

Flood Hazard Delineation: The One Percent Standard

William B. Lord
University of Arizona

Introduction

With the passage of the Flood Insurance Act of 1968, the federal government instituted a new policy for dealing with flood damages, a policy which changed fundamentally the relationship between Washington and the nation's flood-prone communities (Burby et. al., 1988). Before 1968, the *ex ante* federal flood damage control program relied only upon structural means of reducing peak flows or of confining them to contained channels. Moreover, these measures were instituted in response to crisis events or to political demands, rather than to systematically assessed vulnerability. The *ex post* federal involvement, then as today, was one of providing subsidized disaster relief to individuals and communities after a flood event.

The 1968 act offered federal financial assistance to help flood-prone communities delineate hazard zones. It offered subsidized flood insurance to floodplain occupants in participating communities. In return, those communities agreed to limit new development of at-risk properties and to prevent further encroachment of floodways.

The provisions of the 1968 Flood Insurance Act were available to any community with a significant flood risk, and over 18,000 such communities, some 85% of those eligible, now participate (Natural Hazards Research and Applications Information Center, 1992). This broad applicability created a new need for uniform definitions and standards. The 100-year flood (more accurately, a flood of one percent probability of occurrence in any year) was adopted as the standard for defining the Special Flood Hazard Area (SFHA) as presented on Flood Insurance Rate Maps (FIRMs). Participating communities were required to regulate development in these hazard zones, and flood insurance both subsidized and non-subsidized was then available to property owners within those communities. As maps became available delineating hazard zones, any building could be classified as "Pre-FIRM" or "Post-FIRM." New construction was to have floor levels above the estimated one percent flow line. The one percent standard as it was set, was low enough to minimize political opposition and to ensure that community-level adaptation caused only modest displacement of desired economic developments. From the first, it was regarded as only a minimum, to achieve widespread participation but not to dictate to participating communities that they should not do better.

Uniform national standards have become commonplace in U. S. environmental policy. They are easy to

define, easy to enforce, and they create the impression of even-handedness, a notable political virtue. But do they serve well the needs of widely differing communities? Should the federal one percent standard be adopted by each participating community as its own standard for hazard zone delineation and management, as most have done?

The Need for Standards

Limiting uneconomic flood damages and encouraging wise use of floodplains, including protecting their natural values, the twin goals of the national floodplain management program, are unexceptionable, and apply equally within every flood-prone community and to every kind of flood control program, whether structural or non-structural. Translating such broad and universal goals into design standards which are appropriate to specific situations is much more difficult than proclaiming the goals. It will rarely be sensible to make no effort to control flood damages, and it will never be sensible to incur all of the costs necessary to avoid prospective flood damages altogether.

The need for some uniform national design standards is obvious. There must be a clear definition of the scope of any public program. The area of applicability must be specified if the federal government is to continue requiring the purchase of flood insurance as a condition of obtaining a federally-insured mortgage loan. The Corps of Engineers uses the concept of the standard project flood as a design standard for its structural flood control measures. Interestingly, the standard project flood is *not* the one percent flood, but a flood with a much longer recurrence interval (the probable maximum flood, which is based upon the maximum rainfall projection, is even more conservative, and is used as a test standard, although not a design standard). The design standard applied to structural flood control is thus a more conservative one than that applied to the National Flood Insurance Program's (NFIP) non-structural approach. This illustrates and maintains a bias towards structural approaches which has long characterized federal programs.

Just as uniform federal standards are needed for certain federal purposes, so too are site-specific local standards needed to address appropriately the widely varying conditions of the nation's flood-prone communities. Flood damage control measures cannot be designed without some explicit goal or standard to guide the designers, and floodplains cannot be zoned or building regulations implemented without a clear definition of where they apply. The federal

one percent standard does not necessarily make sense as a local floodplain management standard because it is unrelated to the specifics of the local flood problem. The definition of the hazard zone, within which development restrictions apply, should depend upon each community's own unique hydrologic, topographic, economic, and demographic characteristics.

What was originally intended to be a politically acceptable *minimum* standard of protection has too frequently become the *only* standard, and an inappropriate one in most circumstances. It has had the unfortunate effect of encouraging public officials, developers, and even the general public to believe that land outside the boundaries of the hazard zone, so-defined, is not subject to flood risk. Nothing could be further from the truth. Mississippi River levees designed to protect against frequent small floods engendered a false sense of security, encouraged development behind them, and increased the damages ultimately suffered when the flood of 1993 struck (Myers and White, 1993). In like manner, in many communities floodplain management programs based upon the one percent standard are likely to increase the risk of ultimately suffering even greater flood damages than would have occurred without them.

A Universal Objective for Standard Setting

Each community's goal should be to seek the maximum net benefits from its floodplain management planning and regulation program. Such a goal was suggested as far back as 1936, when the Flood Control Act of that year proclaimed that for federal projects, "the benefits, to whomsoever they may accrue, shall exceed the costs." This language offers only a constraint to protect against development which is unduly costly to the nation's taxpayers (Lord, 1981). An appropriate goal at the local planning level would be to maximize net benefits of floodplain land uses, and this was envisaged in the Bureau of the Budget Task Force report.

The words "benefits" and "costs" may be construed to mean only monetary benefits and costs, but this is not the intent. Floods produce both monetary and non-monetary impacts, and all must be evaluated. There has been a persistent pattern in the field of flood protection in particular, and of disaster mitigation in general, of overvaluing some non-monetary impacts, such as loss of life, and of undervaluing others, principally those upon natural environments. Putting a dollar value upon a human life is extremely difficult. Many of us would regard it as inappropriate at best, and possibly immoral. Whatever our individual stance on this issue, we cannot deny that our collective policy choices do this all the time. When we decide how much to spend (and not spend) for health care for the indigent, for medical research, and for structural flood protection, we are unavoidably, if not explicitly and thoughtfully, deciding what we will spend to save a life. It is in this limited sense, not of what

a life is worth, but of what we are willing to spend to preserve it, that the value of human life should be used in flood protection benefit and cost calculations. We should be willing to spend no more, and no less, to save a life through floodplain management than through crime prevention or highway safety.

Similarly, the environmental impacts of floodplain development should be considered, along with other external costs of floodplain development, when reckoning benefits and costs. The environmental values of wetlands have been recognized increasingly over the past quarter century. These values, too, are the subjects of public decision making, and the more explicit we can be about them, the better will be our decisions. Economists have developed a number of concepts and techniques, none of which are perfect, but most of which can be helpful, in exploring the necessary tradeoffs. Option value, existence value, contingent valuation, and the safe minimum standard are examples of these ideas (c.f., Pearce and Turner, 1990).

Standard Setting Considerations

Planning for either structural or non-structural flood damage control projects must consider two kinds of property subject to flooding, that which is already developed (Pre-FIRM) and that which is not (Post-FIRM). Developed properties which are located within the floodway (the normal stream channel within which floodwaters flow at substantial velocities) pose public hazards because they constrict channels, impede flood flows, and raise inundation levels. Most should be removed. Existing programs preclude new construction within the floodway that would raise the flow line more than a specified amount and forbid rebuilding existing structures after they suffer major damage.

Lands outside the floodway, but still subject to flooding (within what is now called the floodway fringe), pose a different problem. Those properties which are open to the public should be regulated in the interest of public safety. Those which are strictly private do not pose risks to the public, and regulation is justified only on the ground of avoiding the subsidized post-flooding disaster assistance which is by now well-enshrined in national policy. A strong case can be made for structural flood protection and/or subsidized post-disaster relief if such properties are already developed, provided that the damages avoided or mitigated exceed the costs of protection or mitigation. If they are as yet undeveloped, however, a much stricter standard should apply, in order to avoid creating an incentive for unwise development. The opportunity costs (losses due to economic development opportunities foregone) of floodplain management programs which would restrict such development may be calculated as the expected net revenue stream minus the expected value of flood damages for a development, if in the hazard zone location, *minus* the expected net revenue stream

of that same development in the next best (non-hazard zone) location. Frequently these opportunity costs will be very small, and often they will be negative. For decades an analogous rule has limited the computation of benefits of prospective structural flood control works. It should be applied in principle in floodplain management planning as well.

The prospective benefits of development of some land on the floodway fringe, when limited by application of the opportunity cost concept, will not equal its costs, including the costs of floodproofing and other forms of flood protection. Such lands should not be developed, and the high costs of protection (if protection is possible at all), together with the similarly high costs of unsubsidized flood insurance, should be enough to deter developers' enthusiasm. But flood insurance cannot create an effective incentive to discourage unwise development unless it is perceived as an unavoidable cost. Such insurance has been an eligibility requirement for certain forms of federal assistance. This helps, but stronger local sanctions against uninsured development will also be needed.

Recommendations

- 1) Federal flood insurance regulations call for hydrologic and topographic studies to define the floodway as a condition of admitting a community to the regular program of the NFIP. This is a useful and necessary standard for controlling the most important externalities of floodplain development, those which are caused by encroachment. And, because some existing structures located within the floodway may properly remain there, yet be exposed to substantial risk, subsidized flood insurance may still be appropriate in those cases. The floodway delineation would provide a limit to the eligibility for such subsidization, which should be further conditioned to be available for relocation, but only for minor post-flood rehabilitation.
- 2) The one percent flood fringe delineation should now be abandoned. It served a useful purpose in encouraging both community floodplain delineation studies and enrollment in the regular program. But, with 85% of flood-prone communities now participating, this encouragement is no longer needed, and the one percent standard has become instead an obstacle to informed and efficient community floodplain management programs. From a federal perspective, subsidized flood insurance should no longer be necessary (by now some quarter century after the initiation of NFIP) for existing properties located in the flood fringe, and to provide it weakens the incentive to relocate outside of the hazard zone as opportunities to do so arise.
- 3) The National Flood Insurance Program, when coupled with local sanctions which make it difficult to avoid purchasing such insurance, can provide valuable incentives to discourage unwise floodplain development. On the regulatory side, zoning and building codes provide the basic instruments for local regulation of floodplain development. Zoning should identify degrees of exposure to flood risk, such as the ten-percent zone, the one-percent zone, and the 0.2 percent (500 year) zone. Insurance rates can then be pegged to the degree of risk.
- 4) Existing hazard zone development should be regarded differently than prospective development. If the diminution in external costs which could be achieved by removing an existing structure which encroaches upon the floodway exceeds the net benefits which that structure provides, then it should be removed and its owner should be compensated. If not, then it should stay. Some existing structures could fall in this category, even if similar new structures could not be justified, because the opportunity costs of providing similar benefits elsewhere outweigh the external costs of continued use of existing structures. In any case, the floodway definition standard is no different than that for new development.

Needs for Research and Training

The information needs for implementing a more flexible and efficient standard for community delineation of flood hazard zones can be examined through the use of the analytical tasks needed to conduct floodplain planning.

- 1) Flood frequency analysis

Flood frequency analyses have been completed for all of the communities in the regular program. As a result, information of this kind is more complete and comprehensive than is that of most other kinds. Still, continuing development of upstream watersheds changes the degree of hazard, creating the need for periodic updating.

- 2) Stage-discharge analysis

As in the case of flood frequency analysis, stage-discharge studies have been completed in communities participating in the regular program. These analyses, however, are site-specific, and may have to be repeated for many locations in the hazard zone in order to create an adequate floodplain map. Nonetheless, much of this work has been done. Periodic updating is needed as new construction occurs.

- 3) Stage-damage analysis

Stage-damage information is less likely to exist, because the one-percent standard has made its collection unnecessary. Simplified methods for estimating potential damages would be helpful to enable communities to

conduct analyses of this type without excessive cost.

4) Damage reduction analysis

The extent to which the potential damages (from the preceding task) would be reduced through the adoption and implementation of floodplain management tools (exclusion, elevation, or flood proofing) must be calculated. A better data base compiled from studies of floodplain management experience would be helpful for this task.

5) Expected value of damages analysis

No new information is needed for this task. It involves only multiplying the monetary value of avoided damages by the probability of occurrence.

6) Opportunity cost analysis

This task requires the estimation of the opportunity costs of floodplain management measures. For example, the real cost of excluding a particular type of development from the hazard zone can be no greater than the additional cost which would be required to conduct the associated activity outside of the hazard zone (it need not be that high, however; an accompanying test of effective demand is also required). Such studies require fairly sophisticated economic analyses, and not only adequate procedures, but also additional training will be needed.

7) Benefit-cost analysis

Given adequate information produced by accomplishment of the foregoing tasks, a straightforward benefit-cost analysis requires only rather mechanical calculations, well-suited to modern personal computer software. However, the results of such calculations should never be used as substitutes for decision making. Too much is excluded, or is only highly approximate, or fails to reflect difficult environmental, distributional, or ethical issues. These should be fully explored and resolved before final decisions are made.

Myers, M. F. and G. F. White. 1993. "The Challenge of the Mississippi Flood". *Environment* 35:6-9, 25-35.

Natural Hazards Research and Applications Information Center, Action Agenda for Managing the Nation's Floodplains. 1992. Special publication no. 25. Boulder, CO: University of Colorado. Institute of Behavioral Science.

Pearce, D. W. and R. K. Turner. 1990. *Economics of Natural Resources and the Environment*. Baltimore, MD: The Johns Hopkins University Press.

William B. Lord is Professor of Agricultural and Resource Economics, as well as of Hydrology, at the University of Arizona. He is a former economic advisor on Corps of Engineers water resources programs in the Office of the Secretary of the Army.

References

Burby, R. J., S. A. Bolens, J. M. Holway, E. J. Kaiser, D. Mullan, and J. R. Sheaffer. 1988. *Cities Under Water: A Comparative Evaluation of Ten Cities' Efforts to Manage Floodplain Land Use*. Monograph no. 47, Program on Environment and Behavior. Boulder, CO: Institute of Behavioral Science, University of Colorado.

Lord, W. B. 1981. "Objectives and Constraints in Federal Water Resources Planning." *Water Resources Bulletin* 17:1060-1065.