

AFTER THE DELUGE

A spate of floods, droughts and heat waves is prompting city and state leaders to take bold steps to protect their people and property

By *John A. Carey*

FOR A CENTURY WORKERS FLOCKED TO DUBUQUE, IOWA. AS THEY raised new generations of laborers, they built houses, shops and streets that eventually covered over the Bee Branch Creek. The water gurgled through underground pipes out of sight and largely out of memory.

Until the rains came. On May 16, 1999, 5.6 inches of rain fell in 24 hours. The creek pipes and storm sewers overflowed, blowing out manhole covers and turning streets into chest-deep raging rivers. Hundreds of homes and businesses were flooded.

Mayor Roy Buol vividly recalls the neighborhood meeting held a few weeks later. “Everyone was upset,” he says. By 2001 the town had devised a master plan to solve the flooding: turn the submerged creek back into an open stream with graded banks capable of handling floodwaters. Of course, that would require tearing down scores of homes. “The plan was not well received,” says Deron Muehring, a civil engineer for the city. Planning stalled.

Then, in June 2002, more than six inches of rain fell over two days, sending storm water back into the same homes and buildings that had just been laboriously renovated. That helped to break the political logjam and united city leaders on a \$21-million plan to remake the neighborhood, which called for razing homes and adding a verdant park with a stream running through it, along with two water retention basins. Their decision did not

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hinge on language about climate change or the need to save the planet for future generations. Residents were fed up, and local leaders worried that the neighborhood would irreversibly decline. The city began buying up 74 properties, and groundbreaking took place after yet another drenching in 2010. Engineers have now restored about 2,000 feet of the Bee Branch Creek. When the project is finished in 2013, the city should even be able to withstand repeats of a 10-inch-plus deluge this past July, which caused several million dollars in damage.

Dubuque’s actions are a microcosm of a larger tale unfolding across the U.S. Federal policies to combat climate change are stalled, and some members of Congress accuse scientists of making the whole thing up. But cities, towns, water authorities, transportation agencies and other local entities are not interested in debating whether or not climate change is real: they are acting now. Like Dubuque, they are already facing unprecedented floods, droughts, heat waves, rising seas, and the death and destruction these events can impose. “We’ve got to get serious about adapting,” says Iowa State Senator Rob Hogg.

Indeed, about 16 U.S. states have climate adaptation plans or are developing them, according to the Georgetown Climate Center in Washington, D.C., which works with states. [Disclosure: the author’s wife, Vicki Arroyo, is executive director of the center.] Although no one has tallied exact numbers, hundreds of communities and agencies are reacting to increasingly severe weather. Those that are not “are going about business as usual with blinders on,” says city planner Mikaela Engert, who helped to develop plans for Keene, N.H.

COURAGEOUS INDIVIDUALS

THE EMERGING TAPESTRY of adaptation efforts is being held together by several common threads. The first is that nothing focuses attention more than flooded homes or dried reservoirs in one’s community. Even in Dubuque, in conservative Iowa, the argument that climate change is a hoax faded as floods kept coming. “How many of these 500-year events happening every few years do you have to have before you realize something is changing?” Mayor Buol asks. “Whether man is contributing or not, the climate is changing at a faster pace than any time in history.”

The second thread is that “all adaptation is local,” as Michael Simpson, chair of environmental studies at Antioch University, observes. The San Francisco Bay Area’s response to rising seas, which threaten airports, seaports and coastal communities, must obviously be different from Chicago’s plan to build “green” roofs, plant trees and install “cool” pavement to tamp down its heat waves. National and regional efforts certainly can play important roles. But adapting to local problems depends on “courageous individuals”

Impasse: Flooding like this by the Delaware River is forcing towns to plan for severe weather.



who will step up to the challenge, says climate adaptation consultant and Stanford University fellow Susanne Moser.

Those individuals have their work cut out for them because of the final thread: adaptation is difficult. “It’s not a priority for enough people,” Senator Hogg says. The planning process itself is challenging because it must bring together many parties. Even when effective steps can be taken, plans often run into budgetary, political or regulatory barriers. Adaptation gets even harder when the threats are uncertain. Although diversifying water supplies in the face of predicted droughts, as Denver Water is doing, seems clear, it is less clear how to adapt to, say, wide-spread crop failures such as those in Texas and Oklahoma.

The complexities explain why responses are mixed. On the one hand, “we have made amazing progress in a relatively short period,” says Steve Adams, managing director of the Climate Leadership Initiative in Eugene, Ore. A few examples: the Southern Nevada Water Authority is digging a \$700-million water-intake system deeper under Lake Mead so that water will still flow to the Las Vegas Valley when the lake’s water levels drop below the two current intakes, which is likely to happen soon. Toronto has built a new network of storm-water basins and drains in response to a series of recent intense deluges. Maryland is building higher docks and is targeting land for acquisition that can act as buffers against sea-level rise and storm surges.

Vermont, reeling from unprecedented damage from Hurricane Irene, plans to rebuild stronger and better. “Before, we were thoughtfully changing our codes and standards to make our infrastructure more resilient to changing weather from global climate change,” says Gina Campoli, environmental policy manager at the Vermont Agency of Transportation. “Now we are just doing it. We can’t be putting things back the same way if they will just blow out again. We’ve upped the ante here.”

On the other hand, these impressive-sounding developments barely scratch the surface of what is needed. Only a tiny percentage of the nation’s communities are tackling adaptation, Moser notes. Looking at the overall situation, “we are really in bad shape,” argues economist Robert Repetto, author of *America’s Climate Problem*. “We’ve only experienced a portion of the change that we’ve already committed ourselves to because of past greenhouse gas emissions—and emissions are still rising. I don’t think we can adapt.”

MORE RAIN, MORE DROUGHT

MORE ACTION seems warranted because science is painting an increasingly certain picture of a climate being altered by human actions. For instance, climate models predict a rise in av-



Banking on it: Dubuque, Iowa, opened a buried creek so that it will absorb water during storms instead of flooding town.

erage nighttime temperatures, and measurements now unequivocally show that is happening. The phenomenon may be causing a drop in corn yields because plants respire (give off carbon dioxide) more during warmer nights, burning fuel they could otherwise use to plump up their kernels.

The models predict that as the earth’s temperature rises, heat and drought will increase in bands across the American Southwest and the Middle East and that heat waves will become more common at higher latitudes, in places ranging from the upper Midwest to Russia. That is happening, too.

Finally, the models predict more deluges such as the ones that struck Vermont and New York this past summer. For each one degree Celsius rise in temperature, the atmosphere can hold 7 percent more moisture. That means 2 to 3 percent more rain in general but 6 to 7 percent more extreme rainfall events.

Without a big cut in greenhouse gas emissions, “these events will become more common,” says Michael Wehner, a staff scientist at Lawrence Berkeley National Laboratory. “I don’t think anyone disagrees with that.” Work by Peter Stott, head of climate monitoring and attribution at the U.K. Met Office, shows that the odds of a heat wave like the one that struck Europe in 2003 have jumped fourfold compared with preindustrial days.

Even though it is impossible to say that any extreme weather event was directly caused by climate change, that “doesn’t matter, because this is what climate change looks like, and we have to prepare,” says David Behar, climate program director for the San Francisco Public Utilities Commission. A project Simpson worked on used New Hampshire rain-gauge data to show that 10 of the state’s 15 biggest floods since 1934 have occurred in the past 15 years—and that the torrential amounts of rain in what used to be 200-year storms now occur in 25-year storms. Yet most town engineers in New England still design culverts, drains and bridges based on rainfall data from the 1920s to 1950s. “A lot of the infrastructure going in right now is undersized,” Simpson says.

FIRST STEPS

THE HIGHLY POLITICIZED TERM “climate change” does not even need to be invoked to convince communities to revise their practices. Cities and towns that have experienced the worst disasters tend to be on the forefront of adaptation, where local leaders can rally community support to overcome the barriers. A good example is Keene. In October 2005, three days after Simpson presented a report to the city council identifying culverts and roads vulnerable to a major storm, the region was hit by 11 inches of rain.

IN BRIEF

Frustrated by political gridlock in Washington, D.C., over climate change policy, cities and states are changing infrastructure on their own to counteract severe weather that is killing more people and destroying more property.

Dubuque, Iowa, has exhumed a buried creek to reduce storm flooding. Southern Nevada is digging new intake pipes under Lake Mead to offset drought. Keene, N.H., is replacing roads with permeable pavement that al-

lows heavy rain to seep through instead of rising. **Adaptation** is best planned by municipalities because solutions must be tailored to local problems, but courageous leaders are often needed to rally support.

The water destroyed those culverts and roads, as well as homes and bridges, shut down the water treatment plant and caused several deaths. The disaster prodded the city, with a little outside help, to develop one of the nation's first and most far-reaching adaptation plans, led by planning director Rhett Lamb, and to find funding for improvements. Sidewalks along one of the city's main roads—Washington Street—have just been replaced with porous concrete, and side roads have been lined with grassy borders instead of curbs, so that in both cases rainwater can spread out and seep slowly into the surrounding ground instead of rising on the road, causing floods.

In Charles City, Iowa, the tipping point was a devastating 2008 flood in which the Cedar River crested nearly three feet higher than its previous record. When people see their homes full of water, “they think about how the number of big rains we get has really changed,” says city administrator Tom Brownlow. “It's up to us in leadership to say, ‘This is a long-term issue that we need to address.’” The city has. It has torn up 16 blocks of streets and installed permeable pavement atop a thick bed of rock and gravel. The system allows water to pass through into the ground below instead of running off the surface, triggering flooding. In addition, the area under the pavement hosts microorganisms that eat oil and other contaminants before the water sinks through and ultimately reaches the river. The city has also transformed the waterfront with amenities such as a world-class white-water kayaking course. Now “we could get a 100-year rain and not have any standing water in the streets,” Brownlow says.

Iowa corn farmers have also responded to the state's increased rains. They have spent tens of thousands of dollars to install more drainage tiles to keep fields from getting too soggy, which can delay planting and stunt crop growth. Ironically, they are also planting up to three times as many seeds per acre, taking advantage of increased spring soil moisture to grow more crops in the same fields. Even though the farmers largely deny that humankind is changing the climate, “they are already adapting and making money at it,” says Gene Takle, professor of meteorology and global climate change at Iowa State University.

Floods are an immediate threat of climate change. Yet certain communities are adapting to longer-term ramifications. The San Francisco Bay Area, for instance, plans to spend \$20 million to \$40 million retrofitting 16 sewer outfalls in the bay to prevent rising seas and storm surges from pushing water back up the outfalls and into sewage treatment plants.

One persistent individual has instilled a long-term view in Hayward, Calif., on the eastern shore of San Francisco Bay. When Bill Quirk, a former NASA climate modeler and nuclear arms expert, won a seat on the city council in 2004, he repeatedly tried to get the city to pay attention to the threat of sea-level rise. No luck. “I was new and didn't know how to get things done,” he says.

Then, on New Year's Eve 2005–2006, storm waves at high tide crashed over the city's protective levees, causing heavy damage. At Quirk's behest, the Hayward Area Shoreline Planning Agency scraped up \$30,000 to study solutions. In centuries past, sediment washing down creeks and streams built up wetlands along the bay, creating buffers against storm waves. But once the streams were channeled into culverts and pipes, the sediment began flowing out into the bay instead, where it fills in marinas and shipping channels. The agency hopes to start pilot

projects that would allow some water and sediment to once again wash back out into the wetlands to help sustain them.

The case for adaptation is harder to make when people are not facing overtopped levees or flooded basements, especially when budgetary and political winds oppose action. In Iowa, Senator Hogg has been pushing a wetlands restoration plan that would slow runoff into rivers, reducing the flooding in cities downstream. But not only has his proposal failed to pass the state legislature, the state's existing programs are being cut. “There are times that feel like I am beating my head against the wall,” Senator Hogg says, “but we've got to keep plugging.”

FINDING RESILIENCE

NASCENT EFFORTS could use greater federal help. More may be coming. In 2009 President Barack Obama signed an executive order that requires government agencies to develop their own climate adaptation plans—due in mid-2012. Among those taking the task seriously is the Department of Defense, which worries about many installations along vulnerable coasts. The Department of Transportation aims to identify roads, bridges and other infrastructure that could be affected. And wildlife agencies are struggling with ways to keep species, ecosystems and wildlife refuges healthy in the face of shifting climatic zones.

Another push for action could come from the private sector. Reinsurance giant Swiss Re has been working with McKinsey & Company and environmental groups on the economics of climate adaptation. Case studies show that it is far cheaper for a locality to spend some money now to become more resilient than to pay for damages from weather disasters later—an approach that obviously benefits insurers as well. The oil industry has already upped standards for drilling-rig strength to combat more intense hurricanes. Similarly, Joyce Coffee, a vice president at Edelman, who had previously helped develop Chicago's adaptation plan, is trying to convince companies that adaptation could create huge opportunities. A shopping mall owner that chips in for a community's storm-water system upgrades, for instance, earns local goodwill, reduces the property's risk of damage from flooding and boosts the chances that people will still be able to shop when bad weather strikes.

Adapting to climate change is certainly paying off for Dubuque. Unemployment is low, and the renovation is expected to lift property values and create jobs. The city has been named one the top five most resilient cities in the nation, one of the 10 smartest cities on the planet and one of the world's most livable communities. “Cities that get in early on sustainability will have economic advantages, and we are seeing that,” Mayor Buol says. ■

MORE TO EXPLORE

Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy. White House Council on Environmental Quality, October 5, 2010. www.whitehouse.gov

Our Extreme Future: Predicting and Coping with the Effects of a Changing Climate. John Carey in *Scientific American*. Published online June 30, 2011. www.scientificamerican.com/article.cfm?id=extreme-future-predicting-coping-with-the-effects-of-a-changing-climate
The Georgetown Climate Center's Adaptation Clearinghouse (information on state and local adaptation plans): www.georgetownclimate.org/adaptation/clearinghouse

SCIENTIFIC AMERICAN ONLINE

For an in-depth report on extreme weather and climate change, see ScientificAmerican.com/dec2011/extreme-weather