BLUE REVOLUTION

Unmaking America's Water Crisis

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CHAPTER 1

The Illusion of Water Abundance

During America's retreat to the suburbs in the 1950s, large home lots, disposable incomes, and a nifty concrete spray called gunite gave families a new marker of success: the backyard swimming pool. For the rest of the twentieth century, residential pools symbolized upward mobility and offered a sense of seclusion not possible at city pools or even private clubs.[1]

The following decades redefined our relationship with water itself—from essence of life to emblem of luxury. By the time of the twenty-first-century housing run-up, even the plain blue pool had lost its luster. Adornments were needed. Aquatic affluence meant floating fire pits, glass portholes, and vanishing edges, which create the illusion of never-ending water.[2]

The amenity to envy was no longer the diving board. The must-have, now, was the waterfall.

No community glorified the trend like Granite Bay, California.

Granite Bay is nestled on the north shores of Folsom Lake, commuting distance east of Sacramento. The upscale suburb is named for the Cretaceous age rock that underlies this region in the foothills of the Sierra Nevada. But during the housing boom, Granite Bay's developers were determined to upstage the area's natural geologic outcroppings.

In Granite Bay's best backyards, rocky waterfalls cascade artfully into boulder-lined swimming pools, set off with grottoes, swim-up

bars, and built-in hot tubs. Thick bushes and trees bearing flowers and fruit adorn the watery wonders, making a place naturally dominated by needlegrass and sedge look more like Fiji. Precisely groomed lawns, a quarter acre and larger, complete the sublimely unnatural tableau.

On Waterford Drive, a beige ranch home with a trim green carpet out front only hints at the tropical excess out back: a pair of waterfalls flow into a clear-blue lagoon, with large rocks positioned for sunning and for diving. This is one of the more subdued motifs. Sacramento landscape architect Ronald Allison tells of a two-and-a-half-acre residential design in Granite Bay with a waterfall, a grotto, a cave, six fountains, a pool with a bridge and an island, *and* a ninety-foot water slide: "It's fun for the grandkids."[3]

Such fun has helped push average water use in Granite Bay to among the highest on Earth. Its residents use nearly five hundred gallons of water a person every day—more than three times the national average.[4] Even when drought conditions cut federal water deliveries to California farmers and closed the state's salmon fisheries, Granite Bay residents continued to consume water as if it were as plentiful as air. After three consecutive years of California drought, Folsom Lake—actually a reservoir created by a dam on the American River—was so dry, it looked like a moonscape. As water levels plummeted in summer 2009, officials from the U.S. Bureau of Reclamation, which manages the lake, ordered all boats removed from the Folsom Marina.[5] Yet the San Juan Water District, which supplies Granite Bay from the reservoir, informed its customers that summer they would have to endure no mandatory water restrictions.[6]

Spectacular squander in the middle of a water crisis is not much of a shock in the United States, where we use about half our daily household water bounty outdoors. The dryer the conditions, the more we tend to pour. What is surprising, however, is to find some of the world's worst waste in the Sacramento metropolitan area. That's because Greater Sacramento has become a national leader in finding solutions to America's energy and climate challenges—and in working to solve other problems brought about by suburban growth.

Sacramento glitters with all things green. But when it comes to water, the city represents a national blind spot.

Somehow, America's green craze has missed the blue.

California's capital likes to call itself "Sustainable Sacramento." The progressive municipal government is spending heavily on light rail and constructing only green city buildings. The utility generates solar, wind, biomass, and hydro power for customers willing to pay more for renewable energy. Sacramento's citizens choose to do so at some of the highest rates in the nation.[7]

The city is so green, it provides organic food to public school children, bike racks to businesses, and free trees to residents who want to cool their homes with natural shade.

But with water, Sacramento isn't so enlightened. The metropolitan area, which lands regularly on lists of top green cities, smart cities, and livable cities, also has earned this startling ranking: it squanders more water than anywhere else in California. That distinction makes it one of the most water-wasting places in the United States. And that makes it one of the most water-wasting places on the planet.[8]

Residents of the metro region use nearly 300 gallons of water per person every day—double the national average.[9] By comparison, the equally affluent residents of Perth, Australia, use about 75 gallons per day. Londoners tap about 42 gallons per day. The water-rich Dutch use about 33 gallons daily.[10]

Grottoed communities such as Granite Bay aren't solely to blame. Some of the same politicians who forged the new path for energy in Sacramento fought for the city's right to keep to the old road for water. The city is one of the last major metro areas in the nation to hold on to flat rates that charge residents the same no matter how much water they use.[11] In 1920, Sacramento had amended its charter to declare that "no water meters shall ever be attached to residential water service pipes." Only an act of the state assembly, which requires the measuring of water use statewide by 2025, has the city installing meters these days.[12]

Sacramento is by no means unique. Even as our green consciousness evolves, we often manage to ignore water not only on a global level but also in our own backyards. The Copenhagen climate accord, negotiated by the United Nations in 2010, did not mention the most immediate threat from a changing climate—the worldwide freshwater crisis.[13] Across the United States, we give little thought to our water use even as we replace lightbulbs with compact fluorescents and SUVs with hybrids.

The conscientious consumer who plunks down $25,000 for a Prius may still wash it every weekend in the driveway. The office manager who rallies every department to recycle paper is unaware of the millions of gallons of water a year that could be recycled from the building's air-conditioning system.

How is that?

One part of the answer is the illusion of water abundance. When we twist the tap, we're rewarded with a gush of fresh, clean water. It's been that way since the turn of the twentieth century, when Americans perfected municipal waterworks, indoor plumbing, and wastewater disposal as a response to diseases like cholera or typhoid fever.

Water is also our cheapest necessity. Four-dollar-a-gallon gasoline helped drive consumers to cars that cost them less to operate. Lower fossil fuel consumption and reduced carbon emissions are fringe benefits to protecting our pocketbooks. No equivalent economic incentive makes us think about our water waste. In fact, our water is so subsidized that many Americans pay less than a tenth of a penny a gallon for clean freshwater delivered right into our homes.

"As a society, from a water standpoint, we're fat, dumb, and happy," says Tom Gohring, executive director of the Sacramento Water Forum, a coalition of business, environmental, and other competing water interests that work together to find solutions to the region's water woes. "In the history of our country, we've had some serious water shortages, but very, very seldom have people been told that they cannot turn on the taps but for an hour in the afternoon, or that they must boil water.

"Water is just too easy to take for granted," Gohring says. "It's always there."[14]

This is true in Sustainable Sacramento, and it's true in the scorched Southwest. The most conspicuous water consumption in America is often found in those parts of the country where water shortages are most serious. Nationwide, we use an average of 147 gallons each day. In wet Florida, the average hits 158 gallons. In Las Vegas, it's 227 gallons per person—in one of the most water-scarce metro areas of the United States, where water managers lose sleep at night thinking about what will happen when the level in Lake Mead drops below the intake pipes that carry water to the city.

Vegas swimming pools—with their glass walls, underwater sound systems, sushi bars, and stripper poles—make Granite Bay's look like they came from the Kmart garden department. But in both locales, the extreme illusion of abundance makes it all but impossible for people who live and play there to notice their personal connection to the nation's water crisis—to understand how wasteful water use in one house, in one backyard, multiplied by 310 million Americans, equals trouble for the generations to come.

Profligate water use today will imperil future generations, the same as profligate use of oil, destruction of forests, and other environmental tipping points will. But water is much more important to our future than oil. That's because there are no alternatives to it, no new substitute for life's essential ingredient being cooked from corn, french fry grease, or algae.

Like our other great, national illusions—say, the unending bull market, or upward-only housing prices—the illusion of water abundance is a beautiful bubble doomed to pop. With petroleum, those $4 gas prices sparked a collective "Aha!" moment for Americans. But there's been no "Aha!" in the case of water, even though the largest of our waterworks are beginning to show a few cracks.

Let's put it this way: It will not be fun for the grandkids.

Rising 726 feet above the Colorado River between Arizona and Nevada, Hoover Dam stands as a breathtaking marvel of U.S. engineering. Its mammoth hydraulic turbines generate energy for hundreds of thousands of homes. Its reservoir, Lake Mead, supplies water to mil-

lions of Americans and another million acres of farmland. The dam's iconic symbolism makes a study by the University of California's Scripps Institution of Oceanography that much more unsettling. In a grim paper titled "When Will Lake Mead Go Dry?," marine physicist Tim Barnett (no relation to this book's author) and climate scientist David Pierce say there's a fifty-fifty chance it will happen by 2021. By 2017, they say, there's an equally good chance water levels in the reservoir will drop so low that Hoover Dam will be incapable of producing hydroelectric power.[15]

Most Americans, including the millions who visit this popular tourist spot each year, don't yet seem to fathom that the largest reservoir in the United States is in danger of drying up, that the famous dam's turbines could cease to hum. Even the Scripps scientists say they were "stunned at the magnitude of the problem and how fast it was coming at us."

A dried-up Lake Mead is only the most dramatically visible of the collapses that scientists say could play out in the seven states—Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming—that rely on the Colorado River and its tributaries as ever-increasing water use, ever-growing population, and a changing climate shrink its flow. Scientists who study tree rings to learn about long-ago climate now say that the twentieth century, when America built its grand waterworks and divvied up its rivers, was the wettest in a thousand years.[16] Now, the wet period is over; the National Academy of Sciences reports it unlikely that the Southwest will see its return. Instead, the region is expected to become dryer, and to experience more severe droughts, than in the twentieth century.[17] Trees in the West are already showing the strain, dying off and burning at unprecedented rates.[18] Now, people must adjust, too, conclude Barnett and Pierce, to forestall "a major societal and economic disruption in the desert southwest."[19]

This dry, dusty American future is not confined to the desert. In the Great Plains, farmers are depleting the enormous High Plains Aquifer, which underlies 225,000 square miles of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, far faster than it can recharge. We pump an average of one

million acre-feet from the High Plains every day. (That's the equivalent of one million acres covered to a depth of one foot.) If that rate continues, scientists say, this ancient aquifer responsible for nearly one-third of all agricultural irrigation water in the United States will dry up within the century.[20] We've even managed to tap out some of the wettest parts of the United States. Florida has so overpumped its once abundant groundwater that the hundred-thousand-square-mile sponge known as the Floridan Aquifer, one of the most productive aquifers in the world, can no longer supply the state's drinking-water needs. The Atlanta region has come within ninety days of seeing the reservoir Lake Sidney Lanier, primary water source for five million people, dry up.

But here's the confounding thing: practically every scientific study that describes these catastrophes and the gloomy future they portend also concludes that it doesn't *have* to be this way. In the Southeast and in the Great Plains, and even in the arid states supplied by the Colorado River, it's possible to reverse the parched path we've set out for our grandchildren and their grandchildren, not to mention ourselves. Conserving water and changing the way we manage water would "play a big part in reducing our risk," says Kenneth Nowak of the University of Colorado at Boulder, coauthor of a recent study that shows the likelihood of depleting the Colorado River's massive reservoirs depends on human actions.[21]

America needs nothing less than a revolution in how we use water. We must change not only the wasteful ways we consume water in our homes, businesses, farms, and energy plants but also the inefficient ways we move water to and away from them. This revolution will bring about the ethical use of water in every sector. Such an ethic is as essential—and as possible—as past awakenings to threats against our environment and ourselves: on the large scale, the way we halted use of DDT and other deadly chemicals; in our communities, the way we stopped tossing litter out car windows and trashing public parks; and at the family level, the way we got used to setting out recycling bins alongside the garbage.

Using water ethically isn't difficult. It's revolutionary only because it's so different from the way modern America relates to water. But

this revolution isn't big, costly, or bloody. It's a revolution of small technologies over mega-waterworks. It's a savings of billions of dollars in infrastructure and energy costs. It's as painless as floating on your back in an azure spring. Call it a blue revolution.

America's Big Gulp

In all, America guzzles about 410 billion gallons of water per day.[22] That's more than the daily flow of the entire Mississippi River. Power plants drink up more than any other sector of the economy, and while much of what they use is returned, it is often at higher temperatures that can change the ecology of the source. Agricultural irrigation, which accounts for about 40 percent of all freshwater sucked up in the United States each day, is by far the largest drain on our aquifers and rivers.

Throughout the twentieth century, farmers and energy suppliers were the mightiest wizards behind the illusion of abundance. Farmers turned the driest grassland states in the nation into the most heavily irrigated to raise corn, wheat, and cattle (chapter 5, "Taproot of the Crisis"). Energy companies tapped the nation's rivers first for hydropower, then to cool coal and nuclear plants, never imagining that someday Hoover Dam's turbines could stop spinning or that the Tennessee Valley Authority would have to shut down a nuclear reactor due to declining river levels (chapter 4, "Powerful Thirst").

But even for the wizards, the illusion is beginning to evaporate. Population growth has fueled residential competition for the shrinking aquifers and rivers long tapped by farms and energy plants. Our sprawling growth is also physically pushing urban America into those parts of the country that farms and power facilities once had to themselves. In recent years, water-scarcity worries have fallowed cropland in the West and halted or held up new thermal power plants in every region of the United States.[23]

In both the energy and agricultural sectors, the green sweep of the nation has not only missed water; it is also aggravating scarcity. It can take ten times as much water to generate power for a plug-in electric vehicle as to produce gasoline for the family car. Biofuels

are worse. The production cycle can consume twenty or more times as much water for every mile traveled than for producing gasoline. When scaled up to the 2.7 trillion miles Americans travel each year by car, scientists say, water could become the limiting factor for our biofuels craze.[24]

Many Americans seem resigned to the notion that agriculture and big industries require a ton of water, and there's not much we can do to change that. This is an especially common refrain in California, where agricultural irrigation accounts for three-fourths of water use.[25] Farmers pump so much, what impact could citizens possibly have on the water crisis? But this is like throwing up our hands and concluding that because coal plants are the nation's top emitters of greenhouse gases, there's nothing we can do about climate change.

It is time, now, to turn our attention to water. Since the turn of the century, Americans have not been involved in the workings of water; we haven't had to be. The conveyance of clean water to homes was one of the most successful feats of technology and engineering in modern times. But occasionally, we've gotten fed up with the nation's direction on water—when pollution-plagued rivers led to the Clean Water Act, for example, and when fed-up ordinary citizens joined environmentalists more than thirty years ago to help bring an end to the era of mega-dams.

Now, the overtapping of nearly every large river and aquifer in the nation, and the inability of our political institutions to change course, call for our involvement once more. In his best seller *Hot, Flat, and Crowded: Why We Need a Green Revolution—and How It Can Renew America*, Thomas Friedman writes that citizens were way ahead of politicians when it came to energy efficiency and green living.[26] The same will be true of water. The citizen involvement and creativity now driving innovation in the green economy will eventually build a blue one.

The blue revolution will require deliberately different choices and the political backbone to make them: No wasted water in agriculture. No subsidies for crops that are irreparably harming aquifers. Water-efficient power plants. Restoring floodplains rather than building taller and taller levees. Planting trees and installing green

roofs on the grand scale, rather than expanding sewers and costly new wastewater-treatment plants. Reusing water and harvesting rain to irrigate our lawns and to cool commercial air conditioners. Replacing wasteful, outdated fixtures in our homes and businesses rather than building expensive new reservoirs.[27]

Though the driest coastal cities will still build desalination plants and the largest ones, like New York City and Los Angeles, will still import water from outside their regions, the blue revolution is a turn from the vast waterworks of the twentieth century toward local solutions. It's an appreciation for local water in much the same way we're embracing local produce (chapter 12, "Local Water").

In that spirit, the blue revolution begins in our own backyards. Just as it's no longer possible to give all large water users as much as they want, any time they want, it's no longer possible for every one of us to use 150 gallons a day from our ailing aquifers and rivers. It's a lot like America's bank accounts: we are seriously overdrawn for luxuries we didn't even need.

So, how much of that daily 410 billion–gallon Big Gulp is just *us* watering our lawns, flushing our toilets, and washing our dishes? Coming in third after power plants and agriculture, about 43 billion gallons a day, or 10.5 percent of the total, goes to public and private utilities. That's where the majority of us get our household water. For the most part, this water comes from aquifers (groundwater) or from surface waters (rivers and lakes). Water managers like to accentuate the difference between groundwater and surface water, but those terms simply refer to the location of water at a given moment. Water is often moving between the two. After falling as rain, water percolates into the soil, then flows underground to river channels. Evaporation and transpiration from plants pick it up again to cycle back into the atmosphere.[28]

To satisfy the Big Gulp, we pump this freshwater from underground, or from a reservoir or river, filtering and treating it at great cost so it meets state and federal drinking-water standards. Then, we move water through a network of millions of miles of pipes under

our cities and highways—some the diameter of a small pizza, some wide enough to drive a Volkswagen Beetle through. All of this takes a remarkable amount of energy. About 13 percent of all electricity generated in the United States is spent pumping and treating water and moving it around.[29] That's nearly double the most generous estimate of U.S. electricity spent powering computers and the Internet. (This means a good way to save energy is to save water, and vice versa.)

And then, the vast majority of this painstakingly purified drinking water is never drunk. Some of it goes down our toilets. But the lion's share is soaked, sprayed, or sprinkled on grass. Waterfalls and grottoes aside, the distance between Americans and their global neighbors who use less than 50 gallons of water per person each day is about one-third of an acre. That's the average size of the American lawn.[30]

The Fifty-First State

California State University research scientist Cristina Milesi grew up in northeast Italy and moved to the United States to pursue a PhD in ecosystem modeling. When she arrived, she was struck by the size of lawns compared with those in Italy and wondered how much they contributed to Americans' super-sized water consumption.

In the early 2000s, Milesi, a remote-sensing expert, wanted to design computer systems that use weather and climate information to help homeowners make better decisions about when and how much to water their lawns. But no one had ever figured out how much lawn actually carpeted the United States. There were no Google Maps for lawns to overlay with rainfall, soil moisture, and other data. So Milesi, who works at the NASA Ames Research Center at California State University, Monterey Bay, began to create her own using satellite imagery.

The findings so surprised her that she repeated her calculations over and over to make sure they were accurate. Her satellite analysis showed that, between our homes and our highway medians, our golf greens and our grassy sports fields, lawns are America's largest crop. We're growing far more grass than corn—with 63,240 square miles

in turfgrass nationwide. That's larger than most individual American states.

To irrigate this "fifty-first state," Milesi estimates that we use as much as nineteen *trillion* gallons of water per year. That's more than it takes to irrigate all the feed grain in the nation. "People don't believe their water use makes a difference, especially because agricultural consumption is so high," Milesi says. "But water is probably the most important issue facing urban areas in the future—and the primary pressure point on urban water use is the lawn."[31]

It's not that we don't have enough water. It's that we don't have enough water to waste. And we definitely don't have enough to pour off nineteen trillion gallons a year, most of it drinking water created at high cost to both wallets and wetlands. Sure, some of our lawn water, now spiked with pesticides and fertilizers, percolates back underground. But much of it becomes so-called stormwater, which local governments then have to handle through an entirely different network of drains, storm sewers, pipes, and treatment to make it safe enough to flow back to streams and rivers. Sometimes, the stormwater never makes its way back to its source; in the coastal United States, hundreds of millions of gallons of freshwater shoot out to sea every day.

Landscaping and sod soak up about half of all household water drawn in the United States. Scientists report that Americans who live in cooler climates use up to 38 percent of their water outside, and those who live in hotter, drier climates use up to 67 percent of theirs outdoors.[32] Water managers say this pattern persists despite multimillion-dollar public-education programs to convince Americans that they need not water their grass every day—or even every other day—to keep it green.

We don't have heroes for saving the planet's blue, the way we do other environmental causes. You can find climate celebrities all along the political spectrum and from Hollywood to Washington. Water is harder. Who in the world would be willing to stand up against watering the lawn or filling the swimming pool?

Maybe Donald Trump could fire water hogs—but he'd have to start with himself. The same year he proclaimed himself a water-loving environmentalist in his bid to build a luxury golf resort and community on a breathtaking oceanfront site in Aberdeen, Scotland, Trump's estate on a breathtaking oceanfront site in Palm Beach, Florida, was the most water-wasting on the entire island.

Trump's Maison de l'Amitié, viewed from the air, looks barren compared to the surrounding estates and hotels. It takes a moment to realize that's because the property has been razed of trees; most of its seven acres is solid grass that stretches all the way to the sea. In 2007, during the worst drought in the history of the southeastern United States, Trump gulped an average of two million gallons of water a month for his outsized lawn and twenty-two bathrooms. He racked up a $10,000 average monthly bill.[33] By comparison, even thirsty Palm Beach looks frugal; the average family there uses about 54,000 gallons of water per *year*.

The '07 drought was dire along the southeast coast of Florida. Lake Okeechobee, primary water supply for Palm Beach and other cities and backup water supply for more than five million Floridians, began to dry up. The grassy lakebed was so parched that it caught fire and burned for weeks. To try to save precious freshwater, local governments in Palm Beach County slapped a 30 percent surcharge on customers who used more than 6,000 gallons a month, enacted lawn-irrigation restrictions, and imposed fines on anyone who didn't follow the rules. But the oceanfront dwellers found a loophole. Residents with new landscaping were allowed to water three days a week instead of one for a month after planting. After the month was up, if they planted more new vegetation, they could again water three days a week. The *Wall Street Journal* found that residents were putting in new trees and turf, at the cost of tens of thousands of dollars a home, just to avoid the water restrictions. "We're all just ripping out the old lawn and shrubs and putting in new ones," one Palm Beacher told the *Journal*.[34]

It may not be all that surprising that Donald Trump and some other Ocean Drive residents (or nonresidents, as is more often the case in summer) would have the highest water consumption in the land. But water hogs come from all corners. Golfer Tiger Woods used nearly 4 million gallons a year at his Jupiter Island, Florida,

home during the region's devastating drought.[35] Pierre Omidyar, the founder of eBay, consumed 13.8 million gallons of water in one year at his Las Vegas mansion.[36]

Canadian pop singer Céline Dion has the dubious distinction of being called out as one of the largest water users in two states—both Florida and Nevada.[37] In 2010, she spent $20 million on her Jupiter Island, Florida, backyard water park with two swimming pools, two water slides, and a lazy river, all of which use 500,000 gallons a month.[38] Then there's Lance Armstrong, who makes his home in Austin, Texas. During an intense dry spell, the local daily newspaper reported that the seven-time Tour de France winner was the city's worst water guzzler. Armstrong used 330,000 gallons in one month at his Spanish-colonial home with its swimming pool, grass, and gardens, according to the *Austin American-Statesman*.[39]

There's not a more perfect picture of the American dream than Lance Armstrong swimming laps in his pool or doing crunches on his lawn. Grass brings the healthy enticements of the outdoors to America's doorstep. It's been associated with physical health in the United States since the nineteenth century, when our fore-families created the first suburbs to escape pollution and disease in the cities.

In recent years, environmentalists have drawn a bead on high-maintenance turfgrasses, not only for their intense water use but also for the pesticides and fertilizers that run off and pollute rivers and estuaries. Lawn lovers—and the $60 billion turfgrass industry—are arming up to defend their turf. But it doesn't have to be all grass, or no grass. There's nothing wrong with a little, especially if it's of a native variety able to thrive in local conditions. We've simply gone way over the top.

Moms and dads with small kids will tell you it's better to play and picnic on grass than, say, gravel or smelly recycled tire treads—the lawn substitutes showing up on urban playgrounds. Life is good with a patch of grass to spread a picnic blanket and let your kids run. But should it really be America's No. 1 crop? Irrigated at more than double the rate needed?

Grass is not the root of our country's water problems; it's a symptom. A 63,240-square-mile indicator of the real ailment—our lack of an ethic for water in America. The illusion of abundance gives us a false sense of security, a deep-down belief that really, there's enough water for anything, anytime. Grottoed new subdivision in the desert? We'll find the water. Sprinklers leaking down the sidewalk? We'll get to it.

Kids bugging you to take them to the nation's largest water park, with its 1.2 million–gallon wave pool that holds more than 20,000 bathtubs full of water?

Jump right in.

Aldo Leopold and the Big Kahuna

When they hear the names of rivers like the Mississippi, the Ohio, the Missouri, and the Delaware, most people assume they were named for the states. It just goes to show how much closer we've gotten to our artificial systems than our natural ones. The river names came first in almost every case, reminding us that rivers were the lifeblood of both Native Americans and colonists.

Mississippi is an Ojibway word for "big river." *Ohio* is derived from an Iroquois word for "great river." The Alabama, Arkansas, Iowa, and Missouri rivers were all named for Native American tribes before the states existed. The Connecticut River came from a regional tribe's description of its waters, and the state came later. Same with Wisconsin, although historians and linguists still argue over the origin of the word. Most have come to agree that it's a rough iteration of a Miami Indian phrase that meant something like "This stream meanders through something red."[40]

The 430-mile Wisconsin River traverses the middle of the state, northeast to southwest, through forests, glacial plains, and hills before it meets up with the Mississippi just south of a historic French fur-trading town called Prairie du Chien. About three-quarters of the way through its journey, the river winds through striking cliffs, canyons, and sandstone rock formations—the likely "something red." This sand-plain region of Wisconsin was both muse and refuge for Aldo Leopold, whose *A Sand County Almanac* has inspired our

evolving ecological awareness ever since it was published posthumously in 1949. Leopold thought through many of his ideas about people and ecology at what he called his "humble shack"—actually, a rehabbed chicken coop—on eighty acres near the Wisconsin River. He, his wife, Estella, and their five children drove up from Madison, where he was on the faculty at the University of Wisconsin, to spend weekends and vacations here in the 1930s and '40s.

Leopold was trained as a forester and founded the field of wildlife ecology. But he was intensely interested in people, specifically in figuring out how to help them see their connection to and responsibility for the natural world. Leopold believed that the answer was "an extension of the social conscience from people to land"[41]—or, put simply, a "land ethic."

If people could see how closely their children's and grandchildren's well-being is tied to the health of the land, personal ethics would drive them to cooperate not only on behalf of their families and communities but also for the natural world they inhabit. The land ethic, wrote Leopold, "enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land."[42] By *land*, he meant the entire web of life, from climate to water, says his biographer, Curt Meine: "The water is a constant."[43]

Leopold died of a heart attack while fighting a grass fire on his Wisconsin River land in 1948, just a week after the manuscript for what became *A Sand County Almanac* was accepted for publication. Had he lived, he surely would have been thrilled: First, that he sold a few books—more than 2 million. Second, that his credo, what we've come to call sustainability, has become all the rage.

Well, it isn't *exactly* the rage in Leopold's own backyard. Leopold's land and shack are preserved in quiet posterity by the Aldo Leopold Foundation, housed nearby in a showcase carbon-neutral building the U.S. Green Building Council has pronounced the greenest in the nation. Visitors can tour the building and then walk through the pine forest and prairie the Leopold family restored and along the sandy banks of the Wisconsin River.

Visitors can, but not many do. Thousands a day, though, flock to a tourist strip that lies exactly ten miles from Leopold's shack. They

come to worship water, although not the sort in the river. For here is the largest concentration of water parks on the planet, including the one at the Hotel Rome at Mount Olympus, where a gargantuan fake Colosseum and wooden Trojan horse loom over a highway choked with miniature golf courses, haunted mansions, and saltwater taffy shops.

The sandstone bluffs that gave the Wisconsin River and the state their names began drawing nature-loving tourists in the mid-1800s to see "the dells"—from the French *dalles*, or flagstone. The town bisected by the river and the dells changed its name in 1931 to the Wisconsin Dells to capitalize on its scenic draw. In the 1950s, a showman named Tommy Bartlett added a water-skiing "thrill show" to the natural water wonders and marketed it like P.T. Barnum would have. In the ensuing decades, one attraction after another opened along the tourist strip. Most were small time, featuring the likes of bumper boats and go-karts. Then, in 1994, Stan Anderson, owner of a Polynesian-themed resort, decided to shore up foul-weather business by building an indoor kids' water park. Children went nuts, and so did their parents.

Fifteen years later, the Wisconsin Dells are no longer the main attraction in the Wisconsin Dells.

Today, the town overflows with twenty water parks that slosh around about 20 million gallons of water. The biggest indoor water park in the world is here. So is the biggest outdoor water park—Noah's Ark. The biggest attraction in the biggest park is called—what else?—the Big Kahuna, a 1.2 million–gallon wave pool. My kids and I found it right next to the fried Twinkies. We had a blast leaping up over fake waves in time with the pop music thumping out of the Big Kahuna's loudspeakers.

The waves build up from the back of the Big Kahuna, roll forward, and crash on concrete beaches. Behind the scenes, a balance tank makes the mega–swimming pool work, a lot like the tank in a toilet. The Big Kahuna is always losing water, so the park uses what are called autofill pipes to constantly pull new water into the tank. To make the waves, a centrifugal fan blower pushes air at high pressure down onto the tank water. An air valve alternately opens to fill the

balance tank and closes to push waves out. The electricity bill just to produce the Big Kahuna's waves: $1,500 a day.[44]

During operating hours, the twenty parks of the Wisconsin Dells constantly pump groundwater from an aquifer that scientists say is robust. Madeline Gotkowitz, a hydrogeologist with the Wisconsin Geological and Natural History Survey who's done extensive groundwater modeling throughout the region, foresees a day when water-intensive industries like microchip plants flee America's arid regions to build a blue economy in places like Milwaukee. The counties with some of the highest unemployment rates in the Midwest happen to sit atop the healthiest water reserves in the nation (chapter 9, "The Business of Blue").

So, maybe the Big Kahuna isn't hurting anyone. Not like Georgia's Stone Mountain theme park would have, if public shame hadn't iced its ill-timed plan to make an entire mountain of artificial snow during Atlanta's 2007 drought emergency, which threatened the city's drinking-water supply. But the surfer-themed wave pool is a 1.2 million–gallon homage to America's illusion of water abundance—particularly to the children exposed solely to the chlorinated wonders of the Wisconsin Dells.

If children's love for water is cradled only within the bright-colored resin sides of a thrill ride, never the wondrous red sides of a sandstone bluff, future Americans will have ever less understanding of, and value for, our freshwater resources.

American kids are often the household nudges who make sure bottles, cans, and newspapers get tossed into the recycling bin. Kindergartners come home singing a song about turning off lights to save energy. But most don't know anything about the watershed they live in, where their house water comes from, or where it goes when they flush. Early on, America had a water ethic. We lost it to indoor plumbing. When we relied on a stream to run a grist mill for the family farm, we understood the value of water. Even the littlest members of families knew that water was worth its weight in gold—because they're the ones who had to lug it in buckets. Another Wisconsin native, Laura Ingalls Wilder, devotes a chapter of *Little House on the Prairie* to "Fresh Water to Drink." She remembers in vivid detail the moment Pa finished digging the family well and the Ingalls had the luxury of hauling water from their yard instead of the creek: "Laura thought she had never tasted anything so good as those long, cold drinks of water."[45]

In summer 2009, one of the Midwest's most famous natural waterfalls, fifty-three-foot Minnehaha in Minneapolis, dried to a trickle because of drought.[46] But at Noah's Ark, children could still whiz down Bahama Falls. They could ride the Black Anaconda water coaster instead of looking for black snakes, play at Tadpole Bay instead of dipping for tadpoles in the sandy banks of the Wisconsin River. In fact, they could no longer see the river from the Wisconsin Dells strip. The town's water parks, with their tall slides, tubes, and coaster tracks, blocked all views of the river and its sandstone walls that drew tourists here in the first place.

The overwhelming popularity of parks like Noah's Ark proves that humans love water. We begin life in water, and we're drawn to it from the day we're born: plop a chubby-legged nine-month-old down on a riverbank, or even on a concrete beach, and the response is usually a huge, gummy smile and a splash attack. Somehow, we have to figure out how to harness that natural affinity to create a shared water ethic: an aquatic revival of Leopold's land ethic that would help Americans see that our future ecological—and economic—prosperity depends on how well we take care of the water flowing under our feet, down our rivers, and through our wetlands.

It's not complicated, especially compared with our climate-change challenge. The easiest, and cheapest, thing we can do is use less. At its most basic, the blue revolution means no one uses more than they really need. Individuals wouldn't pour potable water on the grass. Our agricultural subsidies would help farmers transition to efficient irrigation, rather than give them incentive to deplete aquifers and their grandchildren's ability to farm. With a shared water ethic, we live well, with much less water. Not just a lot less in our own backyards, but a lot less across industries—in much the same way that the smallest households and the largest corporations are evolving a

mind-set for releasing less carbon into the atmosphere. Industrial and agricultural engineers are showing us how in ways that increase crop yields for farmers and save companies millions of dollars in water and energy bills (chapter 9, "The Business of Blue").

Sixty years after Leopold's call for a land ethic, most of us take some personal responsibility for the planet. Think of what's changed in that time: Anglers now catch and release. We recycle our cans at home, our paper at work. And no one with a conscience tosses garbage out the car window anymore.

But when it comes to water, we've gone in the opposite direction. Our homes and lawns are bigger, and so is our thirst: We use quadruple the amount of water today, per person, than we did in 1950.[47] We no longer pay attention to where our water comes from or where it goes. Adults and children alike are disconnected from the nation's rivers and streams. And the nation's illusion of water abundance blinds us from seeing how our own backyard garden hose connects to the bigger picture—a concept we are starting to grasp when it comes to energy use, recycled materials, and other green issues.

In 2010, I went in search of a water ethic for America. The journey took me halfway around the world, but also to some unexpected places closer to home, like the Texas Hill Country, where residents have figured out new ways of living with water based on their own unique cultures and watershed. The water ethic will look a little different from place to place. Some regions, like the Hill Country, will embrace rainwater catchment en masse. Older metropolitan areas will transform as they replace aging water infrastructure, sending water to rain gardens and nature's filters—wetlands—rather than stormwater drains. Philadelphia has switched out even the kids' basketball courts with pervious concrete, allowing water to percolate underground rather than run off to expensive stormwater-infrastructure systems. (An added benefit, say the kids, is that water dries from the courts much faster instead of pooling.)[48]

Although there were some hopeful signs, my search led me to another, harder truth about a water ethic: Americans will embrace it only if it's also supported by the people who make decisions about

our water, from private companies to utility managers to governors. Although the blue revolution may start in our own backyards, it can't stop there. It doesn't make sense for local government to require citizens to lay off the lawn sprinklers, then approve a new subdivision atop the community's most important water-recharge area—no matter how green the new homes are. It's unprincipled for water utilities to fight lawn-watering restrictions, as a group of them did during Florida's last big drought. The fundamental belief in water as a national treasure to be preserved has to catch on at every level of society, including what I'll call America's water-industrial complex.

The American illusion of water abundance follows a long and peculiar tradition. Throughout modern history, humans flaunted water as a symbol of power, wealth, and control of nature—especially, it seems, in places where there is not nearly enough water to control.

In seventeenth-century France, Louis XIV built some of the greatest water features in the world at the gardens of Versailles, spread across both sides of the mile-long Grand Canal (complete with sailing ships and the secondary ships that followed them with violinists and other entertainers). The sumptuous gardens were home to 1,400 water splendors when Versailles was the seat of French political power. The colossal fountains, pools, and waterfalls—and grottoes, too—were positioned so that the sovereign and his visitors would never lose sight of water during exhausting garden tours that lasted from morning until night.

But here's what the royal visitors didn't know: There wasn't enough water at Versailles to keep all those fountain jets soaring, pools overflowing, and waterfalls cascading. They were built in careful groups so they could be turned on and off according to the king's progress around the gardens. A secret palace staff would scurry ahead of the king's touring parties, signaling their whereabouts with an elaborate system of flags and whistle blasts to convey when it was safe to shut down one group of fountains and turn on the next one.[49]

Like Versailles, the American illusion of water abundance is

also carefully maintained—not by palace staff, but by the water-industrial complex. These are the professionals who make sure water gets to agriculture, to energy plants, to the utilities that make our faucets flow—to every interest group that has come to expect large amounts of water. The water-industrial complex includes the $680 billion U.S. construction/engineering industry; thousands of technocrats who populate the nation's mind-boggling array of water agencies; scientists, lawyers, and lobbyists who work for large water users; and the public relations professionals who work for them and for government agencies—often hand-in-hand—to spin the latest water narrative.[50]

America's agriculture, energy, and real estate industries have been built on a water-supply model that no longer works. So have the profits of the water-industrial complex—all of which makes it difficult to change course. The sector's revenues are directly proportional to the size of the water projects they build or land for local communities. In general, the higher the number of gallons captured for our growing thirst, the bigger the profit. Until recently, few companies saw the profitability in saving water, although that is beginning to change, in the same way we've seen corporations like GE and BP increase revenues by creating more energy-efficient products, from small lightbulbs to giant wind turbines.

Up to now, the water-industrial complex has been so good at harnessing water and moving it around cities and regions, even up and over mountains, that Americans, like the visitors to Versailles, have never had to think about how it all works. Most of us never fret about how we use water, where it comes from, where it goes—or whether it is wise to drain so much from our aquifers, rivers, and lakes.

The constant reengineering of those natural systems, from the dammed-up rivers of the West to the canal-dissected Florida Everglades, bolsters the illusion of abundance. Two mighty rivers, the American and the Sacramento, run through the middle of California's capital city. How can it be water stressed? The same can be said of south Florida, surrounded by the Everglades and pummeled regularly by rains that flood the streets. Yet, astonishingly for the amount of water you see when you're standing in Sacramento

or south Florida, these watersheds on opposite coasts of America have been manipulated to the point of near ruin. The Everglades of Florida and California's Sacramento–San Joaquin Delta were two of the most water-abundant ecosystems on one of the most water-abundant continents. Today, they are among the best arguments for a blue revolution—a water ethic for America. That's because they're both dying of thirst.

CHAPTER 4

Powerful Thirst

Spreading out from the Catawba River just north of Charlotte, the largest lake in North Carolina is shaped like the state's signature long-leaf pine. Called Lake Norman, its many branches create 538 acres of shoreline and a surface as big as all of Charlotte-Mecklenburg County, which relies on the lake for its every water need.

In winter 2008, the branches of Lake Norman began to shrivel. Drought sunk the lake to the lowest levels since it was created fifty years ago by the last dam ever built on the Catawba River. The 32,475-acre reservoir, larger than the river's ten other constructed lakes combined, dropped to less than a foot above the minimum level required to run the McGuire Nuclear Energy Station, owned and operated by Duke Energy on the lake's south shore.[1]

Charlotte residents fretted during the drought about brown lawns and dried-up docks. But they should have worried about their ability to flip on lights and power up laptops. For though the name on their electric bill says "Duke Energy," the true source of their power is the Catawba River, which runs for 225 miles through North Carolina and South Carolina.

Though it is often left out of the public debate, energy production now requires more water than any other sector in America, including agriculture. In 2005, withdrawals for thermal power accounted for 41 percent of all freshwater sucked up in the United States, nearly all

of it surface water used to cool power plants.[2] Thanks to conservation and efficiency, the nation's other water demands have flattened slightly despite population growth. But water demand for power grew 3 percent between 2000 and 2005.[3]

Charlotte-based Duke, founded more than a century ago to electrify the Carolina Piedmont region with Catawba River hydropower, is now the largest energy company in the nation. But Duke relies more than ever on the 225-mile-long river, which today powers thirteen hydroelectric facilities and cools three coal plants and two nuclear stations. The Catawba is stretched so thin, and Duke's customer base in the Carolinas growing so fast, that the company is pushing new plants to another river, the Broad River, which also flows through both Carolinas.

Duke Energy is constructing what CEO James E. Rogers calls "the last coal-fired plant I will ever build"[4] on the Broad, where it has also proposed two new nuclear reactors—and three reservoirs to feed them. Company officials fear that one, or even two reservoirs, won't be enough to keep the reactors running during inevitable future droughts.

That just-add-more-water approach to making energy has not changed in more than a hundred years. But it can't last. In the Carolinas and across the nation, a growing population is demanding more energy at the same time it is limiting the supply of water to generate that energy. The more electricity is needed, the more water supplies are depleted. The more water supplies are depleted, the more electricity is needed to concoct new water and bring it to people—with larger pumps, longer pipelines, or energy-intensive desalination.[5]

The Catawba is only a small, southern stretch in the thousands of miles of rivers that quietly carry this energy burden for America. But the story of Duke Power and the Catawba reveals how it came to be that energy has tied up so much of the nation's water supply—and why it seems to be that the sector is last to join the blue revolution.

Born in a modest farmhouse outside Durham, North Carolina, in 1856, James Buchanan Duke is remembered as the most powerful

of the early U.S. tobacco barons, and for his philanthropy, which turned the small Methodist Trinity College into the Ivy League of the American South. He spent most of his working life in New York City, where he built the American Tobacco Company and related businesses until his family controlled four-fifths of the U.S. tobacco production lines.[6] Duke also brought North Carolina's fragrant, golden-leafed tobacco to the world. Before the U.S. Supreme Court ordered the firms dissolved under the Sherman Anti-Trust Act in 1911, Duke family companies controlled 100 percent of America's cigarette exports.[7]

But James Duke had another particular passion, and that was water.

"Especially dramatically moving water," writes biographer Robert F. Durden, professor emeritus of history at Duke University.[8]

In the 1890s, as Duke aggressively acquired firms and soon surpassed three billion cigarettes manufactured a year, in his private life he began to buy parcels of what became a 2,200-acre estate on New Jersey's Raritan River. The times, much like the present, were marked both by conspicuous consumption—it was the Gay Nineties—and economic depression, with widespread unemployment.

Duke hired engineers, landscape architects, stonemasons, and builders to turn his river property into a water wonderland. He also bought controlling interest in the local Raritan Water Power Company to ensure a steady supply to the estate, called Duke Farms.[9]

His construction crews built a chain of nine lakes over 75 acres. They mounded the excavated land into knolls and hills reminiscent of the Carolina Piedmont. At the top of the chain, a two-million-gallon reservoir sent water from the Raritan tumbling from one lake to another. To enjoy the water in action, Duke had it "flowing over boulder-made rapids, and small dams, tumbling over craggy cliffs, and rising skyward in jet streams, falling in multiple arrangements, overflowing bowls and basins."[10]

The stone dams, waterfalls, and well houses were designed artfully among what Duke estimated were two million planted trees and shrubs, including blue spruce, native hardwoods, thousands of rhododendrons, and many tens of thousands of evergreens he ordered

from Europe. Duke spent so much time on the water and the trees that he never built the mansion he'd planned—except for its grand, European-inspired fountains. *American Home and Gardens* in 1914 described the thirty-five gushing water features among "the most beautiful in the world."[11]

But, just like the fountains at Versailles, there simply wasn't enough water to run them all. One July day in 1907, Duke turned his entire wonderland on at once to impress his new wife, Nanaline. The system sucked so much of the river that the intake pipe downstream at the Raritan Woolen Mill ran dry and the plant had to temporarily shut down. By 1910, Duke engineers had fixed the problem, with a remarkably modern recycling system that recirculated twenty million gallons of water through the estate every day.[12]

In 1911, Duke was so angered by the Supreme Court's decision to dissolve his companies that he abruptly gave up on both his mansion and the domestic tobacco industry. He spent an increasing amount of time in London running his British-American Tobacco Company and came close to settling there permanently.[13]

What brought Duke home again was water, the "dramatically moving" kind he loved best. At the turn of the twentieth century, electric power was just beginning to light up the United States. Intrigued, Duke made a substantial investment in hydropower along the Catawba River. The investment would become "the most creative economic endeavor of his life," writes Robert F. Durden, who argues that Duke's hydropower work also represents "the most positive, long-lasting, and far-reaching impact on his native region and its economic health." It certainly changed the Catawba River forever.

With a small hydropower plant at his Raritan River estate, James Duke already understood the power of water. Now, experiments at Niagara Falls and in other parts of the country were proving its potential to electrify entire regions. Duke was heavily invested in textile manufacturing plants in the Carolinas. A competitor's mill had tapped a river and was running with "the cheapest power in the nation."[14]

Duke became interested in the Catawba, named for the Native Americans who lived along its banks beginning in the 1500s. The river originates on the eastern slopes of the Blue Ridge Mountains, flows through Charlotte, changes names to the Wateree River in South Carolina, and eventually joins with the Congaree, which carries it on to the Atlantic Ocean.[15] The trusted general manager of the Duke textile operations reported to the family in 1899 that he was "making a special effort quietly to learn the status of the Catawba River Falls, which is unquestionably the biggest thing in the South." The rocky, four-mile stretch is known as the Great Falls of the Catawba River, near the town of Great Falls in South Carolina.[16]

James Duke and his brother, Benjamin, who ran the North Carolina side of the family empire, lost no time buying up land and water rights along the Catawba. Durden writes that Duke "believed in carefully looking ahead and acquiring water rights as early as possible, long before the public announcement of a project."[17] In 1901, they bought Great Falls for the astonishing bargain of $42,000. Downriver, New York City physician and South Carolina native W. Gill Wylie had just built the first hydro station on the river at India Hook Shoals near Rock Hill, South Carolina. In 1904, he built the first of the river's dams, creating Lake Wylie, which straddles the Carolinas state line. The doctor hired engineers to design his larger vision, a series of plants all along the Catawba linked with dams and reservoirs to capture the power of the entire river. But he needed capital, an estimated $8 million, and of course he needed Great Falls.[18]

Company lore has it that James Duke became a captive audience to Wylie and his grand scheme when his foot got inflamed and the doctor treated it. Duke began to seriously analyze Wylie's business and engineering plans. In spring 1905, the men incorporated the Southern Power Co. in Charlotte. They immediately went to work on a $1.6 million plant at Great Falls. Soon, power lines delivered electricity first to Charlotte, later to Gastonia, Shelby, and other towns and mills throughout the Piedmont.[19]

Duke was especially interested in using electricity to recruit textile mills. Many businessmen were skeptical or frightened of the technology moving in on their coal and steam systems. One mill

owner told a Southern Power engineer, "You must be drunk or a damned fool if you think I will bring electricity into my mill to kill my people." Duke agreed to finance those mills that were willing to locate in the region. By 1911, Southern Power had linked four hydro plants, Catawba, Great Falls, Rocky Creek, and Ninety-Nine Islands, and had begun to connect its transmission lines to other companies throughout the Southeast. *Electrical World* magazine called the network "by far the most extensive interconnected transmission system in the world."[20]

While Southern Power and its subsidiaries developed the northern section of the Catawba, James Duke organized another company, Wateree Power, to build plants on the South Carolina side, where the Catawba turns into the Wateree. The companies dammed up more of the Catawba after back-to-back hurricanes in summer 1916 destroyed plants and the Lake Wylie Dam and washed millions of Duke dollars down the river.[21]

Duke and Wylie's hydropower transformed the Piedmont, and especially Charlotte, from an impoverished farming area in the wake of the Civil War into a booming industrial economy with New South clout.

In the larger region, hydropower helped the rainy and river-rich eastern half of the United States overtake Britain as the world's greatest economic power at the turn of the twentieth century.[22] Between 1907 and 1929, American homes with electricity grew tenfold, to 85 percent. By 1930, Americans consumed more electricity than anyone else on the planet combined. Engineers soon figured out how to make giant, manmade alternatives to the power of naturally falling water, and hydro infrastructure spread industrial development west. Hoover Dam, on the Colorado River, completed in 1936, became the largest hydroelectric facility in the world.[23]

Today, as prolonged droughts in the arid southwestern United States sink water levels in Lake Mead to the point of threatening Hoover Dam's intake pipes, it has become the largest symbol of the need to change our thinking about water and how much we use. Especially to make power.

♦ ♦ ♦

In 1927, a few years after the death of James Duke, his various power concerns merged into the southern energy behemoth now known as Duke Energy. The $13 billion, publicly traded utility (NYSE: DUK) has had more influence on the waters of the Catawba than any other force, natural or artificial, in modern times.

Duke's dams altered the physical shape and flow of the Catawba, from the fast-flowing, rocky river pictured on turn-of-the-century postcards to today's chain of eleven branching reservoirs with water levels controlled by Duke Power. But the company also transformed the human ecology of the waterway almost as profoundly as hydropower changed the Piedmont's industrial economy. Today, the lakes are known for massive shoreline golf course communities and minimansions more than for hydro, coal, and nuclear plants. This, too, is Duke's legacy.

After the company built its more-than-mile-long Cowans Ford Dam and created Lake Norman in the 1960s, it was sitting on a lot of excess real estate. Duke—first the man, then the utility—had been buying up Catawba land since 1901, some of it for as little as $1 an acre.[24] In 1969, the company created a real estate subsidiary called Crescent Resources, transferring thousands of its surplus acres along the river. Crescent instantly became one of the largest private landowners in the Carolinas.[25] It developed upscale communities around Duke's northernmost lake—Lake James, as well as Lake Norman and Lake Wylie, and later expanded into luxury resorts in areas such as Hilton Head, South Carolina, and commercial and residential developments in half a dozen states.[26] In 1996, the company was valued at $2.1 billion when Duke sold half of it to Morgan Stanley's real estate investment arm.[27] In 2009, Crescent filed for Chapter 11 bankruptcy reorganization in the wake of the housing bust.

One summer afternoon, a retired Charlotte contractor named C. D. Collins and his wife, Judy, offered to give me a tour of Lake Wylie on their pontoon boat, the *Pinch Me*. Fifty years ago, C. D. bought a tiny, remote fishing cabin in one of the river's curving coves not far from where Judy's parents owned a cabin. The couple met there, but it took them five decades to marry.

Today, they live in Collins's cabin, now dwarfed by three ostenta-