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Natural and Beneficial Floodplain Functions: Floodplain Management— More than Flood Loss Reduction

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

Background

With the passage of the National Environmental Policy Act over three decades ago, the United States established a foundation for protecting the environment amidst human development. In Section 101 of the Act, Congress declared that

. . . it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

However, the reality is that we seldom achieve this “productive harmony” with regard to our rivers, streams, wetlands, and coastal lowlands. As we move into the new century, we face hard choices about our riverine and coastal floodplains¹. Relatively unfettered economic development, with only a token allowance made for floodplain functions and resources, cannot continue as the status quo. Instead, we need to strike a balance between development and the benefits that would be realized if we were to protect the natural functions of floodplains and coastal areas.

Current floodplain management in this country has twin goals: (1) flood loss reduction, and (2) the conservation and protection of the natural and beneficial functions of our water resources. Although considerable effort has been expended on the first goal (with mixed success), the second has received only minor consideration. Until recently, activities that protected or improved the natural and beneficial uses of floodplains usually were only planned or executed as afterthoughts, or were included in a project only because of a regulatory requirement to mitigate the environmental impacts of another project. The restoration or rehabilitation of a waterway, coastline, or its related resources was rarely considered a project worthy of funding or of being undertaken on its own merits.

¹ We use “floodplain” to mean the total area, which may or may not have a direct hydrological connection to a watercourse, that will be inundated with water during high flows. For regulatory purposes, the floodplain is defined by the area inundated during the 1% probability flood event (100-year flood) and greater, but this may or may not correspond to the area needed for the watercourse or shoreline to maintain its natural biologic, geomorphic, hydrologic, and other functions, nor is it an area that defines the limit of flood damage or losses

Amid significant alteration of our major waterways to optimize commercial benefits and in the name of flood “control,” flood losses have continued to rise each year. At the same time, environmental degradation, particularly of water-related resources, has increased, and anticipated changes in climate bring the potential for significant alteration of existing coastal areas, flood regimes, and already fragile ecosystems. The Association of State Floodplain Managers (ASFPM) believes that we are now at a critical juncture in how we approach flood hazard management. We need to marshal unprecedented forces to preserve and improve the natural functionality of our floodplains and coastal areas and protect the resources they provide. In doing so, we will also mitigate damage and losses that floods bring to society.

This need is urgent. In the next 20 years the U.S. population is predicted to increase by 80-90 million people, a huge increase over the current 300 million. The added population will increase pressure to continue to allow development adjacent to the nation’s water resources. Paradoxically, that population will still expect the nation’s flood risk to be minimized and will demand additional open spaces and natural areas. We need to remember that we have a choice not to occupy our river floodplains and coastal areas and that, if we choose to do so, there is a very real cost associated with the degradation of these water resources—a degradation that is the inevitable byproduct of our occupation of these areas.

Natural Functions and Resources in Riverine and Coastal Floodplains: Understanding the Issues

Management of floodprone areas has for too long been development-centered. The typical strategy has been to confine the waterway or water body to a predefined size and capacity that maximizes the extent of developable or agricultural land and also keeps the flood water away from people and their property. Under such a framework, the floodplain served a singular, human-centered role as a conveyance network to pass the “excess” water as quickly as possible, with no consideration of the loss of ecological function, the potential damage to downstream property owners, or the cultural, economic, or environmental effects of that strategy. Further, floodplains have been viewed as suitable sites for human development; the concern, if any, has been to ensure that structures built there are elevated above some minimal flood level, so they are considered “safe,” and also to insure them. In coastal areas, the typical approach has been to place development, especially residences, as close to the water as possible and then, if necessary, to use structural measures to prevent the beach from migrating away.

In many cases, the communities responsible for these decisions about growth, development, and flood protection possess a minimal understanding of the natural processes that take place in riverine and coastal areas and lack adequate tools to deal with the flooding issues they face. Floodplain management decisions often are made outside of the context of regional or watershed-level planning and without appreciation of the complexities of the water-based ecosystem. Hence, as recent flood disasters and their aftermath have indicated, communities often respond to such disasters by applying more of the same techniques that caused or exacerbated the problem in the first place.

Increasing flood losses and environmental degradation have made it clear that the floodplain cannot be viewed simply as a conveyance channel to keep water away from people. Nor can we continue to implement flood damage reduction measures without considering impacts to riparian and coastal ecosystems.

Flooding as a Natural Process

Flooding is a natural process that forms and maintains floodplains and coastal zones. Periodic flows of water that overtop the banks of a river and that encroach upon coastal areas are the lifeblood of the riparian corridors, marshes, beaches, and other natural areas. The seasonal variability of flow, incessant wave action, and intermittent extreme events all combine to determine both the physical structure and the biological diversity of floodprone areas.

Finding the delicate balance between human needs and environmental sustainability is a difficult undertaking. Successful, sustainable flood hazard reduction solutions need to be based on the forces at work in floodplains and coastal zones and also on the resources that these floodprone areas provide. These processes and attributes can be categorized as (1) hydrologic and hydraulic processes, (2) geomorphic processes, and (3) biologic processes. These processes have interrelated functions, which in their natural state provide numerous resources and benefits to society.

Flooding from hurricanes and storms is the key process in providing such tangible benefits as increased soil fertility, wetland creation, rejuvenation of spawning gravel, creation of barrier islands, promotion of aquatic habitat, transportation of large woody material that provides fish habitat and bank stability, promotion of plant establishment, and the evolution of channels and shoreline features such as dunes. These resources are described in detail in numerous documents, notably *A Unified Program for Floodplain Management* (Federal Interagency Floodplain Management Task Force, 1994) and *The Natural & Beneficial Functions of Floodplains* (Task Force on the Natural and Beneficial Functions of the Floodplain, 2002).

Hydrologic and Hydraulic Processes

Both river and coastal ecosystems are shaped and nurtured by the characteristics of the water, including where it originates as well as its flow and levels. The seasonal and storm-generated variations in water flow, including periodic flooding, are part of the normal function of the floodplain zone. These variations mold streambanks, keep erosion and accretion in equilibrium, replenish soils, recharge groundwater, and filter impurities. In coastal areas, water differences are based on tides, currents, wave action, and storm surges—all of which form shorelines, coastal wetlands, dunes, barrier islands, and estuaries. High flows are critical to maintaining vegetation because they transport sediment and nutrients from the river, ocean, or lake to the connecting floodplain.

Geomorphic Processes

The dimensions and configuration of a stream channel or coastline are determined by ongoing geomorphic processes. For example, the natural transport of sand and sediment dictates the migration of channels, shorelines, dunes, and barriers. This process, in turn, is influenced by the geological composition of the landforms; the caliber, rate, and volume of sediment movement; and the presence or absence of vegetation. Although the geomorphology of waterways and shorelines is constantly changing, in their unaltered state they exist in dynamic equilibrium, which cannot be disturbed without consequences.

Biologic Processes

Floodplain and coastal vegetation helps to stabilize the shoreline and river banks, provide habitat for terrestrial and aquatic wildlife, control erosion and sedimentation, and improve water quality by filtering pollutants. Healthy riparian corridors often provide the highest concentrations of plant and animal communities in a watershed, providing a stable source of biodiversity.

The variable flows of water in riparian and coastal areas have resulted in uniquely adapted species of aquatic and terrestrial organisms—they depend on the variation in water conditions for spawning, seed dispersal, elimination of competing vegetation, and nursery areas for their young.

The ecological integrity of floodplain vegetation depends on the supply of water, sediment, and nutrients; the dynamic stability of the system; the methods of plant colonization; rates of growth and decay; and the contribution of organic matter to the water body.

Interruption of Natural Processes

Naturally functioning riparian and coastal areas are the product of a tightly interconnected system of all of the processes described above. The ecosystems sustain themselves by means of these ongoing processes. Human activity, especially urbanization and alteration of the flooding process as a means of controlling and/or storing water, interrupts these natural processes and thus disturbs the functions and overall health of the ecosystem.

A stark example of the long-term effect of such interruption can be found in the tragedy that Hurricane Katrina brought to New Orleans. The complex interaction between the coastal wetlands and the Mississippi River had not been understood in earlier decades. Long-term projects to increase navigation efficiency and flood protection along the Mississippi River employed extensive use of levees. These levees cut off the supply of sediment to the coastal wetlands, which then began to shrink. The shrinkage was exacerbated by extensive dredging through the wetlands for a range of development and navigation purposes. The absence of their energy-absorbing capacity increased the impact of storm surges and hurricanes to New Orleans and the Gulf Coast. The extent of damage from Katrina was increased because these natural buffers had been lost.

In our attempts to transport runoff and flood waters efficiently through the watershed, we have used structural interventions (such as concrete lining, revetments, floodwalls, jetties, diversions, and dams and reservoirs) that interrupt or modify natural hydrologic, hydraulic, geomorphic, and biologic processes. The ground surface and natural vegetation are disturbed during construction. The structures change the natural movement of water in one or more ways such as altering the speed, restricting movement across the floodplain, and changing sediment loads. Floodwalls and levees increase flow discharge and elevation when they constrict high flows into a narrow path. Land use policies that allow encroachment into the floodplain can cause dramatic channel migration downstream. Changing the frequency of floodplain inundation can encourage invasive species to supplant the native vegetation. Most riparian and coastal animal species are specifically adapted to the flow patterns and other characteristics of their native habitat. This makes them vulnerable to disruptions in the flow and water levels.

Expanding in-stream storage to minimize flooding can result in reduced downstream flows. This reduction can, in turn, cause severe channel aggradation as the floodway fills with sediment. The result can be a cascade of impacts as tributary channels begin to fill in with sediment. In fact, the natural channel can be buried, reducing habitat diversity and eventually result in increased flood elevations as sediment accumulates and the channel's capacity is diminished.

If human activity for development or flood protection constricts or expands the channel, nearshore area, or floodplain, the sediment transport dynamics are altered. This can cause sediment to accumulate in unanticipated places, or the bed or offshore zone can be scoured. In either case, the channel bed and banks can be destabilized rapidly both up- and downstream. For example, a new home may be constructed on a large meander with bank stabilization to protect it from erosion. In future years, increased lateral migration of the channel caused by that stabilization causes problems for existing structures downstream. The owners of those structures then take similar action to stabilize those streambanks, and so on. Such channel alterations march downstream, with individual homeowners exhibiting little understanding of—or having been given little guidance on—the overall impacts of their actions on channel dynamics or on the watershed. This results in the slow and almost imperceptible destabilization of a watershed, and loss of natural function—death by a thousand tiny impacts.

All of these activities in pursuit of development, urbanization, and flood protection have yielded specific, usually localized economic and social benefits, but the long-term impacts have placed both humans and nature at higher risk. Further, they have proved counterproductive, resulting in a system of “reactive” engineering through which the symptoms of the problem are treated at great expense while the underlying causes are not addressed and flood losses continue to rise.

After decades of using these approaches and failing to acknowledge the natural and beneficial functions and values of floodplains, we have destroyed a large proportion of our wetlands, deprived our river deltas of sediments needed to maintain marshes, prevented nutrient-rich flood water from reaching adjacent lands to replenish the soils, interrupted the protective functions of coastal barriers, and contributed to declines in water quality. We now realize that those wetlands, soils, marshes, unspoiled waterways, and related resources and their functions are crucial components of ecosystems vital to human life but which we had been taking for granted.

Solutions and Recommendations

As pressures mount to utilize floodplains and coastal areas, it is imperative that we eliminate the attitude that it is acceptable to obtain short-term reductions in flood risk and/or short-term economic gains by shifting those costs to future generations or causing adverse environmental impacts. We need to replace this thought process with a new focus on ensuring the long-term environmental and economic sustainability of our floodplain ecosystems. In this context, the ASFPM presents below some suggestions for overall policy change, followed by more specific recommendations.

To begin, we need to modify the widespread view of floods as destructive forces of nature. Floods do not cause damage or suffering. Our decisions about where to live, work, and play are the cause. By anticipating the flooding process and planning our development accordingly, we can begin to effect change. Instead of controlling the water, we should control how and where we allow human activities to adversely affect it. The recommendations below reflect this paradigm for managing our nation's floodplains and flood risk.

A Call for Renewed Direction

In order to regain the sustainability of our water-based ecosystems and resources, we must adopt a new approach to floodplain management. The ASFPM sees this as a five-pronged strategy.

- (1) Set a policy that the natural functions and resources of floodprone areas are worthy of protection and should not be sacrificed for human development.
- (2) Prevent new development from encroaching on floodprone and environmentally sensitive areas.
- (3) Remove existing development from floodprone and environmentally sensitive areas whenever possible.
- (4) Rehabilitate and restore degraded riparian and coastal resources.
- (5) Incorporate into all public and private activities at all levels a respect for and understanding of the functions and resources of floodprone areas along our coasts and waterways.

National Policy

A national vision and policy for floodplain management should be enacted that would establish unequivocally the inherent value of these resources and of their role in minimizing flood losses. It would incorporate both a national floodplain management policy and a national riparian and coastal areas policy, with a goal of the sustainability of those ecosystems. It could use the National Environmental Policy Act as both a foundation and springboard for a coordinated flood and coastal hazard management strategy. A standard model for comprehensive watershed planning and management could be produced that would delineate the roles and responsibilities for the federal, state, and local governments and the private sector. It should set out goals and criteria that could be tailored to the specific needs of different watersheds to maintain environmental sustainability and reduce flood risk.

- Existing regulatory programs that emphasize damage reduction or floodplain construction standards over floodplain protection or impact avoidance should be identified, and then revamped. These types of regulations assume that floodplain development is going to occur and then proceed to guide the design and construction of it—the opposite of the preferred approach. Examples of such misguided regulations include the identification of a floodway fringe defined by a specified degree of assumed fill impacts or other encroachments.
- The rules for reviewing proposals for hazard mitigation projects must be revised to account for the environmental benefits of a project, just as the costs of environmental compliance are included. Mitigation projects whose aim is to restore the natural and beneficial functions of floodplains will then be able to compete on a fair basis with other proposed projects.
- A federal water resource coordinating mechanism should be established to suggest and oversee a national floodplain management policy task force. Watershed planning commissions should be formed, based on major riverine, lacustrine, and coastal watersheds, to coordinate flood reduction efforts and resource protection at the federal, state, tribal, regional, and local levels.
- Guidance or criteria should be enacted (*e.g.*, no adverse impact accompanied by environmental mitigation or enhancements) that would direct communities and government activities within or near floodplains and coastal zones to undertake actions that will reduce the need for flood control, and to educate their residents to expect less flood control and more living with the natural fluctuations of the river or coastline. The goal would be to provide strict guidance so activities would not increase the perceived need for government attention to flood control. The restriction would also apply to state, regional, and local governments if they were using federal funding or participating in the National Flood Insurance Program (NFIP).

Avoidance of Floodprone Areas in the Future

Starting now, future development should avoid high-hazard and ecologically sensitive areas. State and local governments should guide development away from these areas by applying land use planning and management techniques. This is the most effective way to minimize cumulative losses and degradation of our water resources.

Voluntary Retreat from Floodprone Areas

Starting now, we need to begin a collective pattern of gradual relocation of existing residences and businesses away from high-hazard and ecologically sensitive areas. We need to begin a strategic retreat along our coasts and rivers.

Restoration of Floodplain and Coastal Resources

It should become a national priority to reclaim those riparian and coastal resources that we have lost. Rehabilitation work should commence to restore the natural buffers that those resources once provided. We should work to recognize and create an understanding of the short-term and long-term environmental impacts of existing flood and coastal protection measures and how those impacts can be mitigated.

Awareness of and Accounting for Natural Functions and Resources

The natural and beneficial functions of our coastal and river corridors must be incorporated into programs and implemented throughout all federal, state, and local flood mitigation programs. All programs should be required to promote the environmental preservation and protection of riparian and coastal functions, whether the activity involves navigable waters, new infrastructures or buildings, flood management structures, coastal protection structures, or any other activity that could have an impact on any watershed or coastline.

Multi-objective management criteria need to be established that strike a balance between social, economic, and environmental issues and also promote the long-term sustainability of our society. Programs also should be required to work within the framework of a watershed master plan, if one exists. If no plan exists, a program should apply criteria to assure long-term sustainability within the watershed. Nationwide initiatives should be undertaken to

- Improve communication and recognize the interests of private landowners in determining the best environmentally and economically sustainable flood hazard reduction alternatives.
- Facilitate the gathering and storage of scientific data and water resource information, provide a venue for determining data needs for research and development, and disseminate the collected information back to the watersheds.
- Determine and quantify the actual short-term and long-term economic and other benefits that are derived from the preservation of the natural and beneficial functions of coastal areas and riverine floodplains. The benefits of natural functions should also be taken into account during the modeling and calculation of benefit/cost ratios.
- Promote a multidisciplinary approach to floodplain and coastal hazard management by integrating land use planning, hydrology, hydraulics, geomorphology, biology, botany, stream ecology, and other fields for a holistic understanding of floodplain and coastal functions and processes.
- Develop comprehensive plans for all inland and coastal watersheds that provide guidance to consider all short- and long-term watershed-wide impacts (including cumulative impacts) for all projects, whether large or small.
- Include the natural and beneficial functions of riparian and coastal areas among the attributes that communities protected from adverse impacts when making decisions about proposed development. That is, in addition to prohibiting increases in flood flows, velocities, erosion, and other hazard-related aspects of flooding, a standard of no adverse impact should also be applied to functions and resources such as groundwater recharge, habitat, carbon sequestration, barrier movement, storm buffering, etc.

Local, state, and federal governments and other public and private entities should

- Assign more weight to environmental management and sustainability when considering flood management projects for any watershed.
- Attach a higher priority to mapping (or re-mapping) the flood hazard areas of communities with coastal and riverine systems that are rapidly developing or have urgent environmental concerns. Communities should consider what environmental changes may take place in their watersheds in the future due to climate change or intensified urbanization, and map and manage accordingly.
- Encourage the collection, scientific study, and use of the biologic, geomorphic, and other data needed to make flood management decisions based on sound science and ensure that these decisions consider the impacts from a watershed-wide perspective.
- Support the development and implementation of watershed planning at all levels of government.
- Propose legislation that makes cost sharing for sustainable floodplain management more attractive, particularly for fast-growing communities.
- Increase the emphasis on ecosystem sustainability in pre- and post-disaster mitigation. Require environmental mitigation as a condition of receiving federal financial assistance after a flood, instead of requiring reconstruction to pre-flood conditions without consideration of mitigation or environmental restoration.

- Change the site-selection criteria for levees to provide for a mechanism to include the impacts on the hydraulic, biologic, and geomorphic processes of the affected stream or river in the planning and design phase of levee construction.

The ASFPM should

- Work to increase the knowledge base of Certified Floodplain Managers and others on the biological, ecological, and geomorphologic functions of riverine and coastal areas.
- Provide tools and guidance through the *NAI Toolkit* for communities to work together, on a watershed basis, to prevent adverse impacts to natural and beneficial functions of their riverine and coastal areas.

Resources

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