in the U.S." The government agency provides convincing details:

> Weapons production resulted in more than 43 million cubic yards of radioactive waste, and over 130 million cubic yards of contaminated soil and debris. Approximately 475 billion gallons of contaminated water was discharged to the soil. Some of the contaminants have made it to groundwater under the site. Over 80 square miles of groundwater is contaminated to levels above groundwater protection standards.

Other Superfund sites are much smaller. These include old city dumps, locations where businesses such as dry cleaners and wood-processing plants once used chemicals, and demolition sites at which old buildings were torn down without regard for proper disposal of dangerous materials such as asbestos and lead paint.

The EPA places the nation's most hazardous sites on the National Priorities List (NPL). As of 2010 there were 1,280 sites on the NPL. Three hundred forty-seven sites had been removed from the list, and sixty-two new sites had been proposed as additions to it.

Solid waste consists of garbage and trash from homes, businesses, and institutions such as schools and hospitals. The majority of this waste ends up in the land, either in legally operated disposal sites called landfills or as junk dumped illegally along roadsides and on neglected lots.

In 2008 Americans produced about 250 million tons of waste, not including liquid, industrial, construction, or hazardous waste. More than half of that trash and garbage came from homes and apartments. The waste consisted of food

scraps, yard trimmings, paper, glass, metal, and other materials such as rubber, cloth, and wood. Paper accounted for 31 percent, or nearly a third, of the total. The EPA reports that slightly more than 54 percent of the solid waste was disposed of in landfills. A little more than 33 percent was recycled or composted. The remaining 13 percent was combusted, or burned in incinerators that produce energy from waste.

Between 1960 and 2008, the U.S. population grew by 69 percent, but Americans' waste production grew by 188 percent. The amount of waste produced for each American man, woman, and child increased from 2.7 pounds per day in 1960 to 4.5 pounds per day in 2008. The news is not all bad, however. Total waste production actually fell from 254 million tons in 2007 to 250 million tons in 2008. Recycling rates are increasing, too. About 69 percent of all solid waste was landfilled in 1990, and 16 percent was recycled or composted. By 2008 the landfills received only 54 percent, while 33 percent was recycled or composted.

Even if waste production keeps falling and recycling and composting rates keep rising, people in the United States and around the world will keep generating solid waste—tons and tons of it each day. It has to go somewhere, and choosing locations for landfills is one of the most important tasks in land management.

Landfills are lined with pressed clay or artificial materials such as plastic. The purpose of the liner is to contain leachate, the liquid formed by rainwater and other fluids present in the waste, which can absorb compounds from the waste and then trickle downward. Despite the use of liners, the soil beneath and around a landfill should be clayey, since clay seals well and drains poorly. Clayey soil helps prevent any leaked leachate from entering the surrounding earth or the groundwater.

Finally, air pollution contributes to land pollution. When the air contains toxic chemicals such as mercury and dioxin, these materials can make their way into the soil. Toxins in the soil, in turn, pollute water that drains through the soil.

Mitigation

Using the land need not mean misusing, overusing, or abusing it. At all levels—from small family gardens to city building permits to regional or national planning of large developments such as freeways, pipelines, and irrigation projects—efficient and environmentally sound land use practices can prevent degradation of the land, or keep degradation to a minimum.

An important element of land management and land use planning is mitigation, which means preventing damage, reducing its effects, or repairing it. At countless sites around the world, mitigation projects organized by the United Nations, by conservation organizations, or by governments and citizens have shown that land degradation can be turned around.

The former Fernald Feed Materials Production Center in Ohio processed uranium for nuclear weapons from 1951 to 1989. Today, the restored site is a nature preserve.

Case History: Fighting the Creeping Desert

One African farmer's fight against desertification became a model for others in his community. Serigne Samb's small farm consisted of plots of inherited land around his village in the northwestern part of the West African nation of Senegal. The region, which receives less than 12 inches (300 millimeters) of rainfall each year, is home to roving groups of herdspeople and their livestock as well as to settled farmers, most of whom grow crops and keep livestock of their own.

Samb's small holding suffered from problems experienced across the Sahel, the vast expanse of semiarid land that stretches across a number of African nations south of the Sahara Desert. Trees disappeared at a rapid rate, browsed by livestock or cut down to provide wood for building and also for burning to produce charcoal, a major fuel source for the people of the region. The loss of tree cover worsened the wind's erosion of the dry, sandy soil. It also reduced the amount of wood and charcoal available for human use, and of vegetation for livestock to eat. Many farmers in the area no longer grew a variety of crops for their own use; instead, they cultivated peanuts to sell. This shift to monoculture left the land more exposed than it was when the vegetation had consisted of a variety of plants, including shrubs and trees. The result: still more erosion. In short, Samb's farm—like the land occupied by many thousands of people across the Sahel—was turning into desert.

Hoping to reverse this trend, Samb applied traditional land use practices, employing farming methods that had been known in the area for generations but had fallen out of use in his time. With technical advice and some financial help from UN agencies in Senegal, Samb enclosed one of his plots—a 25-acre (10-ha) field—inside a living fence, which he created by planting trees and shrubs around the edge of the field. Samb used *Euphorbia*, a genus of plants that grazing animals generally avoid because the plants are toxic to them. This live fence prevented grazing and reduced erosion, so that trees and other vegetation could regrow on the protected plot.

At the start of the project there were fewer than a hundred trees on the plot. Twelve years later there were about 12,500. The trees and other vegetation protected by the fence were a source of wood, charcoal, fodder (livestock feed), and fruit. The Samb family not only used these products but found a source of income in selling the surplus to people in the community. The project—planting a live fence to enclose a plot, then letting the plot regrow its natural cover of mixed trees, shrubs, and plants—halted desertification and also brought clear economic benefits. Samb's success inspired others in the area to copy his methods.

Case History: Reforesting Himalayan Hills

The Shiwalik hills, in northern India's Haryana state, are foothills of the Himalayas, Asia's largest mountain range. Like other areas in and around the Himalayas, the Shiwalik hills are losing their forests. The deforestation has two main causes. First, people harvest trees—often on public land where forests are supposed to be protected—to use the wood. Second, people graze their livestock in the forests. Uncontrolled grazing prevents the forest from regrowing and also strips away the grass and other vegetation, resulting in "severe soil erosion in the hills."

One approach to the problem is provided by the Hill Resource Management Society (HRMS), an organization that lets local people participate in managing the forest resources. An HRMS branch is based in the community, and all adults are eligible to join it. Through the HRMS, local people interact with the government agencies that are responsible for land and resource control. The HRMS and the government must agree on trade-offs; that is, if people agree not to abuse the forest resources, their needs must be met in other ways. The goal is to make forest use sustainable, which means that although people use the resource, they do not overuse it. Usage is limited to a level at which the forest can sustain itself through regrowth.

With funds from the government of India and the Ford Foundation, the United Nations and an Indian research institute launched a pilot HRMS program in an area of sixty-five

villages scattered over 49,400 acres (20,000 ha) of rugged, degraded land in the Shiwalik hills. The goal was protection of the watersheds through conservation of forests and soil. Villagers were asked to reduce their use of the state-owned forests in exchange for new supplies of irrigation water that would help them cultivate other, nonforest land. The Forest Department built new dams to provide the irrigation water, while the HRMS became responsible for maintaining the dams and water channels. As the irrigated land became more productive, pressure on the forests decreased.

The government offered other incentives, or benefits, to encourage people to become involved in HRMS. One incentive was leasing parcels of forest land and pastureland to the HRMS, whose members could use these designated parcels in return for halting their uncontrolled use of other forest areas. Another incentive was leasing commercial fodder to the HRMS at affordable rates. The HRMS also gained permission to increase the harvest from local bamboo forests in return for managing the forests and preventing fires.

Within five years there were twenty-seven HRMS branches in the program area. Members of these groups policed the use of local resources. Illegal grazing and tree cutting were reduced, and so was soil erosion. Degraded areas became revegetated. At the same time, the people served by HRMS experienced economic benefits. Access to more fodder boosted the milk production from livestock, supporting a growing dairy industry. With regular sources of wood and fodder, household incomes increased. The Forest Department benefited, too, as the task of managing the state-owned forests was now shared by the villagers. The program succeeded because the local people who had been abusing public land were recognized as stakeholders. Once they were given a say in managing the forest, they became willing to use it under self-policed guidelines, giving the forest a better chance at long-term survival.

Case History: Restoring a Wetland

In the United States, one of the most serious forms of land degradation involves wetlands, which may be covered with

shallow water for all or part of the year. These marshes, swamps, bogs, and coastal zones provide many benefits. They absorb rainfall, which helps prevent floods. They purify water, absorbing sediment and fertilizer as these materials cycle through the soil. Wetlands are also vital habitat and feeding grounds for many species of birds, animals, and water life.

In the 1600s, when Europeans began settling North America, the area that is now the lower forty-eight states had about 220 million acres of wetlands. Since that time more than half of those wetlands have been drained or built over as people have turned the land to other uses. Agriculture and construction have been the main reasons for the loss or degradation of wetlands, although climate change is also drying out some once-wet areas. In the mid–1970s the rate of wetland loss in the United States began to slow. Scientists, governments, planners, and communities recognized the importance of wetlands, and new laws and policies were put in place to conserve these important resources. Although wetlands are still being lost, some have been restored through mitigation projects.

In Morgan County, Alabama, a 657-acre tract of land along Flint Creek was once a wooded wetland. Years ago the trees were cut, and the land was drained and turned into a cattle and grain farm. Beginning in 1998, however, the land was turned back into a wetland through a process called mitigation banking.

Mitigation banking means creating, restoring, or preserving a natural area such as a wetland in order to balance the environmental damage that can be expected from nearby development. Federal, state, and local governments give developers credits for mitigation projects that have been successfully completed. The developers, in turn, can "cash in" these credits when they plan future developments. Selecting and creating a mitigation site calls for cooperation between a number of public and private interests, including the U.S. Army Corps of Engineers (which must approve the site), the federal Environmental Protection Agency and the Fish and Wildlife Service, local soil and water conservation boards, landowners, developers, and environmental consulting firms.

Restoration of the Flint Creek wetland involved planting 160,000 native trees such as bald cypress, river birch, and oak. Then the site was monitored for five years to see whether the restoration would be successful. It was. The former farmland became a new wildlife habitat, and the amount of soil that washed from it into the creek fell from 15 tons of sediment per acre each year to less than one ton. Another benefit of the mitigation is that the wetland, which now belongs to and is managed by the county, has become "an outdoor conservation classroom for area students."

Four

The Human and Natural Landscapes

"**Land is always** transforming itself," urban planner and professor David C. Soule wrote in 2006. He pointed out that landscape features such as meadows, forests, water channels, and habitat change naturally. "However," he continued, "the human settlement pattern often radically, and usually permanently, changes undeveloped land to developed land."

Ever since humans started digging pit houses and constructing stick huts back in the dawn of prehistory, people have built things on the landscape. When they began herding animals, planting crops, and trampling out paths and roads, they continued this process of change, which in time led to the modern world of twelve-lane highways, towering skyscrapers, and suburbs that stretch to the horizon.

At the same time, however, human beings care, sometimes passionately, about the natural world. In the words of American biologist Edward O. Wilson:

> In the United States and Canada more people visit zoos and aquariums than attend all professional athletic events combined. They crowd the national

> parks to view natural landscapes, looking from the tops of prominences out across rugged terrain for a glimpse of tumbling water and animals living free. They travel long distances to stroll along the seashore, for reasons they can't put into words.

The natural world has the power to stir our feelings of curiosity, relaxation, and awe. Even as the human race continues to multiply across the globe, building, using resources, and changing the face of the world, many individuals and societies work to protect and preserve natural landscapes, wildlife, and ecosystems. The modern conservation and environmental movements have produced, among other things, the American system of national parks and wildlife refuges.

Human needs—water, food, shelter, employment, transportation—determine how people use the land. One challenge of land use in the United States and around the world is balancing human needs and conservation, seeking harmony between the human and natural landscapes. Another challenge is learning how to build and live in a world full of natural hazards and disasters.

People and Land Use in America

During the second half of the twentieth century, two factors reshaped the human landscape of the United States. One was population growth, and the other was the rise of the suburb.

Between 1950 and 2000 the nation's population rose from 151 million people to 281 million—an increase of 86 percent. Growth didn't stop there, of course. The U.S. Census Bureau reported in 2010 that the country's population had reached more than 310 million (out of a total world population of 6.9 billion). Demographers—people who research population statistics and trends—predict that the U.S. population will reach 438 million by 2050.

Along with the explosive growth of the American population between 1950 and 2000 came a major change in the way people lived. The United States was already becoming an urban, rather than a rural, nation. The shift to urbanization

continued in the decades after 1950, but those decades introduced a new type of urban life—one based in the suburbs. These were settled areas, many of them newly developed, outside the more densely built-up centers of cities. Unlike urban cores, where many people lived in apartments, rowhouses or townhouses, or shared buildings such as condominiums, the suburbs consisted of single-family houses on private lots, usually with grass lawns.

It was the automobile that allowed people to move to the suburbs even when they continued to work in the central cities. Land use expert John Randolph writes, "Massive highway construction and the rise of the automobile as the primary mode of personal transportation freed people to flee the crime and grime of the city and find personal space in the suburbs."

Suburbs, in other words, were created by land use decisions, especially the federal government's decision to make highways the center of the nation's transportation plan.

As the American population boomed, so did the growth of suburbs, large tracts of land developed with many homes.

Today many land use planners see the continuing spread of suburbs—usually referred to as "sprawl"—as a problem that should be solved. Others believe that the suburbs are here to stay, because people want them, but that they can be more efficiently designed. Architects, environmentalists, and planners from both sides of the debate are creating new approaches to land use in urban centers as well as outlying areas. These approaches offer alternatives for future development.

Suburbia: Sprawling Nightmare or American Dream?

Former Maryland governor Parris N. Glendening cites the following reasons for viewing the expanding suburbs as unwelcome sprawl:

> In its path, sprawl consumes thousands of acres of forests and farmland, woodlands and wetland. It requires government to spend millions extra to build new schools, new streets, new water and sewer lines. . . . In its wake, sprawl leaves boarded up houses, vacant storefronts, closed businesses, abandoned and often contaminated industrial sites, and traffic congestion stretching miles from urban centers.

There are many reasons to disapprove of suburban expansion. Because traditional suburbs are designed for drivers, not pedestrians or cyclists, and because they are usually located some distance from stores, parks, and workplaces, sprawl makes people dependent on automobiles to get to and from the suburbs. Dependency on cars creates long commutes for workers, leading to traffic gridlock on urban and suburban highways. It also increases gasoline consumption and the resulting air pollution. In addition, suburbs drain the resources of municipalties, which must keep extending services into new areas rather than improving the infrastructure in older communities. Finally, by attracting middle-class and upper-middle-class people who can afford suburban life, the suburbs reduce the social, economic, and cultural diversity of urban cores. City centers are left to the poor and, in the

desirable neighborhoods of cities such as New York and Los Angeles, the very rich.

Another argument against suburban expansion focuses on the loss of farmland:

> Much of the land being consumed by sprawl is prime farmland lost to food production forever. . . . Developers favor farmland because it tends to be relatively flat or gently sloping and cleared. . . . Sprawl threatens the future of farming in America. Over half of the fruit, vegetable, and dairy producing farmland faces development pressure. . . . Pennsylvania lost 20 percent of its farmland between 1969 and 1992. . . . As prime agricultural lands are lost to sprawl, less suitable land for farming must be brought into cultivation, which often require more chemicals or irrigation, both of which create further environmental problems.

Farmland still exists next to a suburb in St. Charles, Minnesota—but for how long?

Many communities have taken steps to reverse the flight to the suburbs, or at least to slow it down. One of the first to take serious steps in this direction was Portland, Oregon, which in 1980 enacted an Urban Growth Boundary "to protect farms and forests from urban sprawl and to promote the efficient use of land, public facilities and services inside the boundary." The Urban Growth Boundary was a line drawn between urban and rural land. Development and growth would be concentrated inside the boundary, in the urban district. The surrounding rural district—the site of many flourishing farms, orchards, plant nurseries, and wineries—would remain rural. In this way Portland hoped to prevent limitless suburban sprawl.

One goal of the Urban Growth Boundary was infill, which means filling the existing city with denser population and development rather than expanding outward. Portland introduced zoning rules and tax benefits to encourage smaller-than-usual private lots, multistory homes and apartment buildings, condominiums, and multifamily residences.

Urban planner and historian Joel Kotkin thinks that projects like the Urban Growth Boundary are ultimately doomed. "Attempts to halt suburbanization, such as those in Portland, have had at best mixed results," he wrote in an article titled "In Praise of Suburbs," published in 2006. "Although widely held up as an exemplar of smart growth, Portland's tight suburban growth limits have tended to drive residents farther out and have done little to reduce the area's traffic congestion." The reality, Kotkin argues, is that city planners want people to live in dense, urban neighborhoods, but "a large percentage of people continue to seek out single-family houses." This point has been made in another way by planner and environmentalist David Soule, editor of a volume entitled *Urban Sprawl: A Comprehensive Guide*: "If sprawl is so bad, why do the majority of Americans choose this pattern of settlement?"

Many Americans simply regard the single-family house on a private lot as the ideal way to live. According to Kotkin, for example, 84 percent of adult Californians prefer that living arrangement to any other. The land use planners who will

influence future development cannot afford to overlook the power of what people want.

Alternative Approaches

Partly as a reaction to suburban sprawl, planners and architects in the United States and elsewhere have come up with alternative approaches to development, such as smart growth, new urbanism, building smaller homes, wet growth, and new suburbanism.

The term "smart growth" is believed to have been coined by urban and regional planner Robert Yaro in the 1970s. The idea behind smart growth, of which Portland's Urban Growth Boundary is an example, is to prevent or limit development on open land while directing development toward cities, suburbs, and town centers that already exist. Governments can accomplish these goals through many means, including zoning rules, purchases of open land to be set aside for conservation, changes in the way federal and state funds are used for infrastructure such as road building, and rewards (tax breaks) or penalties (higher tax rates) for developers. "The smart growth movement recognizes that there must be continued development in the United States, especially of housing," writes Anthony Flint, the author of *This Land: The Battle over Sprawl and the Future of America* (2006). "The humble suggestion is that it can be better planned, designed, and distributed."

A movement that began in the early 1990s has been called the new urbanism. It promotes the creation of new communities that are planned from the start as complete, environmentally friendly neighborhoods. These communities feature sidewalks and bicycle lanes on all streets, houses on small lots with porches in front and alleys or garages in back, and services such as stores, parks, gardens, and libraries within walking distance.

New urbanism emphasizes mixed-use development. Instead of row after row of single-family houses, communities are a mix of houses, apartments, condominiums, rowhouses or townhouses, and work/home structures that combine businesses, studios, or offices with living space. One of the first of

Kentlands, in Gaithersburg, Maryland, is an example of new urbanism. The town center was designed to have an urban feel although it is part of a self-contained suburban development.

these compact, mixed-use communities was Kentlands, Maryland, described on the community website as a "neo-traditional community" and a "town within a city."

Between 1970 and 1990, land used for residences in the large cities of Chicago and Atlanta increased eight to ten times more than population increased. Why the big difference between population growth and the amount of land used for new housing? American houses, on average, kept getting bigger, even though the number of people in the average household was decreasing as family sizes got smaller.

In 2009, however, news media reported that the size of the average new home was dropping, perhaps as a result of a recession that had slowed the American economy. Although the trend toward smaller houses may not last, a small-house movement has formed, with websites and magazines about building, buying, and living in small residences. People can

now purchase home-building kits or plans for very small residences—some, measuring under 200 square feet in area, are called "tiny houses."

Small houses are not for everyone, but they offer affordable, compact, and private living quarters for single people, couples, elders who want to live near but not with their children, and others who like the idea of downsizing their homes. Not only are the houses smaller than traditional residences, but so are the homeowners' expenses, such as heating and electricity bills. Many communities have adopted zoning laws that permit small houses on partial lots as a way of increasing infill.

The relationship between water supply and land use is "one of the hottest topics in land use today," according to Craig Anthony Arnold, author of *Wet Growth: Should Water Law Control Land Use?* (2005). In the view of Arnold and some other planners, the availability and protection of water supplies should be a major consideration in land development. The law is already moving in that direction. In some areas, voters have approved laws stating that developers cannot receive building permits until they demonstrate that there is enough water available to supply the new development for twenty years. And in 2002 the U.S. Supreme Court ruled that the Tahoe Regional Planning Authority had the right to ban new development around scenic Lake Tahoe, located on the California–Nevada border, because the lake's water quality was endangered by "development-related runoff.

Urban development scholar Joel Kotkin predicts that the suburbs, not the central cities, will be the dominant form of American urban life in the twenty-first century. In "Toward a New Suburbanism" he writes:

> In attempting to turn back the clock, urbanists have spent a generation looking for a means to revive city centers as the core of American economic, political, and social life. Yet in seeking to build the urban future, they have largely ignored the one place that

clearly represents the predominant form of urbanism in the twenty-first century: suburbia.

The best way to tame suburban sprawl, in Kotkin's view, is not to try to get rid of suburbs—which won't work, because people like suburban living. Instead, planners should realize that suburbs are not static. They are growing, evolving, and more diverse than they used to be. Business, shopping, and cultural districts are springing up in old, formerly neglected town centers and industrial sites to serve the needs of people who live in older suburbs. Developers of newer suburbs are beginning to include bike paths, shopping districts, and parks, borrowing some ideas from the new urbanism movement.

As a result, many suburbs are becoming more like villages, or at least are closer to shopping districts, hotels and hospitals, and cultural activities than they used to be. Together with technological innovations, such as videoconferencing, that let many people work from home for at least part of the time, these developments have the potential to reduce the suburbs' negative aspects, such as traffic congestion, while preserving the space and privacy that drew people to the suburbs in the first place.

Conserving Nature and Resources

For more than a century the conservation movement has had a voice in land use in the United States. Conservation concerns are now part of land use planning and decision making in many parts of the world.

Although conservation has many meanings, in general it refers to saving, protecting, or making prudent use of nature. It is related to, or part of, the environmental movement, but conservation is less concerned with air pollution and other issues that may affect human well-being than it is with natural places, wildlife, ecosystems, and resources. Conservationists include a broad range of interests. Among them are people who want to preserve areas of untouched wilderness in a pristine state, people whose focus is protecting endangered plants

Activists rally against mountaintop removal for surface mining.

and animals and their habitats, and people who want to see resources such as soil and forests used responsibly so that they will not become degraded or disappear.

Conservation influenced an innovative land use decision in the United States in 1872, when Congress set aside 2 million acres in Wyoming and Montana as "a pleasuring ground for the people":

> This was Yellowstone National Park, the first national wilderness park in the world. In forming the park, Congress was influenced by the railroad companies, which had realized that extraordinary landscapes were a valuable commercial resource: Scenery would draw tourists, and tourists would buy train tickets. Yet although Yellowstone was created in large part for commercial reasons, conservation also played a role. There was a growing sense that the grandest features of the landscape—many

> of which were on land still owned by the federal government, especially in the West—should be both protected from development and made available to the public.

Yellowstone paved the way for the creation of more national parks, both in the United States and in other countries. Conservation lands in the United States are now a patchwork of various kinds of protected areas, administered by a variety of federal agencies. The U.S. National Park System—which includes monuments, preserves, historic sites, rivers, seashores, recreation areas, and more in addition to national parks—consists of 393 different sites covering more than 84 million acres. The National Wildlife Refuge System, managed by the U.S. Fish and Wildlife Service, encompasses 553 sites with a total of 150 million acres, as well as 38 wetlands management districts. The Forest Service, a division of the U.S. Department of Agriculture, oversees 193 million acres of publicly owned forests and grasslands. Congress has also set aside 680 wilderness areas covering a total of more than 106 million acres in 44 states (57 million acres in Alaska alone). Hundreds of state and county parks add to the total.

These American conservation lands enjoy varying levels of protection. The building of new roads is not permitted in wilderness areas, for example; but livestock owners may graze herds in places that were used for livestock grazing before they received the wilderness area designation. National parks are protected from development or resource exploitation; but hunting, mining, and oil and gas extraction are allowed on national preserves and some other public lands. National forests are managed for timber production.

In varying degrees, the governments of many other countries have enacted laws to preserve or protect pieces of land and the wildlife and ecosystems that the land supports. The success of these efforts depends on how effectively the protection granted by law can be enforced on the land. In places that lack funds for staff and training, wild places and animals do not always receive the protection that they have been granted on paper.

Governments are not the only bodies concerned with conservation. NGOs, or nongovernmental organizations, play an active role in conservation at all levels. Local associations clean up parks and beaches. Groups such as the Audubon Society work to educate the public and lobby Congress on issues that affect the well-being of wildlife. The Nature Conservancy is an organization that makes land use decisions with its pocketbook. By using money from donations, the Nature Conservancy is able to buy environmentally important parcels of land around the world for conservation purposes. Many other international nonprofit groups, such as the Rainforest Alliance, monitor land use around the world and strive to make conservation a key element in decision making.

Land conservation is important for many reasons. Biodiversity—which is indicated by the number of species able to live on the land—is vitally dependent upon the survival of natural habitats. Conservation serves long-term human needs, too, by encouraging sustainable use of soil, forests, and other resources of the land. Beyond species counts and the dollars-and-cents wisdom of protecting useful resources, however, the natural world has value that cannot be measured. Conservation lands are important as places of recreation, renewal, and inspiration for people now and in the future.

When Human and Natural Worlds Collide

Natural occurrences such as earthquakes, landslides, wildfires, floods, and tornadoes are severe threats to human life and property. For all levels of government, one important goal of land use planning and management is hazard mitigation, which means trying to achieve "the long-term reduction of the effects of natural hazard events."

There are a number of ways to reduce the effects of natural hazards on people and their property. One of the most obvious is to move away from the hazard, but there are others.

Moving away from the hazard. This is generally impossible or impractical on a large scale—the city of San Francisco, for example, is not going to be moved to a new location, even though it has suffered several disastrous earthquakes.

Visitors observe a herd of bison in Yellowstone National Park.

Individuals and businesses, however, may choose to move away from locations that have experienced floods or other natural disasters, or are at high risk for such events.

Limiting potential damage. Planners and lawmakers can use zoning laws to prevent people from building in hazardous areas or discourage the practice through financial penalties, such as permit fees and high insurance costs. They can also use incentives such as tax benefits to encourage people to build in low-risk rather than high-risk areas. How the land in a hazardous area is used makes a difference, too. Using the land around a volcano as livestock pasturage, for example, carries less potential risk than building cities on it.

A Conservation Hotspot in the Caucasus

You've probably heard or read about the endangered Amazon rain forest of South America. You might know about the many species of lemurs and other animals threatened with extinction on the island of Madagascar, off the coast of Africa. But do you know about the environmental crisis in the Caucasus (right)?

The Caucasus is the region between the Black Sea and the Caspian Sea on Russia's southern border. Divided among the nations of Russia, Georgia, Armenia, Azerbaijan, Turkey, and Iran, this region has been identified as a biodiversity hotspot—an area that has a large number of unique species and a high degree of threat to their habitats—by the nonprofit organization Conservation International. The Caucasus is home to 1,600 species of plants that grow nowhere else on Earth, as well as two endangered species of turs, a type of mountain goat. Illegal hunting, illegal plant collecting, and clearing of the forests for fuel wood now threaten these unique plant and animal species. The natural vegetation and habitat that once

covered 205,800 square miles has been reduced to 55,500 square miles in extent.

A total of 16,500 square miles of the Caucasus is under some form of conservation protection, including a network of six nature reserves and national parks in the Russian part of the region. Conservation International and other environmental and wildlife organizations are working with the nations of the Caucasus, hoping to set aside more protected areas and to improve the enforcement of existing conservation laws. Their goal is to preserve the region's record—so far, no species has gone extinct in the Caucasus.

Strengthening the infrastructure. Buildings, roads, bridges, and other infrastructure in areas prone to natural hazards may have to be constructed to standards that will withstand disasters. This is accomplished through building codes—sets of local, state, or national rules that builders are required to follow. Codes are often strengthened after a disaster. For example, after a serious earthquake has destroyed a number of buildings, city government may adopt a stricter building code that requires new structures to be specially reinforced or made of materials that will have a better chance of holding together during earth movements. Under some circumstances older structures may have to be retrofitted, or brought up to new standards.

Case History: Getting People Out of the Floodplain

Floods surged across the American Midwest in 1993. The disaster affected nine states and caused $12 billion in damage. Much of the devastation involved structures in floodplains, which are flood-prone, low-lying areas along rivers. Previous floods had destroyed homes and businesses in many midwestern floodplains, but once the waters had receded and the land had dried out, people doggedly rebuilt. After the 1993 floods, however, the Federal Emergency Management Agency (FEMA) offered to help local government break the cycle of floodplain rebuilding.

Communities could apply for federal grants to receive money for buyouts, transactions in which the local government or the state buys a property from its owner. The buildings on the property are either torn down or moved to new, drier locations. The land remains public property forever, administered by city, county, or state government. Buyouts can be an effective way to mitigate flood damage, as Cedar Falls, Iowa, learned during the 1990s.

After a neighborhood called Cedar City suffered extensive losses in the spring and summer floods of 1993, the city government of Cedar Falls applied for buyout aid. Within four years the city had bought ninety-nine Cedar City properties at a total cost of $4.3 million: 75 percent from federal grants and 25 percent from state and local financing. As a result of the

buyouts, eighty-nine families moved out of the floodplain, and their former properties were designated as green space, to be converted into parks, bike trails, and recreational land—still vulnerable to flooding, but with far less risk of loss of lives and property.

The state of Iowa predicted that the buyouts would result in a savings of $6.6 million in avoided damages over the next thirty years. By 2001, however, the estimated savings because of the ninety-nine buyouts had already reached $5.3 million.

Hazard mitigation recognizes that the human landscape, a complex outgrowth of people's needs and desires, overlies a physical landscape that can be threatening as well as supportive. Just as conserving nature and resources is part of living in the natural world, so is adapting to the risks posed by earth, wind, fire, and flood.

Five
Tools of Land Management

Thousands of years ago the peoples of the Middle East and Egypt made maps—not of the world as they knew it, nor of their kingdoms, but of land use and ownership. As early as 2300 BCE record keepers in the Mesopotamian city-states inscribed clay tablets with outlines of local properties and buildings. By 300 BCE or so the Egyptians were producing similar maps, showing how the land along the Nile River had been divided into properties. These ancient property maps were probably related to tax collecting. In order to make sure that everyone who used the land paid their taxes, the authorities needed to know who had land, and where, and how much.

Modern governments, as well as other planners, builders, and managers, need land use information, too. They have access to an enormous range of data, including imagery collected by spacecraft and processed by sophisticated computer programs. John Randolph, educator and author of *Environmental Land Use Planning and Management* (2004), describes the wealth of information that is available to anyone who

is interested in land use, now that technology can bring the world to any desktop:

> We live in the midst of an information revolution. Through the Internet, never before has so much data and information been so accessible to so many. Advances in software and hardware, the increasing electronic interconnectedness of the population, and government decisions to post all documents and data on the Internet have all contributed to this revolution. The hard part is making sense of it all, keeping pace with the rate of expansion, and ensuring the reliability of available information.

Geospatial Data

Information about the world that is presented in geographic form is called geospatial data. Formats range from old-fashioned maps and globes to cutting-edge, computer-created images of forest resources, water use, or soil type throughout a neighborhood or a nation. However it is presented, geospatial data is essential for monitoring current land use and planning future use.

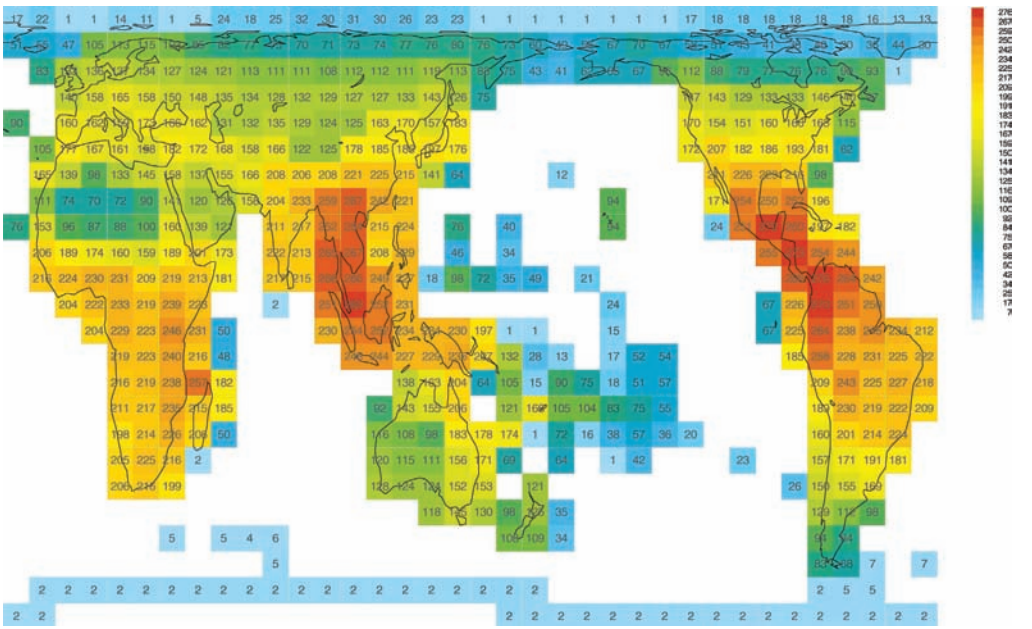
Maps

Maps are "graphic descriptions of the surface features of the land drawn to scale." The larger the map's scale, the smaller the area shown, and the greater the detail. On a large-scale map drawn to the scale of 1:24,000, an inch (2.54 centimeters) on the map's surface represents a distance of 24,000 inches, or 2,000 feet (610 meters), on the ground. On a smaller-scale map of 1:3,900,000, an inch on the map is equal to about 62 miles (6,185 kilometers).

Although many kinds of maps exist, certain types are especially useful in matters related to land use. Remember those property maps created by the ancient Mesopotamians and Egyptians? They belong to a category called cadastral maps, which show property lines and the boundaries of landholdings. Cities, counties, and other administrative bodies use cadastral maps to identify parcels of land and to register their ownership.

Topographic maps show the vertical relief, or distances above and below sea level, of the territory that is mapped. These maps are essential for understanding watersheds, water flow, erosion, suitability for building, and other aspects of land use that depend on the land's flatness or steepness. In addition to relief, topographic maps may show natural features such as forests, as well as human-made features such as trails, roads, and towns.

Thematic maps display various categories of information, such as how land is used and what covers it. Land use maps identify eleven general categories of land use or land cover, from urban or built-up areas to permanent snow or ice. Depending on the mapmaker's needs, each category can be made more specific by using symbols or color shading to represent details. The forest category, for example, can be broken down on a map to show areas of deciduous (leaf-shedding) forest, evergreen forest, or mixed deciduous and evergreen forest.



This thematic map displays the distribution of worldwide biodiversity with red for high biodiversity and blue for low.

Other kinds of information can be displayed on thematic maps as well. A map of population distribution and density, for example, might be darkly shaded in areas with many people per square mile, while areas with few people per square mile are lighter in tone. In the United States, the practice of calling states with predominantly Republican voters red states, and those with Democratic voters blue states, comes from the thematic maps created by news media to highlight political differences.

Remote Sensing

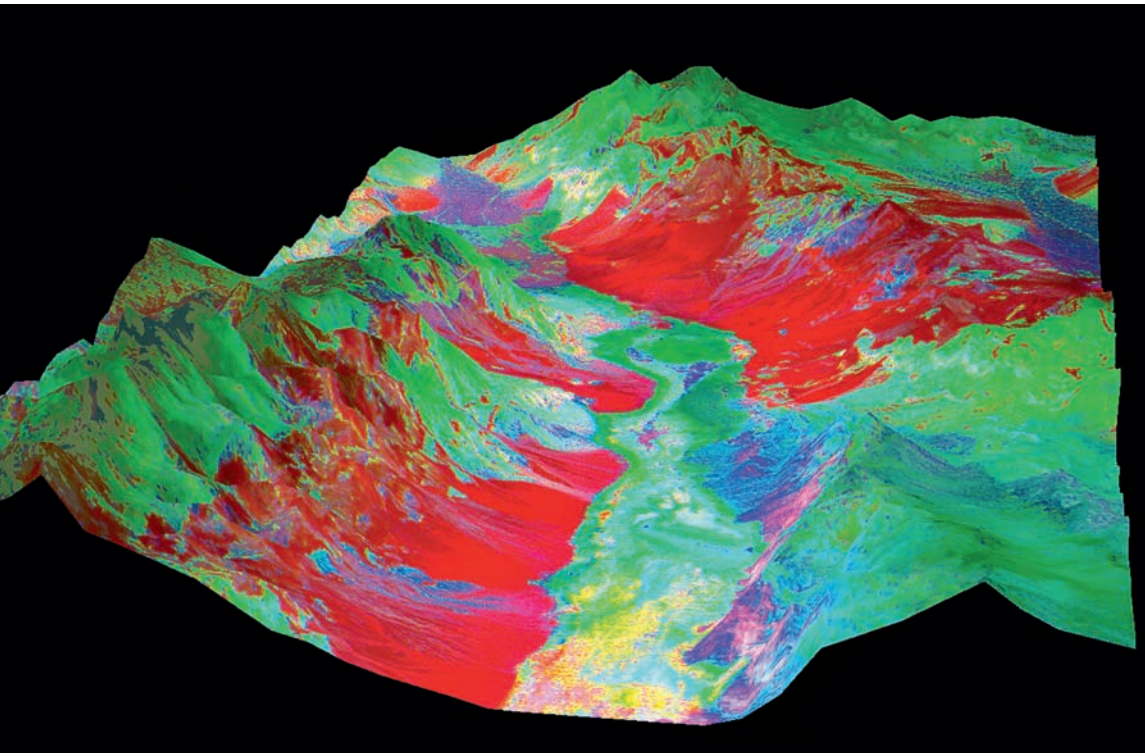
For centuries people gathered geographic information the hard way. They slogged through swamps, climbed treacherous peaks, and sailed across unknown seas to chart the contours of the world's landmasses and bodies of water. These efforts gradually improved the accuracy of cartography, which is the science and art of making maps. Today the most accurate and detailed large-scale maps still rely on local surveys carried out on the ground, but cartographers also have access to a wide range of information gathered through remote sensing.

Remote-sensing technology allows researchers to make observations or gather data from a distance. Mapmakers use various types of remote sensing, including photography, infrared photography (which records contrasts among wet areas, dry areas, and woodlands), and thermal scanning (using sensors that record variations in surface temperature). Also useful are radar and sonar images, produced by sensors that send out electromagnetic waves. These waves bounce off features on the land or the sea bottom and are then picked up by the sensors, which construct images of the terrain based on the signals. One widely used type of radar, called side-looking airborne radar, or SLAR, uses equipment that is mounted on airplanes and "produces images resembling air photos with a low-angle sun and shadow effects."

Aircraft have played a role in land use studies and mapmaking since people started using balloons to ascend into the sky in the late eighteenth century. In the 1830s, soon after the invention of photography, camera-carrying balloonists photographed

Paris and other cities from the air. By World War I (1914–1918) aerial mapping—mapmaking based on photographs taken from planes—was gaining importance, and by the 1960s it had become a major force in cartography.

Then the human race launched itself into space. People and instruments traveled above the atmosphere in spacecraft, capturing images of Earth that added new information and perspectives to cartography. Today scores of satellites circle the planet, observing and recording all kinds of data about land use, from the movement of dust storms to the construction of individual buildings. Satellite images and data have great value for everyone who wants to monitor changes in the surface of the earth, whether those changes occur naturally or as a result of human land use.



This enhanced satellite image provides details of Earth's composition over Death Valley, California.

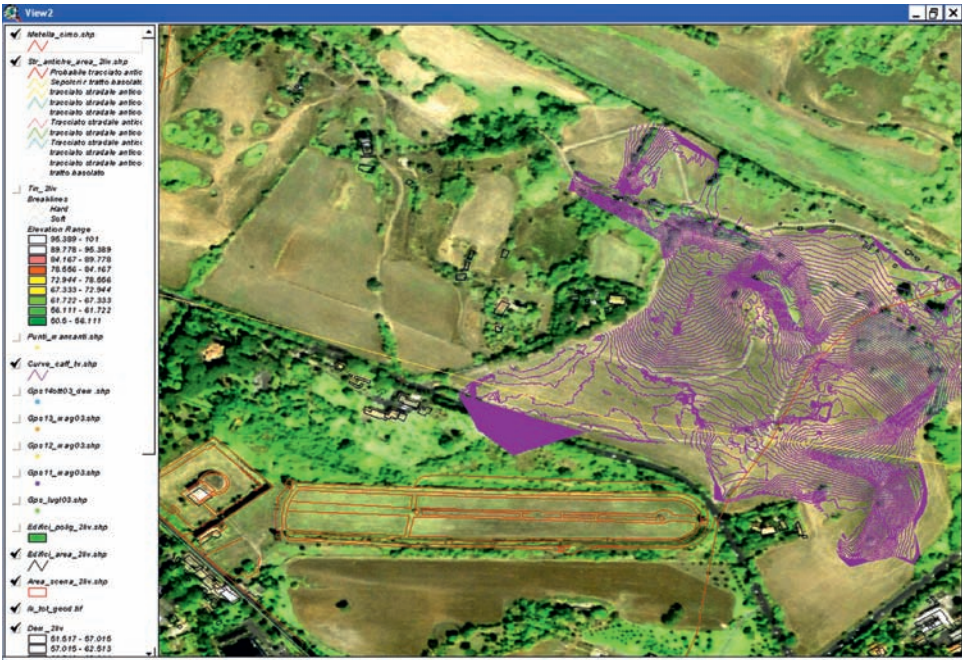
Digital Data and the GIS Revolution

When computers came into use in the mid–twentieth century, they dramatically changed the relationship between people and information. Today almost any kind of data, including geospatial data, can be uploaded, communicated, downloaded, and shared in digital form.

Thanks to the Internet, thousands of maps, data sets, and other kinds of information about land use are just a few clicks away from anyone with access to the World Wide Web. The Natural Resources Conservation Service of the U.S. Department of Agriculture, for example, maintains a "Geospatial Data Gateway" on the Web to make available its information and maps related to the environment and natural resources. The U.S. Census Bureau and the U.S. Geological Survey are also public agencies that provide online access to such materials as population records and topographic maps.

Digital data is one of the three main parts of a powerful tool called geographic information systems, or GIS. The other two parts are computer software and computer hardware—the programs that manage and manipulate the data, and the machines that run the programs and store the data.

GIS works by using data sets that are geocoded, or linked to geographic locations. Those locations may be street addresses, latitude and longitude coordinates, zip codes, or census blocks, which are the smallest units used by the U.S. Census Bureau (usually equal to a city block or a rural tract bounded by roads). GIS software stores different data sets as layers. One layer might consist of an area's soil types, with other layers for the topography, land cover, water sources, population, and roads and settlements of the same area. As long as all the layers use the same type of geocoding, a user can direct the GIS software to create a map or image with exactly the desired features, then manipulate that image. With the layers just listed, the user can make one map showing where people live in relation to water sources and another map showing land cover in relation to soil type. The user can then combine these maps, or further manipulate them to create three-dimensional



A GIS map displays the topography of Caffarella Park in Rome, Italy.

computer-generated images that can be turned, tilted, and viewed from any angle.

With GIS, users can quickly combine digital data sets into graphic displays that convey information visually. The Pacific Disaster Center, for example, wanted to know how many people would be endangered by a flood of Southeast Asia's Mekong River. By using GIS, researchers were able to combine topographic data (the shape of the land along the river) with population data (how many people live in each zone along the river). The result was a map titled "Populations Exposed to Flood Risk in the Lower Mekong River Basin." It showed the lower stretch of the river and parts of three nations—Cambodia, Thailand, and Vietnam. Color shading from yellow to red represented low to high values of flood risk (the topographic factor) times population value (the number of people). Dark red areas on the map meant high population, high likelihood

of flooding, or both. Pale yellow areas meant the opposite: low population, low likelihood of flooding, or both.

Geographers, mapmakers, developers, environmentalists, and land and resource managers constantly find new uses for GIS. It is one of the latest technological tools we have invented to aid us in our age-old quest to understand the world around us—and to use it for our own purposes. Land management tools such as zoning, taxation, building codes, and land trusts increasingly depend on the accurate and up-to-date information provided by geographical databases.

Six
Land Use Decisions

Every human use of the land has changed it in some way. When the pharaohs of ancient Egypt decided to build massive stone tombs on a plateau near what is now the city of Cairo, they made a land use decision whose consequences—the pyramids—have endured for thousands of years. The modern era made it possible for people to affect the land on an even grander scale, with results that cannot always be predicted.

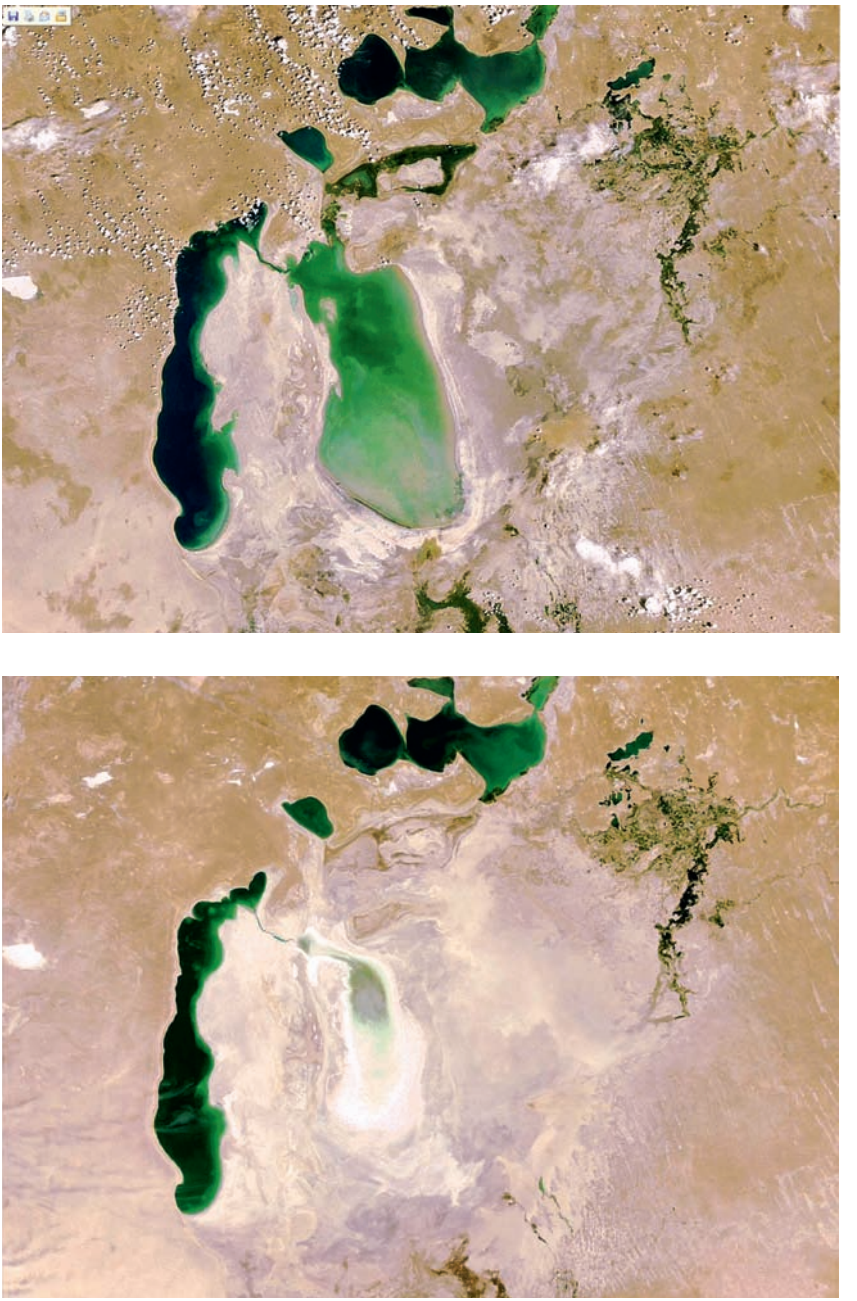
Large-scale changes in land use in the heartland of Asia since the 1960s have created what researchers at American University, in Washington, D.C., called "one of the greatest environmental catastrophes ever recorded." The Aral Sea—which is a freshwater lake despite its name—straddles the borders of the central Asian republics of Kazakhstan and Uzbekistan. The lake lies in a basin and was once fed by rivers that flowed into the basin—in 1965, for example, the lake received about 12 cubic miles of fresh water per year from these rivers. At that time the central Asian nations were part of a Russia-dominated federation called the Soviet Union,

and Soviet economic planners and leaders encouraged farmers and regional land offices to start taking water from the rivers to irrigate land for growing cotton. As cotton cultivation increased, so did the diversion of water from the rivers. By the 1980s diversion was complete. The lake was receiving no water at all.

About 60,000 people worked in the commercial fishing industry on the Aral Sea in the early 1960s. As the flow of fresh water to the lake ceased, salt and minerals built up in the lake water, changing its ecology and killing the fish—and the fish industry, which had disappeared by the early 1980s.

The lake itself was disappearing. Without the rivers to replace the water lost to heat evaporation, the lake has lost more than 60 percent of its former area. The exposed soil of the dry lakebed, full of mineral salts, is carried by wind across a large part of the surrounding region, causing breathing problems for people and damaging crops. The shrinking of the lake has also changed the local climate, shortening the growing season. As a result, many farmers are switching from cotton to rice, which grows more quickly but requires still more water, thus worsening the problem. According to NASA's Earth Observatory, which has monitored the shrinking Aral Sea with satellite images, "Environmental experts agree that the current situation cannot be sustained. Yet, driven by poverty and their dependence upon exports, officials in the region have failed to take any preventive action and the Aral continues to shrink."

Land use problems that build up over decades and involve thousands or even millions of individuals may appear almost impossible to solve. In the United States today, though, most new land use decisions are subject to advance study, review, criticism, and even legal challenges. Decisions about land use can rouse strong feelings, and disputes can turn into legal battles. Such conflict may be the necessary cost of giving stakeholders a voice in the process of deciding how the land we all share should be used.



Satellite images of the Aral Sea in 2006 (top) and 2009 (bottom) show dramatic changes in the disappearing lake.

Battle for the Grand Staircase

Near the southern border of Utah is a huge staircase—a series of cliffs, separated by stretches of level ground, that rise like a miles-long flight of steps. Together with the canyons of the Escalante River, this feature of the land has given its name to a 1.9-million-acre national monument, Grand Staircase-Escalante.

Remote, rugged, and magnificent, this parcel of public land, scattered with relics of ancient Native Americans, was "the last place in the continental United States to be mapped." It is also the cause of a long-lasting land use dispute that has involved cattle rustling, controversy, and a challenge to the federal government from the state of Utah.

The Making of the Monument

The dispute over Grand Staircase-Escalanate stretches back, in a way, to 1906. That year the U.S. Congress passed the Antiquities Act, which gave presidents the power to create national monuments on federal land without a congressional review. The act was intended to allow presidents to act quickly to protect features such as Native American archaeological sites that were in danger of being looted. Since that time, presidents have created more than a hundred national monuments. Some of them, including Arizona's Grand Canyon, later became national parks with congressional approval.

Southern Utah, a land of redrock formations carved by wind, water, sand, and ice, abounds in geological wonders. Many of them, including Arches, Bryce Canyon, and Zion Canyon, had been granted protected status. Environmentalists, archaeologists, and wilderness advocates felt that the Grand Staircase-Escalante area should be protected, too. They worked for years to achieve this goal, and finally, in 1996, President Bill Clinton proclaimed the creation of the Grand Staircase-Escalante National Monument.

Lovers of redrock wilderness rejoiced. Many Utahns, however, did not share the joy. The state's governor and congressional representatives were furious—they had publicly opposed the creation of the monument and were notified of Clinton's

intention just one day before his announcement. To add insult to injury, the president made the announcement not in Utah but across the border in Arizona. Clinton, who was unpopular in Utah, was in the midst of a reelection campaign, and many accused him of staging the announcement in Arizona to win votes in that state. The announcement, however, was only the start of the controversy.

Redrock Rumble

The Grand Staircase-Escalante National Monument is managed by the Bureau of Land Management (BLM), which has had its work cut out for it. From the start, antimonument feeling was strong among the people of the area, who foresaw new limits on their use of the land. Resentment continues to simmer among people who believe that the federal government should not have more control over land than the state or the people who live and work nearby.

Ranchers had been grazing cattle on the public land before it became a monument. Clinton's proclamation specified that existing grazing rights—in the form of allotments, or permissions to use certain areas that must be purchased from the BLM—would continue within the monument. Since that time, however, environmental groups such as the Grand Canyon Trust have purchased some of the BLM grazing allotments and retired them, aiming to reduce what they regard as ecological damage caused by cattle. By 2006 the trust had bought up and retired about 200,000 acres' worth of grazing allotments. Ranchers who continued to graze cattle on allotments that had been retired were ordered to remove their livestock from the monument. A few refused to comply.

In 1996 the Grand Staircase-Escalante in Utah was declared a national monument by President Bill Clinton, opening up controversy about who should decide how to use this land.

After the BLM removed the cattle, the ranchers "rustled" the animals away from the BLM. Area ranchers then organized and filed a lawsuit to prevent the allotments from being retired. In 2006 a federal court upheld the buyouts as legal.

Another controversy concerned the monument's mineral resources. A mining company had planned to open a coal mine on the Kaiparowits Plateau, an area enclosed by the monument. Although existing mining leases, like grazing allotments, were allowed to remain in force after the monument was created, mining operations would have to meet the environmental standards of a national monument rather than those of ordinary BLM land. Monument standards are stricter, and this caused the company to give up its lease. The mine would have created jobs and brought income to the state, and its loss infuriated many local people as well as some of Utah's elected leaders.

Still other controveries have erupted over the use of dirt roads in the monument, the BLM's ban on off-road vehicles, and the pressure by conservation activists to have part of the monument declared a wilderness area, which carries a higher level of protection. The passage of fourteen years did nothing to calm Utahns' ire over the monument—in mid–2010 a candidate for one of Utah's seats in the U.S. Senate promised that if elected he would try to get legislation passed that would limit the federal government's control over federal lands. Although legal experts regarded his proposal as unlikely to succeed, it was a sign of the deep resentment that land use decisions can create, and of the difficulty of reaching agreement on how—or even whether—to use the land and its resources.

Planning for the Future

In 1962 a British scholar of American land use described the U.S. approach to land use as a "prairie psychology," in which people believe that land is almost unlimited. Developers prepared land for use, he claimed, but did not question whether it *should* be used. Today, however, almost any proposed use of land is likely to be questioned. Citizens, neighborhoods,

conservationists, business associations, environmental watchdog groups, and government all take a keen interest in land use decisions.

The best decisions about land use are made on two levels. One level involves ownership and control: whose land is it, and who decides how it will be used? The other level concerns stewardship—meaning the responsibility to take the best possible care of something that will pass into other hands. People entrusted with making land use decisions might do well to ask, are we good stewards of the land? No matter how land is used, if it is used intelligently and thoughtfully for an appropriate purpose, it can still have value for those who will use it after us.

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Global Land Survey
http://gls.umd.edu/
The Global Land Survey, a joint effort by NASA and the USGS, uses satellite images to create a large-scale picture of Earth. The program's goal is to measure the planet's land cover and to show how land use changed the surface of the planet between 2000 and 2010.

Globalis Interactive World Map
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Globalis is an interactive world map that uses information gathered by the United Nations and other national and international organizations to create maps that display information such as rainfall, land cover, and population density.

Guide to Geographic Information Systems
www.gis.com/
The Guide to Geographic Information Systems offers an overview of what GIS is, how it works, and how land use planners use it.

Land Policy Institute
www.landpolicy.msu.edu/
Michigan State University's Land Policy Institute promotes the study of land use, focusing on topics such as revitalizing cities and protecting soil and water resources.

Land Use/Land Cover Change
http://lcluc.umd.edu/
NASA's Land Use/Land Cover Change program tracks changes in land use and land cover worldwide. The site has links to maps and articles, such as a map of global land use hotspots.

People, Land Management, and Ecosystem Conservation
www.unu.edu/env/plec/
The People, Land Management, and Ecosystem Conservation page of the United Nations University has information about projects that team scientists with farmers to develop sustainable land use practices.

Soil Science Education
http://soil.gsfc.nasa.gov/index.html
This Soil Science Education home page is a good starting point for investigations into what soil is, how it is formed and used, and the importance of soil in agriculture and other human activities.

USAID Land Management
www.usaid.gov/our_work/agriculture/landmanagement/
The Land Management page of the U.S. Agency for International Development offers an overview of the challenges created by increasing worldwide demands on the land, with links to pages about the agency's projects in several regions.

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Index

Page numbers in **boldface** are illustrations.

aerial mapmaking, 73–74
agriculture
  Aral Sea and, 79
  desert regions, 41
  erosion, 35, 47
  farmland, **6**, 18, 20, 33, 34
  groundwater and, 27
  irrigation, 35, 41, 46, 49, 56, 79
  livestock, 40, 41, 47, 48, 49, 63, 65, 82, 84
  loam and, 26
  monoculture, 35, 47
  pesticides, 29, 32, 35, 43
  pollution, 35
  population growth and, **35**
  Senegal, 47–48
  slash-and-burn agriculture, 40–41
  soil and, 25, 26
  subsistence agriculture, 36
  suburban expansion and, **56**
  terrace farming, 25, **28**
air pollution, 45, 55, 61
Alaska, 16, 17, 63
Amazon rain forest, 41
Antiquities Act (1906), 81
aquifers, 27, 29
arable land, 33
Aral Sea, 78–79, **80**
Arnold, Craig Anthony, 60
Atlanta, Georgia, 59
Audubon Society, 64
Australia, 25, **27**
automobiles, 19, **20**, 54, 55, 57, 61

bedrock, **24**
biodiversity, 40, 64, 66, **72**
building codes, 12, 68
Bureau of Indian Affairs, 17

Bureau of Land Management (BLM), 16, 82, 84
buyouts, 68–69, 82, 84

cadastral maps, 71
cartography, 73–74
catchment basins. *See* watersheds.
Caucasus region, 66–**67**
Cedar Falls, Iowa, 68–69
chemical weathering, 23
Chicago, Illinois, 59
China, **28**, 40, 43
clay, 23, 25, 26, 45
climate change, 40, 41
Clinton, Bill, 81–82
cobbles, 23
communal access, 18
compaction, 31
compensation, 8–9, 10, 11
composting, 45
Connecticut, 17
conservation
  biodiversity and, 64
  buyouts, 68–69, 82, 84
  Caucasus region, 67
  conservationists, 61–**62**
  endangered species, 61–62
  hazard mitigation and, 68–69
  meaning of, 61
  mitigation, 46, 50
  national parks and, 53, 62–63, **65**
  nongovernmental organizations (NGOs), 64
  planning and, 61
  "smart growth" and, 58
Conservation International, 66, 67
Constitution of the United States, 10–11
control rights, 18
court cases, 8–9, 11, 21, 60, 84

deforestation, 36, **37**, 40–41, 48
demographers, 53
desertification
  high-risk areas, 42–43
  human activity and, 41
  land degradation and, 41–43, **42**
  livestock and, 41
  Senegal, 47–48
  soil fertility and, 42
  soil temperature and, 41–42
drainage, 23, 25, 29, **30**, 31, 41
dust storms, 25, **27**

Earth Observatory (NASA), 79
eminent domain, 8, 10–11
endangered species, 61–62, 66, **67**
Environmental Land Use Planning and Management (John Randolph), 70–71
Environmental Protection Agency (EPA), **43**, 44, 45, 50
erosion, 23, **24**, **31**, 35, 36, 41, 47, 48
Euphorbia plants, 47–48

farming. *See* agriculture.
Federal Emergency Management Agency (FEMA), 68
federal lands, 16–17, 18, **19**, 81, 84
Fernald Feed Materials Production Center, **46**
Fifth Amendment, 10–11
Fish and Wildlife Service, 50
Flint, Anthony, 58
flooding, 29, 31, 40, 68–69
floodplains, 68–69
food, 33, 34, 35, 36, 41, 44–45
Food and Agriculture Organization (FAO), 15, 40
Ford Foundation, 48
Forest Service, 16, 63

fossil fuels, 41

garbage, 44–45
geographic information systems (GIS), 75–77, **76**
geospatial data, 71
"Geospatial Data Gateway," 75
Grand Canyon Trust, 82
Grand Staircase-Escalante National Monument, 81–82, **82–83**, 84
groundwater, 27, 29

Hanford site, 44
Hardin, Garrett, 38–39
Hauge Log Church, 7, 8, 9, 12
hazard mitigation, 64–65, 68–69
Hill Resource Management Society (HRMS), 48–49
housing
  buyouts, 68–69
  erosion and, **31**
  new urbanism and, 58–59
  ownership, 12, 14
  sizes, 58, 59–60
  "smart growth" and, 58
  solid waste from, 44–45
  subdivisions, 18
  suburban, **6**, **54**, 55, 57, 61
  "tiny houses," 59–60
  zoning, 14–15, 20
humus, **24**
hydrologic cycle, 29

Indian trust lands, 17
infill, 57, 60
infrastructure, 68
inheritance, 15
"In Praise of Suburbs" (Joel Kotkin), 57
Iowa, 17, 68–69
irrigation, 35, 41, 46, 49, 56, 79

Kentlands, Maryland, **59**
Kotkin, Joel, 57, 60–61

Lake Tahoe, 60
land degradation
  deforestation, 36, **37**, 40–41, 48
  desertification, 41–43, 47–48
  erosion, 47, 48
  mitigation banking, 50
  pollution, 43–45
  wetlands, 49–51
landfills, 44, 45
land tenure, 14, 15, 18
leachate, 45
livestock, 40, 41, 47, 48, 49, 63, 65, 82, 84
loam, 26

maps
  aerial cartography, 73–74
  cadastral maps, 71
  cartography, 73–**74**
  geographic information systems (GIS), 75–77, **76**
  population density maps, 73
  property maps, 70
  remote-sensing technology, 73
  satellite cartography, **34**, **74**
  scale, 71
  thematic maps, **72**–73
  topographic maps, 25, 27, 72, 75
  World Wide Web, 75
mining, 12, **62**, 63, 84
mitigation, 46, 50, 51
monoculture, 35, 47
Morgan County, Alabama, 50–51

national parks

conservation and, 53, 62–63, **65**
National Park Service, 8, 16
use of, 18, **19**
National Priorities List (NPL), 44
National Register of Historic Places, 8, 9
National Wildlife Refuge System, 63
Native Americans, 16, 17
natural disasters, 29, 31, 40, 64–65, 68–69
Natural Resources Conservation Service, 75
Nature Conservancy, 64
nature preserves, **46**, 63
Nevada, 17
new urbanism, 58–**59**, 61

open access, 18
ownership, 7, 12, 14, 16–17

Pacifica, California, **31**
parking, 14, 19, **20**, 31, 38
pastureland, 33–34, 36, 38, 49
pavement, 19, **20**, 31, 35
pedologists, 23
peds, 26
Perry, Wisconsin, 7, 8–9, 12
pesticides, 29, 32, 35, 43
physical weathering, 23
pipelines, 34, 46
planning
conservation and, 61
geospatial data, 71
mitigation, 46, 50 , 51, 64–65, 68
new urbanism, 58–**59**, 61
public opinion and, 57–58
"smart growth," 58
soil and, 23, 25
topographic maps and, 25
watersheds and, 29
water supplies and, 60, 79
wetlands, 29–30, 50
zoning and, 21
plants. *See* vegetation.
Platt, Rutherford, 14
pollution
agriculture and, 29, 35
air pollution, 43, 45, 55, 61
contamination, 43
landfills, 45
land pollution, 32, 43, 44, 45
solid waste, 43, 44–45
Superfund sites, **43**–44
urban brownfields, 32
water pollution, 29, 32, 43, 44, 45
population density, 19, 36, 73
population growth
"commons," 38–39
geographic information systems (GIS), 75, 76–77
infill, 57
land degradation and, 36
rate of growth, 53
resources and, 34, **35**
solid waste and, 45
suburban growth, 53–**54**
urban growth, 35, 57
"Populations Exposed to Flood Risk in the Lower Mekong River Basin" map, 76–77
Portland, Oregon, 14, **15**, 57, 58
poverty, 36, 79
precipitation, 29, 31, 40, 41, 45, 47, 50
private access, 18
protests, 12, **13**, **62**
public access, 18

Rainforest Alliance, 64
rain. *See* precipitation.

ranching, 82, 84
Randolph, John, 54, 70–71
recycling, 45
reforestation, 40, 48–49
remote-sensing technology, 73
reservoirs, 29
resources, 33, 38–39, 62
Rhode Island, 17

Sahara Desert, 47
Samb, Serigne, 47–48
sand, 23, 25, 26, 47
satellite cartography, **74**
sediment, 25, **27**, 50, 51
Senegal, 47–48
Shiwalik hills, 48–49
side-looking airborne radar (SLAR), 73
silt, 23, 25, 26
slash-and-burn agriculture, 40–41
"smart growth," 58
soil
  agriculture and, 25, 41
  clay, 23, 25, 26, 45
  cobbles, 23
  compaction, 31
  conservation, 49, 50, 51, 62, 64
  depletion, 35, 40–41, 42
  desertification, 41–43, **42**, 47–48
  distribution, 25
  erosion, **31**, 36, 41, 47, 48, 49, 79
  formation, 23
  geographic information systems (GIS), 75
  humus, **24**
  impervious surfaces and, 31
  loam, 26
  pedologists, 23
  peds, 26
  planning and, 23, 25
  pollution, 32, 43, 44, 45
  properties, 22, 23
  sand, 23, 25, 26, 47
  silt, 23, 25, 26
  subsoil, **24**
  temperatures, 41–42
  topsoil, 23, **24**
  Unified Soil Classification System, 25
  urban areas, 30–32
Soil Science Basics website, 26
Soule, David C., 52, 57
Soviet Union, 78–79
"sprawl," 55–58, 60–61
stakeholders, 12, **13**, 14, 79, 84–85
state access, 18
state forests, 18
subdivisions, 18
subsistence agriculture, 36
subsoil, **24**
suburban areas. *See also* urban areas.
  agriculture and, **56**
  housing, **6**, **54**, 55, 57, 61
  pollution and, 53–**54**
  "sprawl," 55–58, 60–61
Superfund sites, **43**–44
Sydney, Australia, **27**

Tahoe Regional Planning Authority, 60
taxes, 12, 57, 58, 65, 70
terrace farming, 25, **28**
thematic maps, **72**–73
This Land: The Battle over Sprawl and the Future of America (Anthony Flint), 58
"tiny houses," 60
topographic maps, 25, 27, 72, 75
topography, 22, 25, 27, 29
topsoil, 23, **24**

"Toward a New Suburbanism" (Joel Kotkin), 60–61
"The Tragedy of the Commons" (Garrett Hardin), 38–39
transfer rights, 15, 18
transportation, 19, **20**, 22, 54, 55, 57, 58, 61
trees, 14, **15**, 33, 36, **37**, 40–41, 47–48, 49, 50, 51

Unified Soil Classification System, 25
United Nations (UN), 15, 40, 46, 47
urban areas. *See also* suburban areas.
  brownfields, 32
  diversity in, 55–56
  groundwater, 27
  population growth, 34–35, 53–54
  soil, 30–32
  tree canopy, 14, **15**
  zoning, 19, **20**
Urban Forestry Division, 14
Urban Growth Boundary, 57, 58
Urban Sprawl: A Comprehensive Guide (David Soule, editor), 57
U.S. Army Corps of Engineers, 50
U.S. Census Bureau, 53, 75
U.S. Congress, 62, 64, 81
U.S. Department of Agriculture, 63, 75
use rights, 15, 18
U.S. Fish and Wildlife Service, 63
U.S. Geological Survey, 75
U.S. National Park System, 63
U.S. Supreme Court, 60
Utah, 17, 81–82, **82–83**, 84

variances, 20–21
vegetation
  Caucasus region, 66–**67**
  conservation, 61–62
  deforestation, 36, **37**, 40–41, 48
  erosion and, 41–42
  Euphorbia plants, 47
  Flint Creek wetland, 51
  land area, 33, **34**
  "living fences," 47–48
  monoculture and, 47
  soil and, 23, 25, 26, 31
  thematic maps, 72
  trees, 14, **15**, 33, 36, **37**, 40–41, 47–48, 49, 50, 51

water
  aquifers, 27, 29
  Aral Sea, 78–79, **80**
  drainage, 23, 25, 29, **30**, 31, 41
  erosion, 36, 41, 81
  flooding, 29, 31, 40, 68–69
  geographic information systems (GIS), 75
  geospatial data, 71
  groundwater, 27, 29
  hydrologic cycle, 29
  impervious surfaces, 31
  irrigation, 41, 46, 49
  land area, 33
  planning and, 60
  pollution, 29, 32, 43, 44, 45
  precipitation, 29, 31, 40, 41, 45, 47, 50
  soil and, 23, 25
  topographic maps, 72
  watersheds, 29, **30**, 49, 72
  wetlands, 12, 20, 29–30, 49–51
water cycle. *See* hydrologic cycle.
weathering, 23, **24**
websites, 26, 59
Wet Growth: Should Water Law Control Land Use? (Craig Anthony Arnold), 60

wetlands, 12, 20, 29–30, 49–51, 63
wildlife refuges, 53, 63
Wilson, Edward O., 52–53
Wisconsin, 7, 8–9, 12
Wisconsin State Journal newspaper, 7

Yaro, Robert, 58
Yellowstone National Park, 62–63, **65**

zoning
  complexity of, 18–19
  Fifth Amendment, 10–11
  flexibility of, 20
  geographic information systems (GIS), 77
  Hauge Log Church and, 9
  hazard mitigation, 65
  housing, 14–15, 20
  infill and, 60
  ownership and, 12, 15–16
  planning and, 21
  urban areas, 19, **20**
Urban Growth Boundary, 57, 58
variances, 20–21

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