

PRACTICE

WHEN RIVERS RISE

Flood protection can be more than just levees and walls, as projects across the upper Midwest demonstrate. **By Adam Regn Arvidson, ASLA**

THERE'S SOMETHING ABOUT homes buried to their eaves in water. Something that gets to us. We worry so much about controlling water—about keeping it out of our basements, out of our attics, out of our farm fields—that the sight of our neighborhoods overrun with it makes us sigh with compassion and disbelief. Some of the images never leave. Banda Aceh, Indonesia. New Orleans. Grand Forks.

In the winter of 1996–1997, nearly 100 inches of snow fell in the Red River Valley along the border between Minnesota and North Dakota. Between November and April, eight blizzards visited the region,



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and the *Grand Forks Herald* began naming the storms like hurricanes. After the seventh one, the snow began to thaw and the river began to rise. Residents, students, and the National Guard began piling sandbags to increase the height of levees protecting Grand Forks, North Dakota, and East Grand Forks, Minnesota.

Then came Hannah: ice, 70-mile-per-hour winds, 100,000 people without power, and seven more inches of wet snow, which was soon melting and flowing toward the river. Evacuations were ordered. Ninety percent of Grand Forks and all of East Grand Forks were vacated. On April 18, water poured into the Lincoln Drive neighborhood, a leafy enclave encircled by an oxbow bend in the river, and the water quickly spread westward. Levees on the eastern side of the river were also breached.



In 1997 the towns of Grand Forks, North Dakota, and East Grand Forks, Minnesota, were flooded by the Red River, above and opposite center. When the cities subsequently improved their flood protection systems, they also created public amenities, including wide decorative gateways between downtown Grand Forks and the river basin, top, and Town Square, a park space between downtown and the river, bottom.

Then suddenly, the historic Security Building caught fire. Because of the floodwater, the fire was difficult to fight and took two days to contain, consuming 11 blocks of downtown Grand Forks. The image of burnt-out building shells standing hip deep in the escaped river was broadcast all over America.

But this isn't a story about a disaster; it's about what happened next. With the help of landscape architects from the Army Corps of Engineers and private firms, the Grand Forks region spent the next decade creating the Red River Greenway, a wide swath of green space that flanks the Red and Red Lake rivers for more than eight miles. The greenway is not only a recreational amenity providing more than 17 miles of trails, 2,200 acres of parkland, and a campground; it also manages floodwaters. Its





higher levees and walls can hold back large surges, and its wider floodplain allows the water to spread out over the open space.

Last spring, the Red River flooded again. The level of the river reached 49½ feet at Grand Forks—not much lower than the 54 feet it reached in 1997 (anything above 28 feet is considered flood

stage). The next city upstream, Fargo, North Dakota, made national headlines for weeks as volunteers frantically sandbagged their levees in an attempt to stave off the fate that befell their neighbors a dozen years earlier. They succeeded, but it was touch and go. Meanwhile, Grand Forks simply closed up its floodgates and waited for the water to recede. Two weeks after the flood

GRAND FORKS, NORTH DAKOTA

EAST GRAND FORKS, MINNESOTA

LEGEND

-  River Level Monument
-  City of Grand Forks, ND
-  Grand Forks Park District
-  East Grand Forks Parks
-  Red River State Recreation Area
-  Permanent Flood Protection System
-  Paved Trails
-  Future Paved Trail
-  2 mi ◀▶ Trail Mileage between points

The Red River Greenway, a bistate open space system, is a 2,200-acre recreational zone between the region's floodwalls and levees and the river itself. It flanks two rivers for more than eight miles and includes numerous amenities, including a campground, a golf course, pedestrian bridges, and neighborhood connections.

crest, residents were biking the trails and playing golf in the floodplain.

This is flood protection as public amenity, and, according to Kevin S. Holden, ASLA, the Red River Greenway "is about the best example we have to date. It responds aesthetically; it responds functionally," he says. "It behaves as an amenity while doing the complicated work of flood control."

Holden is a leading landscape architect with the U.S. Army Corps of Engineers. It is impossible to talk about flooding without talking about the Corps. "We've been in the flood business for 100 years," he says. "Back then people weren't paying attention to the rivers themselves. Flood protection was just infrastructure. People didn't give a thought to the aesthetic side of it, or to the environmental issues either. Projects were approached in a single-discipline way, as functional flood protection."

In the 18 years he's spent with the Corps, Holden has seen that change dramatically. While he admits that the Corps itself never led that charge—credit there is due the communities—it is now a willing partic-



In the Town Square, a concrete obelisk commemorates historic flood levels. The devastating 1997 flood is the topmost line.

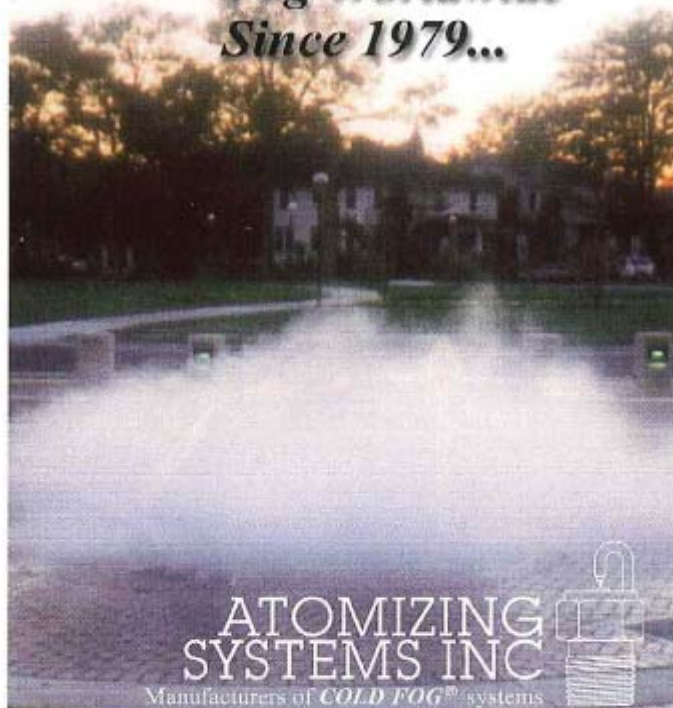
ipant in considering ecology, recreation, urban design, and beauty alongside flood protection. And the Corps' perspective on flooding itself has changed, evidenced by a seemingly ever-transforming lingo. What

used to be "flood protection" became "flood mitigation" and is now "flood risk reduction." This newest term seems to suggest less of the heavy hand the Corps is known for, in favor of the perspective that rivers will, in fact, flood, and that it's better that no homes are in the way.

Holden has been pushing, Corpswide, for what he calls "sustainable flood risk-reduction infrastructure," which is meant to consider, simultaneously, the needs of the Corps' flood management mandate and affected communities. He has some ability to push this idea, as he was recently named the Communities of Practice leader for landscape architecture. In the Corps structure, landscape architects (or any profession, for that matter) are not contained within any particular department but rather are scattered onto teams through the various offices. The Communities of Practice are, in essence, networks of similar professionals. Though there's no "head landscape architect" at the Corps, Holden is responsible for keeping them all talking and sharing and learning.

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The Town Square, in the plan below, serves as Grand Forks' front door to the river. Though within the designated floodway, it has been transformed into usable space. It hosts festivals, left, and includes native vegetation at the river's edge.

Forks, most of the land is below flood stage. In East Grand Forks, the historic commercial district sits below the top of the levee, but it has perhaps the best example of a removable flood barrier. Most of the floodwall, approximately 11 vertical feet worth, is temporary. During normal conditions, views are completely open to the river; concrete columns exist at wide intervals. This allows a line of restaurants and bars to have views of the floodplain and the city of Grand Forks across the river. When the river rises, the city quickly installs a complex system of metal posts, struts, and planks to hold back the water.

The Red River Greenway is full of examples like this, and that is testament to a tenacious community, several different Corps landscape architects, and at least three private firms. That story begins almost immediately on the heels of the 1997 flood, when the Corps stepped in to raise the levees. According to Tom Whitlock, ASLA, of Damon Farber Associates (DFA) in

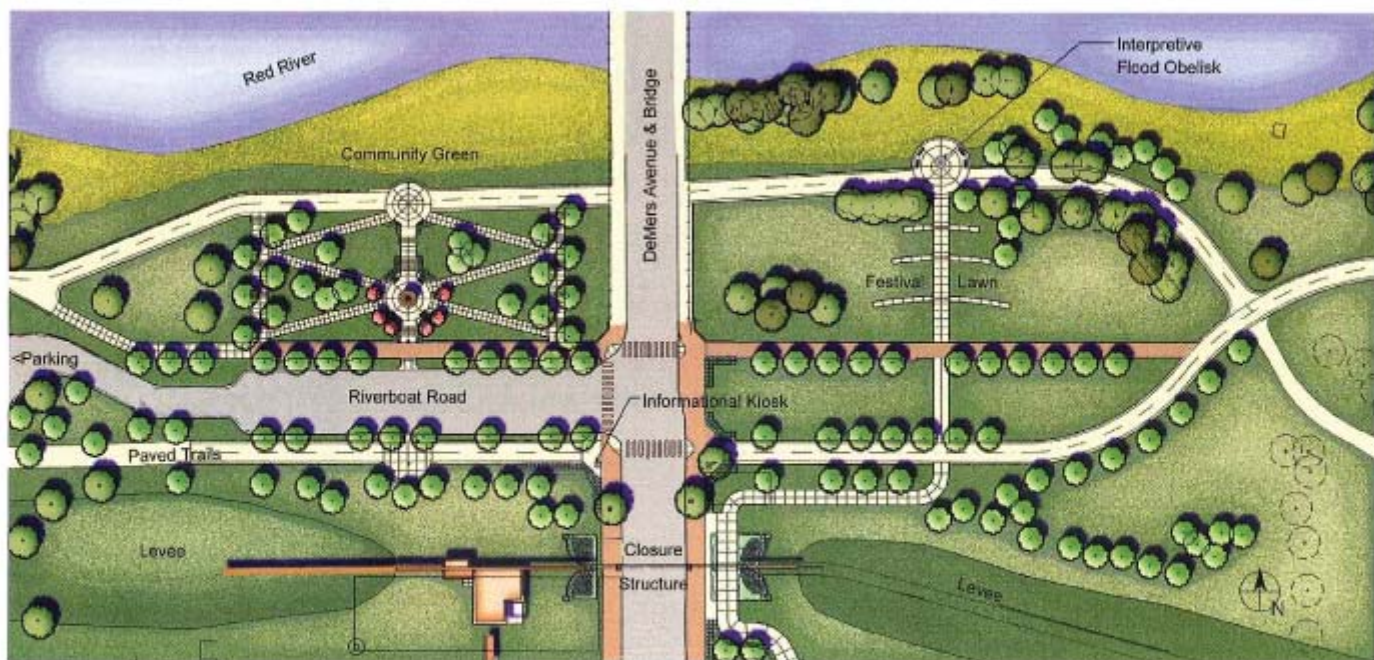
Practically, sustainable flood risk reduction means creating a wider right-of-way for the river by pushing back the levees and clearing low-lying land that is very hard to protect. It also means integrating flood-control systems into the local context—the environmental context and the community context—by making it attractive, usable, and natural.

"When you're faced with areas that flood," Holden explains, "you have two choices: Protect the whole thing or move

people to higher ground. Once you decide to protect it, that's when you get into talking about flood protection as a public amenity: a floodgate that doesn't look like a floodgate, a levee with openings in it so that it doesn't read as a barrier."

Most floodwalls block views of the water. In river towns across the upper Midwest, low-lying neighborhoods hunker down behind opaque concrete, cut off visually and physically from their natural amenities. In Grand Forks and East Grand

the river rises, the city quickly installs a complex system of metal posts, struts, and planks to hold back the water.



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Minneapolis, who has been involved in the project from early on, the region was offered \$100 million in federal dollars for the project. It flatly refused the money, mainly because those initial plans would have been then Corps-standard higher walls or a diversion channel. Two states, two counties, several cities, and two state departments of natural resources came together with the Corps to instead envision a much larger project and eventually secured more than \$400 million from a combination of federal, state, and local sources. This allowed for extensive amenities to be implemented.

The initial master plan was created by North Carolina-based landscape architecture and planning firm Greenways Inc. with Minneapolis landscape architect and park planner Greg Ingraham, ASLA. As the Corps began to design and implement that greenway, it brought on DFA in 2000 to help it meet the scope and speed of the project. The overarching ideal, according to Melanie Parvey, an environmental compliance officer with the city of Grand Forks who was the greenway coordinator from 2000 to 2006,

Innovations in Flood Risk Reduction

AS COMMUNITIES AND THE CORPS move away from the previous standard of turfgrass-clad earthen dikes on the river's edge, new ideas are being tested.

NATIVE VEGETATION In places where uniformly graded floodway slopes come right down to the water, those slopes are most often hard armored, with riprap to protect against the severe scour that occurs during floods. Tom Whitlock, ASLA, of Damon Farber Associates, remembers Grand Forks officials and citizens wanting something different. "They wanted the whole shoreline natural," he says. "They didn't want to riprap the edge." So at Town Square, Whitlock designed a slope that is armored with geotextile fabric and native plants. Grasses and forbs were set into holes cut in the Enkamat, which looks a bit like a tangled fishing net. Two different mixes were then seeded into the mat, and the whole section was covered with two inches of soil and a temporary erosion-control blanket.

At Harriet Island Regional Park in Saint Paul, Minnesota, which sits in the Mississippi River floodplain, SRF Consulting Group and Baird Engineering designed "soil-filled riprap" on the river edge. This type of armoring combines rock and soil and allows for seeding of plants between the stones. In both Grand Forks and Saint Paul, these river slopes do look different than typical levees, but it has proven difficult to keep invasives out of the mix. Every time the river floods,

new seeds get deposited into the fertile soil. Managers are still working out exactly how to maintain these slopes aesthetically, but they are proving to be effective at erosion control.

REMOVABLE FLOODWALLS Wherever roads, railroads, and pathways pass through floodwalls and levees, temporary closures need to be designed. In essence, a temporary closure is a gap in the flood protection that can be filled by stacked metal planks when the waters begin to rise. In East Grand Forks, temporary closures go to great lengths to keep the entire downtown open to the



river. The flood protection wall there, designed by Minneapolis-based landscape architecture and engineering firm SEH Inc., usually looks more like an opening than a wall, with only a low curb and widely spaced ornamental columns hinting at its existence. In the event of a flood, additional metal posts are installed and braced from behind with metal struts, then the metal planks are slid in. The design allows the downtown entertainment strip, a group of two-story restaurants with decks overlooking the river, to keep its views. (Unfortunately, the town is a ways back from the river and there is a large surface parking lot just on the other side of the floodwall, but it would be far worse if that wall were not temporary.)

RIVERSIDE STORMWATER PONDS Grand Forks used the flood protection improvement project to upgrade its stormwater management system for the benefit of both the neighborhoods and the river. Two new stormwater ponds were constructed between the floodwall and the river. Storm sewer pipes run

under the walls to bring water to these large basins, which are currently being colonized by floodplain vegetation (grasses and trees) and various types of waterfowl. Though the technology of these ponds isn't particularly groundbreaking, they do simulate a natural aspect of the floodplain, namely the oxbow lake, an important habitat and water retention feature of a river system. By placing stormwater ponds on the river side of the flood protection, Grand Forks was able to simultaneously improve the quality of urban runoff entering the river and further restore the Red River's natural floodway. Check valves prevent floodwaters from backing up through the sewer and inundating neighborhoods.



One of the flood protection innovations in the region is the removable floodwall between downtown East Grand Forks and the river. The flood protection level is at the top of the large columns in the photo above. When the river rises, a system of metal posts and beams is installed, top. This design allows the views to remain unobstructed most of the time, above.

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Most of the Red River Greenway has a pastoral feel, with trails winding through floodplain trees, below, and rising up and over the levee, here, to connect neighborhoods to the open space.



was to create one seamless composition. "People don't know," she says, "what side of the river they're on."

On a beautiful day last spring, Parvey biked the trails she helped realize, wandering back and forth across the river and slipping through levee openings into the riverside neighborhoods. The flood that had filled the greenway mere months earlier was a ghost. It was expressed only in a few bent railings, some caked silt on the lowest elevation trails, small piles of branches at bridge piers, and a few snapped trees (which were already being replaced).

The Red River is not conventionally beautiful—it's brown and flanked by a thin hedgerow of twisted cottonwood and ash. Muddy banks rise up to exposed tortured tree roots. The ride along the greenway is exceptional, though. The greenway's trails (14 feet wide on the Grand Forks side) undulate lazily through golf courses, restored natural areas, and open grassy parklands as they rise and fall gently with the intricacies of the floodplain. In all but the Town Square, a formal event space between downtown Grand Forks and the river, the landscape is decidedly pastoral, owing to the visual absence of buildings: They are hidden away behind the levee and floodwall.

Design wise, there's little that's groundbreaking here. It's a city park on a grand scale, with ample but unremarkable seating, picnic pavilions, form-liner concrete

walls, and colored concrete at the neighborhood entrances. It is consistent, though, which is a testament to the master plan and its faithful implementation. And more than that, says Parvey, it has changed perceptions of the river and the community itself.

"In addition to being a good recreational resource," she says, "it has also reconnected communities to [that resource]." That has a lot to do with the levee pass-throughs (breaks in the wall that are typically open and can be closed when waters rise) or up-

and-overs (pathways that ascend one side of the levee and descend the other) that occur every quarter mile. The greenway also offers previously unavailable access to the river. There are two new boat ramps (implemented with the collaboration of the North Dakota Game and Fish Department) and trails that run low on the bank, mere feet from the river.

In the other corner of Minnesota, Rochester has flooding problems for exactly the opposite reason as Grand Forks. While the latter is in danger from a river that flows north and gets backed up by ice jams, Rochester's Zumbro River is hemmed in by bluffs, making flash floods the major concern. Doris Sullivan, FASLA, a landscape architect with the Saint Paul District of

the Corps, describes the flood mitigation project there as "one of the early elaborate projects" that included a significant amount of public amenity.

The so-called South Fork Zumbro River Flood Control Project has seven and a half miles of trails, some of them decidedly urban where the river runs through downtown and around the civic center. Water's-edge platforms for fishing, pedestrian-only bridges across the river, and custom railings can be seen throughout. Revised water control weirs are designed to be safer

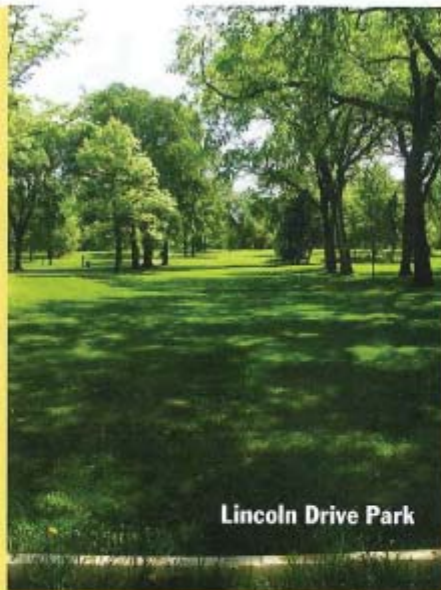


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Old Neighborhoods, New Parks

ONE OF THE MORE DIFFICULT design issues for landscape architects working on flood mitigation projects is what to do with land that was previously occupied. One of the largest such zones in the Grand Forks area was the Lincoln Drive neighborhood. This low-lying residential enclave was almost completely surrounded by a bend in the river and was the first place to flood in 1997. Today, the land looks like a park—but things are a little more complex than that.

“One of the main challenges at Lincoln Drive,” remembers Tom Whitlock, ASLA, of Damon Farber Associates, who designed the park, “was that because the Federal Emergency Management Agency (FEMA) bought all the residential properties, we could not develop a park on any of that land. We had a hard time even putting any trails there.” FEMA has specific rules about what can happen on land that it buys out as a result of river flooding—namely that there can be no impervious surfacing.



Lincoln Drive Park

Whitlock remembers long discussions about whether to restore that area to prairie, but it was eventually decided that a turf-grass landscape would serve as a more appropriate memorial, since it references the manicured lawns of the old neighborhood. The former neighborhood is also remembered with a brick paver map that provides a key to the old streets and a flag that flies on the school's old flagpole—now at the center of the parking lot.

On the other side of the river in East Grand Forks, a neighborhood just north of downtown was cleared of homes and turned into a campground that is part of Minnesota's Red River State Recreation Area. It uses the old roads as vehicular circulation routes and trails, and some of the sidewalks are still in place. Former Greenway Coordinator Melanie Parvey says that at one point there was a suggestion to use the old addresses as campsite numbers, but project managers (thankfully) thought that might be going too far.



Lincoln Drive Park occupies the site of a former neighborhood. The ghosts of streets, flanked by former street trees, are still visible, top. Because of FEMA rules, no impervious surface could be built where the homes had been, so the designers clustered parking and other hard-surface amenities on a former elementary school site owned by the city and left the rest a grassy open space, left.

Lincoln Drive Park occupies the site of a former neighborhood. The ghosts of streets, flanked by former street trees, are still visible, top. Because of FEMA rules, no impervious surface could be built where the homes had been, so the designers clustered parking and other hard-surface amenities on a former elementary school site owned by the city and left the rest a grassy open space, left.

and more aesthetically pleasing. New boulder riffles and deep pools in the river improve habitat. A clean-water discharge from the well-known Mayo Clinic was transformed into a decorative waterfall flanked by public art. Construction began in 1987 and was completed in 1995, with DEA performing detailed design and construction plans.

In addition to her involvement in Rochester, Sullivan also prepared early design sketches for flood protection in Minnesota's capital city. This three-mile project across the river from downtown Saint Paul was also completed in 1995 and was designed and detailed completely in-house by six different Corps landscape architects. It consists of two very different sections: a

narrow, hard-surfaced multilevel walkway and a grassy levee that runs around behind Harriet Island Regional Park, which was renovated by the city of Saint Paul in 1999. The hard-surface section is the most notable, as it very creatively breaks up the

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The Red River Greenway is considered the best example of flood protection as community amenity. The flood levees and walls have architectural detailing and openings to allow pedestrians through, below; the building is a pump house associated with the floodwall. Two pedestrian bridges, one seen here, erase the boundaries between the two states that share the greenway.

hulking floodwall. Inclines, raised and sunken plazas, stairways, and multilevel promenades make for a varied user experience. Patterned concrete walls and softens the walls, while varying textures and colors of concrete add richness to the paved surface.

Each of these projects is a long way from what the larger design community might expect from the Corps. The Corps landscape architects interviewed for this article, however, bristle at the stereotype that they're anti-nature or engineering dominated. "We really try not to ruin things," says Sullivan. "We try to enhance them." Parvey was forthright in her praise of the Corps staff, who, she says, spent a lot of time in Grand Forks, even becoming regulars at local restaurants.

It must be noted, however, that currently, in northwestern Minnesota, the Corps is building a diversion channel around the city of Roseau: essentially a grassy ditch through the surrounding farmland, partially paid for with federal stimulus money. It also recently proposed three options to the public for mitigating Fargo's flood issues: a diversion channel through Minnesota, a diversion channel through North Dakota, or higher walls downtown. None of these cases show much visionary thinking.

And the money that the Corps brings to a community has some specific strings

attached. Aesthetic treatments of things that would be built anyway (basic landscape plantings, textured floodwalls) are paid 65 percent by the Corps. Recreational features like bridges and trails are paid at 50 percent, up to 10 percent of the total project cost. The remaining cash has to come from the community.

So there's a lot riding on local gumption. Parvey remembers that when East Grand Forks proposed the temporary

floodwall to provide views of the river from its downtown, the Corps was not going to certify it, which would have had a severe impact on flood mapping and insurance. The community pushed and pushed and the Corps finally relented. "There's a lot of tradition in flood protection design," says the Corps' Holden. "We have great engineers, but they aren't trained in aesthetics. I haven't worked with anybody [here at the Corps] who doesn't care about the project and the public. Their only limitation is their professional experience." To remedy this, Holden would like to see landscape architects in every Corps district where major designs are generated. "Every Corps office has civil engineers who spend at least some of their time doing things that landscape architects can do," he says.

And as for the Corps' progress on sustainable flood risk reduction? "We need continuous improvement," says Holden. "The next Grand Forks maybe could go further with nonstructural solutions." Nonstructural solutions means protecting buildings by not having the buildings around anymore. That means either preventing encroachment into flood-prone land (something that's mostly standard practice now) or moving people out of the floodplain—buying their waterlogged or flood-threatened houses, tearing them down, and designating entire neighborhoods part of the flood zone. This is the most controversial aspect of flood



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mitigation, both along rivers and at the oceanside.

The cities of Grand Forks and East Grand Forks partnered with the Federal Emergency Management Agency (FEMA) to remove more than 500 homes and create parks in their stead (see "Old Neighborhoods, New Parks," page 87). But not every city can afford to do that (it is the cities that have to pursue the eminent domain cases and assist with management of the purchases). Moving levees back, therefore, a key provision of sustainable flood risk reduction, becomes a cost issue, dependent on city willingness and political ability and FEMA funding. "Sometimes the ultimate solution," admits Holden, "is not within the economic grasp of the [community]."

The problem is that Grand Forks, along with most Corps projects, is still reactive, rather than proactive. Iowa was slammed with flooding in the spring of 2008. Des Moines has projects under construction, designed by Wallace Roberts and Todd, to raise its flood protection and provide more amenities. Cedar Rapids is working on a master plan by Sasaki Associates that would move flood protection back, restore natural floodplain, and remove homes from the floodway. These promise to be

Principles of Sustainable Flood Risk Reduction

KEVIN S. HOLDEN, ASLA, a landscape architect with the U.S. Army Corps of Engineers, is working to make flood risk reduction projects more sustainable—for communities, for the environment, and for the Corps. Here are the two key principles:

WIDE FLOOD PROTECTION RIGHT-OF-WAY. When new levees and floodwalls are built, they should be moved farther back from the river. This has the effect of creating a wider floodplain within which the river can spread out, and it also opens opportunities for natural restoration of those floodplains. Creating a wide right-of-way is what Holden calls a "non-structural solution," which essentially means keeping (or making) more floodway areas building free. It takes communities and the Corps out of the business of protecting neighborhoods built on marginal land and generally simplifies the alignment of levees, which no longer need to twist and turn to follow a convoluted river. The bonus is that these straighter, set-back levees are easier to maintain, because access is possible from both sides.

COMMUNITY AMENITIES. Once the floodplain has been widened, there are ample opportunities for recreation. Former Grand Forks Greenway Coordinator Melanie Parvey remembers the Corps and design consultants saying they needed space for the water anyway, so they might as well put it to good use. Such use can include trails, festival grounds, campgrounds, golf courses, and anything else that can take some inundation from time to time. Holden feels that flood protection should also look good. Floodwalls can look more ornamental than functional, and they can include temporary closures that stay open most of the time and provide views. Currently, the Corps doesn't pay for this stuff, though, so, says Holden, "the best projects are when the Corps is dedicated to a multidimensional project, but the community is behind it, too."

great projects, but they were still triggered by floods instead of anticipating them.

Flooding problems will likely continue to worsen. Grand Forks has seen three 100-year floods in 12 years. Increased impervious surface in the watershed, the possibility of more erratic precipitation caused by global climate change, and the continued removal of natural farmland buffers could all increase the amount of water en-

tering rivers. If the Corps is serious about protecting cities, it will need to financially help those cities clear flood-prone land in advance, and it will need to better address entire watersheds. To go a level higher, the Corps is a branch of the army and could receive new orders from the president. Yes, these new initiatives will cost money, but so does the National Guard sandbagging levees.

Adding recreational amenities to flood mitigation projects costs extra money too. In the wake of the 1997 flood and fire, Grand Forks was understandably overwhelmed, and Parvey, who was studying at the University of North Dakota that spring, remembers difficult discussions about how to use the floodplain. "When we talked about recreation and access to neighborhoods, I was surprised at how much resistance there was," she says. "People said 'How can we talk about spending money on something that isn't a necessity?' Now I don't think you'd have anyone say we shouldn't have spent \$20 million for this recreation system out of [the approximately] \$400 million project." *LADI*

Adam Regn Arvidson, ASLA, is a regular contributor to Landscape Architecture and founder of Treeline, a design/writing consultancy in Minneapolis.



Though it might seem counterintuitive, the designers felt that the flood protection should be permeable, allowing, for instance, connection between downtown Grand Forks and the river. This is not, however, the norm with flood protection projects—even those being built today.