
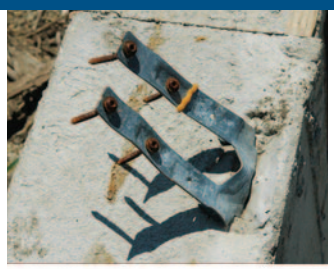


MIDWEST FLOODS of 2008 IN IOWA & WISCONSIN

6 Conclusions

The conclusions presented in Chapter 6 are based on MAT field observations in the areas studied; evaluations of relevant codes, standards, and regulations; and meetings with state and local officials, contractors, and other interested parties. These conclusions are intended to assist the States of Iowa and Wisconsin as well as communities, businesses, and individuals in the reconstruction process; and to help reduce damage and other impacts from future floods. The report and its recommendations are also valuable to FEMA in considering changes or additional guidance that can make mitigation programs more effective.

The conclusions in this chapter are presented in four sections: Section 6.1 Building Performance, Section 6.2 Risk and Communication, Section 6.3 Hazard Mitigation Assistance Programs, and Section 6.4 Floodplain Management. These conclusions relate directly to recommendations presented in Chapter 7.

6.1 Building Performance

6.1.1 Basements

The MAT observed several basement wall failures in older construction that lacked reinforced foundation walls to resist lateral loads caused by hydrostatic forces and saturated soils. These failures were primarily observed in pre-FIRM basement construction within the SFHA and older unreinforced foundation walls outside the SFHA. Ongoing renovations observed by the MAT indicated that foundation walls were being reinforced during repair. Due to the magnitude of flooding, several basements outside the 1-percent-annual-chance floodplain were inundated; however, no observations of failure due to hydrostatic pressure were observed in areas that had newer construction practices with reinforced basement foundation walls. Finally, in the one community visited by the MAT with a basement exception under the 44 CFR §60.6(c) NFIP floodplain management criteria, the certified basements performed as designed.

6.1.2 Foundations

The foundation failures studied by the MAT were primarily due to hydrostatic forces, but, in some cases, hydrodynamic forces were the cause. Hydrodynamic force failures occurred due to high-velocity floodwater acting directly upon the foundation. These failures were seen primarily in two places:

- Near stream channels where floodwater was exiting the channel and entering the floodplain at high velocity, such as at the outer side of stream bends
- Near failed levees that allowed concentrated floodwater to enter the floodplain at high velocity

Figure 6-1 illustrates a pre-FIRM foundation that was exposed to hydrodynamic forces as wind-driven waves flowed from Lake Koshkonong to the Rock River. Figure 6-2 illustrates a residential building that was situated behind a levee and removed from its foundation by high-velocity floodwater when the protective structure was overtopped.

Figure 6-1.
The foundation of this residential building was exposed to floodwater flowing from Lake Koshkonong to the Rock River (Newville, Wisconsin).

Figure 6-2.
This home was moved several hundred feet away from its foundation after floodwater overtopped a levee in Oakville, Iowa.

6.1.3 Openings

Throughout the field visits, the MAT observed a lack of openings in foundation walls, openings that were too high above grade, and openings that were obstructed. Because foundation walls can sustain damage or collapse due to hydrostatic loads, NFIP regulations require that enclosure walls contain openings that allow for the automatic entry and exit of floodwater. These openings are intended to allow floodwater to reach equal levels on each side of the wall, thereby lessening the probability of damage caused by a difference in hydrostatic loads on opposite sides of the wall. In some cases, openings that were designed in compliance with the NFIP and FEMA TB 1, *Openings in Foundation Walls and Walls of Enclosures*, became non-compliant during construction due to the addition of insulation, as shown in Figure 6-3.

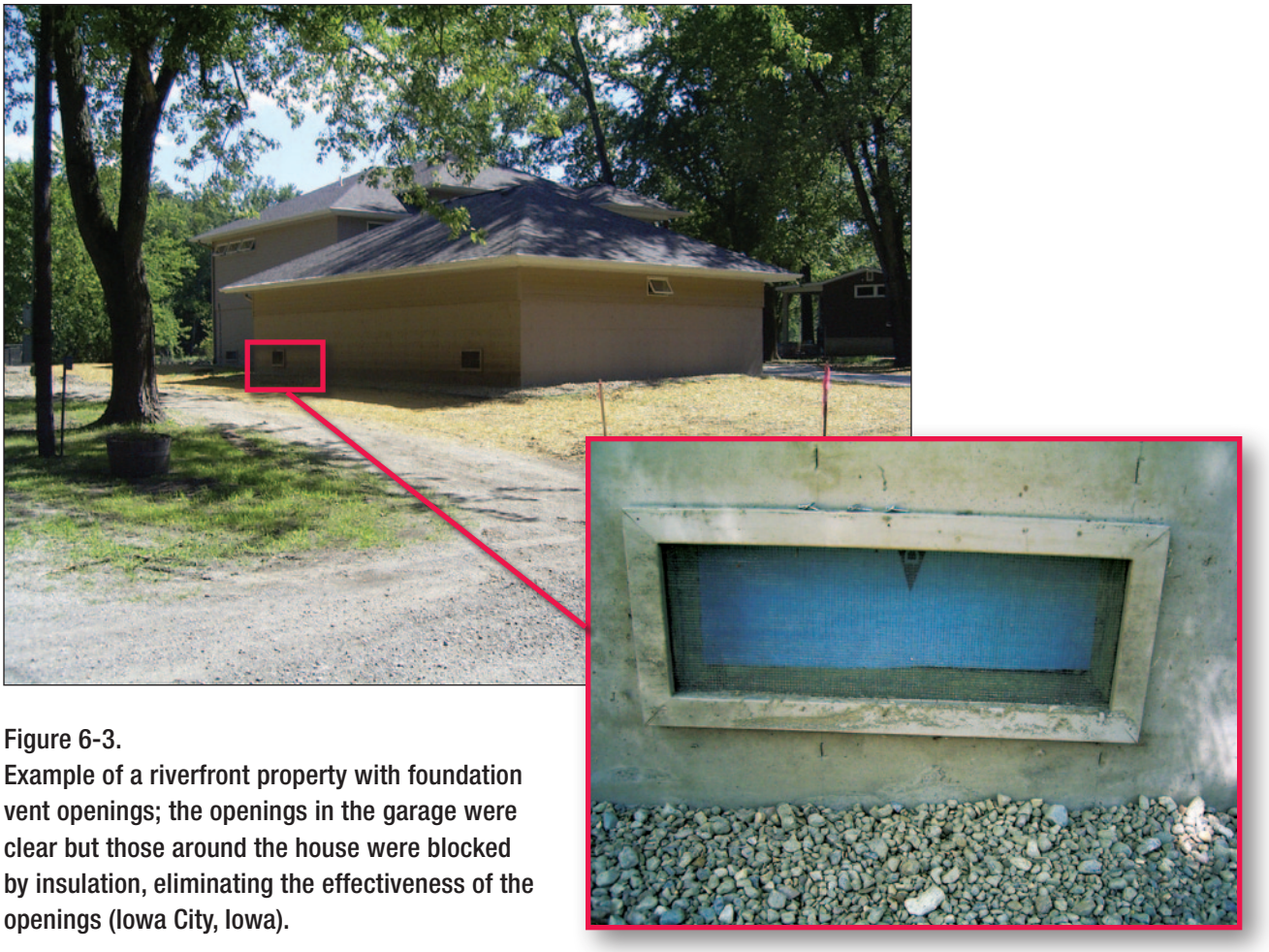

Figure 6-3.
Example of a riverfront property with foundation vent openings; the openings in the garage were clear but those around the house were blocked by insulation, eliminating the effectiveness of the openings (Iowa City, Iowa).

6.1.4 Damage Inspections

Following the floods, local building departments had difficulty keeping up with the high volume of required post-disaster damage assessments, including substantial damage inspections. Several communities put a temporary hold on issuing building permits until their workloads became more

manageable. To help manage their workload, communities trained personnel identified through local home builders associations to provide support with plan reviews and code enforcement. They also utilized emergency contracts to help complete residential substantial damage inspections.

6.1.5 Elevation

Although little new construction was observed in the floodplain, most of the buildings that were elevated above the BFE performed well and had limited damages. However, some that were elevated to the minimum requirements of the NFIP (i.e., at BFE) were still not high enough to avoid damage. Others were damaged because they were constructed pre-FIRM and had what, if constructed today, would be considered NFIP compliance issues, such as basements, utilities, or other functions located below the BFE. As expected, newer buildings performed best when elevated higher on proper foundations. Figure 6-4 is an example of a property constructed on fill so that the first floor elevation was 2 feet above the BFE.

Figure 6-4.
This property was elevated 2 feet above the BFE and sustained minimal damages, whereas the adjacent pre-FIRM properties built at grade had over 4 feet of flooding (Milton, Wisconsin).

6.1.6 Backflow Prevention

During the Midwest floods, backflow from sanitary sewers caused flooding in buildings, some of which could have been prevented with a backflow device. A backflow prevention device is a valve that is located in the sewer line that exits a building. This line is subject to possible flooding due to elevations of the finished floor of the building in relation to the sanitary sewer system elevations. The purpose of this valve is to prevent sewage and floodwater that enters the sanitary system from flowing back into the building through the sewer piping. Sewer flow into buildings occurs when wastewater flows increase and create sufficient pressure to cause sewage to flow backward into buildings via the laterals. Facilities within the building, such as toilets, floor drains, sinks, etc., overflow with untreated sewage.

The elevation of the flooding in the building is directly related to the surface elevation of the wastewater and head in the sanitary sewer system. Sewage backflow can occur in buildings that may not be flooded by overland surface floodwater but are affected by the sanitary sewer system that has collected storm flows to the point that the pressure in the system pushes the flows back into the buildings. With backflow prevention devices, the pressure closes the devices and prevents sewage from entering the buildings, as observed in academic buildings at the University of Wisconsin at Oshkosh. In other areas visited by the MAT, flooding caused sewage from sanitary sewer lines to back up through drain pipes. These backups not only caused damage that is difficult to repair, but also created health hazards.

6.1.7 Critical Facilities

The Midwest floods illustrated the importance of properly locating critical facilities to reduce their flood risk. EO 11988 requires and FEMA 543 recommends that critical facilities either be located outside the 0.2-percent-annual-chance floodplain or, if that is not possible, protected to the 0.2 percent-annual-chance flood level. Several critical facilities that were located within the 0.2-percent-annual-chance floodplain and, in some cases, within the 1-percent-annual-chance floodplain sustained considerable damage requiring several hundred million dollars in repairs and numerous months of closure. In addition, the damages impacted vital resources during response and recovery operations. The three facilities on Mays Island in Cedar Rapids are examples of facilities whose operations had to be relocated for several months due to flood damages. The floods also showed that critical facilities that are near, but not within, a 0.2-percent-annual-chance floodplain still face a residual flood risk, and their staff should plan accordingly. Mercy Medical Center, which is located adjacent to but not directly in the 0.2-percent-annual-chance floodplain, illustrates this residual risk to facilities. Damage to the hospital included flooding of an MRI machine, pharmaceutical robotics, communications equipment, and electrical distribution panels.

Critical facilities that relocated contents or functions to higher levels during the 2008 floods successfully avoided damages to valuable property, as was the case at the University of Iowa library. Thorough planning and integrated design are essential to ensuring a critical facility remains functional during and after a disaster. Having detailed plans in place to vacate a correctional facility, hospital, or other critical facility is essential to properly evacuating to an offsite location. In addition, planning for necessary logistics such as food, water, and fuel are essential to keeping critical facilities functioning during a major disaster when resources can be limited.

To prepare for the floods, several critical facilities visited by the MAT monitored forecasts several times daily and prepared levels of protection based upon projected crests. Some were caught by surprise when the river crests exceeded forecasts. In Cedar Rapids, forecasts versus actual crests differed by more than 7 feet, and the County Sheriff's Department had to evacuate inmates at the correctional facility on Mays Island during emergency conditions. Other jurisdictions staged pumps throughout low-lying communities to help limit sewer backups before they reached residences. In addition to protecting facilities with sandbags, staging equipment, and other measures, one wastewater treatment facility manager coordinated with the facility's major users to reduce demand on the facility, which helped avoid discharge violations, associated fines, and loss of function for the plant.

6.2 Risk and Communication

Based upon numerous observations recorded by the MAT, the Midwest floods demonstrate that a significant number of property owners in the affected area did not fully understand and appreciate their level of flood risk. This has been attributed to a variety of reasons, including:

- **Emphasis on the SFHA.** Many property owners seemed to be misinformed or did not fully understand that they may be at risk of flooding even if they are not located within the SFHA. The areas of inundation associated with the 2008 Midwest floods illustrate that with certain conditions, such as above average soil saturation levels and large quantities of rain over a short period of time, floods can exceed the area delineated as the SFHA.
- **Levees and Flood Control Measures.** Flood control measures, such as levees, dams, or floodwalls, protect areas that are naturally vulnerable to flooding. Many property owners did not understand the limit of protection provided by the flood control structure. Portions of communities visited by the MAT, such as Baraboo, Cedar Rapids, Coralville, and Oakville, were guarded by flood control structures, but the 2008 floods exceeded their design capacity and buildings thought to be protected were exposed to several feet of flooding.

In addition to realizing their flood risk, everyone must comprehend how flood risk is calculated to fully understand and appreciate their level of flood risk. There are two components to flood risk: the probability of flooding and the consequences associated with that level of flooding. For example, the 2008 floods illustrated that structural flood protection measures can actually increase flood risk over time. Although properly constructed levees, floodwalls, and other structural flood protection measures decrease the probability of flooding for the area they are protecting, they indirectly support development in potentially at-risk areas, thus increasing the consequences if or when the structural flood protection measure is overtopped or fails. This is especially true when a structural flood protection measure becomes accredited for the NFIP, thus eliminating the requirement for flood insurance and floodplain regulations in the protected area. Any new development is then constructed as if a floodplain did not exist.

Besides not understanding their flood risk, some property owners stated that they did not have adequate real-time information regarding the magnitude and size of the event. Local officials said there was confusion between correlating stage and estimated crest information with elevations in a FEMA FIS so the public can estimate how deep the water may get at their location. The flood stages were typically associated with a category of damage (minor, moderate, major, or record flooding), but there was not enough information to convert the stages to a known vertical datum and develop depth grids or inundation maps that could be used by the public and/or emergency management officials as recommended by FEMA 64, *Federal Guidelines for Dam Safety*. Based on field interviews and a rainfall-river forecast summit convened by the USACE, NWS, and USGS, the need for better coordination, communication, and collaboration was identified as a lesson learned from the 2008 floods.

6.3 Hazard Mitigation Assistance Programs

6.3.1 Acquisitions for the Purpose of Open Space

Based on FEMA mitigation grant programs data through July 31, 2008, more than 2,000, or approximately 97 percent, of the properties mitigated in Iowa and Wisconsin under FEMA's mitigation grant programs involved acquiring and demolishing or relocating a structure out of the floodplain. The MAT visited several of these locations, most of which were inundated with several feet of floodwater. One example was the Monkey Run neighborhood of Columbus Junction, Iowa. Most of the homes in this neighborhood had been severely damaged by the 1993 floods, and nearly all structures had been bought and removed through FEMA mitigation grant programs. By 2008, most of these properties had been converted into green space such as soccer and baseball fields. Despite flood depths of over 4 feet above the BFE, only 6 houses in the general vicinity of the acquisitions sustained damage in the June 2008 floods. Acquisitions, which are the most effective mitigation measure because they eliminate risk completely, have been a top mitigation priority for both states since 1993.

Following the Midwest floods, homeowner attitudes toward acquisition varied. Some property owners who were substantially damaged expected to be bought out, whether they were in the floodplain or not. Others wanted to repair and remain where they were even if it meant rebuilding to a higher elevation and potentially facing the same level of risk in the future. Figures 6-5 and 6-6 illustrate the effectiveness of acquisitions.

Figure 6-5.
This is the site of a FEMA-funded acquisition project near Lake Koshkonong, Wisconsin; the adjacent building had approximately 3 feet of water throughout the living area.

Figure 6-6.
This park/open area was once the site of Soldier's Grove, Wisconsin, but in the early 1970s the community began to relocate after repetitive flooding; although the park was damaged, the acquisition/relocation program was successful in avoiding damage to residential and commercial properties that had been relocated.

According to the State Hazard Mitigation Officers, Iowa and Wisconsin set acquisition projects as their top priority. Both states planned to invoke FEMA guidance that provides a categorical determination of cost-effectiveness for the purchase of substantially damaged properties located in a FEMA-delineated floodway or floodplain under the HMGP.

6.4 Floodplain Management

6.4.1 Sources of Debris

The MAT observed activities/development in the floodplain that led to sources of debris as the floodwaters rose. Unanchored propane tanks, a traditional source of debris and hazard especially throughout the Midwest, were observed in various locations of the MAT investigations. These floating tanks become a hazard as they often leak and can explode with a spark or other source of ignition. Houseboats from Ellis Harbor in Cedar Rapids were a source of debris unique to this disaster. Both of these debris sources illustrate the need for floodplain managers and local zoning officials to be aware of daily activities in the floodplain and the potential sources of debris and high hazards they create.

6.4.2 Executive Order 11988

Executive Order 11988 – Floodplain Management, which was issued in 1977, requires federal agencies to apply a decision-making process to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains, and to avoid the direct or indirect support of floodplain development whenever there is a practicable alternative.

If there is no practicable alternative, the federal agency must minimize any adverse impacts to life, property, and the natural and beneficial functions of floodplains. EO 11988 establishes the BFE as the minimum standard for all federal agencies. In addition, the eight-step decision-making process for complying with EO 11988 must be applied whenever there is a federal action in or affecting the floodplain. The 0.2-percent-annual-chance floodplain applies to action involving critical facilities, such as hospitals, emergency operation centers, and facilities that store hazardous materials. There continues to be a lack of adherence to the EO through federal funding and support of floodplain development.

6.4.3 Floodplain Management, Flood Insurance, and Mapping

FIRMs show the level of flood risk in certain areas and assign a flood zone designation to each area for flood insurance premium purposes. Properties that are in the SFHA are deemed high risk and are required to have flood insurance when property owners obtain a loan from a federally regulated lending institution or when they receive federal financial assistance for acquisition or construction purposes. For properties deemed to have moderate to low risk of flooding because they are outside the SFHA, the purchase of flood insurance is voluntary.

Due to the magnitude of the Midwest flooding, the inundation extended beyond the limits of the SFHA in most communities visited by the MAT. Many property owners located outside of the SFHA that were, nevertheless, impacted by the Midwest floods had been told or wrongly concluded that they could not carry flood insurance. In addition, many property owners believed that the government would provide them with economic assistance despite their lack of insurance. Finally, several were unaware of provisions like the Increased Cost of Compliance coverage available to them under their policy.

Interviews with several property owners and public officials revealed the need for maps to delineate the level and extent of inundation that would result if levees, floodwalls, and dams fail. Such information will not only help communicate the residual risk to buildings behind these flood-protection structures, but will also help local governments and facility managers plan when failure is imminent.

Finally, as revealed by MAT interviews with homeowners within three CRS-participating communities, there was a general lack of knowledge about the CRS program. Floodplain managers interviewed were aware of the program; however, most homeowners had not heard of it. Most homeowners, both inside and outside communities participating in the CRS, were also unaware of the savings a community can receive for participating in the program.