



Review

National-local land-use conflicts in floodways of the Mississippi River system

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Abstract: Conflicts between national and local governments over land use in floodplains have been well documented in the US and elsewhere. The US National Flood Insurance Program offers subsidized flood insurance to communities that agree to prevent further development in floodplains, but the requirements are poorly enforced and local governments are commonly reluctant to restrain development on flood-prone lands. In this paper we highlight this problem in particularly sensitive areas: the floodways (or flood bypasses) that are essential components of the Mississippi River flood control system. To properly operate the flood control system, the US Army Corps of Engineers must be able to divert flow from the mainstem Mississippi into the bypasses, thereby lowering stage in the main river, and thus minimizing flooding of cities and other vulnerable areas. However, operation of the Birds-Point-New Madrid Floodway in Missouri was compromised in 2011 by local opposition (and a legal challenge ultimately rejected by the US Supreme Court), and it was finally used to accommodate floodwaters. The West Atchafalaya Floodway in Louisiana experienced a threefold increase in the number of structures within the floodway from about 1970 to 2010. Because of the pattern of flooding, the West Atchafalaya Floodway was not needed in 2011, but if it is needed in the future, its operation may be compromised by the extensive encroachments within the floodway. Thus, operation of critical national infrastructure, designed to deal with floods on an interstate, river-basin scale, is compromised by land-use decisions made at the local level.

Keywords: flood risk management; Mississippi River; 2011 Mississippi River flood; flood bypasses

1. Introduction

The history of flood control in the US includes a number of attempts at the national level to reduce flood losses, which have been largely stymied by a lack of follow-through by local governments. Local governments have primary responsibility for land-use planning, and many have permitted proliferation of development on flood-prone lands. As noted by Galloway [10], “State and local governments have little fiscal stake in floodplain management; without this stake, few incentives exist for them to be fully involved in floodplain management. State governments must assist local governments in dealing with federal programs but, in many cases, do not become involved in federal-local activities.”

Because the federal government is repeatedly called-upon to provide disaster relief to flooded communities, it has been seen to be in the national interest to reduce losses from flooding. May and Williams [23] describe both political and implementation dilemmas in national flood management policy. The political dilemma stems in part from the fact that during normal times, no one is interested in disaster policy, but immediately after a major flood, political salience is high and new policies tend to be implemented, as occurred after the 1927 Mississippi flood [2,34]. They note that the most politically popular policy is to expand federal disaster relief, by which politicians can be seen in a positive light as bringing aid to citizens in need. However this “...is both costly and does little to control longer-run growth of disaster losses. On the other hand, the policies ... [that might control disasters in the long run]—preparedness and mitigation—are politically less salient and therefore unlikely to receive much attention during the active stages of federal disaster policymaking.” [23].

The implementation dilemma is that many national policies must be implemented by state and local governments, who have different motivations and constraints than the national government. As described by May and Williams [23], “federal officials have a strong stake in promoting hazard mitigation and preparedness but little direct control over the effectiveness of such efforts... subnational governments and individuals owning property in hazardous areas directly control the effectiveness of mitigation and preparedness policies, but for the most part actions consistent with such policies are low on their list of priorities.” [23].

The National Flood Insurance Program (NFIP), authorized by the US Congress in 1968, provided federally-subsidized flood insurance for residents of floodplains, but for communities to be eligible for the insurance subsidy, they had to adopt land-use policies to prevent further development in floodplains. As colorfully summarized by Houck [13], the federal flood insurance system was designed to operate on a “...‘carrot-and-stick’ philosophy—making federal benefits contingent upon local zoning...” However, as amply documented by Brinkman et al. [3], Burby and French [4] and other scholars since, the motivations of the local governments do not necessarily accord with those of the national government, undermining effective implementation of the program, and resulting in further encroachments of housing and infrastructure into flood-prone areas.

The objective of this paper is to document how this implementation dilemma has played out with respect to land use in nationally-designated floodways along the Mississippi River, floodplain areas explicitly designated to carry flood flows to reduce flood stage in the mainstem Mississippi. While conflicts between national, state, and local actors have been documented before, these conflicts are brought into especially sharp focus in the land-use history of the Mississippi River floodways.

2. Floodways of the Mississippi River system

The Mississippi River drains a 3.1 million km² basin extending from the Rocky Mountains to the Appalachian Mountains; it is the largest river system in North America and the third-largest river basin in the world. Following a devastating flood in 1927, the US Congress authorized the US Army Corps of Engineers to construct the Mississippi River and Tributaries Project (MR&T) to protect lands in the lower Mississippi Valley from floods and to assure the navigability of the channel [15]. While there had been prior, mostly local measures to protect against floods, the sheer magnitude of the 1927 basin-wide flood and the number of states and local government entities involved highlighted the need for a national-level response [2]. Besides levees, reservoirs and backwater areas, the MR&T included four designated flood bypasses (termed ‘floodways’ in MR&T parlance), areas of floodplain designated to accommodate part of the river’s flood flow, thereby reducing stage in the main river: Birds Point-New Madrid (New Madrid), West Atchafalaya, Morganza, and Bonnet Carré (Figure 1). Since the initial planning of the MR&T, the floodways were opposed by residents who did not want their properties flooded to protect other lands along the valley [25]. The US Army Corps of Engineers purchased flowage easements from the owners of all the affected private properties. However, the easements included no restrictions on the use or development of the land, decisions normally left to local jurisdictions. Many structures have been built in floodways, so when the floodways must be used, damage to these developments becomes an issue, as was the case with the New Madrid floodway during the flood of May-June 2011.

Here we consider conflicts between national and local-state interests in managing two of these important features of the MR&T flood control system, the New Madrid and West Atchafalaya floodways. Both of these floodways were built and flowage easements purchased from landowners in the 1930s when the Mississippi River and Tributaries Project was constructed. The Birds Point-New Madrid Floodway was used in the 1937 and 2011 floods; the West Atchafalaya Floodway has never been used.

3. The Birds Point-New Madrid Floodway

The New Madrid Floodway is located on the west bank of the Mississippi River (in the state of Missouri), just downstream of the confluence of Mississippi and Ohio Rivers, and was completed in 1932. It is designed to divert flood flows from the mainstem Mississippi River, thereby reducing the river stage and preventing overtopping of levees elsewhere. Bounded on the west by a 58-km long ‘setback’ levee, the bypass is separated from the Mississippi River by a 90-km long ‘frontline’ levee, which includes ‘fuseplug’ sections 0.6 m lower than the rest of the levee, designed to overtop first [8], and a ‘crevasse’ section with buried horizontal pipes in which explosives can be detonated to artificially breach the levee (Figure 2a) [41]. At the floodway’s downstream end, a 460-m gap between the frontline and setback levees allows floodwaters to return to the main Mississippi channel, and during smaller floods when the bypass is not activated, the gap allows backwater flooding from the Mississippi River to inundate the lowest one third of the floodway, providing shallowly flooded habitat of high value to fish and other wildlife [24].

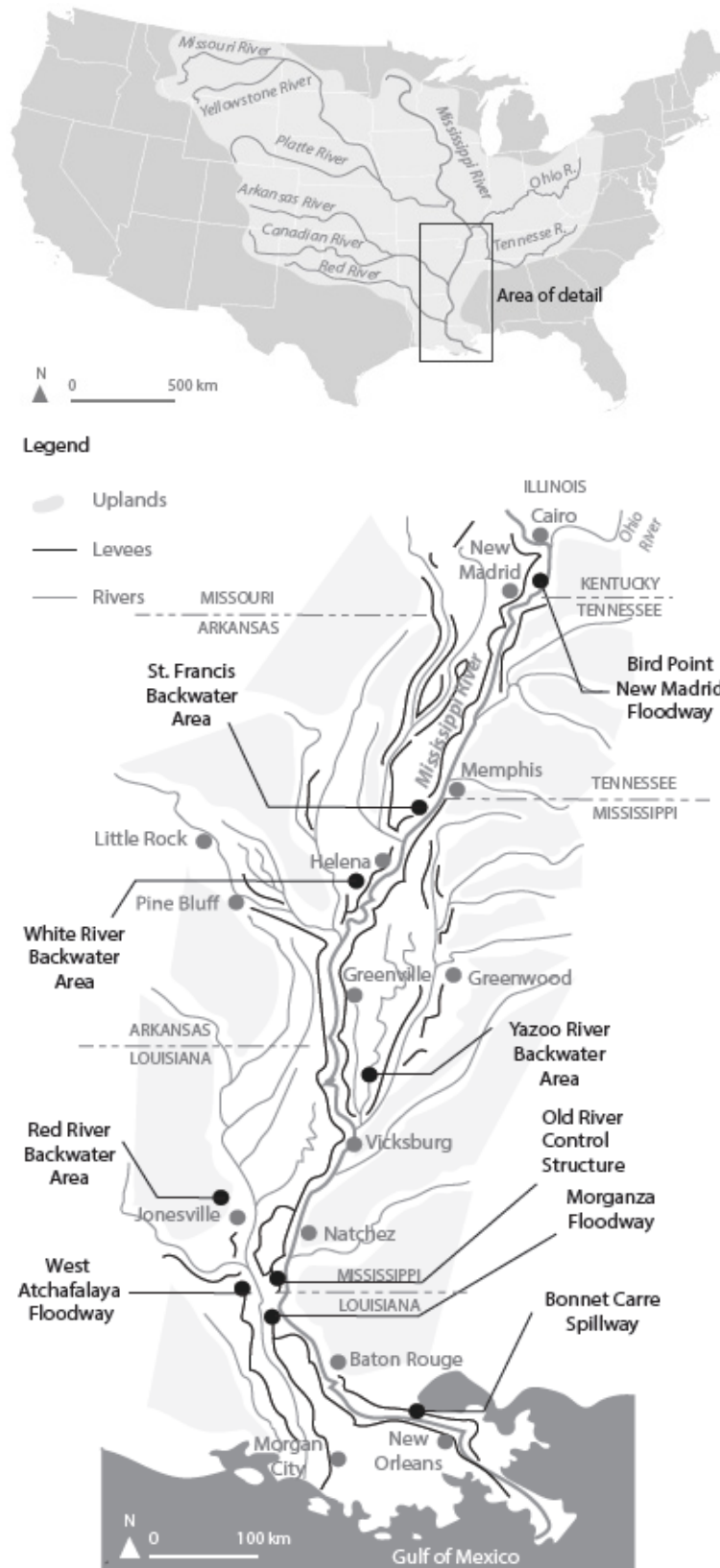
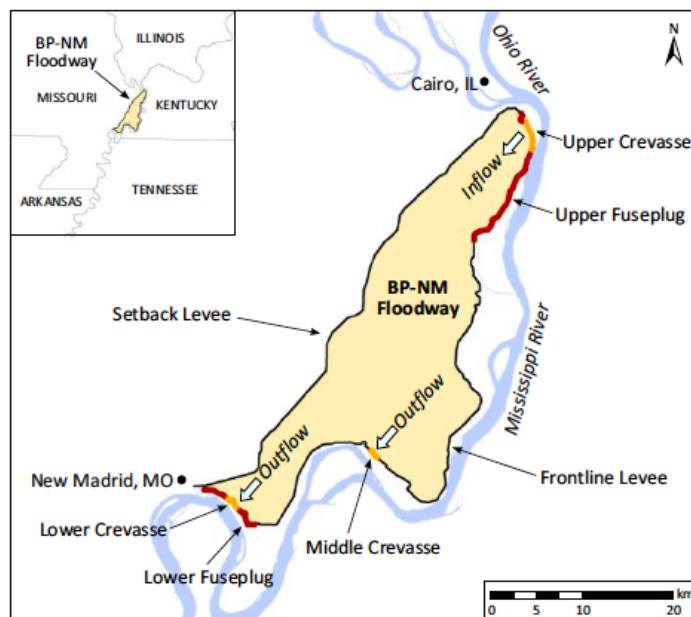
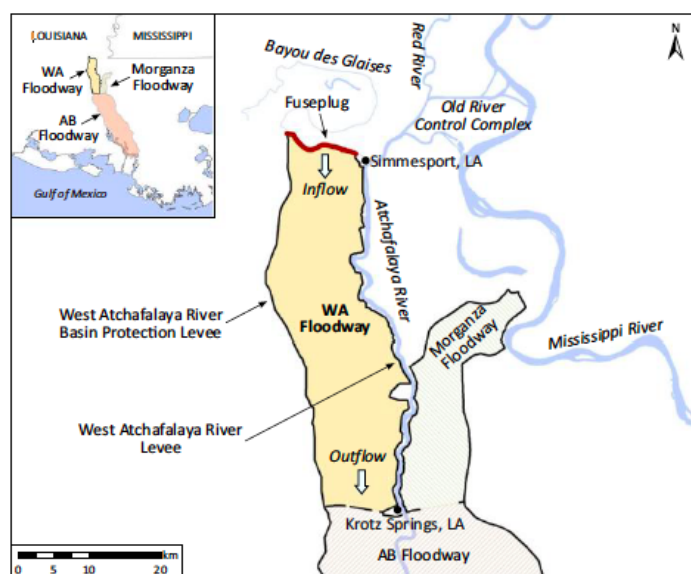


Figure 1. Location of features of the Mississippi River and Tributaries (MR&T) Project. In addition to floodways, backwater areas and principal levees are shown. (Source: Serra Llobet et al. [38], used by permission, redrawn from US Army Corps of Engineers.)



(a)



(b)

Figure 2. Birds Point-New Madrid and West Atchafalaya Floodway schemes showing their main features, with insets indicating the location of the floodways. (a) Birds Point-New Madrid Floodway. (b) The West Atchafalaya (WA) Floodway, whose waters, together with those of the Morganza Floodway, flow into the Atchafalaya Basin (AB) Floodway. (Basemaps: GIS data courtesy of the National Operational Hydrologic Remote Sensing Center; accessed at www.nohrsc.noaa.gov/gisdatasets/) (from [20], used by permission.)

Thus, the flood bypass works by natural overtopping (fuseplug) or detonating (crevasse), with diverted waters returning to the mainstem Mississippi at the downstream end of the floodway

through the gap between the frontline and setback levees, by spilling over a downstream fuseplug section, and/or detonating breaches in downstream sections of the frontline levee [41]. According to the current Operation Plan [41], the floodway is to be activated by blasting the crevasse when a peak stage of 18.3 m is forecast for Cairo, Illinois, to produce a decrease in stage on the Mississippi and Ohio Rivers at and above Cairo and along the east bank opposite the floodway [24].

The US government purchased “flowage easements” over all the lands within the floodways, thereby retaining the right to inundate the lands when needed to manage floods. The floodway is mostly occupied by agricultural land, but contains structures such as barns, houses, and silos, all of which are considered encroachments within the designated path of floodwaters. The number of such encroachments declined from about 1,200 to 600 between 1970 and 2013 [20], probably reflecting primarily increased mechanization of industrial-scale agriculture and reduced need for farm labor, and to a lesser extent, response to the 2011 flood.

3.1. Contention over activating the New Madrid Floodway in 2011

During the record flood of 2011, activation of the New Madrid Floodway by the national government (US Army Corps of Engineers) was delayed until the last moment by objections over potential damage to farmland and structures in the floodway [26,44]. To prevent the activation of the floodway, the State of Missouri filed a suit against the US Army Corps of Engineers, the State of Illinois and the Commonwealth of Kentucky. Missouri argued in part that if the floodway was inundated, numerous farm chemicals, and oil and gas tanks within the floodway would contaminate the water. The Eastern District Court of Missouri, the US Court of Appeals for the Eighth Circuit, and finally the US Supreme Court determined that the floodway should be operated as established in the MR&T Project [5]. On 2 May 2011, the crevasse was detonated and water diverted through the floodway, inundating structures and agricultural lands within [19,29]. Operation of the floodway lowered the river stage at Cairo, Illinois, helping the city of 2,900 inhabitants avoid flooding, thereby reducing total damages and potential pollution from flooding [22,30].

3.2. Attempting to close the ‘Gap’

Agricultural interests within the New Madrid Floodway have long called for the gap between the frontline and setback levees (at their downstream ends) to be closed, to prevent the backwater flooding, and thereby permit farming during high flows. However, the inundated floodplain habitat that exists now (and which would be lost if the gap were closed), is the kind of habitat widely recognized as critically important for riverine ecosystems [6,31]. In response to political pressure from Missouri, the St. Johns-New Madrid Floodway project was authorized in 1954 to close off the current connection with the Mississippi River at the downstream end of the floodway. The project finally started in 2003, but was halted by a federal court ruling that the project had violated the Administrative Procedure, Clean Water, and National Environmental Policy acts [26,39,43]. Further attempts to proceed with the project, pushed by local interests in Missouri [6] met strong objections from the conservation community and from elected official representing residents along the river (especially on the opposite bank and upstream, in other states) whose risk of flooding would be increased [1]. In a multi-agency decision issued in January 2017, the US Army Corps agreed not to proceed with the project unless the project’s impacts could be fully mitigated through advance

restoration of a comparable area of frequently inundated floodplain, effectively meaning that to close off this connected floodplain area the corps would have to open a comparable floodplain area to frequent flooding elsewhere [45].

4. The Atchafalaya Floodway system

The Atchafalaya River is the principal distributary channel of the Mississippi, flowing southward from its bifurcation with the mainstem. The bifurcation is controlled by the US Army Corps at the Old River Control Structure, which maintains a flow split of about 70% into the mainstem Mississippi and 30% into the Atchafalaya. The Atchafalaya flows westward from the control structure, is joined by the Red River, which formerly joined the Mississippi River, but now flows directly into the Atchafalaya [27]. The Atchafalaya then turns southward, at which point it is paralleled by the West Atchafalaya Floodway to the west (Figure 3). Continuing southward, the Atchafalaya River receives discharge from the West Atchafalaya Floodway and from the Morganza Spillway, which diverts flood flows from the mainstem Mississippi into the Atchafalaya. Downstream, the combined floodway is termed the Atchafalaya Basin Floodway, consisting of the Atchafalaya River channel itself, flanked by ‘guide levees’ designed to concentrate flow in the center of the floodway, and a broader area (typically 30 km wide) to accommodate large floods, all ultimately discharging into the Gulf of Mexico [40].

The 69-km-long West Atchafalaya Floodway covers a surface of 610 km², mostly swampland, and is separated from the Atchafalaya River by a levee (Figure 2b). The Floodway was designed to be activated at 19,300 m³/s by passive overtopping of the 12-km-long fuseplug section along its northern end, built at a lower elevation than the rest of the levee (Figure 3) [7,25]. In addition to receiving 7,000 m³/s from overtopping of the fuseplug, the West Atchafalaya Floodway was designed to receive inflow from Bayou Current from the west before discharging at its downstream end into the Atchafalaya Basin Floodway. The purpose of the West Atchafalaya Floodway is to lower stages in the Atchafalaya and Red Rivers, and in the Mississippi River itself by virtue of accommodating some of the water drawn off the mainstem at the Old River Control Structure. Under the MR&T plan, this floodway would be the last component of the MR&T system to be activated [24], and in fact, it has never been used.

The Atchafalaya River channel has incised in recent decades, attributed to increased and sediment-starved flows (due to the water diverted into the Atchafalaya from the control structure having disproportionately lower sediment loads), and the effects of river engineering such as dredging, channel straightening, revetments, and wing dikes [27]. Due to the increased capacity of the Atchafalaya River from channel incision, a much larger flow is probably needed now to passively overtop the fuseplug levee section and initiate flow through the West Atchafalaya Floodway. Despite the magnitude of the 2011 flood overall, this floodway was not activated (though the lowest part was flooded by backwater from the Atchafalaya Basin Floodway). The Red River was not in flood and river levels upstream of the fuseplug did not approach elevations required to overtop and flood the by-pass. Moreover, because of the incision and increased capacity of the Atchafalaya channel, it is unlikely that the fuseplug would now overflow at the intended activation flow of 19,300 m³/s.

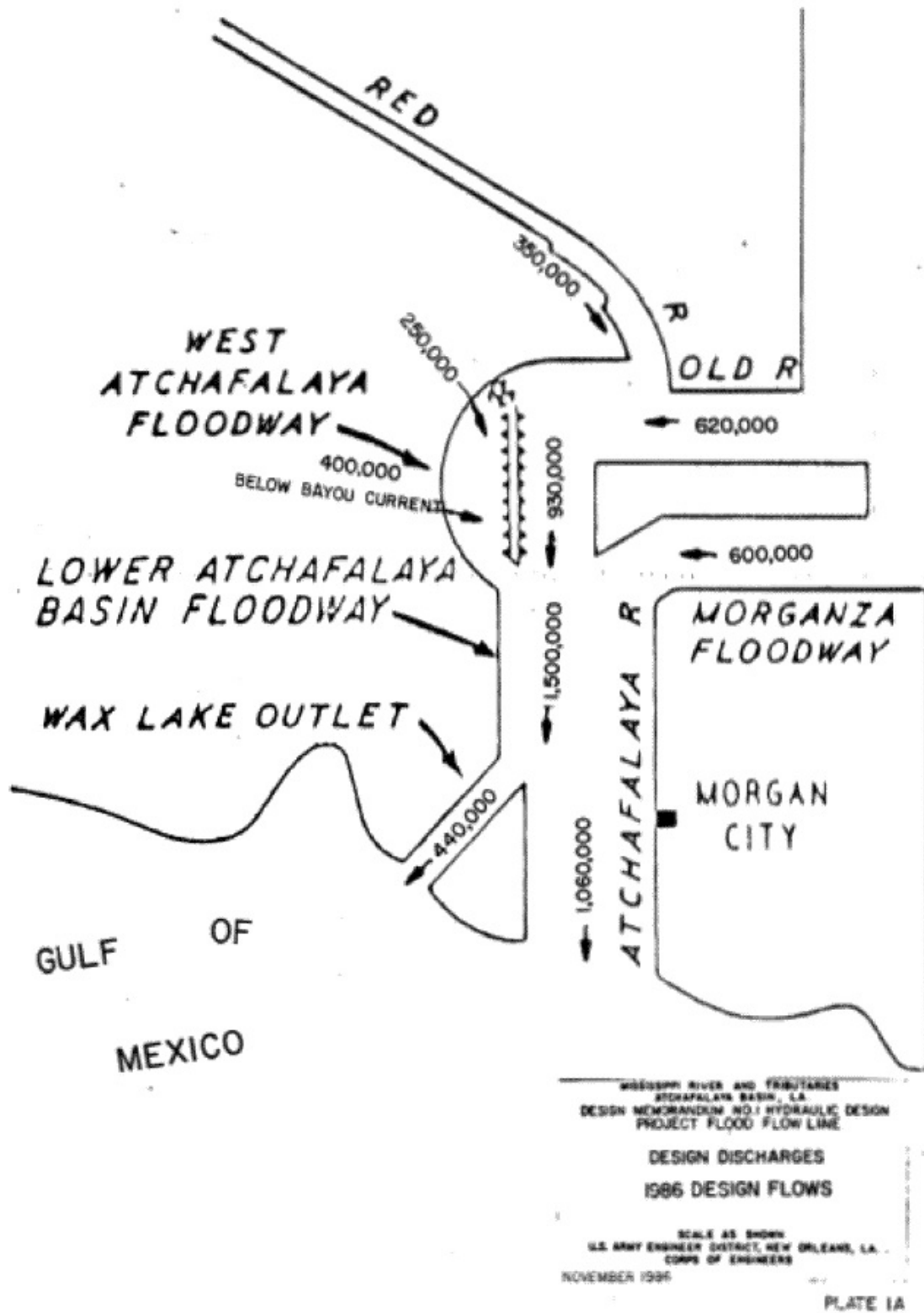


Figure 3. Schematic diagram showing relationship among the Mississippi and Atchafalaya Rivers, the Old River Control Structure, the Red River confluence, the West Atchafalaya Floodway, the Morganza Spillway, and the Atchafalaya Basin Floodway. Source: US Army Corps of Engineers. Flows indicated in ft^3s^{-1} ($1 \text{ ft}^3\text{s}^{-1} = 0.0283 \text{ m}^3\text{s}^{-1}$).

4.1. Encroachments in the West Atchafalaya Floodway

Describing the situation in the early days of the National Flood Insurance Program, Houck [13] documented extensive building within designated floodways of the Atchafalaya Floodway system, including one community, half of which lay within the Atchafalaya Basin Floodway. The community forbade further development in the floodway (as required by NFIP guidelines to qualify for federally subsidized insurance), but officials were “reluctant to limit growth in so large an area,” and tried to interpret the floodway as only the area between the guide levees, a much smaller footprint in which to exclude development. However, “when a flood of that size arrives, it is quite possible that the entire floodway will be opened, exposing development well behind the guide levee to inundation...” Houck [13]. Similarly, local officials in Point Coupee Parish, which includes the Atchafalaya River itself east of the West Atchafalaya Floodway, were found by investigators for the Federal Emergency Management Agency to have allowed extensive development, evincing a “...‘total lack of understanding’ of the NFIP program, and gross neglect of FEMA’s regulations.” [13].

To document recent trends in land use within the West Atchafalaya Floodway, Lopez-Llompарт and Kondolf [20] mapped the number of encroachments in 1968–1969 and 2008–2009, and found that encroachments had tripled in number (from 1,439 to 4,324), mostly after 1994 (Figure 4). The highest density occurred around the town of Simmesport, which lies outside of the floodway within a ring of levees, whose growth has ‘spilled-over’ into the floodway itself. In contrast to encroachments in the New Madrid Floodway, development in the West Atchafalaya Floodway is dominantly residential with some commercial, including an automobile junkyard [20].

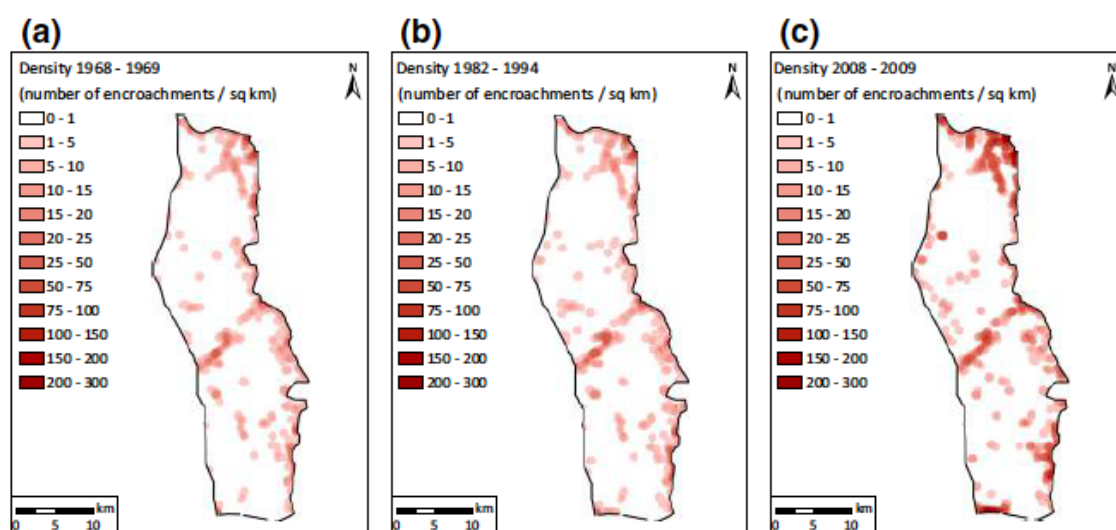


Figure 4. Density of encroachments (number of encroachments/km²) in West Atchafalaya Floodway at the three studied time periods: a 1968–1969, b 1982–1994, and c 2008–2009. The range of years for each map reflects the dates of the combination of US Geological Survey topographic maps and aerial imagery available and upon which the maps were based. (from [20], used by permission.)

While the widespread construction within flood-prone areas is not unique, reflecting as it does a lack of enthusiasm by local governments to enforce land-use restrictions associated with the federal

flood insurance program, the encroachments within the floodways have implications that go beyond inundation of the poorly-sited structures themselves. Although the structures and their parcels occupy less than 2% of the total area of the West Atchafalaya Floodway, the encroachments concentrate along roads traversing the floodway roughly normal to the flow direction (Figure 5). This linear pattern may increase hydraulic roughness during floods, but no studies have been published assessing potential effects on conveyance of the floodway during floods.

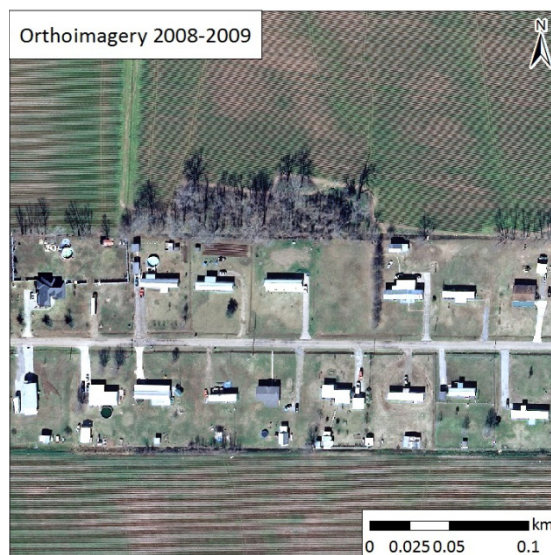


Figure 5. Orthoimage of 2008–2009 of an east-west oriented road within the West Atchafalaya Floodway flanked by residential settlement, at the coordinates $91^{\circ}50'9.288''\text{W}$ and $30^{\circ}59'13.533''\text{N}$ (courtesy of the U.S. Geological Survey; accessed at earthexplorer.usgs.gov).

5. Federal flowage easements and residents' risk perception

Although the federal flowage easement has been part of the deeds of the lands within the floodways for decades, the explicit designation of these lands for inundation did not prevent local interests from attempting to stop use of the New Madrid Floodway in 2011, nor has it discouraged the explosion of residential development within the West Atchafalaya Floodway over the past two decades. Residents in the West Atchafalaya Floodway may be aware that the floodway has never been used, and may consider its chances of being used for its designated purpose to be low. Or the individual choices to settle within the designated flood bypass may simply reflect the apathy and sense of fatalism with which many residents of flood-prone lands regard the potential of flooding. “Believing they have little control over such events, they tend to be fatalistic about the occurrence of catastrophes. As a consequence, the few precautions available to individuals such as moving out of the hazardous area, flood-proofing homes, or purchasing hazard insurance may be overlooked by many” [23].

The flowage easements (held by the federal government) include no land-use restrictions. Land-use decisions are traditionally within the purview of local governments, which are commonly influenced by development pressure [4]. The West Atchafalaya Floodway now contains houses and swimming pools, besides the original swampland. Such encroachments can interfere with the

operation of the floodways by (1) making flood managers reluctant to activate floodways, because of anticipated public resistance, and (2) because of the potential for buildings within the floodway to locally increase hydraulic roughness and reduce conveyance of the floodway. In urban areas, buildings strongly affect flood flow paths [36], but the potential effect of buildings on flow resistance in a broad floodway has not (to our knowledge) been analyzed.

In an effort to more explicitly communicate flood risk, since 2013 the US Army Corps has sent letters annually to residents and businesses in the floodways reminding them that their properties are in a floodway, and that the floodway may be flooded. The letter sent to properties in the West Atchafalaya Floodway states, “You are reminded that the property in which you reside, operate, and/or are doing business is located within a floodway, or a portion of a floodway, which was developed under appropriate Acts of Congress by the United States Army Corps of Engineers. The function of the floodways is to safely pass the flood waters that may be generated in the Mississippi River and its tributaries to the Gulf of Mexico. The United States Government holds a perpetual right to flood the properties and improvement thereon. The Government’s recorded easements provide that the United States shall in no case be liable for damages to property or injuries to persons that may arise from or be incident to operation of the afore mentioned floodways” [42]. The letter sent annually to property owners in the New Madrid Floodway is similar.

The accelerated residential development in the West Atchafalaya Floodway and post-flood reconstruction in the New Madrid Floodway [20] raise questions about residents’ understanding of the flood risk within the floodways, despite the legal standing of the flowage easements on property deeds. Perceptions of risk influence decisions to settle in flood-prone areas, though in complicated ways [21,33]. In an effort to raise public awareness of flood risk through improvements to the National Flood Insurance Program [18], the Federal Emergency Management Agency (FEMA) has remapped Flood Insurance Rate Maps to better incorporate current flood hazards in the floodplains. These maps identify the New Madrid and West Atchafalaya Floodways as “Special flood hazard areas”, i.e., areas that will be inundated by the 100-year flood. However, this is the same classification applied to areas located outside the floodways, some of which are protected by levees (e.g., [9]). This may lead to some confusion among the residents of the floodways about the real risks of living there. FEMA normally makes flood insurance available to properties within special flood hazard areas within communities participating in the National Flood Insurance Program.

However, structural measures such as levees typically induce more development and hence greater exposure of life and property to flood damage [4]. If it were eventually to be built, despite the mitigation requirements spelled out in the 2017 interagency decision, the St Johns—New Madrid Floodway Project would likely lead to greater investment and more encroachment of structures in the New Madrid Floodway, thus creating greater resistance to operating the floodway in future floods. This in turn will increase the threat of flooding to other areas (such as Cairo, Illinois) that the floodway was designed to protect. The effort by interests along the west bank of the river to avoid flooding of structures and farmland within the designated floodway would result in increased flood elevations elsewhere. This is reminiscent of the 19th century “levee wars” in the Sacramento Valley of California, where property owners on opposite sides of the river would incrementally raise their levees just enough so that the levees on other side would be overtopped first in the next flood [16].

6. The state role

While there have been many attempts in the US at the national level to reduce flood losses through land-use planning, these have not always been supported at the state level, and commonly have been circumvented at the local level where land-use decisions are made. The role of states in managing floodplains has varied widely across the nation and over time. In the years after the Second World War, the state of California had a budget surplus and made state funds available to pay the local government cost share for federal flood control projects (which at the time employed exclusively structural approaches), resulting in the proliferation of such federal projects throughout the state [17,46]. More recently, to address the lack of coordination among agencies and other actors involved in managing floodplains and water resources more broadly, in 2002 California passed legislation creating the Integrated Regional Water Management program, which provided financial incentives (but no requirements) for diverse agencies to cooperate in managing water issues, which have included initiatives for improved floodplain management [37].

The National Flood Insurance Program specifies that development be regulated within floodplains inundated by the 100-year flood, but in California, the Central Valley Flood Protection Act of 2008 required a higher standard (the 200-year flood) for urban areas in the Central Valley. Moreover the NFIP guidelines prohibit new construction in the floodplain unless it can be shown that it will not raise flood elevations by more than 30 cm (1 foot). While some states have legislated stricter standards, in 2004 the state of Missouri took the opposite step and “passed legislation that prohibits any county from setting any threshold stricter than the 1.0-foot limit,” thereby contributing to extensive recent floodplain development near St Louis and elsewhere in the state [33].

Management of floodplains has been widely recognized as an example of shared governance, with the federal government providing funding and oversight, “but subnational governments actually operate the programs... and there can be basic disagreement over objectives and means for reaching objectives... Such intergovernmental partnerships are often unstable and sometimes impossible to consummate.” [23]. The Mississippi especially has been recognized as suffering from poor coordination amongst various levels of government, as noted by Sayers et al. [35]: “The reluctance of all levels of government to concede strategic authority and the resources, fearing federal government take-over and a reduction in local influence on decisions, continues...to undermine good longer-term planning. There is a tendency to address issues on a yearly basis with little attempt to coordinate succeeding annual efforts.” The fact that the State of Missouri filed suit to block use of the New Madrid Floodway in 2011 is consistent with Sayers et al.’s [35] characterization of dysfunction in the relations among national, state, and local governments along the Mississippi.

7. National-local land-use conflicts in 18th century China: a comparison

The conflict between national and local interests over floodplain land use is not new, nor has it been restricted to the US. Essentially the same conflicts were documented on the Yangtze River floodplain (China) during the Qing dynasty, as summarized by Perdue [32]: “The maintenance and construction of major waterworks projects was an important function of the Qing state. Officials did not usually undertake large projects on their own; they commonly relied on the cooperation of local elites and landowners. Officials from provincial governors down to assistant district magistrates took responsibility for overall planning and supervision of waterworks, but contributions by the local

wealthy landowners affected by a project relieved the state of heavy fiscal burdens... Subsidies from the state treasury and official coordination of waterworks projects were beneficial to local people, but the narrower objectives of local landowners could cause them to come into conflict with officials who embraced a wider regional outlook...

“...Officials perceived that excessive land clearance and dike building threatened to cause disastrous flooding” by eliminating accommodation space for floodwaters, causing flood levels to rise, making “...the dikes more vulnerable and floods more destructive when they occurred. The officials' solution to the problem was to order the destruction of the newly built dikes and the elimination of the newly cleared land, but these measures contradicted the interests of the landowners who had invested capital in the land. These landowners had many ways of sabotaging official policies. They could ignore unwelcome edicts, coopt local officials into concealing the cleared land, or raise a smokescreen of lawsuits to confuse the issue. In the end, officials were unable to stop the dangerous land clearance and dike building” [32] because local landowners had grown so powerful during the prosperity of the 18th century that they were able to prevent implementation of the central government's policy to maintain floodplain areas to predictably accommodate floods. As a result of the encroachments into the floodplain, the floods of 1788 were disastrous, with multiple levee breaks and uncontrolled flooding.

It is striking how similar the conflicts from the 18th century Yangtze River floodplain seem for the 21st century Mississippi River floodplain. National policies were largely implemented at the local level with financing from the central government. However, national policy to maintain accommodation space for large floods was undermined by well-heeled local interests who sought to profit from building dykes and using the land thereby ‘protected’, and who employed stratagems used today, such as lawsuits and coopting local government officials, to block or circumvent national policies prohibiting development of flood-prone lands.

8. Improving floodplain land use

Following the disastrous 1993 Upper Mississippi flood, a federal interagency floodplain management review committee identified problems with state and local levels of government taking responsibility for floodplain management as a key impediment to controlling building in flood-prone areas, entitling its report *Sharing the Challenge* to emphasize the need for the responsibility to be shared among all levels of government and other actors [14]. The committee concluded that, “The federal government certainly must provide leadership and be a financial supporter of appropriate activities. States, and, as delegated to them by the states, communities, must accept responsibility for land-use planning and should be guiding development in the floodplain.” [11]. The question is how to motivate local governments to enforce land-use controls on flood-prone lands, or to discourage individuals from building in these areas.

Passage of the Biggert-Waters Flood Insurance Reform Act of 2012 started to phase out some of the federal flood insurance subsidies, with the long-term goal that property owners will pay the full actuarial rate for their flood insurance. To reduce the abruptness of premium rate increases, the Homeowner Flood Insurance Affordability Act of 2014 delayed or softened implementation of some of the features of Biggert-Waters [28]. Even with the delayed implementation of some premium increases, these recent federal reforms are expected to create disincentives for individuals to develop in such flood-prone areas.

An alternative to the existing system is community-based flood insurance, which would involve a single insurance policy for an entire ‘community’ (e.g., town or city). Although there are many issues that would need to be resolved before implementing community-based flood insurance, there is already a precedent under the NFIP to incentivize floodplain management measures, the Community Rating System, which had 1,400 communities participating as of 2014 [28].

In the US, national efforts to reduce flood losses have been largely limited to the NFIP and federally subsidized construction of dykes, dams, and channels, which are rarely integrated with water-quality and environmental goals [37]. In contrast to this lack of national-local coordination in the US, ongoing implementation of the recently adopted Floods Directive in the European Union requires systematic mapping of flood risk in all member states and development of flood risk management plan including measures to reduce the risk, such as land-use controls on floodplains. These measures must be integrated within the context of the Water Framework Directive, which set requirements to improve water quality and ecosystem health [37]. The Floods Directive is a top-down approach that would likely encounter political resistance if proposed in the US context, but could probably more effectively prevent construction on flood-prone lands.

9. Conclusion

The basic conflict between national and local interests in floodplain management is not unique to the US situation, nor to our time, as noted above [32]. Conflicts over land-use management on floodplains has been previously considered (e.g., [3,10,12–14,33]). However, the examples presented in this paper are especially compelling because of their implications for the functioning of a national-scale flood management system. The New Madrid and West Atchafalaya floodways are essential components of a river-wide system to manage floods on a large, inter-state river, whose operation reflects national interests. Despite having been compensated for flowage easements, landowners in the New Madrid Floodway objected to inundation of their lands, and through their elected state representatives, attempted to prevent operation of the bypass during the 2011 flood, and have sought to prevent backwater flooding during smaller floods. Despite the government’s flowage easements, there has been a three-fold increase in residential and commercial development within the West Atchafalaya Floodway since the late 1960s. These new buildings are permitted by local jurisdictions under their land-use authority, but these local decisions have potential to compromise effective operation of a flood-control system of national importance. Although the NFIP was designed to prevent additional floodplain development, in its implementation it has failed to do this in many cases.

As observed by the Interagency Floodplain Management Review Committee (1994), the federal government has an important role, but state and local governments must “share the challenge” and make responsible land-use decisions to reduce long-term risks. If not, loss of life and flood damages will continue to worsen in future floods.

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Conflict of interest

The authors declare no conflicts of interest in this paper.

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