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Coping with Natural Hazards Through Land Use Regulations: The Role of Local Governments

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The following article won first prize in the student division of the 1986 writing competition sponsored by the Planning and Law Division of the American Planning Association. In 1986, the writing competition was renamed The R. Marlin Smith Annual Writing Competition in honor of the late R. Marlin Smith, a prominent land use lawyer and teacher.

COPING WITH NATURAL HAZARDS THROUGH LAND USE REGULATIONS: THE ROLE OF LOCAL GOVERNMENTS

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> *Development in areas subject to natural hazards . . . continues to be a major land use problem in this country, resulting in losses of life and property of staggering proportions. In the past, the Federal Government has tended to foot most of the bill for disaster relief. Despite the humanitarian purpose of this relief, an inadvertent consequence has been that it has served as a de facto subsidy for reconstruction of areas subject to recurring destruction and, thus, as an incentive to ignore the potentially severe economic and social costs associated with certain types of development in those areas. . . . Natural hazard areas need not become 'no growth' areas to avoid natural disasters and the economic and social costs they incur. . . . Instead, in most cases, building codes and other land management tools may encourage development which is designed to withstand the force of natural hazards or which does not concentrate people or property so as to unduly risk their safety should potential natural hazards become a reality.*[1]

Naturally occurring hazards in the forms of flooding, soil subsidence, earthquakes, landslides, hurricanes, mudslides, volcanoes and avalanches claim hundreds of lives and damage millions of dollars of property every year.[2] Yet our growing population increasingly concentrates itself in urban areas, subject to these hazards. The result of this ever-increasing concentration has been

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1. Senator Henry M. Jackson, "Memorandum of the Chairman to Members of the Senate Interior and Insular Affairs Committee," from Baker & McPhee, *Land Use Management and Regulation in Hazardous Areas*, Library of Congress No. 75-620041 (1975).

2. The United States Water Resources Council estimates that property losses from flooding alone will exceed $4.3 billion per year by the year 2000. Floods claim an average of 200 lives per year. Kusler & Bloomgren, *Improving the Effectiveness of Floodplain Management in High Risk Areas*, PROCEEDINGS OF THE EIGHTH ANNUAL CONFERENCE OF THE ASSOCIATION OF STATE FLOODPLAIN MANAGERS (1984).

an intensification of the damaging effects caused by natural hazards.

Today, most natural hazards can be identified and mapped, and reasonable predictions can be made as to where damage can be expected to occur. Armed with this technical data, local governments have begun to grapple with natural hazards prospectively through the application of building codes, subdivision requirements, and zoning regulations. The purpose of this paper will be to identify the four major categories of natural hazards—flooding, subsidence, earthquakes, and slide activities—and discuss how land use controls can be used to mitigate damages.

I. Types of Geologic Hazards

A. Flooding

Flooding may occur as the result of a number of natural events: spring runoff or severe thunderstorms over inland rivers and streams; tropical storms and hurricanes in coastal areas; or changes in atmospheric pressure along lakes or other large bodies of water. Flooding may also occur as a result of human activities, such as changes in the slope or grade of building lots; the increased impermeability of the land due to the use of asphalt, concrete and other paving materials in drainageways; and the failure of storm control structures such as dams, canals, levees, or diversion works.

Along most rivers and streams, flooding is a natural and recurring event. Some areas, such as those bordering on the Mississippi River, are subject to yearly flooding that rises gradually and lasts for days. Other areas, such as those adjacent to mountain streams, are subject to flash-flooding caused by sudden storms which give rise to torrents of water that can sweep through an area in only a matter of hours.

Coastal zone[3] flooding is caused by heavy rains, high tides and wave surges. Tropical storms are the most common cause of coastal flooding, but wave surges may be triggered by other events, such as seismic activities or sudden changes in barometric pressure.

Both types of flooding provide important benefits to natural areas. Periodic flooding helps to recharge groundwater aquifers, and maintain wetlands and marine estuaries, while the fast-moving wa-

3. The "coastal zone" may be defined as coastal waters and their adjacent shorelines, including barrier islands, transitional and intertidal areas, salt marshes, wetlands, and beaches. *See* Federal Coastal Zone Management Act, 16 U.S.C. §§ 1451-64 (1982).

ters of flash-floods clean riverbeds of debris and accumulated vegetation. Likewise, the tropical storms which typically contribute to coastal zone flooding produce storm waves which create beaches and sandbars.

When undeveloped, flood-prone areas often contain a number of natural "mitigation devices." In riparian areas, floodplains and flood storage areas[4] allow floodwaters to dissipate. In coastal zones, barrier islands[5] shelter upland areas by absorbing the force of waves. However, when humans encroach upon these sensitive areas, these natural systems are disrupted.[6]

Floods damage developed property in a number of ways. Foundations of structures may become saturated with water or undercut through erosion of supporting soils. Buildings may be weakened or washed away entirely by the sheer force of waves or high-velocity floodwaters. Public services and transportation corridors may be destroyed as well, complicating rescue and recovery efforts. Even after floodwaters recede, the flooded areas may be covered with mud, sediment and accumulated debris. There are currently about 6.5 million homes located in coastal and riverine flood hazard areas. Industrial and commercial properties are frequently located in flood-prone areas as well. Even ignoring the monetary losses from flood damage, the annual loss of human life has risen to two hundred.[7] Although the federal government provides about one billion dollars per year in disaster assistance, the remainder must be pro-

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4. The "floodplain" may be defined as "a natural overflow area adjoining each stream channel." J. KUSLER & R. PLATT, THE LAW OF FLOODPLAINS AND WETLANDS 1-4 (1982). "Flood storage areas" include wetlands and other low lying regions surrounding the floodplain. The "floodway" consists of the channel and adjacent overbank areas. *Id.* at 1-6.

5. "Barrier islands" and "spits" include beaches, dunes, and salt marshes and are located along mainland coasts. They are composed of unconsolidated sands, salts, and clays and tend to migrate landward during storms. O. PILKEY, W. PILKEY, O. PILKEY, JR., & W. NEAL, COASTAL DESIGN: A GUIDE FOR BUILDERS, PLANNERS, AND HOMEOWNERS 33 (1983) [Hereinafter COASTAL DESIGN].

6. Coastal zones and riparian corridors provide rich habitat for many species. Wetland areas also work as natural filtering devices, removing sediment and some forms of pollution from inland waterways. J. KUSLER & R. PLATT, *supra* note 4, at 1-11 to 1-12. When these regions are developed, their natural values are eliminated. To date, more than 30% of the nation's wetlands have been destroyed by development or drainage activities. *Id.* at 1-24.

Barrier islands protect both the bayside wetlands and the mainland shore from the direct effects of storms and erosion. Barrier beaches absorb the energy of storm waves, protecting adjacent marshes and their abundant biotic communities from disturbance. Seawalls, levees, and breakwaters, constructed to stabilize and protect structures, disrupt the migration cycle and may prevent natural restoration of the land. *See* Platt, *Congress and the Coast*, 27 ENVIRONMENT 12, 14 (1985).

7. KUSLER & BLOOMGREN, *supra* note 2, at 3.

vided by state and local governments or borne as losses by the private sector.

B. Subsidence

Land subsidence occurs when soils sink or collapse over underground voids. Subsidence may occur naturally, through seismic activity, through compression of silt and clay, or through the deterioration of soluble bedrock. More often, however, subsidence hazards are created through one of two human activities: underground mining, or the removal of fluids. Once the supporting materials are removed, surface soils either collapse suddenly, or settle gradually over time. In developed areas subsidence may cause buildings to crack or collapse due to the undermining of their foundations.[8] In rural areas agricultural land may lose its economic value when sinkholes make farming less productive.

Subsidence due to fluid extraction is common around oil fields and in those areas where local populations depend heavily on groundwater supplies (notably Texas and California). Although mining regions tend to experience at least a gradual soil subsidence, cave-ins and sudden sinking are common hazards in Colorado and other Western states.[9] The United States Bureau of Mines estimates that nearly eight million acres of land have been undermined by coal and mineral extraction, causing an estimated thirty million dollars in structural damages each year.[10]

C. Earthquakes and Volcanoes

Seismic activities are caused by internal earth processes, termed "endogenic"[11] processes, that build up pressure between opposing geologic materials.[12] When the crust overlying subsurface magma

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8. *See* D. PROUTY & D. SHELTON, NATURE'S BUILDING CODES: GEOLOGY AND CONSTRUCTION IN COLORADO, COLO. DEP'T OF NAT. RESOURCES & COLO. LAND USE COMM'N, 45-47 (1979) [Hereinafter NATURE'S CODES]. "Swelling" and "collapsing" soils caused many of the same problems as land subsidence. Swelling soils increase in volume as they absorb water, creating upward pressure on buildings. Collapsing soils shrink in volume when permeated with water or when subjected to great weight. Collapsing soils are frequently found over landfills. *Id.* at 37-42.

9. *Id.* at 45.

10. U.S. GEN. ACCT. OFFICE, REPORT BY THE COMPTROLLER OF THE UNITED STATES, ALTERNATIVES TO PROTECT PROPERTY OWNERS FROM DAMAGES CAUSED BY MINE SUBSIDENCE 3 (1979).

11. This is in contrast to "exogenic" geologic hazards such as floods, landslides and subsidence. *See* J. COSTA & V. BAKER, SURFICIAL GEOLOGY: BUILDING WITH THE EARTH 56 (1981).

12. Seismic activities are usually not triggered by human activities. However, under-

chambers is weakened or cracked, allowing the magma to move upward under incredible pressure, volcanoes are formed. Likewise, earthquakes occur most commonly at the boundaries of major geologic plats or "faults" in the earth's surface. Therefore it is not surprising that the pattern of active volcanoes and earthquake activity coincides worldwide.[13] Erupting volcanoes spew ash and poisonous gases into the air while sending mud and lava flows cascading down mountain slopes. Earthquakes, which are often triggered by volcanoes, may cause vibrations, subsidence, or a cracking of the earth's surface. In coastal areas, these seismic activities may cause wave surges or "tsunamis" that inundate beaches and upland areas with their tremendous force. Therefore, volcanoes and earthquakes have the potential to cause the greatest amount of damage to life and property of any of the geologic events.[14]

Volcanic regions offer numerous benefits, however, and they have long been attractive areas for human habitation. Geothermal energy is often produced in areas of seismic activity. Volcanic ash is rich in nutrients and holds water for long periods of time, yielding very fertile soil. Volcanic rock provides an excellent source for groundwater supplies. A number of industrial materials are also produced from volcanic material, such as pumice, cinders, boric acid, and ammonia. Additionally, volcanic terrain provides spectacular scenery and a wealth of recreational opportunities.[15]

D. Landslides, Mudslides, and Avalanches

Although landslides, mudslides, and avalanches are not causally related, these three phenomena pose similar threats from a land use perspective. All three are characterized by the movement of material downslope and outward under the effects of gravity. Slides may occur rapidly—in a matter of seconds—or they may occur more gradually, taking days to develop. Areas of past slide activity can be identified through topography and physical appearance, while areas of future activity can be predicted on the basis of geologic composition similar to that of known slide areas.[16]

A slide or avalanche results from changes in the resistant or driving forces which hold surface areas together. Slides may be

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ground explosions and injections in fault zones have triggered earthquakes on occasion. J. COSTA & V. BAKER, *supra* note 11, at 82.

13. J. COSTA & V. BAKER, *supra* note 11, at 58.
14. *Id.* at 57.
15. *Id.* at 113.
16. *Id.* at 242-83; NATURE'S CODES, *supra* note 8, at 26.

triggered by human activities such as excavation, addition of moisture to the mass, or, particularly in the case of avalanches, by a change in surface weight.[17] Avalanches may be triggered by changes in temperature, changes in the depth of the snowpack, the effects of thawing, or the sudden addition of weight.

Landslides, which are composed of combinations of natural rock, soils or artificial fills, occur due to the natural weathering effect of rock, and may be triggered by earthquakes, storms, or a sudden thaw. Mudslides,[18] which contain water and fine-grained earth, surge down slopes at tremendous speeds. Like flash-floods, they are released through the effects of heavy rain or snowfall. Avalanches, on the other hand, are masses of tumbling snow, rock, and debris which slide rapidly down steep slopes.

All types of sliding events are extremely destructive, each combining tremendous force with the potential to bury anything in its path. Landslides alone are estimated to cause more than one billion dollars of damage per year.[19] The damage caused by mudslides and avalanches is unknown.

These natural hazards share important characteristics. All are natural events that, while not necessarily predictable, can be expected to recur on a periodic basis. Those areas subject to past or future damage can be identified and mapped to a reasonable degree of certainty.[20] And, in all cases, human losses due to natural hazards can be minimized by local governments through land use regulations which provide proper siting and construction standards.

II. Coping With Natural Hazards

Governmental agencies typically respond to natural hazards in one of four ways: 1) through disaster relief (including warning, evacuation, and financial aid); 2) through structural improvements (such as dams, channels, levees, seawalls and—in the case of subsidence—reinjection of backfilling); 3) through the provision or regulation of insurance coverage; or 4) through land use controls. Of these four techniques, land use controls have usually proven to be

17. Nature's Codes, *supra* note 8, at 26.

18. If more than half of the solids in a flow mass are larger than sand grains—rocks, stones or boulders—the phenomenon is usually described as a "debris flow." *Id.* at 14.

19. *Id.* at 26.

20. Mapping and identification procedures range from simple techniques such as ground or aerial observation to sophisticated testing through remote sensing and seismic refraction. *See* J. Costa & V. Baker, *supra* note 11, at 21-55.

the most effective.[21]

Disaster relief has been the traditional response to natural hazards. Congress and the Federal Emergency Management Agency have typically responded to catastrophic events by providing massive amounts of financial aid to rebuild damaged communities. Unfortunately, this reconstruction has generally taken place with little thought given to the likelihood of recurring damage in the future, and as a result, some properties have been damaged over and over again, with poor land use patterns becoming institutionalized.[22]

Structural improvements are another traditional approach to natural hazard mitigation, particularly where flooding is the concern. Prior to the 1960s the federal government's policy toward prevention of flood damages was based primarily on a structural approach. The Army Corps of Engineers was charged with the task of reconfiguring river channels and beaches in order to prevent properties from being inundated during floods. Unfortunately, this policy has proven to be extremely expensive, and has not succeeded in reducing cumulative flood losses.[23]

The failure of the structural approach to flood control is primarily due to two related factors: technical inability to predict and build for every conceivable event, and continued encroachment upon floodplains. Due to the technical inability to build structures which actually control flood damage, the structural approach has yielded an illusory promise of protection to those who develop floodplain areas. In some cases, this promise of protection may actually stimulate floodplain development by those who might otherwise forego such development.[24]

Structural solutions to subsidence problems have likewise been relatively ineffective. Backfilling costs in undermined areas have been very high, often exceeding the value of the property sought to be preserved. Despite large expenditures, the result has generally

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21. *Cf.* FLOOD LOSS REDUCTION ASSOCIATES, FLOODPLAIN MANAGEMENT HANDBOOK 21-23 (1981).

22. *See* Baker & McPhee, *supra* note 1, at 3-4.

23. At the 1960 proceedings of the Institute on Planning and Zoning, Professor Gilbert White noted that despite federal expenditures of more than four billion dollars on flood control works, mean annual flood losses were actually higher than they had been at the beginning of the program. White, INSTITUTE ON PLANNING AND ZONING, *The Control and Development of Flood Plain Areas* 93 (1960). Much of this increase was attributable to continued development in flood-prone areas. *Id.* at 97.

24. *Id.* at 97-98.

been only a postponement in subsidence movement.[25] Similar results have been achieved when water has been injected into areas suffering from fluid subsidence.[26] Despite the cost and seeming inadequacy of structural improvements, they are still pursued in many communities, primarily because they offer the promise of development without regulatory restraint.[27]

Although natural hazard damages are not routinely covered in most property insurance policies, private hazard insurance is nearly always available as a separate policy for those property owners willing to pay the price. However, since the premiums for this type of insurance are highest in those areas where damage is most likely to occur, there is a substantial disincentive for the persons who need them most to purchasing such policies. The purchase of some types of hazard insurance has been encouraged through programs instituted by the federal government, such as the subsidization of flood insurance for private citizens through the National Flood Insurance Program (NFIP).[28] At the state level,

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25. REPORT BY THE COMPTROLLER GENERAL, *supra* note 10, at 35-36. The Bureau of Mines estimated the costs of backfilling at $22,000 per acre in 1978; between 1965 and 1978, the federal government spent more than $72 million for backfill projects, primarily in the Appalachia area.

26. Roland, *Land Subsidence in the Santa Clara Valley*, 10 WATER SPECTRUM 2, 11-16 (1978). One "success" story is the re-injection project undertaken at the Wilmington oil field in Southern California in 1953. Oil withdrawals caused subsidence to occur over an area of twenty square miles, with a low point of twenty-nine feet at the center of the field. By 1969, after spending more than $100 million on maintenance and construction of structures and with injections of more than one million barrels of water per day, the project had succeeded in halting subsidence over most of the region and raising some surface areas by as much as one foot. *Id.* at 11.

27. Cost, however, is still a problem. Even in communities intent on developing flood-prone lands, developers are expected to pay their fair share of structural improvements. But determining what the fair share should be is not an easy task. In Wood Bros., Inc. v. City of Colorado Springs, 193 Colo. 543, 568 P.2d 487 (1977), the Colorado Supreme Court found that the city's decision to charge a residential developer the full cost of installing a drainage channel on the developer's property was an abuse of discretion. The court classified the property within the drainage basin. In finding that the city's requirement worked an unfair financial burden on this developer, the court emphasized that "only 2% of the effluent in the channel would be generated by the subdivision." This reasoning misses the point—the need for flood improvements was generated by Wood Bros.' desire to develop the property.

The *Wood Bros.* decision can probably be best explained by a footnote to the opinion:

> One councilman . . . indicated, without challenge, that the council would consider itself "stuck" if Wood Bros. were to decide not to develop: 'If Wood Brothers decides they don't want to develop we could sit here for twenty years saying we want that drainage structure, but we are not going to do it until we can stick somebody with the front end money, isn't that right?'

Id at 491 n.1. (A portion of the property that was subject to flooding had been reserved by the city for later construction of an arterial highway.)

28. National Flood Insurance Program, 42 U.S.C. §§ 4011-16 (1982). In order for prop-

California has recently enacted similar laws for earthquake insurance,[29] and insurance to protect against damage due to subsidence is privately available.[30]

Unfortunately, hazard insurance alone does nothing to prevent damages. In fact, an argument can be made that the availability of insurance, like the structural approaches to flood control, actually encourages development in hazardous areas.[31] However, when used in conjunction with land use regulations that prohibit redevelopment in hazard zones, hazard insurance can be used to encourage relocation instead of redevelopment.

The most effective way to prevent future damages is to avoid building in hazard-prone areas through land use controls. By regulating the siting, density and quality of construction in natural hazard areas, local governments can reduce a community's vulnerability to damage. Such land use regulation can be accomplished through the use of zoning ordinances, building codes, and subdivision controls.

Zoning regulations provide local governments with the most flexible tool for addressing natural hazards. Zoning is used to control all aspects of land development, from the height, bulk and siting of structures, to the density and use of the land itself. Where hazard zones can be clearly delineated, zoning can be used to prohibit or control the placement and intensity of uses and activities within the zone. Hazard zoning may be employed to uniformly control all uses and activities within the zone,[32] or graduated restrictions based on the severity of the hazard for each particular site may be used.[33]

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erty owners to purchase flood insurance, the community in which the property is located must regulate land use in the floodplain in accordance with federal standards. *Id.* at § 4012(c).

29. CAL. INS. CODE §§ 10081-88 (West 1986 Supp.).

30. The National Association of Home Builders' Home Owners Warranty (HOW) also provides coverage for subsidence damage. REPORT OF THE COMPTROLLER GENERAL, *supra* note 10, at 31.

31. *See, e.g.*, Platt, *supra* note 6, at 35.

32. For example, Little Cottonwood Canyon, Utah (home of the Alta-Snowbird Ski Resort) adopted a single multiple-hazard zone in its zoning regulations: "natural hazards—construction of permanent structures is not permitted in areas subject to hazards such as floods, landslides, avalanches."

33. A model zoning ordinance drafted by the United States Water Resources Council for use in coastal communities provides for graduated use restrictions. Only open space activities (agriculture, golf courses, parking areas, etc.) are permitted in "high hazard" areas; in "general hazard" areas, construction guidelines are established for first floor elevations and floodproofing. UNITED STATES WATER RESOURCES COUNCIL, 2 REGULATION OF FLOOD HAZARD AREAS TO REDUCE FLOOD LOSSES 165-70 (1971).

Zoning controls of particular importance in limiting losses of life and property are the density and setback requirements. Control of density is particularly important from a safety standpoint, since one of the major problems when a natural disaster occurs is the evacuation of people from the danger area. Where the number of people who would need to be moved can be reduced, the problems encountered in disaster relief will be diminished accordingly. In a similar manner, most natural hazards occur in geographically defined areas, and proper setbacks can help to buffer developed areas from damage.

Building codes have traditionally been used to insure structural strength and stability in new construction. Nearly all communities have adopted one of the major national codes as their regulatory standard.[34] These codes allow local governments to determine the type and manner of construction, as well as the quality of construction materials. In effect, these codes operate as a form of consumer protection, guaranteeing minimum quality standards to potential purchasers.

One major drawback with current national building codes is their uniformity. Because these codes were designed to insure minimum standards for all parts of the country, the standards are typically set at the lowest common denominator. Thus the model codes are intended to address average conditions, not the exceptional problems created by natural hazards.

Local governments can, however, modify these model building codes to protect residents and insure that buildings have a greater chance of surviving natural hazard damages. Flood damage can be avoided by requiring minimum floor elevations, proper anchorage of structures, and floodproofing of sections subject to inundation; wind and storm damage can be reduced by requiring that all buildings be constructed to withstand specified levels of force and velocity; and earthquake damage can be minimized by requiring that buildings be designed with structural elasticity in mind. Furthermore, a municipality's controls are not necessarily limited to new construction. In some areas, building codes can be used to reach older buildings which present a hazard to the community.[35]

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34. COASTAL DESIGN, *supra* note 5, at 200-01. Major building codes include: the Standard Building Code (SBC, produced by the Southern Building Code Congress International); the Uniform Building Code (UBC, published by the International Congress of Building Officials); the Basic Building Code (promulgated by Building Officials and Code Administrators, Inc.); and the National Building Code of the American Insurance Association.

35. In 1979, the City of Los Angeles amended its building code to require that all pre-

Local governments include grading and drainage requirements in their building codes.[36] Although these requirements were developed primarily to control stormwater runoff, grading is an important part of proper site planning, and grading requirements can be used to mitigate flooding, stabilize soils, and prevent landslides and erosion. For example, the City of Los Angeles, which has been plagued by landslides and mudslides precipitated by poor building practices, adopted a separate grading code in 1952 for the specific purpose of mitigating the damage caused by such hazards.[37]

Subdivision controls may also be used to mitigate natural hazard damages. Subdivision regulations typically establish guidelines for both subdivision and development, and the developer is usually required to prepare a plat of the area to be developed, including the siting of such elements as the roads and utilities. Local governments may require that hazardous zones be identified on the plat, and some municipalities have gone so far as to prohibit subdivision of land which is subject to natural hazards unless the developer can demonstrate that damage can be effectively mitigated.[38]

For maximum effectiveness, any hazards regulatory program must be backed by solid technical data and good land use planning. Potential hazards must be identified, mapped, and included in a community's master plan. Hazard areas should be further divided into "zones" of comparable risk, and these zones should form

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1934 unreinforced masonry buildings be either strengthened or removed. The ordinance established both reinforcement standards and a system of priorities for handling the city's estimated 8,000 targeted buildings. See Kockelman, *Action for Earthquake Hazard Reduction*, 51 EKISTICS 525, 527-28 (Nov./Dec. 1984).

36. Two of the four major model building codes (the UBC and the SBC) include a chapter on grading requirements. C.M. SCULLIN, EXCAVATION AND GRADING CODE ADMINISTRATION, INSPECTION, AND ENFORCEMENT 23 (1983). Grading requirements may also be found in subdivision codes.

37. *Id.* at 14-16.

38. Sun Valley, Idaho and Beaverhead County, Montana are examples of local governments that use subdivision regulations to address natural hazards. Sun Valley prohibits subdivision of land subject to avalanche hazards unless the developer can "conclusively demonstrate" that the development will not create or enhance a danger to prospective property owners or the public at large.

Beaverhead County goes farther in its subdivision regulations, disallowing subdivision of land subject to *any* potential hazard "unless the hazards are eliminated or will be overcome by approved design and construction plans." ("Hazards" is defined broadly to include flooding, avalanches, rock falls, landslides, slopes in excess of a 25% grade, subsidence, high water table, polluted/non-potable water supply, high voltage lines, high pressure gas lines, air or vehicular traffic hazards, and—just in case anything was missed—"other features which may be detrimental to the health, safety and welfare of existing or future residents.") Montana specifically authorizes its local governments to disapprove subdivision of land if natural hazard damage cannot be eliminated or overcome.

the basis of the land use plan. Hazard zones should be specifically included in the community's package of regulatory techniques,[39] so as to provide local governments with the information needed for good decisionmaking, and to provide solid justification for land use regulations should they be challenged in court.

III. The Legal Framework for Regulation of Natural Hazard Areas

Local Governmental authority to control land uses in hazardous areas has been rigorously tested in the courts. It is now clear that municipalities can regulate uses within hazard zones as long as the regulations are fairly adopted and reasonably related to mitigating natural hazard damages.[40]

The idea of using land use regulations to mitigate natural hazard damages was first advanced in the context of floodplain management. As the federal government embarked on ambitious programs to control flooding through construction of dams, channels and levees,[41] critics questioned the wisdom of spending millions of dollars on flood control works when a slight shift of location would assure safety from flooding for both people and property. Since flooding is a recurrent, natural event and flood damage occurs because of human decisions to locate in hazardous areas, governmental emphasis should be on controlling human behavior, not on controlling floods.

Floodplain regulation received considerable attention during the 1950s. As policy makers grappled with the controversial subject of controlling development, legal scholars explored theories that would allow local governments to assert such control. The two principal questions addressed by these scholars were: (1) From what authority would a local government derive its power to regulate development in flood hazard areas? (2) Assuming some authority exists, are there overriding constitutional concerns?

In 1959, Professor Allison Dunham established that local govern-

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39. Whether a municipality decides to address hazards through the subdivision, zoning or development review process will depend initially on the type of authority granted to local governments through relevant enabling legislation. See *infra* notes 47-54 and accompanying text.

40. Turnpike Realty Co. v. Town of Dedham, 362 Mass. 221, 229-32, 284 N.E.2d 891, 896-98 (1972), *cert. denied*, 409 U.S. 1108 (1973).

41. Flood control devices such as these are collectively referred to as "structural" responses. Other natural hazards (such as subsidence and landsliding) may also be addressed through structural measures.

ments could constitutionally regulate development in floodplains through the exercise of the police power.[42] Dunham identified three possible rationales for regulating floodplain development: (1) to prevent uses that would work injury to other landowners (the common law nuisance theory), (2) to protect landowners and residents of floodplains from the consequences of their "irrational" decision to locate in a hazardous area, and, (3) to promote the public welfare by reducing the amount of property subject to damage, thereby diminishing public subsidies for disaster relief and flood control works.[43] Dunham concluded that each of these was a valid police power purpose and could support local governmental control of floodplain development.

In order for floodplain regulations to survive judicial scrutiny under substantive due process,[44] Dunham determined that they must be able to meet the following two criteria: (1) the state legislature must have "enabled" the unit of government proposing regulation to pass a flood zoning ordinance, and (2) assuming that there is statutory authority, the regulation or restriction must be constitutional.[45] Dunham found that statutory authority for floodplain regulation exists in the general zoning enabling legislation in almost every state.[46]

Most states have modeled their zoning enabling legislation after the Standard State Zoning Enabling Act (SSZEA).[47] Under SSZEA local governments are authorized to regulate

> the height, number of stories, and size of buildings and other structures, the percentage of the lot that may be occupied, the size of yards, courts, and other open spaces, the density of the population, and the location and use of buildings, structures and

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42. Dunham, *Flood Control via the Police Power*, 107 U. PA. L. REV. 1098 (1959).

43. *Id.* at 1107-17.

44. The general test for substantive due process has three parts (assuming the regulation has been properly enacted under valid statutory procedures): (1) Does the regulation have a valid purpose? (2) Is the means chosen to implement the purpose rationally related to the end? (3) Does the regulation provide a reasonable balance between the interests of the community and the interests of the individual? *Id.* at 1123-28.

45. *Id.* at 1117. Dunham's tests are part of the standard judicial analysis for testing the validity of any local government action. *See generally* D. REYNOLDS, LOCAL GOVERNMENT LAW, 135-70 (1982).

46. Besides the usual requirements for enactment of ordinances, zoning ordinances must often meet three special requirements: (1) municipalities must submit proposed legislation to local planning commissions prior to passage by the legislative body; (2) public hearings must be held prior to that passage; and (3) notice must be given to the community of the proposed legislation itself. D. REYNOLDS, *supra* note 45, at 395-96.

47. A STANDARD STATE ZONING ENABLING ACT (U.S. Dep't of Commerce 1926).

> land for trade, industry, residence or other purposes.[48]

However, local governments may excercise this power only if the regulations are undertaken

> to lessen congestion in the streets; to secure safety from fire, panic, and other dangers; to promote health and general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to promote energy conservation; to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements.[49]

Therefore, as long as the purpose of the regulation falls into one of the specific categories outlined above, local governments may regulate those types of development. Dunham found that floodplain regulation fell easily into the grant of power outlined in the SSZEA.

Floodplain regulations are typically concerned with the same types of building behavior governed by standard zoning codes—site planning, density, and appropriate uses. However, Dunham found that the purpose of floodplain regulations was somewhat more problematic than the zoning codes. While the first rationale—that of preventing uses which would work injury to other landowners—can be considered a "safety" purpose, the remaining two rationales are less clear.[50] Dunham suggested that the solution was to assert that the general welfare is promoted by land use restrictions which prevent large public expenditures due to damage from natural hazards.[51] While acknowledging that this characterization of the general welfare power was probably stretching the intent of the zoning enabling act,[52] he suggested that his reasoning would work as long as the courts read the enabling act as a broad grant of police power over land use, as opposed to a nar-

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48. *Id.* § 1. This provision is commonly referred to as the "grant of power" to the municipality.

49. *Id.* § 3. Many states have added additional purposes over time. For example, Colorado's zoning enabling act now authorizes local governments to regulate "to secure safety from fire, panic, floodwaters, and other dangers." COLO. REV. STAT. § 31-23-303(1) (1986).

50. Dunham, *supra* note 42, at 1119. In Dunham's words, "[I]f the objective is not primarily safety or prevention of channel obstruction, but rather reduction of flood loss, how can we qualify under the enabling act and yet give reasonable consideration to appropriate land use?" *Id.*

51. *Id.*

52. *Id.*

row grant.[53]

In addressing the constitutional problems with floodplain regulations,[54] Dunham's major concern was with the issue of substantive due process. If promulgated regulations were not found to be rationally related to the goals of promoting safety and reducing public expenditures, they would be struck down as unconstitutional. A similar fate would await those regulations which failed to provide adequate protection for individual property rights.

Dunham believed that the best way to avoid due process problems was through careful drafting, and that in order for a regulation to avoid such problems, a causal connection needed to be established between the landowner's activity and the public expenditure likely to be incurred as a result of that activity.[55] He felt that in establishing that connection the regulation must distinguish between *uses* and *obstructions*, since a prohibition against residential structures in a floodway is less defensible than a prohibition against obstructing structures.

In addition, such regulations must provide a "safety valve" permitting the governing body to allow for exceptions to the regulations when application of the restrictions would work great individual hardship at little community gain.[56] Finally, the objective of the regulation must be a permissible purpose within the authority of the regulating body.[57] As long as local governments follow the

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53. *Id.* Dunham was critical of states such as Tennessee that added specific "flooding" language to their general enabling statutes. In his view, this additional language worked a limitation on local governmental powers by restricting regulations to the purpose of protecting life and property. He suggested adding language along these lines in order to avoid this narrow construction: "to protect the public health and to reduce the financial burdens on the community, its governmental units and its individuals by frequent and periodic floods and the overflows of lands." *See* Dunham, *supra* note 42, at 1120. The courts have generally not shared Dunham's concern, however, and most floodplain regulations have been upheld under the general enabling authority with or without additional language. *See, e.g., Turnpike Realty Co.*, 362 Mass. at 229-32, 284 N.E. 2d at 896-98, and *infra* notes 65-77 and accompanying text.

54. *See* Dunham, *supra* note 42, at 1121. Dunham also discussed the problem of equal protection and the possibility of a supremacy clause challenge to local regulations. Neither of these has proven to be particularly important in most cases. However, there is an additional constitutional issue the importance of which Dunham did not foresee: inverse condemnation (or the "takings" clause). *See* discussion *infra* notes 71-72 and 82-92 and accompanying text.

55. *Id.* at 1124. According to Dunham, "To withstand consitutional objection, the statute must establish a causal connection between the landowner's activity and the need for a structure-free channel." *Id.*

56. *Id.* at 1126-27. Waivers and other safety valve provisions are routinely included in most zoning enabling acts. *See, e.g.*, COLO. REV. STAT. §§ 31-23-301(1), (3) (1986).

57. This overlaps with the "authority" analysis outlined *supra* notes 49-53 and accompa-

state-mandated procedures for enactment of zoning plans, establish an adequate causal connection between the landowner's activity and potential damage, and retain flexibility in implementing restrictions, the regulations should survive constitutional attack.[58]

Dunham's analysis has survived the test of time. During the 1960s and 1970s, there were numerous court challenges to locally created floodplain regulations, but the regulations survived judicial scrutiny in virtually every case.[59] Courts were unanimously supportive of the goals of floodplain management, invalidating regulations only when those regulations were flawed by statutory procedural inadequacies.

Perhaps the most important opinion on the validity of floodplain regulations is that of *Turnpike Realty Co. v. Town of Dedham.*[60]

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nying text.

58. Dunham, *supra* note 42, at 1121-32.

59. For a comprehensive analysis of judicial treatment of floodplain regulations see Kusler, *Floodplain Regulations and the Courts*, in 3 REGULATION OF FLOOD HAZARD AREAS TO REDUCE FLOOD LOSSES 186-255 (1982).

60. 362 Mass. 221, 284 N.E.2d 891 (1972), *cert. denied*, 409 U.S. 1108 (1973). An earlier case that is worthy of mention is Morris County Land Improvement Co. v. Parsippany-Troy Hills Twp., 40 N.J. 539, 193 A.2d 232 (1963). This case is frequently cited by plaintiffs challenging floodplain regulations because it is an adverse decision.

Plaintiffs were owners of 66 acres of marshy meadow located within the boundaries of the Parsippany-Troy Hills Township. The property was a portion of a larger area known as Troy Meadows, a large "swamp" that drained substantial portions of the township. Approximately 75% of the Troy Meadows areas was in private ownership as a wildlife sanctuary.

Plaintiff's land was zoned for residential use. In 1954, the zoning ordinance was amended to provide that development could not occur within Troy Meadows, intending to freeze existing uses in the area until the remainder of the marsh could be acquired as a wildlife preserve. In 1959, plaintiff began filling operations on its land. After citizen and landowner complaints, plaintiff attempted to rezone the property for industrial uses; this request was denied. Plaintiff was allowed to continue filling "at its own risk" while the Township considered appropriate action. In 1960, the Township rezoned the Troy Meadows area to allow only agricultural, recreational and conservation uses. After plaintiff was denied a special permit to continue filling operations, it filed suit to challenge the validity of the 1960 amendment. The primary claim was constitutional: plaintiff alleged that the Township's decision to prohibit development in Troy Meadows in order to retain the area in its natural state was a taking of property without compensation. The New Jersey Supreme Court agreed. In enacting the amendment, the Township had relied on the many "public benefits" that retention of this land in its natural state entailed. One important public benefit was preservation of the natural drainage characteristics of the land. While the court agreed that this was a valid public purpose, it found that the public purpose was "so all-encompassing as practically to prevent the exercise by a private owner of any worthwhile rights or benefits in the land." *Morris County*, 40 N.J. at 555-56, 193 A.2d at 241-42. When the "purpose and effect of a regulation is to appropriate private property for a flood water detention basin or open space . . . public acquisition rather than regulation is required." *Morris County*, 40 N.J. at 555-56, 193 A.2d at 241-42.

The validity of the *Morris County* opinion is highly doubtful today. New Jersey has become a strong champion of public interests in private land through its treatment of the

That opinion discusses most of the important issues that have been decided by the courts: the authority to regulate, the purposes of the regulation, the reasonableness of the regulation in light of those purposes, and the diminution in value of the individual landowner's property.

In 1963, the Town of Dedham amended its zoning code by establishing a "Flood Plain District" in an area of land located near the Charles River. Prior to this amendment, the area had been zoned for residential use. The new district, composed primarily of marshes and swampland, was slated for acquisition by the Army Corps of Engineers as part of a natural flood control project.

Land and water uses within the Flood Plain District were restricted to "any woodland, grassland, wetland, agricultural, horticultural or recreational use" not requiring filling.[61] Buildings accessory to these uses were to be permitted only on approval of the Board of Zoning Appeals.[62] The identified purposes of the Flood Plain District were

> to preserve and maintain the groundwater table; to protect the public health and safety, persons and property against the hazards of flood hazard inundation; for the protection of the community against the costs which may be incurred when unsuitable development occurs in swamps, marshes, along water courses, or in areas subject to floods; and to conserve natural conditions, wild life, and open spaces for the education, recreation and general welfare of the public.[63]

Plaintiff, Turnpike Realty, owned property located within the

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public trust doctrine. *See, e.g.*, Neptune City v. Avon-by-the-Sea, 61 N.J. 296, 294 A.2d 47 (1972), and Lusardi v. Curtis Point Prop. Owners Ass'n, 86 N.J. 217, 430 A.2d 881 (1981). The opinion was also strongly criticized in Usedin v. New Jersey Dep't of Envtl. Protection, 173 N.J. Super. 311, 414 A.2d 280 (1980). The public's interest in wetlands preservation has also been given strong protection by the federal government. *See* Federal Water Pollution Control Act (FWPCA), 33 U.S.C. §§ 1251-1376 (1982).

More importantly, perhaps, one major assumption underlying the *Morris County* opinion is no longer valid today. Justice Hall assumed that all land was technically suitable for development; economic constraints set the outer limits for developability. That assumption is highly questionable today, as 20 years of environmental litigation has taught us that some land is inherently unsuitable for development because of adverse consequences to other people (both now and in the future) and to the environment itself. This change in social values is probably as much responsible for the judicial acceptance of floodplain regulations as any other single factor.

61. *Turnpike Realty* at 224, 284 N.E.2d at 894.

62. *Id.*

63. *Id.*

Flood Plain District, and challenged the 1963 amendment by asserting that the town had gone beyond its authority in enacting the restrictions.[64] Furthermore, it argued that the zoning amendment was unconstitutional both on its face and as applied to plaintiff's land,[65] and that the regulation worked such a substantial reduction in the value of plaintiff's property that a "taking" had occurred.[66]

The court, however, had no difficulty finding a source of authority for the enactment of this regulation. The state of Massachusetts had authorized municipalities to use their zoning bylaws to provide for the health or safety of the occupants of lands subject to seasonal or periodic flooding by prohibiting uses endangering such occupants.[67] Although the plaintiff argued that the town's regulation went beyond this authority, the court disagreed, pointing out that one of the express purposes of the bylaws was to provide protection for persons and property against the hazards of water inundation.[68] Furthermore, the town was authorized to enact this type of restriction even without this specific legislative grant, since the general zoning enabling act provided sufficient authority to support the regulation.[69]

Having determined that the town acted with clear authority, the court next addressed the question as to whether the regulation was clearly arbitrary and unreasonable, with no substantial relation to the public health, safety, morals, or general welfare.[70] The court found that it was not. "The general necessity of flood plain zoning to reduce the damage to life and property caused by flooding is unquestionable,"[71] stated the court, and in applying Dunham's three rationales for this type of regulation, the court found the

64. *Id.* at 227, 284 N.E.2d at 895.

65. *Id.* at 232-35, 284 N.E.2d at 898-900.

66. Plaintiff also alleged that its land was not subject to flooding, that the flooding that did occur was caused artificially and should not be considered under the floodplain regulation, that the regulation delegated too much discretion to the board of appeals, and that the special permit process was valueless because it was impossible to comply with the town's conditions. In addition, plaintiff argued that the regulation should be invalidated because its real purpose was to preserve the land in its natural state, a goal that was more appropriately met through acquisition. Plaintiff lost on all counts.

67. *Turnpike Realty*, 362 Mass. at 227-28, 284 N.E.2d at 896.

68. *Id.*

69. Specifically, the court found that the town could act pursuant to its authority to promote the "health, safety, convenience, morals or welfare" of the public and "to secure safety from fire, panic, and other dangers." *Id.*

70. *Turnpike Realty*, 362 Mass. at 233, 284 N.E.2d at 898, quoting Village of Euclid v. Ambler Realty Co., 272 U.S. 365, 395 (1926).

71. *Turnpike Realty*, 362 Mass. at 233, 284 N.E.2d at 899, citing Dunham and other commentators.

town's bylaw to be consistent with these rationales.[72] The restrictions were neither arbitrary nor unreasonable as applied to plaintiff's property because the town had clear evidence that the land was annually flooded with up to three feet of water.[73]

The court, also, was unsympathetic towards Turnpike Realty's takings claim. Although plaintiff presented expert testimony that the property in question was worth $431,000 prior to the enactment of the bylaw and worth only $53,000 thereafter, the court was "unable to conclude . . . that the decrease was such as to render it an unconstitutional deprivation of property."[74] The town's expert had testified that construction of housing was not economically feasible due to the nature of the terrain.[75]

Turnpike Realty establishes local government authority to enact floodplain regulations as incidental to zoning power, and that such regulations can pass constitutional muster. During the 1970s, similar floodplain and wetland regulations were tested extensively in the courts, receiving overwhelming support at both the state and federal level.[76] From these cases a number of general principles have become clear—principles which should apply with equal force to any type of hazards regulation.

If local control is to survive judicial review, regulations must meet the following four requirements:

> (1) Authority for imposing the restrictions must be conferred by the state. Such authority may be found in general zoning enabling statutes, subdivision or building code enabling legislation, specific hazards legislation,[77] or constitutional home rule provisions.[78]
> (2) In enacting regulations, local governments must follow the procedural steps outlined in the enabling legislation. This step

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72. *Id.* at 233-35, 284 N.E.2d at 899-900.

73. *Id.* at 234, 284 N.E.2d at 899.

74. *Id.* at 236-37, 284 N.E.2d at 900.

75. *Id.* at 236, 284 N.E.2d at 900.

76. Kusler reports that there were at least 55 reported decisions on floodplain regulations, 25 on wetlands regulations, and another 45 on federal flooding issues, including flood insurance and FWPCA dredge-and-fill permits. He states that "the goals and techniques to floodplain regulation were unanimously endorsed." Permit denials were invalidated in only seven of the 125 cases. Kusler, *supra* note 59, at 186.

The "endorsed" goals identified by Kusler include: preventing land uses that will increase flood heights and velocities, resulting in flood damage; preventing land uses that will cause nuisances elsewhere; preventing victimization and fraud, thereby reducing the costs of community services; promoting the most suitable uses of land. *Id.* at 187-88.

77. *See infra* notes 93-97 and accompanying text.

78. Morland Development Co. v. City of Tulsa, 596 P.2d 1255 (Okla. 1979) (Barnes, J., concurring); Famularo v. Board of County Comm'rs, 180 Colo. 333, 505 P.2d 958 (1975).

tracks traditional local government law, requiring notice, public hearing and final publication of all zoning regulations.[79]
(3) The regulations must be enacted to further a legitimate objective of the police power.[80]
(4) The means chosen by the municipality must be reasonably related to a proper goal and must strike a proper balance between community interests and private rights.

This final requirement presents the biggest challenge to municipalities. In order to survive judicial review, a local government must be prepared to show that the method chosen to regulate development is rationally related to the goal of promoting public safety and welfare, and that adequate consideration has been given for individual hardships that may be created by the restrictions. This showing is best accomplished by demonstrating a causal connection between the restrictions imposed and the reduction in damages which results, and by including a "safety valve" provision.

Generally, courts have been willing to defer to legislative findings of fact when considering the rationality of the causal connection between regulation and potential damages. This deference is probably due to the fact that such findings are heavily value-laden. Thus, a regulation should survive review if it is given adequate consideration by the governing body and is supported by competent technical data.[81]

Balancing community interests and private rights, however, is a more difficult requirement for municipalities to meet.[82] When considering this balance, judicial attention naturally tends to focus on the individual, since the judicial role within the political system is the protection of individual rights. A local government faced with making such a determination must be careful to present detailed evidence on the costs that individual actions may impose on the community at large. Emphasis should be on the cumulative impact

79. *See generally* D. REYNOLDS, *supra* note 45, at 394-401; *Morland Development Co.*, 596 P.2d at 1258.

80. *See* Dunham, *supra* note 42, at 1110-17. In reviewing floodplain regulations, courts have upheld all three of Dunham's suggested purposes, as well as more limited specific goals such as protection of flood storage areas. *See Turnpike Realty*, 362 Mass. at 227-28, 284 N.E.2d at 895-96; Dur-Bar Realty Co. v. City of Utica, 57 A.D.2d 51, 394 N.Y.S.2d 913 (N.Y. App. Div. 1977). *See also* Kusler, *supra* note 59, at 211-13.

81. *Turnpike Realty*, 362 Mass. at 226-29, 284 N.E.2d at 895-96; Turner v. County of Del Norte, 24 Cal. App. 3d 311, 314-15, 101 Cal. Rptr. 93, 96 (Cal. Dist. Ct. App. 1972); Wolfram v. Abbey, 55 A.D.2d 700, 701, 388 N.Y.S.2d 952, 954 (N.Y. App. Div. 1976).

82. The primary issue here is one of substantive due process. It overlaps, however, with the takings concern outlined below. See discussion *infra* notes 82-92 and accompanying text.

created by these individual actions; should a court look only to the incremental damage caused by one landowner's acts, the hardship imposed by the restrictions may appear extreme.[83]

Whenever a local government acts to restrict an owner's use of private property, the issue of a taking is likely to arise.[84] Thus, balancing individual and community interests can overlap with the issue of inverse condemnation. Although takings were originally thought to occur only when a government physically took control of the property, today regulatory action alone may give rise to such a claim.[85]

In reviewing floodplain regulations, courts have looked to the following factors to determine if a proper balance has been struck or a regulatory takings has occurred: nuisance prevention,[86] physical interference;[87] public use of private land,[88] the natural suitabil-

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83. Even when a regulation is based on the best technical data available, some anomalous results are bound to occur in application. For this reason, the regulation should provide for waivers or exceptions from the restrictions, with discretion to grant the variance vested in a legislative body. Such a provision helps to guard against unreasonable application of the regulation and avoid undue individual hardship.

84. The takings challenge is based on the fifth amendment to the United States Constitution, which provides that private property may not be taken for public use without just compensation.

85. Ironically, this view of takings theory arose in the context of a natural hazard case. In Pennsylvania Coal v. Mahon, 260 U.S. 393 (1922), the Supreme Court held that a state statute which prevented a private company from mining coal in areas where subsidence would result was an unconstitutional taking of the company's property. Recent decisions of the Court indicate that the holding of *Pennsylvania Coal* was not the Court's final word on the takings issue. In Keystone Bituminous Coal Ass'n v. DeBenedictis, 107 S. Ct. 1232 (1987), the Court upheld as constitutional a Pennsylvania statute which required coal companies to leave approximately 50% of the coal in the ground below surface structures, even though the statute was strikingly similar to the one in *Pennsylvania Coal*. In First English Evangelical Lutheran Church v. County of Los Angeles, 107 S. Ct. 2378 (1987), the Court ruled that where a county has temporarily denied the owner all use and enjoyment of his land through the use of an unconstitutional regulation, the owner may be able to recover damages from the time the regulation took effect. Such a decision is certain to have a chilling effect on the willingness of municipalities to experiment with unproven land use regulation. Additionally, in Nollan v. California Coastal Comm'n, 107 S. Ct. 3141 (1987), the Court struck down as unconstitutional a commission's regulation that required beachfront property owners to grant an easement of public access as a condition of obtaining a permit to reconstruct or enlarge a beachfront home. The Court found that such an exaction was beyond the police power, and that therefore the state could not obtain such an easement without compensation.

86. *Turner*, 24 Cal. App. 3d at 314-15, 101 Cal. Rptr. at 96.

87. Krahl v. Nine Mile Creek Watershed Dist., 283 N.W.2d 538, 543 (Minn. 1979); Maple Leaf Investors v. State Dep't of Ecology, 88 Wash. 2d 726, 733, 565 P.2d 1162, 1165 (1977).

88. *Maple Leaf Investors*, 88 Wash. 2d at 733, 565 P.2d at 1165; Pope v. City of Atlanta, 240 Ga. 177, 240 S.E.2d 241 (1977).

ity of the land for development,[89] the balance of public against private interests,[90] diminution in the value of the landowner's property,[91] and whether there has been a denial of all reasonable use of the land.[92] If the regulation meets a valid public purpose and leaves the owner some economic use of the land, no taking will be found.[93]

One way for local governments to avoid problems with the above requirements is to provide a safety valve in the regulatory scheme. Variances, special permits, and procedures for special review may be used to insure that restrictions are not imposed where they are unnecessary. These approaches will preserve the overall fairness of the regulatory scheme.[94]

Flooding is no longer the only natural hazard being addressed through land use controls. A number of mountain communities regulate both new and established developments in avalanche hazard areas.[95] Many California communities address earthquake hazards through their land use codes.[96] Most coastal states have

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89. Just v. Marinette County, 56 Wis. 2d 7, 17, 201 N.W.2d 761, 768 (1972).

90. *Krahl*, 283 N.W.2d at 553; *Turner*, 24 Cal. App. 3d at 314-15, 101 Cal. Rptr. at 96.

91. Spiegle v. Borough of Beach Haven, 116 N.J. Super. 148, 166-68, 281 A.2d 377, 386-87 (1971); Foreman v. State Dep't of Natural Resources, 180 Ind. App. 94, 387 N.E.2d 455 (1979); *Turner*, 24 Cal. App. 3d at 315, 101 Cal. Rptr. at 96.

92. *Just*, 56 Wis. 2d at 15, 201 N.W.2d at 767.

93. Kusler notes that 36 of the 55 floodplain cases reviewed by courts during the 1970s included a takings claim. The claim was upheld in only two, in cases in which the regulations contained procedural and technical inadequacies. Kusler, *supra* note 59, at 233, 235-36.

94. *See Turnpike Realty*, 362 Mass. at 237, 284 N.E.2d at 901.

95. Vail, Colorado and Ketchum, Idaho provide examples of avalanche zoning. Both municipalities have mapped "avalanche influence zones" which have then been divided into high and moderate risk areas. In Vail, building permits are not issued until the developer provides information to the town on the location of high and moderate risk areas on the property. Residential construction is not permitted in high hazard zones.

To date, Ketchum has been unable to muster the political will to restrict development in avalanche-prone areas. After intense debate along predictable lines (protection of future property owners and the public at large versus takings and a violation of individual freedom to develop property), Ketchum adopted the following compromise regulations: new structures must be designed to withstand avalanche forces; older structures that are not so designed may not be rented in winter; subdivision and building plans must identify avalanche hazard zones, and permit applicants must appear before the city council to receive notice that the proposed development is located in a hazard zone; the city issues "hazard zone" notices to all tenants and lessees of property located in avalanche zones.

96. For example, the town of Portola Valley is bisected by the San Andreas fault. Lots located near the fault line are subject to special setback requirements. If the lot includes a "known" faultline (identified primarily through visual observation), buildings must be located at least 50 feet from the fault. Where a fault line is "inferred" (the visual evidence is less clear), buildings may not be located nearer than 100 feet. Only one story, wood frame, single family residences are located in the earthquake hazard zone. California requires local

adopted regional coastal zone regulations designed to protect barriers and dunes,[97] and some cities and counties have enacted "geologic hazard zones" aimed at addressing multiple hazards.[98]

IV. CONCLUSION

Local governments may use traditional land use controls to regulate development in natural hazard areas. Effective and legally sustainable land use controls should include the following elements:

(1) *A solid technical basis for identifying and delineating natural hazard areas.* The land use regulations should be tied closely to this information to insure that the community achieves its goal of reducing damages. Furthermore, technical data may be used to support the rationality of the municipality's regulatory decisions. This data base should include information on the type and loca-

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governments to include seismic hazards in their comprehensive plans. CAL. GOVT. CODE § 65302(g) (West 1986 Supp.).

97. These regulations have been enacted pursuant to the Federal Coastal Zone Management Act, 16 U.S.C. §§ 1451-64 (1982), or on an individual basis. The regulations share common characteristics: destruction of dunes, wetlands, and natural beaches through building construction is prohibited, and development is not allowed on the seaward side of barriers or on the crests of dunes.

98. This approach has been used most often in California and Colorado, where specific state legislation authorizes local governments to regulate on a multiple-hazard basis. As noted earlier (note 96), California requires a seismic safety element in municipal general plans. Pursuant to the same statute, local governments are also required to consider flooding, slope instability, pollution, and the general safety of the community.

San Mateo County provides an example of the application of this statutory requirement. The county has divided itself into resource management zoning districts. The density and intensity of proposed uses are then evaluated against a number of specific criteria, including location of natural hazards and scenic areas and proximity to services and facilities. Permit applicants must submit an "environmental setting survey" detailing environmental resources located on the property and the restraints they place on development.

Geologic hazard overlay zones have been adopted by at least six Colorado counties. Larimer County's approach appears to be the most comprehensive. Hazards to be addressed include "wildfire, avalanche, landslide, rockfall, mud flow and debris fans, unstable or potentially unstable slopes, seismic effects, radioactivity, ground subsidence, and expansive soil and rock." All applications for subdivisions, PUD's, exemptions, and special review must be evaluated for potential hazards, and development may be conditioned or denied based on the nature of the hazard and the ability to mitigate. Change or expansion of nonconforming uses is also subject to review. The regulations were enacted pursuant to the state's general enabling act (COLO. REV. STAT. §§ 29-20-101 through 29-20-107 (1986)) and the county planning and building code enabling act (COLO. REV. STAT. §§ 30-28-101 through 30-28-209 (1986)), both of which specifically authorize regulation in hazard areas.

Colorado also has a specific multiple hazards enabling act (COLO. REV. STAT. §§ 24-65.1-101 through 24-65.1-108 (1986)), which does not appear to be well used, probably because of its cumbersome enabling procedures. The Colorado Department of Natural Resources was required under this act to promulgate guidelines which appear to have been used as models for the county's regulations.

tion of potential hazards, and the scope of expected injuries to life and property.

(2) *Good planning of the overall land use patterns for the jurisdiction in question.* Areas subject to hazards should be mapped and identified in the local government's master plan. Densities, uses, and future development plans should be closely tied to the suitability of the land in question. Transportation corridors also should be accounted for in hazard areas.

(3) *A package of comprehensive regulations, designed to address specific aspects of the damages that natural hazards can impose.* Regulations should address structural stability (through building and housing codes), site planning (through zoning codes and master planning), setbacks and placement of structures (through zoning and subdivision), and control of densities and activities within hazard-prone areas (through the zoning code). A local government's choice of regulatory tools will depend on the specific enabling legislation enacted by that state. Development of such a package allows local governments to minimize present and future damages from natural hazards while preserving the important benefits that these natural processes confer.