Background reading for the

Gilbert F. White National Flood Policy Forum

2007 Assembly

Floodplain Management 2050

George Washington University
Washington, D.C.

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Hosted by the
ASFPM Foundation

Sponsored by
AMEC Earth & Environmental; Black & Veatch; CDM; Dewberry; Greenhorne & O'Mara; H20 Partners; Michael Baker, Jr., Inc.; PBS&J; Reznick Group, P.C.; URS Corporation; Watershed Concepts; The Widgeon Foundation

About the Gilbert F. White National Flood Policy Forum

To facilitate national policy discussions on important floodplain management issues, the ASFPM Foundation sponsors an annual gathering of leading experts in the field of flood policy and floodplain management. These Forums will develop policy recommendations and establish an ongoing record of flood policy issues and directions for the future. The Forums have been named in honor of Gilbert F. White, the most influential floodplain management policy expert of the 20th century. The Forums are not only a tribute to his work, but also a recognition of the success of his deliberative approach to policy analysis and research.

Periodically, the Forum will explore one pressing national flood policy issue by facilitating a dialogue among about 80 topical experts, representing various stakeholders, including government, industry, and academia. The goal of each Forum will be to provide recommendations for policies that will reduce the human casualties and economic losses associated with flooding, as well as policies to protect and enhance the natural and beneficial functions of floodplains.

The discussions and recommendations for action and research formulated at each Forum will be summarized and distributed as a report by the ASFPM Foundation.

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INTRODUCTION

In his ground-breaking dissertation, "Human Adjustments to Floods," Gilbert F. White clearly articulated the idea that people would need to adjust and/or adapt in a variety of ways if they were to live successfully with the risk of flooding and with the natural resources and functions provided by floodplain areas. This concept of "human adjustment" to natural phenomena—in contrast to the alternative of controlling flooding or living completed insulated from nature—has stood the test of time and stands unequalled in the literature of human/land interaction.
The human adjustments listed by White, in contrast to the prevailing vision of the day, urged behaviors that went beyond flood control, introduced how land use management could be used to minimize flood damage, and introduced behaviors designed to respond to or manage individual risk. Specific human adjustments advocated by White were

- Elevation
- Flood Abatement (known today as watershed management)
- Flood Protection (known today as structural flood control)
- Emergency Measures
- Structural Adjustments (known today as adjustments to buildings and infrastructure)
- Land Use
- Public Relief
- Insurance

Sixty-five years later, the United States has in place a framework of mechanisms to cope with its flood hazard, incorporating to some extent all of the adjustments White listed. However, much has changed in the ensuing decades and it appears that additional—perhaps more drastic and more rapid—changes lie just over the horizon.

Over the next few decades, as the United States grows by 100-million people, the impacts of climate change are felt, and other hurdles arise – ranging from shrinking discretionary federal spending to housing affordability to seriously damaged ecosystems–our exposure to flood losses will increase**.** In the year 2050, will we be prepared for this new reality?

The 2007 Assembly

The challenge facing the second assembly of the Gilbert F. White National Flood Policy Forum is to determine what human adjustments to flooding will be adequate and appropriate in 2050. Will the eight classes of adjustments originally offered by White also apply to that future world, or are there others that should be cultivated now?

Over 40 brief invited papers on this topic have been collected within this document, roughly grouped into eight categories. These background papers set out the thinking of experts in the field as they ponder the future of floodplain management, and will underlie the discussion at the assembly of the Forum.

1. **Anticipated Changes related to Flood Risk by 2050**
   What types of alterations in the social, political, economic, and environmental fabric will have an impact on flood risk and how we ought to manage it in 2050?

2. Insurance as an Adjustment

How well is the flood insurance mechanism as is it currently operating serving us as an adjustment to flood risk? What are the implications of that model of flood insurance for federal budgets and for the economy as a whole?

3. To Occupy or Not to Occupy, Act One
Land Use as an Adjustment

The patterns of land use that have emerged over the past several decades have presented greater challenges to the management of floodplains than White probably could have imagined. What does this adjustment mean today?

4. To Occupy of Not to Occupy, Act Two
Natural Functions and Resources

An increasingly important factor in managing flood risk is the recognition that the natural resources and natural functions of floodprone areas—riparian, coastal, estuarine, wetland—in many cases serve humans better by being left in a natural state. What does this mean for "wise use" of floodplains?

5. Elevation, Building Standards, Infrastructure, and Flood Control

These adjustments have been used in a range of ways and in different combination. What lessons have been learned and what are the prospects for the future applicability of these techniques?

6. Understanding, Delineating, and Communicating Flood Risk

The adequate transmission of accurate and meaningful information about the flood hazard was a difficulty not addressed in White's list of adjustments, but has emerged as an enormous underlying challenge in effecting appropriate human action in response to the risk. New ideas and new technology promise improvement.

7. Vulnerability Reduction

All of White's adjustments were aimed to some extent at minimizing vulnerability. Today, however, a more holistic approach is being adopted, "mitigation" is an accepted overall goal, and the prospect of large-scale changes to make dramatic reductions in vulnerability are being discussed with more seriousness, particularly in low-lying coastal areas that face threats from changes in relative sea level.

8. Improvements to the Mix of Adjustments

Finally, there is always room for improvement, particularly in the way adjustments to flood hazard are combined, or operate in isolation, or result in unanticipated outcomes. A few fundamental changes in existing adjustments could yield great dividends in the future.

2007 ASSEMBLY OF THE
GILBERT F. WHITE NATIONAL FLOOD POLICY FORUM

"Floodplain Management 2050"
Marvin Center, George Washington University

P R E L I M I N A R Y A G E N D A

Tuesday, November 6, 2007

1:00-1:45 pm **Welcome and Introductions – 3rd floor amphitheatre**
Larry Olinger, President, ASFPM Foundation, Dewberry
Participants (brief self-introductions)

1:45-2:15 pm **The Forum Topic and Process: Applying Gilbert White's Adjustment Concept to Address Floodplain Management in 2050.** Taking the eight human adjustments delineated in Gilbert White's 1945 dissertation as a starting point, the Forum will try to determine what similar—or new—adjustments will be needed to manage floodplains effectively in 2050.
Larry Larson, Executive Director, Association of State Floodplain Managers

2:15-4:15 pm **What Factors could be Driving the Management of Floodplains in 2050?** Three speakers will set the stage by describing key factors that are likely to shape a future in which floodplain resources and flood losses may need to be addressed with adjustments that differ from those of today. Questions and discussion by the Assembly.

2:15-2:50 pm **Human Factors in 2050: Population Trends, Growth, Urbanization**
Dr. Arthur C. "Chris" Nelson, Virginia Tech-Alexandria Campus

2:50-3:15 pm Break

3:15-3:45 pm **Environmental Factors and Natural Resources in 2050: Climate Change, Ecosystem Degradation, Land Use**
William H. Hooke, American Meteorological Society

3:45-4:15 pm **Government and Other Factors in 2050: Devolution Upwards and Downwards**
G. Tracy Mehan, III, Principal, The Cadmus Group, Inc., Former Assistant Administrator for Water, U.S. Environmental Protection Agency

4:15-5:00 pm **Challenges to Floodplain Management as we move towards 2050** Through facilitated discussion, the Assembly will list the broad changes expected by 2050 that will present challenges to floodplain management, and the scenarios that could evolve from those changes.

Dr. Gerald Galloway, University of Maryland
Doug Plasencia, Michael Baker, Inc.

5:00-7:00 pm: Reception

Wednesday, November 7, 2007

8:30-9:00 am **The Use of Scenario Based Planning to Guide Future Adjustments.** This example of Scenario Based Planning was done in the United Kingdom with considerations through the year 2080. Should the United States consider doing a similar effort?

Colin Thorne, Professor and Chair of Physical Geography, University of Nottingham

9:00-10:45 am **Session One (Break Out): What Human Adjustments will be Needed by 2050?**
The Assembly will divide into three groups; each group will devise a list of adjustments that it believes will be effective in managing floodplains in 2050. Groups will start with White's eight adjustments and add, subtract, or alter them as needed.

10:45-11:00 am **Break and transition to amphitheatre for feedback session**

11:00-11:30 am **Feedback Session #1.** A spokesperson from each group will present a "revised" list of human adjustments that will be needed to meet the floodplain management challenges of 2050. Discussion by the Assembly and combination of lists.

Gerry Galloway, Doug Plasencia, facilitators

11:30-1:00 pm **Lunch** *(participants' choice)*

1:00-2:45 pm **Session Two (Break Out): What Changes are needed so that Appropriate Adjustments will be Available and Effective by 2050?**
Three small groups will discuss what shifts in program, policy, funding, etc. will have to take place in order to implement appropriate adjustments by 2050.

2:45-3:00 pm **Break and transition to amphitheatre for feedback session**

3:00-3:30 pm **Feedback Session #2.** A spokesperson from each group will summarize that group's ideas about shifts in program, policy, and other matters. Discussion by the Assembly and combination of lists.
Gerry Galloway, Doug Plasencia, facilitators

3:30-4:10 pm **Session Three (Plenary): An Action Plan for Floodplain Management in 2050**. The Assembly will catalog its recommended modifications to programs and policies, along with needs for data, research, and funding.
Gerry Galloway, facilitator

4:10-4:30 pm **Wrap Up** Next steps to be taken by the ASFPM Foundation, the ASFPM, and others to advance the recommendations made by the Assembly. Discussion of possible topics for the next Assembly of the Forum.
Larry Olinger and Larry Larson

4:30 pm **Adjourn**

HUMAN ADJUSTMENT TO FLOODS—2050

Doug Plasencia, P.E., CFM
Michael Baker, Jr.

Introduction

In his ground-breaking dissertation, "Human Adjustments to Floods," Gilbert F. White clearly articulated the idea that people need to adjust and/or adapt in a variety of ways if they were to live successfully with the risk of flooding. This concept of human adjustment to natural phenomena—in contrast to the alternative of controlling flooding or living completely isolated from nature—has stood well the test of time. The concept stands unequalled in the literature of human/land interaction and indeed is shared among many other fields and disciplines ranging from resource management to the forces that govern a capitalistic economy. In all of these cases layered, adaptive behaviors tend to be more sustainable and generally out perform systems governed by single purpose, regimented controls. The challenge facing the second assembly of the Gilbert F. White National Flood Policy Forum is to determine which human adjustments to flooding will be adequate and appropriate in 2050. Will the eight classes of adjustments originally offered by White also apply to that future world, or are there others that should be cultivated now?

The human adjustments prescribed by White, in contrast to the prevailing vision of the day, urged behaviors that went beyond flood control to introduce how land use management could be used to control flood damage along with concepts designed to respond to or manage individual risk. Specific adjustments delineated by White were

- Elevation
- Flood Abatement (watershed management)
- Flood Protection (structural flood control)
- Emergency Measures
- Structural Adjustments (adjustments to buildings and infrastructure)
- Land Use
- Public Relief
- Insurance.

White did not advocate a wholesale retreat from the floodplain, recognizing the importance that such areas could play in meeting human needs, but rather he proposed a series of strategies that humans could deploy in order to reduce their vulnerability to flooding. These eight adjustments became the foundation of modern floodplain management programs and in 2007 remain the building blocks for flood risk management.

Emerging Trends

When considering the year 2050 and whether the eight adjustments are adequate or relevant it first is necessary to consider some of the changes facing the United States that will shape that future.

Population. According to U.S. Census estimates, by the year 2030 the population of the United States will have increased by 82 million to total 380 million people in the nation. Half of this growth is expected to occur in four states: 12 million additional people *each* in Florida, Texas, and California, and an additional 5 million in Arizona.

Density of Development. In 1940 it was estimated that there were 37 million homes in the United States. In 2050 there will be over 150 million. In 1940 this represented a density of 10.5 homes per square mile in the lower 48 states, compared to over 43 houses per square mile in 2050. Although this does not take into account our tendency to cluster development, it demonstrates starkly just how much more land we will occupy in the future and the increasing pressures that will bring to bear on our watersheds and floodplains.

Economics of Housing. Assuming that housing affordability will continue to be an issue, creative solutions such as those recently experienced in the sub-prime mortgage market will continue to resurface or the trend towards longer and longer mortgages will increase. Today in California it has been reported that 50% of all mortgages are interest-only, meaning that the borrower is not paying down the note's principal. The net impact of this is increased fragility of financial markets that are tied to housing, longer risk exposure for lenders while the loan is being repaid, and increased personal risk as home ownership takes on a larger and larger proportion of many personal balance sheets. Flood or flood-related loss, depending on the extent of the damage, clearly will have increasing personal and societal economic impact.

Digital Data and Processes. As a society we have become increasingly reliant on all types of digital data and digital transactions that lead to the creation of more data. There is no doubt that by the year 2050 this reliance will have grown many-fold. In 1940 records were stored onsite and transactions tended to take place in the neighborhood and were not part of a "world wide web." However, digital data is not a resource unto itself, but is a human practice that has changed the way we manufacture, communicate, and live and has become part of the next generation of infrastructure on which we rely to live and conduct business.

The impact of digital data and digital infrastructure is every bit as revolutionary as human advancements in transportation and manufacturing were in their time. As demonstrated in the aftermath of the 9-11 attacks, perhaps one of the success stories was the planned-for redundancy in our financial systems. Had the Federal Reserve, banks, and companies trading on Wall Street not invested in these contingencies, the short-term delay in market operations could have been long term and the subsequent economic downturn, fueled by even more uncertainty and caution, could have potentially been catastrophic. A century ago, when individuals were more tied to the family farm, or their economic life was contained on "Main Street," the loss of a central financial data system, would have had much less impact than it does today.

These data vulnerabilities extend beyond our financial records but in too many cases businesses and governments store their data today in much the same way they managed paper files in 1940—the only difference being that the extensive on-site paper files have been replaced by an air-conditioned server room or perhaps reside in a half-dozen desktop towers. Unlike a paper record that might be salvaged, these digital records, if compromised, may be virtually useless. Yet, at the same time if the are properly stored and protected they yield unparalleled flexibility for cost effective, safe storage and access that ultimately provide individuals, commerce, and government a critical component in their recovery and continuity.

Resource Degradation The emerging trend that will have perhaps the greatest impacting is the accelerated pace at which we are losing estuaries and depleting fisheries, to mention two critical water-based natural resources. Population growth is fueling floodplain encroachments, pollution, the depletion of fresh water that can be key to these ecosystems, and in the case of coastal Louisiana the loss of marsh land to open the encroaching Gulf of Mexico. In 1942 and before, the world had dealt with micro-environmental disasters that surfaced as public health problems or in land-based conservation issues (most notably excessive soil erosion from farmlands). However in 1942 the development (not preservation) of water resources was still the prevailing notion and the seemingly abundant riparian areas and estuaries were in essence mined to provide for economic and population growth. Since then, in the public's eyes conservation and protection of environmental resources has been primarily about aesthetics, recovery of iconic resources (e.g., bald eagles), or controlling public health problems. We continue to use permitting systems as a primary means of protection, but in the end these permits focus on a limited individual impact and in reality amount mostly to a sanctioned degradation of the resource. Management programs on public lands are limited due to funding, and management programs on private lands only affect a small portion of the total resource.

Today we perhaps are just beginning to realize the real consequence of these decisions, but from a policy perspective may not yet understand the economic consequences. With climate change impacts upon us we are just beginning to see and understand the wholesale migration of flora and fauna that will take place. For nature, this migration is nothing more than another successional change. In the arctic regions some of the species may go the way of the wooly mammoth or be isolated to geographic areas that are a fraction of the size of what they once roamed, yet in the end nature will adjust. The problem is that these changes take time and at the very point at which we need to reverse human impacts on the land and water, the consequences are being accelerated because the systems are facing climatic stressors.

Human Adjustments in 2050

The eight classes of adjustment proposed by Gilbert F. White in 1942 provided the foundation for modern floodplain management and will serve as cornerstones in 2050. However, the changing world and societal needs over this 100-year period might require the consideration of two additional classes of adjustments.

The first proposed addition to these classes is **Natural Resource Sustainability**. At the time White offered his initial adjustments, the perception was that the United States had an excess of "environmental" resources and, because of the smaller population, apparently abundant open spaces. Society was focused on improving life via technology. The need to conserve and protect natural lands and their functions was less important and, for that matter, society gladly exchanged these resources for growth and development. White would have considered these natural functions broadly in what he termed "factors," but in 1942 natural resources were still very abundant.

Since that time our water, riparian, and associated resources have been gradually used up, altered, and degraded—ironically to enable two of the very trends (population growth, density of development) that now are further threatening them. Today in some areas fisheries of international renown are gone, water supply has reemerged as a pressing problem, and we are on the brink of losing resources such as the Louisiana coastline that are economically important, serve flood protection and natural resource needs, and are culturally iconic. For the future we

should acknowledge our natural resources as part of our human occupance of the land (floodprone or not), and recognize that our occupance can be negatively and positively affected by flooding. We need to introduce a class of adjustment tied to benefiting these ecosystems and natural resources and to ensuring their viability in the long term.

The second proposed addition to the human adjustments to flooding is **Geographic Continuity and Interdependence.** To a large degree White's adjustment classes, taken as a whole, suggest continuity but their implementation has for the most part been focused on a specific structure or community. With ever-increasing specialization, eased transportation, enhanced communication, and the explosion of digital data and its easy transfer; our society is becoming intricately linked. This has created not only efficiencies but also vulnerabilities—some related to national security, some related to global economies, and others related to individual livelihood. Flood damage to an industry is no longer a relatively isolated event; instead, the ripples are felt hundreds if not thousands of miles away. In the meantime, our nation continues to move closer and closer to some of our most flood prone areas. Geographic continuity and interdependence is a two fold recognition for those that host businesses within flood-prone areas and for those that rely on those businesses. For 2050 it appears that our nation will be ever more specialized and interdependent both locally and globally.

Conclusion

In the year 2050 population growth and all of the associated impacts will put increased pressures on the floodplains. Gilbert F. White's 1942 dissertation, with its eight classes of human adjustment, still provides the framework for modern floodplain management. What will be needed in 2050, however, is continued evolution of a flood risk management strategy coupled with more aggressive action to manage and conserving natural floodplain and estuary resources. As such, the eight adjustment classes may require expansion to ten, with the next two factors being natural resource sustainability and the second geographic continuity and interdependence. These recommendations are offered not as an absolute conclusion, but rather as a concept and invitation to those knowledgeable about flood policy and the work of Gilbert F. White to engage in a discussion about the need for, relevancy, and appropriateness of such additional adjustments.

Part 1

Anticipated Changes related to Flood Risk by 2050

ANTICIPATING CHANGES IN FLOOD RISK TO 2050

Scott Edelman, Cheryl Johnson, and Kevin Coulton
Watershed Concepts

Introduction

"Flood risk" can be a difficult concept to describe and more difficult yet to visually display and understand over a large land area such as the United States. One definition of risk is "the possibility of suffering harm from a hazard" (Cohrssen and Covello, 1989). The determination of risk can come from an analysis that accounts for the magnitude of the harm—based on the vulnerability of people and property to a hazard—and the probability of the harm occurring (Deyle *et al*, 1998).

In recent years FEMA has made an effort to quantify flood risk on a national basis to establish a better understanding of this particular risk and to utilize this information to help determine which areas of the country should be prioritized in receiving flood maps through the Map Modernization Program (FEMA, 2006). FEMA's approach was to analyze flood risk at the Census-block group level using a geographic information system (GIS). Flood risk is associated with risk parameters that are intended to represent the broad characteristics of flooding that affect people and local economies, as well as property. The identification of a relative ranking of flood risk for each of the 211,684 Census block groups in the nation (Figure 1) is expected to provide an improved basis for FEMA to make decisions on mapping priorities at the regional, state, and local levels.

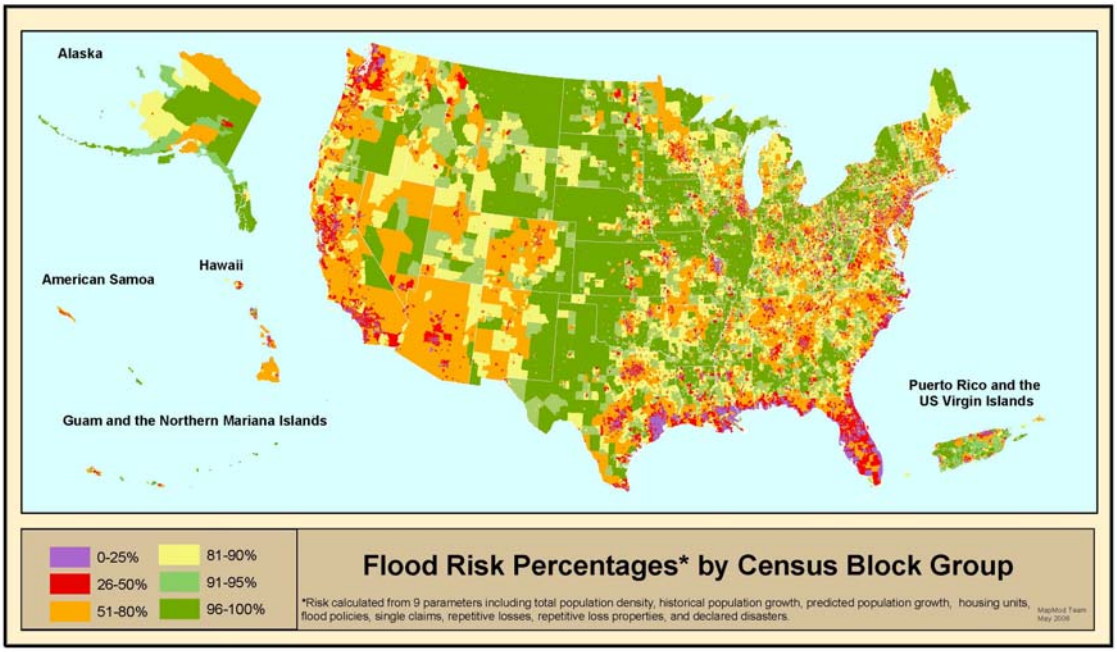

Figure 1. National Flood Risk by Census Block Group
(FEMA MHIP version 2.0, chapter 3, pp. 3-4)

This "National Flood Risk" spatial database is intended to be periodically updated as flood hazards, human vulnerability, and flood risks change in the U.S. over time. This paper presents considerations for how these data may be modified over time to account for changes and guide policies and programs for the management of flood risk to the year 2050.

Changes in Flood Risk

FEMA's current definition of flood risk is associated with nine risk parameters based on data from the U.S. Census Bureau, the Federal Insurance Administration (FIA), and other sources. A listing of these parameters and the "issues of change" suggested by the ASFPM Foundation for discussion in this forum is shown below. Note some of these variables are not exclusively independent of each other and therefore generate a weighting of similar factors.

Flood Risk Parameters
Declared Flood Disasters
Population Density
Population Growth 1980-2000
Population Growth 2000-2010
Housing Density
FIA Policies
FIA Claims
Repetitive Loss Claims
Repetitive Loss Properties

Issues of Change
Population Growth
Social Factors
Federal Budgets
Hurricane Katrina
Climate Change
Risk Communication
Technology
Transportation and Critical Infrastructure
Natural Resource and Environmental Issues

Given this framework, the following considerations are provided for how FEMA's current definition of flood risk may be modified over time to account for potential changes and support future floodplain management needs to the year 2050:

1. **Population Growth** – The Census Bureau provides projections to 2050 but only down to the state level. Population growth has been accounted for as a risk parameter but a consistent dataset of projected population for the nation was available only to the year 2010 at the county level. Efforts could be made to contact individual state demographers for county or block group projections or data may be extrapolated to 2050 to refine flood risk forecasts.
2. **Social Factors** - Aging populations may lead to increased flood risks where the elderly are more vulnerable and require additional evacuation and emergency response needs; Census data on the U.S. elderly population (age 65+) can be incorporated to better define this component of flood risk.
3. **Federal Study Budgets** – The potential impact of various funding levels for map modernization maintenance will have a dramatically different affect in various portions of the nation. For example, an area that may need a high cost study that could affect a significant portion of the population may not be performed if sufficient funds are not available.
4. **Climate Change** – FEMA's flood risk data is currently a planimetric representation of risk derived from two-dimensional data. To better assess relative sea level change impacts from climate change (i.e., sea level rise coupled with land subsidence/uplift considerations) it would be advantageous to incorporate topographic data to estimate changes in inundation areas and flood risk out to 2050.

Summary

The "National Flood Risk" spatial database is a very powerful resource that can be used to help determine how floodplain policies and programs might be altered by 2050. If the currently defined flood risks were to be expanded to include the above considerations, and other considerations, the end results of policy decisions made today will have a greater impact on society in the year 2050.

References

Cohrssen, J.J. and V.T. Covello, 1989. Risk Analysis: A Guide to Principles and Methods for Analyzing Health and Environmental Risks, Washington, D.C., Council on Environmental Quality.

Deyle, R.E. S.P. French, R.B. Olshansky, and R.G. Patton,1998. Hazard Assessment: The Factual Basis for Planning and Mitigation, in: Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities, R.J. Burby editor, Joseph Henry Press, Washington, D.C., 356 pp.

FEMA, 1996. FEMA Map Modernization: National Flood Risk and Regional Funding Distribution for FY06-FY08, Version 1.4, August 30

THE ARID REGIONS IN 2050

Kevin Houck
Colorado Water Conservation Board

The arid regions of the United States have, in recent years been quietly recognized as one of the two fastest growing areas of the country (the coastlines being the other), a trend that is expected to continue. Due to the high profile of their hazards, which include elements not common to standard riverine flooding, coastal counties have received special attention for some time, and justifiably so. These areas have been further thrust into the spotlight in recent years due to heavy tropical seasons in 2004 and 2005.

The flood risk in arid regions has in many cases been a low profile concept. It is also often poorly understood by citizens and local governments, and it is often demoted to a "back burner" problem in favor of more political issues, such as water supply. The extent of the "arid regions" is a moving target as there is no exact method of defining what makes a region "arid." The generally accepted definition includes all lands with average annual precipitation less than 20 inches. Although mountain ranges in arid regions do not meet this definition, they are often included in the discussion of arid regions as they are often critical in the supply of water, species habitat, and in many cases flooding sources for nearby dry areas. This definition would include the entire states of Nevada, Idaho, Arizona, New Mexico, Utah, Colorado, Wyoming, and Montana, as well as parts of Washington, Oregon, California, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. By strict interpretation of the criteria, parts of Hawaii and much of Alaska would also be included, but they are often left out of the "arid regions" discussion. When arid regions issues are discussed, the region of the country most often considered is the southwest, from southeast California to the four corners states of Utah, Arizona, Colorado, and New Mexico.

The Arid West has been experiencing a population explosion for the past 30 years. This is expected to continue and, in some cases increase in the coming decades. According to projections offered by the U.S. Census Bureau, the West will be the largest growth rate region in the country (in terms of growth percentage) up through the year 2030. With an anticipated annual growth rate of 1.7% as a region, this will enable the West to well surpass the Midwest as the second-largest region of the country behind the South. For the period 2000-2030, population projections indicate that five of the six fastest growing states are located in the Arid West (only Florida is outside the region). Indeed, two of these western states (Arizona and Nevada) are predicted to double in population during this short period.

Besides the fact that this burgeoning of population will result in significant development pressure in general, a number of factors unique to the West make this area even more threatened. First, due to the topographically diverse nature and high federal ownership of lands of the region, there is limited room for development. Second, a number of natural hazards relatively, although not exclusively, unique to the region. These include alluvial fan flooding, mudflows, debris flows, and ice jams, although no hazard is more significant to the Arid West than the drought-wildfire-flood cycle.

As the West explodes in population and development pressures increase, it is anticipated that infrastructure will shift somewhat from safe building sites to more marginal sites. With little or no attention placed on these unique hazards, many newcomers may find themselves subject, for example, to an alluvial fan flood because the hazards associated with that fan are not found on any Flood Insurance Rate Map. While local officials in largely populated areas often have the technical sophistication and resources to address these hazards, in the large majority of small and medium-sized communities, there are no provisions whatsoever to address these unique hazards. More attention must be given to these hazards in the coming years as a larger percentage of the nation's population becomes at risk to them.

One area of extreme concern in the Arid West that will require multi-disciplinary cooperation to develop solutions is the drought-fire-flood cycle. A number of circumstances have converged in recent years to make this perhaps the biggest flood problem currently present in the Arid West. First, the West continues to struggle with a multi-year drought. This drought has been characterized by the following:

- High temperatures—For example, Phoenix, Arizona, recorded an unprecedented 31 days at or above 110°F in 2007 breaking the old record of 27 days last set in 2002. While some of this is explained by the heat island effect present around the weather recording station at the Phoenix airport, it is also indicative of a much warmer climate in the short term. The World Meteorological Organization indicates that 2005 was the warmest year on record followed by 1998. This trend is anticipated to continue, although the magnitude is hotly debated.
- Relatively low precipitation—In 2002, Denver, Colorado, recorded its driest year since weather records began being kept in the 1870s. 2002 was also the driest year in Phoenix, Arizona with only 2.8 inches of rain recorded. Los Angeles recorded its driest year on record in the 2006-07 water year despite the presence of a Pacific El Nino event, which normally results in a wet seasonal pattern for the southwest.
- Dropping reservoir levels—Lake Powell, perhaps the most representative reservoir of the Arid West as a whole, has dropped to its lowest level since 1980. It currently sits at about 40% of capacity, with many long-term projections suggesting it could drop even further, precipitating a full-blown "water war" between the western states. A further illustration is Lake Mead, which has dropped to its lowest level since 1965.
- Insect infestation—Many drought-stricken forests throughout the West are currently experienced epidemic infestations of beetles that have the ability to weaken and kill large stands of trees. The only natural solutions to kill these insects are through drought reversal or extreme cold snaps, which have been less common in the past decade. Once these stands of trees are killed, they further add to the wildfire fuel that threatens to ignite.

Second, fire management policies have been shifted in recent decades with apparently disastrous outcomes as a result. For the past 30 years, fire suppression policies throughout the West have been the norm. These policies interrupt the natural cycle of fires by attempting to quickly put out fires that do erupt with little or no wildfire mitigation activities performed between events. While the opposing "Healthy Forest" initiatives are gaining momentum, it still may be some time before these mitigation activities erase the decades of unnatural fuel buildup that have occurred in the West.

The result of these conditions has resulted in the worst fire decade on record for the Arid West. Consider the following statistics:

- In eight(!) western states, the largest fire on record (or in some cases, the past 100 years) has occurred just since the year 2000. These include:
  - New Mexico: Cerro Grande Fire, 2000, 63 square miles (notable because it originated from a National Park prescribed burn that became out of control)
  - Arizona: Rodeo-Chediski Fire, 2002, 723 square miles; seconded by Cave Creek Fire, 2007, 388 square miles
  - Oregon: Biscuit Fire, 2002, 781 square miles
  - Colorado: Hayman Fire, 2002, 216 square miles
  - California: Cedar Fire, 2003, 438 square miles; seconded by the Zaca Fire, 2007, 375 square miles
  - Alaska: Taylor Complex Fire, 2004, 2030 square miles (note this is an area larger than the state of Delaware)
  - Idaho: Murphy Complex Fire, 2007, 1020 square miles (note this is an area larger than the state of Rhode Island)
  - Utah: Milford Flat Fire, 2007, 567 square miles
- During 2004, an incredible 10,000 square miles was burned in wildfires in Alaska. This represents an area the size of Maryland.
- Although often incorrectly not considered part of the Arid West, northwestern Texas has also experienced this problem. In 2006, the East Amarillo Complex burned in the northern Texas panhandle burning 1,417 square miles.
- As of the time of this writing, the largest tundra wildfire on record continues to burn in northern Alaska. The Anaktuvuk River Fire has already burned over 400 square miles. Tundra wildfires, which may become more prevalent in the coming years, are of particular concern to climatologists because they have the ability to melt permafrost and can release massive amounts of carbon dioxide, which could further exacerbate climate change potential.

The end result of these fire scars is a much increased threat of flooding and debris flows for an indeterminate period of time. This increased flooding risk caused by the removal of vegetation and scarring of the soil is often severely heightened for the first flood season following the fire with a gradual recovery, which may extend out as long as fifty years. For most post-fire watersheds, it is generally assumed that the watershed will substantially (though not completely) recover hydrologically five years after the fire. This length varies based on the severity and coverage of the fire itself.

The flood following the Buffalo Creek fire in 1996 in Colorado provides a stunning example of the new threat of flooding created in the wake of a wildfire. While not a large fire in terms of areal extent, the Buffalo Creek fire was an intense burn that decimated the Buffalo Creek watershed, southwest of Denver. The flood that followed three months after the fire was triggered by a 100-year rainfall. However, the flood that occurred was stratospheric in nature for the watershed. The 100-year flow from the Flood Insurance Study at the mouth is 630 cfs; the post-fire flood that occurred was 17,100 cfs. This means that a 100-year rainfall event initiated a flood *27 times the 100-year flow*. This fire completely destroyed the unincorporated town of Buffalo Creek, with a high water mark six feet high on the town's fire station, rendering it

completely useless. Before the flood, none of the town's structures had been considered to be in the floodplain.

Another example of the lingering flood and debris problem can be seen downstream of the Hayman Burn area, the largest wildfire in Colorado history. Nearly five years after the devastating burn, roads and culverts continue to be washed out by sediment generated during even moderate rainstorms. In fact, the costliest flood since 1999 in the State of Colorado occurred in 2006 downstream of the Hayman Burn area in Douglas County, Colorado, four years after the fire. This flood resulted in $15 million in damage, although no federal disaster was declared because the majority of damage was to federal facilities.

Douglas County has taken a unique proactive approach in responding to the threat of post-wildfire flooding. As of this writing, they are the only community in the country to formally adopt a post-wildfire floodplain study and request its inclusion on the official Flood Insurance Rate Maps for the community. Because this is an increasing problem throughout the Arid West, this approach merits further consideration. Although this policy of using post-wildfire flood conditions has been suggested to many communities in the wake of a fire, only one has adopted it thus far. Other local communities have responded that their reluctance to adopt this information is the result of two sets of uncertainties. First, watershed recovery times vary, although the threat of flooding is often drastically reduced after five years. Of greater concern is the fact that FEMA has not demonstrated in past years a successful track record in keeping floodplain maps up to date. Indeed, in many areas of the Arid West, floodplain maps more than 30 years old that are still effective are somewhat common. Local officials are concerned that if they place post-wildfire conditions on effective Flood Insurance Rate Maps, they could potentially be burdened with restrictive floodplain management regulations and onerous flood insurance requirements long after the increased threat has passed. Local officials often balk at the Letter of Map Revision process, citing its slow, difficult process as a barrier to its use to address this problem. One solution to this problem could be the introduction of a new, temporary flood zone with a predetermined sunset date. Many local officials have indicated that if such a resource was available, they would likely have a much easier time adopting the post-wildfire conditions, which they consider the right thing to do.

A greater solution to the problem is better management of forest resources. This is not simply a timber or forest resource problem. Large wildfires also result in environmental degradation and flood potential and in some cases, a significant threat to municipal water supply. Floodplain managers must be supportive of holistic watershed protection plans and projects that extend all the way to the headwaters, which is essential to protect downstream communities. This should include a "Healthy Forest" approach with fire management techniques that include a variety of tools, not just fire suppression. Most critically, work on this must include input across disciplines. This is critical to flood mitigation efforts throughout the West. Without this, flood potential could skyrocket in the arid regions due to increasingly devastating wildfire scars along with the ongoing population explosion in the area.

MUSINGS ON THE HYDROLOGY OF THE FUTURE

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Forecasting the characteristics of flood impacts in the year 2050 is certainly speculative, but there are some trends that are becoming evident and some past history that one should consider in making such an attempt.

Global Warming

It is a fact of 2007 despite what some of our political leaders tout. Science has proven it time and again. There is strong evidence of the polar ice caps receding as are the glaciers in Alaska, the U.S. Cascades, and the Andean mountains of South America. Sea levels have positively been noted as increasing and the frequency of occurrence and severity of storms is increasing. Severe shoreline erosion is occurring as we speak along the Atlantic coastline of the Maritime Provinces of Canada and far northern animals are severely threatened due to the loss of sea ice. In Alaska, melting of the permafrost is disrupting the lives of indigenous peoples in many coastal communities through excessive shoreline erosion. The disruption and loss of normal living patterns is particularly problematic to those persons who are faced with subsistence living under even normal conditions. And, in spite of all of these facts, the United States is still one of the greatest, if not the greatest, contributor to greenhouse gases and continues to resist signing of the Kyoto Accords.

That being said, there seems to be an international upwelling of consciousness on the parts of people that in fact global warming is a problem and one that must be addressed. While this movement in many cases is at the grassroots level, there is evidence that it is beginning to trickle up to governments. Globally, industrialized nations are beginning to recognize and address the need for incentives promoting the use of more fuel efficient cars and disincentives for those vehicles that are not efficient. Many communities are adding infrastructure for various forms of mass transit and enhancing existing facilities. Incentives for use of high efficiency appliances and lighting fixtures are prevalent. More emphasis is being placed on cleaner sources of electrical power. It is fast becoming recognized that we can no longer continue to hide our heads in the sand and ignore the benefits of nuclear power generation. The technology for this form of energy production has made it very safe. The lessons of 3-Mile Island and Chernobyl were very strong but they have not been ignored. And other clean sources of energy are continually being developed and enhanced, such as geothermal, wind and tidal energy.

Once found only in academia, the concept of lessening humanity's carbon footprint is now coming to the forefront, not only in university settings, but in industry and in the market place as carbon credits are bought and sold at the international level. The idea of carbon sequestration, thought to be esoteric only a few years ago, is now an accepted principle that will bear an international growth in acceptance.

Land Use
Past trends in land use have seen huge areas of open space and farmland turned into suburban and urban subdivisions, office parks, and commercial developments with the resulting increases in rainfall runoff and flood levels. The past half-century housing boom fueled by continued appreciation in the value of land and housing has contributed to this "urban sprawl" far more than just the growth in population.

But there are some reversals in these past trends in many parts of this country. Younger persons in the non-agriculturally oriented workforce are moving to or staying in the cities, particularly the large urban areas. And, they are staying there and raising their families in these urban settings rather than migrating to the suburbs as many of their parents had done. Additionally, farming is becoming more efficient, producing more on the same or smaller quantities of land. Zoning and open space preservation laws and ordinances are also helping to minimize the loss of open space or agricultural land.

Musing (or forecasting or guessing) to 2050
The expansion of cities will be more upward rather than outward. Multi-story apartments and condominiums will be on the increase. The overall impact on the hydrology of urban and suburban areas, at least in regard to riverine flooding, will be a slowing of the trend to increases in runoff. Flooding will still continue to occur, but the likelihood of it affecting more and more people is less apt to be the rule as the populations and their workspaces continue to expand either upward in high-rise or elevated buildings. Coastal flooding will likely continue to be a very big problem as the effects of global warming will take more than the next 40+ years to reverse.

Of necessity, people will need to ensure they are not located in floodplain areas as it is likely that government sponsored programs such as insurance and grants for retrofitting floodprone structures will see significant reductions in scope and application. Governments at all levels need to find ways to be more efficient and cost effective. Continuing to provide financial assistance to people to occupy floodprone areas will become less acceptable, not only to the governments themselves, but to the people that are ultimately called upon to support these actions.

In short, as we move to the age of George Jetson, the likelihood of seeing the increases to exposure of flooding will not occur and may tend to actually diminish, particularly in riverine areas. Impacts in coastal floodplains are very difficult to predict. In 2050 we likely will still be seeing significant coastal flood problems due to the effects of global warming. But, if world governments begin to work together to address these issues, we may observe a tempering of the effects of sea level rise. In addition to the above trends, the lessening of the degree of flood exposure may also be attributed to our past and current efforts in improving the way we have managed our floodplains and the attempts to reduce adverse impacts brought on by development. Unfortunately, studies have shown our efforts to be only marginally effective, but we are certainly in a better position floodplain-wise had they not occurred. We will continue to have our share of problems to address in 2050, but flooding may be one of the lesser windmills to joust.

THE WORST OF YEARS

Windell A. Curole
South Lafourche Levee District

The hurricane seasons of 2005 and 1893 may have been the worst for Louisiana. But how do they compare? And will the future bring worse seasons yet?

1893 was an important year for Louisiana in ways other than hurricanes. Huey Long was born that year. It was also the first time Louisiana State University played Tulane in football. But this 1893 hurricane season was a memorable one also for the nation.

New York was hit in August with an 85 mph storm, and then on August 18 Newfoundland was hit with a storm packing 90 mph winds. August 1893 ended with a hurricane striking the area from Tybee Island, Georgia to Charleston, South Carolina killing an estimated 2,000 people.

On September 7, 1893 a storm hit Louisiana with 95 mph winds. But it was the Oct. 1, 1893 storm which makes this storm season special to Louisiana.

Cheniere Caminada, across the pass from Grand Isle, with its population of 1,700 had only half as many people alive the day after the hurricane. The storm took over 2,000 lives and is still, to this day, the deadliest storm ever experienced in Louisiana.

This storm is personal to me. My grandfather was born in February 1893 at Cheniere Caminada and was one of the few lucky children to survive the night of Oct. 1. But his mother's family, the Bonamours, all died.

In other fishing villages throughout the massive Mississippi estuaries of South Louisiana, the hurricane destroyed the entire fishing hamlets of 40 to 50 people leaving no survivors. But the people of south Louisiana who did survive migrated north, or up the Bayou, to establish new fishing communities further from the coast.

As we compare the 2005 season to 1893, Chris Landsea, a researcher at the National Hurricane Center, offers that we know of every storm of the 2005 season because of our weather satellites. All hurricane seasons prior to our eye in the sky may have had storms which were never documented. In my recent discussion with Mr. Landsea, I asked about articles relating to global warming and hurricane frequency and intensity.

Was the 2005 hurricane season an anomaly? Or had we experienced a profound change affecting hurricanes which would alter all coastal communities from Texas to Maine? His response was that with increased temperatures, we should have seen a slight increase in intensity, but not to the explosion of strong storms like we experienced in 2005.

With many researchers ready to pin all extreme weather on global warming, and with the weather we had in 2005, it would appear an obvious truth. Yet, with the tragic year of 1893 and others in between, it appears that many other unpredictable factors need to be considered. The

2006 and 2007 hurricane seasons are not comparable to 2005, yet we still have a planet as warm as it was in 2005.

Another comparison between the 2005 and 1893 seasons is the ability to observe all of the hurricane activity of the entire Atlantic and Gulf of Mexico. Science is based on observation. With a greater population to impact in 2005 and much more technology, there is no chance of any hurricane activity going unnoticed. With far fewer people to observe, and the only dependable technology, the barometer, it is obvious that 1893 was terrible and that its true fury will never be know. The hurricane season of 1893 may or may not have been as bad as 2005.

So are we, or are we not experiencing more storms and more powerful storms? Chris Landsea may choose Bob Dylan's words, "Don't speak too soon, for the world's still in spin…for the times they are a-changin'."

And as far as Louisiana is concerned, we may still debate which disaster was greater in 1893. Was it the Cheniere Hurricane, or the birth of Huey Long?

IMPACTS OF URBANIZATION AND CLIMATE VARIABILITY ON FLOODS IN NORTHEASTERN ILLINOIS

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Overview

Changes in land use and climate variability can lead to increasing flood peaks over time and subsequent increases in flood risk. Assessment of the magnitude of the change requires understanding the contributions of the various factors and identifying the appropriate tools for analysis of non-stationary data. Trend analysis of the annual flood peaks on 12 small (<100 square kilometer, km^2) urbanizing watersheds in Northeastern Illinois indicates that the annual peaks, and thus frequency and impact of flooding, increased over the past several decades. The increase in peaks can be explained by intensive urbanization, and also by increasing trends of heavy rainfall in the region. This paper summarizes the results published by Markus and others (2007a, b, and c) listed in the references.

Average urbanization of the 12 watersheds increased from 10.6% in 1954 to 61.8% in 1996. Figure 1 shows the locations of the watersheds, and Figure 2 shows the change in urbanization with population increase in the study area. In addition to land-cover changes, numerous studies report increasing frequency and intensity of heavy precipitation in the region. As a consequence, older studies such as U.S. Weather Bureau Technical Paper No. 40 or TP-40 (Hershfield, 1961) produced lower design rainfall estimates than more recent sources such as National Oceanic and Atmospheric Administration Atlas-14 or NOAA-14 (Bonnin et al., 2005). The NOAA-14 estimates are, on average, 20.51% larger than those of TP-40. A sensitivity analysis conducted in this study based on L-moments demonstrated that 100-year, 24-hour precipitation could vary significantly based on period of record.

Given the non-stationarity of the streamflow data, standard statistical approaches for streamflow data analysis, such as the Log Pearson Type III (Interagency Advisory Committee on Water Data, 1982) are not applicable to time series of streamflow records that exhibit trends (i.e., due to urbanization and climate change) during the period of record. Continuous flow simulation models are an alternative, but often sufficient data are not available for calibration of these models. While there is debate on the validity of the assumption that a given return period storm will produce runoff with the same return period, the design storm approach using an event runoff model was found to be appropriate for computing peak flows in the study watershed.

In order to evaluate the impact of changing land use and precipitation, the hydrologic HEC-HMS model (Scharffenberg and Fleming, 2006) was used to calculate design flood peaks for four different scenarios representing combinations of land cover and design storms. The hydrologic model parameters were calibrated using hourly rainfall-runoff data of two large regional floods, observed in 1954 and 1996 at 12 small urbanizing watersheds in the metropolitan Chicago area. This study indicated that urbanization induced a greater increase in peak flows than climate variability. The average contribution of urbanization in the metropolitan Chicago area to the increase in flood peaks was 29% larger than that of the increase in rainfall. Increased urbanization would cause flood peaks to become even higher.

Trends in Discharge
Application of the Kendal τ-test (Helsel and Hirsh, 1995) indicated that 10 of the 12 watersheds in this study exhibit statistically significant increasing trends in annual flood peaks with a significance level of α=90%. One watershed showed an increase at the significance level of α=80%, and the other had no significant trend at α=80%.

Increases in Precipitation
To further illustrate the temporal variability, the average regional design precipitation amounts were calculated using the L-moments method for eight 30-year moving windows datasets between 1901 and 2000. The results indicate that the design rainfall estimates for the most recent 30-year period, 1971-2000, are two times larger than the estimate for the first period, 1901-1930.

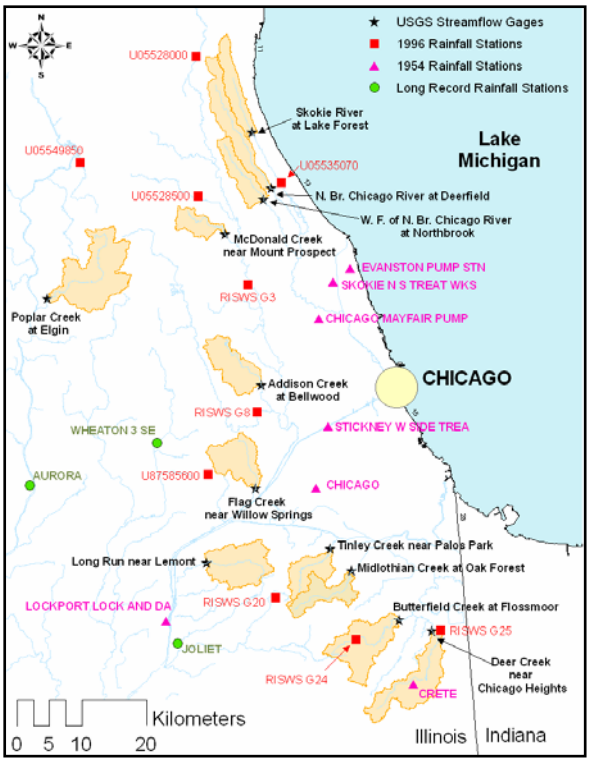
Model Parameters
The runoff curve number is an empirical parameter used in hydrology for predicting runoff from rainfall (USDA, 1986). Curve number values are a function of available data for land cover and soil type distributions over each watershed. Two curve number values were estimated for each watershed based on the land cover from aerial photographs taken between 1954-1961 (representing the 1954 storm) and 1999 (representing the 1996 storm). A comparison of model parameters for 1954 and 1996 shows the curve number increased while the time of concentration and storage coefficient decreased. The values of the initial loss for the floods of 1954 and 1996 do not differ significantly.

Relative Contribution of Land Cover and Precipitation Changes
This study also provides insight into relative contributions of the land cover and precipitation changes to the increasing flood peaks in the metropolitan Chicago area. First, the flood peaks were computed for the 1954-1961 (Baseline scenario) and for the 1996-1999 (Urbanization and Precipitation Increase scenario) periods using the design storm method. The source of design precipitation for the Baseline scenario was TP-40 (Hershfield, 1961), which is based on data through 1957. The source of design precipitation for the Urbanization and Precipitation Increase scenario was NOAA-14, which is based on data through 2000 (Bonnin et al., 2006). To isolate individual effects of urbanization and precipitation increase on flood peaks, two additional scenarios were created: Urbanization scenario, and Precipitation Increase scenario. The former scenario (Urbanization) assumed no change in precipitation with respect to the 1954-1961 design storm estimates (Baseline scenario) while the latter scenario (Precipitation Increase) assumed no change in urbanization compared to the Baseline scenario. Figure 3 indicates that the average flood peak for the Baseline scenario is exceeded by the average flood peak for the Urbanization and Precipitation Increase scenario by 136%. The large difference indicates that both urbanization and precipitation increase significantly contributed to the increase in flood peaks. When comparing the contribution of urbanization and precipitation singly, Figure 3 indicates that the contribution of urbanization is 29% larger than that of the increase in design precipitation.

Comparison with Previous Studies
On average, the flood peaks for the 1996-1999 period are approximately 14% higher than those published in Federal Emergency Management Agency, Flood Insurance Studies effective as of 2005. Under the assumption that urbanization increased after 1996-1999, the current flood-peaks could exceed the certified discharges by more than 14%.

Conclusions

An increasing trend was demonstrated in flood peaks in small streams in Northeastern Illinois for the datasets starting in 1940s and ending in 2004. The trend was explained by increasing precipitation and urbanization in the watersheds. Both factors appear to be major contributors. It was found that in this region the regulatory discharges, on average, underestimate the flood peaks. Transferring the results of this type of study to different regions is not recommended. Nevertheless, the methodology presented herein could be used in similar analyses for other small urbanizing watersheds. Given the non-stationary precipitation and streamflow data, standard statistical approaches are not appropriate and care must be exercised in data analyses. Rainfall and runoff processes are highly variable, non-stationary processes, thus, design precipitation and design discharge are highly uncertain even for longer records, such as 50 years. Hence, it is recommended that the design rainfall and flood peaks are recalculated periodically.



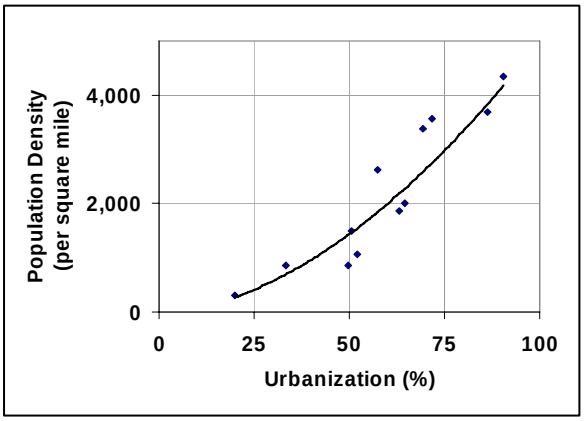


Figure 2. Urbanization as a function of population density in the 12 watersheds

Figure 1. Locations of 12 watersheds in Northeastern Illinois

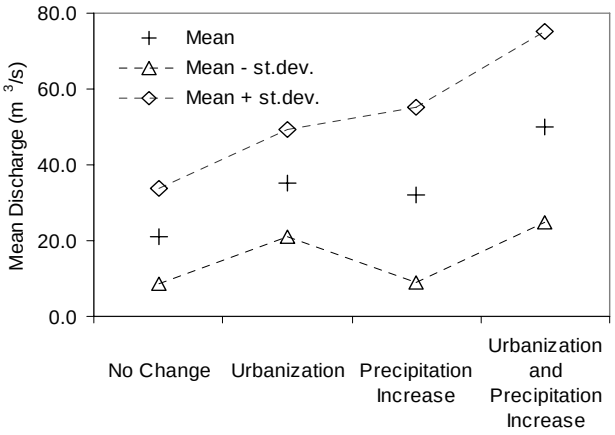


Figure 3. Individual and joint contributions of the increased precipitation and urbanization

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Part 2

To Occupy or Not to Occupy, Act 1: Land Use

HUMAN OCCUPANCE OF FLOODPLAINS: PAST, PRESENT, FUTURE

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Past

In the first assessment of research on natural hazards, Gilbert F. White and J. Eugene Haas (1975) addressed the rising losses and potential losses from natural hazards. According to the assessment, the nation's vulnerability to natural hazards was increasing due to 1) shifts in population from rural to urban and suburban areas with more people living in unprotected floodplains and coastal areas; 2) more people living in new places with less familiarity with the local risks and ways to respond to them; 3) the increasing strength of corporations allowing them to absorb more risks from decisions to locate in hazardous areas; and 4) the proportional increase in manufactured homes and dwellings that are easily damaged by natural hazards. Thirty years later, a National Research Council report cited many of the same vulnerability drivers as the nation's natural hazards losses continued to escalate (NRC 2006).

Present

The pattern of vulnerability and increasing losses is most evident in riverine and coastal environments. Yet, we have spotty information on how exactly many people live in such hazardous areas, how many structures and what infrastructure are potentially in harm's way, and the actual annual loss from flooding (insured and uninsured). Why is such critical information lacking?

First, we do not have an accurate spatial representation of the hazard zone, whether it is a riverine floodplain or a coastal county that contains V zones. Flood maps for many communities are out of date or in some places non-existent, despite FEMA's Map Modernization effort. At present, FEMA's Q3 data (often used as a planning standard) are available, but their spatial coverage is for only 40% of the nation's counties, although these are the most heavily populated (representing 75% of the nation's population). An equally problematic area is the definition of coastal, with the oft-cited statistic that 53% of the U.S. population lives in this area (Crowell et al. 2007). In order to determine the population and the built environment that is at risk, we need to delineate the hazard zone as a first step. This delineation should take into consideration the dynamic nature of the risk and changes in the exposed population and their demographic characteristics. In other words, floodplains are dynamic and the flood hazard potential responds to changes not only in the natural environment (increasing the impervious surface; use of structural control measures), but also changes in the number and composition of the population and the built environment.

Second, we do not have a systematic inventory of all flood losses for the nation at a detailed geographic unit such as floodplains, census tracts, or even counties, despite repeated calls for such a disaster loss database (Mileti, 1999; National Research Council, 1999a, b; Heinz Center 2000, Cutter 2001). While losses are reported with sufficient geo-referencing (generally through the NFIP program), they *only* represent insured losses and *only* in those communities that participate. Presidential disaster declarations are another source of flood losses, but obviously,

these only apply to larger, declared hazard events. Non-participating communities in the NFIP, un-insured losses, and losses that do not qualify for a Presidential disaster declaration are rarely included in loss statistics. What is the true geographic pattern of flood losses and how has this changed over time? We cannot answer that simple question, because as a nation we choose not to systematically collect natural hazard loss data when and where such losses occur.

Future

The next half century will see profound changes in the settlement and demographic patterns in the U.S. Coastal in-migration, especially to the hurricane coasts (Atlantic and Gulf of Mexico) will continue (Cutter et al. 2007). Of particular importance will be the number of elderly and Hispanic populations living in more vulnerable locations. The income gaps will become wider, and affordable housing will continue to be in form of manufactured or mobile homes. These social and demographic patterns, coupled with environmental changes (urban sprawl, wetland degradation, global warming and climate variability), and aging infrastructure, produce the vulnerability of the future and it is not a pretty sight. More people will be living in high risk areas than ever before with disaster losses escalating beyond our wildest expectations, unless we take action now.

I envision a future in 2050 where we know exactly how many people live in such hazardous areas, how many structures and infrastructure are potentially in harm's way, and the actual annual loss from flooding. I envision a future where we use such data in support of public policies to reduce losses, not ignore them. I envision a future in 2050 where we can examine the temporal and geographic patterns of flood losses because we put in place a systematic and comprehensive flood loss inventory (geo-referenced to floodplains) for the nation, forty years earlier. We are able to determine when and where flooding produced the most economic and human losses and can develop mitigation programs accordingly. I envision a future where we use baseline data to evaluate the effectiveness of our flood control and flood hazard policies and finally achieve the post-audits on adjustments (specifically flood policies) that Gilbert White so strenuously argued for a century earlier. I envision a future where we can determine the inequalities in the patterns of flood losses and the disproportionate burdens placed on those social and economic groups that are least able to respond to hazard reduction measures, but more importantly, we do something about it. I envision a future where science-based policy is the norm and that we make rise-wise decisions based on science not politics.

Achieving such a vision is possible, but it will require us to plan in different ways and cooperate more effectively. The provision of a consistent and integrated set of metrics is a first step. This is not an intractable problem but it does require input and collaboration from various agencies and sectors (government, private, non-profit) as we define losses and calculate damage in the same way. Such information should be open and accessible so that we can collectively monitor our successes and failures and provide a scientific and rational basis for public flood hazard policies rather than base them on political whim or expediency. A science-based approach to floodplain management will reduce the federal burden and entitlement mentality by not rewarding individuals and communities for building in flood-prone areas, but instead force them to take personal (and financial) responsibility for their locational decisions.

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FLOODPLAIN MANAGEMENT CIRCA 2050: The View from the Land Use Planner's Vantage Point

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Tropical Storm Thelma struck the Philippines in November 1991, killing over 6,000 people on the Island of Leyte. Most of the deaths occurred in and around Ormoc, where a massive flood destroyed two-thirds of the city. It was the deadliest tropical cyclone in Philippine history. I was working there as a community developer for the Christian Reformed World Relief Committee and was given the responsibility to help rebuild one of the villages with funds from the U.S. Agency for International Development and the Canadian International Development Agency. The reader may wonder, "How could so many people die from one storm?" Most of the dead were living in squatter communities within floodplains and on deforested hillsides. The deaths were not ultimately the result of a natural disaster; they were the result of human-made conditions: poverty, lack of planning, poorly enforced building codes, no land use zoning, careless management of the environment (deforestation), and government indifference and incompetence. I was pleased to help, representing my country, feeling somewhat smug, knowing that something like this could never happen in the United States.

In August 2005 Hurricane Katrina devastated the Louisiana and Mississippi Gulf Coast, shattering my illusion of American superiority. At least 1,836 people lost their lives in Hurricane Katrina and in the subsequent floods. The human made causes were essentially little different than those in the Philippines. I find myself morally outraged that this can happen in this country, the wealthiest and most technologically advanced nation on the planet. This should never happen again. But I fear that it will because the root causes of the disaster aren't a lack of financial resources, knowledge, technological proficiency, or organizational expertise. Instead, as both of these disasters illustrate, the challenge lies in the human social endeavors of planning, cooperation, proactive compassion, and caring for the earth.

It is through this lens that I peer into the future of 2050. From my vantage as a land use planner I consider the facts of continued robust population growth, increasing urbanization, global greenhouse-gas-induced climate change, stubbornly enduring professional isolation, and governmental fragmentation all combining to create the perfect storm for 2050 floodplain management. As a planner I see it as my calling to consider the problem comprehensively and to identify the appropriate tools with which to address it.

Population Growth and Urbanization

Having passed the 300 million mark a year ago the United States of America is expected to grow at a robust rate well into the future, adding an additional 100 million by 2040. By 2050 we could be well on our way to 450 million.

This population increase will not be evenly distributed. Seven out of 10 newcomers will be in 10 megapolitan regions, constellations of socially and physically connected urban metropolitan areas with at least 10 million population: These include the Northeast (*Richmond, VA to Washington DC to Boston),* Midwest (*Pittsburgh to Milwaukee*), Southland (*Los Angeles to Las Vegas*), Piedmont (*Raleigh, NC to Atlanta, GA*), I-35 Corridor (*Kansas City, MO to San Antonio, TX*), Peninsula (*Tampa to Miami to Daytona Beach*, *FL*), NorCal (*San Francisco to Reno, NV*), Gulf Coast (*Pensacola, FL to Brownsville, TX*) Cascadia (*Salem, OR to Seattle, WA, and beyond to Vancouver, BC*), Valley of the Sun (*Phoenix to Tucson*).[1] Some of these regions are witnessing increasing population density as well, a reversal of historic trends, particularly in the West where physical limitations and federal land ownership patterns hinder sprawl. Others such

as the I-35 corridor and Piedmont are expected to sprawl at ever decreasing densities based on current trends and the abundance of land and interstate infrastructure.

Household size in the US has been declining since the 1950s: from an average of 3.5 in 1950 to 2.6 today. At the same time the average size of single family residences (still the predominant residential type) has more than doubled from 950 square feet in 1950 to 2,350 square feet in 2006.[2] There is an increasing demand for urban living in amenity rich, mixed use, and higher density neighborhoods. The demand for smaller lot sizes is outstripping supply. National market research studies consistently show 25 to 33% of housing demand to be for attached and small-lot detached homes.[3] Based on national market research Arthur C. Nelson concludes that the market demand for new homes through 2025 may be almost exclusively for attached and small lot units and that the existing supply of large-lot homes is sufficient to meet demand in 2025.[4]

More people, larger homes, greater density, more impervious surface; much of this growth will occur in areas susceptible to flood and coastal hazards.

Greenhouse-Gas-Induced Climate change

The United Nation's Intergovernmental Panel on Climate Change (IPCC) in its fourth assessment report notes that based on growing evidence, there is high confidence that the following effects on hydrological systems are occurring:

- increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers; and
- warming of lakes and rivers in many regions, with effects on thermal structure and water quality.[5]

In the Rocky Mountain West, where I sit comfortably safe from coastal hazards at 5,280 feet, this means lower snow pack, early melting, more flooding, and more wildfire, further compromising the ecological functions of forests to positively affect water flows and quality.

There seems to be little doubt among scientists that the oceans will indeed rise by another meter within the next 50-150 years. The IPCC report notes that coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution. Population growth and the rising value of infrastructure in coastal areas increase vulnerability to climate variability and future climate change with losses projected to increase if the intensity of tropical storms increase.[6]

Governance and Professional Realities

Fragmented governments at all levels, vertically, horizontally, and internally, are not well set up to deal with natural systems such as riparian complexes, coastal zones, and watersheds. Professional isolation exacerbates the fragmentation by making it difficult or impossible to effectively deal with complex interdisciplinary issues such as flood hazards. Even within professions we see myopic viewpoints on the issues we face.

Below, a brief summary of the critical governance and professional realities we face.

1) Weak federal and state planning law. There is virtually no federal land use legislation and the vast majority of states merely enable local governments to regulate land use. Only four

states—Hawaii, Oregon, Washington, and Florida—require local government comprehensive land use plans to be consistent with an overall state land use plan. Most authority to regulate the use of land is delegated to the local level, where increasingly the parochial concerns of NIMBYism (not in my backyard) frequently limits the ability to pursue sustainable policies.

2) Local Government Fragmentation. Local governments have police power to regulate for public health, safety, and welfare. This is a powerful tool, but it is extraordinarily fragmented geographically and by service type. In Chicagoland, for example, there are 138 municipalities (cities, villages, and incorporated towns) within Cook County's 956 square miles. In Colorado there are over a thousand special districts which provide a range of services including fire protection, flood control, parks, and recreation facilities, development of infrastructure, mosquito control, safety protection, sanitation, solid waste disposal or collection and transportation, street improvement, television relay and translation, transportation and water.

3) Professional Isolation. Professional "silos of excellence" remain steadfastly separated, although we are seeing evidence of tentative reaching out as it is increasingly apparent that isolation is failing to address many critical environmental and social problems we all share.

This isolation is manifest within local government operations where, frequently, civil engineering, land use planning, ecology, and environmental health are separate entities. For example, while the engineers are happily designing state of the art flood control structures, the planners are approving "big box" retail centers with acres of impervious surface parking lots, wherein they proudly plant a few pretty irrigated landscaping islands. The conservation biologists may have nary a clue about any of this until they notice riparian wildlife disappearing. The environmental health community struggles in the fight to maintain water quality as dramatically increased flows cause sedimentation and scouring of river banks.

A prominent movement within the architecture and planning professions, New Urbanism, while very promising for improving human urban systems, fails to take natural systems and hazards seriously enough. These just don't seem to be nearly as cool and creative as coffee shops and pretty streets. Their myopic approach has lead to surprisingly outrageous post-Katrina rebuilding plans within coastal hazard zones along the Gulf Coast wherein only architectural and town design matters. Massive new urbanist building projects underway on the barrier island on which sits Galveston, Texas, arrogantly state that human works will prevail against any natural forces, ignoring the reality of past deadly hurricanes and the many that are sure to come.

An Agenda to Prepare for 2050

As a planner I believe we must address the issue of floodplain management comprehensively. As a citizen I believe we must be proactively compassionate, that is, address the issues of social inequity and powerlessness head on in advance of disasters.

1. *A renewed and invigorated land ethic*

Despite improved environmental awareness in our culture, we are still trying to dominate nature instead of working with it: engineered solutions to flood control; the ever expanding industrial agricultural landscapes; a continued excessive reliance on the automobile for transportation; failure to maintain adequately sized habitat patches and corridors for wildlife; and so on, the sorry list of unwise practices continues. A renewed land ethic respects and preserves the natural capital upon which we all depend.

2. Mandatory interdisciplinary approaches

A sustainable future requires an interdisciplinary approach to the myriad complex issues we face. We must move away from compartmentalized professionalism toward ongoing inter-professional dialogue and problem solving. This will require a reorganization of local government functions and a more cooperative relationship between governments mandated by states and the federal government where necessary.

3. Planners must take the central lead

The professional land use planner is best positioned to take a leadership role because of the unique interdisciplinary and comprehensive nature of the profession. This necessitates that civil engineers, environmental health professionals, conservation biologists, and others must be engaged at all levels of the planning and throughout the implementation process. Too often engineers take the approach of finding a solution without questioning the underlying patterns and drivers, while the planners fail to understand downstream effects beyond political boundaries.

4. Stronger regional political integration

Natural systems require coordinated efforts that match system boundaries and processes. Regional cooperation---either by mandate or by intergovernmental agreement—is critically necessary. Metropolitan Portland's (OR) regional planning and urban growth boundaries have long been touted as a model for political cooperation and integration. Denver's Regional Council of Governments has made significant progress in regional transportation and land use planning through voluntary pacts with local governments. These types of efforts must be accelerated in areas where local and regional planning are weak such as along the Gulf Coast and rural areas of the Rocky Mountain West.

5. Stronger state land use planning laws

The parochial nature of local governments is often a barrier to regulations that are necessary to deal with environmental issues. We may not have the time to wait for change. It may be necessary to resolve through state mandates. For example, in California local resistance to distributed energy solutions such as windmills and solar panels has led to state statues preempting local government zoning ordinances that restrict such uses. A similar scenario can be imagined for floodplain management.

6. Proactive compassion

As a people we are very compassionate when disaster strikes, quickly filling the coffers of relief agencies. However, we too easily ignore the underlying socio-economic disparities and the needs of vulnerable populations, and fail to support strong regional and national governmental initiatives that would mitigate the inevitable disasters. A proactive compassionate approach would apply funds and resources to the existing problems in advance such that when natural disasters occur, the human impacts are minimized.

7. *Need integrated and comprehensive land use codes at the local government level*

Without integrated and comprehensive land use codes at the local government level we will not be able to effectively and in a timely manner deal with the complex issues that effect floodplain management and hazards. To address the complex issues of our day in a socially responsible and enduring manner, development codes must take a dramatic evolutionary leap to an entirely new model, if it is to remain relevant in addressing the array of global, regional, and local environmental and social issues we face today.

The Rocky Mountain Land Use Institute is taking up this challenge in its initiative to developing the Sustainable Community Development Code which incorporates the following features:

- It must be comprehensive;
- It must artfully and intelligently integrate natural and man-made systems;
- It must be progressive, drawing upon useful features of other code types already proven and in use –e.g. in the areas of design, procedures, performance standards, incentives;
- It must be based on a sustainable comprehensive policy plan and long term civic engagement; and
- It must be tailored to local and regional climate, ecology, and culture.

With respect to environmental and physical quality regulations concerning natural hazards are a critical and important component with the objective of increasing safety and protection of natural ecological functions through restrictive zoning and safe building practices. Specifically this means minimizing steep slope disturbance, restricting development within flood zones to avoid any adverse impact to floodplains, and requiring the practice of low impact development for effective stormwater management. But it doesn't end there: the entire code from parking requirements to protecting forest eco-system all have a bearing on floodplain management.

Regardless of the brilliance of engineers in using best practices in this field, their work can be easily undone by myriad harmful regulations and practices elsewhere beyond their control. The Association of State Floodplain Managers is wise to invite dialogue from other disciplines in considering how to prepare for 2050.

Endnotes

1 "Beyond Megalopolis: Exploring America's New "Megapolitan" Geography", Robert E. Lang and Dawn Dhavale, Metropolitan Institute Census Report Series, July 2005.
2 National Association of Homebuilders, "Housing Facts, Figures, and Trends for March 2006."
3 "Leadership in a New Era," Journal of the American Planning Association, Autumn 2006, p. 397, Arthur C. Nelson, citing Robert Charles Lesser & Company, a national market analysis firm.
4 Ibid.
5 "Summary for Policy Makers," Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, item 1.3, Brussels, Belgium, April 205, 2007.
6 Ibid, items 14.2 and 14.4.

FROM FALSE SENSE OF SECURITY TO RESIDUAL RISK: COMMUNICATING THE NEED FOR NEW FLOODPLAIN DEVELOPMENT MODELS

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Introduction

In 1942, Gilbert White advocated strongly for a comprehensive approach to floodplain management centered on careful evaluation of the desirability (or lack of desirability) of floodplain occupance and various adjustment options at any given location (White, 1945). In too many ways, however, it appears that little has changed, even though we have more experience with the flood hazard and disasters from which lessons could have been learned. Inevitably, it seems that the old model persists, that is, structures are rebuilt and repaired in the same location, only limited flood insurance is purchased by those at risk, land uses rarely change to reduce flood impacts, while all the time disaster relief flows from the federal government. Creeping incrementalism is the usual mode of operation and getting things "back to normal" following flooding is the common mantra of politicians.

It is time for an honest evaluation of the risk that communities face when they employ current development models. Rather than continuing to do the same thing following each flood and expecting a different outcome, it is time to devote resources to communicating risk in such a way that new development models evolve – that we look to do things differently. We know that flood protection leads to a false sense of security (Tobin, 1995; White et al., 1958), something recognized in many places for many years.

While this false sense of security has undoubtedly led to increased development in areas that are "protected" by flood control structures, there is now a greater awareness of ongoing threats, and the term residual risk has been used to describe the danger that remains even with such protective works. Unfortunately, however, the extent to which that risk is incorporated into urban development decisions, both in and out of the floodplain, is highly questionable. Thus, there are two elements of concern here: 1) how and where development takes place, and 2) how the risk to and caused by that development is communicated.

Development Patterns

It is no secret that development, no matter where it occurs in a watershed, affects flooding (Montz, 2000). Whether in the floodplain where it is directly in harm's way, or on higher ground where increased imperviousness leads to increased runoff, development alters the hydrologic regime. Although for some land uses the benefits of a floodplain location may outweigh the costs, White acknowledged that there are many land uses for which the floodplain location is no longer necessary – a fact that may be more true today than in 1942. Thus, while we do not need to build in floodplains, we continue to do so, for a variety of reasons.

Urban and suburban development patterns, housing costs, and changing demographics have led to increased sprawl, something with which many metropolitan areas are trying to cope—Yuba

County, California, and Broome County, New York, provide useful examples. Yuba County was the fastest growing county in California in 2006, while Broome County experienced a decline in population between 1990 and 2000, but saw 2,000 more single family units at the end of this period than at the beginning. Both have large flood prone areas and are experiencing sprawling, low-density development that creeps into areas such as hillsides contributing to runoff (Broome County) or into sites behind levees with a residual risk of flooding (Yuba County).

These two represent the changing risks that are being created by local development decisions made everyday. This development frequently comes fraught with risks, in this case the danger of flooding that is often not recognized and not part of the decision-making criteria, particularly when such development occurs in a non-designated floodplain or outside the floodplain. Too frequently, those who profit from the development have little stake in the risks, being focused more on short-term gains (Committee on Disaster Research in the Social Sciences, 2006). At issue, therefore, is how to document and communicate these very real risks so that communities, decision-makers, and individuals understand the need for a new development model, one that takes into account the full range of costs of this development, thus leading to the comprehensive approach that was advocated by White all those years ago.

The current mode of development, either ignoring the impacts on downhill or downstream development and/or passing the risks off to buyers, needs to be altered so that the effects of any development (a house, commercial property, or subdivision, for example) on flooding and the impacts of flooding on any development are part of the building approval process. This starts with adequate and accurate information on inundation that can be caused or that can be incurred if such actions are approved, through maps and models, and followed by implementation of land use and building policies that incorporate such information. One cannot insure that information on risks will be used in decision-making, but it is reasonable to assume that more reliable, and therefore more trusted, information on risks will facilitate better decisions. Of course, the development model we envision also keeps responsibility for impacts in the hands of the developer and the community, avoiding the problem of passing off risk and responsibility to perhaps unknowing buyers.

Communicating Risk

Communicating flood risk has been shown to be quite difficult, given the lack of understanding the public and even officials have of common terminology such as risk and particularly of the 100-year flood (Bell, 2004; Covello et al., 1989; Hance et al,. 1989). Similarly, the causes of flooding are often assigned to rivers and streams and not to the encroachment of urban infrastructures onto the floodplain or to the impact that changed land use has on the hydrologic regime. For example, while the Flood Insurance Rate Maps (FIRMs) associated with the National Flood Insurance Program (NFIP) are one way of depicting risk, they are too frequently misconstrued as predictive techniques rather than simply tools for administrative guidance. Existing requirements for zoning, protective structures, building standards, water quality maintenance, and other concerns related to flooding do not address the impact of hydrological changes on communities downstream. For instance, what about increased overland flow under extreme conditions? These are not part of the decision-making equation, illustrating that local officials either do not recognize the dynamic nature of the flood risk or are unconcerned about it, given the usually small scale and incremental nature of the development. The cumulative impact of all changes in the watershed is thus either not recognized or is ignored.

These examples are not uncommon, suggesting that different ways of communicating the risk need to be considered. Lessons can be taken from work on communicating risks associated with climate change (Moser and Dilling, 2007), but there is much to be learned about how such information can be disseminated most effectively (Committee on Disaster Research in the Social Sciences, 2006). Certainly, the focus needs to be on local and regional scales that take into account geographically appropriate trends, needs, and priorities.

With increases in technology have come new tools to facilitate research and understanding of both the elements (hydrologic, physical, and anthropogenic) contributing to the risk and their relative contributions, thus broadening the range of potential management strategies and their application to specific problems in specific locations (Tobin and Montz, 2004). Geographical information systems (GIS), remote sensing, and satellite imagery have been combined with complex models to allow for comprehensive evaluation of the dynamics of watersheds.

Given the above, it is clear that we now have tools that can be applied to both understanding and communicating risk. Effort has been devoted in recent years to bridging the gap between physical and social scientists with respect to developing and presenting information about risk and uncertainty, but much remains to be learned (Gerber and Neely, 2005). Every effort must be given to communicating the risk that exists in an area, in a comprehensive framework, with at least some emphasis on translating the findings to be locally relevant. Thus, locally applicable models of runoff and inundation under various conditions need to be available, along with useful templates for applying them to local land use decision-making.

Conclusions and Recommendations

Land use development is a local prerogative, but the impacts of development decisions are frequently felt more broadly, particularly downhill and downstream when it comes to flooding. Because of the magnitude of flood losses and the costs of many adjustments, mitigation has historically been undertaken, or at least assisted, by extra-local entities. Such an approach, while understandable from humanitarian and technical perspectives, has allowed local decision-makers to avoid taking a comprehensive look at local and regional flood risk and their contributions to it. The NFIP is one means of shifting some of the responsibility to local areas, but the Broome County and Yuba County examples (as well as other research) suggest that this program has not been fully and effectively embraced. Flood risk is increasing, a result of some combination of climatological, hydrological, and anthropogenic factors, at the same time that pressure for federal dollars is growing. It seems apparent that current trends cannot continue, but concerted efforts on the part of policy-makers are required to bring about any changes. Change is essential and will require political will at all levels of government, something that is challenging given the range of factors contributing to flood risk, within a pro-growth development context.

The first step is developing models that depict current and potential flood risk for local areas. FIRMs, particularly modernized and updated FIRMs, can do this. However, as communities look to respond to a flood event or to prevent the next one, user friendly decision-support systems that allow for mapping of flooding under various land use development and precipitation scenarios could facilitate understanding of related impacts and costs. Obviously resources will have to be devoted to data collection and model dissemination and adaptation, however, the investment can be justified if it reduces future flood losses, as investments in both structural and nonstructural measures have been justified in the past. Yet, having the information is not sufficient – using it to help frame decisions is critical, while recognizing the needs, goals, and values of the range of

stakeholders. This is a very difficult part of the process, because these factors will differ widely among different groups. One would hope that better information on the risks presented by new development would lead to wise decisions, but this is certainly not guaranteed.

The landscape, both visible and political, is changing, given population growth trends, land use development priorities, deteriorating infrastructure, and budgetary constraints to prepare for and respond to disasters. Our practices have to change as well with a greater focus on the relationship between science and policy with respect to flood management. This starts with various means of depicting flood risk under different land use and climatological scenarios at the local and regional levels, combined with "templates" of land use practices, including incentives, regulations, and other tools that can be applied in different circumstances. This will not be easy, as it requires a regional perspective for both land-use and water management, a serious re-evaluation of the total costs of development, and a recognition of the shared responsibility for the impacts of land use decisions.

The ultimate goal of the steps advocated here is development and adoption of a framework or methodology for decision-making that facilitates, indeed incorporates, hydrologic and economic factors at several scales, leading to the comprehensive approaches advocated by White in 1942. In turn, it is anticipated that these will lead to economic uses of floodplains that cause communities to internalize rather than externalize the costs and benefits of their development choices. In this way, perhaps, we can overcome the propensity to underrate or undervalue the risk, thus generating a false sense of security.

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THE NEED FOR INTEGRATED PLANNING

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The need for better management of our floodplains is clear, particularly amid the concerns about potential increased hazards exposure due to climate change and population growth in highly vulnerable regions. It also becomes increasingly clear that the planning to support better management must become increasingly detailed and sophisticated, but also increasingly visionary, in its focus.

There is only one essential way to broaden our vision of what we must accomplish in floodplain management for the future, while improving our implementation of that vision to ensure success—particularly if we want that vision to be a positive one of using our floodplain resources to improve the environment and not just one of reducing losses to the built environment and the people who live in it. What is required is an understanding of how to integrate our vision into all levels of the planning process, both within individual neighborhoods and communities and across communities at a regional level. All of that is much easier said than done, and it is not even so easy to say.

What is Integrated Planning?

Positive floodplain management is the active understanding that floodplains are natural resources that can benefit human society as well as posing a threat in the form of flood hazards. Making that vision requires a level of intellectual discipline and political will well above that achieved to date by most communities, but it is not unachievable, and there are communities paving the way. It also will require a serious commitment to public education about floodplain functions within the ecosystem and about how many short-term "best uses" of floodplain lands can impede more sustainable long-term "best uses."

No vision, whether it is in a community, civic organization, corporation, or other entity, is likely to be successfully implemented without commitment to a game plan. In the community planning process, the centerpiece of that game plan is a comprehensive plan. In the past, most local comprehensive plans have lacked significant references to natural hazards and issues like floodplain management, but that is changing. About a dozen states include some requirement for addressing natural hazards in local comprehensive plans, and California this year added floodplain hazards as a required consideration among safety elements in already-mandatory local comprehensive plans. We are making progress.

Real progress will occur when every community uses such tools to cross-reference any opportunities in other elements of the local comprehensive plan to address issues like floodplain management. For instance, a transportation element ought to examine the implications of road and bridge design and transit routes for floodplain safety, better management of watersheds to reduce flood hazards, minimization of impervious surface where it matters most, etc. Historic preservation elements can address ways to reduce flood hazards to historic properties. Economic development elements can examine ways to reduce the costs and maximize the economic results from better floodplain management. The implications for addressing floodplain management in a

housing element are virtually self-evident. So are the possibilities for proposing positive solutions in the context of a parks and open space element. The APA touched on some of these issues a decade ago when it produced a FEMA-funded Planning Advisory Service Report, *Subdivision Design in Flood Hazard Areas* (1997). We are exploring them more deeply in a new FEMA-funded project, *Integrating Hazard Mitigation into Local Planning.*

But the question runs deeper. One obstacle to making all this happen is a frequent lack of communication between agencies and professional disciplines even in local government. Emergency managers, floodplain managers, civil engineers, and urban planners all need to discuss how their work cuts across professional lines so that all these groups, and more, have input when it matters in reaching the substantive conclusions that appear in comprehensive plans, and the same should happen with other forms of local planning, such as sub-area plans for neighborhoods, corridors, and business districts, and functional plans, such as those for sewer districts and transit.

Integrated Implementation

None of this planning means much unless there is an effective scheme for implementation. One way to do that, outlined in APA's *Growing Smart Legislative Guidebook*, is to include an implementation element within the comprehensive plan itself, outlining what steps are needed to make the vision a reality. There is no escaping the need for a close inspection of the implications of current zoning and subdivision codes, for instance, and how well what they allow relates to what is intended, presuming that our intentions reflect a positive, environmentally sound vision in the first place.

One of the most progressive approaches to use in this regard is a build-out analysis that assesses the potential floodplain challenges posed by currently allowable development in the floodplain. Very, very few communities have gone this far, and doing so would put any community well ahead of the vision embodied in current Flood Insurance Rate Maps. Zoning maps can be complex things, and understanding all the implications of what current zoning allows requires a commitment to adequate planning staff and resources to undertake such an analysis. It would not hurt at all if states began to commit to such a process, putting additional planning resources into play as incentives for communities to perform or contract for such studies in order to determine the best means for guiding development correctly before floodplain resources are further compromised, resulting in some inevitable future losses that could have been avoided.

Tools and the Future

We can be optimistic about the prospects for all this as a result of evolving technologies, which have given us increasingly robust geographic information systems, hazard assessment tools, and the ability to relate floodplain management issues to larger questions of watershed management and environmental quality. We are learning how to cross-fertilize thinking about water quality and urban forestry, for example, and we can think publicly about these mutual impacts in the context of visionary comprehensive planning. Given the changes of the last forty years since the environmental movement produced huge changes in federal law, there is no reason to think we cannot make similar huge changes in thinking about and implementing integrated planning for floodplain management in the future. The underlying imperative for making it all happen, however, is that we must all begin to think outside our silos.

FLOODPLAIN MANAGEMENT IN THE FUTURE

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There will be basic changes in floodplain management by 2050. First, there will be a shift from single purpose floodplain management that focuses on delineating floodplain hazard areas and using zoning powers to restrict development in those areas to multipurpose floodplain management which focuses on managing the floodplain as a resource to yield multipurpose benefits. Sujrt Chakraborty of India, when analyzing wastewater management said, "the solution is the result of a whole process of unlearning what the Western ecologists have taught regarding 'treating,' not utilizing sewage."[1] When this mode of thinking is applied to floodplain management, current efforts that delineate hazard areas and seek to regulate land use will evolve into programs that result in multiple uses of floodplain lands that will generate synergistic benefits and result in a sustainable program.

Floodplains are ideal locations to integrate the hydrologic, the nutrient, and the carbon cycles. The beneficial uses that will result from such synergism include

1. Space for natural storage of flood waters.
2. Production of floodproofed crops, e.g. switch grass, big bluestem, Indian grass which can be irrigated with reclaimed wastewater to stimulate plant growth, recycle plant nutrients, abate water pollution and generate revenues from crops and carbon sequestration.
3. Using the harvested floodproofed crops to produce ethanol (CHO) for fuel and brewers mash (NPK) for cattle feed.
4. Trade the carbon credits that will accrue from the integration of the three basic cycles on the floodplain to generate an annual stream of revenue that can be used to finance other environmental improvements.
5. Use the fields from which the floodproofed crops were harvested for recreational areas, wildlife habitats and groundwater recharge areas.

An acre of floodplain land managed in this manner would generate over $3,700 of tangible benefits annually or a present value of $42,365.

A careful analysis of Dr. Gilbert F. White's article "Water Science and Technology: Some Lessons for the 20th Century" stated, "after the Federal Emergency Management Agency (FEMA) moved beyond disaster management, it became interested in Programs to mitigate the continuing burden of disaster losses . . . but no mention is made of accounting for the possible beneficial uses of floodplains. A small example of a possible beneficial use of unprotected floodplains is the cultivation of switchgrass, which could then be used to manufacture ethanol to generate electric power with a minimum of air pollution." [2] Sequestration of carbon would be another benefit. Managing floodplains to realize beneficial uses will be an important element in 2050 efforts.

It has been almost 100 years since the single purpose flood control project for the Miami Basin was implemented, which purportedly made it impossible for such a thing (the 1913 flood) to

happen again.[3] It took many decades to shift from single purpose dry flood reservoirs to multi-purpose reservoirs. Similarly, it is likely that it may take several decades to shift from single purpose floodplain management to a program that manages floodplains as resources that concurrently mitigate flood damage, abate water pollution, and reduce the buildup of carbon in the atmosphere and at the same time generate revenue from the beneficial uses of the floodplain. The revenues have the potential to make the National Flood Insurance Program sustainable.

Change frequently makes us uncomfortable. Nevertheless this change will occur because the amounts of land and water on planet Earth are finite but the population is expanding by more than 6.0 million people per month, an increase of more than 72 million annually worldwide.

In the United States, our population increased from 150 million in 1950 to 300 million in approximately 50 years. Census projections estimate that there will be another 120 million in the United States by 2050 (420 million).[4] Population growth alone will demand that we convert our single purpose program that focuses on delineating flood hazard areas and using zoning powers to regulate land use to a resource management approach that generates beneficial uses of the floodplain. An acre of publicly owned cleared floodplain costs $500 to $1,500 per year to maintain as open space, a present value of $5,725 to $17,175 which is added to the social overhead of the political entity that owns the land.[5]

The last letter I received from Gilbert F. White in September 2006 stated that there is a need to integrate the hydrologic, nutrient, and carbon cycles to make a resource management program sustainable[6]. I believe this sets forth his vision for a sustainable floodplain management program in 2050.

Endnotes

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THE ELEPHANT IN THE ROOM

Matthew B. Miller, P.E.

Scientists have reached near consensus that the world is warming and as a consequence, sea levels will rise at a rate in excess of that of the previous century, which averaged approximately 2 mm per year. This rise will occur even if all greenhouse gas emissions cease, because of what is termed "oceanic thermal inertia"; consequently, the world's mean temperature will increase by a minimum of another 1° C with a corresponding increase in sea level.[1]

Sea level rise associated with climate change has a number of implications for floodplain managers, two of the more important ones are: increasing rates of coastal erosion and higher coastal flood elevations.[2] The net result of these two phenomena in the long term will be to make coastal areas less and less inhabitable, until the point is reached where they must be abandoned for the purpose of habitation, unless very costly, and in the long term nonviable, structural solutions are implemented, such as beach nourishment[3], seawalls, and levees.

The Elephant in the Room

Property abandonment and pullback from coastal areas might occur 1) after a period of gradually increasing economic stagnation and physical deterioration of the land and infrastructure; 2) immediately after a major flood event; or 3) through a deliberate, governmentally sponsored process designed to minimize social disruption as well as private and public costs. This last alternative seems the most desirable; it is not widely seen as politically palatable, but must be made so. It is the "elephant in the room".[4] A national discussion on adapting to sea level rise and shoreline loss must take place, or we face the real danger as a country muddling into non-optimal adaptations. For instance, under the Stafford Act[5], federal disaster grants are available to communities that have "engineered beaches" for the purpose of re-nourishing disaster-damaged beaches.[6] When increasing numbers of communities "engineer" their beaches in response to sea level rise, federal expenditures for these projects could increase uncontrollably.

Structural Solutions are not a Panacea

Structural solutions are not a long term, viable national alternative to a planned retreat from the coast because they would have to be of a massive scale with an "open-ended" design and funding stream. Seawalls and levees would have to be made higher and higher and ever stronger if they were to continue to provide an acceptable level of protection as sea levels rose and shorelines shrank; beach nourishment projects would ultimately fail when the sand source or funding to maintain them were exhausted. These may be site-specific or short-term solutions in limited, already developed areas, but they are financially and technically unsupportable for the thousands of miles of coastline in the United States affected by sea level rise over the long term.

Lessons from Katrina

The recovery in the coastal Louisiana parishes following Hurricane Katrina is an example of what might occur in other areas of the country in the future as relative sea level rise occurs and shorelines retreat. More and more land disappears every year along the Louisiana coast due to erosion and local sea level rise, and as a result, a flood of a given magnitude extends further and further inland.

Proposed flood loss mitigation measures following Hurricane Katrina included:

- elevation of structures,
- stronger building codes,
- construction and/or reconstruction of higher and stronger levees,
- more flood resistant pumping stations with larger pumping capacities,
- restoration of coastal wetlands, and
- non-reconstruction of damaged public and private infrastructure and housing in the most low lying and flood vulnerable portions of the parishes.

All but the last two mitigation measures have been implemented to some degree. Restoration of coastal wetlands is a decades or century long endeavor that will not provide immediate flood protection to coastal Louisiana, even if funded and implemented.

The deliberate non-reconstruction of damaged public and private infrastructure and housing in the most flood-prone areas has been a complete non-starter, particularly in the city of New Orleans. Sporadic reconstruction of homes, next to abandoned structures, is occurring in portions of the city, even in the lowest and most dangerous places to rebuild. It is highly questionable if the city is capable of providing supporting infrastructure and services for these homes. However, the city has not publicly committed to not providing these services in the most flood-prone areas. A permanently blighted city in a slow death spiral seems likely. It did not have to be like this. A more compact, but economically and socially robust, and flood-safer city could have emerged from the devastation caused by Hurricane Katrina.[7]

Implementing Strategic Retreat from Shrinking Coastlines and Rising Flood Levels
Basic authorities and programs are already in place to implement a strategic retreat from the most vulnerable portions of our coastlines. In addition, relevant geomorphological and engineering data are readily available that could be compiled within a 7-year time frame to delineate erosion hazards areas that would conform to National Flood Insurance Program (NFIP) mapping standards.[8] What is missing are plans, political will, an educated public and legislators, and funding commitments.

- The states have authority to take title or govern land use in the most vulnerable coastal areas of the United States. A strong argument can be made that the costs of property acquisition or the costs for the exercise of land use control by the state or local governments are far outweighed by the construction costs of flood control works or beach nourishment and the concomitant maintenance costs over the long term.
- The Federal Emergency Management Agency's (FEMA's) flood hazard mapping program under the NFIP already has the authority to identify areas subject to erosion. It does not have funding or authorities to regulate land use in these areas or explicitly include them in insurance rate making.[9]
- Hazard mitigation plans are already required as a condition for disaster assistance and mitigation grants under the Stafford Act as administered by FEMA. These state plans are a potentially powerful tool for executing an orderly retreat from an encroaching shoreline and adapting to increasing flood levels in a planned and optimal manner.

Conclusions

- Sea level rise by 2050 will cause increasing rates of coastal erosion and result in higher coastal flood elevations and a landward migration of areas subject to coastal flooding.
- Structural measures, such as beach nourishment, levees, and seawalls are not the best long-term solutions to sea level rise and coastal erosion. However, they are often seen as such by the public and elected officials.
- A planned, governmentally supported program to manage land use in coastal areas subject to long term sea level rise and erosion is needed. The NFIP would be an appropriate vehicle to do that.
- FEMA has programs in place that can begin to address this problem, but they lack authority and funding in some cases.
- The incomplete recovery in the coastal Louisiana parishes following Hurricane Katrina, and the likelihood of major flood disasters there in the future, is an example of what might transpire in other areas of the country as relative sea level rise occurs.
- A national discussion on adapting to sea level rise and shoreline loss must take place, or else we face the real danger as a country muddling into non-optimal adaptations.

Notes and Source Material

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Part 3

To Occupy or Not to Occupy, Act Two: Natural Resources and Functions of Floodplains

EMERGING CONSERVATION ISSUES: CLIMATE CHANGE AND SEA-LEVEL RISE

David J. Stout
U.S. Fish and Wildlife Service

Introduction

Few environmental challenges are more threatening than the specter of habitat change and loss, species extinctions, and socio-economic disruption that is anticipated to occur in the next 50 to 100 years as a result of global climate change. Emerging environmental issues such as sea-level rise, habitat losses due to anthropogenic activities and global climate change are now prominent conservation challenges.

The Fish and Wildlife Service (Service) must strategically focus and engage on these emerging conservation issues now, in order to remain a leader and trusted partner in fish and wildlife conservation, known for our scientific excellence, stewardship of lands and natural resources, dedicated professionals, and commitment to public service.

This paper presents tools and opportunities of the Division of Habitat and Resource Conservation (DHRC) that are available to assist in the assessment, planning restoration, and mitigation of threats emerging from climate change and sea-level rise. It is designed to foster internal collaboration and discussion to help identify shared priorities and avenues to connect people in understanding the stake they have in natural resource conservation in a changing world.

Tools and Opportunities

Service regional and field office biologists primarily provide expert advance planning assistance and on-the-ground assessments of the potential impacts to fish and wildlife habitats resulting from proposed development, and offer technical assistance to avoid or minimize these impacts. They work closely with landowners and communities to protect and conserve habitat, and provide high quality wetland and other habitat information in support of planning and decision-making. This field based approach to landscape level conservation is well suited to help address emerging issues related to climate change and sea-level rise. Representative tools and opportunities of DHRC follow.

Sea Level Rise – Assessment and Modeling

- Digital wetlands data of the National Wetlands Inventory (NWI) is a key baseline layer of nationally consistent information for geospatial analyses of coastal habitat change and trends. For example, the U.S. Environmental Protection Agency (EPA) has used NWI data in their model to determine impacts of sea level rise on wetlands for use in Congressional testimony.
- The Service obtained sea-level rise predictions for four National Wildlife Refuges in Florida as an outgrowth of a long-standing relationship with the EPA and will work with the Service's Division of Refuges on ways to make modeling data available for other Refuges to determine impacts on trust species, coastal habitats, and evaluate mitigation and future land acquisition options.

Landscape-scale Conservation Planning

Healthy Communities and Ecosystems

- The DHRC recognizes it will be imperative to work with communities and employ incentive-based planning approaches and technical assistance to help them adapt to, and mitigate the expected effects of climate change.

- This proactive programmatic approach will be developed in coordination and partnership with other federal, state, tribal, and local governments engaged in climate change issues, and implemented in the Service via Field Offices nationwide.

- We envision providing both technical staff expertise and assistance in community-based landscape level planning to address issues of growth and development related to climate change and/or sea-level rise. This would potentially include assistance with community planning, streamlining federal regulatory and environmental compliance to adapt, minimize, or offset climate change effects due to flooding, storm surge, coastal land loss and protection, etc.

- By employing strategic habitat conservation principles in collaboration with communities, field biologists can help protect and restore native species, habitats, and maintain the ecological processes and structure (i.e., Green Infrastructure) crucial for ecosystem integrity and to moderate the effects of climate change.

- Green Infrastructure plans developed with local communities, and other consensus-based landscape-level planning approaches provide a framework to guide future development and conservation decisions necessitated by expanding coastal populations that will be impacted by sea-level rise and climate change. The resulting plans for key geographic focal areas will protect human health and safety, as well as preserve community assets and vital natural resources. The desired future condition is sustainable ecosystems for fish, wildlife, and people.

Coastal Ecosystems Conservation

- The Service is also engaging in other science-based landscape level forums to better integrate the conservation of landscapes and communities vulnerable to sea-level rise. Using traditional authorities such as the Fish and Wildlife Coordination Act, the Service is participating in several Gulf Coast landscape-scale restoration efforts pursuant to the Coastal Wetlands Planning Protection and Restoration Act, and is involved in the Louisiana Coastal Protection and Restoration project to help evaluate construction of a comprehensive suite of restoration wetlands and protective structures to help Louisiana withstand Category 5 storm events.

- Coastal wetlands play a vital role in protecting human health and safety, in addition to providing habitat for fish and wildlife. For example, for every 2.7 miles of wetlands that a hurricane crosses, its storm surge is reduced 1 foot in height. The integration of wetlands in coastal development projects and conservation plans that are reviewed by Service field biologists helps to cost-

effectively protect these important habitats and guide restoration to locations beneficial to people and wildlife.

Coastal Barrier Resources Protection

- Coastal barrier islands are the mainland's first defense against storms. Development of these low-lying, hurricane prone areas place people and property at risk. Rising sea level and the increased frequency and intensity of storms due to global climate change, greatly increase this risk and the value of undeveloped coastal barriers as cost-effective buffers of coastal storm damage.

- The Coastal Barrier Resources Act designated relatively undeveloped coastal barrier lands and wetlands along the Atlantic, Gulf, and Great Lakes coasts as the John H. Chafee Coastal Barrier Resources System (CBRS). CBRS units are depicted on a set of maps enacted by Congress.

- These maps are a key tool for coastal conservation, restoration, and development planning. They identify over 3 million acres of relatively undeveloped coastal habitat that support many public trust resources and fish and wildlife species. Most federal expenditures that support development are prohibited within the CBRS, including federal flood insurance.

- The Service is modernizing CBRS maps using digital technology to correct map errors and make this updated information more readily accessible for planning purposes as federal, state, and local agencies address the potential impacts of sea level rise.

Carbon Sequestration

- Although the oceans represent the largest available carbon sink to help mitigate climate change, forests and wetlands contribute greatly to the reduction of carbon and carbon dioxide.

- Restored wetlands have the potential of additional carbon sequestration to help ameliorate the effects of greenhouse gases produced through human activities and thus could be one step to reduce climate warming. Wetlands digital data and geospatial analyses depict wetlands on the landscape and opportunities where they can be strategically restored for more carbon sequestration. Wetland trend studies can statistically document wetland and forest losses or gains in potential carbon sequestration capabilities over time.

- The DHRC must better capitalize on restoration opportunities involving carbon sequestration and provide guidance to Field Offices on environmentally compatible methods for implementing forest and wetlands conservation into project reviews, especially large landscape-level efforts. Additional guidance will be provided on mitigation techniques to expand the replacement of native forest and wetlands habitats.

Energy

Wind Energy and Wildlife

- Wind energy is now the fastest growing renewable source in the nation. It has grown in popularity because it produces no emissions, and is considered an environmentally friendly technology.

- Properly sited wind energy development can reduce the loss of wildlife and their habitats, and potentially replace other more disruptive forms of energy development, thereby reducing carbon emissions associated with global warming.

- The Division has collaborated with the Migratory Bird Management and Law Enforcement divisions to develop voluntary guidelines for development of wind energy facilities that may pose minimal impacts to wildlife. We will continue to work closely with all Service programs to provide other innovative tools to assist in the evaluation of proposed wind energy developments.

- The Service is also assisting the Department of the Interior in leading the new advisory Wind Turbine Guidelines Advisory Committee to provide recommendations on effective measures to develop wind resources while protecting wildlife and their habitats.

Hydropower, Fish Passage, and New Energy Technologies

- With appropriate fish passage and suitable in-stream flows, hydroelectric energy is an environmentally friendly technology. Hydroelectric energy is renewable, produces no airborne emissions, and has the potential to reduce carbon emissions associated with acid rain and global warming,

- The Service coordinates with other agencies, tribes, and non-governmental organizations to help promote hydropower and opportunities that sustain or restore our nation's fisheries resources.

- The Service is collaborating with proponents and agencies involved in new hydroelectric power technology, such as wave and tidal energy generation. This includes working with the Minerals Management Services on offshore wave generation technology, and the Federal Energy Regulatory Commission for near-shore and estuarine tidal energy generation. We are committed to working proactively to help promote clean energy and minimize possible short-term/long-term deleterious effects to fish and wildlife.

Marine Mammals – Monitoring Sentinel Species

- Marine mammals provide valuable insights into the health and vitality of coastal and ocean ecosystems. These species are the sentinels that can provide key understanding of the effects of climate change on these ecosystems. Marine Mammal conservation efforts of the Service are especially timely in the Arctic, where sea ice retreat resulting from warmer global temperatures adversely affects the survival strategies of polar bears and walrus.

- Sea-level rise and an increase in water temperature can impact marine mammals by altering their habitat (e.g., loss of sea grasses and other habitat structure), as well as disrupt fundamental physiological processes (e.g., interfere with thermoregulation).
- The Service is engaged in several efforts to elucidate the effects of climate change and sea-level rise on public trust species including: 1) cooperative studies to understand population trends of marine mammals in Alaska, Florida and along the Pacific Coast; 2) a collaborative multi-year effort with international partners on a range-wide walrus survey; 3) aerial surveys to monitor polar bear population distribution, abundance, status, and trends to better understand the effects of sea ice retreat on this ice-dependent species; and 4) coordination with the oil and gas industry during exploration, development, and production in the Beaufort Sea to gain information on the location and frequency of sightings for both polar bear and walrus, as well as identifying the location and use of polar bear dens.

Summary

The nationally important issue of climate change is an emerging strategic priority that will shape the future conservation legacy of the Service and the nation. In shaping the foundation for our future, the Service is pursuing key decisions where we should allocate the majority of our resources and people to address the highest conservation priorities from a landscape and geographic focal area perspective. Climate change intersects all of the Director's conservation priorities, those of many of our partners, and all landscapes upon which fish, wildlife, and people depend. The opportunity is at hand for the Division of Habitat and Resource Conservation to strategically plan and begin implementation on several fronts to address these issues to help better connect people with nature and the inevitable forthcoming changes resulting from climate change.

FLOODPLAIN MANAGEMENT 2050: PROTECTING NATURAL AND BENEFICIAL FUNCTIONS

Jon Kusler, Esq.
Association of State Wetland Managers

How should floodplain management policies be altered to better protect the natural and beneficial functions of floodplains over the next 40 years? The natural and beneficial functions of floodplains including wetlands, riparian areas, and associated lakes, rivers, streams, and oceans, will be under increased pressure. Population will dramatically increase in both coastal and inland areas with demand for more land for residential, commercial, and other buildings and activities such as gravel mining and agriculture. These activities and the accompanying levees, seawalls, groins, and channelization projects will threaten floodplain open spaces and natural habitat, pollution control, flood storage, flood conveyance, and other functions. Climate change and accompanying sea level rise pose additional threats.

What is needed to protect floodplain natural and beneficial functions?

1. Congress should adopt a "no adverse impact" standard for floodplains and wetlands. Local, state, and federal agencies could strengthen their hazard reduction programs and reduce flood losses by adopting a "no adverse impact" standard for floodplains and wetlands of the sort suggested by the Association of State Floodplain Managers. This would include a "zero" rise floodway and prohibition of fill in the floodplain. Such a standard should also pertain to natural and beneficial functions.

2. The Administration should update and revise the Floodplain Executive order to adopt a no adverse impact standard (see 1 above) and tighten the protection of floodplains.

3. Local governments in the 20,000 communities with floodplain regulations and states need to tighten their regulations. Communities and states need to adopt a "no adverse impact" standard for public and private activities in the floodplain. They need to adopt zero rise floodways. They need to zone floodplains for open space uses and prohibit fill in outer flood fringe areas. They need to adopt wetland and riparian area protection regulations. They need to adopt stream setbacks. They need to acquire floodplains in greenways and recreation areas. Congress needs to help fund these efforts through FEMA "mitigation" funding or other funding approaches.

4. FEMA should continue and enhance (with the help of Congress) FEMA's Community Rating System which provides communities with reduced flood insurance rates if they tightly regulate hazard area and protect open space including wetland areas.

5. FEMA, the U.S. Army Corps of Engineers (Corps), U.S. Geological Survey (USGS) and other agencies need to develop or assist the states and local governments in developing updated and more accurate floodplain maps taking into account watershed development and identifying zero rise floodways. Congress needs to support such efforts.

6. FEMA, the Corps, USGS and other agencies should continue to improve dissemination hazard maps and other flood-related data. U.S. Fish and Wildlife Service, state water resource and wildlife agencies, and state Heritage programs should improve dissemination of maps and other data pertaining to natural and beneficial functions. Ideally, such data should be in digital form and easily accessed over the Internet. Federal floodplain, wetland, and other mapping efforts are moving in this direction and this direction should be continued.

7. The Corps needs to more carefully take into account natural hazards in its Section 404 and Section 10 permitting. More detailed guidance should be provided to staff concerning the assessment and mitigation of natural hazards.

8. The Corps and FEMA should prepare "how to manuals" for state, local, and federal floodplain managers concerning wetland, riparian habitat, and floodplain functions and values and measures to reduce the impacts of projects on these areas.

9. The Corps, U.S. Environmental Protection Agency, USGS, NOAA, USDA Natural Resources Conservation Service and other agencies should provide training to wetland and floodplain managers at all levels of government concerning the identification of natural hazards and techniques to reduce and avoid natural hazard losses. Hazard managers should be trained in protecting and restoring wetlands, riparian zone, and floodplain functions.

10. The Corps, Bureau of Reclamation and other federal and state agencies should more broadly incorporate floodplain open space protection and restoration measures into water projects (e.g. the Charles River Project) This could both better protect floodplain functions and reduce flood losses at all levels of government.

11. Post-disaster teams should identify wetland, riparian area, and floodplain restoration opportunities and implement restoration in post disaster contexts. Post-disaster interagency teams at all levels of government should move quickly to identify restoration opportunities after flood and hurricane disasters. Priority restoration opportunities and sites should be identified. Funds and technical assistance should then focus on priority areas. Additional, earmarked funding is needed from Congress for such efforts.

12. All levels of government should help relocate development after disasters. All levels of government could help relocate development and infrastructure out of coastal and inland floodplains as part of recovery. Such efforts could target repetitively damaged structures. For example, tens of thousands of flood-damaged structures were relocated out of the floodplain as part of recovery efforts from the Great Flood of 1993 along the Mississippi and tributary rivers.

13. All levels of government and the private sector should reflect sea level rise in floodplain mapping, the design and construction of levees and sea walls, the establishment of elevation and flood proofing standards for residential, commercial, and industrial buildings, and other floodplain management efforts at all levels of government. Federal, state, and local governments should zone floodplains as open space to permit wetlands to migrate inland as sea level rise occurs.

FLOODPLAIN MANAGEMENT 2050: THE VALUES OF RIVERINE AND COASTAL FLOODPLAINS

John McShane
U.S. Environmental Protection Agency

Introduction

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. Despite the expenditure of billions of tax dollars trying to control floodwaters, mostly with structural measures such as dams and levees, flooding remains the greatest threat and most persistent natural hazard facing our nation. It is now widely recognized that naturally functioning floodplains contain an abundance of water, biological, and cultural resources that are of immense value to the nation. However, the cumulative economic, ecological, and social costs of the structural approach to reducing flood losses (since at least the early part of the last century) have been significant. These costs have been incurred nationwide, but more significantly in some regions of the country than others. Clearly, formulating and implementing a new, or more effective paradigm for floodplain management at this time will have numerous economic, social, and environmental benefits for communities, as well as the nation, by 2050 and beyond.

In his 1942 dissertation, *Human Adjustment to Floods: A Geographic Approach to the Flood Problem in the United States,* Gilbert White recognized both the hazards and resources of floodplains when he advocated "…adjusting human occupancy of the floodplain environment so as to utilize most effectively the natural resources of the floodplain, and at the same time, of applying feasible and practicable measures for minimizing the detrimental impacts of floods." There is a strong consensus among floodplain managers, as well as other resource managers, that to achieve the vision of Gilbert White a more comprehensive, watershed approach to reducing flood losses that is both economically and environmentally viable is needed, not just in the United States but in other countries around the world also experiencing unacceptable flood losses.

Floodplain Management 2050

Floodplain management encompasses two co-equal goals – reducing the loss of life and property caused by floods *and* protecting and restoring the natural resources and functions of floodplains. These goals were clearly stated in the 1994 document *A Unified National Program for Floodplain Management* prepared by the Federal Interagency Floodplain Management Task Force. This document, and the report *Sharing the Challenge: Floodplain Management into the 21st Century* published at the same time, emphasize the importance of formulating and implementing policies and strategies that would reduce flood losses while not impairing the natural resources and functions of riverine and coastal floodplains. Since that time, a number of organizations, committees, government agencies, local and state officials, etc. have come to recognize the importance and benefits of embracing these goals and implementing these strategies in a timely manner.

With global climate change continuing, it is anticipated that by 2050 there will be sea level rise of at least a few inches, mostly due to thermal expansion. With warmer waters and higher storm surges

likely increasing to mid-century (and beyond) the impacts on coastal property, infrastructure, community integrity, as well as natural resources such as wetlands, could be devastating and costly.

Efforts to protect coastal floodplains, especially wetlands, are therefore critical. One of the most important functions of coastal wetlands is providing a natural buffer that slows down and dissipates waves and storm surges from hurricanes, a critically important function that protects a community's infrastructure, as well as individual property owners along the shore.
In addition to being ecologically productive, coastal wetlands (including estuarine and freshwater tidal wetlands) also provide significant value by controlling shoreline erosion, improving water quality, and providing habitats for a wide variety of flora and fauna. It is significant that although a "no net loss" of wetlands has been achieved nationwide, there is a still a net loss of coastal wetlands.

Relative to their size, coastal wetlands are one of our most valuable natural resources, for both economic and environmental reasons. Because of the numerous benefits they provide, increasing our efforts to protect and restore these valuable "gems" of our coastal landscape will provide a long-term return on our investment.

The change in weather patterns from global climate change will also likely bring more frequent flooding to rivers and streams in some regions of the country, (and long-term drought in others) adversely impacting property, infrastructure, and the health of communities.

Recommendations
Therefore, to achieve the vision of Gilbert White and the goals of floodplain management the following recommendations, that can be implemented in the near term to achieve results by 2050, are submitted for consideration:

(1) That an interagency Water Resources Coordinating Council be (re)established that will address both water quantity and water quality issues, as well as floodplain management.

(2) That the 1977 Executive Order 11988 *Floodplain Management* be updated and revised to reflect the growing risks to life and property from flooding as well as the benefits of naturally functioning floodplains. The E.O. should also promote an institutional change that will encourage federal agencies to have "no adverse impact" on the built and natural floodplain environment in the implementation of their programs.

(3) In 2005, a National Research Council committee published a report "Valuing Ecosystem Services" which evaluated the effectiveness of various methodologies of determining the economic values of aquatic and related terrestrial ecosystems. This report was an excellent first step towards assessing and valuing the services provided by aquatic ecosystems and floodplains. However, a follow-up study should be conducted to provide meaningful data on the actual relative values of aquatic ecosystems and coastal and riverine floodplains that can be used by decision makers at all levels of government, as well as the private sector.

(4) The NFIP should encourage communities to adopt a "zero-rise" floodway and that their efforts need to be recognized by other federal agencies such as EPA for the water quality, groundwater recharge, wetlands protection, and other benefits that would accrue from such a designation. In

addition, the NFIP should consider the consequences of global climate change when updating or creating new flood maps relative to sea level rise and increased inland flooding and that insurance rates be adjusted to reflect the risk. In addition, coastal erosion should be reflected on flood maps and in flood insurance rates.
(5) That coastal and riverine floodplains be viewed as "green infrastructure" that can provide numerous services or functions such as conveying floodwaters, improving water quality, providing wildlife habitats, etc. at relatively little or no cost to local and state governments.

In conclusion**,** protecting and restoring the natural resources and functions of riverine and coastal floodplains will help to reduce flood losses as well as ensure the long term sustainability and integrity of natural systems, as well as our cities and towns. Although there will always be a need in some communities for structural measures to protect lives and property from flooding, the benefits and values derived from a "living river" as well as coastal resources such as wetlands, should be assessed and that information shared with decision-makers at all levels of government, as well as the private sector.

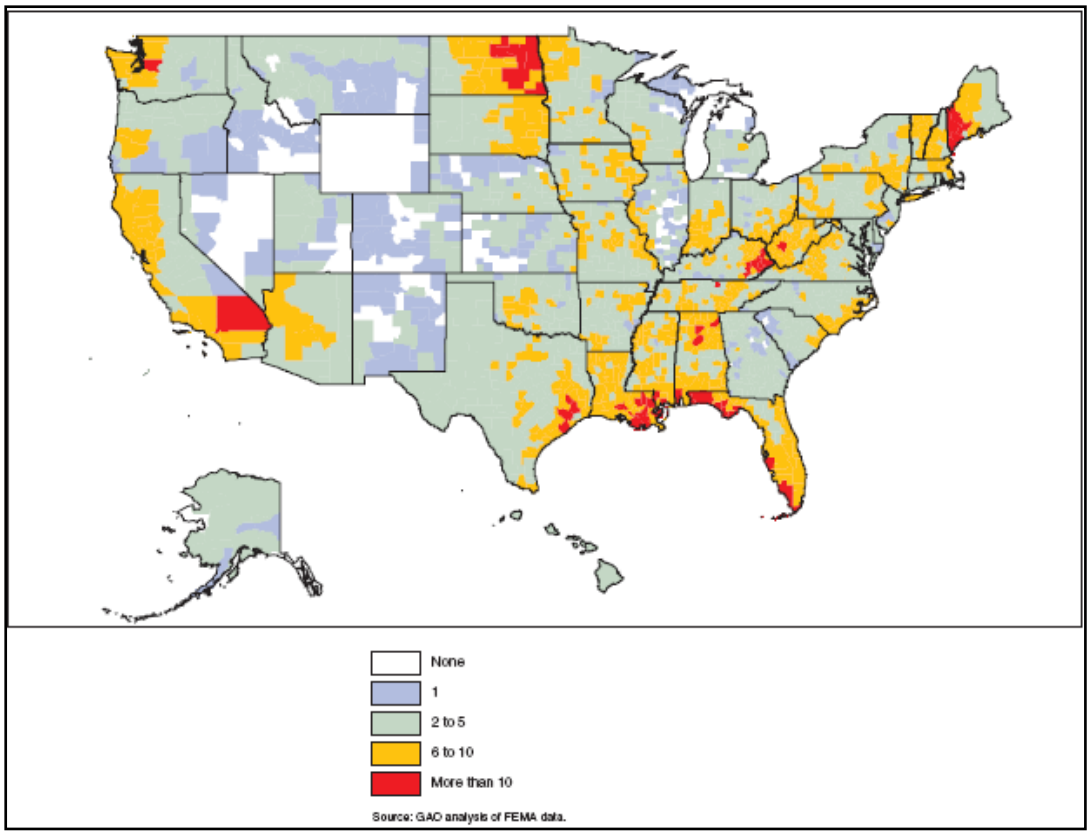
THE DOW IN 2050—IT'S NOT ABOUT STOCKS ANY MORE

Dale A. Lehman, PE, CFM
URS Corporation

Programs affecting water policy and ultimately floodplain management and water quality in the United States are distributed across a number of federal agencies. State and local floodplain managers must deal with these separate programs to cobble together a consistent and integrated floodplain management strategy at the local level. This can be very difficult at best and in many instances nearly impossible.

Flood losses continue to increase at an alarming rate. This trend is not limited to the Hurricane Katrina impact area. The following graphic from the U.S. Government Accountability Office's (GAO's) August 2007 report on Natural Hazard Mitigation shows just how much flood risk there is the nation.

GAO completed a detailed examination of flood mitigation strategies in their August 2007 report on Natural Hazard Mitigation. Their findings and the state of integrated floodplain management and water policy at the national level can be summed up in the complete title to their report, *Natural Hazard Mitigation: Various Mitigation Efforts Exist, but Federal Efforts Do Not Provide a Comprehensive Strategic Framework*.



Number of Major Flood Disaster Declarations by County, 1980-2005

Effective floodplain management and mitigation requires collaboration between state and local government with a number of federal. If you begin to look at the number of federal agencies with floodplain management and water policy programs that the local officials must work with, you can begin to see the challenge that they face. The table below provides just a few of the agencies and some of their programs that can impact local floodplain management.

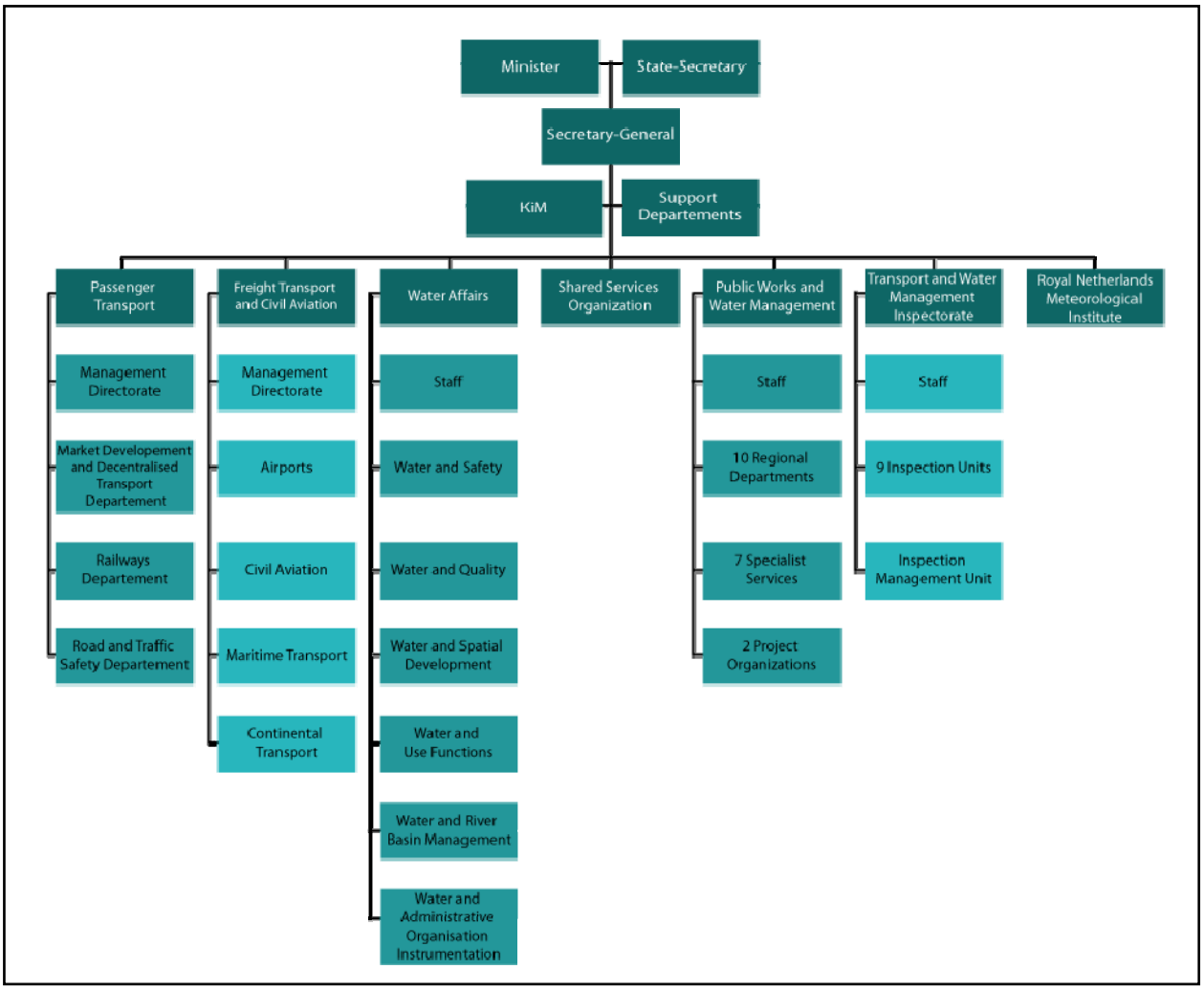
Agency	Example Water Programs
US EPA	Watershed Management, Nonpoint Source Pollution (CWA – Section 319), NPDES, TMDL
USACE	Civil works flood control, wetlands, navigation,
NRCS	Rural flood control, emergency watershed protection
FEMA	NFIP, hazard mitigation, disaster recovery
NOAA	National Estuary Program, Coastal Zone Management
USGS	National Stream Flow Information Program

In the GAO August Report, they stated that federal agencies collaborate on floodplain management and hazard mitigation efforts "through a variety of informal mechanisms such as teleconferences and discussions." However, when you begin to look at the number of agencies and considering that the list in the above table represents six different cabinet level organizations, it is no wonder that GAO concluded that "these efforts are fragmented and do not provide a comprehensive national strategic framework for mitigation" and that flood damage in the nation has risen by a factor of four since the early 1900s.

This fragmentation of national flood and water policy makes it difficult to ensure that the federal government is effectively identifying hazard risks and that those undertaking floodplain management and mitigation efforts are working collectively. Further, without an integrated framework, federal efforts may not be leveraging resources and developing synergies (e.g., with watershed management and water quality initiatives) across the various programs to accomplish common national hazard reduction goals.

This fragmentation of floodplain management and water policy at the national level is a leading factor in this alarming trend. Models do exist that can guide change to provide a fully integrated policy and more effective programs.

In the wake of the devastation from Hurricane Katrina, many federal agencies looked to the Netherlands for different approaches to flood risk management. The nation looked to the Netherlands because of their effective and innovative flood risk management program. One fundamental difference between the Netherlands and the United States is that nearly all of their water policy programs are housed in one ministry, The Ministry of Transportation and Water Management. This ministry was founded in 1877 with components (e.g., The Rijkswaterstaat which is "the national agency that provides dry feet, clean and sufficient water and a quick and safe flow of traffic") that date back to 1798. The organizational structure for this ministry is presented below:



In the United States, and in just looking at water aspects of this ministry, it would take more than seven cabinet secretaries and more than 8 federal agencies to coordinate the water programs and policy that are integrated and managed by this single organization.

In implementing floodplain management and water policy at the local level, this Ministry coordinates with 27 Local Water Boards throughout the Netherlands. The Water Boards are among the oldest government authorities in the Netherlands. They literally form the foundation of the whole Dutch system of local government. The Boards have the responsibility for water management for the residents of their area. It has always been in the common interest to keep water out and polder residents have always had to work together. That is what led to the creation of water boards. It is important to note that the Boards borders do not coincide with municipal borders which allows for more regional and watershed approaches to floodplain management and water policy.

The unification and integration of the water and flood programs at the national level in the Netherlands leads to a consistent national approach that is well connected for implementation at the local level. This in turn has lead to the success of that country's flood risk management program in the face of extreme flood hazards.

That is the vision that the United States should have, a consistent fully integrated national strategy. The GAO has called for this in its August 2007 report. However, the GAO fails to point to a much needed consolidation of programs into one fully integrated cabinet level department, the United States Department of Water (DOW).

The DOW should consolidate water and floodplain management programs and staff from the many agencies that are currently doing this function. This needs to include water quantity, quality, environmental, and navigation programs so that truly multi-objective management and economic impacts can be factored into the national water policy.

In the wake of the September 11th terrorist attacks in the United States, it was decided that fragmented efforts and programs across a myriad of federal agencies should be consolidated into the Department of Homeland Security (DHS). The thought behind the Executive and Legislative branches of government to implement this consolidation was to provide a fully integrated approach to national security that could be more effectively coordinated with state and local government.

This transition has not been easy and the DHS integration continues to be refined. The consolidation of water and floodplain programs into the DOW would also be a difficult task. However, when you look at the attack that was the driver for integrating national security into a single cabinet level department, and compare the every day, ever present flood risk in the nation (The GAO figure at the beginning of this report and average annual flood losses in excess of $6 billion), it is clear that we need change.

The nation will receive multiple attacks from floods each and every year and the only way to combat this risk is through a fully integrated approach. GAO in their August 2007 Report on Natural Hazard Mitigation recommended that "To more effectively identify natural hazard risks, minimize the effects of hazards before they occur, and reduce overall future hazard losses to the nation, we recommended … (the development and maintenance of) … a national comprehensive strategic framework for mitigation that incorporates both pre- and post-disaster mitigation efforts."

This cannot be fully realized with the current fragmentation of programs at the national level. Furthermore, implementation at the local level without a single integrated voice is also nearly impossible. Consequently, the United States should consider consolidating its programs into the DOW similar to the Dutch model. This process needs to begin soon to have a robust and fully integrated program by 2050 that will greatly reduce the current level of flood risk in the nation.

TOWARD A CLIMATE-WATER COALITION

Mark Limbaugh
The Ferguson Group

The topic of climate change has dominated the news around the world during much of the past year, and has been hotly debated for the past 20-years. As the climate change/global warming debate continues, most of the discussion has focused on mitigation of greenhouse gases from human-made sources, with very little emphasis on adaptation as a strategy for dealing with a warming climate—especially when it comes to possible future impacts on our water supplies.

At the **World Water Week** forum held this past August in Sweden, climate change impacts to water supplies were the main subjects of concern and discussion from the over 2,000 international participants. Anders Berntell, executive director of the Stockholm International Water Institute, welcomed participants, saying, "Together we try to advance efforts related to water and sanitation, the environment, livelihoods and poverty reduction. " What becomes apparent," Berntell said, "is that climate change hits us first through water. Too much or too little water, at the wrong time, at the wrong place. And I don't think that anyone can say that my country, or my city is prepared," he said. And, according to Berntell, as the population grows, by 2050, double the current amount of food will be needed to feed the global population, which also doubles the amount of water needed to produce that food. "We are not prepared to deal with the implications this has for our planet," warned Berntell.

Although mitigation may be important in dealing with global climate change in the very long term, the fact remains that, even if CO2 emissions are reduced to the optimal levels today, our climate will not begin to react for 50 or 60 years. In fact, according to Intergovernmental Panel on Climate Change models, over the next 25-years the embedded warming commitment is approximately a 1°C increase, regardless of any changes in greenhouse gas emissions.

The impact of climate change on western water supplies is fast being considered one of the most complex and difficult challenges of the next 50 years. These impacts will not favor one water use over another—all water users may suffer, from cities and towns, to farms and ranches, to industry, to the environment. The expense of doing nothing to prepare for such impacts will be tradeoffs (i.e., winners and losers) in affected watersheds. The environment will suffer if predicted floods and droughts intensify, destroying habitat and placing additional burdens on water resources in the watershed to lessen the impacts. The battle with a changing climate will not be fought entirely in Washington, D.C.. Successes will depend on local and regional efforts to deal with the problem, because projected impacts will be different and unique for each situation.

During the past decade, western water resources have already been under tremendous stress from a variety of sources: population growth, environmental needs, extended drought, aging infrastructure, and increased conflict and crises over water management and allocation—even without factoring in the predicted future impacts of climate change. Yet federal funding for water-related programs and partnerships continues to erode, especially compared to the looming challenges for western water, the more than $100 billion investment in water infrastructure over the past 100 years, and the need for collaboration through public-private partnerships at the local level, combining limited federal and state resources to help tackle these issues.

The time for action is now; and, fortunately, there is a way to prepare, innovate, and avoid those costly tradeoffs that could spell disaster in some watersheds in the West. This paper recommends

that local and regional water providers and stakeholders form a Climate-Water Coalition that will advocate for the federal authorization, funding, and public-private partnerships to adapt our water systems and improve our predictive capabilities to address the impacts of climate change to all our water uses, both today and tomorrow. Composed of municipal, industrial, and agricultural water providers, environmental groups, state and tribal governments, and other allied stakeholders in the West and other regions, the Climate-Water Coalition would pursue congressional and federal agency strategies to develop localized predictive modeling capabilities and pursue adaptive approaches that will deal with the impacts of climate change on western water supplies.

Many reports and studies have recently been published regarding climate change—water supply impacts in the western United States, including studies from the American Water Works Association Research Foundation, the Natural Resources Defense Council, the Intergovernmental Panel on Climate Change, the Western Governors' Association, and the Family Farm Alliance, just to name a few. Some of the findings of these reports and predicted future impacts to western water supplies include:

- Smaller snowpacks and earlier snowmelt;
- More extreme flood events, forcing changes to flood control releases;
- Higher evaporation and evapotranspiration rates;
- Fewer groundwater resources;
- More intense drought conditions for longer periods;
- Diminished water quality, affecting aquatic ecosystems and species as well as potable water supplies; and
- Energy, recreational, and navigational impacts.

Although most of these reports and studies analyze the possible impacts of a warming climate, predict probable outcomes, and offer recommendations, few offer focused solutions that identify actions that the federal government can invest in today with the goal of measurable results.

When managing climatic impacts to water supplies in the West, water managers at the local, regional, and state levels must focus on adaptation as the key to future success. And, in order for adaptation to work, several foundational actions involving federal agencies will be crucial.

The Climate-Water Coalition would, in conjunction with the western state and local governments, help focus and direct congressional and federal agency activities to authorize (when necessary), fund, and implement, through partnerships with states, tribes, water providers, and others, prioritized, measurable, and effective action items that will ensure successful results in an adaptive approach. The following action items are tailored to produce such results.

The Climate-Water Coalition will focus on three primary goals:

- **Water Infrastructure for Today and the Future:** Design and implement—through local, regional, and state/federal partnerships—construction of both short-term and long-term, high-priority water supply, water management, and environmental/habitat enhancement water infrastructure that is deemed necessary to meet the challenges of climate change to western water supplies.

- **Knowledge and Understanding:** Develop accurate climate-water predictive models that are watershed specific; complete, and implement local, regional, and statewide water planning through local leadership and federal support.
- **Technologies for the Future**: Through federal investments in focused research partnerships, develop the "next generation" of water treatment and desalination technologies.

Water Infrastructure for Today and the Future

Water management facilities for improved supply and environmental enhancements must be designed and constructed in order to help meet the challenges of climate change impacts to local and regional water supplies, yet federal funding levels for this work have not kept up with these requirements. Existing water management and storage infrastructure may also need newly constructed upgrades that would allow local and state water managers even more flexibility in immediately dealing with climate change impacts to people and the environment. In their report, *In Hot Water—Water Management Strategies to Weather the Effects of Global Warming*, the NRDC states, "Increased investments in water efficiency represent a sound and basic 'no regrets' water management approach to future climate change impacts." Well over half of all federal water management and storage facilities in the western U.S. are over 50 years old—with many over 100 years old—yet there are many opportunities for these "no regrets" water management improvements to be designed and built. Improving the effectiveness of these existing facilities through technology upgrades will be essential to meeting today's water needs while effectively adapting to the future impacts of climate change. As uncertainty over these impacts and the demands for water continue to grow, there are significant concerns that much of this older infrastructure will not be able to handle these demands.

Investing in new, water management and environmental improvements, along with the application of advanced water management technology through upgrades to existing facilities, can add new flexibility, realize energy savings, increase the use of renewable energy sources, and increase control in the management of existing water resources. These investments will also allow for more effective, state-based water management tools (water marketing, water banking, supply augmentation, surface/groundwater conjunctive management, etc.) to be used to better adapt to the impacts of climate change, such as meeting unmet water needs or protecting aquatic species and the environment.

New water management and conservation facilities should be a part of adapting to climate change impacts, and might include constructed wetlands in strategic areas to improve aquatic habitat while capturing and storing untimely runoff into groundwater management and storage basins for future use; increased storage capacity at existing water storage structures; or construction of regulating storage facilities to improve water delivery efficiencies. These new projects will need expedited appraisal and feasibility design and engineering work, as well as environmental compliance studies, to determine estimated design and construction costs, identify multiple benefits and the appropriate federal cost-share, and allow for integrated water resource planning efforts with state and local entities.

Goal. Increase local, regional, and state water management capabilities through federal participation in funding/financing partnerships in the design and construction of new water management and environmental enhancements; increase use of water recycling, reuse, and conservation in high priority climate-sensitive areas; modernize existing water facilities to

increase flexibility and control in water management; and increase coordination of federal programs and priorities through public-private partnerships at local, regional, and state levels with cost-sharing partners.

Coalition Actions.

- Authorize and fund Bureau of Reclamation cost-shared grants for climate change-related water projects that enhance existing water supplies through infrastructure improvements to water and energy efficiencies, conservation, management, environmental enhancements, state-sanctioned water markets, and other tools.
- Increase the federal investment in the highest priority water recycling and reuse projects in areas of the West most impacted by climate change through authorization and funding of projects through the Bureau of Reclamation's Title XVI Program.
- Provide blanket authorization and criteria for the Bureau of Reclamation and the U.S. Army Corps of Engineers to participate in, fund, and/or finance cost-shared state and local partnerships for the design and construction of new water management, conservation, and environmental enhancement water projects, prioritizing those identified as "no regrets" projects (projects that will produce positive results regardless of climate change impacts) but considered critical to successful climate change adaptation strategies; develop, authorize, and fund innovative financing tools (such as federal tax credit bonds, targeted federal infrastructure revolving funds, etc.) to leverage local and state funds to construct such water infrastructure projects.
- Fully fund the Bureau of Reclamation's Safety of Dams program, Water Conservation Field Services program, Loan Guarantee program, and other water infrastructure-related programs necessary to modernize existing facilities to adapt to climate change and meet future water needs.

Knowledge and Understanding

Improved understanding and knowledge of existing water supply inventories, the interrelationships between surface and groundwater resources, and the impacts of predicted climate change on watersheds will be critical to water managers at all levels as they adapt to and manage for climate change and endeavor to improve the reliability of future water supply for people and the environment. Most recent studies on climate change and water supply suggest that federal agencies must focus on vulnerabilities and improve knowledge-based data collection. Current predictive models for climate change are useful in illustrating general areas of impact, but are not particularly accurate at the local or regional scale. In particular, the Western Governors' Association report, *Water Needs and Strategies for a Sustainable Future,* calls for improvements in data collection, predictive models, and climate change impact assessments, emphasizing enhanced watershed planning efforts that factor in such impacts. And, the Natural Resources Defense Council report, *In Hot Water—Water Management Strategies to Weather the Effects of Global Warming,* stresses the need to carefully consider an integrated regional water management approach to climate change response.

Goal. In partnership with state and local entities, develop an accurate understanding of climate change impacts on water resources through committed, well funded federal data collection programs, enhancing hydrologic modeling capacities to be accurate at the local and regional watershed scale. Focus and direct federal policies and programs to support state and

local integrated water resource planning; fund and complete feasibility-level planning for climate-change-affected water supply and environmental projects in partnership with state and local entities.

Coalition Actions.

- Direct the U.S. Geological Survey and the National Science Foundation to work in partnership with state and local entities in completing a western water census that would characterize both ground and surface water resources for the West.
- Increase the federal investment in data collection (USGS streamgage/cooperative water programs, Natural Resources Conservation Service Snotel, and National Oceanic and Atmospheric Administration-National Weather Service Cooperative Network)—including implementation of advanced measurement technology in the field, thereby increasing efficiencies and reducing operating costs.
- Direct NOAA, the National Aeronautic and Space Administration, and the USGS to support coordinated partnerships with state and local entities in climate-water research that can improve predictive climate-water modeling capabilities, producing watershed-scale models that can be more useful to water managers in the longer term.
- Direct the Bureau of Reclamation and the U.S. Army Corps of Engineers to support locally led federal/state partnerships in climate change-related water resource planning and integrated regional water supply enhancement studies. Integrate key federal programs and priorities with state/local water supply and use planning efforts when dealing with climate change impacts.

Technologies for the Future

Water treatment and management technologies have been steadily improving over the past several decades, but more must be done to improve and deploy "state of the art" technology. Researching and developing new, more effective water management technologies can result in much needed water management improvements throughout the West. For example, improving the availability of new geospatial management products using space-based GPS, mapping, remote sensing, and satellite thermal-band technologies could improve the conjunctive management of ground and surface water supplies, aid in reducing some of the negative impacts of climate change to the environment, and help to reduce the demand for water for farms and cities while adapting to and dealing with predicted climate change impacts.

Water desalination may become an important part of future regional water supply portfolios in certain areas of the West, particularly where coastal communities can utilize seawater desalination or where remote inland communities can take advantage of brackish groundwater deposits. However, the current state of the technology is not yet competitive to alternative supplies. Investing in the targeted research and development of "next-generation" water treatment technologies could allow new, cost-effective water treatment methodologies, together with environmentally sound brine disposal techniques, to be made commercially available and implemented. Reducing the cost of water treatment, particularly in areas of the West where water is impaired but available, will improve water supplies and help many western communities adapt to climate change impacts.

Goal. Increase federal investment and partnerships in the research and development of "next-generation" water treatment and water management technologies to help meet the challenges of climate change impacts to water supplies in the future.

Coalition Actions.

- Direct federal funding and investment to targeted priority research, development, and testing of innovative water management technologies, such as remote sensing, geospatial and GPS management tools, and SCADA systems. Work through the USGS, Bureau of Reclamation, and U.S. Army Corps of Engineers grants to state and private research universities.
- Direct federal funding and investment to targeted, coordinated priority research, development, and testing of advanced water treatment technologies, with an emphasis on energy savings, new membrane technologies, and innovative desalination techniques, working through the grant programs of the USGS, Bureau of Reclamation, Environmental Protection Agency, Department of Energy, Department of Defense, and the U.S. Army Corps of Engineers.

Conclusion

The impacts of climate change on sensitive western water supplies, although not thoroughly understood today, will significantly challenge all water users in the West—municipal, industrial, agricultural, and environmental—in the near future. Preparation to invest and adapt in the management of western water supplies in order to meet these challenges should begin today—before crises, before conflict, and before there are winners and losers. The Climate-Water Coalition should be focused to provide specific outcomes to address these future impacts and to successfully accomplish these goals.

WHY HAVE WE FAILED TO INTEGRATE NATURAL RESOURCES MANAGEMENT AND FLOODPLAIN MANAGEMENT?
Congress' Fractured Jurisdiction Limits Program Integration

David R. Conrad
National Wildlife Federation

Ecologists point to the "natural and beneficial functions" of floodplains as providing many basic services to human society that we value and depend on in a variety of ways, but we often overlook, ignore, damage, and even eliminate them in the course of developing our floodplains. Natural floodplain functions are generally aggregated into eight broad categories

(1) provision of natural flood and erosion control,
(2) water quality maintenance,
(3) groundwater recharge,
(4) biological productivity,
(5) habitat for fish and wildlife,
(6) areas for harvest of wild and cultivated products (e.g., forestry, enhancement of agricultural lands, aquaculture sites),
(7) areas for recreational opportunities, and
(8) areas for scientific study and education.

Examples of our failure to integrate wise and far-sighted natural resources management with thoughtful floodplain management are legion. For much of the past century, the nation ditched, drained, leveed, jettied, bulkheaded, filled, and otherwise developed millions of acres of biologically productive wetlands and riparian and coastal shorelines, many of which today are severely degraded and now support huge amounts of property and population at-risk of significant and potentially catastrophic flooding.

We need look no further, however, for how profound the effects of such failures can be than to contemplate the massive deterioration of critical coastal Louisiana wetlands that were nature's "infrastructure" and at one time served to buffer coastal Louisiana communities from impacts of coastal storms while also providing the critical ecological underpinnings for much of the region's economy and culture. These wetlands are now in such a degraded state that it will cost society and the nation enormous sums of money and decades of focused effort just to begin to reverse the losses that already have occurred. But failure to make these investments would likely just compound the problems our descendents would otherwise have to face.

There are probably many reasons why we often fail to make the critical connections that would link active efforts to protect and restore natural floodplain values with our other floodplain management activities (which continue to focus primarily on the protection of floodplain development and property). But the recent National Flood Insurance Program (NFIP) reform legislation provides a case in point that Congress' committee structure may have itself become one of the most formidable obstacles to wise floodplain and water resource management, causing key water resource programs to be diffused and disjointed,

and failing to view basic water resources in a holistic, multi-dimensional fashion that is necessary to meet both human and ecological needs.

The congressional jurisdiction over the NFIP is now lodged in the Senate's Banking, Housing and Urban Affairs Committee and the House's Financial Services Committee, whose principal duties are overseeing the nation's programs relating to regulating the financial services sectors and housing. Understandably, in the wake of Hurricane Katrina and the first two back-to-back "catastrophic loss years" (2004 and 2005) for the NFIP, the principal focus of these two committees was the abysmal financial condition of the National Flood Insurance Fund. The resulting bills, so far, have focused primarily on long-needed reforms in the areas of phasing out subsidized flood insurance for certain classes of older buildings and buildings with substantial histories of flood losses and claims, and on the need for updating and improving and expanding the types of areas covered by flood hazard maps. The House, responding to constituents' calls for help as private sector insurance companies are increasingly reluctant to renew or sell new coverage for hurricane and wind-related damages, chose to direct FEMA to add a whole new line of wind-related insurance to federal flood insurance, potentially placing the NFIP in a much more precarious financial position than even at present.

Although the wind issue continues to be controversial and it is unclear how it will ultimately be resolved, what is clear is that the legislation remains focused almost exclusively on property protection and financial risk management (for the nation's real estate and financial sector, as well as controlling the federal government's exposure), but the bills steer fairly wide of addressing improvements in better coordinating and managing the natural and beneficial functions of floodplains.

While the original 1968 National Flood Insurance Act called for a flood insurance program that should be **"integrally related to a unified national program for floodplain management"** and to **"encourage state and local governments to make appropriate land use adjustments to constrict the development of land which is exposed to flood damage,"** it seems that the "unifying" of the nation's floodplain management will likely continue to be elusive, in part, because of the difficulty in gaining a broader perspective and approach. For the NFIP, this can probably best be explained by recognizing that the "frame" of Congress' banking committees is generally not to focus on the physical and biological attributes of floodplains, but mostly on the financial and building-related aspects. With a few modest exceptions, this has been the pattern with previous NFIP legislation.

Again, even the most obvious pieces of a unified program are spread so widely that it would be exceptionally surprising to see any good coordination. The major hazard mitigation programs are now lodged in House Transportation and Infrastructure Committee and the Senate Environment and Public Works Committee, the same committees that have jurisdiction over Corps of Engineers flood damage reduction programs that still principally rely on flood protection works as the main "adjustment" approach, and which often substantially alter and damage floodplains' natural and beneficial functions. The hazard mitigation programs are often given less attention than the much larger transportation and water development programs they administer, and historically these committees have been no more inclined to "encourage state and local governments" to adjust their land use to constrict

floodplain development, than the Banking Committees have been. They are, however, generally much more aware of fish and wildlife, water quality, and habitat-related concerns.

The major creation of the Department of Homeland Security, which now houses FEMA, and the new House and Senate Homeland Security Committees has increased the complexity of policymaking, but in the wake of Hurricane Katrina, these committees held important hearings that focused attention on how the failure to protect Louisiana wetlands was a factor in increasing vulnerability to Louisiana populations.

Finally, other committees, such as the House Agriculture Committee, House Natural Resources Committee, House Energy and Commerce Committee, and Senate Agriculture, Nutrition and Forestry Committee, Senate Energy and Natural Resources Committee, Senate Commerce, Science and Transportation Committee, and Select Committee on Indian Affairs, all have critical roles and programs that affect the nation's floodplain management. Congress' Appropriations Committees and Subcommittees further define what programs are actually funded. Altogether these committees create and oversee hundreds of programs affecting the shape of floodplain development and conservation. But even 40 years after Congress sought to have a unified approach to floodplain management, the nation's approach may be even less unified than it was in 1968. Interestingly, more than 60 years after *Human Adjustment to Floods,* we clearly have developed more and better "human adjustment" tools to implement a unified plan, if we had the will and a framework in which to do it.

Given the fundamentally fractured nature of water resources-related jurisdiction, the growing challenges and threats posed by the impacts of global warming and sea-level rise, and the fact that we continue to lack a plan that could serve as a unified national program for enlightened management of the nation's floodplains, many of the goals of floodplain management – flood loss reduction, reducing the cost of disaster relief, reducing fatalities and human suffering, promoting wise land-use and protecting and restoring the natural and beneficial values of floodplains – may remain beyond reach. Water resources need to be approached holistically. Congress and the Administration should consider development of a Floodplain Management Act that brings these goals together in a unified program. Congress should also consider consolidating some of its water resource jurisdictions to bring natural resources management together with other elements of flood programs.

Part 4

Flood Insurance and its Economic Implications

WHO WILL PAY FOR FUTURE HURRICANES?

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As the second anniversary of Katrina approaches, residents in hurricane-prone areas are still concerned that they cannot obtain insurance to cover damage to their homes from future disasters. Specifically, the decision by State Farm, Mississippi's largest insurer, to discontinue selling new policies on homes and small businesses there has sent shock waves beyond the state. Banks that normally require homeowner's insurance as a condition for obtaining a mortgage are also not sure what impact this will have on their clients' ability to buy such coverage.

The insurer's motivation is economic. Rates are regulated by the states, so insurers are often restricted in the premiums they can charge. In addition, State Farm faced a lawsuit contending it was liable for flood losses from Hurricane Katrina. Homeowners' policies cover only losses caused by wind in such storms; flood coverage is provided by a separate policy as part of the National Flood Insurance Program. The state of Mississippi, however, charged that insurers were responsible for hurricane damage from Katrina because surging floodwaters were caused by the wind. State Farm eventually won the case, but it was a costly process and led to its decision to discontinue selling new policies.

State Farm's decision is only the tip of the iceberg of a much broader problem: how this country can reduce future losses from natural disasters and aid victims in their recovery efforts. Because of increasing development in hazard-prone areas and the effects of climate change, we are in a new era of catastrophic losses from natural disasters.

Ten of the 20 most costly natural disasters have occurred during the past five years —all 10 of them hurricanes, typhoons, or tropical storms.

The four hurricanes in Florida in 2004 (Charley, Frances, Ivan, and Jeanne) collectively totaled more than $29 billion in insured losses; Hurricane Katrina is estimated to have cost insurers and reinsurers $45 billion.

At the same time, victims have complained about receiving substantially less than the actual costs of rebuilding or repairing the damage. Many have turned to the Small Business Administration for low-interest loans; however, a property owner is eligible for a loan only if he or she can show the ability to repay it. Hence, low-income residents must find other assistance.

We need a new approach to financing the costs of natural disasters and to encouraging individuals in hazard-prone areas to undertake mitigation measures. Two principles, which appear to conflict with each other, are guiding a large-scale research study being undertaken by the Wharton Risk Center in conjunction with Georgia State University and the Insurance Information Institute (as well as with firms and organizations from the public and private sectors, some of whom pay for this research).

- **Principle 1: Risk-Based Premiums.** Insurance premiums should be based on risk to encourage individuals to reduce their vulnerability to catastrophes.
- **Principle 2: Dealing With Equity and Affordability Issues.** Any special treatment given to lower-income residents in hazard-prone areas should come from general public funding and not through artificially low rates.

Principle 1 is important because it provides a clear signal of relative risk to those living in areas subject to natural disasters, as well as those who are considering moving into these areas. Risk-based premiums also enable insurers to give discounts to homeowners and businesses who invest in cost-effective loss-reduction measures. If the premiums are not risk-based, insurers have no economic incentive to offer discounts. In fact, insurers forced to charge artificially low premiums prefer not to offer coverage because it is a losing proposition in the long run. More generally, those living in hazard-prone areas should have safer structures and buy enough insurance to cover their losses from a future disaster.

Principle 2 reflects a concern for low-income residents in high-hazard areas who will face large premium increases if Principle 1 is followed. Today, in many Gulf Coast states, premiums in regions subject to hurricane damage are highly subsidized because of rate regulations imposed by state insurance commissioners. If insurers are permitted to charge risk-based premiums, homeowners in hurricane-prone areas will pay considerably more for coverage than they do today.

To deal with the affordability issue, the state or federal government could provide some type of insurance vouchers to low-income residents. It could work like the food stamp program, in which families are given vouchers to buy food based on income and size of family. A homeowner in a hazard-prone area would pay an insurance premium that reflects risk, and then get reimbursed by the state for part of the increased cost. The amount of reimbursement would be determined by income and the premium charged. Under such a voucher system, insurance could reward individuals for undertaking risk reduction measures by lowering premiums.

Principle 1 gives us a better chance of making our hazard-prone areas safer and affordable.

Principle 2 implies that we as a society need to recognize that all taxpayers will have to bear a share of this cost. Rather than waiting for the next catastrophe, we can take constructive steps now to protect those in harm's way. In the process we will reduce the likelihood of having to deal with another Katrina-like disaster.

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A PROBABILISTIC APPROACH TO FLOODPLAIN INSURANCE AND MANAGEMENT FOR THE NEXT 50 YEARS

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Insurance can be a much improved mechanism to manage the economic impacts and realities of floodplain management, especially as we face the potential for dynamic and evolving climate trends.

The current situation of the federal flood program is outdated and does not utilize new advances in risk management and other related technologies.

The ability to significantly raise the bar in determining and assigning flood loss costs to an ongoing flood risk management program exists today and could be implemented in a reasonable timeframe.

The current technology is more suitable for coastal risk assessment as opposed to rising river flood events. Technology for much of the coastal flooding risk quantification is incorporated in the windstorm risk assessment models currently being utilized in the insurance industry and other governmental agencies. Due to the existence of the federal flood insurance program, little investment has been made to extend to flood risk assessment.

Good information about property locations and elevations is more available today as new technologies have come on line and have had reductions in cost.

The opportunity to significantly upgrade the risk assessment process and also obtain economic value analysis for different risk options is on our threshold.

Existing Flood Risk Determination

Existing floodplain designation is a tiered deterministic process

- Establishment of the 100 year floodplain,
- Tiering as properties get closer to the water,
- 25 year timeframe for loss assessment – too short,
- Process can be significantly improved with current technologies.

A probabilistic approach is achievable and provides significantly more information to make decisions and trade-offs.

Expanding Existing Knowledge to Assess Flood

Coastal flooding losses are often intertwined with windstorm losses. Moving to a risk based analysis will encourage private market participation in flood risk and potentially remove the wind vs. water arguments which exist due to the bifurcated market.

A project to determine the appropriate loss costs for coastal flooding (more exposed to potential climate change) could be accomplished in 2 years for a cost of $20 million. Technologies to capture improved location data already exist in some parts of the country, LIDAR, GPS, etc. Focus on the key areas first and do manageable projects. Other countries have information as they have undertaken studies as well.

Quantifying the Economic Impact is the Key
The economic calculations for flood risk need to start with probabilistic loss costs. Correlation with other risks needs to be understood. How to align with "capital factors" and also align with environmental and other factors is a deep pool which needs suitable tools.

A phase-in process will need to be created as risk rates will likely be very different than current in many situations(both high and low). Public market products should be bare bones to discourage moral hazard issues.

The benefits of an upgraded, more market-based program are

- Better economic incentives for coastal risk,
- Economic calculation of mitigation effects,
- Ability to overlay other environmental concerns in a numerical framework,
- Make value based decisions in grey areas,
- Geographic normalization for tough relocation issues,
- Improve the information and delineation of flood risk,
- Provide a basis for a potential river flooding project.

There are many aspects of current flood risk assessment which can be improved to provide better economic signals. Incorporating these in a market based product can be helpful, but obtaining a better quantification of the risks and the potential benefits of actions can provide great information to our overall eco-system.

A CONCEPTUAL APPROACH TO FLOODPLAIN MANAGEMENT IN 2050

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PBS & J

Gilbert F. White's 1942 dissertation, *Human Adjustments to Floods*, forms the basis of our current floodplain management system. The tenets of this document remain strong and valid today, nearly seven decades later.

However, there is a strong negative reaction against existing floodplain management practices. Both the public and public officials often feel that the average homeowner is burdened by common provisions such as mandatory flood insurance for federally-backed loans, building elevation requirements, and substantial damage/improvement provisions. In areas served by levees, there is often an unrealistic confidence in the levee system, and a single-minded focus that the levee is "the" way to prevent flood damage. Finally, the immediate benefits of many actions in the floodplain, including lower cost and economic development, are often weighed to be more important than the potentially much larger, but uncertain costs of flood damage.

The current floodplain management system in the United States is burdened by a number of issues:

1) The need to explain and accurately convey reasonably complex technical issues to the general public and public officials. For example, the concept of the "100-year flood" is widely misunderstood. Given the normal turnover in elected officials and the small amount of time the average citizen spends thinking about floods, the educational effort required to maintain minimal societal understanding of floodplain management concepts is very significant.
2) Complexities associated with flood insurance, including the fact that it is not a part of standard homeowner's insurance. Other complexities include the reliance on the Lowest Adjacent Grade to determine the need for insurance, but the Lowest Floor elevation to rate the premium for the policy.
3) The National Flood Insurance Program (NFIP) does not have a diverse risk pool. This means that the program largely insures those at high or moderate risk, and contains very few low-risk policyholders to offset risk to program. This is evidenced by the enormous indebtedness of the program following Hurricane Katrina.
4) Although a movement in that direction is afoot, NFIP insurance premiums are not strictly actuarially-based, and the degree to which rates can rise are capped.
5) The need for continuous flood map updates to accurately reflect risk, the associated cost of these updates, and the collection and maintenance of the data required for the updates. Central to this is that the NFIP is not sufficiently self-supporting to pay for all of these maintenance needs, and is thus dependent on appropriations to develop essential technical information.
6) Persistent budget crises at all levels of government, making it difficult to finance necessary studies or projects.
7) Difficulties relaying *all* the relevant information to the average citizen or elected official to allow them to make informed decisions. For example, the average citizen may well

assume that the levee near their home is fine because it looks well-maintained and has not failed in past storm events, but it may in fact be fatally comprised by underseepage issues. Only a very vigilant and involved resident would even be aware of such issues in most cases, and even fewer would understand the potential consequences.

8) A short-term economic disincentive for participation in risk management activities, such as obtaining flood insurance, but long-term consequences to those same decisions. This encourages "playing the odds."
9) The binary nature of floodplain mapping today, where a single line on the map determines which structures are "in" and which are "out" rather than a gradation of levels of risk as exists in the real world. This same nature also means that levees and other flood control structures are often built and maintained to only the minimum level required to eliminate flood insurance requirements.
10) Social and societal issues, including an increasingly transient population lacking the localized geographic memory of our predecessors. In short, we as a society often no longer live in a single place long enough to learn of all the risks in the area, or to have long-term memory of past events.

As we move towards 2050 and beyond, our floodplain management philosophies and techniques must change to adapt to broad societal trends, and the weaknesses of our current system. One potential concept of a floodplain management program for 2050 is detailed below.

The central tenet of the conceptual floodplain management program is that flood insurance would be mandatory for every structure and piece of infrastructure in a community. In a flood, the community suffers losses for destroyed roads, bridges, and infrastructure, as well as municipal buildings. The citizens of the community suffer losses for their personal and business structures. All must be repaired or rebuilt. Requiring mandatory flood insurance eliminates the current arguments over "in versus out of the floodplain." Mandatory flood insurance also greatly increases the risk pool, making it feasible for the risks to be absorbed by the insuring entities.

Another change proposed here is that the flood insurance would be purchased at the community level, rather than the individual household or business level. This would allow several key benefits. First, the risk for the community would be pooled. Second, the community could either seek the best price available alone, or go in with other communities as a pool to achieve a better price. Third, there would be a strong economic incentive for communities to enact strong floodplain management ordinances, and many of the provisions of the Community Rating System to achieve a lower rate. And, fourth, because the insurance would be paid through the community, it could be passed on to the citizens in the form of property taxes, which are usually tax-deductible, as opposed to premiums, which are not. Additionally, the community-based payment system would integrate well in communities with existing stormwater utilities. The cost of the program would also include fees to be collected to cover administration and risk analysis. While there would no doubt be cries that this is an unfunded mandate, the reality is that the current floodplain management system is in effect an unfunded mandate on citizens who are placed at risk by bad governmental decisions, and on society as a whole to bail out those who flood.

Another key feature of the proposed program is that flood insurance would probably be provided by private companies rather than the NFIP. While private companies have historically been adverse to providing flood insurance, several structural changes would make that more feasible,

including a larger risk pool, fully actuarial rates, and perhaps the use of the NFIP as a re-insurer. Privatizing the flood insurance would also insure competition and best market pricing, and would de-politicize the process to at least some extent. It would be critical to the success of this new process that the minimum insurance standards are consistent everywhere, as are the technical standards for determining risk.

States would be the primary developer and keeper of technical data under this plan. Operating on a rolling five year basis funded by fees collected through the communities, the states would analyze flood risk in detail. The flood maps developed would of course be entirely digital, and instead of reflecting a binary in or out of the floodplain status, would reflect the continuum of risk to allow for accurate rating. A consistent funding source, and a consistent pattern of remapping would allow for robust programs to be developed and sustained at the state level, and would take advantage of the leverage provided by existing state data, as well as new data developed for the process. States would also administer a grant program designed to encourage responsible pre-disaster mitigation, and to provide relief for economically distressed communities.

Under the proposed program, the federal government would set the requirements for technical analysis to be consistent across the nation, and would provide technical and administrative assistance to the insurance and grant programs.

The program proposed above would also result in increased public education about floods, because the matter of flood insurance would be a key item on the budget of every community. Rather than arguing the in or out status of each house in the floodplain, neighborhoods could be discussed as a whole, and well-planned programs developed to mitigate risk. As noted above, communities would have a strong financial incentive to enact appropriate floodplain management standards. Poorly planned development would result in near-immediate cost increases to the community. Thoughtful, well planned development could not only continue, but could have the effect of reducing the community's rates by offsetting older existing risk. Insuring infrastructure along with commercial and residential structures would also encourage better "hardening" of structures and disaster preparedness.

GOVERNMENT AND CAPITAL (AND INSURANCE) MARKETS: ACHIEVING THE BALANCE

Pat Borowski
National Association of Professional Insurance Agents

The Parties in Control of Effecting Solutions

Katrina demonstrated in great human suffering terms to all in this country just how many and deep the shortcomings are in the comprehensive natural catastrophe (NAT-CAT) response system/network – and the magnitude of the price that we pay for ignoring these. In the view of the National Association of Professional Insurance Agents (PIA) most if not all these issues have raised their ugly head in one or more ways, more or less over the years in previous disasters. Lessons that became evident in these past events and interest in improving and adding to needed solutions had tragically short life spans, especially in the ongoing attention and commitment of governments to cooperatively and continually act to solve and mitigate.

PIA believes that there are challenges in four major areas that need to be addressed:

- Federal/state/municipal response, partnership and responsibility as they relate to immediate disaster relief/response, first-stage recovery, ongoing economic redevelopment efforts, and long-term prevention/mitigation efforts.
- Sufficient, flexible state reserving for temporary insurable interests that develop because of the effects of long-term NAT-CAT impacts, stemming from insurance related circumstances.
- Full recovery requirements for disaster victims
- The staged-recovery of private insurance markets in adversely affected states.

By demonstrating some of our suggested ideas in response to just the first challenge, one will see how the organization of these suggested solutions provide a structure upon which governments and private markets can build more effective responses to the other noted challenges.

Challenge #1 - Federal/state/municipal response, partnership, and responsibility as they relate to immediate disaster relief/response, first-stage recovery, ongoing economic redevelopment efforts, and long-term prevention/mitigation efforts.

A federal system is legally required and functionally necessary to coordinate and ensure that disaster reserve funding among governments is in place and available when these needs are called upon. Improvements are necessary to the current system, as expressed under the federal Stafford Disaster Assistance Act. The distribution of financial and mitigation responsibilities between and among federal government, states, and municipalities' greatly needs to be updated, more clearly articulated, improved, and properly funded. Given the size of events over the last years, additional government-capital reserve programs are needed.

These reserves can in part be supported by a newly formed private capital and/or municipal bonds market, addressing governments' estimated insurable interests for anticipated events, as well as additional capital access when events exceed estimated reserves. The balance would

come from required state capital reserve amounts set by states and the federal government as a part of participating in this program.

The fund would provide the governments with money for disaster relief, disbursing the money as needed and to the extent required by the circumstances to include line-of-draw-down-credit for immediate needs, long-term financing for spent funds, and required reserves for future long-term recovery projects and future events.

While governments cannot stop disasters from occurring, governments are uniquely authorized to act and impose actions that mitigate the severity and scope of loss to their people and property. The new federally backed program would require a carrot and stick approach.

Because this concept centers on NAT-CAT recovery funds, insurable and unique NAT-CAT related financial needs of governments and flowing into the redevelopment government monies, capital markets will require several fundamental elements be present:

- A clear line of investment earning recovery for investors, i.e. – how do their investors get paid and make money?
- What additional "rating" factors would bond/capital markets need to financially assess these new capital risk factor?
- These markets can't replace federal obligations, and if we have another Katrina, these investing programs can't go bust, because no one would & why should anyone invest, so where's the backstop?

The PIA looked at the current Federal Depositors Insurance Corporation (FDIC) and federal Terrorism Risk Insurance Act (TRIA) programs for possible guidance. In both programs, the federal government is adding a discipline to the players in that "protected" marketplace so as to increase the best chances for mitigating the monetary severity impact to the existing federal government reserves should the worse happen, because the federal government is still the obligated backstop.

The FDIC program is based on two things. First, FDIC shows citizens that a bank has their money "covered" should anything go wrong. Second, the FDIC insurance "underwriting" assessment program evaluates (as well as sets) standards of financial soundness and quality banking operations. This creates a per account cost to the bank for the FDIC insurance and provides another level of safety from banks going under.

In TRIA, the federal government acts in two major capacitates. First, it actual creates the terrorism coverage provided, thus standardizing the terms and conditions upon which potential future claims would be paid. This permits both the federal government and private insurers to "know" what they are insuring under TRIA. Second, it provides a federal backstop should losses exceed per affected carriers and per industry aggregate totals, i.e. carriers don't go down should "the big one hit" and investors are saved.

In this additional federal NAT-CAT fund, the federal government will set government mitigation standards and then with each state customize the details of these standards to reasonably anticipated exposures of the state, region, and may include some national aspect (i.e. repay the

U.S. Treasury note for a Katrina-like hit to reserves). A financial proposal is developed covering these costs that includes

- Federal monies being made available and/or will be made available should needs arise.
- State and municipal funds required to "match" their sharing for the cooperative federal funding.
- Additional/unique state plus municipal insurable interests/exposures that arise in the aftermath of a NAT-CAT experience.
- Plan of state as to what portion of their estimates that they will fund by direct state designated reserve funding.
- How federal government will capitalize their portion direct from federal budget reserving into a designated account.
- Then a government NAT-CAT capital markets/bond proposal is developed and presented to the money markets.
- Federal government declares at what level they will "backstop" the system.

The broad spectrum of mitigation standards are exclusively under the authority of governments to establish, impose, fund, and update as needed. The federal government should encourage the promulgation of such standards by requiring states to mandate adoption of these standards by local municipalities. While no effort can eliminate natural events from happening, governments have the greatest ability of all parties to limit damage and save lives through mitigation programs. The carrot and stick from the federal government is this:

- Participation is required in order for states to access the full long-term recovery federal funding of government projects (al la using the successful model of federal highway bills' successful approaches).
- States are expected to resolve any disagreements between and among their municipalities v/v those that wish to counter, challenge or change agreed to mitigation standards, projects, timelines, funding and the like.
- Government program response to treat particular social needs exceptions in a separate manner al la using the successful model of federal-state-municipal cooperative programs for housing incentives, rent subsidies etc.
- Mitigation standards will include per se building codes.
- However, mitigation standards' rating factors also include;
    - Effective inspection régimes.
    - Public works projects meeting quality standards & completion timelines
    - Land-use restrictions/requirements
    - Set/control of local variance permissions/authorities – more common protocols
    - Formalize state-to-local NAT-CAT comprehensive planning.
    - Others as may be needed.

Far more than imposing per se building code requirements are necessary. Individual structures built to the strictest codes alone does not a mitigation program make. Further mitigation is also needed in related and directed government decisions and actions. These comprehensive mitigation standards may also provide a more uniform guide for capital markets to use/refer to in their government bond/money market ratings.

NFIP FINANCIAL STABILITY: TIME TO CONSIDER ALTERNATIVES TO CURRENT MODEL OF FUNDING NFIP CAT CLAIMS

Jo Ann Howard
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Proposal

Members of the 110th Congress and the investigative and auditing agencies of the Legislative and Executive Branches of the United States, with the assistance of the National Flood Insurance Program (NFIP), should examine whether the current model for financing the flood insurance program—through premiums, fees and U.S. Treasury borrowing in high-claims years—should remain the sole method for funding catastrophic loss year claims.

The history of NFIP financial record demonstrates its soundness and the program should not be considered in need of major financial reform. However, at this pivotal time in the program's history, it is prudent to consider all alternatives for funding "spike" or catastrophic loss years using financial mechanisms combined with the program's sole current outside funding source: the U.S. Treasury. Congress and FEMA should consider various alternatives for fiscal viability while retaining the original intent of keeping flood insurance rates affordable for purchasers of NFIP coverage, thereby contributing towards pre-funding their recovery from flood disasters.

NFIP Historical Financial Condition

Gilbert White's work laid the foundation for the federal flood insurance program, which Congress created with the passage of the National Flood Insurance Act of 1968.[1] This Act established the NFIP, which provides an alternative to federal disaster relief for individuals living in flood-prone areas, promotes positive land use decision-making and reduces the overall cost to government for recovery due to flooding. The NFIP provides flood insurance to some 4.8 million homeowners, renters, and business owners in over 20,118 participating communities generating $2.2 billion in premiums.[2] The NFIP remained self-supporting from 1986 until 2005, covering all expenses and claims payments out of cash flow of policy premiums and fees.

When income generated from insurance premiums and investments was insufficient to pay all claims in heavier loss years, the NFIP borrowed from the U.S. Treasury to cover losses and other expenses in the short term.[3] The National Flood Insurance Act of 1968, as amended, permits the NFIP to borrow from the Treasury and repay principal and interest.[4] Amounts borrowed in higher than "average loss years" were fully repaid, with interest, thus causing no net impact on taxpayers. Operating losses occurred between the years of 1972-1980 and in 1983, 1984, 1989, 1990, 1992, 1993, 1995, 1996, 2004, and 2005.

In 2000, the NFIP proposed to the Office of Management and Budget (OMB) that alternative financial funding mechanisms be considered for catastrophic loss funding of NFIP claims in addition to the authority to borrow from the U.S. Treasury; however, the OMB did not proceed with such an inquiry.

Current NFIP Debt/Liabilities

As a consequence of the 2005 tropical storms and hurricanes, massive flood claims overwhelmed the NFIP. There were 27 named storms that year, of which 14 were hurricanes, including Wilma,

Katrina, and Rita. The Congressional Research Service estimated in early 2006 that the NFIP would need about $3 billion in additional borrowing authority to cover flood insurance claims.[5] Incurred liabilities from the 2005 events were estimated at $23 billion (almost double the total amount paid over the NFIP's 38-year existence), exceeding the $2.2 billion in premiums earned annually by the NFIP and its former $1.5 billion borrowing authority from the U.S. Treasury.[6] In 2005, in order to meet the flood insurance claims payment obligations, Congress enlarged FEMA's ability to borrow from the Treasury from $1.5 billion to $3.5 billion, then to $18.5 billion through fiscal year 2008 to help fund claims from the 2005 hurricane season. The Director of FEMA's Mitigation Division stated in 2006 that it was highly unlikely that the program could generate sufficient revenues to cover a debt of this size.[7] Disaster experts and government economic analysts agree that the NFIP would not be able to repay the current debt, which as of June 2007 stands at $17.5 billion and is expected to grow over $900 million based on current flood insurance policies and subsidy rates.[8]

Future Financial Risks Considered Significant

In 2007, the Director of Natural Resources and Environment reported that the effects of climate change on weather-related events and, subsequently, insured and uninsured losses, could be significant.[9]

Average global surface temperature has risen over the past century and climate models predict even more substantial, perhaps accelerating, increases in temperature in the future. According to the Intergovernmental Panel on Climate Change (IPCC), observed increases in temperature in the past 100 years cannot be explained by natural variability alone.[10] Rising temperatures are expected to increase the frequency and severity of damaging weather-related events, such as flooding, although the timing and magnitude are as yet undetermined. The growth in population in hazard-prone areas and resulting real estate development have increased liabilities for public and private insurers and help explain the increases in property losses.[11] Flood-related property losses have almost doubled in the past decade.[12] In fact, the NFIP's total coverage has quadrupled from 1980 to 2005, nearing $1 trillion.[13]

Because infrequent and catastrophic weather-related events pose challenges to insurers due to their unpredictability and potential to overwhelm insurers' capacity to pay claims, the GAO recommended that a strategic assessment of the potential implications of climate change for the major federal insurance programs would help Congress manage an emerging high-risk area with significant fiscal implications.[14]

Market Alternatives for Smoothing Financial Impact of Catastrophic Losses

In addition to strategically assessing the potential implications of climate change on the federal flood insurance program, all financial mechanisms for managing the government's exposure of insured flood losses should be explored.

Global warming raises the question of the role of public and private sectors in managing risks and providing protection to potential victims. An interdisciplinary collaboration between multinational insurers, academic researchers, and scientists from the U.S., Canada, and Germany are studying sets of decision-related tools for insurance managers faced with direct and indirect effects of climate change. Existing insurance programs and the government should join the effort by exploring financial instruments to transfer risks not only to other insurers through reinsurance

or the federal funds, but also to the capital markets, which have the capacity and willingness to take on insurance risks.

In 2002, the U.S. House of Representatives Subcommittee on Oversight and Investigation, Committee on Financial Services looked at natural disaster exposures and the use of capital markets as a way to spread risk beyond the traditional insurance markets through mechanisms such as catastrophe bonds, risk-linked securities, and traditional reinsurance products.

To develop a catastrophe bond, a sponsor (usually an insurance or reinsurance company but could be banks) creates a special purpose reinsurance vehicle (SPRV). SPRVs receive payments in the form of insurance premiums, interest and investor principal, then invest in the Treasury and other highly rated securities to pay out investors in the form of interest.

Reinsurance provided through catastrophe bonds (Cat bonds) are non-indemnity based. This means they are structured to make payments to the sponsor upon a verified occurrence of specified catastrophic events. The payments are based on pre-agreed financial formulas. The payments from the investor's principal to the sponsor are triggered by an event that meets an objective index or measure such as wind speed in the case of a hurricane. In this way, investors avoid exposure to the risk that the sponsor or primary insurer has a high-risk insurance portfolio. Capital markets have precedence in the securitization of other risks, such as mortgages, credit card receivables and other types of cash flow. Although the securitization of insurance risk is not a cure-all for the funding of catastrophic risk, it should be considered as an addition rather than a replacement of NFIP funding sources for high-level catastrophe risks. Supplementary funds raised through capital markets could support additional risk identification, including floodplain mapping, and help the NFIP remain a financially viable program.

Endnotes

1 42 U.S.C.S. §§ 4001-4129 (Lexis Supp. 2006).
2 Rawle O. King, Congressional Research Service, *National Flood Insurance Program: Treasury Borrowing in the Aftermath of Hurricane Katrina*, CRS Report for Congress, RS22394 (June 6, 2006).
3 *Id*.
4 42 U.S.C.S. §4016(a) (Lexis Supp. 2006). The interest rate fluctuates based on the size of the note.
5 *See* King, *supra* note *2.*
6 *Id*.
7 David M. Walker, United States Government Accountability Office, *Challenges for the National Flood Insurance Program*, Testimony before the Chairman, Committee on Banking, Housing and Urban Affairs, United States Senate, GAO-06-335T (January 25, 2006).
8 Congressional Budget Office, *Value of Properties in the National Flood Insurance Program*, (June 2007).
9 John B. Stephenson, United States Government Accountability Office, *Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant*, Testimony before the Select Committee on Energy Independence and Global Warming, United States House of Representatives, GAO-07-820T (May 3, 2007).
10 Working Group I, Intergovernmental Panel on Climate Change (IPCC), *Fourth Assessment Report of the State of Climate Science: The Physical Science Basis of Climate Change*, (forthcoming Nov. 2007), *available at* http://www.ipcc-wg2.org. The IPCC also reported an updated 100-year linear trend of 1.3 degrees Fahrenheit.

11 *See* Stephenson, *supra* note 9.
12 Alex Frangos, *U.S. Launching a Massive Effort to Redraw Nation's Flood Maps*, WALL STREET JOURNAL, Sept. 19, 2003 at A1.
13 See Stephenson, *supra* note 9.
14 *Id*.

Part 5

Understanding, Delineating, and Communicating Flood Risk

IMPROVED DELINEATION OF COASTAL FLOOD HAZARDS

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Christopher Jones and Associates

Identifying and evaluating human adjustments to floods first requires knowledge of the flood hazards, and in coastal areas, this includes knowledge of waves, erosion and long-term changes in water levels and sediment supply. Present mapping methods consider wave effects (wave setup, wave heights, wave runup, wave overtopping) and dune/bluff erosion during the 1% annual chance flood event – they do not consider waves and dune/bluff erosion during other flood frequency events[1], nor do they consider the effects of long-term changes in water levels, sediment supply, shoreline position and topography-bathymetry that are known to affect coastal flood hazards.

Of course, taking all these factors into consideration when coastal flood maps are drawn is largely beyond our capabilities at present. In one way or another, we tend to lack the necessary coastal process knowledge, data, models, computational capacity, budget, and time necessary to identify and delineate coastal flood hazards accurately. This is not to say that recent, post-Katrina developments in coastal flood hazard modeling and mapping on the Gulf coast are lacking – it is a recognition that despite the tremendous effort, time and money being expended on new coastal flood hazard maps, the resulting maps could be out of date in the near future.

Speaking as an outside observer, it seems that there are two possible paths that we can follow:

- Continue to invest ever increasing resources into model development and operation with each new coastal Flood Insurance Study (which probably means it may be decades before we revisit these maps), or
- Make use of existing fast and relatively inexpensive models on an as-needed basis, so that maps can be updated frequently.

Choosing the second path may actually allow us to free-up our mapping resources and devote a greater portion to improving methods to characterize and predict water levels, wave effects, and shoreline erosion. At some point in the future – probably decades from now – we may have the ability to put all this together and to quickly produce detailed, accurate coastal flood hazard maps. I do not think we are at that point today.

I propose that in many coastal studies it is of greater benefit to use simpler (but validated) models and Monte Carlo methods to estimate the water level and wave statistics, and to assess erosion effects across several flood frequencies, than it is to use the most sophisticated and resource-intensive models to estimate a water surface in great detail over a large, essentially static ground/seafloor surface, where we cannot account for storm effects on that ground/seafloor surface.

So, where does that leave us? The development of coastal models (storm surge, waves, and process-based erosion) is important and should go forward, with an eye toward integrating those models. But that does not mean that all this work is necessary for the production of coastal

FIRMs and for the delineation of coastal flood hazards. Despite our best efforts and most sophisticated models, there is much uncertainty in the results. Why not recognize the uncertainty and disclose the *range* of likely shoreline locations and flood elevations and wave conditions to the coastal public?

There has been much work devoted to uncertainties associated with flooding and the determination of spatial probabilities of flooding (e.g., see Davis, 2004; Smemoe, et. al, 2007). Perhaps it is of greater value to us to map flood elevation probabilities in more detail in coastal areas. Perhaps it is of greater value to us to map probabilities of erosion (e.g., Jones and Rogers, 2002). Perhaps we should produce a series of flood hazard maps taking sea level rise into account. The point is, even though we are bound by certain requirements when producing FIRMs, there should be no reason why we can't provide other information to communities that gives them improved hazard information.[2]

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Endnotes

1 This is changing gradually. FEMA issued guidance (September 7, 2007) for mapping the wave envelope along transects during the 0.2% annual chance event, determined the dune cross-section to prevent dune removal during the 0.2% annual chance event, and modified its WHAFIS model to allow for 0.2% annual chance wave height calculations. See FEMA Procedure Memorandum 47 at http://www.fema.gov/library/viewRecord.do?id=2923 .

2 The LiMWA (Limit of Moderate Wave Action – 1.5 ft breaking wave height) line being included in a Mississippi DFIRM layer is one example of providing more information to communities. Other information is also needed.

CALIFORNIA'S FLOOD RISK NOTIFICATION PROGRAM

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Legislative Statute
In October 2007, California Governor Arnold Schwarzenegger signed into law Assembly Bill No. 156 which requires the California Department of Water Resources (DWR) to provide written notice to each landowner whose property is determined to be within a levee flood protection zone, starting in September 2010 and annually afterwards. The bill would also require DWR to prepare and maintain maps for levee flood protection zones and authorize DWR to revise the maps to include updated information.

Program Description
In the Governor's fiscal year 2007-08 budget the Department of Water Resources (DWR) proposed a "Flood Risk Notification Program" for properties protected by the 1,600 miles of state-federal levees (project levees) in the Central Valley.

The cost of the Risk Notification Program is estimated at approximately $1 million per year and will involve the effort of approximately 2.5 personnel years and the assistance of a team of consultant engineers. This estimate does not include the cost of developing Flood Risk Notification Maps and detailed floodplain mapping.

The major technical components of the program include the following:

1. Development of approximate and detailed Levee Flood Protection Zone (LFPZ) maps for areas protected by 1,600 miles of Project Levees.
2. A database of parcel information and property owners that are within the LFPZ.
3. A letter sent (with an LFPZ map) on an annual basis to each property owner stating that their property is protected by a Project Levee or Levees. Ultimately, this letter will identify a specific depth of flooding for their property if that levee were to fail. The letter would also state the expected damage to their property based upon that depth of flooding, the type of structure, and the replacement value the structure. The letter will encourage the property owner to consider adopting a set of mitigation strategies which include the purchase of flood insurance, flood proofing of the structure, development of a personal evacuation plan, and other specific flood damage reduction strategies or activities.

This program will expand in scope and detail over the next 5 years as DWR develops a better understanding of the potential flood hazards associated with the Project Levees. In the initial years, the information contained in the notifications will be based on "approximate" technical data and will be limited to notification of as to whether a parcel is likely in or out of a flood zone. As more technical work is done, the notifications will be based on "detailed" technical data and will present more extensive information that is related to the potential depth of flooding.

Levee Flood Protection Zone (LFPZ) Maps
A critical technical component of the Flood Risk Notification Program is the LFPZ maps. DWR will be using the concept of best available data for this program. Information from several sources is currently available, including: FEMA floodplain maps, FEMA Q3 data, the most recent regional study completed by USACE – Sacramento and San Joaquin River Basins California Comprehensive Study Interim Report, December 20, 2002 (Comp Study), and local project-level studies. These sources provide "approximate" technical data that will support the initial stages of the program.

DWR is in the process of launching an aggressive 5-year program to prepare detailed floodplain mapping for the areas protected by the Project Levees. This effort includes new topography, new hydrology (including acknowledgment of climate changes), new hydraulic models, etc. This work will greatly enhance DWR's understanding of the hydraulics of the system. The results will provide extensive new "detailed" information that will serve as a base for the Flood Risk Notification Program for many years.

While the detailed floodplain mapping effort is underway, DWR is utilizing the information and models from the Comp Study to advance the understanding of the potential flood risk. However, the modeling effort performed as part of the Comp Study does not always provide reasonable results. Some model runs under-estimate the potential flooding in certain areas because the runs included multiple levee breaks in upstream reaches thereby removing volumes of water from the system. DWR is in the process of analyzing the Comp Study results and updating the models to provide as much interim benefit as possible.

Parcel Information Database
There are several sources of digitized parcel data available to DWR. Every county maintains assessor parcel information in various levels of detail. The Project Levees span fourteen (14) counties and impact approximately 200,000 parcels. Several private vendors also maintain databases of this information. It is likely that DWR will utilize one of the private vendors that maintain GIS-based real estate databases. Some of these vendors utilize county assessor data as well as data maintained by title companies, which is updated frequently. These databases include a significant amount of parcel information including: ownership, size, zoning, structure type, and value.

Flood Risk Notification
The ultimate goals of the DWR annual notification program will be to (1) educate parcel owners and as well as the inhabitants (renter, leases, employees, etc.) as to the potential flood hazards associated with each individual parcel and to (2) encourage the property owner and occupants to consider adopting a set of mitigation strategies which include the purchase of flood insurance, flood proofing of the structure, development of a personal evacuation plan, and other specific flood damage reduction strategies or activities, and (3) promote coordination with local floodplain administrators.

As the program develops, the level of specificity is anticipated to increase. However, the process used to generate and distribute the notification letters will likely remain relatively constant. Utilizing GIS technology, the parcel information will be intersected with LFPZ information and notification letters will be automatically generated.

The following types of information that may be included in the notifications:

- Parcel number
- Type of structure
- Assessed value of structure
- Levee(s) providing protection to the parcel
- Whether or not the parcel is exposed to potential flooding under several flow conditions
- Source(s) of potential flooding
- Depth(s) of potential flooding
- Approximate cost of potential flood damage
- Directions as to how to contact their local floodplain administrator
    - Local emergency response information
        - Evacuation plans, emergency services, etc.
    - Flood insurance information
- Guidance on information sources for flood damage reduction and mitigation strategies

Ultimately, the LFPZ maps may also be available to the public via the internet. A web-based application may be developed to allow the public to enter a parcel number and have the flood risk notification program information displayed.

GENESIS AND EVOLUTION OF NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S FLOOD INUNDATION MAPPING SERVICES

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Victor Hom
Pedro Restrepo
National Weather Service

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Introduction

The Intergovernmental Panel on Climate Change (IPCC) will complete its Fourth Assessment Report (AR4) entitled "Climate Change 2007" for the World Meteorological Organization and United Nations Environment Programme this fall and include findings from Working Group II: Impacts, Adaptation and Vulnerability, which cited twelve impacts to North America. These impacts include increased risks of flooding, droughts, sea-level rise, and heat waves. It is critical to recognize these impacts, continue to monitor the trends, and take appropriate measures consistent with the vision of the late Gilbert White to integrate science-based, non-structural approaches to floodplain management.

National Oceanic and Atmospheric Administration (NOAA) is engaged in a spectrum of activities designed to address these issues. Most notably, under the Advanced Hydrologic Prediction Service (AHPS) and the Water Resources Programs, NOAA's National Weather Service (NWS) plans to modernize services through infusion of new science and technology, improve flash-flood and seasonal freshwater forecasts, quantify forecast uncertainty, produce more accurate and timely forecasts and warnings, and develop more visually oriented products. An emerging and important component of this modernization effort is NWS partnered activities to develop flood inundation map libraries. A plan to address the needs of floodplain managers was unveiled in the last Gilbert F. White National Flood Policy Forum. NOAA now has 17 flood inundation map libraries to better convey flood risk and help bridge the gap between floodplain management and flood forecasting. The development of additional libraries and future work towards inundation forecasting will assist the Nation to better mitigate flood impacts, respond to future challenges, and make more informed floodplain management decisions.

Flood Inundation Map Libraries

NOAA's NWS and National Ocean Service (NOS) Coastal Services Center (CSC) have partnered with Federal Emergency Management Agency (FEMA) and United States Geological Survey (USGS) to develop inundation map libraries for inland freshwater flooding. These libraries are comprised of inundation maps which provide information on the spatial extent and depth of water for various flood levels, ranging from minor flooding to the largest flood on record. The impetus for the creation of these libraries in the vicinity of NWS river forecast locations grew from user requirements and The Inland Flood Forecasting and Warning System Act of 2002, Pub. Law No. 107-253, 116 Stat. 1731 (2002), codified at 15 U.S.C. § 313c,drafted

in the wake of Hurricane Floyd, and championed by Representative Bob Etheridge (2nd District NC).

Outreach activities conducted with Claes Fornell International Group, including two national Customer Satisfaction Index Surveys, helped establish and validate requirements for inundation mapping within NOAA's Hydrology Program. An objective was to determine whether the NWS flood severity index satisfies the user's needs. Although emergency managers and users expressed familiarity and understanding of the NWS flood severity categories, they strongly believed the communication of risk and understanding of NWS flood indices would be enhanced through flood inundation maps. Map libraries, combined with river observations and forecasts, provide decision makers information needed to better plan for and respond to floods. Given this, the NWS will incorporate all future libraries in NOAA's NWS AHPS web portal (http://www.weather.gov/ahps/).

Figure 1. Example of the National AHPS Home Page

NOAA recently completed work with the State of North Carolina, FEMA, and USGS to develop map inundation libraries at 17 NWS river forecast locations. These libraries are accessible through AHPS at http://www.weather.gov/ahps/inundation.php . This effort was partly motivated by PL 107-253, which authorizes NOAA to conduct activities to improve inland flood forecasting; develop a new flood warning index; train and educate officials regarding improved forecasting techniques and an inland flood warning index; and assess previous flood and erosion trends.

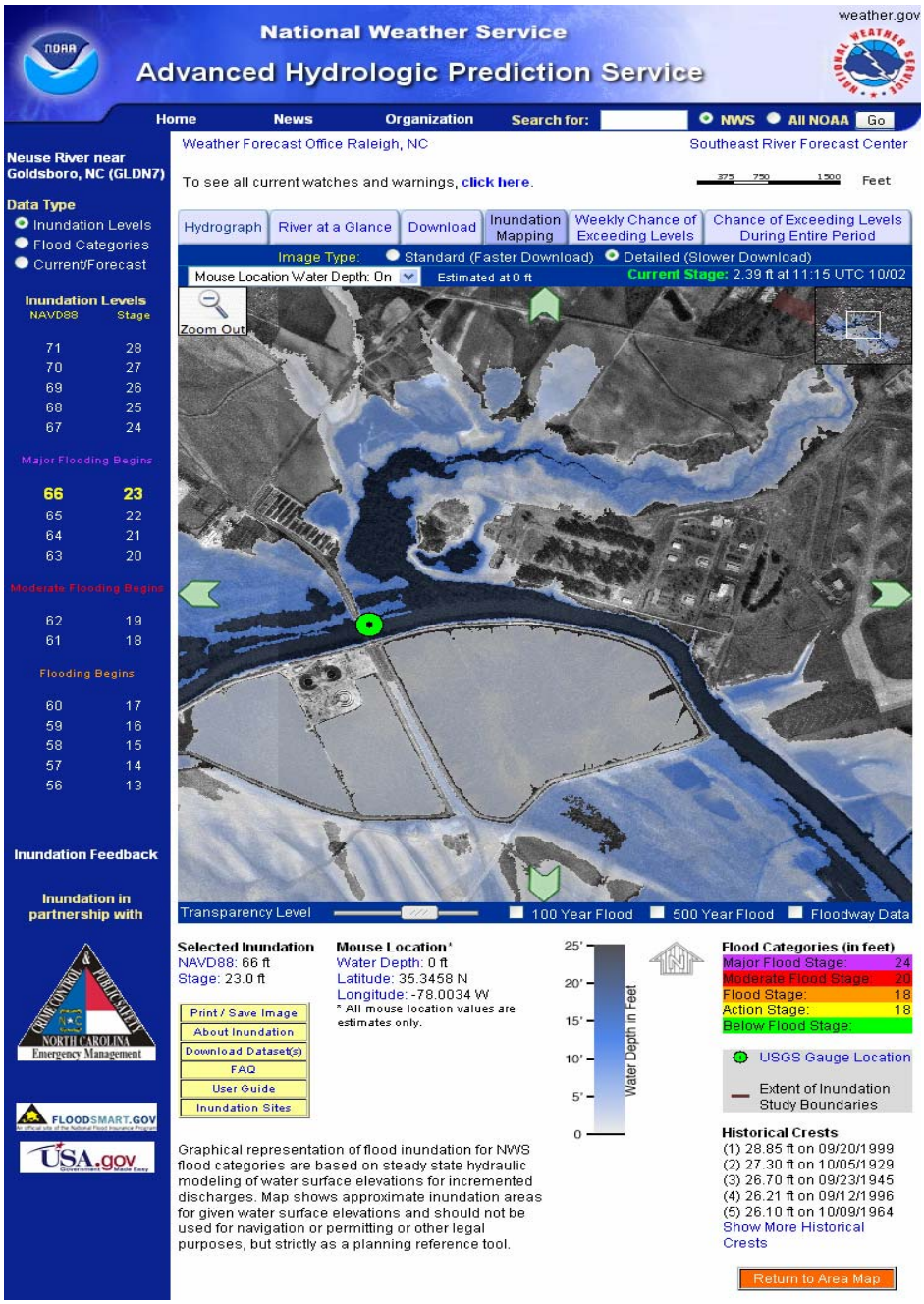

Figure 2. AHPS Flood Inundation Map Web Interface.

During flood events, these maps help decision makers determine where to safely position assets, who needs to be evacuated, and what routes are safe. The engineering and planning community can also download shapefiles to show impacts on current or proposed infrastructure. These inundation maps, showing levels more frequent than FEMA 1% flood recurrence levels, further the understanding of the floodplain thereby allowing decision-makers to better manage the floodplain and promote the development of more resilient communities.

The Building Process

Flooding has an annual significant socioeconomic impact on the Nation. For the 30-year period ending 2004, floods on average have caused over 100 deaths and $5.3 billion in damage annually in the United States. Three fourths of all presidential disaster declarations are associated with flooding. These long term impacts are larger than those for any other severe weather related phenomena. Consequently, users are asking the NWS for more flood hazard information.

NOAA's NWS is responsible for flood forecasts and warnings in the U.S. Information about the spatial distribution and water depth is highly valued by users of NWS flood forecasts. Determination of where water flows during a flood is complex. The development of inundation libraries requires high resolution topographic information, geospatial analysis, and hydraulic modeling to account for structures like bridges and other controlling features that affect flood flows. Many areas currently do not have adequate topographic data to create quality inundation maps, but significant advancements in geospatial data analysis and techniques are being made. The prospect of adding new map libraries to help the mission of "Saving Life and Property" is encouraging.

Accurate inundation mapping requires a significant investment in data collection and modeling that are beyond the current resources of NOAA. NOAA is partnering with FEMA's Map Modernization Program Managers and Cooperating Technical Partners (CTPs) who participate in the National Flood Insurance Program and provide similar inundation maps to establish regulatory flood boundaries. These new partnerships will allow for the creation of an expanded series of inundation maps between the 1% chance flood and NWS flood categories. Given the small incremental cost (roughly 2%) and significant benefit, NOAA would like to see FEMA expand the flood insurance studies to include the routine creation of map inundation libraries.

NOAA is developing inundation libraries for 30-35 additional river forecast locations in the Gulf Coast area using Hurricane Katrina Supplemental resources. FEMA is assisting NOAA on this project by facilitating coordination with FEMA Regional Offices, state, and regional map modernization partners to access existing Flood Insurance Study data. These data are crucial building blocks of map inundation libraries. These new Gulf Coast libraries will be made available during FY2008 through the AHPS web portal.

An important NOAA initiative is to create federal guidelines, consistent with FEMA's "Guidelines and Specifications for Flood Hazard Mapping Partners" to produce high-quality, standardized flood inundation libraries. The NWS and USGS are working with other agencies through the Advisory Committee on Water Information (ACWI) Subcommittee on Hydrology (SOH) to create these guidelines. Inundation maps benefit riverine and/or coastal communities.

The Future of River Forecasting

The sciences, principles, and technologies of inundation forecasting can be blended into decision support tools for the Nation. Prior to 2050, NWS river forecasting will have expanded from the traditional one-dimensional model to two- and three-dimensional physically based probabilistic multi-model ensembles, closely coupled with numerical weather prediction models. The NWS model will incorporate hydrodynamics and produce water quality, transport, and temperature forecasts at the community level. On a global scale, NWS will provide inputs to a forecast model of the Earth's hydrologic cycle, so that nations can optimize the management of a vital resource – potable water. The NWS role in precipitation and water forecasting (surface and subsurface)

will become more crucial, as water is needed for growing consumption, increased irrigation, and other water resource applications.

Recognizing the increasing importance of federal partnerships and collaboration to track freshwater from summits to the seas, NWS has begun the development of a Community Hydrologic Prediction System (CHPS). Future developments within this open architecture computer framework are forthcoming. The dream of having instant verification through satellites to verify water forecasts, assess impacts, and properly allocate water, will become a reality. Unmanned aerial systems (UAS) will provide remotely-sensed information on topography, land use, and soil moisture in real time, to allow updates to the NOAA hydrologic forecast models.

Conclusions

NOAA's National Weather Service is taking steps to meet future challenges. In order to transition to more advanced real-time water forecast modeling, the efforts under AHPS and CHPS must grow. NOAA will also continue to incorporate innovation its service delivery outlets. Flood Inundation Mapping Services will grow as NOAA expands partnerships. Moreover, NOAA will continue to support the growth of real-time dynamic inundation modeling. This will ensure the agency is positioned to integrate its information with datasets from other cooperating agencies to be in a better position to help build safer communities following the legacy of Gilbert White.

TECHNOLOGY AND FLOODPLAIN MANAGEMENT IN 2050

Matthew Watkins
National Association of Home Builders

Looking to the future of floodplain management and the most recent advances in technology, technology is expected to be a driving force behind floodplain management in 2050. Building on the most recent effort by the Federal Emergency Management Agency (FEMA) to modernize the floodplain maps by updating and digitizing vital floodplain information, it is expected that continued work in that direction would be most beneficial to the population as they make decisions about risk and gain. The National Association of Home Builders (NAHB) believes that a continued focus on improving and upgrading the information on which floodplain management decisions are made will do the most to ensure reduced risk to life and property.

An enhanced dynamic mapping system is essential to the future of floodplain management. The recent mapping effort to update the floodplains maps is just the start of ensuring this vital tool is available to reduce risk. NAHB envisions the advancement of mapping leading to a GIS-based digital streaming system that could show a time-lapse stream of images mimicking the ebb and flow of the most frequently-measured storms. Imagine a planner using this tool to design a master plan for a town or community. Instead of a static map of base flows and the 100-year floodplain, he/she could express how any number of storms – from the 2-year to the 100-year – might affect the floodplain in that community. USGS monitoring stations along the channel could feed back to the system and document even minor adjustments to the floodplain on an event basis. Because this advancement in technology and data gathering would touch each of the identified "issues of change" and affect smart decision making for the program, NAHB believes it is an important step.

The infrastructure for such a program is most likely already in place. Considering the collective resources of USGS, USDA, NOAA, FEMA and all of DHS, local floodplain management agencies, communities, and private consultants, the monitoring stations, satellite imaging, GIS equipment, and personnel have largely been established. All that is necessary is a coordinated and concerted effort to pursue the technology to complete such a system. In addition to informing land use decisions, a technological advancement such as this could give almost real-time information about floodwaters and where to deploy rescue or emergency management personnel during an event. With information on the depth and duration of flooding for a specific locale, the data collected during storms could also be used to assist in assessing damage to property as well as evaluating the structural integrity of bridges, culverts and other critical infrastructure. Similarly, with the increasing concerns over rising sea levels, the data collected on water levels could be compared to yearly-average temperatures to confirm or demonstrate the need for adjustments to floodplain management efforts due to the effects of climate change. Finally, continued evaluation and documentation of the floodplain could also lead to a better understanding of its function, such as its capacity to convey and/or store floodwaters, control erosion, or prevent or reduce pollution. With this information, local communities gain flexibility in their management approaches and are empowered to take steps to trade or mitigate functions within the watershed. For example, the benefits of a regional floodplain could be factored into a

local community's efforts to manage storm water and/or water quality issues (i.e. TMDL for nutrients).

Due to the growing population and changing demographics, there will continue to be pressures to build and develop in the nation's floodplains. The NFIP plays a critical role in directing the use of flood-prone areas and managing the risk of flooding for residential properties. The availability and the affordability of flood insurance give homebuyers and homeowners the opportunity to live in a home of their choice in a location of their choice, even when the home lies within a floodplain. The NFIP, by enabling the choice of purchasing a home in a floodplain, allows consumer preferences to shape towns and cities into communities that maximize quality of life and economic development. None of this can be accomplished without sound data. Therefore, NAHB believes that updating and pursuing an actively dynamic mapping system that is centrally located and easily accessible is the most sensible direction to take floodplain management.

There obviously is a challenge in trying to "crystal ball" the future of floodplain management and it is clear that a new dissertation could be written concerning human adjustments to flooding. While Dr. White has left us a bulwark with which to craft our efforts, the many variables, factors, and criteria that affect floodplain management make the task all that more difficult . There are many speculative efforts that those involved in floodplain management can pursue between now and 2050, but a concerted effort on the course already laid out would be best when looking to the future. Continuing on the track of incorporating new technologies and cooperating with other public/private entities in the mapping process would do "the greatest good for the greatest number." Because of the potential benefits, NAHB believes proceeding in the area of new technology would greatly contribute to reducing risk to life and property and prove the logical path for floodplain management in 2050.

IMPROVING PUBLIC SAFETY – FROM FEDERAL PROTECTION TO SHARED RISK REDUCTION

Major General Don Riley
U.S. Army Corps of Engineers

Responsibility for flood risk management in the United States is a shared responsibility between multiple federal, state, and local government agencies with a complex set of programs and authorities. Nationally, both the U.S. Army Corps of Engineers (Corps) and the Federal Emergency Management Agency (FEMA) have programs to assist states and communities in reducing flood damage and promoting sound flood risk management. The authority to determine how land is used in floodplains and to enforce flood-wise requirements is entirely the responsibility of state and local government. Floodplain management choices made by state and local officials, in turn, impact the effectiveness of federal programs to mitigate flood risk and the performance of federal flood damage reduction infrastructure. One key challenge is to ensure that as the public and government leaders make flood risk management decisions, they integrate environmental, social, and economic factors and consider all available tools to improve public safety. Importantly, we must ensure the public is educated both as to the risks they face and actions they can take to reduce their risks. Because of this complex arrangement of responsibilities, only a life-cycle, comprehensive and collaborative systems approach will enable communities to sustain an effective reduction of risks from flooding.

Where we are now – "The government will protect us"

Individual agency processes and procedures typically have provided the venue for planning and implementation of flood damage reduction measures. The present process to engage the Corps of Engineers is on a project by project basis, even though the Corps has made advances in incorporating collaborative approaches and assessing alternatives in a watershed context. Traditionally, the Corps focuses on reducing flood damage by managing floods that cause damage largely by decreasing the probability of flooding. The Corps develops alternatives based on reducing known potential flood damage, with minimal consideration of future land use or other social effects. Additionally, the Corps infrequently assesses options to reduce consequences should a failure occur. Whether communities strive for 1% level of protection or greater, the present process drives decisions based on reducing the potential for failure or *reducing flood damage* and does not incorporate an assessment of localized risks and consequences. Figure 1 is an example of the present paradigm – a system based on an appropriate "level of protection", which provides credence to the notion that "the government is responsible" and "therefore, we are protected." Complicating the matter, many prudent cost share sponsors seek to limit their costs; and this drives some to seek to achieve only a level of protection whereby community members will not be required to purchase flood insurance.

Where we need to be – "We are all responsible for our safety"

To significantly improve public safety, we are pursuing a level of public education at which our fellow citizens are so well informed they are able to assume responsibility for decisions they make about where and how they want to live and work. We then can engage in a comprehensive

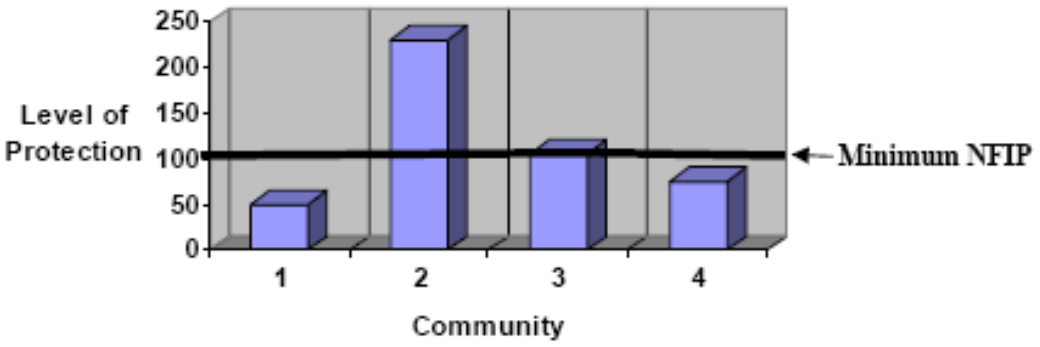

Figure 1 – Selecting Level of Protection

and multi-government and private citizen collaborative process of *managing flood risk* to achieve levels of tolerable risk. The Corps is expanding our traditional approach to focus on the most effective combination of tools available that citizens may use to lower or "buy down" their flood risk (as illustrated in Figure 2). We will consider not only reducing the probability of flooding, but also reducing the consequences should a flood occur. A multitude of options and tools becomes more evident through the process of assessing the consequences of a flood. Furthermore, the decision on which tools to implement involves all stakeholders. For example, the Corps can help reduce risk by levee construction. In a coordinated but independent action, local government can further reduce flood risk by implementing floodplain management actions such as evacuation plans, zoning ordinances, and public outreach.

This cannot be achieved without a new paradigm of joint partnerships in a comprehensive approach of public education and flood risk management. For instance, the insurance industry has a similar goal of assessing hazards and therefore, there exists an opportunity for the federal government and insurance industry to leverage efforts, possibly in the areas of research and development, implementation of assessment tools, and increase of public and policy-makers awareness.

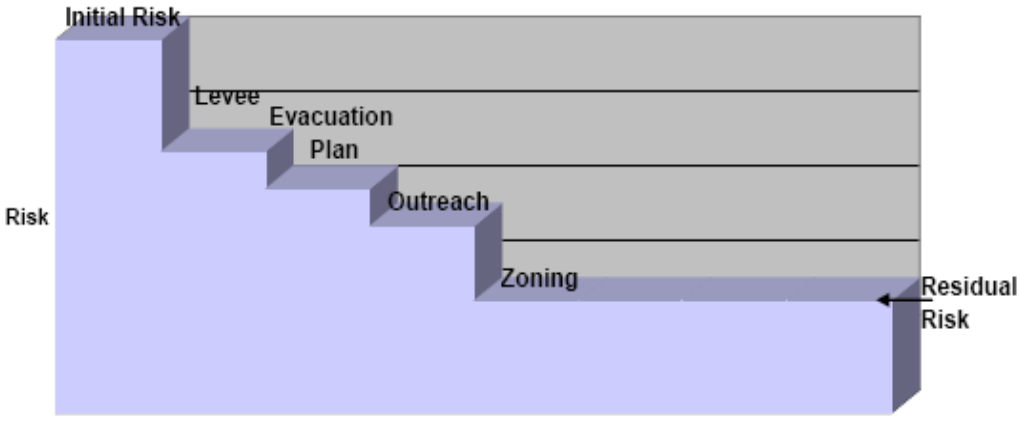

Figure 2

What we are doing now

In May 2006, the Corps established the National Flood Risk Management Program (NFRMP) to take the first step of bringing together other federal agencies, state and local governments and agencies, and the private sector to develop and implement a unified national flood risk management strategy that eliminates conflicts between different flood risk management programs and takes advantage of all opportunities for collaboration. Additionally, we are seeking partnerships with those that best understand risk, such banking and insurance industries, to share data and risk model development. We also wish to collaborate more closely with business councils and developers so they understand local flood risks, and can assist us in public education campaigns.

An integral part of the NFRMP is the Interagency Flood Risk Management Committee (IFRMC), with core leadership from the Corps, FEMA, Association of State Flood Plain Managers (ASFPM), and the National Association of Flood and Stormwater Management Agencies (NAFSMA). This committee will be expanded to include other stakeholder groups, such as, the natural resource agencies. Through this committee, organizational leadership should use or change, when possible, existing policies and programs to transition into a comprehensive and shared process of lowering or "buying down" flood risks. As the transition occurs, the IFRMC should identify and recommend necessary administrative, policy, and legislative changes for complete implementation of the collaborative risk-informed decision process for managing flood risks.

FLOODPLAIN MANAGEMENT 2050

Clive Goodwin
FM Global

If we do not succeed helping society better understand the nature of the flood hazard and the risks they face, the increase in lives and livelihoods at risk will continue to rise exponentially.

The easiest way to look to the future is to project forward the changes we have seen over the last 40 years. If we do this the rise in economic value and lives at risk due to flooding is rather alarming. How can this be, when we have a framework that is aimed at controlling development in floodplains? The simple answer is that political pressure over the years has forced the floodplain management scope to become the absolute minimum of avoiding the black zones on FEMA flood maps (High Hazard zones, often referred to as 100yr or 1% chance). This outcome is not unique to flood, all building codes are provided as a "minimum" and in order to cut costs and win contracts, developers will routinely work to the absolute minimum. Yet time and time again, when the future owners are made aware of the nature of the "minimum standard" and what level of protection it affords them, they explore the alternatives. For example when a prospective building owner understands the impact a hurricane of greater magnitude than used in the minimum design standard, they are keen to investigate other options. Typically the additional cost of new construction to a higher standard is a small percentage of the project cost and therefore more often than not, once the owner understands the risks and costs, they opt for the safer solution.

If we look back to the original work spearheaded by Gilbert White in the 1960s, the concept was to absolutely avoid the worst flood risk areas and make sure that all important facilities such as hospitals and the critical infrastructure was constructed taking into account for a more extreme level of flooding (500yr or 0.2% risk areas). But over time, this has been ignored in favor of the minimum standard. The common perception in the community at large and all key players / decision makers is that areas outside the black zone on a FEMA map are immune to flooding. This in turn leads to development to within inches of the zone and of course in areas behind levees. The end result is an exponential increase in those at risk to more extreme flood events, and as development and urbanization occurs many buildings become more exposed to high hazard flooding. Those behind levees, who are unaware of the risk are at danger because they do not appreciate that in an extreme event, the flooding may be worse than if the levee where not there. This together with the challenges of the aging infrastructure represents a major unseen risk and future nightmare.

So what is the solution? The USACE, FEMA and many of the state and federal agencies and floodplain management associations are doing a great deal to educate key players and the public. We are seeing positive steps forward in many areas. One example is the move away from describing levee systems as a form of "flood protection" (which implies that flooding will never happen) to "flood damage reduction" which is fantastic and results in those impacted asking questions – which is the first step in the education and awareness program.

The biggest impediment to all these combined efforts to increase public awareness of the flood risk is ironically the source of flood information itself! Everyone involved in floodplain management knows that the FEMA maps are "Flood Insurance Rate Maps" (FIRM) and they serve the NFIP program well. However, once we succeed in creating the desire within the community to learn more about the local flood risk, the first point of call is the FIRM, which explains the insurance needs but does not address the risk beyond the black zone. The expectation is of course that FIRMs are providing comprehensive flood hazard information and therefore they are very misleading. Even the experts in the flood industry are likely to forget "what we have chosen to ignore!" on the maps, such as the levee risk.

The solution is that we must make clear the limitations and intent of the current zones on the FIRMs and make publicly available a comprehensive flood hazard map that includes the wider floodplain and the areas where the flood risk is reduced by levee systems. It is absolutely essential that areas prone to flooding beyond the black zone are easily identified together with the residual risk created by levee systems should extreme events occur that overtop them or systems fail. A comprehensive flood hazard map will enable us to capitalize on public concern and awareness that will come from all agencies combined efforts.

Let's not forget the primary aim is to maintain an appropriate level of public safety. How can we possibly expect our emergency planning professionals to ensure safe evacuation from areas at risk if they do not have an appreciation of the flood hazard beyond the back areas on a FIRM? A comprehensive flood hazard map is a critical part of emergency planning to ensure that communities are aware of the flood emergency scenarios they may one day face.

Part 6

Elevation, Building Standards, Infrastructure, Flood Control

FLOOD PROVISIONS AND THE INTERNATIONAL CODES IN 2050

Michael Armstrong
International Code Council

Floods are the natural disaster that costs the most – both in loss of lives and property. Due to the length of time floods can span, floods take an immeasurable toll on loss of jobs and communities. In the future, we can, however, make a positive impact regarding this natural disaster. The most effective way to accomplish this is through construction requirements in the building codes that address proper design and construction in flood areas, thus substantially reducing the effects floods can have on the health, safety, and welfare of a community.

Having an effective building code is recognized as having a positive impact on flood areas. Part of the evaluation process for FEMA's flood insurance plan includes whether the community has adopted a building code, how current that code is, and the degree to which code requirements are enforced. As a consequence, the more current the code and the better the enforcement, the better the rating a community receives. The result is a savings for the property owners, and improved stability and sustainability for the community as a whole.

Having the flood provisions in the building code is a very practical approach. Architects and contractors are familiar with the codes, and all use the codes as the requirements for constructing their buildings. In addition, these requirements are enforced by a virtual army of code official across the country. This is a very proactive approach to reducing potential flood losses. If buildings can be designed and constructed flood resistant from the beginning, FEMA will not have the same level of devastation to deal with when a flood does occur.

FEMA has been working with the code developers for a number of years, coordinating requirements in the codes with the requirements in federal guidelines. (See the end of this paper for a list of some of the sections in the codes that currently contain provisions for construction in flood areas.) The goal of this coordination is two-fold: to eliminate any conflicts between the federal regulations and code requirements; and, increasing the level of compliance with the flood insurance program.

Changing or updating FEMA requirements through the governmental processes is relatively time consuming. Meanwhile, codes exist as an ever-evolving document that can quickly address new construction methods and technical advances. While the goal of FEMA and the codes are the same, i.e., to protect lives and property during flood events, providing criteria in the codes that is outside of the FEMA regulations could be perceived by some as a conflict. A more effective approach would be for FEMA to work through the model code hearing process to update requirements instead of unnecessarily using valuable time and resources to develop separate construction requirements.

This approach would be extremely cost-effective and streamline existing processes. The International Codes promulgated by the International Code Council (ICC) are adopted across the United States. The Code Council's mission is to promulgate a comprehensive and compatible regulatory system for the built environment, through consistent performance-based regulations that are effective, efficient and meet government, industry, and public needs. The codes

reference consensus national standards, such as *ASCE 24 – Flood Resistant Design and Construction.* These codes are published every three years, resulting in a 'living' document that can address new construction techniques and materials as well as address new problems. Current examples include two standards addressing issues that may come with flood events: *Standard for Residential Construction in High Wind Regions* and *Standard for Storm Shelters*. This process also would allow FEMA a process to offer clarification of issues, such as requirements for additions on pre-flood regulation buildings.

Changes to the International Codes are through an open hearing consensus process in which any interested parties can participate (code official, design professionals, trade associations, builders/contractors, manufacturers/supplier, government agencies, etc.). The process includes safeguards to avoid domination by proprietary interests. All meetings are in a public forum, including broadcasting live on the intent. All proposals, actions, and reasons are available in electronic and printed formats. The final decisions rest with those with no vested interest other than health, safety, and welfare of the public: the governing authorities who adopt and enforce the codes.

Ideally, in the future (hopefully before 2050), FEMA will feel comfortable that participating in the model code development process can prove to be a more effective way to evolve with new construction techniques. They can eliminate their own construction requirements and reference the model codes. This will in turn free up FEMA to concentrate on projects such as developing new flood maps, evaluation of communities, developing plans for new areas for flood controls, etc.

In the year 2050, a more efficient FEMA could reference the International Codes for requirements for new construction, alterations, and additions. Homes and businesses would be constructed 'flood' resistant in a cost effective manner. Cooperation in this manner will bring a higher level compliance and a safer environment for everyone affected.

International Building Code: 106.2.5 Site plan, 106.2.5.1 Design flood elevations, 109.3.3 Lowest floor elevation, 801.1.3 (Interior finishes) Applicability, 1107.7.5 (Accessibility) Design flood elevation, 1203.3.2 (Under-floor ventilation) Exceptions, 1403.6 (Exterior walls) Flood resistance, 1403.7 Flood resistance for high-velocity wave action areas, 1603.1 (Construction documents) General, 1603.1.6, Flood design data, 1605.2.2 (Strength or LRFD) Other Loads, 1605.3.1.2 (Allowable stress design) Other Loads, SECTION 1612 FLOOD LOADS, 1801.1 (Soils and Foundations) Scope, 1803.4 Grading and fill in flood hazard areas, 1807.1.2.1 Flood hazard areas, 3102.7 (Membrane structures) Engineering design, 3403.1 Existing buildings or structures, 3403.1.1 Flood hazard areas, 3407.1 Historic Buildings, 3407.2 Flood hazard areas, 3410.2.4.1 Flood hazard areas, APPENDIX G FLOOR RESISTANT CONSTRUCTION, APPENDIX J GRADING, J101.2 Flood hazard areas.

International Residential Code: R102.7 Existing structures, R102.7.1 Additions, R104.10.1 (Modifications) Areas prone to flooding, R105.3.1.1 Substantially improved or substantially damaged existing buildings and structures in areas prone to flooding, R106.1.2 Information for construction in areas prone to flooding, R106.2.2 Site plan, R109.1.3 Floodplain inspections, R112.2.1 Determination of substantial improvement in areas prone to flooding, R112.2.2 Criteria for issuance of a variance for areas prone to flooding, R301.1 Design, R301.2 Climatic and geographic design criteria, Table R301.2(1) Climatic and Geographic Design Criteria, R301.2.4 Floodplain construction, R301.2.4.1 Alternative provisions, Table R301.2(1) Climatic and Geographic Design Criteria. Flood Hazards, R309.5 (Garages) Flood hazard areas, SECTION R324 FLOOD–RESISTANT CONSTRUCTION, R401.1 (Foundations) Application, R401.2 (Foundations) Requirements, R401.3 (Foundations) Drainage, R408.6 (Under-Floor Space) Finished grade, R408.7 (Under-Floor Space) Flood resistance, R506.2.1 (Concrete Floors (on Ground)) Fill, M1301.1.1 Flood resistant installation, M1401.5 Flood hazard, M1601.3.8 Flood hazard areas, M1701.6 (Combustion air) Opening location, M2001.3 Flood resistant installation, M2201.6 Flood resistant installation, G2404.7 (301.11) Flood hazard, P2601.3 (General Plumbing Requirements) Flood hazard area, P2602.2 (Individual Water Supply and Sewage Disposal) Flood resistant installation, P2705.1 General, P3001.3 Flood resistant installation, P3101.5 Flood resistance, Appendix E Manufactured Housing, AE101 Scope, AE502.3 Footings and foundations, AJ102.5 Flood hazard areas.

FLOODPLAIN MANAGEMENT AND HIGHWAYS
AN OVERVIEW OF PROCESSES AND LESSONS FROM 1945 TO 2050

Joe Krolak
Federal Highway Administration, Office of Bridge Technology

Cynthia Nurmi
Federal Highway Administration, Resource Center

Introduction

Historically, trying to predict trends in the United States' transportation system has not been a very successful endeavor. In 1808, Treasury Secretary Albert Gallatin proposed a series of roadways to link the young nation. Historians note that the subsequent 1800's were primarily a period of steamship and railroad transportation. The 1892 establishment of the United States Office of Road Inquiry promoted roadways initially to placate bicycle advocates. The Office did not foresee the development and increasing use of private automobiles and aircraft occurring a few decades later. And it wasn't Dwight Eisenhower's 1919 epic (62 day, 3,251 mile) cross country trek along the Lincoln Highway that led to his advocating the Interstate system. Rather, "Ike" was impressed by the German autobahns he encountered during WWII.

The only constant in transportation appears to be that that change is a key constituent. Therefore, hoping to have learned something in the 199 years after Secretary Gallatin, any attempt to predict transportation trends and conditions in 2050, especially in the arena of floodplain management, should review the path that got us where we are today and acknowledge that any projections be taken with a large grain of salt.

Background & Issues

In July 2006 the highway community celebrated the 50th anniversary of the Eisenhower Interstate Highway System (Interstate). The Interstate system consists of 46,876 miles of roadway, including 22,971 bridges and several million culverts. The Interstates are only a part of the 161,970 mile National Highway System (NHS) that includes approximately 116,000 bridges, crossing nearly every kind of waterway. In addition to the NHS, there are several million miles of roadways and over 500,000 bridges owned and operated by state, local, and other governmental or private entities. The age of these systems span the Interstates and have been built with varying levels of federal assistance (including none).

Although appearing rather monolithic to people outside the highway community, each entity involved in highways (which includes Congress) has varying degrees of control over roadway policy, design, and specifications. In reality, the FHWA probably has less "control" over highway projects than other federal agencies exercise in analogous programs' policy, regulation, and oversight. Even with these disparate entities involved, roadways still form an increasingly interconnected network that allows (and governs) movement of people, goods, and services across the country. Additionally, the network stretches across wider boundaries than those associated with physical or political borders. For this reason, the highway community often has to balance "traditional highway" objectives (i.e., traveling from point A to point B) with equally compelling objectives of interests located between these points (i.e., preserving a neighborhood

or not adversely impacting a floodplain). For a long time, there has been a certain amount of tension between these objectives as the highway community often focused on the former to the detriment of the latter. Fortunately, looking back at highway hydraulic practice suggests that these objectives are not mutually exclusive.

A Little History

Transportation officials have long recognized vulnerability of the system to a variety of issues and hazards including age of infrastructure, service life, increased traffic and loads, seismic activity, vessel collision, scour, and flooding. Some transportation officials have also recognized that highway engineering approaches and attitudes often are a major contributing factor to such vulnerabilities.

For example, in June 1945, Mr. Carl Izzard, Senior Highway Engineer of the Public Roads Administration, Federal Works Agency, wrote: *"… drainage of highways is frequently handled by standardized treatment with too little consideration to peak rates of run-off. … The highway engineer should consider that he is responsible for the whole effect of the highway improvement on the surrounding countryside, and that it is his duty … to avoid actions which unnecessarily damage property abutting the highway."*

In 1954, even before beginning construction of the Interstate system, Bureau of Public Roads hydraulic engineers placed these "thoughts into deeds" as they mandated that bridges and culverts on the Interstate system be designed to pass the 0.02 annual exceedance discharge, limit backwater, and consider impacts to the floodplain. In doing so, they (probably accidentally) complied with many of the eight floodplain management factors described in Gilbert White's 1942 dissertation.

Unfortunately, while other Interstate related design approaches and specifications such as geometrics and material specifications became the basis of national practices, other highway systems, (and some portions of the Interstates themselves) did not adopt similar "floodplain aware" insights. Also, while the Interstate led to advances in highway structural and materials design, tools available for hydraulic analyses of bridges did not progress as rapidly. Complexity and uncertainty associated with hydraulic methods available to highway engineers resulted in the practice of designing the bridge (including situating the bridge into the floodplain using mostly structural considerations), determining the hydraulic effects, and hoping for the best. Results included promulgation of varying and inconsistent floodplain and hydraulic practices within FHWA and state DOT hydraulic units and associated highway projects.

Additionally, during the late 1960's and early 1970's, while other parties began to use higher returns periods (i.e., 100-year and 500-year) to manage floodplains, mitigate risk, and reduce flood damage, the highway community did not evolve similar practices. This approach persisted even though 60% of bridge failures have a hydraulic component (although not necessarily as a result of flooding or overtopping).

Fortunately, this approach began to change with issuance of Executive Order (EO) 11988. EO 11988 led to updated FHWA floodplain regulations. Specifically, Title 23 of the Code of Federal Regulations (23 CFR) – Highways, Chapter I – Federal Highway Administration, Department of Transportation, Part 650 – Bridges, Structures, and Hydraulics, Subpart A - Location and Hydraulic Design of Encroachments on Flood Plains – referred to as "23 CFR 650 A." Issued in

1979, *23 CFR 650 A* prescribed FHWA policies and procedures for the location and hydraulic design of encroachments of federal-aid highway projects onto floodplains. The regulation led to recognition of and involvement with other floodplain management and environmental parties, policies, and practices (especially NFIP and NEPA). *23 CFR 650 A* also required state DOT and other highway partners to better coordinate their efforts – effectively providing a more consistent and uniform highway floodplain practice. Finally, by requiring analysis of impacts of 100-year events as part of design, the highway community became more in line with national floodplain management practices.

Today and Tomorrow

Since the adoption of *23 CFR 650 A*, the highway community has increasingly acknowledged the importance of floodplain management policies. state DOT hydraulic units regularly perform hydraulic design studies in coordination with federal, state, and local floodplain policies. The most successful hydraulic units form partnerships with their floodplain regulators and endeavor to build relationships built on mutual trust and appreciation of each others roles. Advances in computer models and other tools have resulted in better hydrologic and hydraulic predictions of highway impacts in floodplains. Often, state DOT hydraulic units and designers work in a multi-disciplinary fashion – designing bridges (and replacement bridges) to mitigate floodplain effects – including looking at pier and structure alternatives that will minimize or eliminate backwater effects.

However, not all aspects are as positive. Fiscal constraints and changes in highway financing are posing increasing pressures on staffing of highway hydraulic units. One result has been fewer staff responsible for the same or growing workload. Also, as experienced engineers retire, there are fewer veteran engineers to take their place. Universities have not developed curricula and infrastructure owners not promoted the institutional knowledge needed to effectively balance highway and floodplain priorities adopted in *23 CFR 650 A* and other regulations.

These fiscal constraints manifest themselves in other situations as well. For example, there is no national program of updating basic hydrologic data used in floodplain studies. In portions of the United States, peak flow regression equations exist based on data that is decades old. Given that even an up-to-date, "good" regression equation can have a standard error of 30 percent (or more), how much confidence does this imply about the precision of a flood insurance study or proper extent of a floodplain? In many cases, state DOTs become the funding source to updates of regression equations. Rainfall/runoff models fare no better. As a result of this lack of funding, in some parts of the United States, the best available rainfall data is over forty years old. Will 2050 find the floodplain community using primary hydrologic sources dating from the previous century?

Technical advances offer exciting opportunities for more robust and accurate floodplain analyses, emergency management, and risk and vulnerability abatement. But even here some discrepancies emerge. Better hydrologic and hydraulic tools are available than are routinely applied in daily practice or accepted by floodplain regulators. Additionally, some modelers perceive that, to quicken the rate of new mapping, FEMA and states are opting for less accurate tools and methods. If true, are such practices consistent with the factors described by White?

The highway community also perceives a deviation from a national floodplain management vision as federal, state, and local floodplain regulatory agencies develop divergent and

inconsistent approaches. For example, a local community and a federal floodplain agency recently pressured a state DOT to certify an Interstate embankment as a levee! Fortunately, they refused, but should they have even been asked? At another state bridge project, floodplain regulators objected to a temporary (30 day) construction equipment access padway within the floodplain, citing potential risk and NFIP (i.e., CLOMR) concerns. While acknowledging risk concerns were prudent, highway engineers had difficulty in understanding how a temporary causeway required a map revision. The highway community faces an infrastructure consisting of older bridges, increasing congestion, and stretched resources. How can the highway community begin to prioritize replacement or improvement projects when these divergent floodplain management approaches make this a moving target? Will 2050 find increasing divergence in floodplain policy and interpretations?

Floodplain issues have also become just one of many technical and policy constraints and challenges. Today there are many social, environmental, floodplain, engineering and other priorities for the hydraulic units to consider. State DOT hydraulic units describe situations where they become caught between conflicting floodplain management and environmental agency agendas.

Finally, the aftermath of Ivan, Katrina, and other flooding events illustrate that the interconnected highway network remains extremely vulnerable to disruption resulting from failure of a small number of linkages. The highway community has used the aftermath of these events to reflect and rethink floodplain and hydraulic structure policy and procedures on a fundamental level. Interaction with the floodplain community will continue to play a critical element in shaping those policies and procedures. Both communities have to start taking a holistic view of all their policies and procedures they have in place and how they are all interconnected with a goal to function as one smooth operation.

So, daring to make some predictions, here's two. First – 2050 will see an increase in interconnectiveness of the highway network. Secondly – Gilbert White's original vision will continue to serve the highway community in ensuring the nation's highways and bridges remain safe for the traveling public with minimal impact to sensitive environments such as floodplains.

FLOOD PROTECTION SYSTEM MANAGEMENT IN 2050

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In anticipating what the societal conditions will be as it relates to floodplain management and flood protection in 2050 I am first inclined to consider how someone in early 1960's would have responded when posed with a similar question of floodplain management conditions in 2007. The United States, and California, in particular, at that time was in a growth and optimistic condition seeing technology as a solution to many of the world's ills. Human attempts to subdue nature were in effect.

On a local scale maximizing developable lands by channelizing streams and waterways was the common response to drainage issues. Concern over the quality of the waterways was largely ignored. For someone in the 1960's to have contemplated the year 2007 they would have probably considered a world of man's conquest over nature and his further removal from it in a urbanized setting. With that retrospect I now ponder how I would anticipate the urban setting in 2050.

Today, 2007, we live at time of paradox. On the one hand we have greater environmental sensitivity than in the 1960's and the trend has been towards tighter environmental regulatory controls and increased non-governmental advocacy towards environmental stewardship. At the same time the desire to maximize developable lands has not diminished. Governmental flood protection agencies responsible for keeping waterways clear and at design conveyance capacity are often frustrated by the lack of concern over flood risk versus sensitivity for the environment. At the same time the vulnerabilities and consequences flood protection system failures continues to be of national significance.

In the year 2000 the Santa Clara Valley Water District received the necessary two-thirds voter support required to pass its flood protection measure entitled: "Clean Safe Creeks and Natural Flood Protection." A May, 2007 survey of residents in Santa Clara County found that less than 10 % of those surveyed considered flooding a problem for them while over 80% voiced support for preserving and restoring the natural habitat of streams and creeks.

Given societal trends since the 1960's I anticipate great opportunity and challenge for those responsible for continuing to provide flood protection services particularly in an urbanized setting. Flood protection agencies will have evolved from flood management to stream stewardship agencies where value will be placed on the system as a whole versus component parts acting independently. Concurrently, emphasis will also be placed on asset management where the asset will not only be the physical structure providing flood protection but the quality of the water in the stream and the condition of the natural environmental within and near the riparian corridor. Those stream steward agencies will be largely self-regulated since, with the diversity of disciplines found within an agency (engineers, environmental planners, biologists, geomorphologists) the knowledge of the stream system will be concentrated within that agency.

By 2050 society, particularly in the west, will have further evolved to consider the natural environment as a precious asset. Water reuse, particularly storm water, will be in effect with upstream retention ponds storing waters for agriculture, non-potable and perhaps potable uses, and environmental uses. That conservation ethic will further extend to society valuing water and the environment with an individual's stewardship practices and actions in a manner similar to the public's concern and reaction to energy and gasoline consumption. The wise use of natural resources will be in full effect

As the flood protection infrastructure further ages over the next 40 years the desire to restore stream systems from concrete channels to more natural systems will become the norm and lands surrounding streams will be better integrated into the stream and flood protection system. Streams will be given more room to function. With the further move towards natural flood protection these systems could be more self maintaining.

Finally, by 2050 the trend towards reconnecting urban areas to their local streams and watercourses, long since abandoned with the influx of imported water and land use practices that devalued streams, will be in full force. We will have moved from integrated, multi-objective planning to integrated deployment of those plans and thereby realize the value of working with nature versus seeking only to contain it.

COMPLIANCE ISSUES IN THE NATIONAL FLOOD INSURANCE PROGRAM

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Congress created the National Flood Insurance Program 39 years ago by passing the National Flood Insurance Act – Housing and Urban Development Act of 1968 (PL-90-448) and 1969 (PL 91-152). Under the Act, the federal government makes flood insurance available at an affordable cost in communities that have adopted and enforce at least the *minimum* NFIP regulations (via a local flood damage prevention ordinance). Participation in the NFIP is voluntary but, once enrolled, local enforcement of the ordinance is mandatory. Failure on the part of communities to enforce their ordinances properly and meet other NFIP standards can bring on sanctions from FEMA. However, there were no consequences if a community did not enroll in the NFIP. Federal financial assistance (loans, grants, disaster assistance, and other federal programs) continued to be available, even in areas designated as Special Flood Hazard Areas. After struggling with the voluntary issues of the NFIP, Congress passed the Flood Disaster Protection Act of 1973 (PL 93-234) creating the mandatory compliance requirements that we know today. Federal financial assistance is no longer available in Special Flood Hazard Areas unless the community is participating in the NFIP.

In the 1970s, Congress also funded an aggressive nation-wide floodplain mapping program, with technical assistance to be provided by federal and state agencies to prepare the flood maps needed by for local communities to establish sound floodplain management programs to meet the minimal requirements and goals of the NFIP. The number of communities participating in the NFIP quickly grew to over 20,000 in this short period, primarily due to the mandatory requirements of the NFIP, primarily the non availability of flood insurance and many other types of federal financial assistance unless the community is participating in the NFIP.

We have now experienced almost 40 years of the first nation-wide floodplain management program in the history of the United States. Since home mortgages are 30 years or less, one would think that the flood losses would have decreased over time as new properties are constructed in compliance with the NFIP land use and construction standards. This has not been the result. Since 1974, flood losses have continued to rise and after 30 years, the number of flood claims and number of repetitive loss properties have continued to increase to a point where flood claims exceeded NFIP policy revenues during 2004 and 2005 by over $18 billion. The number of Severe Repetitive Loss Properties now exceeds the 8,237 initially identified in FEMA's report to Congress. This leads one to consider that

- The NFIP requirements are not stringent enough,
- Communities have not been enforcing their flood damage reduction ordinances, and/or
- The 100-year (1%) national flood standard is too low to adequately reduce flood losses.

If in fact the community compliance rates are low today, that means that property is being developed that does not meet minimum standards of flood resistance. This situation will have

reverberations in 2050, reflected in rising costs of flood damage to property owners, communities, the NFIP, and federal taxpayers.

The NFIP is often referred to as a "carrot and stick" program. The federal government makes flood insurance available at an affordable rate to local communities that adopt and enforce the minimum NFIP requirements. If the community fails to fulfill the bargain then the availability of flood insurance should be removed. In fact, the National Flood Insurance Act of 1968 prohibits FEMA from providing flood insurance in a community unless the community adopts and enforces floodplain management regulations that meet or exceed minimum NFIP criteria.

When local enforcement problems are discovered by FEMA or by a state agency, attempts first are made to resolve them by providing community assistance or consultation to the community. If that fails, the FEMA Regional Director may place a community on "probation." The probationary period lasts at least until all deficiencies in the local program have been corrected and violations have been remedied to the maximum extent possible. Probation has no effect on the continued availability of flood insurance; however, an additional charge of $50 is added to the premium of each flood insurance policy in the community for at least one year.

A community also can be "suspended" from the NFIP for failure to adopt compliant floodplain management measures, for repealing or amending previously compliant measures, or for failing to enforce its floodplain management regulations. Within a suspended community, new flood insurance coverage cannot be purchased and policies cannot be renewed. The community is also precluded from obtaining other types of federal assistance.

It is interesting to note, however, that an extremely small number of communities that have been sanctioned by the NFIP. According to the October 2006 report, *An Evaluation of Compliance with the National Flood Insurance Program Part A: Achieving Community Compliance*, only 49 communities have ever been placed on NFIP probation. The states with the largest number of NFIP communities and policies in the NFIP are as follows:

State	NFIP Communities	Suspended Communities	Withdrawn Communities
New York	1,471	16	0
California	516	0	0
Louisiana	293	0	0
Florida	450	0	0
Texas	1,128	5	3

Source: NFIP Statistics posted on http://www.fema.gov as of October 1, 2007

Several FEMA Regions have no communities on probation or suspended in the past year or number of years. However, it is a virtual certainty that all 20,000+ communities are not in full compliance with the NFIP requirements.

The low number of probationary, suspended, and withdrawn communities, coupled with rising flood losses and a growing number of repetitive loss and Severe Repetitive Loss properties in the nation suggest that many communities may not be adequately enforcing their ordinances and that, in turn, FEMA has not used the sanctions available to it to force them to do so.

For the NFIP to continue as a viable program that reduces loss of life and minimizes flood damage nationwide, compliance with the NFIP requirements must be a high priority. Mitigation, retrofitting, and structural flood protection can only be successful if new construction meets the minimal NFIP standards. The number of known and suspected building violations nationwide suggests that flood losses will not be reduced by 2050 unless different steps are taken. In short, if we intend to rely on the NFIP to carry out Gilbert White's first, sixth, and eighth adjustments to flood hazard (elevation, land use patterns, and insurance), we should ensure that the specifics of the NFIP are universally and accurately applied.

Full compliance with the NFIP standards is an ambitious goal. Ongoing compliance is complex because it is a function of time, floodplain management education, and budgets at multiple levels of government. Small communities are faced with multiple staff assignments to fulfill needed tasks in building inspection, code enforcement, floodplain management, and emergency management. Community, state, and federal staffs change so continual education in floodplain management must be ongoing. If the local floodplain administrator is not technically qualified or trained then we cannot expect to see sound floodplain management result. By the same token, if a community receives an NFIP compliance visit only once every 10 years (the estimated national average) or FEMA does not take punitive action against a noncompliant community when a pattern of violations and deficiencies is apparent, then we cannot expect to see a compliant floodplain management program. Where do we go from here to get to reduced flood losses by 2020, 2030, or 2050? Vigorous enforcement of our existing program would be a good start.

A related avenue would be ensuring the continual training of local personnel, because understanding the complexities of floodplain management fosters a willingness to take the steps needed to keep communities functioning in compliance with the NFIP. Many states have undertaken coordinated initiatives by local, state, federal and non-profit (technical associations) to provide training and technical assistance at all levels. Professional certification of floodplain managers is another positive step being taken in this direction.

A third possible solution would be to revise FEMA's Community Rating System (which rewards communities and their policy holders) and allow enrollment *only by those communities that have adopted standards that exceed the NFIP minimums* and have reduced flood losses. Some of these "higher standards" include

- New and substantially improved structures elevated 1 or more feet above base flood elevations;
- BFEs based on fully developed (future conditions) hydrology;
- No Adverse Impact (NAI) requirements;
- Stormwater detention; and
- More restrictive floodways (zero-rise).

Communities that have adopted and enforce higher standards exhibit reductions in flood damage and number and size of NFIP claims; reduced numbers of repetitive loss properties; increased property values; and protection of natural and beneficial functions of the floodplain.

Part 7

Vulnerability Reduction

CANADA–U.S. FLOODPLAIN MANAGEMENT IN 2050

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International Joint Commission

Canada and the United States share a 5,500-mile boundary. They also share the water resources that lie along and across that boundary, and both countries have a common interest in the floodplain management issues affecting the populations in those watersheds. The Boundary Waters Treaty of 1909 provides the principles and institutions for preventing and resolving disputes concerning boundary and transboundary waters, including the International Joint Commission (IJC), and the two countries have a long history of cooperation at varying levels of government.

The two countries hold much in common. Both are large, highly-developed nations with significant floodplain management expertise and resources at their disposal. They are large trading partners and share a common culture, including a common language along much (but not all) of the boundary. However, there are also differences that affect floodplain management and cross-boundary cooperation regarding floodplain management. The relationship between the U.S. federal government and the states differs from that of the Canadian federal government and the provinces. There are fewer federally administered programs in Canada, and with some notable exceptions the provinces take primary responsibility for managing water resources within their boundaries. Federal flood insurance – a well-established program in the United States – does not exist in Canada. Rather, Canada preferred to initiate a national flood damage reduction program that restricted development in the flood hazardous areas, through land-use planning and floodplain delineation. The intent was to reduce the rising tide of flood losses that were being experienced. Once a populated centre was designated by the Canadian federal and provincial governments as a flood prone area, both governments would not support development in the designated area by evoking zoning and preventing any governmental financial funding or mortgage insurance (CMHC) for homes in the area. Technical differences (metric versus English, differing data collection and analysis protocols, mismatched information at the border, model preferences, etc.) can complicate transboundary cooperation despite good coordination and programs that foster joint efforts.

The two countries together have risen to flooding challenges and taken steps to help ensure that future flood events have lesser impacts. Major floods on the Red River of the North in 1997 captured widespread public attention in both nations. The IJC in 2000 provided a report to the governments of Canada and the United States on reducing flood impacts in the Red River Basin. The IJC stated that comprehensive, integrated, binational solutions were needed that took into account impacts in other parts of the basin. Many of the recommendations contained in that report have been acted upon by both countries. For example, Canada and Manitoba are dramatically increasing the capacity of the Red River floodway, a structure that diverts flood waters of the Red River around the city of Winnipeg. Many other investments have been made since the flood of 1997 that include both structural and non-structural solutions. Further efforts remain to be accomplished. The Red River basin provides one example of U.S.-Canada cooperation.

What lies in store in 2050 for cooperative U.S.-Canada floodplain management?
Seven factors cited by Gilbert White – elevation, flood abatement, flood protection, emergency measures, structural adjustments, land use, and public relief – are basic building blocks of floodplain management efforts in both countries and are expected to remain so in 2050. As one example, programs are in place in both countries that require elevation of structures above certain flood hazard levels. In the United States, this is a nationwide minimum standard geared primarily to the current 100-year flood level. Some U.S. jurisdictions impose requirements more stringent than the federal minimum requirements. In Canada, specific requirements may be imposed by a province or in a specific floodplain. For example, Ontario, Manitoba, Alberta, and parts of Quebec have chosen the 100-year flood as the design standard, while British Columbia has chosen the 200-year event and Saskatchewan has selected the 500-year. Some jurisdictions may also require more stringent protection based on historical flood levels or design storms. In the Red River floodplain in Manitoba, for example, structures must be elevated three feet above the 100-year floodplain or to the level of the historic 1826 flood, whichever is higher.

Federal flood insurance is unlikely to be established in Canada. For one thing, its 1,300 flood-prone communities are concentrated in the Great Lakes – St. Lawrence River region instead of being more geographically dispersed, as is the case for the 19,000 flood-prone communities in the United States. Both countries provide financial and other assistance in time of crisis. The promulgation of different approaches to reducing the losses from flooding in the two countries does not seem to be a major impediment to transboundary cooperation in floodplain management; however, binational cooperation will need to be fostered to build relationships and ensure that useful linkages are in place.

There is a growing recognition of the need for public education with respect to floodplain management. In both Canada and the United States, effective programs seek to provide information to the public that will not only inform the public what actions to take during and after flooding, but change behavior in advance of flooding. It is important that such efforts be sustained over the long term. Successful flood risk reduction can easily lead to a sense of complacency – and, without attention, an erosion of the capacity to respond to those rarer, but more devastating, flood events that exceed design standards. The effects of changing land use and climate change are not always fully known, and actual risks in the future may well differ from those estimated now.

While the need for public relief has long been recognized, there is also new understanding of the widespread and long-term nature of social and economic impacts. Populations in particularly hazard prone areas during the flood event may also be least able to access long-term assistance for such issues as depression, health care (rates of infection can increase during and post event), domestic violence, and other social impacts documented to increase following floods. As well, there is recognition that efforts are needed to mend the damaged local economy following major flood events.

What will changes mean for U.S.-Canada cooperative floodplain management in 2050?
The U.S. and Canadian populations are heavily concentrated along coastlines and waterways. In Canada, nearly half of the population lies within 100 miles of the U.S.-Canada border. As population increases along the US-Canada boundary region, the need for coordination and cooperation will also increase. Anticipated population growth in the southern (U.S.) portion of

the Red River Basin is prompting exploration of options to meet projected water supply needs, with likely pressure to consider bringing water to the Red River basin from other, more water-rich basins. As well, increased population often results in increased impact to the waters, such as increased runoff quantity or increased pollutant loading. Such impacts often have undesired environmental effects on the aquatic ecosystem and the physical characteristics of the waterway.

Climate change may have significant impact on the flood producing mechanisms and may result in increases or decreases to the flood maxima experienced in certain areas. In the Great Lakes, for example, various climate change projections indicate that water levels on average may drop substantially by 2050. These greatly lowered levels may prove a floodplain management boon, as the potential for flood risk may be reduced and potential damage resulting from wave action may be lessened. There is the potential for increased encroachment on the hazard prone shoreline area. It also provides an opportunity for increasing the designated level of protection for flood-risk areas, assuming projections are correct. Similarly, in the Osoyoos watershed (Washington and British Columbia), warmer lake temperatures and declining lake levels driven by climate change offer opportunities for reduced flood risk; however, if more residents move onto the floodplain (already stressed with growing population and demands for water), this will increase the risk of flood damage when high runoff events occur in the spring, as they have in the past and will in the future.

In the St. Mary and Milk River watersheds (Montana, Alberta, and Saskatchewan), glaciers in the headwaters currently provide a significant steady flow and, coupled with snowmelt, and significant spring flush. If the glaciers vanish, the underlying nature of water management may need to adjust, possibly resulting in increased looks to storage facility to better weather the dry summers. In this arid region, a likely focus on water conservation and storage for drought, coupled with more intense rainstorms due to climate change, may introduce floodplain management risks.

Technological advances and an increased focus on watershed-based approaches provide an opportunity for watershed-based mapping along the U.S.-Canada boundary. Already, a pilot project in the St. Croix River watershed (Maine and New Brunswick) has provided a shared digital tool for water management. Anomalies between U.S. and Canadian data have been addressed so that the mapping is seamless across the border – and reflects this seamless data back in agency-based databases so that the two countries' official digital maps can match along the boundary. The relative effort is small, and the potential benefits considerable. By 2050 such digital mapping could long have provided a comprehensive framework for shared floodplain management efforts by the U.S. and Canada.

Shared data and science generally will inform coordinated policy. Changes will bring new knowledge, both expected and unexpected. And the relationship between national neighbors will continue – perhaps tested by change in some areas, but remaining strong.

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MANAGING COASTAL FLOOD RISK BY REFORMING GOVERNMENT POLICIES THAT INCREASE VULNERABILITY

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The greatest challenge to floodplain and flood risk management during the next four decades is likely to occur not in riverine floodplains, but in regions subject to coastal flooding due to storm surge caused by hurricanes. The magnitude of coastal flooding—and thus the importance of coastal flood risk management in the decades to come—is indicated by the huge disparity in flood insurance operations among the states. Approximately 70 percent of the National Flood Insurance Program (NFIP) portfolio, accounting for more than $760 billion of flood coverage, is located in just five states, each of which is prone to coastal flooding—Florida, Texas, Louisiana, California, and New Jersey.

Florida alone accounts for nearly 40 percent of the flood policies issued by the NFIP portfolio. Two states—Florida and Texas—represent over 50 percent of the entire NFIP portfolio. In Florida, the counties with the highest total amount of coverage in place for single-family dwellings in 2005 were Broward, Miami-Dade, Palm Beach, Lee, and Pinellas. Paradoxically, Miami-Dade and Palm Beach counties, which are highly exposed to hurricane risk (and thus to storm surge), have among the lowest costs of flood insurance in the state. While the low cost of flood insurance in these two counties would suggest that water damage from hurricanes is not likely to be significant, evidence from the last several years suggests that the opposite is true; Miami-Dade and Palm Beach counties are among the top 10 counties for claims payments between 2000 and 2005, mainly due to storm surge.

Flooding due to storm surge is a matter of particular concern to property insurers because it is the basis of the "wind versus water" disputes between insurers and policyholders that have led to dozens of lawsuits filed in the wake of the 2005 Gulf Coast hurricanes. The disputes were largely caused by the widespread failure of property owners located in coastal areas at risk of storm surge (i.e., Zones V and VE as designated in NFIP flood maps) to purchase flood insurance.

For example, in Florida, less than one percent of single-family residences located in zones V-VE had NFIP policies in force in 2005—despite the fact that flood insurance is mandatory for Zone V-VE properties that are backed by federally-insured mortgages.[1] In cases where hurricane-related losses are due to flooding, it is hardly surprising that many property owners who lack flood insurance will attempt to seek compensation for their losses from their private insurer, notwithstanding that flood loss is almost universally excluded from standard homeowner insurance policies.

Many observers believe that the solution to this problem is to encourage greater participation in the NFIP by owners of properties in coastal floodplains. The Flood Insurance Reform and Modernization Act of 2007 (H.R. 3121), introduced on July 19, 2007, would attempt to accomplish this by increasing penalties on mortgage lenders who fail to enforce federal rules requiring owners of mortgaged properties to purchase of flood insurance, and by raising public awareness of the importance purchasing flood insurance through the NFIP. At the same time,

both H.R. 3121 and a Senate version of the bill (S. 3589) seek to improve the financial stability of the NFIP by increasing the maximum allowable premium increase from 10 to 15 percent, and by moving toward adoption of "actuarially sound" rates (although neither bill gives a clear definition of the meaning of this term).

Increasing the take-up rate for flood insurance in coastal floodplains while simultaneously raising rates and scaling back subsidies would appear to be a lofty goal. A better strategy, especially if one takes a long-term view, is to enact policies that promote *vulnerability reduction* in coastal floodplains. The case for such an approach is reinforced by the belief among many climate scientists that global warming will increase the intensity of Gulf and Atlantic coast hurricanes between now and 2050, which in turn will increase the severity of coastal flooding due to storm surge.

The central problem was identified in a statement issued by ten of the nation's most eminent climate scientists in July 2006. While the debate over the possible influence of climate change on hurricane activity is "of considerable scientific and societal interest and concern," they wrote, "it should in no event detract from the main hurricane problem facing the United States: the ever-growing concentration of population and wealth in vulnerable coastal regions. These demographic trends are setting us up for rapidly increasing human and economic losses from hurricane disasters, especially in this era of heightened activity." [2]

Indeed, the U.S. Census Bureau projects that Florida's population will grow from 17.5 million in 2005 to 23.4 million in 2020—an increase of nearly 39 percent in just 15 years. While it may make sense to persuade more of Florida's current coastal residents to purchase flood insurance (which, if successful, would significantly increase Florida's share of the NFIP policy portfolio), the real question for flood risk managers and policymakers is whether the time has come to rethink government policies and programs that encourage the migration of people and wealth from relatively low-risk interior regions of the country to regions prone to catastrophic flooding due to hurricanes.

In their joint statement, the ten climate scientists correctly noted that "rapidly escalating hurricane damage in recent decades owes much to government policies that serve to subsidize risk. State regulation of insurance is captive to political pressures that hold down premiums in risky coastal areas at the expense of higher premiums in less risky places. Federal flood insurance programs likewise undercharge property owners in vulnerable areas." They concluded by "call[ing] upon leaders of government and industry to undertake a comprehensive evaluation of building practices, and insurance, land use, and disaster relief policies that currently serve to promote an ever-increasing vulnerability to hurricanes." [3]

Such an evaluation is urgently needed, and obviously beyond the scope of this short essay. However, it is clear that government entities at the federal, state, and local levels with jurisdiction over hurricane-prone coastal regions must be disabused the notion that unbridled population growth and economic development are always desirable. In particular, state governments must resist not just populist demands for "affordable" property insurance in high-risk areas, but also pressure from powerful economic interests—including real estate developers, mortgage lenders, and the construction industry—to artificially suppress the price of residential property insurance through insurance rate regulation. They must also resist the temptation to create or expand government-run insurance entities—such as the Citizens Property Insurance

Corporations that currently operate in Florida and Louisiana, and the Florida Hurricane Catastrophe Fund—that subsidize coastal development that is both economically unsound and environmentally irresponsible.

The current trend, however, is in the opposite direction. Legislation was recently introduced in the U.S. House of Representatives (H.R. 3355) that would encourage more states to create such funds, thereby facilitating further population growth and economic development in hurricane-prone coastal regions at the expense of taxpayers nationwide.

A more sensible approach would be to move toward a system in which private insurers are allowed to charge risk-based premiums for property insurance in coastal areas, and the NFIP is required to do so. For property owners of modest means who truly cannot afford insurance priced according to risk, direct government assistance could be made available in the form of grants or vouchers, modeled after the federal food stamp program. No such assistance should be made available to purchasers of new construction, however, nor should new NFIP policies be issued to purchasers of newly-constructed properties. More stringent land use policies should also be part of the mix. But simply abolishing insurance price controls on private insurance, as well as making new coastal development ineligible for subsidized government-run insurance programs, would go a long way toward stemming what the climate scientists called "our lemming-like march to the sea." [4]

Notes

1 The 2005 percentage had declined steadily since 2000, when it stood at a mere 1.23 percent.

2 "Statement on the U.S. Hurricane Problem," July 26, 2006. Signers include Kerry Emanuel, Richard Anthes, Judith Curry, James Elsner, Greg Holland, Phil Klotzbach, Tom Knutson, Chris Landsea, Max Mayfield, and Peter Webster. Available at http://wind.mit.edu/~emanuel/Hurricane_threat.htm.

3 Ibid.

4 Ibid.

A MITIGATION CAROL
(with apologies to Charles Dickens)

Fran McCarthy and Natalie Love
Congressional Research Service

We can all remember the ghosts of Mitigation Past:

- the faith in levees ("if we only build them higher");
- the codes not enacted;
- funding for years of research—produce mitigation approaches that could work, but precious few funds to implement those approaches;
- Project Impact banned and the Hazard Mitigation Grand Program reduced in actual funding percentage.

But the ghosts of Mitigation Present offer some hope:

- disaster response and recovery funding soared and due to revised funding formulas, mitigation funding also began to greatly increase.[1] Pre-Disaster Mitigation Funding is now $120 million.
- FEMA spokesmen have once again embraced the savings involved in mitigation investments[2]
- more leadership has evolved from the local and state level to provide the energy and ideas for mitigation that can succeed.
- an international awareness of that the frequency and scope of disasters continues to increase and impacts more and more people due to development surges in the last century.

Almost 50 years from now we can hope that the ghosts of *Mitigation Future* will provide new challenges to engage and different issues to consider rather than scaring us with old problems that rattle their chains and won't go away.

In the year 2050 there are *headlines that we don't want to see*:

- "Repetitive Flood Damage: 20 Strikes and Maybe You're Out" or
- "Coastal Development Surges in the Wake of Hurricane Recovery" or
- "Insurance Commissioners Agree: Hazard Insurance Neither Affordable nor Available"

Conversely, the ghosts of Mitigation Future could provide some *headlines that would be welcome* on our morning digital paper:

- "Wetlands continue to Grow on Gulf Coast" or
- "Major Earthquake, Minor damage – California Codes Cited for Protection or
- "Historic Flooding Inundates Park Lands, not Neighborhoods – Some Games have to be Rescheduled"

Who is Scrooge in this story? There could be many nominees for that role. But consider that Scrooge, at the end of the tale, sees the possibilities and seizes them. Our society has the wallet, the will, and the imagination to seize the days ahead as well.
That bright future could be helped along by a consistent approach from government at all levels to build more resilient communities but also to accomplish that task through a cooperative approach that recognizes local creativity and commitment as well as the roles of the private and non-profit sectors.

It also can be helped at the federal level by leadership that understands how departments and programs interconnect. That should result in funding decisions that complement those relationships rather than exacerbate them.

In some ways, each President's budget tries to tell a story. It may not be of the quality of a Dickens story, but it does emphasize initiatives that reflect the President's leadership and attempts to weave sometimes disparate program decisions into a tapestry of cohesion and purpose.

Perhaps in 2050 we can have tapestries at many levels where local, state and federal priorities come together to reinforce a mitigation message that can become part of the culture of daily living rather than something imposed from on high. The concepts of mitigation can infuse many plans at all levels of government and society. They should not be a separate compartment that is unlocked following a disaster and then forgotten until the next big event.

With the dawning of 2050, the increase of international collaboration will be a testament to the recognition that large-scale disasters threaten the stability of both the global ecology and economy. Organizations such as the Office of the United Nations Disaster Relief Co-ordinator, the International Association of Emergency Managers, and the Organization of American States will provide a forum for regional disaster mitigation collaborations such as the Balkan Seismic Risk Project in which Albania, Bulgaria, Greece, Romania, Turkey, and Yugoslavia collaborated to assess the earthquake risk to their countries.[3] The new international disaster mitigation community will enable an exchange of ideas in developing areas such as hazard assessment, the earth sciences, meteorology, instrumentation advances, and detection and prediction techniques.

Public-private collaborations such as the Disaster Recovery Business Alliance and the Florida Institute for Business and Home Safety will have strengthened.[4] As the private sector has begun to acknowledge environmental concerns and address them, that same sector can lead an approach to development that reduces risk in the future. That private sector can also sell a mitigation message that goes beyond boards for windows during hurricane season and feeds a market ready for preparedness and protection of life and property and reduced risk from all hazards. It can show the benefit of mitigation investments throughout a community.

Notes

1 P.L. 109-295, §684, Stafford Act amended Section 404.

2 U.S. Department of Homeland Security - Federal Emergency Management Agency, *Washington Mitigation Measures Pay Off in Major Savings, at [*http://www.fema.gov/news/newsrelease.fema?id=34969] visited on Sept. 19, 2007.

3 United Nations, *Disaster Mitigation: Disaster Management Training Programme*, prepared by the Department of Humanitarian Affairs (Cambridge: United Kingdom, 1994).

4 Richard T. Weber, David A. McEntire, and Robie J. Robinson, *Quick Response Report #155, Public/Private Collaboration in Disasters: Implications from the World Trade Center Terrorist Attacks* (University of Colorado: Boulder, Colorado, 2002).

THE FUTURE OF HAZARD MITIGATION: HOW DO WE GET THERE FROM HERE?

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In the year 2050, all properties located in a floodplain should be protected and mitigated. All citizens living in tornado alley should have safe rooms available to them in or near their homes, their schools, their workplaces, and their places of worship. All businesses in earthquake-prone areas should have taken the steps necessary to make their buildings able to withstand seismic activity. And all coastal dwellers should be aware of the risks they face when they build in hazardous areas and should be required to build so that when Mother Nature strikes, as she will again and again, the cycle of event-damage-rebuild-event damage rebuild is finally broken.

Wishful thinking? Perhaps. Naïve? Maybe so.

But it's time to stop kidding ourselves and demand that our leaders at the local, state and federal levels no longer tolerate the idea that the direct and indirect consequences of disasters are allowable or affordable. The buck must stop here and now. There must be no more "acceptable losses" when it comes to natural hazards

Within FEMA's Mitigation Division and the National Flood Insurance Program we continue to do all we can to foster a culture of reducing our vulnerability to natural events. We continue to work with states and communities to educate their citizens about their risks, and we continue to provide technical assistance and resources to communities across the Nation to help them:

- Analyze the risks communities face and plan how best to mitigate those risks
- Actually reduce their risks through a variety of measures including floodplain management, grants, and technical advice, and
- Insure against flood losses.

But we cannot do it alone. We cannot do it without the leadership of policymakers from all levels who recognize that we live on a restless planet. And we cannot ignore that the technology and resources exist to enable Americans to build safer, stronger, smarter, and more resilient to natural events.

For the last decade, we have heard gloom and doom prognostications from experts from science, engineering, and academia. Global warming. Sea-level rise. A high-point in the cycle of hurricane activity. And now, sadly, that terrorists will again target us on our own soil. Any way you say it, according to the experts, the "big one" is coming.

And as we speak, even more attention is being raised on topics like glacier loss, sea-level rise, poor land use decisions and disappearing wetlands and barrier islands. So it is likely that for years to come we will hear similar, and perhaps more foreboding, predictions.

From 1900 to 2000, our Nation grew from 100 million to about 300 million – a three-fold increase. But in terms of real dollars, flood losses were six-fold. If we continue to build in ever-higher risk areas and then add in factors like climate change and disappearing protective lands, and don't dramatically increase our mitigative actions at all levels of government and society, how much worse will it get?

How soon? How big? How devastating? These questions are difficult to answer with any certainty even though some are trying. But we can be reasonably sure of one thing – we won't be able to stop these natural events. So what can be done?

The Nation's Mitigation Strategy is built upon three principles: identify the risk, plan for how to deal with the risk and insure against the risk.

And each principle requires some difficult decisions from a policy perspective, but each is critical to ensuring that every possible step is taken to make communities better able to survive a natural hazard event and recover quickly from it.

Leaders at all levels must take seriously the hazards they face and recognize that no one is exempt from dealing with hazards now or in the future. You won't save any lives by ignoring the obvious and hoping for the best.

Right now, leaders at all levels and citizens need to:

- Truly incorporate mitigation into land use planning and management strategies to reduce their communities' vulnerability;
- Educate citizens about the risks they face;
- Support higher levels of safety during reconstruction and recovery;
- Require that everyone who lives in a floodplain -- renter or property owner – have adequate flood insurance;
- Look seriously at this question: Is the 1-percent annual chance standard used nationwide to determine flood risk adequate? And if it's not, we must make necessary changes;
- Understand the mitigation resources available to them now and hold their elected and community leaders accountable for continuation of those resources and the development of new ones; and
- Implement and maintain sound mitigation plans and strategies.

Until messages about protecting yourself from disasters are as common as messages about the hazards of drunk driving and the value of smoke detectors, I believe meaningful change will be hard to come by. And until laws are adopted at all levels instituting a culture of mitigation, we'll never be safe. Again, FEMA and the NFIP cannot do this alone.

As the Subcommittee on Disaster Reduction stated in their *Grand Challenges* report: "we cannot avoid hazards, but we can act to minimize their impacts. After all, hazards do not become disasters unless the communities they touch are unprepared to deal with them."

In 1942, President Franklin Roosevelt, in his "A Call for Sacrifice" radio address, detailed a multi-step plan that he acknowledged would affect all Americans – from business owners to rural

farm hands. But, he said, such sacrifice "is the only effective course of action" to help finance America's participation in the Second World War.
To a Joint Session of Congress in May 1961, President John F. Kennedy made the commitment to land a man on the Moon and return him safely by the end of the decade. Later, he told an audience at Rice University, "We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard."

America needs the same kind of commitment to disaster resiliency. This movement toward resiliency will require a national framework with representation and commitment from traditional players like academia, associations, and agencies and new partners like the private sector and government at every possible level.

It's in the private sector, I fear, where our greatest challenges may lay. Telling a client ready to buy a new home (especially in these declining times) that the home under consideration is subject to some calamity or other is not taught in real estate agent training classes. Consumers don't demand it. And corporate American rarely talks about it.

"People typically purchase homes based on the number of bedrooms and bathrooms, location, and aesthetics (e.g., curb appeal)," writes Stephen Leatherman, Director of the International Hurricane Research Center at Florida International University in the September issue of the Natural Hazards Observer. "Realtors rarely discuss building safety and hurricane resiliency with their clients; therefore, the public has scant information or insight on these issues. Full-scale destructive testing of houses will change the public's perception of building safety."

Maybe it won't take that. Maybe it will. Maybe it's this factoid from Roger Pielke at the University of Colorado at Boulder – 2008 marks the 70th anniversary of the 1938 hurricane which devastated much of New England. The "Long Island Express" as it has come to be known, made landfall on Long Island as a Category 3 storm, killing up to 700 people and causing nearly $4.5 billion in damage. If the same storm were to hit today, damage would exceed $40 billion according to Pielke's research.

Largely a rural farming and fishing community when the 30 to 50-foot waves crashed ashore in 1938, Long Island now boasts a population of approximately 2.83 million people and is one of the most affluent areas in the United States – especially along the shorelines.

I'm heartened that both the U.S. Conference of Mayors and the National Association of Counties have committees now looking at topics like climate change and sea-level rise and how those phenomena might affect community infrastructure. And some local officials, undoubtedly, are doing the right thing and not accepting short cuts or succumbing to pressure from better-heeled interests. But all mayors and all county officials and all elected and appointed leaders need to understand that building communities resilient to disasters is economically defensible and operationally necessary. FEMA learned two years ago that for every dollar spent on disaster mitigation, society saves $4 when an event occurs.

Likewise the federal government has a role to play in this too. FEMA, NOAA, USGS, NIST, EPA, NASA and others all have roles to play in the mitigation realm. We must stop playing turf warfare with money and begin to leverage each other's energy, resources, brainpower, and budgets so that we better support community action toward resilience.

As the Nation's mitigation leaders; FEMA, the Mitigation Directorate, and the NFIP will continue to serve as a mitigation facilitator and resource clearinghouse: developing, improving, and distributing technical support, educational materials, planning assistance, guidance, and policy.

And we'll continue strengthening our mitigation partnership at all governmental levels, and with the private sector, so that communities recognize the value of these resources and put them to good use.

But the front line of the war to convince America on the value of mitigation begins on Main Street. It is the people in communities, whether leaders or those who vote for leaders or those who buy their products, who must be ultimately accountable for community resiliency. And it's there that the culture of mitigation must have its birth.

SHARING THE KNOWLEDGE

Alberto de Sousa Costa, Ph.D.
DMS Foundation

"*We must learn something that no nation or group of nations yet mastered: the art of helping others to improve their lot even as differences between them grow.*"[1]

—Gilbert Fowler White

Gilbert Fowler White was not only a great American and visionary par excellence, but also a man who was respected worldwide. His leadership and role in the Point Four Youth Corps, the International Cooperation Administration, and the Peace Corps under the Kennedy Administration are recognized worldwide. In the 1970s he served as chair the United Nations Development Programme task force that examined a number of major water storage projects in the African Nile, Volta, Senegal, and Zambezi River drainages. White's work on that, on the downstream effects of damming the Nile River with the construction of the High Aswan Dam in Egypt, and on many other projects, is still held in awe.

Gilbert White's legacy to the world and to you gathered here today, as Floodplain Managers and Members of the Association of State Floodplain Managers must continue. You have much to offer the world, particularly in those countries where your knowledge, experience, and skills are most in demand and where you can improve their lot irrespective of culture, creed, race or any other idiosyncrasies and differences that may exist.

No natural disaster causes greater grief, loss of life, untold economic losses, and loss of livelihoods than floods. Yet, we are beginning to see at least in America a decline in damage caused by riverine floods as a result of such policies as ''No Adverse Impact"' and the perseverance and hard work of the Association of State Floodplain Managers and legislators. The emergence of well qualified and dedicated Certified Floodplain Managers is responsible at least, in part, for these changes as they are in the front-line. However, there is no time for complacency, for there is still much work to be done.

Climate change is no longer a cliché reserved for academics, but a reality. You don't have to be a rocket scientist to see the results of these changes throughout the United States and the world. Global warming, higher disaster frequencies, be they floods caused by tropical storms, hurricanes or seasonable floods and yes(!), the question no one wants to think about, rising sea levels. This is your next challenge all along the Atlantic, the Gulf states and Pacific coastlines.

It will be decades before the Kyoto Accord, which has been signed by most countries and/or any other accord that may follow Kyoto is improved upon and fully implemented and before anyone will see any significant change or impact in the world's climate and before coastal flooding can be tamed or at least controlled. Things will get worse before they will get better as sure as the sun will rise tomorrow. It is Floodplain Managers as yourselves who must spring into action not only in the home front, but worldwide and in developing countries in particular where the loss of

life is widespread. Take the initiative and seize the boundless opportunities that await you all over the world.

Be creative, don't wait for a tragic event before initiating action, for when major natural disasters occur, much needed help tends to arrive too late and tends to be disproportionate to local needs at the time of delivery (wrong materiel, wrong time, wrong place).

Debarati Guha-Sapir, director of the Belgium-based Centre for Research on the Epidemiology of Disasters ("CRED") said "Past experience has shown that 8 to 12 hours is the maximum delay within which to rescue people, if they are to survive". Yet international search-and–rescue teams continually arrive too late – often days after the disaster has occurred. The lesson that never gets learned, according to Guha-Sapir, is that "community preparedness is the only practical solution for economically poor communities located in high-risk areas. The locals are the ones who can bring any effective help in the first few hours and it is their capacity that has to be strengthened. This is less heroic than flying in after the event waving fist-full of dollars". Local community–based prevention and disaster mitigation programs are cheaper and more effective" says Debarati Guha-Sapir.

I make an appeal to the International Committee of the Association of State Floodplain Managers to look at those countries that face the greatest hurdles and lack cohesive floodplain management policies and organization and encourage them to embrace the principles of the ASFPM. Offer and fund CFMs wanting to volunteer their time to a myriad of international bodies that include the United Nations, International Financial Institutions such as the Asia Development Bank or the Bank for the Reconstruction of Eastern Europe to several Non-Governmental Organizations working throughout the world to help create floodplain policies and implement No Adverse Impact solutions that can be adapted to local environments and save lives, property, livelihoods and the environment.

If Gilbert White were here with us today in person, he would probably agree that the time has come for members of this Association to go forward and teach others what they have learned. One nation practicing good floodplain management techniques and policies cannot hope to offset the effects of global warming. We must be prepared to share our knowledge with other countries in need and to glean the best of other nations' floodplain management programs.

Notes

1 Quoted in *Living with Nature's Extremes The Life of Gilbert Fowler White,* by Robert E. Hinshaw, 2006, p. 98.

TRANSLATING SCIENCE TO MANAGEMENT TO APPLICATION: ACHIEVING THE PRACTICE OF COMMUNITY RESILIENCE

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Despite Katrina, No New National Policy or Programmatic Changes

Nearly two years have passed since the devastation in the Gulf Coast and New Orleans from Katrina. This event was unprecedented in recent US history. Yet, our nation's history and the world's history provide ample evidence that large natural disasters occur frequently and through the predictions of the impacts of global warming and climate change, these disaster events will continue with a vengeance. Whether we are discussing tsunamis, hurricanes, floods, droughts, wildfires, or earthquakes, natural hazards remain a primary force that can bring about catastrophic consequences to every region of the United States.

In the past two years there have been many studies and untold amounts of data collection and technological review. Despite these efforts, there has been no significant national policy change in how we address the impacts of natural disasters. What happens to this "new data"? Will it make its way into the hands of the local and state decision makers or those that are responsible for the short term recovery decisions and long term revitalization of our communities? If our state and local officials gain access to this information—will they use it? Will they know how to use it? Will they now base their decisions for rebuilding in a way that will reduce the risk of flooding and hurricanes in the future? Will these officials make the tough development decisions needed in order to truly achieve community resilience? Even armed with this data, will state and local officials ever truly have the capability to make the dramatic changes needed to address the dramatically changing regime of floodplain development over the next 50 years?

Community Resilience and Human Factors in 2050:
Population Trends, Growth, and Urbanization

A community that has unhealthy planning and development practices has less capacity to absorb hazard impacts or effectively recover from disasters. The long pattern of these community land use practices are not keeping up with surging coastal populations, aging infrastructure, and sprawling urbanization issues. Everyday deliberate decisions, actions, and inactions all contribute to current and future resilience capacity of individuals, families, communities, and societies. Resilience isn't something you do. Resilience is a characteristic that cumulatively results from things you do or don't do. Effective community resilience strategies seek to improve the overall health of communities in diverse capacity areas that are critical to long term resiliency. These capacities can range from things such as education and health care to social structure, hazards preparedness, natural resources, and the economy. As a result, successful strategies are heavily dependent on information sharing and collaboration among groups that have not traditionally worked closely together toward common outcomes.

What Human Adjustments Can be Made to Meet the Floodplain Management Challenges of 2050?

One of the biggest challenges we face in the resiliency arena is effectively translating resilience concepts into practical tools and implementation techniques on the ground. Fortunately, many of the tools and resources associated with hazard mitigation and floodplain management also have great potential for supporting resiliency objectives. This presentation will explore the linkages between coastal community resilience and ongoing initiatives such as the Coastal No Adverse Impact (CNAI), and the development and implementation of RiskWise Communities.

"No Adverse Impact Floodplain Management" is a managing principle, developed by ASFPM to address the shortcomings of the typical local floodplain management program. Rather than depending on minimum requirements of federal or state programs, NAI provides tools for communities to provide a higher level of development approaches for their citizens to prevent increased flooding now and in the future as well as protecting property rights and providing social equity. NAI is an approach that ensures the action of any community or property owner, public or private does not adversely impact the property and rights of others. NAI extends beyond the floodplain to include managing development in watersheds where floodwaters originate. NAI does not mean no development, it means that any adverse impact caused by a project must be mitigated, preferably as provided for in the community or watershed based plan.

For local government, No Adverse Impact represents a more effective way to tackle their flood problems. The concept offers communities a framework to design development programs and standards that meet the true community needs, not just the requirements of a federal or state governmental agency. The NAI floodplain management initiative empowers communities (and their citizens) to work with stakeholders and build a program that is effective in reducing and preventing flood problems. NAI floodplain management is about communities being proactive—understanding potential impacts and implementing prevention and mitigation activities before the impacts occur. NAI is one of the most effective approaches communities can use to reduce community liability and legal challenges to their permit and planning decisions.

Making the Appropriate Adjustments to Apply the Science and Policy to Reduce the Impacts of Disasters

One of the ultimate objectives in addressing the needed policy and program shifts to more effectively meet the floodplain challenges over the next 50 years is to retrieve the latest developments in technology and data gathering and translate that into sound policy. However, more important is implementing policy into management and practice at the local level. Risk-Wise achieves that through four elements: Partnership Exploration & Development; Education Development; Community Implementation Element; and Community of Practice: Accessing Web Resources.

Risk-Wise is a concept for a collaborative partnership network to help improve the safety and resiliency of communities threatened by coastal hazards. Using an education-based approach, Risk-Wise will utilize collaborative outreach and extension as an effective means of facilitating informed risk management at the community level. The program will focus exclusively on educating local decision-makers on the linkages between hazard impacts, community vulnerabilities, and risk-wise policy alternatives. Local officials must be educated about community resilience concepts and become knowledgeable about the relative resilience of their communities and how their actions (such as local land use decisions) contribute to increasing or

decreasing their communities' resilience. It is only through this critical understanding of how their decisions ultimately impact their community will there be any possibility that they will make the "tough" decisions to achieve sustainability thereby lessening the impacts of future natural disasters.

One of the key aspects will be to develop and maintain communication links between network programs, partner agencies, and related organizations. Risk-Wise is a very active ongoing effort and is actively engaged in creating a partnership focused on community resilience and includes the NOAA Coastal Services Center, Sea Grant, Office of Coastal Resources Management, and CSO. Equally involved in this effort are other key core partners including the Association of State Floodplain Managers (ASFPM), the Coastal States Organization (CSO), the Institute for Business and Home Safety (IBHS), and the American Meteorological Society (AMS), to name a few.

Establishing an Action Plan

As data collection and interpretation improves over the next 50 years communities, through various federal mandates, programs and policy initiatives are identifying and addressing their risks and vulnerabilities. Data and successful case studies must be made accessible to practitioners by maintaining a real and virtual library including a strong community of practice web presence - developing, collecting, and collaborating on educational materials, presentations, products, and discussions. However, with the advent of better technology can we implement the latest data and technologies into the social processes that define vulnerable communities? Federal, state, local, and private resources must be made available in order to reach this critical objective. For example, the collection of geospatial resources is a critical component and will be achieved through working with partner agencies to collect resources and tools for local government to use in better policy development and land use decision making. In addition to communication, training is also a critical component of Risk-Wise and multi-agency and organization training work plans should be developed facilitating professional development among network and affiliated partners through workshops, and conferences and accredited training programs. Finally, performance tracking is also a very important element in transferring the technical knowledge to application and implementation by local officials. Performance tracking measures the effectiveness of the network programs by tracking the implementation of risk management strategies and pursuing the development and implementation of resilience indicators or indices.

ACHIEVING MINIMUM FLOOD RISK IN THE YEAR 2050 WHAT MUST HAPPEN BETWEEN NOW AND THEN?

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Background

In 2007, our nation remains extremely vulnerable to flood risk. In a broad sense, this risk comes in the form of economic cost to the nation, to the region, and to the local area directly impacted; in the form of personal financial hardship to residents living in the path of flood water; in the form of a high level of threat to personal safety; and in the form of an unacceptable level of risk to human life. In spite of all the effort that this nation has expended in terms of funding and overall focus to reduce flood risk, the risk simply continues to increase. Damage has been ever increasing for the past decades with no end to the increase in site. This reflects that, as a nation, we simply have been and currently still do, build in the wrong places and at elevations that are too low. The profession of floodplain management recognizes what needs to be done to stop this ever increasing flood risk and has fervently pointed in the correct direction over the years with great frequency and vigor. However, the enticement of short term economic and political gain that transfers to local governments via tax base increase, to floodplain developers via economic gain, and to short term focused politicians at all levels has been far too strong resulting in long term economic and political loss to the nation as a whole. This paper will focus on some actions that need to be considered to move this nation to minimal flood risk in the year 2050.

Communicate the Flood Risk

Historically we have done a very poor job of communicating the flood risk. As a nation, our efforts have really been to "hide" the risk and take the position that "this area is safe for development" and "this area is no longer in a floodplain." Flood risk communication is, historically, the most important part of flood risk reduction that this nation has consistently ignored in terms of getting the information to people and government at all levels on a continuing and on a factual basis. If this nation has any hope of achieving minimal flood risk in the year 2050, sound flood risk communication is the key. Without it, people living in harms' way are unaware, land use decision makers are unaware, politicians making policy that affects floodplain/flood risk management are unaware, and taxpayers who ultimately pay the bills for unsound decisions are unaware.

- Flood risk maps must be accurate and current within no more than 5 years. A reliable funding source must be available.
- Areas protected by flood risk reduction measures must have the residual flood risk fully conveyed in terms of design exceedance or project failure.
- Flood risk communication must be a highest priority in terms of funding and done on an annual basis at a minimum. This must be done at all levels with focus on the individual tenant and owner.
- Signs stating clearly the residual risk in areas protected by flood risk reduction measures must be standard practice.

- Government agencies must make flood risk decisions based on technical information, existing policy, and existing law without tainting the decision process with bias based on anticipated political reaction.

Responsibility for the Flood Risk

As a nation, we have migrated to where floodplain occupants really do not take responsibility for ensuring their own safety from flood risk. The predominant feeling is, in the case of flooding, people want to live as though flood risk did not exist because the federal government will ultimately "bail them out". Floodplain developers are "in and out" for the quick economic gain with no subsequent or long term responsibility. Local land use decision makers are looking for the economic gain from tax base. Politicians are looking for the next vote that results from the "short term economic gain" from floodplain development. As our process exists now, responsibility for flood risk ultimately rests with the federal taxpayer who did not have a direct role in the decision making process to develop and live in the flood risk area. The National Flood Insurance Program (NFIP) has made it economically feasible from an individual's point of view, to live in areas that are simply too hazardous.

- Full actuarial insurance rates that are fully commensurate with the actual risk.
- Legal liability for floodplain development that is subsequently flooded, rests with the individual, the developer, and the land use decision making authority.
- Congressional "bail out" funding to individuals to provide relief and recovery that did not have flood insurance must stop.
- Flood insurance should be based on risk. With this in mind, some areas are simply too hazardous to insure.

Floodplain/Flood Risk Management

The national standards for floodplain/flood risk management are not adequate. The 100-year standard has out lived its time. Floods repeatedly demonstrate that the 100-year standard especially for urban areas is too low. Some areas are simply too hazardous to occupy and should be designated and enforced as no building zones. This nation's floodplain/flood risk management policy and its flood recovery policy are many times at odds to each other in terms of consistency of programs, application of those programs, and long term incentives to people to do sound floodplain/flood risk management. The nation, in general, focuses first on structural projects to mitigate flood problems. This type of project, especially levees, leads to more flood problems in the future due to actually inducing new development in the "protected" area that is built as if a floodplain did not exist. To this end in terms of levee projects and present floodplain management and flood insurance standards of the NFIP, most communities support only 100-year levees because their short term goal is to eliminate the protected area from being in the "floodplain" for purposes of the NFIP. Their goal is really not actual flood risk protection but "protection" from flood insurance purchase and floodplain management requirements.

- 500-year standard minimum for urban areas
- 1000-year standard minimum for critical facilities
- No adverse floodplain impacts to properties that are located in areas that can be affected negatively by projects of any type located in floodplains.
- No building zones in high hazard areas along coastlines such as "V" zones. This concept would be similar to a floodway for riverine areas. Some areas should be made void of all human habitation.
- Future conditions are an absolute must for any flood risk mapping

- The 1 foot rise criterion for an acceptable floodway for purposes of the NFIP inherently allows adverse floodplain impacts. This must be changed.
- Incentives need to be provided to communities in the form of reduced project cost share if those communities are proactive in reducing flood risk beyond the national standard.
- A National Floodplain/Flood Risk Management Policy is needed to provide consistent direction across all authorized programs dealing with flood mitigation and flood recovery
- With NFIP standards as they presently exist, stop immediately building 100 year levees in urban areas. Either build a 99-year levee or a 500-year levee.
- Requirements for new construction in areas protected by levees are based on flood elevations as if the levee would fail.
- When developing flood risk reduction projects, focus on nonstructural alternatives first rather than today's common practice of focusing on structural alternatives first.

Short Term Versus Long Term Focus

This nation has a short-term focus when it comes to dealing with flood problems. That focus needs to shift to long term. Currently the decision making process for individuals who realize they live in a floodplain is often short-term: a flood will not happen while they live there. Local land use decision makers often are biased to short-term decisions that do not reflect the risk of flood but rather the risk to the local tax base. Politicians often are biased to short term policy since that is the directional focus of vocal constituents. The Gulf Coast recovery from the 2005 hurricane season is a prime example that will lead to more, not less, flood risk in the year 2050. Some individuals are rebuilding as low as is allowed, assuming another flood will not happen while they live there. The federal government has provided new flood risk information in the form of advisory flood elevations based on the 2005 hurricane season information (advisory base flood elevations or ABFE). The decision to use this information in land use decisions is at the discretion of the local community. Some communities are ignoring the ABFE allowing the rebuild to occur based on the lower elevation of the currently effective flood insurance rate map in order to not lose tax base, etc.. This ultimately results in short term economic/political gain with long term economic/political loss when the next disaster occurs.

- In areas being rebuilt following a Presidential disaster declaration, the land use decisions during the rebuild will be made at the federal level.
- Infrastructure/facilities that are critical to the regional and national economy must be removed from the floodplain
- Communities that are in high flood risk areas need to move to areas of minimal flood risk.
- Use concepts such as tax incentives, transfer of development rights, purchase of development rights, innovative annexation, etc to accomplish relocation of communities and critical infrastructure/facilities over the long term thus achieving what is considered in the short term impossible.
- In all future planning studies and ultimate project implementation, long term objectives must be an integral component

Achieving minimum flood risk in the year 2050 is something that this nation will adopt as good. The adoption process is easy. The hard part is making it happen. The key issue is does this nation have the will power to make decisions that are tough and unpopular in the short term but are

critical to make this long term goal. Can the nation get past its historical perspective of short term economic/political gain that has resulted in long term economic/political loss when flood disasters strike? Does the nation have the long term focus? The 2005 hurricane season was devastating to individuals; to the local, regional, and national economy; to agencies; and to politicians. This devastation can become positive only if this nation uses this event to focus on what is needed from now forward to really achieve minimum flood risk in the year 2050.

Part 8

Improvements to the Mix of Adjustments

ONE NATION, ONE POLICY, ONE PROGRAM
FLOODPLAIN MANAGEMENT 2050

Peter D. Rabbon
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Background

The U.S Army Corps of Engineers (USACE) and the Federal Emergency Management .Agency (FEMA) are the lead federal agencies in the area of flood damage reduction and floodplain management. The Corps' programs primary focus is on management of flood water (such as levees) and management of floodplains (such as elevating structures and floodplain acquisitions) to reduce the flood risks. FEMA programs emphasize the use of hazard mitigation programs, floodplain management measures and flood insurance to mitigate flood related losses.

State and local agencies are involved with flood risk management thru partnerships with the Corps and FEMA. They also have vital flood risk management responsibilities that are separate from the federal government, such as establishing building code requirements and regulating land use.

Several key connections, or "nexus", exist between the two federal agencies' programs and the nonfederal governments. For example, under the FEMA administered National Flood Insurance Program (NFIP), all areas in a community designated as a Special Flood Hazard Area (SFHA) are subject to mandatory flood insurance purchase requirements and development restrictions. The condition and performance of USACE constructed levees play a role in determining what areas of a community are subject to flood insurance. The local community has a significant role as it is their safety, quality of life, and economic stability that are at risk.

Not only do programs and policies need better coordination to improve program results, but inconsistencies should also be addressed. For example:

- Nonfederal Cost-Sharing: For Corps flood damage reduction projects authorized after 1996, nonfederal local sponsors must pay 35% of the total project costs. For FEMA mitigation projects, the local sponsor pays 25% of costs.
- Benefit-Cost Analysis: The Corps must follow detailed procedures for benefit-cost analysis as described in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, while FEMA follows the less stringent Circular No. A-20 issued by the Office of Management and Budget.
- Levee Certification Standards: FEMA requires three feet of freeboard above the 1-percent-chance flood to certify levees for purposes of the NFIP, while the Corps uses risk-based procedures. The risk-based approach could result in either a higher or lower levee height depending on the uncertainty of the situation.

- Deed Restrictions: If a local government purchases property using FEMA mitigation funds, required FEMA deed restrictions could prohibit future USACE flood damage reduction projects.

Flood risk management policies and programs should be considered on a cross-agency compatible basis rather than an organizational basis. Solutions would be more comprehensive and avoid the "that's not our responsibility" syndrome.

Collaborative Framework

The mission of USACE's National Flood Risk Management Program (NFRMP) is to integrate and synchronize the ongoing, diverse flood risk management projects, programs and authorities of USACE with counterpart projects, programs and authorities of FEMA, other federal agencies, state organizations and regional and local agencies.

Over the past two years, the Corps and FEMA have implemented an initiative called "Silver Jackets". The intent is to develop federal-state teams to better coordinate existing agencies authorities in flood risk management. The State of Ohio pilot has shown promise in fulfilling the goals of the initiative and additional teams are forming in other states.

The General Accountability Office released a report entitled, "Natural Hazard Mitigation: Various Mitigation Efforts Exist, but Federal Efforts Do Not Provide a Comprehensive Strategic Framework," GAO-07-403, August 22, 2007. This report concludes that FEMA, other federal agencies, and nonfederal stakeholders have collaborated on natural hazard mitigation, but the current approach is fragmented and does not provide a comprehensive national strategic framework for mitigation. Collaboration typically occurs on a hazard-specific basis, after a disaster, or through informal methods. A comprehensive framework would help define common national goals, establish joint strategies, leverage resources, and assign responsibilities among stakeholders.

Floodplain Management 2050

By 2050, we should have a unified approach to flood risk management between all levels of government. We should evolve into a single national vision and policy for flood risk management. The policy should be applicable vertically and horizontally within the federal, state, and local governments. The vision and policy should be based on a shared responsibility through partnering and collaboration to achieve long term economic, environmental, and socially sustainable flood risk management, which improves public safety and reduces flood risk through a comprehensive watershed approach.

THE NFIP—IMPROVING FOR THE FUTURE

Cheryl Small
First American Flood Data Services

Background
The intent of Congress when establishing the NFIP was to reduce future flood damage and its toll on the federal government through community floodplain management and to offer protection to property owners against potential losses by providing federally backed flood insurance. While communities seek to mitigate the risk of flooding through floodplain management, floodplain development proliferates. Furthermore, many property owners seek to avoid the protection of flood insurance viewing it as unnecessary. Hurricane Katrina revealed that the NFIP's reserves are not sufficient for its needs perhaps partially based upon the current rating structure. The NFIP certainly occupies a valuable role for the Nation and has contributed to the protection against and the recovery from the catastrophic effects of flooding for millions of property owners. Nevertheless, with the expectations of climate changes in our future and the current financial state of the NFIP, a vanguard approach is needed to support the original legislative mandate by Congress to reduce flood loss and its cost to the Nation.

Proposal
Consider the following suggestions for changes the National Flood Insurance Program could make to further prepare itself for the future and continue its pursuit of the objectives mandated by Congress.

(1) Change the public's perception of flood insurance, flood protection, and flooding disaster by using terms other than "100-year floodplain", "1% annual chance flood", or "hundred year flood". The language used to describe risk directly impacts the public's perception of and response to the risk. For about thirty-five years, the public has believed that a "floodplain" will flood only one time in 100 years, in other words, most likely not in any one particular person's lifetime. As a result of this misunderstanding, the public at large views flooding as a very rare occurrence and flood insurance as an unnecessary burden imposed upon them by their lender and as something to avert at all costs. Property owners, developers, community officials will spend thousands of dollars in many cases to navigate FEMA's processes in an effort to remove the federal flood insurance requirement or to remove the label on a property or properties as being in the "100-year floodplain". In reality, a base flood (44 C.F.R. § 59.1) should be understood as the minimum (or *base*) event in which catastrophic flooding is likely to occur. New Braunfels, Texas, for one, has experienced eleven of these *once in a hundred years* events within the past sixty-five years. By making the change to language that conveys to the public the reality of the floodplain and the risk that it presents to property and life, the public's perception will begin to change resulting in less development in the floodplain and more insurance protection in areas around the floodplain.

(2) Supplement the use of the base flood (or "1% annual-chance flood") as determined presently with other important climatic and geographic information to determine risks and establish flood insurance rates. "The 1% standard, as currently applied, is inadequate and as a result is not contributing effectively to accomplishment of the goals of the NFIP" (Water Policy

Collaborative, 2007). A more realistic and actuarial evaluation of the risk of flooding can be determined through use of a community's or region's mean annual precipitation, NOAA climate reports, USGS paleohydrology reports, and stream gage reports. Through a more comprehensive risk evaluation, a pricing and rating structure can be developed for NFIP flood insurance policies that generates more premiums.

(3) Require flood insurance on each federally backed mortgage loan. FEMA states every property is in a flood zone and every property needs flood insurance. In the face of global warming, climate change, sea level rise, and severe weather disasters, the NFIP will want to strengthen its financial situation in order to deal with the cost of the increase in size and number of natural disasters. The NFIP would not be dismantled but strengthened with proper implementation of a national plan to spread the costs equitably across the Nation by rating policies based upon properties' risk of flooding. Properties in low-risk areas (in areas outside the current "100-" or "500-year" flood zone) would pay a very low and pre-set premium, or in the alternative, a premium based on the property's elevation in relationship to the closest Special Flood Hazard Area elevation. Properties located in moderate-risk areas (within the current "500-year" flood zone) would pay a preferred risk premium, which is a higher pre-set annual premium, or in the alternative, a premium based on the property's elevation compared to the nearest Special Flood Hazard Area, or the water surface elevation. These requirements would also apply to properties that are removed from the Special Flood Hazard Area by a Letter of Map Amendment or Revision. Properties located within the delimited Special Flood Hazard Area would have their flood insurance premiums calculated based upon actuarial principles. The NFIP would be financially strengthened and flood insurance rates would be more equitable.

(4) Exclude development within the Special Flood Hazard Area in areas that are now undeveloped and discourage development within the Special Flood Hazard Area generally. Even with floodplain management requirements, billions of dollars of property are built in known at-risk areas. As has been discovered, even if buildings are constructed above the Base Flood or "100-year" flood level, this is not sufficient to avoid property damage in many cases in the event of a natural disaster. The naturally occurring floodplain should be kept free from obstructions to the extent possible and instead be reserved for roads, utilities, parks, and wetlands. In addition, this also has an environmental benefit in the protection of wetlands and their ecology. This is a common sense solution to a human-made problem.

Conclusion

The NFIP is financially distressed and substantive changes should be considered to both the insurance and floodplain management sides of the program. By utilizing language which supports the Program's purposes, transitioning away from a reliance solely upon the 1% annual chance flood standard, requiring flood insurance on every federally-backed mortgage loan, and excluding development within the Special Flood Hazard Area, the NFIP will be able to generate significant revenue, increase stakeholder confidence in the program, and fulfill the charge by Congress to reduce the damaging impact of flooding on the nation.

THE NEED TO BUILD STATE CAPABILITY FOR FLOODPLAIN MANAGEMENT IN 2050

Larry Larson
Association of State Floodplain Managers

Over the past 50-70 years the nation has come to rely more heavily on the federal government to reduce flood losses. Citizens, communities, and states seldom see that they have a responsibility and role in public safety related to the human suffering and property loss associated with flooding. Instead, over the past seven decades, the perception has grown that flood loss reduction and flood "protection" are the responsibility of the federal government.

Flood losses in the United States continue to increase in real dollars, despite years of national programs and policies to manage flood risk. Some argue the damage is not a problem when compared to our Gross Domestic Product (GDP), but the bottom line is that paying for disasters is usually done by reducing other federal domestic spending, such as that for health or education. Even if the $150 to $200 billion cost of Katrina-Rita-Wilma are written off by Congress, that action will merely passes the debt to our children and grandchildren. This makes it a true issue of priorities (and who wins and who loses) in the federal budget, which should demand our attention. Continuing the current approaches into 2050 holds little or no prospect of improving the situation, but will merely allow a continual increase in losses and human suffering as more property and people move to flood risk areas or, as a result of changing global conditions, have flood risk move to them.

That being said, national policy discussions are getting deeper and deeper into exploring the need to change the paradigm of how the nation accomplishes floodplain and flood risk management. The current model relies heavily on federal-level approaches, which in turn rely on state and local partners to implement land use, building codes, and mitigation programs. However, the 500-pound gorilla in this mix is federal disaster assistance, which rushes in when flood disasters occur. These federal disaster dollars too often reward those communities and states who do little or nothing to reduce their flood risk. Furthermore, there are no incentives in the current approaches to encourage state or local partners to go beyond minimum national standards so that they can actually reduce total damage, let alone to foster innovation and the integration of programs to achieve multiple objectives, such as improving water quality or providing local recreational opportunities.

Local and state decision makers must understand their decisions can lead to people and property being at flood risk and suffering flood damage. At the local level, permits are issued for development. If locals allow building in flood hazard areas, the consequences are easily predictable. If development anywhere in the watershed is allowed without considering the adverse impact the increased runoff will have on existing properties now and in the future, those community officials have just contributed to somebody's future flood damage. When state or local legislators try to weaken regulations intended to reduce flood risk, or say in essence, "You can't prepare for something like this and you're not sure if it will happen again," there is an obvious risk communication problem, with federal disaster assistance perceived as the bailout.

State and local officials, elected and staff, must lead the way to reduce flood risk—public safety is their primary role and legal responsibility.

While the most dangerous areas must be avoided, there are techniques to protect property in lower risk flood areas. Just because a property is outside that "magic" 100 year flood line doesn't mean it is not at flood risk. Fully 1/3 of the flood insurance claims are from outside the 100-year floodplain. Just because a property is behind a levee does not mean that levee will not fail or overtop. Every levee has a 99.9999 % chance of failing or being overtopped at some point in time. Did the nation learn nothing from Katrina? It is two years later and there are still communities and states insisting they should not have to buy flood insurance if they are behind a levee.

In the past decade there have been numerous national policy dialogues with partner organizations. These have include the private sector, non-profit professional organizations representing a myriad of interests whose members are players or are impacted by flooding and discussions with the leadership of numerous agencies, the White House staff, and researchers. One concept that is receiving more and more support in these discussions and beyond is the need to change our top-down model of flood risk management so that states become the focal point for managing flood risk. The logic is that the methods that will most effectively manage and reduce flood risk rely on authorities that are reserved to the states under our Constitution, namely land use management, building codes, and community planning for development, mitigation, and resource protection.

In 1965, House Document 465 set forth the proposition that flood losses could only be reduced through a Unified National Program, which would require the integrated involvement of the federal, state, and local governments. This integration has to be both vertical and horizontal, and result in the situation in which those who live at risk bear the proportionate cost of doing so. For those interested, you can read the above-mentioned document at: http://www.loc.gov/rr/law/floods89-465.pdf .

What factors would encourage or induce states to step up to the plate? This is a critical part of the ongoing discussion. For the past 70 years, starting with the1936 Flood Control Act through the 1968 National Flood Insurance Program Act and its reforms, along with various versions of the Disaster Relief Act, those national programs and policies have led state legislatures, governors, and local decision makers to believe that flooding is the problem of the federal government. Over the decades, this has resulted in many states and locals putting little or no resources or effort into reducing flood risk. There are no incentives for states and locals to accept their responsibility to reduce flood risk. An exception is the participation of about 1,000 communities in the NFIP's Community Rating System, which encourages some local activities beyond the national minimums. However, under the CRS model, the rewards (lowered insurance premiums) go to individual residents who have flood insurance policies. Broader, long-term results would be achieved by offering incentives directly to the state or community—the entities that must plan, adopt and carry out the specific flood loss reduction programs or actions, and whose strengthened capability will reduce future losses.

What is the appropriate model to devolve flood risk and floodplain management programs to the states? Almost none of the current federal flood risk programs are delegated to the states, and that includes the NFIP, flood mitigation, and water resource development programs. Many of

these programs have some state involvement or some contractual arrangement with states, but do not delegate authority or decision making to the states. Few governors or legislatures are interested in those non-delegated approaches, and they continue to view such efforts as federal programs with federal disaster assistance as a backdrop, thus not requiring state or local leadership or funding. Models of programs that actually delegate authority for decision making and funding to states include the Clean Water Act and the federal highway programs. Under these models, the state works with federal programs to reach agreement on the state-specific goals of the program, then designs the state program to achieve those goals. The program is not delegated to a state until appropriate state laws and capabilities are in place. The federal program then has oversight and auditing functions to ensure the goals are being met, and can and does withhold federal funds if the state does not uphold its end of the agreement.

What incentives might be most effective? The ASFPM has long advocated that federal programs use a sliding cost share to reward positive state actions. A sliding cost share could apply to disaster assistance payments, which might have a 50/50 or 75 federal/25 state/local as a base, but the federal share could increase as states undertake more and more actions that will reduce their risk to flooding and other natural hazards. The same sliding cost share could apply to water resources and flood mitigation projects. Another approach would be that, when states invest in important flood risk activities, such as flood mapping, that amount of money could be "banked" toward the non-federal share of the next disaster. In this way, state legislators and governors can see the benefit of a "pay now or pay later" scenario, and in the meantime their citizens are safer, suffer fewer flood losses and trauma, and future disasters are reduced.

What about the local role? This is where programs are implemented, so state programs need to be developed with strong local input and incorporate a process for rewarding communities that do more, just as, under this proposed model, states that do more are rewarded with increased federal funds.

Over time, this or a similar shift in our flood risk management paradigm will build state and local capability and result both in reduced flood damage and losses and also in reduced federal spending for disaster assistance.

FLOODPLAIN MANAGEMENT 2050: LINKING THE NFIP TO ELEMENTS OF CONTINUITY OF OPERATIONS

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Background on the National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a federal program that enables property owners that reside within participating communities to purchase flood insurance as a protection measure. In exchange, a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains. The NFIP was established by the U.S. Congress in 1968 via passage of the National Flood Insurance Act. This insurance program is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods.

Over 20,000 communities nationwide participate in the NFIP today. In addition to providing flood insurance and reducing flood damage through floodplain management regulations, the NFIP assists communities in a partnership to identify and map the nation's floodplains.

Evolution of the NFIP Past 1968

Up until 1968 most actions related to flooding taken by the federal government were primarily in response to significant events that resulted in using structural measures to control flooding. Despite the billions of dollars in federal investments in structural flood-control projects, the losses to life and property and the amount of assistance to disaster victims from floods continued to increase. In 1973 Congress passed the Flood Disaster Protection Act of 1973. The Act prohibited federal agencies from providing financial assistance for any community that did not participate in the NFIP by July 1, 1975, or within 1 year of being identified as flood-prone. The 1973 Act also required that federal agencies and federally insured or regulated lenders had to require flood insurance on all grants and loans for purchase or construction in areas designated as Special Flood Hazard Areas (SFHAs). This requirement is also known as the Mandatory Flood Insurance Purchase Requirement. While this requirement resulted in a dramatic increase in the number of communities that joined the NFIP in subsequent years as well as the number of flood insurance policies, it was still evident that further improvement was needed to the program. It wasn't until 1994 that Congress amended the 1968 and 1973 Acts with the National Flood Insurance Reform Act (NFIRA). This Act included measures, among others, to:

1. Increase compliance by mortgage lenders with the mandatory purchase requirement and improve coverage;
2. Increase the amount of flood insurance coverage that can be purchased;
3. Provide flood insurance coverage for the cost of complying with floodplain management regulations by individual property owners (Increased Cost of Compliance coverage);

4. Establish a Flood Mitigation Assistance grant program to assist states and communities to develop mitigation plans and implement measures to reduce future flood damage to structures;
5. Codify the NFIP's Community Rating System; and
6. Require FEMA to assess its flood hazard map inventory at least once every 5 years.

While the 1994 Act presented a marked improvement for the Program, one would argue that further changes were needed 13 years later. After all, with every flood event, lives, homes, and properties were still being lost and/or damaged and many communities continued to build in areas designated as floodplain given the protections afforded by the NFIP in the form of insurance. As we look ahead to 2050 we have to recognize that the Program will continue to evolve with the certainty that communities will continue to grow and more construction will take place in areas that are at risk of flooding or other natural or man made hazards. We should also recognize that it took almost 40 years for us to shape our floodplain management capabilities to what they are today and therefore; change will not happen at the pace that we desire. We do believe however; that there are certain elements of improving our floodplain management techniques in the years to come and we examine them below.

Concept of COOP and Potential Connections with the NFIP

Today's changing threat environment and the potential for no-notice emergencies, including localized acts of nature, accidents, technological emergencies, and military or terrorist attack-related incidents, have increased the need for public or private sector agencies to have robust continuity of operations (COOP) capabilities and plans. COOP is defined as the activities of individual departments and agencies and their sub-components to ensure that their essential functions are performed. This includes plans and procedures that delineate essential functions; specify succession to office and the emergency delegation of authority; provide for the safekeeping of vital records and databases; identify alternate operating facilities; provide for interoperable communications; and validate the capability through tests, training, and exercises. COOP planning is simply a "good business practice"—part of the fundamental mission of agencies as responsible and reliable public institutions. Without well conceived continuity plans, jurisdictions at all levels risk leaving their citizens without vital services in what could be their time of greatest need.

Figure 1 - Vital Records Destroyed in Hurricane Katrina's Flooding

Because the nation's most common and costly disaster remains to be flooding, as Hurricane Katrina demonstrated, this paper will explore the linkage of COOP planning to floodplain management and the NFIP.

Facility Location and Data Storage in the Floodplain

A critical element in COOP planning is the identification and preparation of facilities that can be used to accomplish essential functions if the organization's primary facilities become unusable. Alternate facilities should be readily accessible, appropriately protected, and should provide adequate space for COOP personnel

COOP personnel and equipment. When deciding on locating a primary or alternate facility, a facility risk assessment needs to be conducted that includes a flood zone determination. Alternate COOP sites should be located outside of the 100-year floodplain and possibly the 500-year floodplain as they are considered critical facilities under Executive Order 11989 on floodplain management. COOP operations may be adversely compromised or disrupted if they must be conducted during flood conditions that impact the alternate facility.

COOP plans should account for identification and protection of vital records, systems, data management software, and equipment (including classified or sensitive data) that are needed to perform essential functions and activities. Once again, careful consideration must be given to locating any vital records or databases in flood prone facilities. The devastating effect of losing vital records during a flood event, as shown in Figure 1 above, was evident in Louisiana where over 3,000 criminals were set free because critical law enforcement evidence was lost or destroyed. Citizens also had difficulty proving their identity as birth where certificates, driver license, and other vital records were damaged during flooding.

Conclusion

COOP plans and procedures must carefully consider floodplain proximity when determining alternate facility location and the storing/retrieval of vital records or database. Identification and evaluation of the linkages between the NFIP and COOP will yield improved floodplain management practices as we look to 2050. While we only examined one element of integration in this paper, we would recommend the establishment of a committee of professionals from a cross section of floodplain management and COOP experts across the nation to work together in identifying how we can evolve to a point where there is full integration so that we meet and manage the demands of our growth in a positive and responsible way.

POST-DISASTER FLOOD DAMAGE ASSESSMENT: THE KEY TO HOLISTIC DISASTER RECOVERY

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Immediately after a flood disaster, whether regional or catastrophic, there is an urgency to assimilate situation reports and initial damage assessments from local governments to fast-track the process of enabling a governor to request federal aide from the president through the provisions of the Robert T. Stafford Disaster Act and 44 CFR. The initial local government or tribal damage assessment, and the joint preliminary damage assessment, performed by local, tribal, state, and federal officials, are performed primarily to compile damage data based on categories relevant to federal aid program requirements. If certain damage thresholds are met, a presidential declaration of major disaster is obtained, and a federal-state partnership is defined at a Joint Field Office. Rapid roll-out of narrowly defined Stafford Act assistance occurs: Individual and Households Assistance Program, Public Assistance Grants and Hazard Mitigation Grant Program. In addition, businesses and individuals may qualify for special Small Business Administration loans. Disaster recovery can be confined to these programs or expanded to holistic community recovery if opportunities to expand disaster recovery to include strategies adopted in all-hazard mitigation plans, community revitalization plans, and local comprehensive planning. This essay will address the relationship between disaster recovery and hazard mitigation planning.

Across America many responders and recovery managers in local, state, or federal government have followed this cycle through the years in response to local, regional, and statewide flood and hurricane events. While the Mississippi River floods of the early 1990's enabled a comprehensive land use policy discussion in the context of long-term solutions to flooding and the dependence on infrastructure such as levees, flood walls and dikes, each impacted state, county, city and town made decisions and recovered differently. Numerous successes occurred, and thousands of acres reverted to natural floodplain following bold decisions to stop fighting the river after 1992. Yet many communities that did not pro-actively mitigate or even abandon floodplains were impacted again during 2007 mid-western flooding events. Often, societal decisions are made with the first statement of "we will build it back stronger than it was before and we will recover." At the same time, we try to emphasize to individuals, businesses, local and state governments that the FEMA administered Stafford Act programs will assist recovery but are not designed or intended "to make you whole." For many repeatedly impacted individuals, neighborhoods, towns, cities and counties in high hazard areas, the disaster cycle continues its downward spiral.

The spirit of a community can be made or broken following a disaster. Mississippi Governor Haley Barbour stated on his website within 48 hours of Katrina, "Mississippi's spirit is strong. We can do this…be willing to think anew, because you've got a fantastic opportunity." While Mississippi has a generation of work to do, it is clear that a decision was made by the state, local communities, businesses and citizens to build back the coastal region. Grand Forks North Dakota converted more than 600 residential and 40 business properties back to green space floodplain use while pro-actively reconstructing schools and other critical facilities in a flood resistant

manner following the famous 1997 floods and subsequent fires. In both cases, communities were transitioning into recovery in the midst of catastrophic disaster response, making bold, sustainable decisions through a planning process. Yet until such an event occurs, there is usually a huge disconnect between the emergency management community, that directs disaster preparedness, response, recovery and mitigation, and the planners, zoning officials, building officials and elected representatives that direct local planning, zoning, and development policy decisions.

In many ways, the Disaster Mitigation Act of 2000 attempted to merge these disciplines through stringent state, regional and local plan guidelines, and requirements. A rigorous planning process was highlighted through program guidelines, *How-to-Guides* and the two-day *G-318: Mitigation Planning* workshop. Seven years following passage of the Disaster Mitigation Act of 2000, state, regional and local hazard mitigation plans have been developed *and adopted,* enabling continued eligibility for federal pre- and post-disaster hazard mitigation grant programs and the more financially significant post-disaster public assistance program that repairs, replaces and mitigates public infrastructure. Continued eligibility for essential federal disaster recovery programs was a great motivating incentive for plan development. Yet are these plans being effectively used? Are they being implemented in today's environment of limited dollars and traditional land-use management? Finally, are these plans relevant to disaster recovery? In many instances, it is my belief that we are missing an opportunity to implement these plans holistically through the traditional methods outlined in the plans as well as through integration with disaster recovery measures. In the current post-911 and Katrina government and private sector environment, we've exhausted ourselves reacting to every opportunity, each low and high-probability disaster scenario or new program initiative while trying to keep up the daily grind of work demands. A common theme among local government officials, state and federal emergency managers and our private sector partners is, "I sure hope we aren't hit this season so we can catch up and become ready." As Anderson Cooper succinctly stated in *Dispatches from the Edge,* "hope is not a plan."

Yet there is a plan, in fact there are shelves and website repositories full of plans: Emergency Operations Plans, Damage Assessment Plans, Standard Operating Procedures, The National Response Framework, All-Hazard Mitigation Plans. Perhaps it is time to be smart and merge some critical plan elements to facilitate disaster response and recovery. I'll bet some pro-active smart communities and states have done just that. We simply haven't heard about it and grown it into a standard business practice of managing disaster recovery while we scramble to assure that we have enough generators, food, ice, and water, appropriate and effective evacuation plans, enough shelters and emergency operation plans for critical facilities.

Gilbert White laid it out so succinctly in his 1942 dissertation before the birth of federal disaster recovery programs and before the birth of many of us currently in the disaster recovery profession. While on the one hand, its tragic that we are still having this discussion, the optimist in me hopes, sorry Anderson, that by 2050, no, let's be bold and say by the next flood forum, we can address merging modern disaster recovery procedures with White's eight critical "geographic" approach flood recovery elements:

1. Elevation
2. Flood Abatement (Watershed management approaches)
3. Flood Protection (Structural flood control)

4. Emergency Measures
5. Structural Adjustments (adjustments to buildings and infrastructure)
6. Land Use
7. Public Relief
8. Insurance

Smart, tactical Initial Damage Assessment and Preliminary Damage Assessment can enable success of comprehensive long-term community recovery and mitigation if it is pre-targeted using the community all-hazard mitigation plan. Recovery actions can track the eight themes Gilbert White discussed in his thesis. In the midst of a local disaster response, the emergency manager struggles to multi-task to adequately respond to community needs by directing implementation of **emergency measures** (4). Disaster damage assessment must be completed quickly, potentially adding to the burden of tasks to complete. Yet this can be streamlined and simplified using the vulnerability analysis to target local Initial Damage Assessments. The Hazard Mitigation Plan vulnerability analysis maps highly vulnerable areas across each hazard. Thus knowing where flooding is probable, the local emergency manager can fast-track evaluation of likely impacted neighborhoods, enabling rapid reporting to the state Emergency Operation Center. This facilitates information flow to the Governor's office.

Stream-lining the federal-state-local Joint Preliminary Damage Assessment is key to provision of federal **relief programs** (7). These programs will not make an impacted individual, family, business, school, or community whole. Yet if even limited federal relief programs get those impacted functional, a self-directed, informed, creative, sustainable long-term recovery effort will have long-term positive effects on the community through the reduction of future vulnerabilities. During the disaster damage assessment process, potential sustainable mitigation actions can be noted and incorporated into the disaster-specific Mitigation Strategy. This strategy should incorporate appropriate state, regional and local mitigation strategies outlined in adopted all-hazard mitigation plans, in partnership with local governments. **Elevations** (1), **structural adjustments** (5), and required **insurance provisions** (8) can be implemented enabling communities to flourish with mitigation measures in place. As recovery ensues, the larger issues of **flood abatement** (2) and **flood protection** (3) can be part of the larger policy development of long-term **land-use** allocation (6).

This over-simplification presents a panacea of post-disaster opportunities. Many elements that can foster success are found in all-hazard mitigation plan strategies. While we should not wait for a flood event to trigger the damage assessment process that facilitates federal recovery aid and potentially more holistic recovery as described above, the possibilities are boundless. In addition, when the inevitable happens, damage assessment can be tactical, targeted, and efficient if disaster recovery operations plans have been integrated with all-hazard mitigation plan vulnerability assessments.

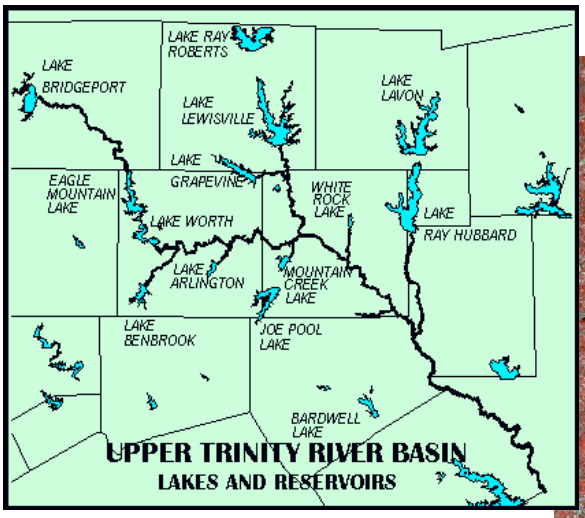
DALLAS/FORT WORTH CHALLENGES & OPPORTUNITIES FOR FLOODPLAIN MANAGEMENT 2050

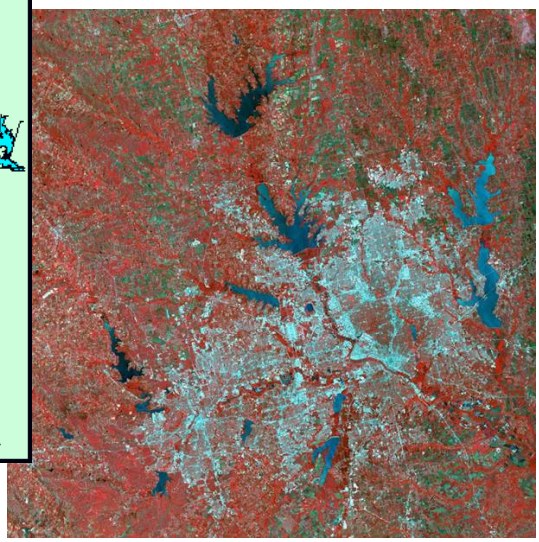
John Promise, P.E.
North Central Texas Council of Governments

Question? As the Dallas-Fort Worth region doubles in population by 2050, can we better apply Gilbert F. White's philosophy to protect and enhance our region's environmental corridors?

The DFW region continues to grow rapidly. North Central Texas is the nation's largest inland metropolitan region, with 6.3 million people. During the 1990's, the *region* added more people than all but 4 states. By 2050 the region is anticipated to have close to 12 million residents.

The Trinity River's major branches have been impounded. To assure an adequate long-term drinking water supply, each of the major branches in the upper watershed of the Trinity River has been impounded by manmade reservoirs. Thus the river as it flows through the Dallas-Fort Worth urban core faces great extremes, with low flows composed almost totally of treated wastewater, to massive floods with the potential for billions of dollars in damage and untold loss of life across the 240 square mile floodplain of the river spine alone.





For almost 150 years, the philosophy was to "tame" the river. From the 1850's until very recently, the region's dream was that of a federally-funded navigation canal, with barges transporting goods from DFW more than 300 miles to and from the Gulf. When this 19th-Century federal "structural" approach died in the early 1980's because of changing national priorities, it was replaced by new local "structural" pressures to fill and reclaim significant portions of the floodplain. Studies by the U.S. Army Corps of Engineers with the North Central Texas Council

of Governments (NCTCOG) demonstrated the devastating effects that massive reclamation would have on existing properties, especially to the downstream Dallas levee system.

21st-Century Trinity River COMMON VISION emerged in 1990. From these important discussions emerged an unprecedented local/state/federal partnership to more comprehensively address the problems and opportunities of the river corridor and watershed towards a multi-objective Trinity River COMMON VISION for the 21st-Century:

- ***SAFE*** Trinity River, with stabilization and reduction of flooding risks
- ***CLEAN*** Trinity River, with fishable and swimmable waters
- ***ENJOYABLE*** Trinity River, with recreational opportunities linked by a Trinity Trails system within a world-class greenway
- ***NATURAL*** Trinity River, with preservation and restoration of riparian and cultural resources
- ***DIVERSE*** Trinity River, with local and regional economic, transportation and other public needs met.

NCTCOG on behalf of its member local governments entered into a cost-shared *Upper Trinity River Feasibility Study* with the U.S. Army Corps of Engineers. Regionwide, these goals have been translated into a vision and action plan to SEE Safe Clean & Green by 2025 for more than 2,400 miles of regional environmental corridors.

A Success Story: Flooding risks along the main river spine have been stabilized with the innovative Corridor Development Certificate process. *The Regional Policy Position* for the COMMON VISION called for stricter regulation of development within the Trinity River corridor to stabilize the flood risks (as opposed to even more levees). After several years of detailed discussions, an innovative Corridor Development Certificate (CDC) process emerged. It carefully balances structural (property rights) realities with non-structural (health safety & welfare) desires. Each local government still issues the development permit under the National Flood Insurance Program, but regional requirements have been added (and adopted by each city in its floodplain ordinance):

- applies consistent and specific regionwide criteria, such as no rise in the 100-year flood elevation, and maximum allowable loss of valley storage for 100-year and Standard Project Flood discharges of 0% and 5% respectively
- the U.S. Army Corps of Engineers reviews every CDC request for its flood impact, not just Section 404 applications
- every other local government along the corridor is given 30 days to review and comment upon the development request
- NCTCOG tracks the process through its Trinity River Information Network

While the individual city still makes the final call, it is well understood that a bad decision will land them in court opposed by other cities and the USACE's public interest findings. More than a decade after its initiation the process is still working … with no court cases … yet.

Challenges & Opportunities for DFW Floodplain Management 2050. Recognizing Gilbert F. White's advocacy for adapting to or accommodating floods rather than using structural approaches:

- How can we maintain citizen, business and elected official support for the 21st-Century Trinity River COMMON VISION in a rapidly-growing and ever-changing region?
- How can the fast-growing rural areas apply a "non-structural" approach to their floodplains, when much of the county land is unincorporated with little government regulation, or in small towns with big-growth ambitions?
- How can we best apply new tools such as integrated Storm Water Management for new development/redevelopment (http://www.iswm.nctcog.org) that combines better site design with BMP's for stormwater quality/quantity; or "greenprinting" with partners such as the Trust for Public Land (http://www.tpl.org) to identify high-priority ecological areas for protection?
- How can an exciting new private-public partnership between the Urban Land Institute & NCTCOG titled *Vision North Texas* (http://www.visionnorthtexas.org) best apply Gilbert F. White's philosophy as it addresses regionwide growth issues to 2050, and pursues "green" infrastructure along with the gray?

Bottom Line. This unique and successful intergovernmental partnership called the Trinity River COMMON VISION has been recognized by the U.S. Army Corps of Engineers as a 21st-Century model for its civil works program. Among its many awards, the Trinity River COMMON VISION program was selected in 1997 as one of the top 25 *Innovations in American Government* by the Ford Foundation.

It's happening … moving from independent to coordinated actions, from structural to nonstructural, from a 19th-Century barge canal to a 21st-Century Trinity River COMMON VISION. How can we help make it happen faster?

A PERFECT STORM OF OPPORTUNITIES TO ESTABLISH AND FUND A PROGRAM TO REDUCE MISERY AND PROTECT WATER RESOURCES

Edward A. Thomas, Esq.

A confluence of six recent, major events has created a flood of opportunity for those of us concerned about how we, as a nation, can best deal with the reality of the hazards created by human occupancy of those areas that are particularly afflicted by the normal processes of Nature that we, all too often wrongfully, call "natural hazards." As the father of modern floodplain management, Gilbert White, correctly pointed out, floods are not disasters until humans occupy hazardous areas without due regard for the what Nature will do in the area.

The six events that have brought this matter to prominence in the public consciousness are

- The growing awareness that even in the water-rich United States many areas, including some of our most rapidly expanding regions, are facing a critical shortage of both potable water and for that matter, any water at all;
- The recent human fatalities and over $1 billon in damage due to the current and ongoing (as of October 28, 2007) wildfires in Southern California;
- The failure of the levees in New Orleans during Hurricane Katrina, and the $278 billion in litigation that followed that disaster;
- The huge financial settlement resulting from the catastrophic failure of levees in California, known as the *Paterno* case;
- The recent U.S. Supreme Court decision in the wetland regulation case known as *Rapanos-Carabell*; and
- The nationwide effort being undertaken by the Federal Emergency Management Agency to update Flood Insurance Rate Maps, known as Map Modernization.

The concept of No Adverse Impact helps us develop linkage between hazard managers, and other folks: the development community, community development officials, water quality managers, stormwater managers, wetland managers, wildfire managers, earthquake managers, the public, and many others, which has the potential to serve as the foundation of a transformation of public policy towards land use and public protection.

No Adverse Impact

NAI or No Adverse Impact is defined by the Association of State Floodplain Managers (ASFPM) as "…an approach that ensures the action of any property owner, public or private, does not adversely impact the property and rights of others." This principle makes a community look at what really needs to be done to prevent damage to people, property, and the environment. This concept requires looking beyond business as usual, including rote reliance on local, federal, and state minimum standards.

NAI is a *principle* that leads to a *process* of decisionmaking that is legally acceptable, non-adversarial (neither pro- nor anti-development), understandable, and palatable to the community as a whole.

The National Flood Insurance Program (NFIP) and the NFIP's Community Rating System (CRS) can serve as the foundation and conceptual basis of No Adverse Impact floodplain management. The NAI principle kicks the NFIP up a notch or two!

The concept of No Adverse Impact is supported by numerous recent court cases, as well as by truly ancient legal and moral concepts. NAI has profoundly deep legal roots, and if properly applied should resist legal challenge as much as anything can in this uncertain world.

The NAI process clearly establishes that the "victim" in land development is not the developer, but rather the other members of the community who could be adversely affected by an ill-conceived proposed development. The developer is liberated to understand what the community's concerns are so they can plan and engineer their way to a successful, beneficial development.

NAI management

- Is consistent with no net loss of ecological functions,
- Provides a pragmatic standard for regulation,
- Complements good wetland and stormwater regulation, and
- Makes sense on a local and regional basis.

NAI is, however, not some new concept. Rather, NAI is a very old idea—so old that it is in fact a maxim of ancient Roman law expressed in Latin as *Sic utere tuo ut alienum non laedas*. Or, in English, Use your own property so that you do not injure another's property.

Mohandas K. Ghandi, the father of Indian independence and one of the great moralists of the twentieth century called "*sic utere tuo ut alienum non laedas*" "a grand doctrine of life" and the basis of loving relationships among neighbors. Other commentators have indicated that this NAI-type philosophy is central to the tenets of virtually all major religious beliefs.

The Taking Non-Issue in Hazard Regulation

No Adverse Impact is consistent with ancient common law and is also sound moral doctrine. It is also fully in accord with modern law. The Fifth Amendment to the U.S. Constitution says, "…nor shall private property be taken for public use without just compensation." There have been some famous court cases that clarified this, notably *Pennsylvania Coal Company vs. Mahon*, which stated that a government regulation can restrict the owner's freedom to use his property to such an extent that it can constitute a "taking" of that property without compensation. This is often referred to as the "taking issue."

One reason often cited by local officials for not fully considering hazard regulations as they issue building permits is the fear that a limitation of what a property owner wishes to do might be considered to be an unconstitutional "taking" of private property. Such concerns are not well founded. Over the last few decades, there has been an increase in taking issue cases and related controversies involving development. But in fact, a careful case-by-case review of these "taking" cases discloses a common thread: the courts have modified common law to require an increased standard of care as the state of the art of hazard management has improved.

State and local governments are far more likely to be successfully sued for permitting development that causes problems, such as poorly engineered and designed roads, stormwater systems, and bridges, than they are for prohibiting or requiring safe and proper design of such development. Almost no hazard-based regulations have been held to be a taking—almost none! On the other hand, there have been many, many cases in which communities and landowners were held liable for harming others.

Takings Law Clarified. The United States Supreme Court recently issued a ruling in the case of *Lingle v. Chevron*, 125 S.Ct. 2074 (2005). The Court summed up its reasoning by stating that the tests articulated in *Lingle* "...all aim to identify regulatory actions that are functionally equivalent to a direct appropriation of or ouster from private property…."

This clear statement by the nation's highest court tremendously supports both the principles of the NFIP and NAI floodplain and stormwater management. Both the NFIP and NAI seek to require the safe and proper development of land subject to a hazard. Neither the NFIP nor NAI floodplain and stormwater management require or support government regulations that oust people from their property.

The NFIP does, however make a good start at encouraging the sort of regulation that will be needed at the local level to safely regulate all forms of land use in hazardous areas. As one of our nation's most prominent water resource engineers pointed out in a recent article, "There is little leverage at the national level beyond the flood insurance program to steer development away from areas vulnerable to flooding." (See Lewis E. Link, "Katrina Policy Lessons Learned: Coping With Change is A Risky Business," in the *National Wetlands Newsletter* 29(5) August-September 2007.) The bottom line is that the taking issue is really a non-issue for fair and equally applied hazard management regulations. However, whether we can successfully incentivize changes in attitude at the local level—where most development decisions to regulate hazardous areas are made—is quite another question.

The Six Recent Opportunities

(1) Growing Awareness of the Increased Scarcity of Fresh Water. As the population in the United States increases at an unprecedented pace, we are seeing a growing scarcity of water due to increased demand, pollution, climate change, and even sea level rise endangering fresh surface and groundwater. This phenomenon was well documented in the lead article in the October 21, 2007, *New York Times Sunday Magazine*, "The Future is Drying Up," by Jon Gertner. We are not making a sufficient effort to develop and protect our water resources both as we develop land for housing, businesses, agriculture, and industry, and as we design the nation's water infrastructure. Proper engineering and planning can do much to help alleviate a potential crisis.

(2) The California Wildfires. Much as they did after the devastation from Hurricane Katrina, many of our commentators on the recent devastating fires in California have opined something like "Why do people occupy hazardous areas? They should not be allowed to rebuild!" Unless otherwise constrained, people will live where they want due to location, location, and location. Most often proper land use and building codes can work to make occupancy of all but the most hazardous areas possible. Sometimes, there are in fact areas that are too dangerous or environmentally sensitive for some types of occupancy and use. The folks

who make the extremely difficult decisions as to what will be required to regulate the development of hazardous areas are local officials who right now have little incentive to say no to development, which is needed to pay local taxes. The challenge we face is how to incentivize all connected with development in such a manner as to encourage sound engineering and proper planning in areas that can be developed; and constrict improper development.

(3) The Katrina Disaster. So much has been written about Katrina from the perspective of a hazards manager that we need say little about it. The United States has an official policy, set forth in legislation, that this nation is committed to encouraging the provision of housing for all Americans which meets four criteria: decent, safe, sanitary, and affordable. Katrina serves as a reminder to all involved in community development that housing that does not take natural hazards into account cannot be decent, cannot be safe, is highly unsanitary, and is not affordable by the disaster victim, by her community, by his municipality, by her state, or by the nation.

The ongoing battle in the courts swirling around over $278 billion in claims for damages after the Katrina levee breaches may also help us focus on prevention and safe planning and engineering. (See E. A. Thomas, "Recovery Following Hurricane Katrina: Will Litigation and Uncertainty Today Make for an Improved Tomorrow?" in the *National Wetlands Newsletter* 29(5) August-September 2007 found at http://www.floods.org). Hazard managers can supply the information about natural hazards at a particular site which can serve as a "no adverse impact," sustainable foundation for a decent, safe, sanitary, and affordable community.

(4) The *Paterno* Case. The civil litigation against the State of California known as the *Paterno* case involves assigning damages for a catastrophic failure of levees in California. The state has been required to pay nearly one half billion dollars to recompense a large number of property owners for the failure of levees. The result in this case is illustrative of modern legal trends towards a concept based on an NAI-type legal philosophy with respect to payment for damage caused by the failure of dams and levees. The State of California is now has embarked on a massive program to prevent levee failure; and the California voters will have an opportunity this fall to approve an even larger and more ambitious program of repair.

The steps taken by that state already to seriously address concerns about its deteriorating levees are illustrative of the positive benefits of NAI, even when it must be required by a court.

(5) Map Modernization. The Federal Emergency Management Agency (FEMA) has embarked on a nationwide effort to digitize and update all the Flood Insurance Rate Maps in the country. As part of that effort some states and municipalities are developing studies that use future-conditions hydrology that documents that, in certain situations, if floodplains are fully developed, future flood heights may increase by as much as six feet. Modern hydrology and hydraulic modeling will be able to be used by municipalities and plaintiffs to encourage adherence to NAI. Many other communities are now, some grudgingly, recognizing the existence of flood hazards that had been ignored in development decision making.

(6) The *Rapanos-Carabell* Case. Recently the U.S. Supreme Court issued a strange and confusing opinion that can be understood as a call for coordination among all those concerned with water—stormwater, floodplain, and wetland managers alike. The case, which is known as *Rapanos-Carabell*, involves the geographic extent of the area that the federal government may regulate as "wetlands" under the Clean Water Act. The plaintiffs claimed that the land areas in

question were not properly subject to the jurisdiction of the Corps under our federal system of government. The Court determined that in determining whether the areas in question were subject to federal jurisdiction, courts must determine whether there was a demonstrable connection between the area and "waters of the United States."

When one is seeking to quantify the impact of filling a wetland, floodplain/stormwater hydrology and hydraulics are invaluable analytical tools. Courts have historically been extremely sensitive to protecting public safety by supporting fair and proper regulation of development so that it does not cause harm (including flooding) to others.

A Comprehensive Program for Water

These six events present an enormous opportunity for everyone who has anything to do with decisions as to whether, and how to safely design and engineer structures that occupy hazardous areas. The principles of public safety and safe land use are essentially the same for deciding how to plan and engineer for safe occupancy of a hazardous location, whether the location's hazard is caused by flood, wildfire, levee failure, hurricane, earthquake, tornado, stormwater, or drought. To best serve everyone in our nation, developers, regulators and the public need to work in partnership by developing win-win relationships with each other to meet the challenges posed by Mother Nature.

One place to start such transformation would be with water, which is essential for our economy, and our existence itself. Let us begin to address the problem of development in hazardous areas by again considering water resources, not in our usual stovepipes, referred to by one wag as our "cylinders of excellence," and instead have floodplain, drought, stormwater, wetland, water quality, and water quantity regulators and experts begin to work harmoniously, and with the development community and the public to fashion strategies that will begin to meet the need for the safe delivery of potable water to our rapidly growing population, while protecting the public from un-mitigated adverse consequences of development that is ill planned and engineered .

The first portion of the model for the accomplishment of this goal would be to adapt some of the concepts of several successful programs in such a way as to focus on unifying support for water resources. At one time our nation suffered from urban fires far more than any other hazard. As a result of a concerted push to reward good fire management and dis-incentivize less effective fire management behavior, we have progressed to the point that the average homeowner who occupies a home in the so called 100-year floodplain is far more likely to suffer flood damage than fire damage. This effort was spearheaded by America's insurance industry through the establishment of organizations such as the Underwriters Laboratory, and the Institute for Business and Home Safety as well as formulating a system whereby each community was rated on its individual ability to prevent and fight fires. Similar efforts are underway to rate the ability of building codes in each individual community to protect buildings from loss due to high winds. A similar rating program could be developed for rating communities' unified water resource efforts. The NFIP established such a rating program for local efforts that exceed the minimum standards of the NFIP to protect against floods. An expansion of this program to cover unified water resources protection—flood, quality, stormwater, wetlands, water availability, groundwater and more—should be considered.

Insurance companies as well as the federal government could use this rating system to reward communities that were taking steps to protect water resources, through reduced insurance

premiums, as well as more favorable treatment on cost sharing for disaster assistance, as well as water resources related funding from the Environmental Protection Agency, the U.S. Department of Agriculture, and all other agencies.

The second prong of this effort would be the establishment of a fund to assist communities in paying for their efforts to protect water as a valuable resource.

One way to find the money for such a fund would be to further the concepts of the Coastal Barrier Resources Act (CBRA). CBRA is an effort to relieve development pressures on an especially hazardous and environmentally sensitive location: undeveloped coastal barrier beaches. This was accomplished by forbidding federal expenditures for anything that supported such development. The ban on federal expenditures means no funding for roads, bridges, water and sewer plants, disaster assistance, or flood insurance. When CBRA was being considered, a ban on federal support for development through the tax code was considered to no avail. Therefore, IRS casualty losses, as well as deductions for interest on loans for development and purchase of these hazardous properties remain in effect.

CBRA is generally considered to have been effective in areas where local governments zoned the area in question so as to constrict development. CBRA has been less effective in areas where there are no effective land use restrictions. Suppose we developed a system whereby federal tax incentives were removed or lessened on a sliding scale from any development that did not meet safe land use, engineering, and planning standards? Any funds that would otherwise accrue to the U.S. Treasury could be diverted into a revolving fund to pay for future improvements in water resources, with priority in funding to communities that are protecting their water resources. Additional funding could come from a variety of changes in the formulas for providing federal water resources funding.

Opportunities to work together are there. The law favors protecting the public from harm. Techniques for protecting the public and also developing most parcels of land to the highest and best use also exist. Partnerships, incentives for proper conduct, and finding the will to transform are next steps.

This article is a pro bono presentation on behalf of the Association of State Floodplain Managers. It reflects the personal views of the author, and is not legal advice.

This article was inspired by a conversation with Congressman Earl Blumenauer of Oregon; and dedicated with thanks to him and his efforts to effectively and efficiently protect our nation's water resources.

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