



MIDWEST FLOODS of 2008

IN IOWA
& WISCONSIN

7 Recommendations

The recommendations in Chapter 7 are based on the observations and conclusions of the MAT, as discussed in the previous chapters of this report. They 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 future damage and other impacts from similar flood events.

The recommendations parallel the topics discussed in Chapter 6. They are presented in four sections: Section 7.1 Building Performance, Section 7.2 Risk and Communication, Section 7.3 Hazard Mitigation Assistance Programs, and Section 7.4 Floodplain Management.

7.1 Building Performance

7.1.1 Basements

The primary observation related to basements was the failure of unreinforced walls.

Recommendation #1: NFIP regulations require residential property owners of substantially damaged buildings in the SFHA to remove their below-BFE basements. This requirement applies unless the community has obtained a basement exception from FEMA and the basement is certified by a design professional to resist flood loads. When repairing a non-substantially damaged building in the SFHA, serious consideration should be given to filling in the basement with sand, gravel, or other granular fill material up to a level that allows crawl space access only beneath the first floor. Cohesive soils such as clay may also be used, but granular soils are typically easier to work with when filling a basement. If a crawl space is created, permanent openings must be installed in accordance with FEMA NFIP TB 1 (August 2008).

Recommendation #2: When repairing a non-substantially damaged building and not filling the basement as discussed in Recommendation #1, all basement walls should be evaluated to determine if they have adequate reinforcement. Specifically, foundation walls constructed of unreinforced Concrete Masonry Units (CMUs) should be reinforced during repair. Other modifications like replacing unreinforced basement slabs can make a foundation system more resistant to flooding and should be considered. The owner should consult with a qualified structural engineer or architect in this regard. Consideration should also be given to permanently relocating utilities to a higher floor of the building, above expected flood levels, along with any vulnerable contents that cannot be evacuated easily and quickly. FEMA 348, *Protecting Building Utilities from Flood Damage*, provides retrofitting techniques for floodproofing existing utilities, including elevation/relocation and component protection.

Recommendation #3: Homeowners should exercise extreme caution if their basement is flooded. Specifically, homeowners should not pump water out of a basement immediately following a flood. Even after the flood crest has passed and floodwaters have receded, homeowners should avoid removing water from a basement too quickly. Removing floodwater too quickly could cause basement wall and floor failure due to hydrostatic forces on the outside face of the wall. When removing/pumping water from a basement, homeowners should pump the water level down only approximately 2 feet, mark the level, and wait overnight. If the water level rises overnight, it is too early to drain the basement. When the water stops rising, the homeowner can continue pumping approximately 2 feet of water at a time and again test the following day for rising water levels before pumping further. Although most property owners impacted by the 2008 floods knew not to pump out their basements, post-disaster advisories from FEMA, state, and local emergency management officials should alert homeowners on proper techniques and timing for pumping out basements after floodwater recedes. These advisories would be beneficial for all homeowners, but especially for those new to the area.

Recommendation #4: In communities in which a basement exception has been granted by FEMA, community officials must ensure that basements are constructed in accordance with 44 CFR §60.6(c). Basements in the SFHA should be allowed only in communities that meet the criteria, and the basements must be certified by a registered engineer or architect.

7.1.2 Foundations

The MAT observed some foundations that were exposed to high-velocity floodwater and hydrodynamic forces, as well as erosion and scour. In addition, the team observed connection failures between the foundation and the superstructure in a number of older pre-FIRM buildings.

Recommendation #5: Communities should consider open foundation requirements for buildings that are constructed in potential high-velocity flow areas, such as those along river bends and immediately adjacent to the floodway. Open foundations are found on buildings that are built on piles, posts, piers, or columns with the building's first floor elevated above the BFE. The pile, post, pier, or column embedment depth must be designed to account for the maximum potential erosion and scour depths, as determined by a design professional familiar with site specific building design issues, including flooding. In the limited areas visited by the MAT that were exposed to high-velocity floodwater, buildings elevated on open foundations performed better than buildings on closed foundations. Figure 7-1 is an example of a residential single-family house on an open foundation that was exposed to high-velocity floodwater.



Figure 7-1. This residential building on an open foundation was able to withstand the hydrodynamic forces; note the opening in the wall, which is indicative of high-velocity floodwater (Oakville, Iowa).

7.1.3 Openings

Properly designed openings in foundation walls are intended to allow floodwater to reach equilibrium (equal levels) on both sides and reduce the probability of damage caused by hydrostatic loads. An absence of openings in the foundation walls of post-FIRM buildings was widespread in the communities visited by the MAT. In addition, in some cases where openings were present, the openings were obstructed or too high, thus reducing their effectiveness.

Recommendation #6: Ensure openings in foundation walls are in accordance with FEMA TB 1 (August 2008), which provides guidance on foundation openings. In addition, ensure that existing openings remain free of obstruction so that they serve their purpose.

7.1.4 Damage Inspections

Based upon interviews with local officials, several communities were overwhelmed by the volume of required inspections immediately following the Midwest floods of 2008. Jurisdictions had to complete substantial damage inspections throughout the SFHA, perform plan reviews and process permits throughout their community, and conduct code compliance inspections of repairs at a volume much larger than their normal workload.

Recommendation #7: The City of Cedar Rapids and several other jurisdictions contacted local home builder and building official associations to help identify potential inspectors. They conducted training for identified candidates and used these individuals to help expand their building department workforce and complete required post-disaster inspections as well as plan reviews and code inspections during recovery. The MAT recommends communities consider this approach in their response and recovery planning. In addition, the MAT recommends FEMA develop standard operating procedures to support local jurisdictions with conducting Residential Substantial Damage Inspections and urge jurisdictions to adopt/enforce the latest building code.

Recommendation #8: With respect to substantial damage inspections, State NFIP Coordinators and communities should consider updating their floodplain management ordinances so their substantial damage and improvement criterion is cumulative, i.e., the sum of permitted repairs and improvements over the life of the property versus the current replacement value. This cumulative approach is recognized in the CRS and can help communities reduce their flood risk, especially those with pre-FIRM properties that sustain repetitive losses.

7.1.5 Elevation

Several residential elevation projects, both existing and ongoing, were visited by the MAT; the overarching observation was that the higher the floor system (in some cases up to 4 feet above the BFE), the better the building performed.

Recommendation #9: All new construction, substantial improvements, and repair of substantially damaged properties should follow flood damage-resistant criteria and be elevated above the BFE as specified by ASCE 24 (dwellings have 1 foot of freeboard and critical facilities have 2 to 3 feet; temporary facilities are allowed to be at the BFE). The ASCE 24 design and elevation requirements apply to utilities and attendant equipment as well. Property owners and developers should weigh the potential savings from damages avoided against the upfront cost of elevating a few feet higher. The potential for lower flood insurance rates as a result of lower flood risk should also be taken into account. As highlighted in Chapter 5, homeowners who carry flood insurance and are substantially damaged can use Increased Cost of Compliance funds to help finance an elevation project. As previously stated in Recommendation #1, if the elevation project is a substantial improvement, the elevated property must be constructed on foundations with proper openings and without

basements unless they are in compliance with 44 CFR §60.6(c). The most effective way for communities to utilize the flood damage-resistant design and construction criteria in ASCE 24 is to adopt and enforce the International Codes (IBC and IRC), which incorporate ASCE 24 by reference.

Recommendation #10: When elevating an existing structure, it is critical to ensure it is properly secured to the new foundation. The MAT observed several ongoing elevation projects where the foundation was being prepared with connections to properly secure the structure to the foundation. Proper connection between the elevated home and the new foundation should be required for all new construction and substantial improvements, in accordance with Chapter 4 of the IRC. Although most failures occurred in older buildings with unreinforced foundation walls, an emphasis on the importance of continuous load paths (specifically ensuring a connection with the foundation) needs to be maintained, especially given the number of potential elevation projects in the area.

7.1.6 Backflow Prevention

The lack of backflow prevention devices caused avoidable flooding in buildings, especially those outside the SFHA.

Recommendation #11: Backflow prevention valves should be installed, both within and outside the SFHA, on sanitary sewer and basement floor drain pipes; this will avoid sewer flow into a building when wastewater flow increases due to rainfall and surcharging events that create sufficient pressure to cause sewage to flow backwards. Backflow valves can utilize this backwards pressure to block drain pipes temporarily and prevent return flow. The types of valves range from check valves or backflow preventer valves, which open to allow flow out of the structure but close when the flow reverses, to gate valves, which are closed manually. These valves would not fully protect the facility from inundation by surface floodwater, but they would avert sewer water flowing into it via drain pipes. The owner should consult with a qualified engineer to determine the effectiveness of installing a backflow prevention valve in the building.

7.1.7 Critical Facilities

In general, most critical facilities visited by the MAT performed well structurally, but the ability of the facility to remain operational after a major flood event was an issue in several cases.

Recommendation #12: Critical facilities should be sited outside the 0.2-percent-annual-chance floodplain. For federally funded activity involving critical facilities, these facilities should not be constructed without a thorough analysis under the provisions of EO 11988. If federal funds are provided, the facilities should be elevated above the 0.2-percent-annual-chance flood elevation or in accordance with the freeboard requirements of ASCE 24-05 and FEMA 543. In addition, critical contents, including public documents, electrical and mechanical equipment, and any critical or expensive equipment should be located above the 0.2-percent-annual-chance flood level, in accordance with FEMA 543. As a short-term solution to reduce recovery time, existing facilities that cannot be relocated or elevated sufficiently should relocate critical functions/services, create a back-up,

and/or floodproof equipment and interior finishes. The long-term strategy should be to relocate the facility entirely outside the 0.2-percent-annual-chance floodplain.

Recommendation #13: Equipment and utilities should not be located at or below ground level in critical facilities in or near a floodplain. Electrical, mechanical, and security equipment should be located well above the BFE, in accordance with FEMA 543. Rooms where critical activities, such as operations, take place and that house patients who cannot be relocated quickly should also be located well above the BFE. Facility managers for critical facilities located in or near a floodplain should utilize the “Checklist for Building Vulnerability of Flood-Prone Critical Facilities” in FEMA 543 to help identify and address their flood susceptibility, as illustrated in Figures 7-2 and 7-3.

Figure 7-2.
The primary access road to the Des Moines Water Works is expected to be under several feet of water during a 1-percent-annual-chance flood (Des Moines, Iowa).



Figure 7-3.
The Des Moines Water Works incorporated a secondary access road along the berm system that protects the treatment plant from flooding (Des Moines, Iowa).



Recommendation #14: Critical facilities should have emergency operations plans and checklists in place for response to disasters. For example, a wastewater treatment facility should have contact information for its major customers as part of the facility’s emergency action plan so that customers can reduce inflows to the treatment facility, if necessary, in the event of a major flood. As another example, a correctional facility should have detailed plans outlining the evacuation of prisoners.

Recommendation #15: Accurate flood predictions depend on many parameters including the flood characteristics of the stream and basin, the time of year, the pre-flood basin conditions, among others. Because of the variability of these parameters from flood to flood, accurate prediction of flood size and flood timing is not always possible. It is important for emergency managers, homeowners, critical facility managers, and others to take this into consideration when preparing for a flood. Critical facilities located in the floodplain should add 2 feet of freeboard to the estimated crest elevations when preparing for flood events, similar to the freeboard requirement of 2 feet for essential facilities in ASCE 24.

Recommendation #16: Facility managers responsible for critical facilities should perform a comprehensive vulnerability assessment, including an evaluation that addresses the loss of municipal utilities (i.e., electrical power, water, sewer, and communications). In addition, critical facility managers should take preventive measures to ensure replacement equipment (e.g., pumps, generators, etc.) and essential supplies (e.g., fuel) are staged outside of the floodplain so that they are readily available and accessible following a flood. Equipment that cannot be relocated should be elevated or floodproofed so that repair times are reduced after floodwater recedes.

7.2 Risk and Communication

Based on conversations with several floodplain managers in communities affected by the flooding, there is still a widespread misperception of flood risk among homeowners. The mitigation planning process, as required by the Stafford Act, is a good tool for this purpose. The process includes the development of comprehensive risk and capability assessments that can be used to guide decision making. The process also includes the participation of a wide range of stakeholders who play a role in setting goals and identifying mitigation actions.

Recommendation #17: Government, at all levels, must improve flood risk communication and education. Through a variety of outreach efforts implemented repeatedly, property owners should be made aware of their exposure to flood risk and of the magnitude of flooding at their general location when flooding is imminent. The FIRM could provide critical support for this outreach by showing more comprehensive flood risk information indicating residual flood risk outside the SFHA boundary. For example, it should show whether a levee/floodwall is or is not certified and the respective floodwater surface elevations so people understand the flood risk that exists even in areas “protected” by levees and floodwalls.

Recommendation #18: Development behind structural flood control measures, such as levees, floodwalls, or dams, should be controlled over the life of the flood control measure

to ensure the development that occurs subsequent to the flood control measure does not actually increase an area's flood risk. In addition, due to land development upstream and other hydrologic and hydraulic factors, the flood control measure may not provide the same level of protection as when it was originally designed. Communities and developers protected by these structures should integrate redundant flood reduction measures to help limit damages when the design level of the flood control measure is exceeded. As illustrated by damages in communities like Oakville, Iowa, flood control measures may not provide complete protection from severe flooding. Redundant flood risk reduction measures include requiring that new construction be built to a certain elevation, requiring flood-resistant materials at lower elevations, and/or elevating critical interior functions above the BFE. Figure 7-1 is an example of a residential building behind a levee that was elevated on an open foundation and, as a result, suffered much less damage than buildings nearby that were not elevated and that were built on closed foundations.

Recommendation #19: Programs like FEMA's Flood Smart help educate the public on flood insurance and risk. Local floodplain managers should use Flood Smart and/or other means to communicate flood risk to property owners in their area, including those located outside the SFHA. Property owners share the responsibility of making themselves aware of their own flood risk. The property owners whose property flooded must realize that their property is in a floodplain and at risk of being flooded again. By rebuilding in that location, they are accepting flood risk and, ultimately, their responsibility to understand that risk and address it; this is especially important for those who were not substantially damaged and, thus, are not required to be brought into compliance with local flood damage reduction regulations that were not in effect at the time of the building's original construction. Inundation maps illustrating the 0.2- and 1-percent-annual-chance floods, as well as the 2008 floods, are an effective way to communicate this risk. In addition, floodplain managers can use modeling software to help communicate flood risk prior to a flood and support decision making during response operations. As an example, the Johnson County Iowa Emergency Operations Center utilized HAZUS-MH to develop estimates of potential impacts to their infrastructure. Modeling software could also be used to help bring together critical flood information like the BFE, flood stage, crest, and peak discharge to help emergency managers facilitate response and recovery operations.

Recommendation #20: The MAT observed facilities with historic flood levels marked on walls as a reminder. Local floodplain managers should consider applying the same concept and mark traffic signal and sign posts with historic flood elevations or the 1-percent and 0.2-percent-annual-chance flood elevations throughout the floodplain to help communicate the level of flood risk to the public. Also, to help educate residents about the residual risk associated with structural flood damage reduction measures, local officials should consider placing signs stating: "This area is a floodplain protected by levees or dams; these structures could overtop or fail resulting in flood depths of 'X' feet in this area." This is similar to the requirements in Executive Order 11988, which requires federal facilities that have suffered flood damage or are located in an identified flood hazard area to delineate past and probable flood height to enhance public awareness of flood hazards. Figure 7-4 is an example of a wall marked with historic flood levels from 1903 to 1993.

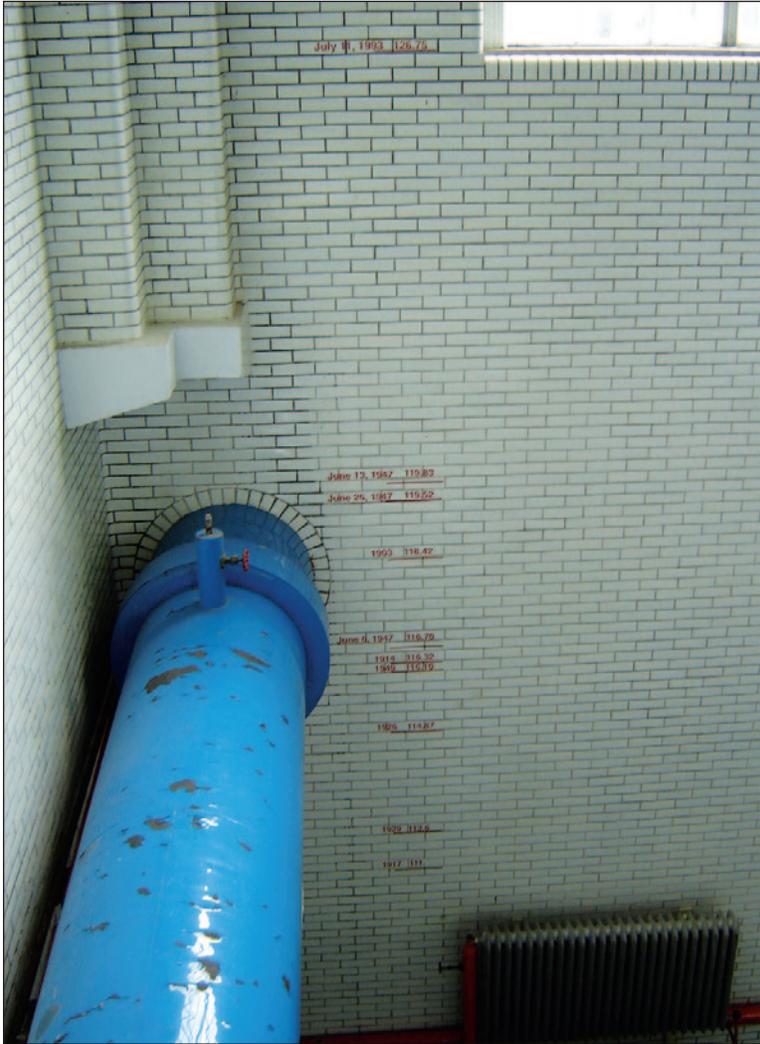


Figure 7-4.
The Des Moines Water Works has marked historic flood levels at their pumping facility for more than 90 years (Des Moines, Iowa).

7.3 Hazard Mitigation Assistance Programs

The MAT visited the site of several FEMA-funded acquisition projects; these sites demonstrated the success of the acquisition strategy.

Recommendation #21: The MAT recommends that acquisition be considered by states and communities with access to HMGP funds. Acquisition is the most effective mitigation measure, leaving no residual risk for property to be damaged. Following the 2008 floods, both Iowa and Wisconsin set acquisitions as their top priority for mitigation projects. It is important for floodplain managers and local government officials to take a holistic approach to acquisition projects; not only should the individual properties be removed from the floodplain, but also all associated infrastructure. By integrating hazard mitigation planning into recovery planning, floodplain managers can ensure that ongoing mitigation/reconstruction efforts are consistent with long-term plans.

Recommendation #22: FEMA and other federal agencies should continue mitigation grant programs to support communities in pursuing opportunities to prevent future loss of life and property from hazard impacts. In addition, communities should identify and budget funding to finance mitigation projects internally. For example, the Milwaukee Metropolitan Sewage District Flood Management Program manages over \$100 million annually for mitigation projects through funding collected from sewage disposal fees. Their projects include creating increased temporary water storage, improving the sewer system to avoid backups during floods, and acquiring developed property to convert to open space or undeveloped property to ensure it remains open.

7.4 Floodplain Management

7.4.1 Sources of Debris

Whether it is unanchored fuel tanks, shipping containers from a port, or rail cars from a rail bridge, each disaster has its common and unique types of debris. The MAT observed various operations and activities that local floodplain managers should consider monitoring to help limit potential debris during a flood.

Recommendation #23: Floodplain managers and residents must be aware of potential sources of debris and ensure actions are taken to remove them from the floodplain or ensure they are properly anchored. Specifically, FEMA should continue education and outreach of its existing guidance for anchoring fuel tanks. When anchored in accordance with FEMA's guidance, the tanks remain in place and are functional after floodwater recedes. In addition, local floodplain managers and residents should conduct assessments of their areas to secure or relocate unanchored items, such as supplies staged in a storage yard, recreational equipment, or patio furniture when floods are imminent. At the state level, NFIP coordinators should address limiting potential sources of debris in their model floodplain management ordinance.

7.4.2 Executive Order 11988

EO 11988 requires federal agencies to avoid any adverse impacts on the floodplain through development when there is an alternative to locating or affecting the floodplain.

Recommendation #24: FEMA and other federal agencies should ensure EO 11988 is being properly implemented when funding recovery projects to help reduce future flood damages. Specifically, critical facilities should be relocated outside the 0.2-percent-annual-chance floodplain whenever possible.

7.4.3 Floodplain Management, Flood Insurance, and Mapping

A FIRM identifies the special flood hazard areas and the risk premium zones applicable to a community, and helps lenders determine if a property is required to carry flood insurance. In addition, a FIRM commonly serves as a local floodplain manager's primary resource to communicate flood risk to the public.

Recommendation #25: Local jurisdictions should continue to integrate freeboard requirements into their floodplain management ordinances and require homeowners to build above the BFE. In urban areas, jurisdictions may wish to consider adopting the 0.2-percent-annual-chance elevation as the design flood elevation because, as development increases, so does the community’s exposure and flood risk. Communities should strengthen floodplain management regulations to require new construction to be elevated to at least 1 foot above the BFE and follow flood-resistant design and construction criteria as outlined in ASCE 24. Several ongoing elevation projects observed by the MAT were designed to be 3 feet above the BFE. This design decision was based upon experiences from recent events as well as knowledge of neighboring properties that were not elevated high enough to avoid flooding during events that exceeded the 1-percent-annual-chance flood (see Figure 7-5).



Figure 7-5. The property on the left was elevated to the BFE after flooding in 1993 (no freeboard) and flooded in 2008; after the 2008 floods, the homeowner of the ongoing elevation project on the right decided to raise his home 1 foot above the high water mark for the 2008 floods, which is almost 4 feet above the BFE (Iowa City, Iowa).

Recommendation #26: FIRMs should continue to delineate the current flood zones for the purposes of designating risk levels and setting flood insurance rates. However, communities should understand the flooding hazards of the entire watershed area. The 2008 Midwest floods illustrated that the 1-percent-annual-chance flood is not the limit of the floodplain; most communities visited by the MAT experienced a flood that exceeded the SFHA boundaries. A property owner located just outside the SFHA or in an inundation area protected by a certified levee should consider taking preventive measures to reduce flood damages; floodwater may not stop at the SFHA boundary and a structural flood control measure may be overtopped or otherwise fail. Education and outreach material should emphasize that the NFIP guidelines are the minimum requirements and that designers, planners, builders, and property owners should take additional measures in floodprone areas.

Recommendation #27: Through the map modernization initiative, local communities receive complete digital delivery of their FIRM. This digital delivery enables communities to overlay their flood hazards on their built environment in the geographic information system (GIS) platform. Taking full advantage of this can help communities communicate flood risk more effectively and better plan for and prioritize mitigation projects. Most of all, it enables communities to use the information to conduct stronger risk assessments and more accurately identify flood vulnerabilities throughout their community. The MAT recommends that the digital delivery include a depth and velocity grid that can be used to determine the extent and dynamics of flooding throughout the floodplain, identify more detailed levels of risk within the SFHA, help the community plan with their built environment information, and possibly even support design professionals with deciding on a foundation design. To communicate this risk, local floodplain managers may consider using different colors to indicate different levels of flooding in and outside of the SFHA. Note: Several of the rapid recovery maps (including those for Mahaska County, Iowa) developed under Disaster Number 1763 included digital delivery with a depth grid.

Recommendation #28: Ensure education and outreach materials reach property owners outside the SFHA, so they understand that flood insurance can be purchased anywhere within a community or legal entity that satisfactorily participates in the NFIP; this material should especially be sent to those property owners that are protected by a levee. State and local officials should promote the purchase of flood insurance as well.

Recommendation #29: The MAT recommends that federal, state, and local officials increase their emphasis on Increased Cost of Compliance coverage after a flood through outreach materials to homeowners and/or NFIP insurance agent workshops. In addition, NFIP workshops for insurance agents should stress the agents' role in informing homeowners of the importance of carrying flood insurance even if they are outside the SFHA, regardless of whether or not they obtained a loan from a federally regulated lending institution for their property.

Recommendation #30: Three of the communities visited by the MAT participated in the CRS program. However, not many homeowners were aware of the program or that a community's efforts beyond the NFIP minimum standards could reduce flood insurance premiums for the community's property owners by 5 to 45 percent. Through education and outreach, federal, state, and local officials should promote the CRS program so that it is considered by potential homeowners or renters in the area in the same way potential buyers look for strong school districts and competitive property taxes.