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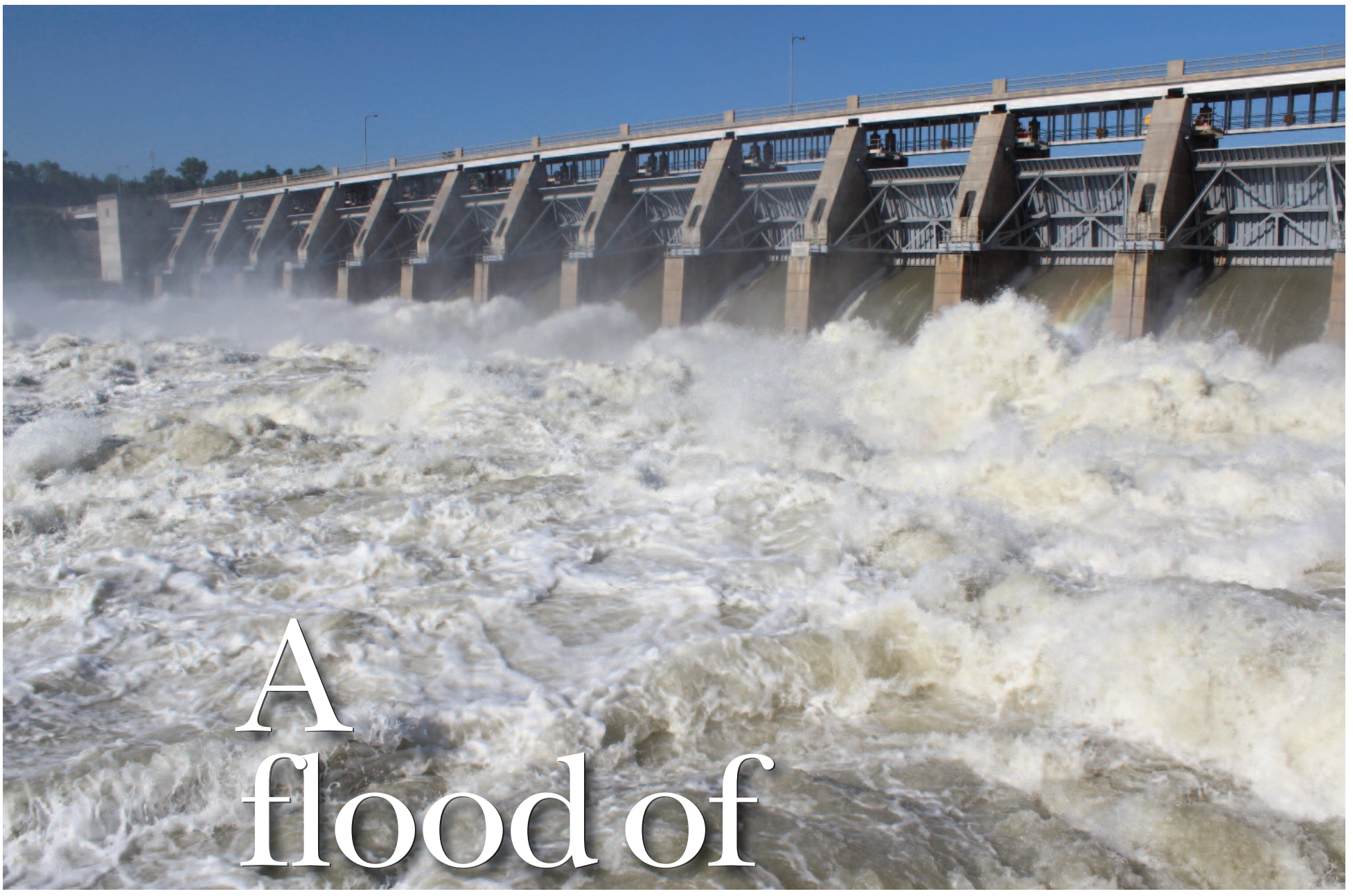


Top photograph by Ronald A. Wirtz

A flood of floods

Above: Gavins Point Dam in July, where 165,000 cubic feet of water was discharged per second, 50 percent more than Niagara Falls.

Floods are common in the district, but the floods of 2011 were anything but typical

By RONALD A. WIRTZ
Editor

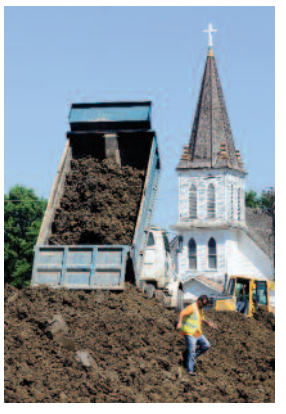
It's rare in today's media-soaked world for things to be understated. Small, even trivial, events are sensationalized, framed as epic, over the top, bigger than life.

But for the floods of 2011, it might be the opposite: too widespread, torrential and destructive to overstate their imprint across the Ninth District.

If you haven't heard much about them, you live either on very high ground or nowhere near water, for it's hard to ignore lazy rivers and streams that turn into property vandals seemingly everywhere. Floods are also tragically photogenic; they make for great news stories expressly because they are visible, personal, indiscriminating and utterly heartless.

That's what brought the national media to Minot, N.D., in late June when a biblical surge of water in the Souris River pushed through the middle of town. The spotlight also came to Billings, Mont., when a burst oil pipeline underneath a raging Yellowstone River put a slick spin on an all-too-common disaster.

Continued on page 2



In Minot, N.D., dikes built for a 100-year flood were no match for the Souris River, which inundated 4,100 homes and businesses.

These floods were also exceptionally three-dimensional, often coming at great height and velocity, and enduring for weeks, even months.

A flood of floods from page 1

Abstract:
The floods of 2011 were historical in breadth, volume and duration, particularly in the Dakotas and Montana. They forced thousands of people to flee their homes, sometimes for months. They inundated homes, damaged businesses, ruined public infrastructure and swamped local budgets. The public cost of floods—while still sketchy—will likely run into the hundreds of millions of dollars in district states; the private loss of wealth is mostly unknown, aside from anecdotes, and possibly even higher. With the exception of Minot, N.D., it could have been much worse. Cities like Bismarck and Mandan (N.D.) and Pierre and Dakota Dunes (S.D.) faced significant peril from floods. But advanced warning, heavy levee fortifying and community bootstrapping helped these communities avoid much worse fates.

In the end, however, the national media acted like a flood of their own: right here, right now and gone tomorrow. The real floods, on the other hand, stayed like an old college roommate, hanging around until everyone prayed for them to leave. While many people might have heard about the plight of Minot, few can appreciate the flood's duration in the city, said Mayor Curt Zimbelman in mid-July. Three weeks after the initial flood, "houses are still up to the middle of the picture window. It has been devastation. And that's the good areas," he said.

As such, the floods of 2011 can be hard to appreciate as a headline news story. They were so widespread, so huge in volume and so long in duration that they read more like a novel in their scale. They forced thousands of people to flee their homes, sometimes for months. They inundated homes, damaged businesses, ruined roads and bridges, turned parks into messy swimming pools and swamped local budgets. They interrupted and upended life for entire communities as never before. Flood costs will likely run into the hundreds of millions of dollars in district states—and those are just the public funds that are relatively easy to track; the loss of private wealth is mostly unknown and may run even higher than public losses.

Somewhat overlooked in the chaos of floods is a backhanded feel-good story. Were it not for aggressive, protective actions on the part of communities—including private individuals, but also numerous federal, state and local government agencies—the floods of 2011 would have been much worse, inflicting devastation far beyond hard-hit communities such as Minot and its immediate neighbors. Cities like Bismarck and Mandan (N.D.) and Pierre and Dakota Dunes (S.D.) faced significant peril from floods, but advance warning, heavy levee fortifying, community bootstrapping and even a little bit of luck helped these communities avoid catastrophe.

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One of the Minneapolis Fed's congressionally mandated responsibilities is to gather information on the Ninth District economy. The *fedgazette* is published quarterly to share that information with the district, which includes Montana, North and South Dakota, Minnesota, northwestern Wisconsin and the Upper Peninsula of Michigan.

The opinions expressed in the *fedgazette* are expressly those of the authors or of attributed sources and are not intended to represent a formal position of this bank or the Federal Reserve System.

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"A torrent of water everywhere"

Flooding is not unusual in Ninth District states. Flooding of some rivers—like the Red River, which flows north between Minnesota and North Dakota—is almost an annual ritual. This year, Fargo, N.D., saw the Red River rise 21 feet over flood stage, which sounds dramatic until you learn that this is the third year running that the river has threatened to inundate the city. Two years ago, the river crested 23 feet over flood stage and left behind an estimated $70 million in damage.

One of the big differences this year was that so much water filled so many rivers and streams, reaching so many places in the district, many of which hadn't seen significant flooding for 50 years or longer. Although historical comparisons are difficult, the floods of 2011 appear unprecedented in their breadth, depth and duration.

Ed Tinsley, administrator of Montana Disaster and Emergency Services, knows something about nature's fury. He noted that the state has "had its share of catastrophic disasters," whether flood, drought, wildfire, even earthquake. While they take a toll, "the disastrous flooding of 2011 was an unprecedented series of events. ... As we look back, and even as we look ahead, it has been an adventure on many levels."

Andy Peterson travels the neighboring state widely as head of the North Dakota Chamber of Commerce: "I get into every corner of the state. What I have witnessed is a torrent of water everywhere you go."

The U.S. Geological Survey (USGS) constantly monitors thousands of streamgages—depth sticks—to measure levels across the country, including the Ninth District. Data from these gages show the widespread nature of flooding, especially in Montana and North Dakota (see map on page 3). Between April 1 and July 31, streamgages in 74 unique rivers, streams and other tributaries in Minnesota, the Dakotas and Montana hit flood stage—the point at which a river overtops its banks and spreads onto its flood plain. These torrents affected 150 unique locations—cities large and small, as well as unpopulated rural areas.

(The northwestern portion of Wisconsin and the Upper Peninsula of Michigan, both part of the district, were not included in this analysis because these areas had comparatively fewer floods, especially large, unseasonal ones.)

Nor do these figures represent the full extent of flooding because not every river and tributary is tracked by the USGS, and even major rivers are staked only intermittently, which means that "the number of locations that have had flooding issues is actually higher than what is reflected by our gage data," according to Ryan Thompson, a hydrologist in the South Dakota USGS office.

These floods were exceptionally three-dimensional, often coming at great height and velocity, and enduring for weeks, even months (see sidebar on page 5).

Regions of the Dakotas and Minnesota are also experiencing basin flooding—a type of slow-motion flooding of glacial lakes that have no natural or significant outlets to release large inflows from rain and snowmelt. (These lakes were not included in the above flood counts and will be the subject of a future *fedgazette* article.)

Not so nice to meet you, Mr. Flood

As one might imagine, such widespread, intensive flooding puts much life and property in harm's way. There were few firm estimates of flood costs by the end of summer, especially from Montana or South Dakota, mostly because damage was widespread, and floodwaters were slow to recede and allow for assessments.

As of early September, the state of North Dakota had identified more than $500 million in flood-related costs, including $305 million in public infrastructure damage; earlier in the summer, it estimated that total public and private damages could exceed $1 billion. Almost 8,800 individuals have been approved to receive $90 million in grant assistance from the Federal Emergency Management Agency (FEMA) for temporary housing and essential home repairs. The U.S. Small Business Administration has also approved $210 million in low-interest disaster loans to residents and businesses. (Those figures will also change, given late-September deadlines for assistance.)

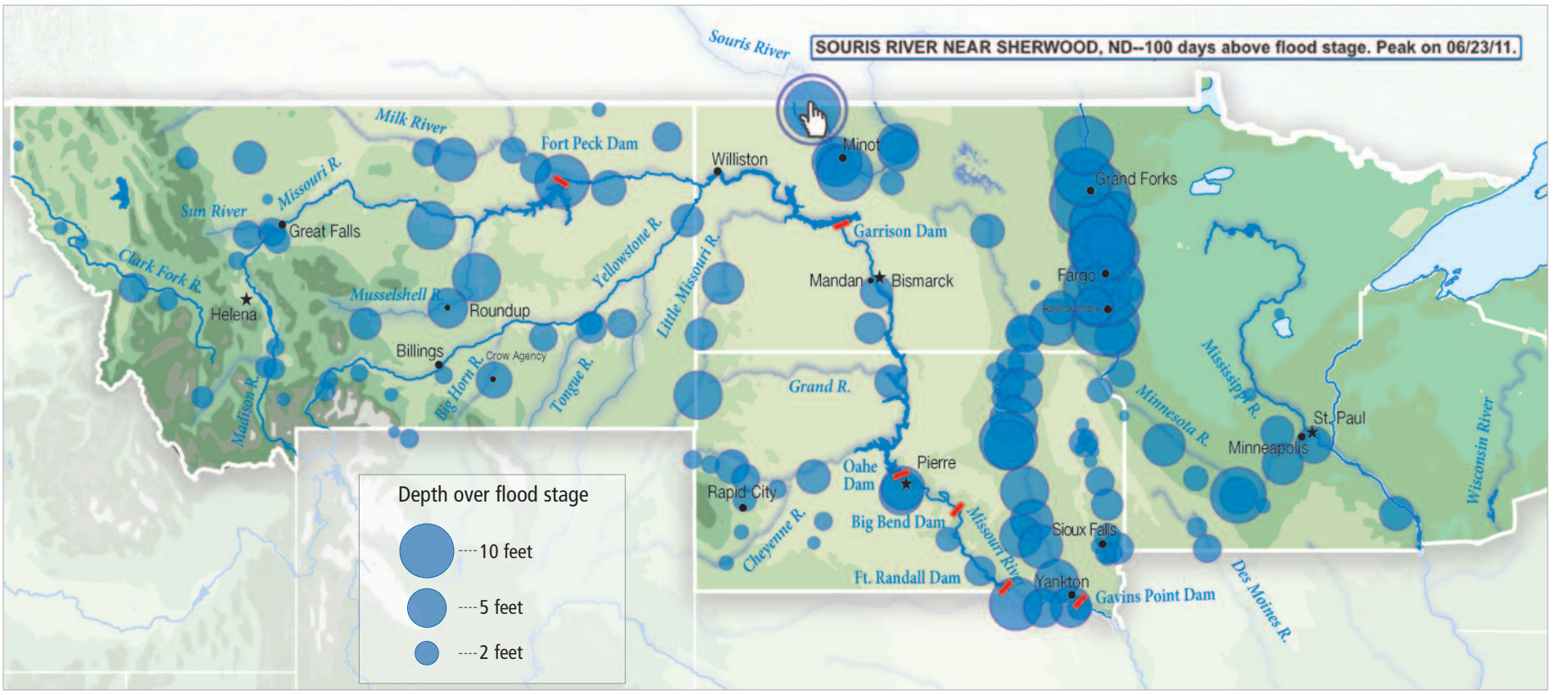
Suffice to say that where water invaded, most everything was affected—homes, businesses, roads, parks, water and sewer infrastructure, schools—life in general. (For more detail on the economic impact of floods, see article on page 11.)

Minot was flood-zero. Despite a rush

Check online

A dynamic version of this stream data can be found in the *fedgazette* online. The stream data map uses Google Public Data beta for visualizing peak flood height, duration of flood between April 1 and July 31, and day of the highest peak for each flood station in Minnesota, South Dakota, North Dakota and Montana.

Streamgage readings suggest a sense of scale of 2011 flooding



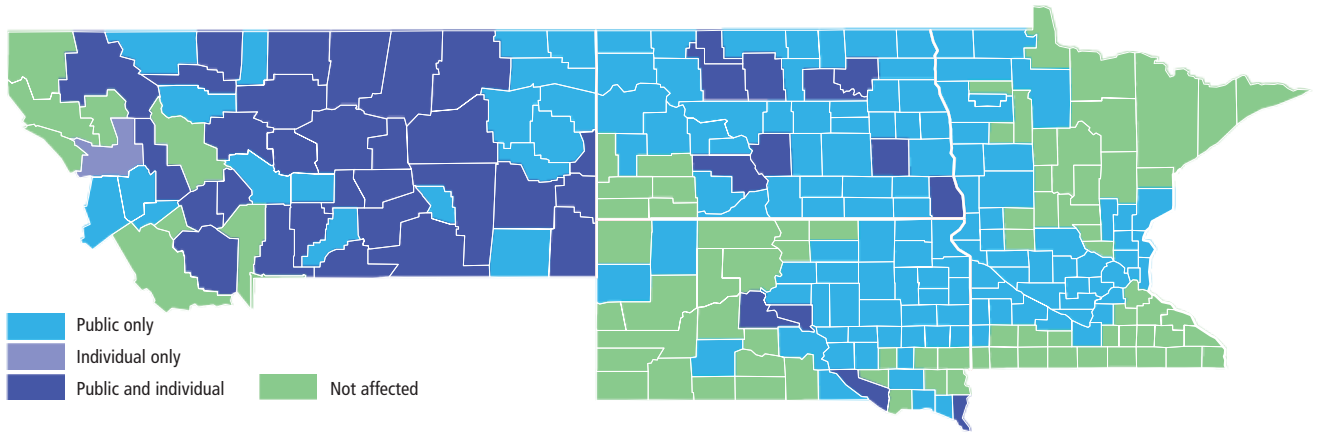
The U.S. Geological Survey has measuring sticks–called streamgages–scattered in the many rivers and their tributaries winding their way through district states. The above map identifies rivers and streams above flood stage anytime between April 1 and July 31 of this year and shows just how widespread the flooding was in the Ninth District, especially throughout the Dakotas and Montana. The map is also a conservative illustration of flooding because it shows only those areas where the USGS has a marker. For example, hundreds of miles of the Missouri River were above flood stage for most of the summer. But because its flow is constantly controlled (by the U.S. Army Corps of Engineers), the USGS has comparatively few gages marking its depth.

to build up existing levees to ward off rapidly rising water, the city watched helplessly as the Souris River filled the valley and with it the oldest portions of the town that had grown up around it. Some 4,100 structures—mostly homes and businesses—were inundated, about 80 percent of which took at least six feet of water on their main floor. An analysis by Job Service North Dakota identified 283 businesses located in the flood zone. Affected businesses included "hotels to insurance companies to Dairy Queen. It runs the gamut," said David Waind, the city's administrator. He noted that "even Red Cross is flooded out" and had to shift its daily office operations to the municipal auditorium, the same building from where it was coordinating relief help and emergency shelter for residents. (See sidebar on page 8 for more on Minot.)

But while Minot received the lion's share of media attention, many other places also suffered significant flood damage. In Montana, the Dakotas and

Continued on page 4

Disaster assistance to Ninth District counties



When disaster strikes, FEMA has tiered aid programs that reimburse local governments and residents for expenses related to flood prevention and cleanup. Disasters are declared at the county level and officially made by the president of the United States in consultation with FEMA. The first level of disaster aid is called **public assistance** and is declared where flood-related costs and damage to public property exceeds FEMA-defined thresholds. Reimbursements go only to local governments. **Individual assistance** is disaster aid for homeowners and businesses, and damage thresholds are considerably higher. Where designated, homeowners become eligible for grant assistance that tops out at about $30,000; businesses are eligible only for low-interest loans through the Small Business Administration.

"Over the first two or three weeks, it was a panic" to get the dikes built, and then praying they would hold. —Ray Roggow, emergency services director, Union County, S.D.

A flood of floods from page 3

Minnesota, two-thirds of all counties (193 in total) and 12 tribal reservations have been declared flood disaster areas this year, making governments in those counties and reservations eligible for federal assistance to help pay for flood-related damages and other costs.

As of September, 45 counties and five reservations in Montana and the Dakotas were also eligible for individual federal disaster assistance, which signifies much more extensive damage. The program offers up to $30,200 in individual grant assistance to households and makes low-interest loans available to homeowners and businesses, but eligibility is much stricter than assistance for public infrastructure damage.

In Montana, 70 percent of the state, local and tribal jurisdictions declared emergencies in response to flooding. But even the counties that didn't declare local emergencies still reported some flooding, said Monique Lay, a spokesperson for the state Disaster and Emergency Services Division. "So, truly, the flooding was statewide." She added that the state hasn't had an individual assistance declaration in over 20 years, "so this has been quite an adventure for us. It certainly would have been easier to address had the disaster been more concentrated. The vastness of it has made it a much lengthier and more complicated response and recovery—very similar to the hurricanes that traveled all the way up the East Coast."

The hardest hit areas included Crow Agency about 60 miles east of Billings (which itself saw flooding and national news coverage when a gushing Yellowstone River carved out enough of its bottom to expose and break an oil pipeline). At Crow Agency, the home of the Crow Tribe, late-May flooding of the Little Bighorn River killed two people. About 300 people had to be evacuated, and water reached the main floor of 60 homes; 23 saw major damage. The flood also knocked out the reservation's water and sewer systems and closed 70 miles of Interstate 90 for five days. In June, the tribe was forced to lay off 150 workers—about a fifth of its workforce—due to flooding.

About 20 miles west of Great Falls, the Sun River flooded 55 homes in its namesake city in June. Yet by mid-July, many still did not have drinking water—some wells had tested positive for coliform bacteria—and portable toilets and showers had to be brought in for residents.

In the Dakotas, aside from Minot and its immediate small-town neighbors (like Burlington, which reportedly lost about one-third of its 320 homes), the flood appears to have done its worst to low-density residential areas without the capacity or resources to mount a defense against rising waters. In Burleigh County, home to Bismarck, a marauding Missouri River damaged 450 homes; 75 were severely damaged or destroyed. Virtually all of them lay outside the city.

Across the river in Morton County, another 75 or so homes were ravaged, mostly in township developments along the river north of the city of Mandan, according to Bruce Strinden, chairman of the Morton County Board of Commissioners. While the county would like to have offered residents more protection, it could only provide sandbags and fill. The rest was up to residents. "It's extremely difficult for government entities to protect rural residences. We don't have enough people to sandbag" all the property that would have been necessary to protect rural developments, said Strinden.

The Missouri River found similar low-lying victims as it flowed southward, near Pierre and Fort Pierre and in rural developments in southeastern counties. At Riv-R-Land Estates, a private subdivision at the southeastern tip of South Dakota, 52 of the 56 homes flooded and

Continued on page 6

Table 1

Homes waterlogged

Number of flooded houses, by water depth on main living floor, identified by August

State	Destroyed (more than 10′)	Major (6′ to 10′)	Minor (2′ to 6′)	Slight damage (0.5′ to 2.0′)
Montana	15	102	256	221
North Dakota*	831	2,427	967	416
South Dakota	7	104	301	238

*Roughly 90 percent of the inundated homes in North Dakota were in the Minot area.

Sources: Montana Department of Disaster and Emergency Services; North Dakota Office of Emergency Services; South Dakota Office of Emergency Management

Ronald A. Wirtz

Linn Thomas

Amid the flood: Heartache, hard work and hope

Linn Thomas and Peggy Petry are neighbors outside Mandan in rural Morton County, N.D. In late May, the Missouri River was predicted to reach historic heights—enough to reach halfway up both homes. So the two joined forces to move out their possessions and build a six-foot wall containing 30,000 sandbags around their two houses.

"We built the Great Wall of China and moved out in eight days," said Thomas.

The water came as predicted, and the sandbag dikes held, but they were powerless to prevent an immense influx of groundwater. Luckily, the property retained power, and both homeowners ran 15 pumps around the clock to remove thousands of gallons an hour of groundwater seepage—which they did for the next seven weeks—Thomas said during a visit in mid-July. They expected to have to keep pumping for several more weeks.

Having just come from his home—via boat—and standing on a highway-turned-boat-dock, Thomas said they've managed to keep their homes dry for the most part; both houses have water in their crawl spaces, but their main floors are dry. If the pumps go down, "in two hours, we'll have a lake in our house," he said. By about mid-July, Thomas had burned out three pumps.

He took turns with Petry's two grown sons to keep an eye on both properties. Thomas mans the pumps four days a week, and Petry's sons cover the other days. Thomas is an employee of Morton County. "I work the most I can," he said. "My bosses and co-workers are behind me." The time off is unpaid, and Thomas said he has had to spend $5,000 in retirement funds to buy pumps and other items in the fight to keep his house dry. He has no flood insurance. His wife is staying elsewhere, and the couple is getting $477 in rental assistance from FEMA.

Despite the personal and financial toll, Thomas and Petry both put a positive spin on their predicament. Petry, for example, said her electricity bill increased from a typical $150 per summer month to $740 because of the constant pumping—and she seemed almost happy. "It could have been worse. I was expecting $1,000," she said.

Asked about having to deal with the flood since late May, Thomas said with a tired voice but not a shred of sarcasm, "We have a lot of hope." He noted optimistically that the water level outside the dike had dropped, even though at the time it was less than an inch from peak. "We can't look a month down the road. We try to get through tomorrow."

—Ronald A. Wirtz

At the Oahe Dam near Fort Pierre, S.D., normal summertime river flow is 24,000 cfs, according to Mayor Sam Tidball. "We got up to 160,000. That's one hell of a difference."

Souris River floodwater in Burlington, N.D.

A long, tall slap of water

The breadth of flooding is only one of its noteworthy dimensions. Just as remarkable is its collective depth and duration.

Many rivers and streams overtop their natural holding pens in spring, or during heavy rains, and some flooding in the district was of such garden variety. But most rivers and streams didn't flood just a little. In district states, 18 rivers or tributaries rose at least five feet above flood stage at more than 40 locations (and given data limitations, there were likely more). In many of these rivers, flood stage is between 8 and 15 feet of river height, which means many sloshed easily and widely over their natural borders. The Wild Rice River near Abercrombie, N.D., shot past its flood stage of 10 feet to peak near 26 feet.

In fact, depending on location, it doesn't take a big rise in river level to cause serious consequences. "Depending on how flat the topography is, even one foot above flood stage can inundate a lot of land," said Ryan Thompson, a hydrologist with the South Dakota office of the U.S. Geological Survey. For example, "the James River basin is very flat along most of its length, so small rises above flood stage can submerge a lot of agricultural land."

This year the James' rise was not small. The river also known as "the Jimmy" runs the vertical length of South Dakota, and USGS markers in eight locations across the state showed that the river rose between 5.8 feet and 11 feet over flood stage—a level sufficient to swamp thousands of acres of farmland. The basin's flat topography also means that the water meanders, in no hurry to go anywhere—one reason that seven of these eight locations had been flooded for 120 days at the beginning of August.

Indeed, maybe more than any other characteristic, the floods of 2011 will be remembered—water-tortured into local memory—for their longevity; they lasted weeks in many places (see chart at top right). "People expected the flood to exit quickly. This is a different breed; it's much longer going away," said Bill Wocken, Bismarck, N.D., city administrator.

More like the Big Meanie

It's hard to say just how much dry land, how many homes, how much community got swallowed by floods in the district because existing data systems don't track inundation (though new satellite and other technology may change that, at least for future floods). But other measures such as a river's discharge—how much water is passing by at a given moment—help to illustrate the sheer volume of water involved in this year's flooding.

USGS data show that the 2011 floods have obliterated flow records in many rivers and streams. Twice in the span of about two weeks, the Musselshell River flooded the city of Roundup, Mont. The first onslaught came suddenly, in the middle of the night on May 26. Average flow for that time of year, according to USGS data, is about 600 cubic feet (or about 4,500 gallons) per second. The previous week, the Musselshell's water levels were elevated and rising, and by the morning of May 25, water was whistling by at about 3,500 cfs.

Turns out that the Musselshell was just getting warmed up. By the end of the next day, it would briefly touch 15,000 cfs. Flood stage is 10 feet; the river roared to almost 15 feet, close to 2 feet higher than the previous mark set in 1975. A week later, the water finally fell below flood stage, only to quickly swell again on June 8, topping 14 feet for a repeat dousing of Roundup. The river didn't fall below flood stage again until June 18.

Dozens of other small watercourses in the district have a similar story, and most of them eventually pour into the Missouri River (see map on page 7). The results were predictable. This summer, the Big Muddy reached levels not seen since the Pick-Sloan Act slung a harness on the river back in the 1940s. The law authorized and paid for the U.S. Army Corps of Engineers to install five additional dams (one in North Dakota, four in South Dakota) to go along with the Fort Peck Dam in Montana. The dams created monstrous reservoirs that could hold water as needed while controlling downstream releases at each level. The six impoundment lakes—among the largest freshwater lakes in the country—can hold enough water to put the entire state of North Dakota about a foot and a half underwater.

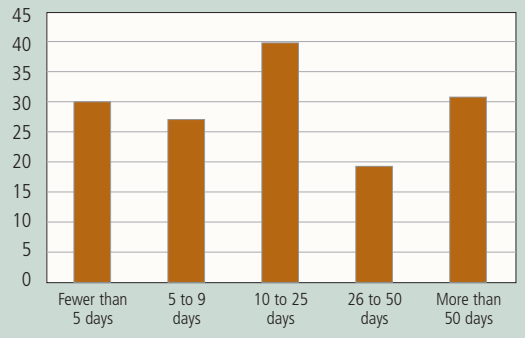
Normally, the reservoirs have ample room to absorb spring rains and snowmelt, but this year's runoff was unprecedented. The Army Corps measures total runoff into the Missouri River above Sioux City, Iowa, in acre feet (an acre of water 1 foot deep, or about 325,000 gallons). This past June, runoff in the region was 13.8 million acre feet (MAF), the single highest monthly runoff since recordkeeping started in 1898. This outpouring came on top of May runoff of 10.5 MAF, the third-highest monthly runoff ever recorded. In those two months, the Missouri basin absorbed as much water as it typically receives in an entire year.

So much water came, so quickly, that the Corps was forced to literally open the floodgates. The river's six dams in the district were opened wide so that each discharged 150,000 to 165,000 cfs for much of the summer. Not only were these record flows—by far—for each individual dam, but each was releasing 50 percent more water than Niagara Falls on a high-flow day. At the Oahe Dam near Fort Pierre, S.D., normal summertime river flow is 24,000 cfs, according to Mayor Sam Tidball. "We got up to 160,000. That's one hell of a difference."

—Ronald A. Wirtz. Aaron Richins, research assistant, contributed data research to this article.

Flood, flood, go away

Number of locations* above flood stage, between April 1 and July 31, by duration

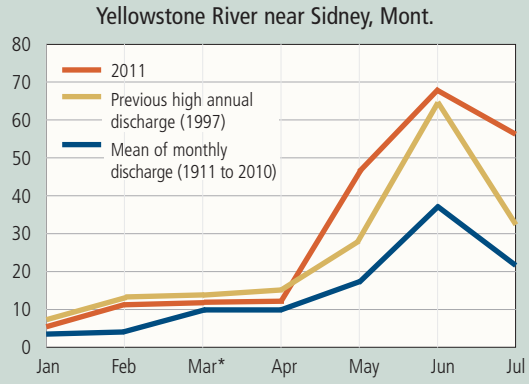


* A location is a water-level gage, often identified by a nearby city, town or township. Source: U.S. Geological Survey

Hope you brought your waders

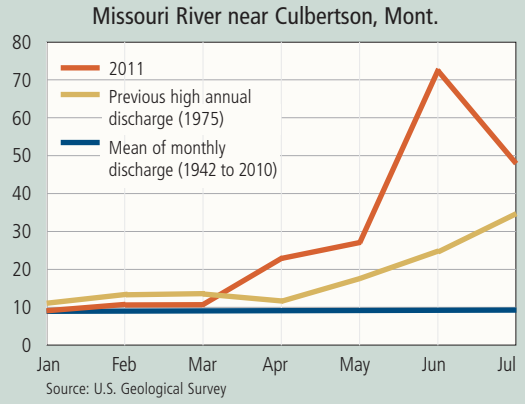
Mean daily discharge per month (thousand cfs)

Yellowstone River near Sidney, Mont.



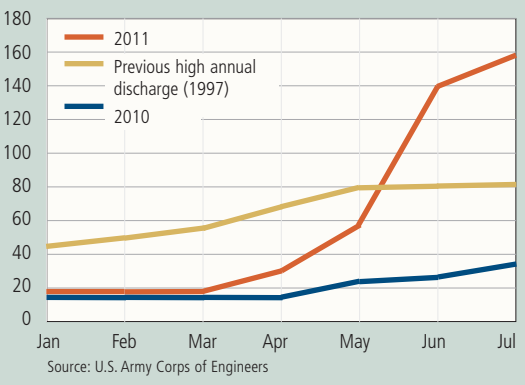
*March 2011 discharge is an estimate. Source: U.S. Geological Survey

Missouri River near Culbertson, Mont.



Source: U.S. Geological Survey

Missouri River at Gavins Point Dam near Yankton, S.D.



Source: U.S. Army Corps of Engineers

A flood of floods from page 4

42 sustained major water damage, according to local officials.

Only grazed by the bullet

Amid the widespread flooding and severe damage to some areas, many people and communities were fortunate, narrowly avoiding disaster.

In South Dakota, for example, roughly 2,800 homes were under voluntary evacuation orders, and untold numbers of others were in the flood's path, mostly on the Missouri River. But floods ultimately hit about 650 homes, according to August estimates. Outside the Minot catastrophe, about 500 homes were inundated elsewhere in North Dakota—less than 10 percent of the (non-Minot) homes originally believed to be in the flood's path. About 600 homes were inundated in Montana.

In the southeastern South Dakota county of Yankton, some 400 homes were believed to be in the Missouri's floodway, according to Carmen Schramm of the Yankton Chamber of Commerce. But "actual water invaded about 20-some (homes). … Not to minimize [those affected], but we have a lot to be thankful for."

Part of the reason for the lesser impact was the nature of these floods. For one, the Missouri's flow was so large and swift that the river scoured itself deeper, allowing its expanded channel to hold more water. In some places, this scouring reportedly took almost a foot off the river's eventual crest.

But probably more important, the floods announced themselves well in advance—thanks to close tracking by the USGS and the U.S. Army Corps of Engineers—which helped mobilize private individuals and governments, either to protect assets or to move people and property to higher ground.

(It should be noted that the Army Corps has taken blistering criticism for its management of the Missouri River before and during the flood, as well as its subsequent predictions of flood crests, which were frequently revised upward during critical planning and mobilization stages in late May and early June. These matters deal with, among other things, the Corps' multi-headed and often conflicting missions and are outside the scope of this article. Irrespective of the Corps' performance in helping to mitigate the floods themselves, or accurately predicting the timing and size of crests, numerous community officials lauded the agency for its help and expertise in building protective levees.)

Trace a route down the Missouri River—which overwhelmed virtually every water level and flow rate on record since the dam-and-reservoir system was completed more than half a century ago—and the potential for catastrophic loss was palpable. For example, when the Corps released final projections of flood peaks along the Missouri, Bismarck faced the likelihood that an estimated 5,550 structures, mostly homes but also 70 commercial buildings, would be inundated, according to Gloria David, the city's public information officer.

Those projections jarred residents and local governments into action. Over the next week or so, a total of 8 million sandbags were filled in Bismarck and the surrounding area. Businesses and residents—often aided by higher-ground community members—walled off their properties as best they could, not knowing if the city could build more substantial levees in time or whether they would be on the dry side of the levees if they were built.

In the span of a week, with major help from the Corps, about nine miles of levees in the city and county were thrown up to protect everything possible, given the time and material available. Based on 2000 Census data and inundation estimates, the homes of 14,000 people were shielded by these levees and dikes. Thanks to the levees and river crests that were a foot lower than predicted, no homes or businesses within the city limits of Bismarck were inundated, David said.

Across the river in Mandan, city administrator Jim Neubauer said roughly 420 homes were in harm's way. But not a single home or business was damaged by overland flood waters, "mainly due to protective measures that were put in place."

Float down to Pierre, and community development coordinator Scott Carbonneau estimated that 400 to 500 homes were initially at risk. The Corps built two levees protecting most of the city's southern flank and the wastewater treatment plant, and the city reinforced those by tying them together with a third levee. In all, about three and a half miles of levee were built. As a result, the city "was largely unscathed in a direct sense. I believe we have only seen one or two homes with actual floodwater," Carbonneau said.

In Fort Pierre, across the Big Muddy, an estimated 600 homes—in other words, most of them—"would have been inundated and received substantial damage" given the river's predicted crest,

Continued on page 8

River basins in the Ninth District

Although historical comparisons are difficult, the floods of 2011 appear unprecedented in their breadth, depth and duration.

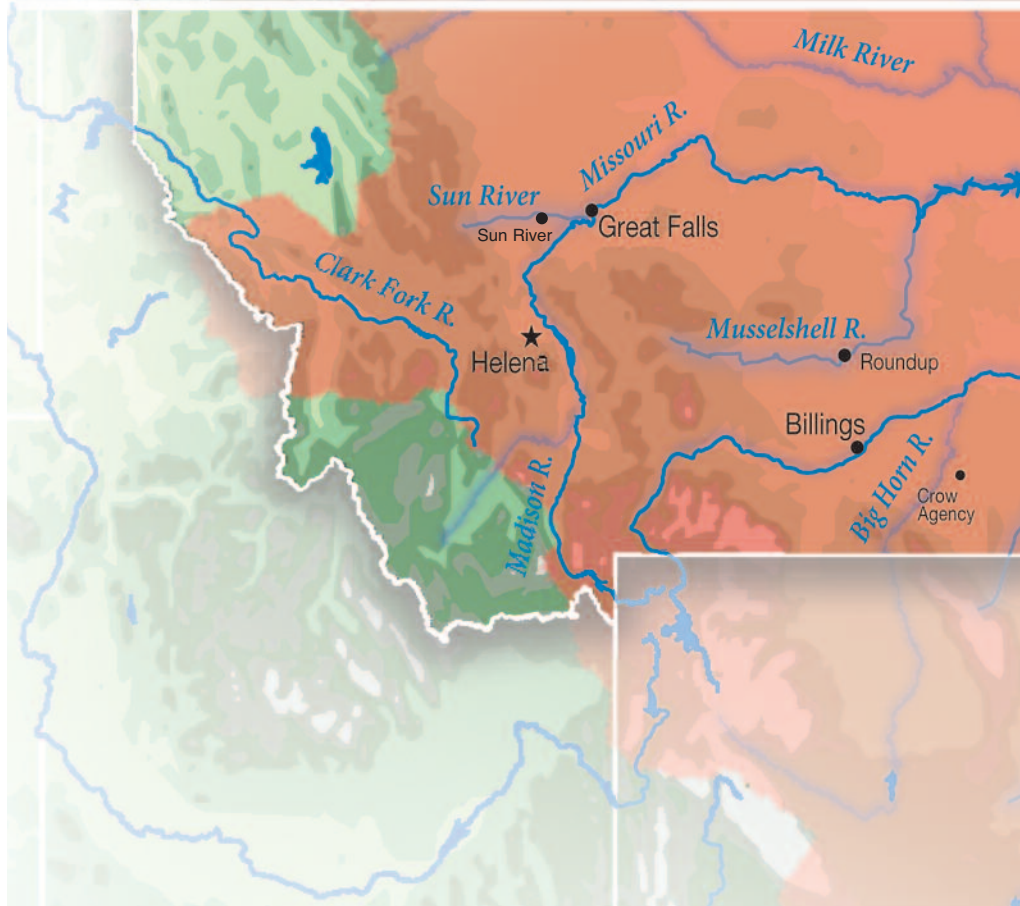
Montana

27 different bodies of water were above flood stage at some point since spring

Sun River

55 homes inundated in June

Many without drinking water into July



Yellowstone River

Oil pipeline dug out and broken by the raging river

Roundup

Flooded twice in two weeks

North Dakota

15 different bodies of water above flood stage by an average of 6.5 ft., and for an average of 46 days

(as of August 1)

Minot

4,100 homes and businesses inundated

Bismarck

8 million sandbags filled

Garrison Dam

Emergency gates opened for the first time ever

Souris River Basin
Souris River
Minot
Fort Peck Dam
Williston
Yellowstone R.
Missouri River Basin
Little Missouri R.
Garrison Dam
Mandan
Bismarck
Red River Basin
Red River
Grand Forks
Fargo
Abercrombie
Upper Mississippi River Basin
Lake Superior
Tongue R.
Grand R.
James R.
Minnesota R.
Mississippi R.
St. Paul
Minneapolis
Wisconsin River
Lake Michigan
Rapid City
Cheyenne R.
Oahe Dam
Pierre
Big Bend Dam
Missouri River
Sioux Falls
Ft. Randall Dam
Yankton
Gavins Point Dam
Dakota Dunes
Des Moines R.

Pierre

3 million sandbags filled

Gavins Point

165,000 cfs
50% more than Niagara Falls

Dakota Dunes

300,000 cubic yards of fill for levees

1 dump truck every 45 seconds

James River

Eight locations on the river were above flood stage for more than 100 days

Photographs: Roundup, MT.—Larry Mayer, The Billings Daily Gazette, Garrison Dam, Riverdale, N.D.– Maj.Gen. David Sprynczynatyk, N.D. National Guard

A flood of floods from page 6

said Mayor Sam Tidball. The Corps installed a dike protecting the older, eastern portion of the city, where most of the city's commerce takes place, but left unprotected most residential areas, located to the north along the river.

But Corps policy is to build levees only where significant public infrastructure—water and sewer plants, roads, schools and other public buildings—are at risk. So the Corps did not act to protect all areas of a given city, even if homes were clearly in danger. As happened in other cities, Fort Pierre hired a private contractor to build a second dike two feet above projected flood stage to protect as many homes as possible, Tidball said. After all the work, Tidball estimated that 25 homes were inundated with water. "There was not a terrific amount of damage, which is amazing given the height of the river," he said. "There wasn't more major damage because we got the dikes built."

Even where cities got involved in levee building, difficult decisions had to be made, because the exigencies of levee placement often do not conform to the jagged boundaries of cities. "You hate to see people unprotected, but that's the nature of dikes," said Bill Wocken, Bismarck city administrator.

In that city, despite intensive levee building and sandbag filling, pockets of homes went unprotected, like the well-to-do Southport neighborhood on the banks of the Missouri, which the city controversially decided to leave on the wrong side of the levees. Southport residents reportedly spent upward of $3 million of their own money to erect private levees and pump out groundwater, successfully protecting 226 homes from flooding.

Earthen fences make good neighbors

No single location probably benefited more from Army Corps levees than Dakota Dunes, S.D., a town of 2,500 situated a stone's throw from Nebraska and Iowa in the southeastern corner of the state. About 460 homes in this upscale bedroom community would have filled to the rafters without a massive, four-mile levee built over the course of about a week in June.

Ray Roggow is the emergency services director for Union County, home to Dakota Dunes. Ironically, Roggow was fishing on an upstream stretch of the Missouri River when he received word that the Corps planned releases from Gavins Point Dam near Yankton that would ultimately inundate Dakota Dunes downstream.

"I said, 'Roll up your reels; we gotta go' because I knew we were in big trouble." At the time, the Corps was predicting discharges of 85,000 cubic feet per second, a record amount at the time. A few days later, Roggow said, "85,000 went to a whole lot more"—eventually 165,000 cfs—and the wheels of flood protection went from first to fifth gear with little shifting in between. "Over the first two or three weeks, it was a panic" to get the dikes built, and then praying they would hold, Roggow said.

With dump trucks unloading every 45 seconds, 300,000 cubic yards of fill was spilled and graded as a sodden barrier between the river and threatened homes, up to 12 feet high in places. As of August, not a single home behind the levee had taken floodwater.

Among other heartaches, the flood "shut down one of the most unique golf courses in South Dakota," with its signature hole number 18 and others underwater or bisected by the levee, Roggow said. "But had we not got the levees up, we would have had devastation."

Something in the water

But make no mistake, there is misery, and it will linger. Homes and businesses inundated with water have months of dreary, backbreaking cleanup ahead of them; tens of thousands of others,

Continued on page 10

Table 2

Narrow misses

City	Homes at flood level	Homes inundated	Total inundation in home county
Bismarck, N.D.	5,500	0	About 450 homes in Burleigh County
Mandan, N.D.	420	0	About 75 homes in Morton County
Pierre, S.D.	400–500	1 or 2	Several hundred homes in Hughes County
Fort Pierre, S.D.	About 600	About 25 (all outside of levees)	Several hundred homes in Stanley County

An earth mover packs down a dike as higher crest estimates of the Souris River were announced.

Minot

Reeling but resilient

They saw it coming. They just didn't see *this* coming.

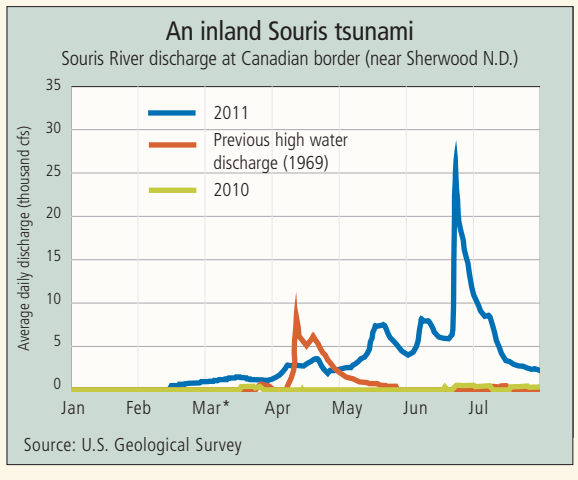
Minot, N.D., captured the nation's attention for a few days in late June when the city discovered that a quarter of its homes would get flushed by a lazy-turned-raging Souris River, which flows south from Canada, meanders through the heart of Minot and eventually makes its way back up to Canada.

On a normal summer day last year, the Souris flowed at a couple hundred cubic feet per second (cfs), a rate that would fill an Olympic-sized swimming pool in about four minutes. By May, major flooding was predicted, but existing levees were believed sufficient to avert severe damage. Built after a disastrous 1969 flood, the dikes were designed to protect the city against a 100-year flood in which the Souris was expected to reach 5,000 cfs, a fill rate of about 20 seconds for that same Olympic-sized pool.

"It worked as designed every year since it was built," said David Waind, city administrator.

But record rain fell in May in northern Canada and flowed southward in the Souris. Based on early warning and river crest estimates, the city twice hired contractors to raise dikes to withstand 11,000 cfs—the river's record flow during the 1969 flood.

It wouldn't be enough to stop the Souris. Final estimates of river crests were cartoonishly large—the type of deluge that occurs once every 500 years. A late warning made matters worse; Minot received just three days' notice of the eventual river crest, in part because heavy rains came in remote parts of Canada where the government doesn't maintain streamgages. In contrast, most cities on the Missouri River received seven to 10 days' notice of historic river crests—advance warning that can make a world of difference in flood preparation. Said Waind, "If we [had] had early warning, it might have taken the edge off of [damage] because we would have had three or more [extra] days to prepare. It gave us very little time to react."



On June 23, the river also known as the Little Mouse roared to 29,000 cfs (see chart), almost three times its previous peak flow. Enough water to fill that Olympic pool in three seconds swamped all man-made defenses; more than 10,000 people were evacuated ahead of the flood, as the Souris eventually rose 4 feet higher than ever recorded.

The flood gutted the valley, the oldest and most heavily developed portion of the city. Roughly 4,100 homes and businesses were inundated, most of them catastrophically. The Souris remained at flood stage for weeks, wreaking havoc on efforts to clean up and assess damage.

Floodwaters reach homes on East Central Avenue near Roosevelt Park and Zoo.

Work proceeds on a dike, privately built to protect a small business.

Sudden impact

Whenever the flood's final tally is tabulated and underlined, it will be large. The city's infrastructure has been hit hard. Twelve of its 27 lift stations used to pump water were down this summer, and officials suspect that some water mains have been crushed. Others simply are not operating. Sinkholes have eroded some city roads from the bottom, and heavy equipment has trashed others from the top. The zoo was closed and the animals moved to safer ground. Parks turned into fouled and debris-strewn lakes, and some 60 park buildings were damaged. In late August, Ron Merritt, the city's parks director, put damage to the city's parks system, including zoo, golf course and swimming pools, at $25 million to $50 million.

Six Minot school buildings, serving about 1,200 students and 50 adult learners, suffered major damage. None will be usable this fall, according to Scott Moum, district business manager. Moum said in July that damage estimates were uncertain, "but could run upwards of $50 million," and that doesn't include the cost of bringing in 60 temporary modular units. Though federal and state government will cover most of these recovery costs, Moum said the city's property tax base—which provides the bulk of school revenue—is expected to drop by 15 percent, denying the district about $2 million in funds for the coming year "and possibly twice that [amount] in 2012-13."

But thanks to Minot's proximity to the booming oil patch in western North Dakota, the city has seen strong growth in recent years, which has given it the wherewithal to deal with the flood. For example, the city plans to reduce property assessments for flooded homes and businesses to zero for the remainder of the year, halving annual tax bills of those affected. That's a big budgetary hit, but Minot has been growing so fast that higher revenue from local sales tax and higher property values in nonflooded areas will largely offset the property tax reduction for flooded areas, according to Waind.

But the flood has also compounded growth-related problems. The city's infrastructure needed upgrading before the flood because of torrid oil-related growth, Waind said. Before the flood, the city had identified $120 million in sewer, water, road and other infrastructure improvements needed simply to accommodate a burgeoning population. Now the flood has pushed that cost much higher. "We gotta do what we gotta do," he said.

Similarly, the flood has exacerbated a long-standing housing shortage. Val Bruels, a real estate agent with Prudential Minot, said monthly average rents have doubled in the past few years, with the rate for smaller or lower-end apartments increasing to about $700. Bruels did a citywide search in July and found 41 available properties (home, condo, apartment) for sale or rent. But 26 were either flooded or not ready for occupancy, leaving just 15 available housing units in a city of 40,000. Some landlords are taking advantage of very tight supply to increase rents further, Bruels said. "People are getting gouged."

The flood gutted the valley, the oldest and most heavily developed portion of the city. Roughly 4,100 homes and businesses were inundated, most of them catastrophically.

Business as unusual

Not surprisingly, the flood disrupted any notion of normal business.

In mid-July, when officials closed Broadway Avenue—the main north-south route over the river and through the city—"luckily we didn't have to worry about any customers," joked Charles Kramer, president of I. Keating Furniture. The business saw orders canceled by people who no longer had homes or apartments to put furniture in and by those who considered such expenditures ill-advised, given the circumstances.

Kathleen Gaddie, president of Ryan Family Dealerships, said none of the firm's three car dealerships around town flooded directly, "but nobody wanted to buy a car" in a community in crisis. Most companies also sustained productivity losses because employees were flooded out of their homes. At Ryan, 31 of 130 employees lost their homes. "There's a lot of people that don't know what to do," Gaddie said.

Richard Campbell, executive vice president of First Western Bank and Trust in Minot, said 22 of 100 employees were affected by the flood. Of these 22 homes, 18 "were flooded up to the rafters," and only three had flood insurance. So the bank went into flex mode. "Whoever needed time off or wanted to help out, we let off. … A lot of them were very appreciative."

The outlook for the business community is uncertain because so many people face an uncertain future. Several sources speculated that many fixed-income residents will leave because they have no good reason to stay. Elderly people, for example, have little incentive to slog through the hassle and expense of rebuilding or finding a new place to live in a very tight housing market.

Jon Backes is a partner at the law firm McGee, Hankla, Backes & Dobrovolny. He said one client, a 79-year-old retiree, "was flooded up to the rafters, and he said, 'I'll either go to California or Minneapolis (where his two kids live). I see no reason to rebuild here.'"

For businesses, "people don't know where they should invest," said Kramer, pointing out that discretionary income is going into home repair and other things considered more essential. For businesses selling more discretionary goods and services, "it's going to be a problem for a while."

It's all part of the weary rebuilding process, said Kramer. "Everyone is seeking the new normal … This is almost like a death. They are going through that process of grieving for their home. You have to be sensitive. There's a lot of standing around the coffee pot. They have to do that."

In many ways, affected city residents got an early start on the grieving process by leaning on others in the community for support. The flood displaced between 10,000 and 12,000 people. Yet the number in three emergency shelters for homeless residents numbered only about 350 at the height of the flooding. Of the rest, "the vast majority are with family and friends," said Waind—evident by the many campers, RVs and tents around town this summer; entire neighborhoods were camped out as though they were gathered for family reunions or Fourth of July celebrations.

Wendy Howe heads the city's convention and visitor's office and was one of thousands forced out of their homes—her basement swamped and 5 feet of water on the main floor. When she was finally able to get into her house to assess the damage, mold had already spread to the ceiling, "and everything has to come out down to the studs."

Like most, her home was not insured against flood. She inquired about it earlier in the spring, but decided against it because more than 40 years had passed since the valley had flooded, before the construction of the dikes and dams to control the Souris. She expected to receive assistance from the federal government to help pay for rental accommodation.

But Howe has every intention of rebuilding, whatever it takes. She expects nothing less of the city. "We can't pretend there won't be an impact," she said. "But Minot is called the magic city, and the magic is its resilience."

—Ronald A. Wirtz

If water tables don't drop before the freeze, the aftermath of the floods will wreak additional havoc on public and private water and septic systems.

A flood of floods from page 8

including those in Dakota Dunes, are coping with groundwater in basements and crawl spaces. Some rivers and streams remained above flood stage well into August, and where water lingers, mold takes hold.

The duration of floods also leaves scant time for critical cleanup before frost and snow freeze the mess in a cold time capsule until next year's thaw. And if water tables don't drop before the freeze, the aftermath of the floods will wreak additional havoc on public and private water and septic systems.

Local governments spent many millions preparing for the flood and protecting residents from it. But it will take many more millions to repair the damage to roads, bridges and other public infrastructure once things dry out, though the financial strain is cushioned by federal and state disaster reimbursement programs.

The same is not true for homeowners and businesses, whose properties were generally not covered by insurance. Officials in Minot estimate that only 10 percent of inundated homes were insured for flood, and anecdotes from elsewhere suggest similarly low coverage. Most people didn't buy insurance because they believed that flooding was unlikely; and if it did occur, existing levees and other measures would protect them. Now, only the most egregiously damaged areas will receive grant assistance from federal disaster programs, and it won't come close to covering private losses.

The floods have also imposed myriad small indignities on community life. The North Dakota State Fair in Minot had to be canceled this year because of damage to the fairgrounds and the city's general state of emergency. "For the city, it's a difficult thing to lose," said Waind, city administrator. But he admitted (and other local sources concurred), "I think there was a little bit of relief."

Many people spoke of stress and depression, and of a grieving process similar to that experienced with the loss of a loved one. Some of that grief is over trees—millions upon millions—that are feared drowned because roots have been submerged for weeks on end, starved of oxygen.

Communities likely will have to rebuild with less help from the outside compared with previous major disasters. In the 1997 flood that devastated Grand Forks, the city received a pile of federal money from a variety of agencies to help affected homeowners, businesses and local governments, with grant money for home buyouts, new flood protections, even new home building. Said one North Dakota state official: "Grand Forks was made whole."

While Minot will receive significant reimbursement for the money spent preparing for and cleaning up after the flood, fiscal realities at the federal level mean the city and its residents will bear more of the costs of flooding—including improvements to existing flood protections—than Grand Forks. "We're telling them that. You might as well tell them the facts," said the state official.

In Pierre, Mayor Laurie Gill was asked if the city expected any additional support beyond FEMA assistance. "I'm not getting my hopes up," she said.

At the same time, Gill and other local sources repeatedly expressed pride at the can-do mentality of their communities. Residents across the district played an integral role in efforts to protect the property of family, friends and complete strangers, particularly early on when communities were scrambling to develop and execute broader safeguards. An estimated 15 million to 18 million sandbags, and possibly more, were filled by local government workers, residents and even nonresidents looking to help.

Gill insisted on that bootstrapping early on. Once it was known how severe the flooding would be, the city told residents "to prepare as if there is no government [flood] protection. We didn't want to get into that pickle." City engineers, with the help of private contractors, went neighborhood to neighborhood measuring property elevations and scratching lines on homes to show people how high the flood would get and telling them where they could find sandbags.

After the floods, Pierre is facing steep costs—upward of $13 million, according to the city—for myriad repairs to roads, water systems, parks, a municipal golf course and other items. "It would be easy to get sucked into the gloom and doom, the oh-woe-is-us," said Gill. "But there's a [recovery] plan, and we're organized." She pointed to recent efforts to oversee cleanup and debris management, a recovery group that includes community stakeholders and a public facilities committee that is focusing on long-term restoration of the city.

The city is also sitting on a healthy fund balance of $11 million, or about 25 percent of the city's annual budget. Said Gill: "We've done everything we could over the years to save money, and now everybody sees why we do that." f

—Aaron Richins, research assistant, contributed flood data and other research to this article.

A seeping feeling

One of the most widespread but hidden effects of flooding in the district involves groundwater. Though many communities avoided widespread inundation, the height of floods in the Missouri and Souris rivers and their many tributaries pushed up groundwater tables everywhere, sending water seeping—sometimes gushing—into basements and crawl spaces.

Cheri Kilby is the head of emergency services in Fergus County, Mont. There, she said groundwater seepage "has been almost unreal. We have had people talk about water shooting up from cracks in the basement. We have springs where there were not springs before. Hillsides are slipping down and taking foundations with them."

Groundwater seepage can usually be managed with a sump pump or two. But the longevity of floods in many locations meant that homeowners were battling groundwater seepage on a 24/7 basis for weeks or even months. The failure of a pump—or even a temporary power outage—can lead to significant water damage. Even if pumping succeeds in keeping water at bay, high groundwater also creates tremendous pressure on structures; foundations can buckle. And like flooding, damage from groundwater is often not covered by homeowners insurance.

Save for the many pump hoses that snake out of homes in affected areas, these problems are mostly out of view, so no one knows the full extent of the problem. But anecdotes about groundwater problems abound. One Montana restoration business said it received 450 calls from people with flooded basements in Billings, Joliet and Roundup in early June. One store in the Billings region reportedly sold 150 water pumps in an hour; another store, 80 pumps in 40 minutes.

Ronald A. Wirtz

Multiple pump hoses carry groundwater over a dike in rural Union County, S.D.

The city of Pierre, S.D., conducted a (nonscientific) survey of area residents, including those across the river in Fort Pierre. Among 314 respondents, 240 had water in their crawl space or basement, more than two-thirds were already dealing with mold issues, 54 experienced structural movement and one in 10 had experienced a sewer backup. Separately, Fort Pierre Mayor Sam Tidball estimated that about half of the 800 or so households in the community were dealing with groundwater seepage.

Rick Jensen owns several small businesses, most of them in or near downtown Pierre, which was threatened by flooding from the Missouri River. Thanks to major levees, downtown was spared, but virtually everyone is coping with encroaching groundwater. Jensen said he has bought 12 sump pumps for his properties, at $140 each.

The long duration of the Missouri River flood brings additional challenges as winter approaches. Blake Barringer, manager of Brosz Engineering and president of the Pierre Economic Development Corp., said that if the ground freezes before high water tables recede, the city faces all kinds of problems. "We're going to have busted basements, water mains and roads."

—Ronald A. Wirtz

After the flood

The floods of 2011 will leave financial and other marks on district communities

By RONALD A. WIRTZ
Editor

"Great floods have flown from simple sources."

Shakespeare writes that in his play "All's Well that Ends Well." What the Bard overlooked is another, more painful truth about floods: They leave behind messy problems that make for difficult, not easy, endings.

Bruce Strinden lived in Grand Forks, N.D., at the time of the great 1997 flood, in which two family members lost homes. He later moved to Mandan, N.D., across the river from Bismarck. "When I left Grand Forks, I thought I was done fighting floods," he said.

While he lives on safe, higher ground and has been personally unaffected by the flood, this time around he might be even further into the flood soup. As chairman of the Morton County Board of Commissioners, he has had to deal nonstop with flood-related issues, from emergency protection to access and safety concerns to budget issues. He'll take all of them over what lies ahead for residents and the entire county.

"The preparation for floods is bad. The flooding part is bad. But the cleanup is the worst. It's messy, disgusting and heartbreaking," said Strinden.

Along with the roughly 6,000 inundated homes and businesses in the Dakotas and Montana, damage to public infrastructure and government budgets have communities across the Ninth District facing a long, expensive cleanup process.

But you didn't have to be in the floods' path to feel their effects. The impact of the floods on commerce shows that collateral damage extends well beyond those deluged by water. Full measures of flood damages and associated costs are a long time coming because flooding was so widespread and enduring. But enough information has become available to offer a snapshot at the wide-ranging effects of the 2011 floods.

Open for business, kind of

Aside from Minot, N.D., where a couple of hundred businesses reportedly found themselves in the flood zone, comparatively few businesses elsewhere in the district were inundated. It's hard to say just how much business has suffered because damage estimates focus almost entirely on homeowners and local governments—the ones eligible for grant assistance from the federal government. Businesses are eligible for low-interest loans, but only if they're in a county that has seen widespread flood damage.

But even without official tallies, it's not hard to see the significant collateral damage inflicted on local businesses by the floods' scale and duration.

The Missouri River, for example, has been off limits most of the year, which has greatly affected businesses that cater to the recreational trade, such as boat dealers, marinas and guide services; most marinas were either badly damaged or purposefully plugged, effectively putting them out of service for the year. Many riverside campgrounds were destroyed.

In Bismarck, the Lewis and Clark Riverboat—which gives Missouri River tours and is something of a local icon—saw revenues "fall off the table" when the boating season was closed, according to a local source.

Downriver in Pierre, S.D., the flood wiped out the recreational season, even off the river. Water claimed the municipal golf course, along with the softball fields, all of which were low-lying. Local festivals, which bring in out-of-towners, have been canceled as well. Three marinas have been wiped out and have no rentals, and all campsites in or near Pierre—reportedly about 500 in all—are out of commission.

In summertime, "we're usually packed with fishermen in the motels, and right now we have none," said Lois Reis, head of the Pierre Convention and Visitors Bureau. The city lies below the Oahe Dam, and the torrent it discharged all summer ended any fishing or recreation. Above the dam, the river is open, and the fishing was reported to be great—but the action is 10 to 15 miles away from the city.

Minot Daily News

The miserable cleanup in Minot begins.

"The preparation for floods is bad.
The flooding part is bad.
But the cleanup is the worst.
It's messy, disgusting and heartbreaking."
—Bruce Strinden,
Morton County Board of Commisioners

Minot Daily News

That might seem like a trifling matter, but it makes a difference for many businesses. "What we sell [conventioneers] is fish and golf" nearby, and both have been eliminated, said Reis. As a result, a half dozen or more conventions scheduled for the city have been canceled or relocated from Pierre. Reis also worries that unless significant work ensues to reopen the golf course and other local attractions, the flooding will also hurt next year's convention season, which was already being scheduled.

Stunted sales

Given the soft economy, many businesses are living on the edge to begin with, and small hiccups can be catastrophic to survival. The city of Roundup, Mont., was virtually cut off from the rest of the state in late May and June when the Musselshell River flooded twice. Shawn Dutton, CEO of First Security Bank in Roundup, said there was "substantial loss to retail sales" when the flood cut off all access to the town for weeks.

Dutton said the community "has taken a huge hit financially in the physical

Continued on page 12

The impact of the floods on commerce shows that collateral damage extends well beyond those inundated by water.

After the flood from page 11

losses and maybe a bigger loss in lost income during the flood, when nobody could pass through on the highway." While repair and cleanup work might pump more revenue into some businesses, this new spending will happen "over an extended period of time and may be too late for some to keep their business open or make their house payment," he said.

Randy Hellman can relate. He and brother Brad own Hellman Brothers, a men's clothing boutique in Bismarck. When city residents got wind of the coming flood in late May, "I could have closed my doors for three weeks" because so few customers came by, Hellman said. The store has been open for 14 years, and Hellman said sales in May were down 40 percent from the previous month. June followed with another 10 percent decline. "July has picked up just because I'm giving things away," he said.

In Pierre, Rick Jensen owns a local restaurant and retail shop, a bed and breakfast, and several rental properties. He said retail operations were down 50 percent in June and July. "When people are uncertain, they do nothing. They freeze."

Tim Hennessey, regional president for U.S. Bank in Bismarck, was seeing the same mentality among bank clients. "Our business customers are being very conservative," he said. Given the slow national economy, "there was a lot of uncertainty even before the flood. This just exacerbates it."

Most banks contacted for this article said their exposure to risk from flooded homes and businesses was small to modest. Most said they were working out new loan terms with affected borrowers. Kevin Strege, president of a new Bremer Bank branch in Bismarck, had a different problem. Open only a month before the flood hit, the bank didn't have time to make a lot of loans. "But business shut down. It just came to a halt," Strege said. At the office, everyone was distracted. "We have 15 to 20 conversations a day on [flood] things."

Possibly no sector has suffered more from floods than agriculture. Estimates differ slightly, but in North Dakota, between 5.5 million and 6.3 million acres of farmland—about one-quarter of the total cropland typically seeded—did not get planted this year because of flooding or ground that was too saturated to plant.

Whatever the final figure, "that's just enormous, far worse than anything we've ever seen," said Ted Quanrud, public information officer with the state Department of Agriculture. The previous high for prevented planting was about 3 million acres in 1999. A July study by a team of researchers at North Dakota State University showed that farmers stand to lose about $1.1 billion due to this year's prevented planting.

Minot Daily News

This figure doesn't count acres that were planted but subsequently flooded in late May and June in many parts of the Ninth District. Few tallies have been made regarding spoiled crops. According to Montana's application for federal disaster assistance, only about 8,000 acres went unplanted because of wet conditions in Big Horn County on the state's southern boundary. But another 43,000 acres were later ruined by flood, which also killed nearly a thousand animals.

Farther north in Garfield County, the state reported that flooding affected 25 percent of farm acres, with low-lying hayfields "flooded, stunting or drowning."

The public dime

Governments—specifically their budgets and infrastructure—have also taken big flood hits. By the end of August, Montana and North Dakota had received $24 million and $13 million, respectively, in reimbursements from the Federal Emergency Management Agency (FEMA) for damage to public infrastructure. But those numbers are expected to climb significantly as reimbursement applications from local governments are processed.

At the local level, enough data have trickled out to show that cities in the direct path of a flood spent significant resources to protect residents and assets from flood. When the U.S. Army Corps of Engineers chose not to plug the mouths of three marinas in Mandan, the city decided to do so itself—dumping an average of 1,800 truckloads of fill into and around the mouth of each marina, at a total cost of $2 million. In all, the city will likely spend about $8 million just for costs related to flood preparation and cleanup, according to City Administrator Jim Neubauer.

Across the river in Bismarck, whose lower elevation exposed it more to a rising Missouri, the city had spent about $10 million through mid-July and was authorized to spend up to $15 million. City Administrator Bill Wocken said it could have been much worse, if not for a "really good set of disaster plans." Earlier in the year, many staff had also attended an emergency disaster conference, which helped them fine-tune their response to the flood. Those things might not seem like much, but in a real emergency, "you can run around in circles spending money like you wouldn't believe," Wocken said.

And similar costs—for new levees, sandbags, emergency response, law enforcement and other protection, debris removal—are incurred at every level of government. Burleigh County, home to Bismarck, estimated its costs at $8 million.

Fortunately for cities, much of these flood costs are eligible for reimbursement from FEMA, which covers 75 percent to 90 percent of the eligible flood expenses, including levee building, emergency response and debris removal. States also assume another 10 percent, often leaving local governments with less than 10 percent of the bill and sometimes much less. Several local governments said they expected to pay as little as 3 percent to 5 percent of their flood costs.

But total costs will also run much higher as governments bend to the task of flood repair. North Dakota has estimated public infrastructure damage, similarly eligible for FEMA reimbursement, at $305 million, with total flood-related costs topping a half-billion dollars.

Roads in particular have been hard hit. In South Dakota, 140 sites were in need of repair by the state Department of Transportation at an estimated cost of $21 million, according to Scott Rabern, a state DOT construction engineer. The Montana DOT counted 179 affected areas along state highways in need of attention as of late August, at an estimated cost of $36 million, according to an official there. Those statewide figures also don't include city and county roads, which saw considerable damage. In Fergus County, Mont., roadway in 139 locations was damaged—eroded pavement, landslides, washed-out culverts and the like—according to county officials. Early estimates put total damage at about $10 million in a county whose annual road and bridge budget is $1.5 million.

In many communities, roads took a beating not from floods, but from the trucks used to build protective dikes. In Fort Pierre, S.D., four miles of levees were built, and "those hundreds of trucks … beat the heck out of roads," many of which will now have to be replaced, according to Mayor Sam Tidball. There are also numerous ongoing costs, whether for personnel or maintenance, like the 50 pumps that ran nonstop for much of the summer to prevent groundwater from pooling inside the levees.

As a result, the floods will leave a financial scar. Fort Pierre, a city of just 2,000 people, expects to ring up between $5 million and $10 million in flood repair costs. "In our budget, we don't have that much money sitting around," said Tidball. The city has received a $5 million line of credit from the state to tap if cash flow becomes a problem. But the mayor added that the city plans to postpone some previously scheduled infrastructure projects.

Across the Missouri River in Pierre, the flood dealt the city many indirect blows that could not be deflected by the three and a half miles of levees built to protect hundreds of homes. "We might not have had a lot of inundation, but our infrastructure got hammered," said Mayor Laurie Gill. Along with battered roads, construction of the levees badly damaged much of the city's park system. The city also estimates costs for storm sewer repair at $2 million and for street repair at $1.6 million. Rehabbing the flooded municipal golf course will probably cost upward of $1 million. In all, the city expects to spend $13 million to $15 million on flood remediation.

The impact of these expenditures will be compounded by lower assessed values for properties damaged by flooding; in coming months and years, many communities will take in less property tax revenue.

Regardless of the mess, the flood aftermath could have been worse. Dakota Dunes, S.D., a bedroom community in the southeastern corner of the state, spent an estimated $10 million on, among other things, four miles of new levees to protect about 460 homes from sure destruction. With cleanup and repair costs, the total bill is expected to reach $25 million.

But according to Ray Roggow, director of emergency management for Union County, the value of the property behind the dikes is $370 million. "So to spend $25 million to save $370 million, it's kind of a no-brainer," he said. f

Brookfield Renewable Power's $35 million project on Lower St. Anthony Lock and Dam near downtown Minneapolis involved installing 16 turbines in an auxiliary lock next to the shipping channel. Power from the project can provide electricity for as many as 7,500 homes.

A new look at hydropower

Thanks to new technology and recent tax incentives, new energy proposals are coming to district rivers

By FRANK JOSSI
Contributing Writer

Call it a return to renewable roots.

Hydropower has been around long before the words "renewable energy" became a political lightning rod in the energy industry. But over the years, proponents of hydropower have watched it become a stepchild to sun-absorbing solar panels and spinning windmills.

But thanks to new technology and new applications of old ideas—and tax incentives for both—hydropower is again being talked about, as proponents argue that thousands of dams could be retrofitted to produce small-batch electricity.

The Mississippi River, for example, has never been much of a hydropower producer, especially compared with the Colorado, Missouri and Columbia rivers. But spurred by aggressive renewable energy tax credits and new hydropower technology, a handful of companies have filed plans to transform the lock-and-dam system on the Upper Mississippi from Minneapolis to Rock Island, Ill., into a small powerhouse of hydro. There are similar plans for several other lock-and-dam rivers throughout the country, including the Fox in eastern Wisconsin.

Though traditional dam-and-turbine hydropower has become somewhat passé over the years because of environmental protests, its relative efficiency—especially compared with other forms of renewable energy—is also creating renewed interest in this old-form power source. Montana, for example, has 12 proposed and active projects involving dam-and-turbine hydropower on rivers.

The Ol' Miss

The main player on the Upper Mississippi, Boston-based Free Flow Power, has several projects at various stages of the approval process with the Federal Energy Regulatory Commission (FERC) to develop hydropower at lock-and-dam systems in the U.S. Army Corps of Engineers St. Paul District. The company has several approaches, but the fundamental idea attaches turbines to existing dam infrastructure to capture water energy at five locks and dams (numbers 3, 4, 6, 7 and 9) between Red Wing, Minn., and Lynxville, Wis., that will generate more than 51 megawatts (MW).

And that's not all that's happening on the river. Free Flow has proposed projects using the same technology for dams at Coon Rapids, Minn. (8MW) and at Genoa, Wis. (10 MW). Hydro Green Energy is working on a similar plan at a Red Wing, Minn., lock and dam (4MW). And in downtown Minneapolis, Crown Hydro has proposed to divert part of the river to an underground tunnel to create 1.7 MW of renewable power, but has run into a storm of opposition.

Continued on page 14

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The full-scale potential of such projects is modest; the Upper Mississippi proposals alone could add close to 100 MW, give or take, to the energy grid, or a tenth of the power of Xcel's Prairie Island nuclear plant, and enough to power about 75,000 homes for a year. Despite all the FERC filings and grand designs, the only project to reach fruition is Brookfield Renewable Power's 10 MW project near downtown Minneapolis at the Lower St. Anthony Falls Lock and Dam, which recently began producing power.

But the new proposals have other advantages. Dams have been heavily criticized for producing environmental debacles, but there seems to be no great opposition to the lock-and-dam proposals at this time. Rupak Thapaliya, national coordinator for the Hydropower Reform Coalition in Washington, D.C., said the proposals he's seen are "relatively benign" since they build off existing infrastructure that has no chance of being removed as long as shipping remains viable on a river. And as energy companies and the public alike seek more renewable energy, the Mississippi and other rivers in the Ninth District not yet tapped for much hydro are likely to see more attention.

"We're seeing hydropower included more and more in both state and federal incentives, whether that be for state renewable energy standards or federal tax incentives like the production tax credit," said Jeff Leahey, the National Hydropower Association (NHA) director of government affairs. "Those are providing incentives for people to look at new developments."

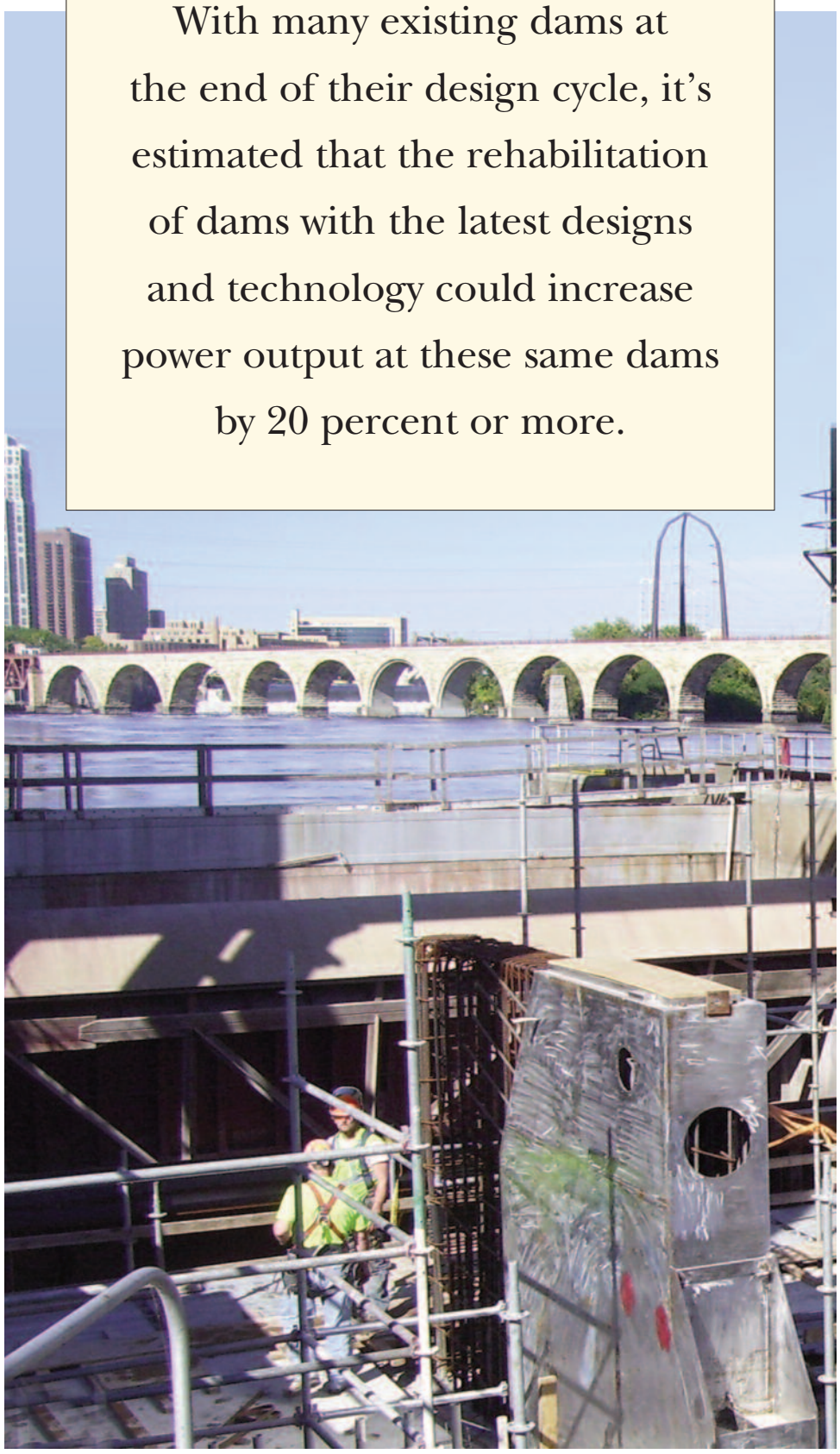
Hydropower supplies 7 percent of total annual electricity generation, but two-thirds of the nation's renewable electricity, the result of its efficiency in generating electricity compared with other renewables. Jon Guidroz, Free Flow's director of project development, said water is 800 times more dense and carries 26 times the force of air.

In fact, some hydro plants generate electricity more efficiently than even coal, evident in the average cost per kilowatt for each. Reports from the Wisconsin Valley Improvement Co., which helps operate 25 hydro plants on the Wisconsin River for 10 utilities, show that hydropower there is produced for less than one cent per kilowatt hour, half the cost of nuclear and one-third the cost of fossil fuel. Other reports show similar results.

New spin on an old idea

Despite that efficiency advantage, environmental concerns and protests have halted any new large-scale dam projects for decades. Still, many believe there is potential for significantly more hydropower production. A recent NHA study, corroborated by earlier studies by the U.S. Department of Energy, concluded that by 2025, there could be 60,000 MW of additional capacity across the country, enough to power tens of millions of homes. The added capacity comes from a variety of sources, including in-stream hydrokinetics, which features turbines underwater capturing wave energy, according to Leahey.

With many existing dams at the end of their design cycle, it's estimated that the rehabilitation of dams with the latest designs and technology could increase power output at these same dams by 20 percent or more.



The majority of the additional generation, however, comes from doing more with the infrastructure in place. With many existing dams at the end of their design cycle, it's estimated that the rehabilitation of dams with the latest designs and technology could increase power output at these same dams by 20 percent or more. PPL Montana is spending $230 million to upgrade Rainbow Dam at Great Falls, which will increase its current 36 MW of production by 70 percent.

But as much as a third to one-half of that potential new capacity comes simply from adding turbines to dams that currently generate no power, and that's also where new technology comes into play. Most dams in place today do not generate power, and that's because they suffer from "low head"—when the height of a river above and below a dam or lock is less than about 30 feet; the lower the drop, the less energy that can be produced.

The Garrison Dam over the Missouri River—the fifth-largest earthen dam in the world—generates 580 MW of electricity, but is the only source of hydropower in North Dakota. Other rivers in that state simply don't have the flow to produce much energy or do not have a lock-and-dam system that could add hydro, according to Mike Diller, director of economic regulation at the North Dakota Public Service Commission.

South Dakota has four major dams on the Missouri River, one reason that hydro generates almost half of the state's electricity. But the state otherwise has few untapped hydro assets. "The flows on our rivers vary dramatically—in spring you have good flows; in summer not much is happening," said Chris Nelson, vice chair of the Public Utilities Commission.

Follow the money

Relatively new federal incentives might change the equation a bit. In 2005 and 2008, production tax credits were extended to hydropower developers to encourage them to improve existing facilities, add hydro to nonpowered dams and build hydrokinetic power in rivers and oceans that takes advantage of constantly moving water to spin submerged turbines.

Through the energy investment tax credit, hydro and other energy developers write off 30 percent of the cost of a project. And since developers may want that in the form of cash, rather than a write-off, a Treasury Department program allows them to get a direct grant from the federal government, said the NHA's Leahey.

That's not all. FERC has been encouraging "small hydro"—defined as less than 5 MW—by streamlining the permitting process and dedicating staff to answer inquiries about it. In a speech last year before the U.S. House of Representatives, FERC's director of energy projects, Jeff Wright, said that "small hydropower is an important part of the nation's energy mix, and offers the potential to add a substantial renewable, flexible capacity."

Mark Stover, Hydro Green's vice president of corporate affairs and the architect of many of the tax credits as the former lobbyist for the NHA, said one of the primary challenges for hydro in rivers like the Mississippi is attempting to capture energy in low-head settings. Advocates of evolving low-head technology say the approach allows for energy capture without having to create lakes and change the basic contours of rivers.

The energy created is modest, but could be widely applied; only about 3 percent of the nation's 82,000 dams currently produce any power, and about half of those nonproducing dams are at least 25 feet in height, according to the National Inventory of Dams, compiled by the U.S. Army Corps of Engineers.

One of those is Clark Canyon Dam on the Beaverhead River in western

Montana, where Riverbank Power is installing 4.7 MW of new generation. Turnbull Hydro recently put a 13 MW plant online in an irrigation canal—a glorified, manmade ditch—in Fairfield, Mont., with the support of a local energy supplier. Hydrodynamics, another small energy provider, has proposed nine small projects on existing dams in that state, the majority under 3 MW, but none have been built yet, according to Tom Kaiserski, who manages the energy promotion division of the Montana Department of Commerce.

Free Flow's Guidroz agrees that low-head technology has come of age. "You've got dams out there with 10, 15, 20 feet of head, with an enormous potential onsite to realize power," he said. "You have to dust off the lenses of hydropower and come at it with a new perspective."

Hydro Green used the nation's first hydrokinetic energy pilot project at the lock and dam in Hastings, Minn., to develop a new low-head turbine for in-stream applications. But Stover said the Hastings experiment proved to Hydro Green that the best market for its turbines was in conventional hydropower, and not hydrokinetic, and is now applying that wisdom to lock-and-dam systems. Using the knowledge gained from two years of field tests, the company has created a low-head hydropower turbine "we are confident will work in these [lock-and-dam] settings," he said.

Potential challenges

Still, the reality of widely retrofitting dams, or of new hydrokinetic applications, is a bit more sobering. A 2009 NHA study revealed that the Midwest—from the Dakotas to Michigan and Ohio—have the least hydro potential of any region in the nation.

And for all the potential running through these many small-scale projects, there are many roadblocks, including the expense of retrofitting a lock and dam on the Mississippi, and finding the money could pose a problem. Brookfield, which built the only finished project, is a deep-pocketed player in energy. Free Flow and Hydro Green, in contrast, are relatively small companies with aggressive business goals.

Hydro Green has a total of 34 low-head dam projects in the pipeline nationwide, totaling 1,000 MW and has raised $5.5 million in corporate financing. The company just moved its corporate offices from Houston to Chicago to be closer to the sites of its proposals. Free Flow brought in $5.7 million this year from investors and claims a staff of more than 30 employees, with offices in Boston and New Orleans.

Still, neither company would release even the rough details of the cost of adding hydro to a lock and dam. Brookfield Power's project on the Lower St. Anthony represented a $35 million investment, according to the company's website.

More than a few proposals have come and gone. Nanette Bischoff, FERC coordinator with the U.S. Army Corps of Engineers St. Paul District, said market conditions have doomed proposals over the years. "It comes down to an economic decision, and if energy companies won't pay enough for the power, the energy developer figures it will be a waste of time and money," she said.

And if the first few projects on conventional dams or locks and dams have negative environmental consequences, the energy developers on the river may have a harder time moving forward, according to Bob Larson of Nelson Energy, a two-person firm in suburban Minneapolis that develops hydro concepts, including the Brookfield Power operation on Lower St. Anthony Falls.

FERC's permitting process requires energy developers to notify all parties impacted by new dam proposals, including environmental groups. Though the Hydropower Reform Coalition and others have not expressed opposition to the lock-and-dam proposals, Larson recalled something he has heard many times. "Hydro is easy to go after for opponents because, compared to other renewals, it has been around the longest and the opponents are so well-educated on the topic." f

Hydro in the Ninth District

Since 1999, the hydropower share of electricity production has generally declined in the district—by as much as a third in some states.

That is partly due to two reasons. First, hydropower has seen little expansion over the years, while energy production and consumption have risen significantly since 1999. Second, hydropower depends on river flows, and the years of drought in the Dakotas and Montana have had an impact on its production. That influence can be seen in 2010 figures, which increased dramatically in the Dakotas, taking advantage of a high-water year in the Missouri River basin.

Hydropower's share of a state's electricity production is also a bit misleading because some states are major power exporters. South Dakota produces about three times the hydropower as its northern sibling, but hydropower's share of state electricity production is more than 10 times higher (54 percent versus 4 percent, respectively). That's because North Dakota's vast coal reserves have made it a major producer (and exporter) of power.

The federal government defines energy in "megawatt hours," or MWh. One MWh is 1 million watt hours.

Montana
Production
2009: 9,505,940 MWh
2010: 9,230,000 MWh
Percent of total electricity production from hydro (2009): 35.6 percent

North Dakota
Production
2009: 1,475,251 MWh
2010: 2,042,000 MWh
Percent of total electricity production from hydro (2009): 4.3 percent

South Dakota
Production
2009: 4,432,451 MWh
2010: 5,765,000 MWh
Percent of total electricity production from hydro (2009): 54.1 percent

Minnesota
Production
2009: 809,000 MWh
2010: 752,000 MWh
Percent of total electricity production from hydro (2009): 1.5 percent

Wisconsin
Production
2009: 1,393,988 MWh
2010: 1,392,000 MWh
Percent of total electricity production from hydro (2009): 2.3 percent





Sources: U.S. Energy Information Administration

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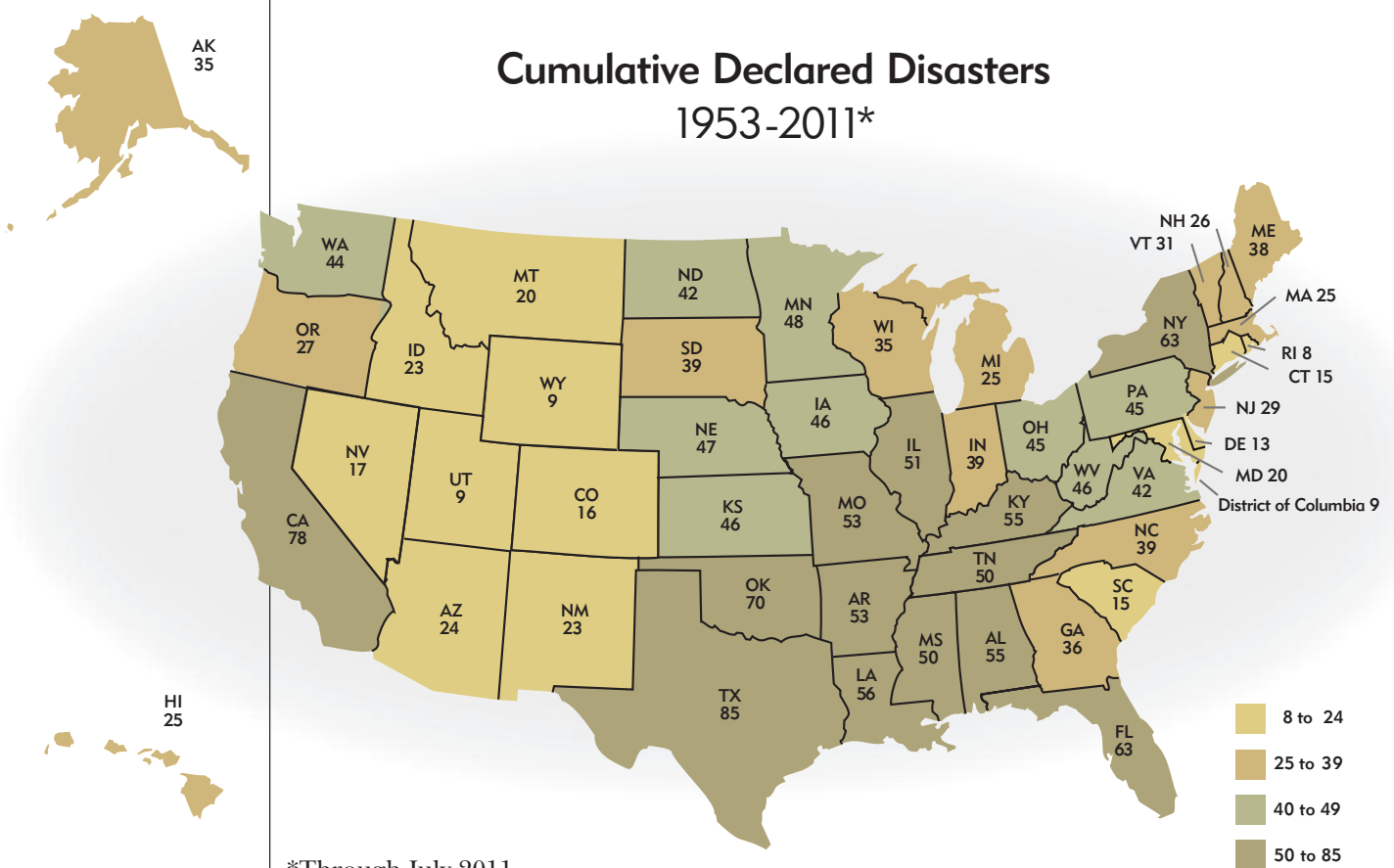

*Through July 2011
Source: Federal Emergency Management Agency