

National Flood Policy Challenges Levees: The Double-edged Sword

ASFPM White Paper Internal Discussion Draft

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

New Orleans is only one example of a community that has felt both sides of the “sword.” Many flood events were repelled by the levees around the city over the years, but catastrophic flood damage resulted in 2005 as a result of levee failures and overtopping . Subsequent efforts to properly reflect on flood maps the location of and true protection provided by levees 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 often are placed so that they excessively encroach 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 (1) must be designed to a high standard; (2) must be maintained and inspected; (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 generally 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;”
- Existing and future levee inventory;
- Future levee design standards;
- Levee operation and maintenance, including inspection and certification;
- Managing for residual risk including (1) identification of all areas at risk of flooding from levee overtopping or failure and from internal drainage; (2) emergency action plans (EAP)

that address flood warning and response actions; (3) flood insurance, floodplain management measures, and effective risk communication about the residual risk areas “protected” by levees; and

- Mitigating for adverse flooding impacts of levees on others.

Levee Definition

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.

The ASFPM urges that FEMA and the U.S. Army Corps of Engineers, along with other federal water resources agencies, revisit and revise the definition of levee so that it includes elements of function, risk, and vulnerability. 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 that purport to or are recognized as providing a 100-year level of protection, 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 from a cursory physical inspection. The number of structures (and estimate of people) at risk when that levee fails should also be calculated in that initial inventory. Detailed engineering analysis of the

geotechnical or other aspects of the levee is the responsibility of the levee owner, who made the choice to use levees as a mitigation option.

The ASFPM believe 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 few cases when a levee is found to be an appropriate measure to protect urban areas or credited for protection, the levee should be constructed to a high level of protection. As described in various reports, the 500-year level of protection with freeboard is considered an appropriate minimum standard for constructing and accrediting levees within urban areas.

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 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 just 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 practices 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 U.S. Army 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 the flood insurance purchase requirement. 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 levee 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 provide more than the 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 inundation. 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 fire just like flood can be devastating. However, today our 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 mirrors 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, than 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 traffic safety standards and investments in a retirement community because the residents are no longer working and hence providing limited return to the nation’s economy? While ludicrous, this example 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 lead to thousands of people living at great risk behind levees, while they think 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 currently catastrophic, as demonstrated in New Orleans in 2005. There is a need to design levees to withstand overtopping, or to control the overtopping to a limited number of planned spillways in the system. This type of effort has recently termed “resiliency.” If fail-safe spillways were designed into the levees at the design flood height (typically lower than the top of the levee), then when the levee design is exceeded excess flow would spill through that area, preventing failure of the levee system. This is the “safety valve” feature used in 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 protected 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.

Levees should be used as a structure of last resort and only after other measures, especially nonstructural ones, have been considered. Levees should not be used as a means to encourage the development of floodprone lands.

To the maximum extent possible, levee construction and reconstruction 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.

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.

Benefit/cost analysis (BCA) is an appropriate tool from which to evaluate and contrast projects, but it should be bounded by a strong public safety design standard, which for levees should be the 500-year level of protection.

The design of levees should include improved methods of providing resiliency, most notably the inclusion of designed fail-safe spillways built into the levees at a lower elevation than the levee height so that when the levee design is exceeded, excess flow spills through that area, preventing catastrophic overtopping or failure of the structure.

The impacts of any new, rehabilitated, or reconstructed levee that would result in economic, social, or environmental adverse consequences must be mitigated, and 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.

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, however, 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 a structural 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, or were private levees built specifically for purposes of compliance with the requirements of the NFIP, or were constructed to protect lands (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 was the result of 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 bail out flood insurance—all leaving the nation's taxpayers to foot the bill. These policies combine to create a lack of understanding and accountability for levee owners to properly design, construct, inspect, and maintain 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 a 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 which encourage states to undertake effective state levee safety programs, which then reduce the federal cost identified above.

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.

A federal policy should be clearly articulated that the certification and inspection of levees 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.

Non-federal levee owners must be required to demonstrate 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 ongoing operation and maintenance must be in place and enforced.

A national levee safety program administered by the states is needed to protect the federal interest in public health, safety, and fiscal responsibility. It must be fully integrated with state and local programs of flood risk management, especially floodplain management and dam safety, and should not be operated as another independent program like the present National Dam Safety program. 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.

FEMA should require that all communities with a 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.) with action steps to account for any of these factors that affect the safety of the levee. FEMA should require this plan be updated at least every 5 years, including any changes in flood flows based on increased watershed development. The potential for catastrophic consequences of levee failure or overtopping should be included in levee planning, design, regulatory, 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 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 in the development of levee-related policy, 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 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 communications, 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 provide coverage for the residual risk that exists behind levees. Modifying the

mandatory flood insurance purchase requirements to require 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 in combination with design standards and insurance increases the overall level of protection afforded to property owners commensurate with the threat to individuals and the community, as well as the nation's taxpayers.

The area that would be inundated when a levee fails or is overtopped should be mapped as a residual risk flood hazard area and depicted on Flood Insurance Rate Maps.

The purchase of flood insurance and appropriate development standards should be mandatory for all property protected by levees, to reflect the potential for the catastrophic consequences of levee failure.

Levees with less than 500-year protection, but meeting all the requirements to be recognized by federal programs as meeting the standards for 100-year protection, and that are currently recognized as fully meeting that safety standard, should be provided grandfathered status. This would allow flood insurance in the "protected area" to be eligible for preferred risk rates. This grandfathered status could continue until a claim for federal funds (levee repair or rehabilitation for the Corps, disaster payments or flood insurance claims for failure or overtopping) at which time the levee must be upgraded to 500-year standards with all associated requirements.

Communication of the residual risk behind levees should be an explicit component of all aspects of proposed and current levee activities. It should include posting signs in all land areas "protected" by levees stating clearly that the area is protected by levees, that the levees may fail or be overtopped, that the area is a floodplain, with indications of the depth of flooding when the levee fails or is overtopped.

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, interfere with the natural attenuation of flows, cause backwaters, generally increase 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 adverse impacts. 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.

Secondarily, but equally important, levees often provide a lower level of protection than designed because of the transfer of adverse impacts in the river system or watershed to the leveed reach. This practice of transferring adverse impacts silently erodes the level of protection.

FEMA and the Corps 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 specifically agree to this intrusion of flooding on their property.

Levee construction, repair, and reconstruction should account for the protection of existing natural functions to avoid adverse impacts to the natural system, or during repair/reconstruction restore these functions to the maximum extent that is practical to account for past adverse impacts.

Recommendations

Levee Definition

- The ASFPM urges that FEMA and the Corps, along with other federal water resources agencies, revisit and revise the definition of levee so that it includes elements of function, risk, and vulnerability. The Federal Interagency Task Force on Floodplain Management is one potential vehicle to undertake this task.

Existing and Future Levee Inventory

- The ASFPM believes that the Corps 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

- Levees should be used as a structure of last resort and only after other measures, especially non-structural ones, have been considered. Levees should not be used as a means to encourage the development of floodprone lands.
- To the maximum extent possible, levee construction and reconstruction 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.
- The ASFPM urges Congress and the Administration to adopt a policy that the 500-year level of protection is the minimal standard for levee design for purposes of flood insurance and other federal investment.
- Benefit/cost analysis (BCA) is an appropriate tool with which to evaluate and contrast projects, but BCA should be bounded by a strong public safety design standard, which for levees should be the 500-year level of protection.
- The design of levees should include improved methods of providing resiliency, most notably the inclusion of designed fail-safe spillways built into the levees at a lower elevation than the levee height so that when the levee design is exceeded, excess flow spills through that area, preventing catastrophic overtopping or failure of the structure.

- The impacts of any new, rehabilitated, or reconstructed levee that would result in economic, social, or environmental adverse consequences must be mitigated, and 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.

Certification and Inspection

- Written guidance is needed on what constitutes a “proper” inspection and what is needed for certification to allow 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.
- A federal policy should be clearly articulated that the certification and inspection of levees 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.
- Non-federal levee owners must be required to demonstrate 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 ongoing operation and maintenance must be in place and enforced.
- A national levee safety program administered by the states is needed to protect federal interest in public health, safety, and fiscal responsibility. It must be fully integrated with state and local programs of flood risk management, especially floodplain management and dam safety, and should not be operated as another independent program like the present National Dam Safety program. 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.
- FEMA should require that all communities with a NFIP-recognized levee must have a multi-hazard mitigation plan that considers how other hazards impact the safety of their levee (e.g., earthquake, subsidence, river sedimentation, erosion, etc.) 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 5 years, including any changes in flood flows based on increased watershed development. The potential for catastrophic consequences of levee failure or overtopping should be included in the planning, design, regulatory, and insurance considerations.

Residual Risk, Insurance, and Communication

- The area that would be inundated when a levee fails or is overtopped should be mapped as a residual risk flood hazard area and depicted on Flood Insurance Rate Maps.
- The purchase of flood insurance and appropriate development standards should be mandatory for all property protected by levees, to reflect the potential for the catastrophic consequences of levee failure.
- Levees with less than 500-year protection, but meeting all the requirements to be recognized by federal programs as meeting the standards for 100-year protection, and that are currently recognized as fully meeting that safety standard, should be provided grandfathered status. This would allow flood insurance in the “protected area” to be eligible for preferred risk rates. This status could continue until a claim for federal funds (levee repair or rehabilitation

for the Corps, disaster payments or flood insurance claims for failure or overtopping) at which time the levee must be upgraded to 500-year standards with all associated requirements.

- Communication of the residual risk behind levees should be an explicit component of all aspects of proposed and current levee activities. It should include posting signs in all land areas “protected” by levees stating clearly that the area is protected by levees, that the levees may fail or be overtopped, that the area is a floodplain, with indications of the depth of flooding when the levee fails or is overtopped.

Adverse Impacts of Levees

- FEMA and the Corps 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 specifically agree to this intrusion of flooding on their property.
- Levee construction, repair, and reconstruction should account for the protection of existing natural functions to avoid adverse impacts to the natural system, or during repair/reconstruction restore these functions to the maximum extent that is practical to account for past adverse impacts.