

# Protecting Floodplain Resources

A Guidebook for Communities

Federal Interagency Floodplain Management Task Force

---

# PROTECTING FLOODPLAIN RESOURCES:

## A Guidebook For Communities

**Dr. Richard Smardon, Professor**  
Faculty of Environmental Studies

**Dr. John Felleman, Professor**  
Faculty of Environmental Studies

with editing by

**Dr. Susan Senecah, Assistant Professor**  
Faculty of Environmental Studies

with the assistance of

**Elizabeth Myers, Graduate Assistant and**  
**Kevin Olvany, Graduate Assistant**  
Faculty of Environmental Studies

and graphic design and illustration by  
**Scott Shannon, Associate Professor**  
Faculty of Landscape Architecture

in cooperation with

**Cory Giacobbe and Jori Wesley**  
U.S. Environmental Protection Agency

**John McShane**  
Federal Emergency Management Agency



sponsored and funded by

### Federal Interagency Floodplain Management Task Force



The Federal Interagency Floodplain Management Task Force was established in 1975 within the U.S. Water Resources Council to carry out the responsibility of the President to prepare for the Congress proposals necessary for a Unified National Program for Floodplain Management. In 1982 the Office of Management and Budget assigned responsibility for the Unified National Program to the Federal Emergency Management Agency, which assumed the role of chair of the Task Force. Membership of the Task force consists of the Departments of Agriculture, Army, Commerce, Energy, Housing and Urban Development, Interior, and Transportation; the Environmental Protection Agency; and the Tennessee Valley Authority.

---

---

---




# PROTECTING FLOODPLAIN RESOURCES

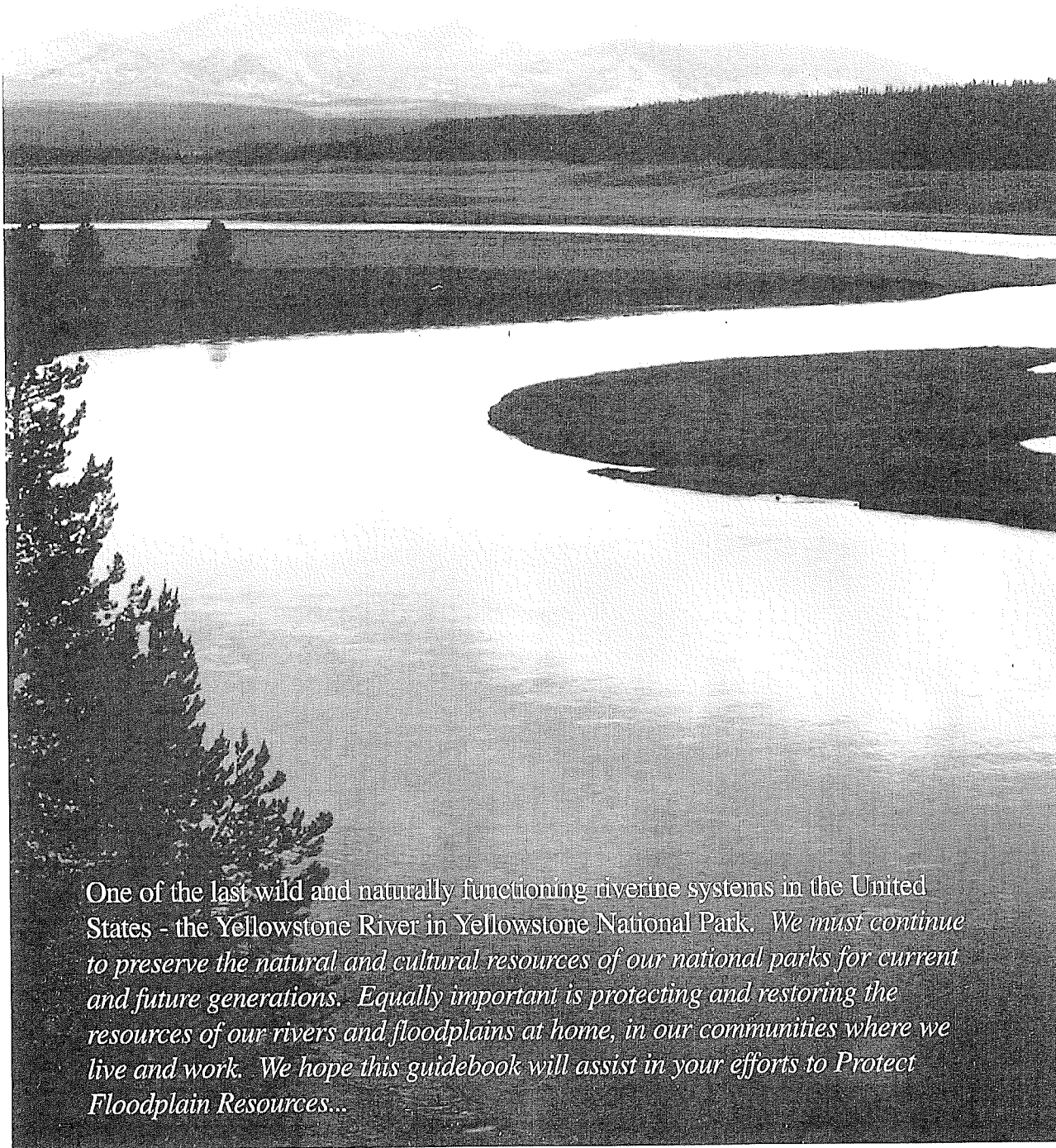
A Guidebook  
for  
Communities

The Federal Interagency Floodplain  
Management Task Force

2nd Edition - June 1996



---



One of the last wild and naturally functioning riverine systems in the United States - the Yellowstone River in Yellowstone National Park. *We must continue to preserve the natural and cultural resources of our national parks for current and future generations. Equally important is protecting and restoring the resources of our rivers and floodplains at home, in our communities where we live and work. We hope this guidebook will assist in your efforts to Protect Floodplain Resources...*

John H. McShare

---

# Protecting Floodplain Resources

A Guidebook for Communities

## ■ Table of Contents

---

<b>Background &amp; Preface</b>	<b>iii</b>
<b>Chapter I. - Introduction</b>	
□ Statement of Purpose for the Guidebook	1
□ History of Floodplain and Natural Resource Management	2
<b>Chapter II. - Understanding Floodplain Resources</b>	<b>5</b>
□ What Are Floodplain Natural Resources?	5
□ How Do Natural Floodplain Systems Function?	7
<b>Chapter III. - Human Activity - Multiple Uses of Floodplains</b>	<b>13</b>
<b>Chapter IV. - Planning for Resource Protection &amp; Restoration</b>	<b>17</b>
□ Step 1: Identify the Planning Area	18
□ Step 2: Conduct an Inventory and an Analysis of Land Use and Environmental Concerns	18
□ Step 3: Conduct a Problem and Need Assessment	21
□ Step 4: Define the Corridor Management Boundary	22
□ Step 5: Develop an Action Plan/Agenda	22
□ Step 6: Implementation and Monitoring of the Action Plan	26
<b>Chapter V. - Case Studies</b>	<b>27</b>
□ Wildcat and San Pablo Creek	28
□ Blackstone River National Heritage Corridor	31
□ Verde River Corridor Project	34
□ Chattahoochee River Corridor	37
<b>VI. - References</b>	<b>39</b>

---

## BACKGROUND

This guidebook is the result of an elaborate process carried out over a two year period. The authors initially met with the Federal Interagency Floodplain Management Task Force to define the scope, focus, and target audience for the guidebook. The authors then talked with representatives of the Association of State Floodplain Managers and prepared a mailback questionnaire to determine the specific needs and interests of local officials and private interest groups. From these discussions and questionnaires, the basic outline and specific information was modified and refined accordingly.

The final step was to prepare sequential drafts which were reviewed by a working group of the Task Force. Throughout the development of this guidebook the U.S. Environmental Protection Agency and the Federal Emergency Management Agency provided extensive comments and guidance. A revised draft was provided for final review and graphics and photographs were provided simultaneously with the completed guidebook. Following the distribution of the first printing in September 1995, overwhelming response has resulted in the printing of this updated second edition.

## ACKNOWLEDGMENTS

This guidebook was prepared under the auspices of the Federal Interagency Floodplain Management Task Force with funding from U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers. Administrative support was provided by the U.S. Environmental Protection Agency, Wetlands Division. Special thanks go to Jeanne Melanson, now with the Natural Resources Conservation Service for the initial concept and support and to Cory Giacobbe and Jori Wesley of EPA and to John McShane of FEMA for their continued support, comments, and guidance. A special acknowledgment goes to Jon Kusler of the Association of State Wetland Managers for offering his valuable expertise in floodplain and water resource management.

Project research and initial writing was done by Elizabeth Myers and extra case study research by Kevin Olvany. Editing and facilitating the Tulsa workshop was done by Dr. Susan Senecah and graphics and layout were prepared by Prof. Scott Shannon. Drs. Richard Smardon and John Felleman provided overall project direction and management at the SUNY - College of Environmental Science and Forestry's Randolph Pack Environmental Institute.

Copies available from:

Federal Emergency Management Agency  
Washington, D.C.  
(1-800-480-2520)

U.S. Environmental Protection Agency  
Washington, D.C.  
(1-800-832-7828)  
[contractor operated]

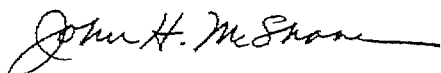
---

## PREFACE

Floods have caused a greater loss of life and property, and have devastated more families and communities in the United States than all other natural hazards combined. In the past, efforts to reduce flood losses often relied on trying to control floodwaters, rather than encouraging people to avoid flood hazard areas. Yet, despite the expenditure of billions of tax dollars for “flood-control” structures such as dams, levees, and stream channelization, flood losses continued to rise. In addition, this structural approach frequently had adverse impacts on the natural resources and ecological integrity of our rivers and floodplains. In recent years many communities have come to recognize that the floodplain environment is an important community asset and have taken the initiative to create greenways, riverside parks, and other popular amenities. Significantly, protecting the natural resources and functions of floodplains has proven to be effective in reducing flood losses as well.

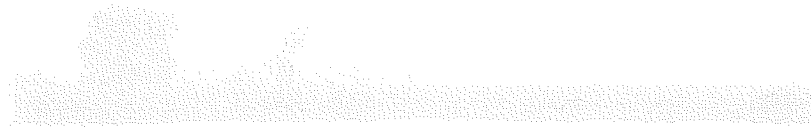
In the last few years, state and local officials, planners, engineers, property owners, and others, have requested information from Federal agencies on flood hazard mitigation methods that will preserve the integrity of floodplain systems. In response, this guidebook was prepared for local officials, and other interested citizens, to help in the development of a community action plan to protect and restore important floodplain resources and functions.

Rivers and their floodplains are dynamic and complex natural systems that can provide important societal benefits, both economic and environmental. By adapting to the natural phenomenon of flooding, rather than trying to control floodwaters, we can reduce the loss of life and property, protect critical natural and cultural resources, and contribute to the sustainable development of our communities. In towns and cities across the nation, protecting and restoring floodplain resources will enhance the quality of life for this and future generations into the 21st century, and beyond.



John H. McShane, Acting Chair  
Federal Interagency Floodplain Management Task Force





## 1 Introduction

### Statement of Purpose

*"The natural resources and functions of our riverine and coastal floodplains help maintain the integrity of natural systems and provide multiple benefits for people, both material and spiritual."*

This guidebook has been written to introduce you, as officials and citizens at the local level, to a basic understanding of natural resources in floodplains, and to offer suggestions for creating strategies for wisely managing these important areas. As our scientific understanding of ecosystems grows, we increasingly recognize the importance of conserving and restoring the natural resources and functions of floodplains. Historically, effective floodplain management was recognized as a necessary task to reduce the loss of life and property. However, floodplain areas are now also recognized as having an intrinsic value of their own as a part of the interconnected ecosystem and an influential role in increasing a community's quality of life. For example, the recognized benefits of a naturally functioning floodplain include the storage and conveyance of flood waters, the recharging of groundwater, the maintenance of surface water quality, and the provision of habitats for fish and wildlife. These areas also provide diverse recreational opportunities, scenic value, and a source of community identity and pride. Clearly, the potential gains of transforming stream and river floodplains from problem areas into value-added community assets are substantial. Local leaders are uniquely positioned to tap these resources for the benefit of their communities.

The overall objective of this guidebook is to help you learn about and understand floodplain management issues in order to take action toward conserving and restoring floodplain natural resources. Whereas case studies will showcase communities that have successfully implemented such projects, a step-by-step formula for universal application to all communities would be unrealistic. Rather, this guidebook is intended as a starting point and a resource for ideas so you can utilize current knowledge about floodplain natural resources in order to customize floodplain management projects to your unique local context.

Chapters 2 and 3 of this guidebook provide an explanation of natural floodplains— their functions and importance in reducing flood losses, maintaining clean and plentiful water supplies, and generally enhancing other factors that affect the quality of life in communities. Recognizing the importance and the sensitive nature of these areas is an important first step in designing an effective strategy for stewardship.

Chapters 4 and 5 of the guidebook suggest ways to successfully plan for and manage floodplain natural resources. They provide information on establishing partnerships to include the public and private sector to identify community objectives, and encourage

creative local application of existing federal, state and private programs to achieve local goals. They also identify sources of technical information which are essential to effective management programs, and explain the importance of continued monitoring and stewardship.

Some excellent examples of floodplain management programs have emerged at the local level. A number of communities have taken great initiative, utilizing public participation to define local objectives and tapping into available resources in state and federal programs. The Case Studies at the end of the guidebook illustrate the variety of approaches that can be taken to avoid future problems in floodplains and show how to take advantage of the assets that rivers and streams can offer to a community. Finally, the References direct readers to additional sources of information and support for communities that accept the challenge to protect these vitally important resource.

### A Brief History of Floodplain and Natural Resources Management

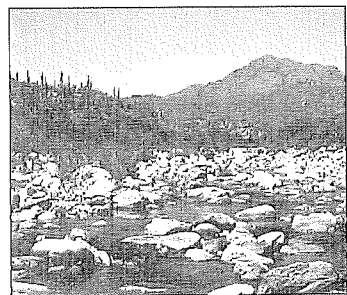
Throughout history, people have settled next to waterways because of the advantages they offer in transportation, commerce, energy, water supply, soil fertility, and even waste disposal. Many major cities are located along rivers, and even the smallest community is likely to be near a creek or stream. In spite of these benefits, however, our historic attraction to settling along rivers and streams is not without its drawbacks. Human uses of floodplains are associated with dangers both to humans and to the natural functions of the riparian or floodplain environment. Loss of property and degradation of critical wildlife habitats are just two of the threats posed by civilization at the water's edge.

Community planning is often a complex balancing act. On one hand, planners often try to dedicate a certain amount of open space for natural areas and passive recreation, or habitats for wildlife. On the other hand, planners also must be aware of the need to limit or avoid development in sensitive areas like wetlands. These objectives often intersect in natural floodplain areas, which are likely to harbor more wetlands, greater wildlife diversity, and higher scenic values, and yet are under a more intense threat of flood losses than any other area within a community. It makes sense, then, to consider combining these objectives by focusing careful attention on the wise and creative use of floodplain lands.

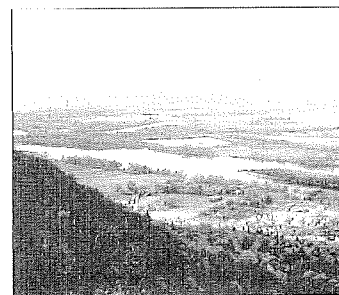
Unfortunately, the wisdom of such an approach can be difficult to recognize because in many communities, distinct organizations are often responsible for parts of the goals mentioned above. For example, agencies in charge of parks, recreation, or stormwater management may operate at the municipal level, while separate state or federal agencies address wetland permitting, wildlife protection, and flood insurance issues. Private environmental education organizations or environmental groups may be particularly concerned about a rare species, scenic beauty, or recreational experiences. Each of these agencies or groups has a different primary goal, yet their interests are more closely related than they may suspect because their common ground is the floodplain. Often, however, the existing processes do not afford them the opportunity to discuss their interests, share their knowledge, and plan together; hence, valuable collaborative energy is untapped.

In order to understand some alternative strategies that can be employed in managing resources in floodplains, it is essential that we become acquainted with the history of floodplain and natural resource management, especially in recent decades. Figure 2 illustrates the evolution of this need for the coordination and integration of strategies for managing floodplain natural resources. Although the time lines present an overview of the federal programs and agencies charged with managing the hazards and resources associated with river corridors throughout U.S. history, the chronology also tells the story of our evolving understanding of these dynamic systems.

*Figure 1a & 1b - Floodplains are noted for their significantly variable character, both between different river systems and from season to season on the same watercourse...*



S. Shannon



R. Smardon

Figure 2 - Timeline of primary floodplain and natural resource management efforts in the United States.

The Frontier Era	
Pre-1917	Limited federal involvement in flood control or relief.
The Structural Era	
1917	Federal Flood Control Acts. In response to flood disasters in many areas of the country, the federal government took on the costs of constructing reservoirs, channels, dams, and levees. The Army Corps of Engineers was responsible for these efforts. This type of flood controls are referred to as "structural controls."
1928	
1936	
1938	
1950	Federal Disaster Act provided relief to flood victims.
The Stewardship Era	
1960	Flood Control Act. Corps of Engineers assists communities in planning uses of floodplains.
1965	Water Resources Planning Act combined federal and state efforts in creating river basin commissions to do comprehensive planning. Unified National Program for Managing Flood Losses sought to combine federal, state, and local efforts for comprehensive floodplain management. Evolving over several decades, this program attempted to discourage unwise development and to provide education about strategies and tools for managing floodplains.
1966	
1968	National Flood Insurance Act made flood insurance available to homeowners in communities that have implemented local floodplain management regulations. National Wild and Scenic Rivers Act.
1969	National Environmental Policy Act required broad consideration of environmental impacts before implementation of federally funded projects.
1972	Water Pollution Control Act Amendments and Clean Water Act establish a permitting system for development in wetlands.
1977	
1977	Executive Order 11988, <i>Floodplain Management</i>
1986	Water Resources Development Act made provisions for cost sharing in water projects.
1990	Omnibus Water Bill requires Corps of Engineers to consider environmental protection as one of its primary missions, and encourages the protection of wetlands; Stafford Disaster Relief Act.
1994	National Flood Insurance Reform Act

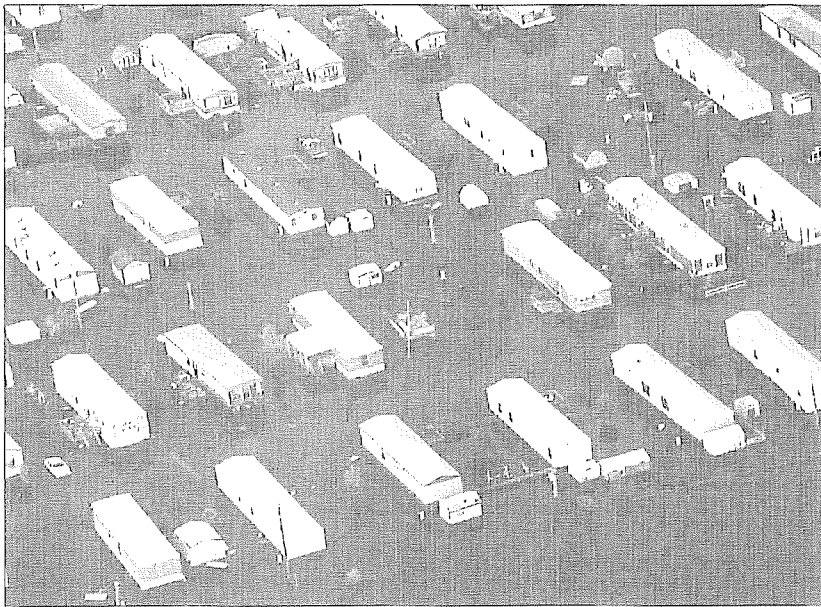
Despite the fact that the hydrology, vegetation, wildlife, and soils in floodplains are intricately connected to one another, agency programs were often designed to deal only with single aspects of floodplains, such as flood control or erosion. This single-purpose approach to management has been limiting because it did not recognize the complexity of these systems and the interdependent components of natural areas. As the connections between networks of streams and rivers, adjacent wetlands, soils, vegetation, wildlife, and people are increasingly understood, many experts have begun to encourage "multiobjective management" of river and stream corridors. This shift in approach is reflected in the time line, which shows the parallel histories of floodplain and natural resource management as each has moved toward more broad-based, comprehensive management efforts.

From the birth of the United States until the early 1900s, many federal policies and programs encouraged the development of land, a plentiful resource in a continually expanding nation. In this period, which might be classified as the Frontier Era, the common goal was to conquer the wild landscape of the young nation and to promote "productive use" of land. Flood hazards were the problem of the individual property owner or were dealt with cooperatively at the local level.

As the land became more populated and developed during the first half of the twentieth century, federal and state governments began to set aside natural areas for protection. Such legislative actions were useful, but they treated natural areas as discrete parcels and lacked appreciation for the interconnectedness between preserved areas and the surrounding land. At the same time, in response to a series of devastating flood disasters throughout the country, the federal government began to take an active role in preventing flood losses by assuming costs for the construction of structures such as dams and levees for flood control. This period, known as the Structural Era, was characterized by attempts to alter and control floodwaters and get water off the land as quickly as possible.

In the 1960s and 1970s, however, the complexity and interconnectedness of natural systems triggered in resource managers a new respect for the multiple values of natural areas. Federal agencies that had traditionally operated under single-purpose directives were charged with broadened mandates, such as considering the effects of timber management practices on water quality and wildlife. These shifts in policy heralded an Era of Stewardship for natural systems. Also during this period, despite impressive flood control engineering feats, flood losses continued to rise. In response, federal disaster relief programs were created to deal with the reality of ongoing flood losses throughout the country, and others, such as the National Flood Insurance Program, encouraged appropriate development of flood hazard areas. More recently, the lessons of natural resource stewardship have begun to influence our thinking about floodplain management, and as we realize not only the limitations of our ability to control flooding, we also realize the tremendous benefits that naturally functioning floodplain systems can offer. This realization is responsible for the shift to managing floodplains for multiple objectives.

There are three stories running through this brief history of floodplain management in the U.S.. The first is the story of our evolving understanding of the complexity of natural resource functions. The second is our recognition of limitations on our ability to control floods. And the third — perhaps the most important — is the story of shifting responsibility. Although the burden of flood hazard protection was accepted by the federal government earlier in this century, we have come to recognize that the most sensible, least costly approach to flood hazard protection may have less to do with dams and disaster relief, and more to do with land-use patterns within floodplains. In the U.S., most land-use decisions are made at the local level. This means that there must not only be a renewed emphasis on community responsibility for preventing flood losses, but also for stewardship of the valuable natural functions associated with floodplains.



St. Louis Post Dispatch

*Figure 3a - The cost-effectiveness of reducing flood losses by elevating or relocating homes was dramatically demonstrated in parts of the Midwest in June, 1995. The top photograph shows an inundated mobile home park along the Missouri River during the Great Flood of '93. The same area flooded again in 1995 (bottom photograph, as the floodwaters were rising), but there was little flood damage because the families had been moved to new safe sites. Some 10,000 homes in the Midwest have been elevated, relocated, or acquired with Federal and state funds since 1993.*

*The New York Times noted that relocating homes out of the floodplain "...follows a shift toward a more realistic national floodplain policy, one that takes the emphasis off trying to control nature...by moving residents out of harm's way - changing the behavior of people instead of rivers." (5/6/96)*

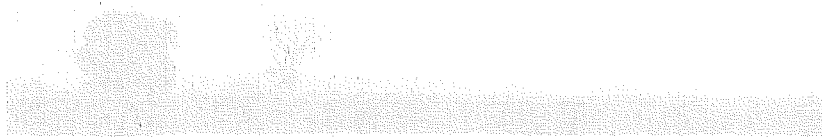


M. Campbell

*"For years the Government spent billions of Federal dollars trying to keep water away from people. Missouri woke up and started moving people out of harm's way..."*

*Governor Mel Carnahan of Missouri, 1995*

Aspects of the strategies of former eras still influence us in many ways — flood control structures, land-use patterns, agencies and programs, and even our thinking about these systems still reflect a single-purpose approach in many ways. Certainly we must live with some decisions of the past. But it is important to incorporate the new knowledge that is available to us, and to protect and enhance the valuable resources that are so important to the well-being of our communities. It is our hope that this guidebook will help those at the local level to successfully meet this challenge.



## 2 Understanding Floodplain Resources

### What Are Floodplain Natural Resources?

The term “natural resources” often brings to mind products, such as timber or fossil fuels that may be extracted from their natural environments and sold as commodities for profit. But the natural values of floodplains are different; their value lies not in their removal and sale, but in the functions that they perform within the floodplain environment. Floodplain natural resources include the soils, nutrients, water quality and quantity, and diverse species of plants and animals that exist in the areas between the water’s edge and the higher ground adjoining flood-prone areas. These can be considered as natural “infrastructure.” But what is it about these resources that make a naturally functioning floodplain so valuable? We will begin the discussion with some basic information about how floodplains are formed.

**Rivers Shape the Landscape** - The formation of a floodplain is intimately tied to the adjacent river or stream, which over long periods of time carves out the surface geology of the landscape and deposits sand, silt, and other material (these deposits are referred to as alluvium) that form rich soils. A typical river corridor has several features that result from the geological and hydrological processes that form these landscapes (Figure 4). The **river channel** meanders through the landscape, carving through the terrain and depositing sediment as it goes. Sediment deposits and depressions around the water’s edge may result in the formation of **wetlands**, areas that are always or periodically inundated with water.

The level areas bordering river channels are known as **floodplains**. These portions of river valleys are frequently defined in terms of the likelihood of flooding in a given year. Hence, the “100-year” flood is the flood having a 1% chance of occurring during any given year. (Similar definitions can be made for the 25- or 50-year floods.) As the river cuts downward it may leave **terraces**, formed from a time when the river flowed at higher elevations. These landforms are a part of the larger river corridor, and are extremely important to the functioning of the floodplain ecosystem.

**Watersheds** - While the floodplain and its resources are the centerpiece of discussion for this guidebook, watersheds are central to the understanding and management of resources in floodplains. A **watershed** includes the area of land that is drained by a river and its tributaries. Different watersheds are separated from each other by ridges

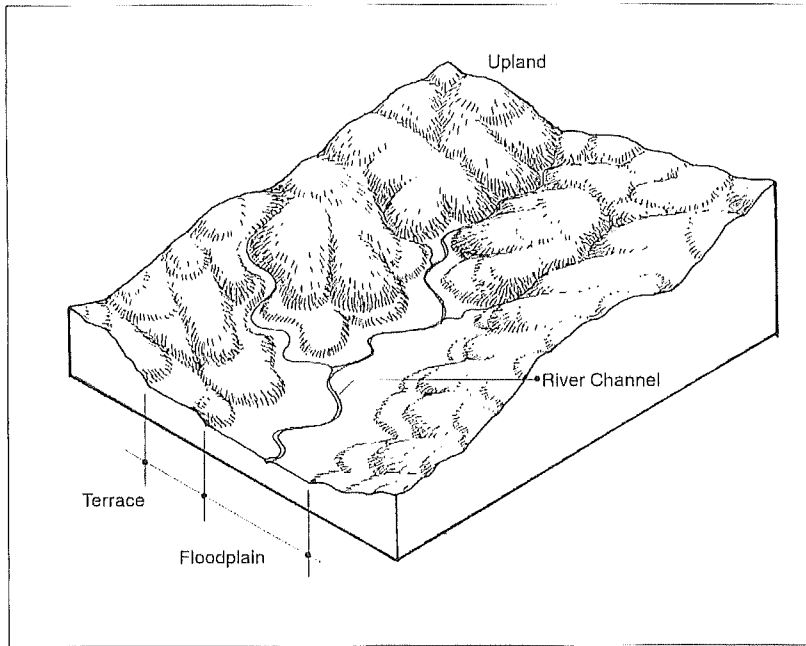


Figure 4 - Major physiographic elements of a typical floodplain.

or divides. Like floodplains, watersheds are formed over time by various climatic, hydrological and geological processes. But a watershed is much bigger than a floodplain and can therefore be more difficult to manage, since large land areas are usually covered by a number of separate municipalities with different governments and land-use strategies. It is important to understand, however, that upstream uses of land and water within a river's watershed are likely to have adverse impacts downstream including the potential for increased flooding.

**Natural Resources and Ecosystems** - Both the hydrological and the geological characteristics of the landscape play an extremely important role in determining what vegetation will inhabit the area. Many of the plant species that grow in floodplains are adapted to thrive in the specific conditions created by the soil types and water flow cycles that characterize river corridors. In turn, this vegetation plays an important role in determining how water flows across the land, and is a major factor in controlling erosion and sediment deposits that can change the face of the landscape.

In a mutually supportive cycle, the living and nonliving parts of natural floodplains interact with each other to create dynamic systems in which each component helps to maintain the characteristics of the environment that supports it. These systems of interacting parts of the physical and biological worlds are called **ecosystems**. Together, these parts of the floodplain ecosystem function to store and convey floodwaters, protect water quality, prevent erosion, and maintain rich habitats for fish and wildlife. In recognizing the relationships between the hydrological, geological and biological features of these systems, we can begin to understand how changes to one feature can alter the entire system in significant ways. This was dramatically demonstrated during the Great Midwest Flood of 1993 when the Mississippi River reclaimed much of its floodplain. The flood reconnected the river to traditional spawning areas, resulting in a significant increase in fish populations.

**Natural Communities** - Throughout a floodplain and its adjacent landforms there may be a number of different **ecological communities**, groups of plant and animal species

Figure 5 - Coastal floodplains are geologically dynamic areas where moving sands, shifting inlets, and erosion are common. Coastal salt marshes are among the most productive ecosystems on earth and are a vital link in both commercial and recreational fishing.

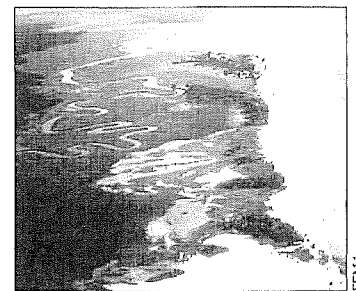
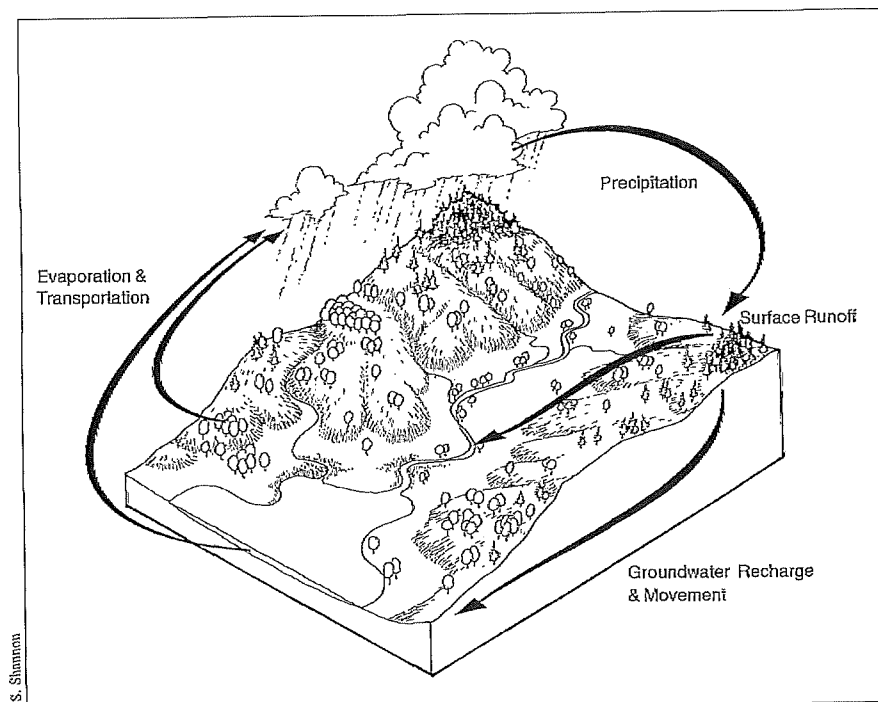


Figure 6 - Major elements of the Hydrological Cycle in floodplains.



that coexist in a certain area. The various plant species within an ecological community may share the need for a certain soil type or level of soil moisture that is available only in a particular portion of the floodplain. Wet meadows, bottomland hardwood forests, and riparian shrub wetlands are examples of such communities. The boundaries of these ecological communities can be identified by the landform, soil, and plant types that cover a portion of the floodplain.

**Summary** - This section has introduced floodplain natural resources with an explanation of floodplains, watersheds, ecosystems and natural communities. The basic characteristics of floodplains and their natural resources function in ways that make them so valuable to humans and to wildlife. This is the subject of the next section.

### How Do Natural Floodplain Systems Function?

**The Floodplain Ecosystem** - Floodplain ecosystems are typified by the bottomland hardwood forests found in southern regions of the U.S., the floodplain forests of central and eastern areas, and small wooded areas and streambank vegetation in the western portion of the country. Each floodplain ecosystem has specific conditions that make it unique, and it is important to recognize these distinctive attributes when planning projects for a given area. But there are some general characteristics that are common to the functions of ecosystems in stream and river corridors.

**Hydrology** - Flooding is extremely important to the maintenance of floodplain ecosystems, and may be the primary reason for their biological richness. Floodwaters carry nutrient-rich sediments and trigger chemical processes that cause beneficial changes in the soil, which contribute to a fertile environment for vegetation. The degree of soil saturation from flooding (and resulting elevated groundwater levels) determines the types of vegetation that can grow throughout the floodplain and can create wetlands along stream channels. This is especially important in dry climates, where water is a particularly limiting factor for vegetation. In these areas, floodplains may be far more biologically productive than surrounding upland areas, which are often drier.

The ultimate determinant of the structure of floodplain ecosystems is the **hydroperiod**, or the timing (frequency and duration) and intensity of flooding. The hydroperiod, which is governed by the climate, soils, and geology of the area, determines the amount and movement of water in soils across the floodplain. This rise and fall of flowing water typically occurs at least once within the growing season. The saturation of soils for at least part of the year is one reason why wetlands tend to form in floodplains along stream channels. These hydrological features, combined with the connections to upland and aquatic ecosystems, are what make riparian ecosystems so special. (See Figure 7.)

**Soils and Nutrients** - The distinctive attributes of soils in riparian ecosystems are directly influenced by the hydroperiod, which determines the soil aeration (or oxygen level) as well as nutrients and content of organic material. In turn, the soil affects the structure and function of plant communities in these ecosystems. The aeration of soils is extremely important for rooted vegetation. When the corridor is flooded for long periods of time, low oxygen conditions can be created. Some plants have adaptations that help them to survive in such conditions. Soils in riparian areas (especially wetlands) generally have a high level of nutrients because of the continual replenishment of nutrients during flooding. The periodic wetting of the soil also releases nutrients from the leaf litter. (See Figure 8, page 10.)

**Vegetation and Habitat** - Any ecosystem that forms the edge of two other distinct ecosystems tends to be more biologically diverse than its neighboring systems. This is indeed the case with floodplains, as nutrients, energy and water provide for high biological productivity. The soil conditions that result from varying amounts of moisture in soils leads to a greater diversity of plant species in riparian areas. Floodplains may be characterized by different zones of vegetation, with shallow aquatic vegetation shifting gradually to shrubs and trees toward the upland elevations. This variety in plant life translates into greater diversity of habitats for wildlife. (See Figure 9, page 11.)

Diverse vegetation can support a wide variety of wildlife and smaller organisms that feed on the plants. In addition, the trees and shrubs of upland areas offer protection and nesting and roosting areas for many species. Trees standing or fallen adjacent to the

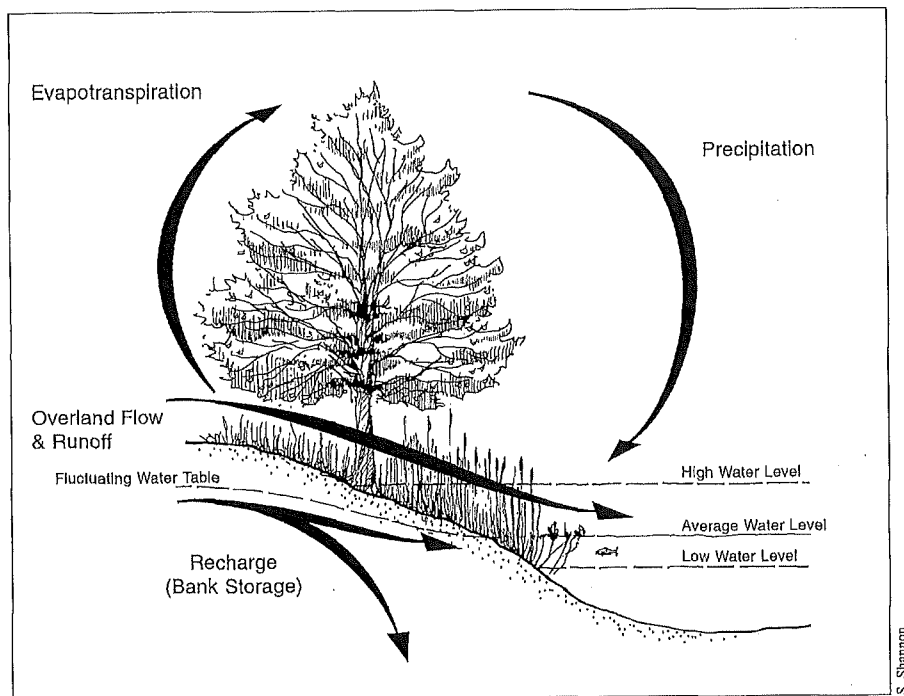


Figure 7 - Hydrologic Features in the floodplain.

Table 1 - Natural Resources and Functions of Floodplains.

#### ☐ Water Resources

##### *Natural Flood and Erosion Control*

- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce peak flows
- Reduce sedimentation

##### *Water Quality Maintenance*

- Filter nutrients and impurities from runoff
- Process organic wastes
- Moderate temperature fluctuations

##### *Groundwater Recharge*

- Promote infiltration and aquifer recharge
- Reduce frequency and duration of low surface flows

#### ☐ Biological Resources

##### *Biological Productivity*

- Rich, alluvial soils promote vegetative growth
- Maintain biodiversity
- Maintain integrity of ecosystems

##### *Fish and Wildlife Habitats*

- Provide breeding and feeding grounds
- Create and enhance waterfowl habitat
- Protect habitats for rare and endangered species.

#### ☐ Societal Resources

##### *Harvest of Wild and Cultivated Products*

- Enhance agricultural lands
- Provide sites for aquaculture
- Restore and enhance forest lands

##### *Recreational Opportunities*

- Provide areas for active and passive uses
- Provide open space
- Provide aesthetic pleasure

##### *Areas for Scientific Study and Outdoor Education*

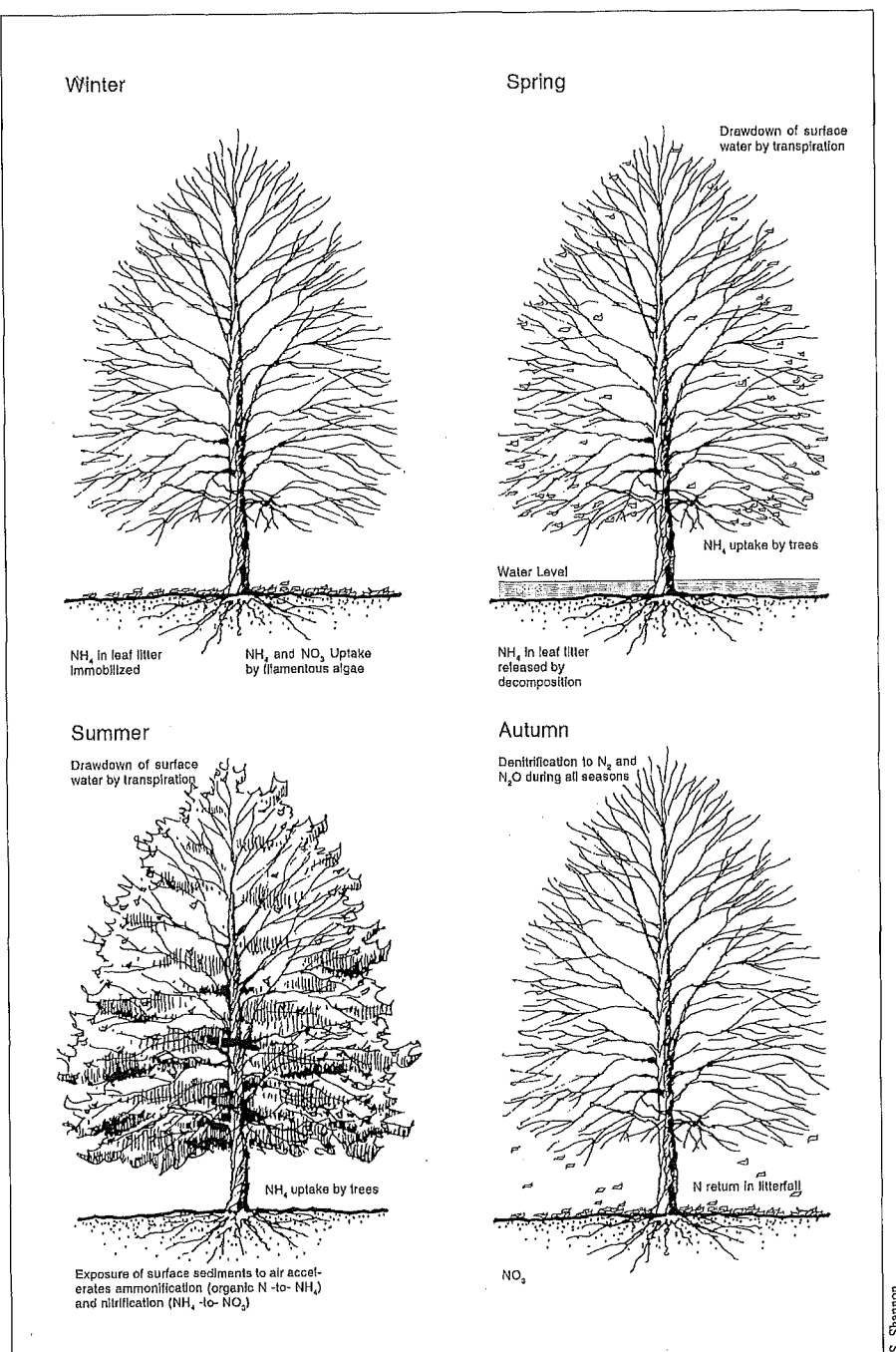
- Contain cultural resources (historic and archeological sites)
- Provide opportunities for environmental and other studies

Adapted from: *A Unified Program for Floodplain Management*, 1994.

river's edge act to stabilize its banks, while fallen branches and root masses create aquatic microhabitats in the form of pools, breaks, and ripples. A stream itself can be a source of food and cover for wildlife, and the corridors themselves offer pathways along which birds, mammals, and fish can migrate. Wetlands are particularly valuable as nesting and feeding areas for fish and waterfowl.

**Vegetation and Water in the Floodplain** - While the type of vegetation inhabiting a riparian ecosystem is largely determined by its hydrological conditions, the vegetation itself plays an important role in maintaining these very conditions. The interaction of

Figure 8 - Nutrient Cycling in a floodplain forested wetland ecosystem.



vegetation and water influences local microclimate conditions. Plants in river corridors provide natural floodwater storage capacity by retarding runoff and increasing the rate at which water infiltrates soils. This can result in the reduction of flood peaks downstream. Vegetation also allows the water to spread horizontally and more slowly, rather than running directly from upland areas into rivers or streams. In addition, the leaf litter and soils associated with floodplain vegetation act as sponges in absorbing some floodwaters. Vegetation also passes water to the atmosphere through transpiration.

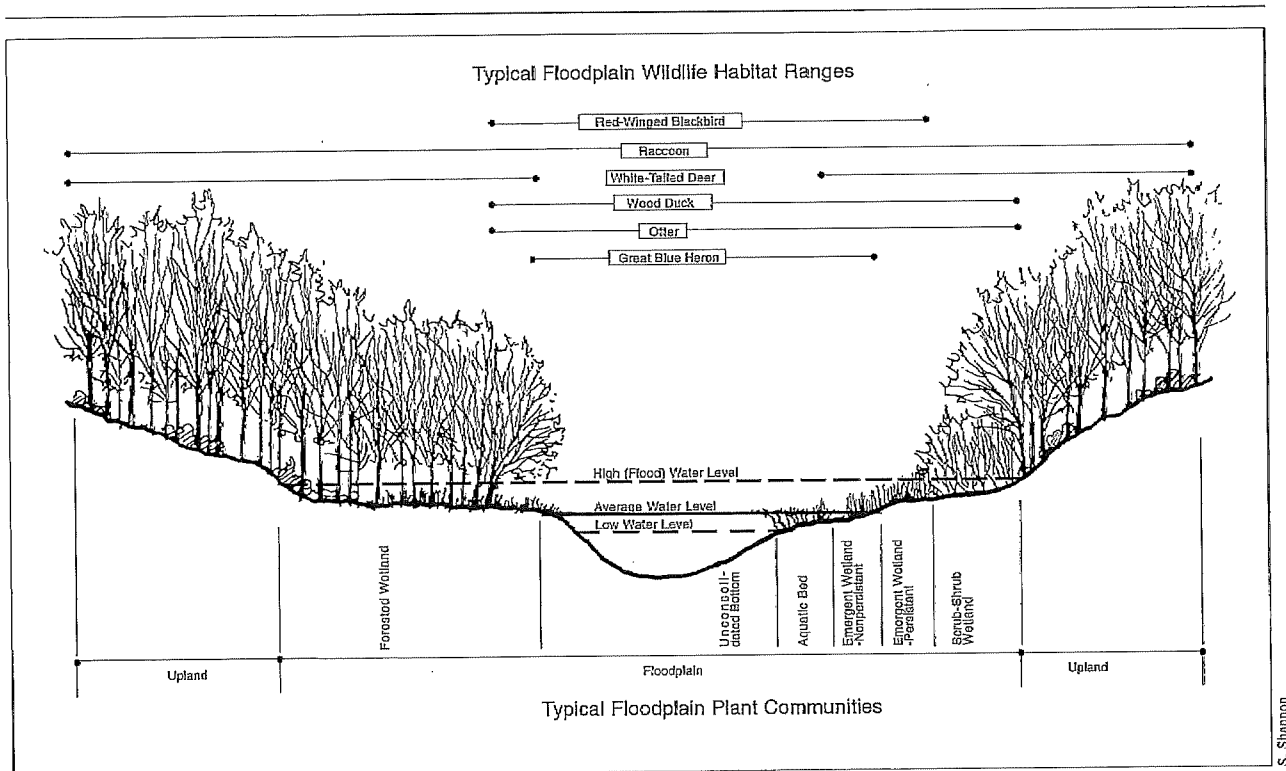


Figure 9 - The structure of plant communities and interconnecting wildlife habitats are strongly influenced by spatial and temporal patterns in the floodplain .

**Surface Water Quality** - Maintaining the ecological integrity of riparian areas can help to protect and even enhance the quality of surface water. This is true because of the critical role that riparian vegetation plays in these systems. First, trees and shrubs along streambeds can maintain the temperature of water by shading it. This is important as lower temperatures increase the capacity of the water to carry oxygen, which is critical for the support of aquatic life and decomposition of organic material.

Second, floodplain vegetation filters sediment and nutrients that move toward rivers and streams from upland areas. This function is crucial because excessive nutrients in aquatic ecosystems can disturb the balance and growth of species and reduce the availability of oxygen in the water. The results can include reduced diversity, unpleasant odors, and, ultimately, human health problems. The degree to which floodplain vegetation performs its filtration function is dependent on several factors, including the slope and width of the floodplain and the nature of the vegetation.

Excessive sediment in waterways can also blanket the gravel beds that are home to invertebrates such as insects and crustaceans. These creatures are an important link in the food chain, and destruction of their habitat can have far-reaching effects on other species in the ecosystem. Excess sediment can also disturb the areas in which fish eggs and young fish develop, with harmful effects on populations that may be essential to recreational fishing areas.

**Groundwater Supply and Quality** - Floodplains and wetlands can play an important role in contributing to sources of water supply for human consumption. The slowing and dispersal of runoff and floodwater by floodplain vegetation allows additional time for this water to infiltrate and recharge groundwater aquifers. Floodplain soils and vegetation can also help to purify the water as it filters down to the aquifer. The ability of wetlands to contribute to groundwater recharge varies with geographic location, season, soil type, water table location and precipitation, as well as wetland type.

In addition, water can also flow from higher groundwater systems into lower surface waters during periods of low flow, so that the frequency and duration of extremely low flows may be reduced. Many wetlands store water that is important for wildlife and may be used for irrigation during periods of drought.

**Summary** - Natural resources in floodplains interactively function to determine the distinctive attributes of soils, vegetation, habitat, and water. They also carry out valuable functions that provide benefits both to humans and to wildlife. How these functions can be encouraged or impeded by human activities on the land is the subject of the next section.



*"...ten thousand river  
commissions, with the mines  
of the world at their back,  
cannot tame that lawless  
stream, cannot curb it or  
confine it, cannot say to it "Go  
here," or "Go there," and  
make it obey; cannot save a  
shore which it has sentenced;  
cannot bar its path with an  
obstruction which it will not  
tear down, dance over, and  
laugh at."*

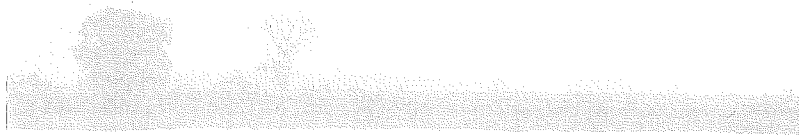
- Mark Twain,  
*Life on the Mississippi*

Figure 10 - The Mississippi River reclaims its floodplain during the Great Flood of 1993.

---

*"Rivers were here long before man, and for untold ages every stream has periodically exercised its right to expand when carrying more than normal flow. Man's error has not been the neglect of flood-control measures, but his refusal to recognize the right of rivers to their floodplain..."*

*-Engineering News-Record, 1937*



### 3 Human Activity - Multiple Uses of Floodplains

While it is important to understand that natural resources of floodplains serve many valuable functions, we must recognize that humans use the land in ways that can impede these natural functions. If vegetation and soils play crucial roles in maintaining water quality and retarding runoff, then their disturbance or removal can inhibit or eliminate the functions that these ecosystem components perform. Loss of these functions should raise concerns for those communities in which floodplain land uses are not compatible.

Every community makes choices about land use. These choices will vary according to the characteristics of a particular community, and in many cases choices are limited by land-use decisions of the past. Current land-use patterns may reflect inadequate consideration or understanding of the consequences of altering natural features of the environment. Even so, it is important that an awareness of the value of natural functions is incorporated into the land-use decisions that will affect the future of any community.

Different levels of development and disruption to natural systems will have varying impacts on natural resources. For example, if the floodplain in your community is already fully developed, your management objectives will be quite different from those of a community that has a considerable amount of open space. Here are some different levels of land use development and corresponding considerations:

- Urban Areas — It is likely that the floodplain within an urban community is already highly developed. Here, the management options include restoration of natural areas and the relocation of structures that are particularly threatened by flood hazards.
- Suburban Areas/Urban Fringe — Urban fringe areas often face great development pressures, but may be fortunate enough to have some open space to work with. Effective planning is critical in these communities, and can include a focus on maintaining existing open areas along waterways and restoration of vegetation.
- Rural Areas — Agricultural communities have a different set of floodplain concerns. They have an advantage in the fact that open space is probably already plentiful in the floodplain. Management strategies here should focus on controlling erosion and excessive nutrient loadings, as well as revegetating streambanks to restore natural ecosystem functions.

- ❑ **Wildlands** — Communities with very low-density development and much more open space already have functioning natural systems. Local officials in these areas have the opportunity to safeguard floodplain functions at the outset, and to maintain valuable habitats and superior water quality.

It may seem burdensome to plan for the protection of natural resource functions, particularly in heavily developed areas where economic concerns and space limitations are pressing issues. But every community must recognize that decisions about floodplain resources are decisions about the community's future. With careful consideration and planning, rivers and streams can be aesthetic and functional assets that reflect community pride and ingenuity. However, a community that ignores the importance of natural floodplain functions may ultimately face flood losses and deteriorating water quality. In the end it would be less costly to plan well now.

Of course, not all human activities are incompatible with healthy, functioning floodplain ecosystems. Land uses that allow native vegetation to flourish and do not disturb soils are highly suitable within the floodplain. Well-placed parks or recreational areas that include vegetation are often ideal for maintaining flood storage capacity, and help to support the floodplain functions that protect water quality and sustain habitats for diverse wildlife species. Even open space areas such as agricultural lands can help to maintain flood storage capacity. In addition, there are proactive measures to restore naturally functioning floodplains, such as protecting or planting vegetated buffer strips and creating channel alterations for fish habitat improvement. The following sections describe specific land uses and their relationship to floodplain functions:

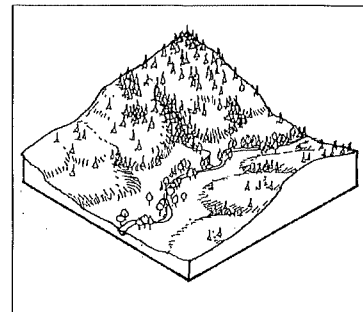
**Urban and Urban Fringe Areas** - Development within floodplains often occurs without consideration of the effects on floodplain natural resource functions. If an area is built up during a period when there have been few floods, the need for the flood storage capacity of a naturally functioning floodplain may have been overlooked. The loss of natural floodplain functions in heavily developed areas not only impedes flood storage, but also increases erosion and reduces the mitigating effects that vegetated areas can have on the pollution of waterways.

Impermeable surfaces such as buildings and pavement replace vegetation as ground cover, increasing the runoff that would have infiltrated in a natural floodplain. The removal of vegetation, destruction of wetlands, and paving in urban and suburban settings can thus increase the risk of flooding. Upstream development outside the floodplain can also result in increased runoff. Vegetation loss and excessive runoff within the floodplain can also cause increased erosion and sedimentation, which may cover spawning areas and bury food sources in streams. Loss of vegetation also removes sources of shelter and food for wildlife, and human-made structures may present barriers to migration and reproductive activity.

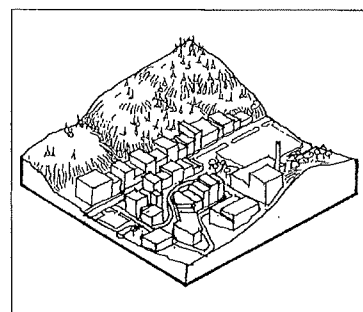
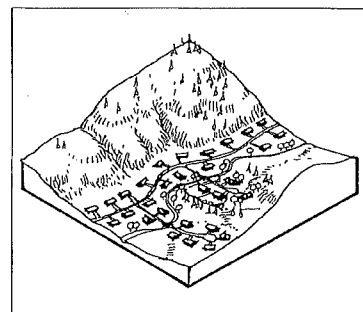
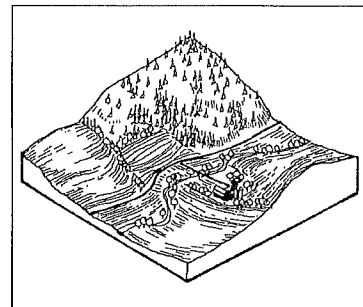
The lack of naturally functioning floodplain resources in urbanized or developing areas also has significance for water quality. Diffuse "nonpoint sources" sources of pollution related to urbanization, such as lawn fertilizers, leached materials from waste disposal areas, and chemicals leaked from automobiles, present a threat to water quality. Although it is most effective to address such problems at their source, vegetative buffers along waterways can help to mitigate such pollution. Urban areas also present direct "point sources" of pollution to waterways, such as sewage treatment plants and industrial discharge. Riparian vegetation would have little effect on this type of pollution.

Wetlands are particularly vulnerable to loss through human intervention. The draining and filling of wetlands for development and agriculture results in the loss of an important natural system for reducing runoff and maintaining the quality of surface and ground-

*Figure 11 - Floodplain development in the United States, as well as other countries, has significantly increased flood damages and often degrades the floodplain environment.*



S. Shannon



*Figure 12 - Agriculture is a significant and important land use in many floodplains.*



water, and destroys the diversity and habitats for which these areas are recognized. In general, it is important to recognize that there must be a balance between the need for some floodplain occupancy and the tremendous benefits to be gained from maintaining naturally functioning floodplains.

**Agriculture** - While agricultural land uses do not impede the absorption of floodwaters as urban development does, agriculture can present other problems for floodplain resources. Fertilizers and pesticides associated with farming are major sources of nonpoint pollution of waterways. Erosion from poorly managed agricultural operations can cause excessive sedimentation in streams. The removal of vegetation along stream and river banks compounds these problems by eliminating valuable filtration functions.

**Recreation and Open Space** - Parks or recreation areas are one type of land use that is generally considered to be quite compatible with the healthy functioning of floodplain ecosystems. A tremendous variety of recreational activities can occur along rivers and streams. A simple trail provides an opportunity for hiking, jogging, cycling, or horse-back riding, as well as increasing accessibility of the waterway to birdwatchers, photographers, and beachcombers. A more ambitious recreation plan might include provisions for water-based activities such as swimming, boating, and canoeing. Well-planned picnic or camping areas may encourage waterfront use by families, and some waterways and wetlands may be ideal for fishing or hunting waterfowl.

If recreational land uses are planned for the floodplain, it is wise to lay out a strategy carefully and to recognize the needs of different recreational groups. For example, swimming and powerboating in a narrow waterway might not be compatible activities, while pollution may detract from water recreation possibilities altogether. Wetlands may have particular value in performing natural floodplain functions, and are better suited to trails or waterfowl hunting than to picnicking. A good starting point is to take an inventory of existing recreation patterns for a waterway and of floodplain features that are unused but have potential. When planning for recreational uses of floodplains, it is important to design areas in ways that minimize potential damage. Heavy recreational use of riparian areas can destroy vegetation, thus reducing its water quality maintenance functions. Trampling off-trail vegetation can also lead to disruptions that reduce diversity of plant and animal life.

**Aesthetic Resources** - Scenic vistas can enrich the quality of life in any community, and are quite likely to be found overlooking waterways. Such areas make excellent targets for floodplain natural resource management plans. Existing or potential scenic areas can be identified easily with input from the public, who are most familiar with a community's special landscapes.

**Cultural Resources** - The centuries-old tendency of humans to settle near waterways has resulted in many historic structures and archeological sites along rivers and streams. Protecting these artifacts of our heritage may be an important part of a floodplain protection strategy.

**Greenways** - Greenways are linear parks or corridors of open space that may extend across many communities. They embody a strategy for keeping riverside areas largely undeveloped while providing recreational, cultural, and aesthetic resources. These chains of green may be dotted with nature centers, historic structures or other semi-open-space land uses, in addition to parks and wild areas with native vegetation. Greenways can help to protect long stretches of floodplain ecosystems, and serve as migration corridors for wildlife.



*Figure 13 - Boulder, Colorado is a good example of a community that has taken the initiative to transform its flood hazard areas into community assets by creating greenways with wildlife preserves, parks, and bike paths.*

J. McShane

**The Floodway** - The floodway is the most significant component of the floodplain, relative to maintaining the flood-carrying capacity of rivers and streams. The floodway is defined as that area of the watercourse plus adjacent floodplain land that must be preserved in order to allow the discharge of the base flood without increasing flood heights more than a designated amount. Communities are required to prohibit development within a floodway that would cause an increase in flood heights. Because a floodway is, in many respects, a *de facto* preservation tool, it also acts to protect critical riparian habitats, minimize degradation of surface water quality, and provide for greater ground-water recharge.

A number of states and local communities have adopted a more restrictive floodway which generally results in a wider floodway; thus a greater area of floodplain, especially sensitive riparian areas, would likely remain undeveloped. Some 5.8 million acres of floodways have been delineated along 40,000 stream and river miles in 7,800 communities nationwide. This is an area the size of Vermont or more than 2 1/2 times that of Yellowstone National Park.

**Watersheds — The Big Picture** - While it is important for communities to plan and take responsibility for the land uses that occur in their own floodplains, it must be recognized that flood level and water quality can be very much affected by land use activities that occur elsewhere in the watershed. Land uses along tributaries are likely to have an impact on downstream communities. Wise management of tributaries is therefore extremely important, as their protection can yield benefits for the entire network. Broad planning efforts among communities within a watershed can thus have far-reaching advantages.