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National Flood Policy Challenges Levees: The Double-edged Sword

This is a position paper prepared by the Association of State Floodplain Managers, (ASFPM), a non-profit professional organization dedicated to the reduction of flood losses in the United States.

Introduction

It has long been recognized that flood protection provided by levees is a double-edged sword. On one hand, levee systems have provided flood protection. On the other hand, given enough time levees either will be overtopped or will fail—leading to severe flood impacts on an unsuspecting population. Unlike a natural flood, levee failure flooding is often rapid, forceful, extremely damaging, and occurs with little or no warning.

New Orleans is only one example of a community that has felt both edges of the “sword.” Many floods were repelled by the levees around the city over the years, but catastrophic flood damage occurred in 2005 as a result of levee failures and overtopping. Subsequent efforts to properly reflect the location of and true protection provided by levees on flood maps in the nation has heightened the awareness of policy makers and citizens about the enormous risk the nation faces in levee-protected areas.

An additional concern is that levees are often placed so that they encroach substantially on river systems. This creates adverse impacts both on flood frequency and severity as well as on the natural functions of the river system.

Because of the nature of levee failure flooding, the ASFPM believes that levees are not a wise community choice and should never be used to protect undeveloped land so development can occur in the flood risk area behind the levee. However, many levees already exist in the nation, especially in communities that were built right on the river or coast, usually at a time when the nation was convinced it could engineer its way out of flooding. Where levees already exist, or where a levee appears to be the best option after careful analysis of all alternatives to mitigate the incidence of flooding to existing development, the ASFPM advocates that levees (1) must be designed to a high protection standard; (2) must be frequently and adequately inspected, with all needed maintenance funded and performed (if this does not occur, the levee must be treated as nonexistent); (3) should be used only as a method of last resort for providing a LIMITED means of flood risk reduction for existing development; and (4) are inappropriate as a means of protecting undeveloped land for proposed development.

It is apparent that over time the nation has gradually and imprudently modified its various policies that affect levees and levee failure. The outcome is an unacceptably high risk of catastrophic levee failure and the resultant damage and costs at numerous sites across the United States.

Correcting this problem will require an evaluation of

- The definition of a “levee”;
- The existing and future levee inventory;
- Levee design standards;
- Levee operation and maintenance, including inspection and certification;
- Management for residual risk including (1) identification of all areas at risk of flooding from levee overtopping or failure and from internal drainage; (2) community and citizen emergency action plans (EAP) that address flood warning and response; (3) flood insurance, floodplain management measures, and effective risk communication about the residual risk areas for which levees provide “some level of protection”; and
- Mitigation for adverse flooding impacts of levees on other people, property, and communities.

Levee Definition

Due to the risk inherent in levees and the resulting implications for their design, operations, maintenance, and accompanying floodplain management measures, there is a need to more precisely define when a structure is a levee, dam, or some other incidental work that can modify flood flows. There are a number of definitions of a levee, depending on the program and its purpose. The Federal Emergency Management Agency (FEMA) has defined a levee in the National Flood Insurance Program (NFIP) regulations at 44 *CFR* as “a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.” Its primary function is flood protection.

From an engineering perspective, this is a reasonable definition of levee function; but it lacks any mention of risk, residual risk, or variation in consequences, therefore suggesting that all structures are the same. Further, the definition is sufficiently broad that it could include linear embankments (canals, roads, railroads) that could function like levees (controlling riverine flows) or in many cases merely trap and impede surface flows that are moving towards a stream or river system.

The net result is that while we are attempting to manage the significant problems associated with “true levees,” we inadvertently are expanding the size of the problem to include non-levees and are failing to adequately consider the risk and vulnerabilities associated with varying sizes of levees and of the populations that are protected by them. This is leading directly to delays in releasing flood maps, and ultimately may lead to poor management decisions about the extent of the levee issue.

Recommendations

1. *The ASFPM urges FEMA and the U.S. Army Corps of Engineers, along with other federal water resources agencies, to revisit and revise the definition of levee so that it includes elements of function, risk, and vulnerability. This effort should include defining a levee,*

dam, or incidental work that modifies flood flows and the interrelationships among these definitions. The Federal Interagency Task Force on Floodplain Management is one potential vehicle to undertake this task.

Existing and Future Levee Inventory

At present the nation lacks data and information about the physical location of its levees, their ages and conditions, the level of protection each provides, whether levee failure warning and evacuation plans exist and are exercised, who owns and maintains a specific levee system, and the adequacy of the operation and maintenance plan, exercises, and implementation.

An inventory is necessary of all levees that purport to provide flood protection, federal and non-federal, both within NFIP-identified flood zones and outside of those zones. To ensure uniformity and priority, the federal government is the most logical entity to undertake this inventory and a lead agency for the initiative should be identified. However, to be successful, the inventory must include examination of all levees (public and private) that are enrolled or recognized by any federal program, not simply those that are components of the lead agency's programs. During this inventory phase the federal government would not perform detailed engineering analysis of the levees, but would geo-reference all levees and state the general condition of the levee based on a cursory physical inspection. A rough estimate of the number of people, structures, and infrastructure at risk when that levee fails should also be calculated in that initial inventory. Detailed engineering need not be provided by the levee owner to the federal government at the inventory phase but providing this information would assist the federal government in assessing the levee's condition.

Recommendations

- 2. The ASFPM believes that the Corps of Engineers should be tasked as the lead agency to develop and maintain a comprehensive inventory of current and future levees. This would start with federal levees and ultimately include non-federal and private levees.*

Levee Design Standards

In those cases in which a levee is found to be an appropriate measure to protect urban areas or to be credited for protection, the levee should be constructed to a high level of protection. As described in various reports, the level of the 500-year flood, plus freeboard, is considered an appropriate minimum protection standard for constructing and accrediting levees within urban areas, with some possible exceptions on streams where dams regulate flows up to the 500-year or larger flood event.

By default, the design standard for levees is currently based on either (1) the 100-year standard of the NFIP, or (2) the level of protection justified using federal, development-oriented policy that attempts to maximize the levee project's net national economic development (NED) return to the nation. The NFIP and NED factors, along with cost-sharing requirements and the federal budget process, have resulted in "lowering the bar" for most levees in the nation to the 100-year standard, even in cases in which the consequences of the failure of a particular levee would be catastrophic. Ironically, based on current practice, the nation and citizens would fare better if a community built a "99-year levee," because this would lead to the continuation of both mandatory flood insurance as well as continued floodplain management construction practices—which collectively would lower vulnerability and risk much more than would a 100-year levee by itself.

Why are so many levees built only to the 100-year standard?

Before the 1970s, the Corps of Engineers focused on building levees to protect property from the “standard project flood,” which in many cases is roughly equivalent to a 500-year flood. In some areas, as communities began feeling pressure from the requirements of the NFIP, developers and communities often sought to “remove” land from the mapped 100-year flood zone. The presence of a 100-year levee, when certified under the NFIP procedures, removes the flood zone designation from the “protected” property, and thus eliminates the NFIP requirement to comply with construction standards, such as elevation of any new or substantially improved buildings in that area, and also removes requirement for purchasing flood insurance. Increased development in these flood risk areas provides a short-term economic benefit with potentially long-term adverse consequences.

The attractiveness of this short-term relief from NFIP requirements, the resultant ease with which the levee project can be “sold” to the public, the fact that the damage costs from catastrophic failure can be largely externalized to the federal taxpayers, and the relative lack of immediate project benefits that can be derived from providing a higher level of protection, all conspire to make the minimal, 100-year level of protection the most popular standard for new levees.

This is not to suggest that pro-active local sponsor agencies and officials are not attempting to obtain more than 100-year protection, but budgeting and the overwhelming attractiveness of a perceived federal standard are making it difficult for these officials to justify more than a 100-year level of protection. At the same time, these local officials may be caught in a dilemma that the NED federal project is justified for a level that is at the 100-year level of protection, falling short of the need seen by the local officials.

Why is the 500-year standard more appropriate than the 100-year standard for urban areas?

Levee failure flooding is different from most riverine flooding both in terms of the rapidity of inundation, the concentration of high-energy flood waters in the area of the failure, and in many cases the large areal extent of the flood waters. These factors combine to pose potential impacts on buildings little prepared for flooding. The 500-year standard for levee design is just as arbitrary as the 100-year standard so the question becomes, “what level of risk to public safety can we accept?” When one compares the potential for fire damage to an individual home, case history would indicate that a 100-year standard falls far short of the level of protection afforded by modern fire systems. While fire and flood are different agents of destruction, the results of both can be similarly devastating. However, today’s fire systems tend to significantly limit the degree to which an entire community can be affected by fire, yet we continue to use a much lower threshold in levee design that most certainly will result in community-wide inundation. Although there is no perfect answer to this problem, adopting a 500-year standard would move the United States closer to what it currently demands in fire protection and at the same time would mirror what other nations have done, many of which that have a considerably longer history of levee management.

There are those who believe the level of protection standard for levees should be based purely on an evaluation of benefits vs. costs. If benefit/cost analysis could adequately consider risk tolerance, then there could be some merit to this argument. There are many intangibles when evaluating public safety risks, whether they be floods, auto safety, or other personal decisions of risk that border on issues of demographics and social justice. For example, as a society would we condone relaxing the standards and expenditures for traffic safety in a retirement community because the residents are no

longer working and hence providing limited return to the nation's economy? Although this example is ludicrous, such a suggestion differs little from a policy that suggests that within residential areas we vary our level of protection based on the total existing investment at that location. The ASFPM believes that benefit/cost analysis is a valuable tool for comparing investment opportunities but that by itself, unbounded by a public safety standard, is a dangerous and potentially inequitable tool for "sizing" flood risk reduction systems.

The 100-year standard used by the NFIP was developed for use in a program concerned with the flood-resistance of individual buildings, not public safety. This confusion between public safety and insuring buildings has led to thousands of people living at great risk behind levees, thinking that they are perfectly safe because they do not believe that the government (federal, state, or local) would allow them to live behind the levee if such were not the case.

An added element of risk in current design practices is the lack of designing "planned failure" into levees. When levees fail, either by structural failure or overtopping by flood waters that exceed the design event, the results are often catastrophic, with the levee experiencing massive damage, as demonstrated in New Orleans in 2005. In many instances it is useful to design levees to withstand overtopping, or to control the overtopping to a limited number of spillways designed into the system. The aim is to prevent loss of the levee, by allowing it to be overtopped and slowly flood the area in planned locations rather than randomly, so that damage is reduced and the community can recover more quickly. If fail-resistant spillways were designed into the levee, then excess flow would move through the designated area when the levee's design level is exceeded, and failure of the whole levee system might be prevented. This "safety valve" feature is used in the design of dams to allow the passage of large flows that exceed the design capacity, so the structure stays in place and can function as soon as flood heights diminish to design levels. Strategically locating these spillways in combination with land use practices would greatly reduce the potential for catastrophic loss by directing flows away from highly developed urban areas. Coincident design features would include land use management and evacuation plans in the areas around the spillways to protect lives and property.

As accentuated by the levee failures in New Orleans, a 100- or 200-year level of protection is insufficient to avoid catastrophic losses and their resultant financial implications to all federal taxpayers. Although a catastrophic levee failure of the magnitude and impact of that experienced in New Orleans is uncommon, current planning processes for levees fail to capture the magnitude of this impact and the resulting economic, social, and environmental consequences. If similar planning, construction, and maintenance approaches were applied to dams, aircraft, and nuclear power plants, the nation would be exposed to significantly more disastrous events than would be considered acceptable. A levee failure more closely resembles a dam failure or other calamity than it does "normal" riverine flooding, and should be subject to procedures more appropriate to that risk. As such, a 500-year level of design coupled with an insurance and land use mechanism is more reflective of the risk.

Estimating the 500-year Flood

To continue to improve estimates of the 500-year flood, it will be necessary to keep collecting essential data and perhaps adapt hydrologic prediction methods to better reflect this level of flood event. This should not, however, be used as a reason to delay implementation of a 500-year standard for levees. There are vast areas of the country where the 100-year flood is estimated through methods that are accepted as reasonable and reproducible. A similar approach can and should be employed to make 500-year flood estimates.

Other Levee Standards

There is a need to review and evaluate past and current levee design practices. Among these issues are the adequacy of hydrologic and hydraulic techniques, geotechnical design, use of closures or other features that penetrate the levee embankment or floodwall, vegetation management, and the incorporation of safety factors such as freeboard vs. the use of risk and uncertainty to model risk.

Recommendations

3. *Levees should be used as a structure of last resort and only after other measures, especially nonstructural ones, have been fully considered. Levees should not be used as a means to facilitate the development of currently undeveloped floodprone lands.*
4. *Federal investments in levees should not be made for a structure that provides less than 500-year protection, and the Corps of Engineers planning process of maximizing the NED should explicitly incorporate this public safety standard as a lower boundary for federal investment.*
5. *Levees should not be constructed in floodways and, to the maximum extent possible, when constructed or reconstructed levees should be set back from rivers to allow the river to function more naturally and to provide for the protection or restoration of riparian and wetland resources between the river bank and the levee.*
6. *The ASFPM urges Congress and the Administration to adopt a policy that the 500-year level of protection for levee design is the minimal standard for purposes of flood insurance and other federal investment.*
7. *Current levees that provide less than 500-year protection but meet all the requirements for design, maintenance, and operation, and are recognized by federal programs as meeting the standards for 100-year protection, could be provided grandfathered status. Criteria should be developed to determine when and if protection provided by a specific levee would need to be upgraded and how that would be achieved.*
8. *Benefit/cost analysis is an appropriate tool with which to evaluate and contrast federal projects, but it should be bounded by a strong public safety design standard, which for federally supported levees should be the 500-year level of protection.*
9. *The design of levees should include improved methods of providing resiliency, most notably the inclusion of designed fail-resistant spillways built into many levees so that when the levee design is exceeded, excess flow spills through that area, preventing catastrophic overtopping or failure of the structure.*
10. *The impacts of any new, rehabilitated, or reconstructed levee that would result in the transfer of damage or in adverse economic, social, or environmental consequences must be mitigated.*
11. *The local sponsor must demonstrate the financial and staffing capability to provide operation and maintenance for the life of the structure—before the project is approved, constructed, re-constructed, or recognized as providing a certain level of flood protection.*

12. *Congress should fund the National Research Council to engage experts to evaluate and propose modifications to levee design, operation, and maintenance standards. These efforts should include review of previous National Academies reports, and the extent to which previous recommendations have been addressed.*

Certification and Inspection

The United States has in place requirements for inspecting and certifying numerous private and public enterprises that affect human health and safety. However, the nation's sole requirements for operation and maintenance of levees are found either in an agreement between a federal agency and a non-federal sponsor (executed during construction of a levee), or as a requirement imposed by FEMA in the course of mapping flood hazard areas associated with levees. In the latter case, proper inspection and certification is mandated in order for a levee to be recognized as providing 100-year flood protection.

For many of the nation's levees, the federal government planned and built the structure, with a non-federal "sponsor," often a local government, contributing some share of the cost. Under this arrangement, the local sponsor assumes responsibility for operation and maintenance of the levee after it is built. The certification and inspection of the levee is thus the responsibility of the local party who chooses to use that structure as a mitigation measure. The certification and inspection of levees is not the financial responsibility of the federal government, except in those instances where the federal government is the sole owner and operator of the levee. Although it is clear that the local sponsor is responsible for operation and maintenance, the local entity is not required to demonstrate financial or technical ability to carry out these tasks. Further, both federal and state oversight and enforcement of the adequacy of ongoing operation and maintenance is problematic.

In numerous other cases, levees were constructed by local or state governments, were private levees built specifically for purposes of compliance with the requirements of the NFIP, or were constructed to protect areas (most notably agricultural lands) from occasional inundation. These non-federal levees have become part of the protection system with varying degrees of ongoing operation and maintenance.

This haphazard approach to levee certification and inspection fails to protect the federal interest in public health, safety, and fiscal responsibility. These requirements for levees are far less stringent than the certification, design, maintenance, and inspection requirements for dams. When flood damage results from levee failure (even if the failure results from the negligence of the levee owner who did not meet the agreed-upon inspection and maintenance duties), federal programs come into the picture to rebuild failed or damaged levees, provide disaster assistance, and sometimes to provide additional financial support to the NFIP—leaving the nation's taxpayers to foot the bill. These policies combine to create a lack of understanding and accountability for levee owners to invest in proper design, construction, inspection, and maintenance of their levees. Reversing this trend will take strong leadership, a sense of shared responsibility, and sharing of the costs and consequences of levee failure.

As with other flood loss reduction programs, a federal-state partnership is the logical avenue for the effective and efficient oversight of the certification and inspection of all levees. The certification process should consider elements of the NFIP but be more aligned with determining whether a levee meets specified design, operation, and maintenance criteria rather than simply whether a

professional engineer is willing to attest that the levee will not fail. Over the long term, levee certifications that are provided to FEMA should be delivered by an approved levee safety program, most appropriately housed within state government. Although the private sector may perform much of the engineering work, it should be reviewed and approved by qualified state staff. State capability in this area is critical and must be developed through federal legislation that provides incentives and disincentives that encourage states to undertake effective state levee safety programs, which then will reduce the federal costs described above.

Recommendations

- 13. Written guidance is needed on what constitutes a “proper” inspection, what is needed for certification to enable the NFIP to recognize the levee, and what the actual consequences are to the levee owner if the levee is not properly maintained to meet these requirements. Both the Corps of Engineers and FEMA have guidance for requirements of programs that come into play with these issues, and the guidance from each agency must be consistent and correlated with the other agency’s guidance.*
- 14. A federal policy should be clearly articulated that the periodic certification and inspection of levees, including related operation and maintenance, is the responsibility of the levee owner and that transferring this responsibility to the federal government is inappropriate. Participation in federal programs of repair, insurance, and disaster relief must be contingent on levee owner compliance with these elements.*
- 15. Non-federal levee owners must be required to demonstrate the long-term financial and technical ability to carry out operation and maintenance tasks. Further, both federal and state oversight and enforcement of the adequacy of periodic inspections and ongoing operation and maintenance must be in place and enforced.*
- 16. A state-administered national levee safety program is needed to protect the federal interest in public health, safety, and fiscal responsibility, as well as to protect public safety and costs related to all levees not in the federal system. Such a program must be fully integrated with state and local programs of flood risk management, especially floodplain management and dam safety, and should use a state delegation model similar to that used to implement the Clean Water Act, rather than function as an independent program like the existing National Dam Safety Program. State capability in this area is critical and can be developed most effectively through federal legislation that provides incentives and disincentives for states to accept delegation for the development and implementation of effective state levee safety programs.*
- 17. FEMA should require that all communities with an NFIP-recognized levee have a multi-hazard mitigation plan that considers how other hazards affect the safety of their levee (e.g., earthquake, subsidence, river sedimentation, erosion, etc.) and appropriate emergency action plans (EAPs) with action steps to account for any of these factors that affect the safety of the levee. FEMA should require that this plan be updated at least every five years, including accounting for any changes in flood flows caused by increased watershed development. The potential for catastrophic consequences of levee failure or overtopping should be included in levee planning, design, regulations, and insurance considerations.*

Residual Risk, Insurance, and Communication

The levee problem currently facing the nation has been in the making for nearly a century. It will take time, perhaps 20 years or more, to reverse our vulnerability. As such it will be necessary to identify and directly communicate the risk to individuals, but at the same time provide options that allow realistic and politically viable means for adjusting direction. In the mean time, it will be essential that we properly use all tools to minimize the impact of levee failure.

There is now widespread misunderstanding of the true risks associated with levees. This in turn has helped lead to the current over-reliance on structural solutions to reduce the impact of flooding, and to the creation of a false sense of security among those living, working, or seeking to build in areas behind levees. Communication with citizens and stakeholder groups is rarely an explicit consideration when levees are permitted or built, or in the development of policy for levee design, insurance, or regulation. As a result, the problems noted herein tend to be perpetuated, and the risks associated with levees compounded by continued development. Risk communication is the responsibility of all levels of government and the private entities associated with development, lending, insurance, and conducting any business in or near flood hazard areas near levees. Communication of the residual risk associated with any levee is key to public understanding and acceptance of appropriate public safety and flood risk reduction policies in the nation.

Due to poor communication, levees promote a false sense of security. Investors, property owners, business owners, and others tend to live and conduct business with little consideration of the levee systems that protect their property. When a levee fails there are always a significant number of individuals and businesses that lose everything in the resulting flooding and are never able to recover financially. There is an essential need to modify NFIP flood insurance and perhaps other lines of insurance to recognize that coverage should be provided for the residual risk that exists behind levees. Modifying the mandatory flood insurance purchase requirements to require the purchase of insurance in residual risk areas protected by dams or levees is an essential step.

Residual risk insurance would help manage the risk that remains within those areas protected by a levee. Another component of managing risk might be to consider design practices with levees that account for potential failure modes (e.g., incorporation of spillways at key locations) coupled with development practices behind levees that project and account for some level of inundation should the levee be overtopped or fail. While a 500-year standard by itself may fall short of societal acceptance of risk, a 500-year standard combined with design standards and insurance will increase the overall level of protection afforded to property owners to make it commensurate with the threat to individuals and the community, as well as the nation's taxpayers.

Flood maps produced by FEMA are intended to show the risk to flooding for both the 100-year and 500-year floods. Many of the nation's maps do not show areas behind levees as flood risk areas that will be flooded when the levee fails or is overtopped. Identification of those areas as flood risk areas is essential to communicating flood risk to property owners and communities, so they can take responsibility for that risk, whether by applying appropriate development practices behind the levee, by developing evacuation plans, or by purchasing flood insurance.

Recommendations

- 18. The area that would be inundated when a levee fails or is overtopped, or when internal drainage systems are overwhelmed or incapacitated should be mapped as a residual risk flood hazard area and depicted on Flood Insurance Rate Maps.*

19. *Emergency action plans (EAPs) that address flood warning and evacuation should be required for all residual risk areas behind levees in order to protect lives and minimize property damage. These plans, and the periodic exercise of them, should be a requirement of any federal or state program that recognizes the levee as providing protection.*
20. *The purchase of flood insurance and implementation of appropriate development standards should be mandatory for all property protected by levees, to reflect the potential for the catastrophic consequences of levee failure.*
21. *Communication of the residual risk behind levees on a regular basis should be an explicit component of all aspects of proposed and current levee activities. It should include notification to all property owners of the risk (e.g., a notice in an annual water bill or tax bill) along with other measures such as posting signs in all land areas at risk behind the levees. All communication should state clearly that the area behind the levee is provided with some level of protection by levees, that the levees may fail or be overtopped, and that the area is a floodplain, with indications of the depth of flooding when the levee fails or is overtopped. Communication to the property owners should provide clear information on their role if an evacuation is ordered.*
22. *The liability of owners of structural flood control projects, such as levees and dams should be communicated to the owners of those structures on a periodic basis. Information on that liability is on the ASFPM website:*
http://www.floods.org/PDF/NAI_Liability_Failure_Facilities_0906.pdf.

Adverse Impacts of Levees

Levees by their very nature adversely affect properties that are upstream, downstream, adjacent to, or across the waterway. Levees transfer flood waters onto other property or communities, interfere with the natural attenuation of flows, cause backwaters, generally increase the depth and velocity of flood waters, and encourage channel degradation and eventual bank erosion. In addition, if the levee is located immediately adjacent to the bank or the stream edge, as is common practice, important riparian vegetation is often destroyed either directly during the construction phase, or as a result of the high velocities, erosion, or sedimentation that result from the river's being narrowed by the presence of the levees.

Current policies do not adequately consider the adverse impacts of levees. For example, often levees constructed by the federal government are sited along the boundary of the floodway, which often coincides with the environmentally and hydrologically sensitive area. In some cases the transfer of these impacts is acknowledged and mitigated but frequently the impacts are ignored. This suggests the need for clarifying legislation and/or guidance that states that the creation or transfer of adverse impacts is unacceptable and these impacts must be accounted for and mitigated as part of any levee project—before that project is approved, constructed, re-constructed, or recognized as providing a certain level of flood protection. The presence of a levee encourages development in the flood risk area behind it, bringing people into harm's way when the levee fails or is overtopped.

Second, but equally important, over time levees often provide a lower level of protection than designed because upstream development or levees across the river or elsewhere in the river system or watershed result in the transfer of flooding to the leveed reach. This practice of transferring adverse impacts silently erodes the level of protection provided by the levees. Cumulative impacts

caused by levees need to be addressed. One levee in the system may not have measurable impacts, but if levees are built in additional portions of the system or watershed, the cumulative impacts can be significant, adversely affecting many communities and properties.

Recommendations

23. *FEMA and the Corps of Engineers should evaluate and eliminate practices that cause increased flood damage or that lead to induced flooding (the transfer of flooding to other property that is primarily open space) unless property owners agree to a permanent flooding easement in return for this intrusion of flooding on their property.*
24. *The cumulative impacts of levees within a system or watershed should be evaluated before any levees are permitted, so those impacts are considered and mitigated, including increasing the design height to account for increased flood levels.*
25. *Levee construction, repair, and reconstruction should account for the protection of existing natural functions to avoid adverse impacts to the natural system. In addition, during repair or reconstruction of the levee, these natural functions should be restored to the maximum extent that is practical to account for past adverse impacts.*

Summary

The nation has thousands of miles of levees, with millions of people living in the flood risk areas behind them, many believing they are completely protected from flooding. Communities often choose levees as their option to reduce flood damage to existing development. Current national flood policies not only encourage communities to choose a levee, but also encourage building the levees only to the low standard of the 100-year flood. Communities realize that they can gain the benefits of a levee (an increased local tax base and minimal disturbance to the people and infrastructure of the community) while externalizing the costs of levee failure and overtopping to the federal taxpayers through disaster relief, federal levee construction and repair programs, and the perception that, when flooded, they are the victims.

The result is a nation in which millions of citizens and hundreds of communities neither recognize their flood risk nor accept responsibility for reducing that risk. The overriding aim of ensuring public safety has been lost in the morass of complex benefit/cost calculations and in two misperceptions at the local level: first, that the levee option must be a completely safe and prudent one because the federal government allows (or even encourages) it; and second, that the responsibility for operation and maintenance of the levee does not rest solely with the local owner of the levee but is somehow shared with or even borne by the federal government.

To reverse these negative trends, changes will be necessary at the federal, state, and local levels, as well as on the part of citizens who live, work, and play in flood risk areas. This paper has set out the recommendations from the Association of State Floodplain Managers that we believe will be necessary to yield a public that is both safer and better informed about levees and the flood risk associated with them.