Chapter 5
Tornado and Severe Storms

Massive areas of the U.S. are vulnerable to tornadic activity and severe storms, and a variety of government agencies are responsible for providing public warnings for tornado and severe thunderstorm threats. However, there are serious technological and socio-political limitations that make tornado and severe storm preparedness and mitigation extremely difficult. Moreover, the national definition of "disaster" may affect state and local preparedness, response and recovery efforts for tornados and severe storms. Unlike earthquakes and hurricanes, tornados and severe storms do not automatically trigger presidential disaster declarations. Tornados have occurred in virtually all 50 states, but most in the central and eastern U.S. Coastal states are as vulnerable to tornado and severe storm damage as inland states are.

The United States experiences more tornado activity than any other country. The National Weather Service (NWS) considers tornados to be nature's most violent weather phenomenon. Some tornados have been clocked with wind speeds well over 200 mph. Maximum tornado winds are extremely difficult to measure because metering equipment is usually destroyed by the force of the winds themselves. Tornados have resulted in an average of 80 deaths and 1,500 injuries each year. For 1995, there were 30 tornado fatalities which was less than half of 1994's total of 69, and significantly lower than the 30-year average death toll of 73. The number of fatalities from tornados is in part attributable to tornado unpredictability and rapid speed of onset.

Tornados have touched down in all 50 states, but the areas at greatest risk are the Great Plains region east of the Rocky Mountains and the Midwestern states of Wisconsin, Michigan, Illinois, Indiana, and Ohio. The Great Plains area from Texas to Canada is dubbed "Tornado Alley" for the frequency of tornados that strike the area. Tornados cause more deaths east of the Mississippi River (higher population densities), and more damage west of it (endnote 1).

Table 1 contains the primary disaster incident category "flood and tornado." There is a separate "flood" primary incident category in the table already discussed in the previous chapter. The umbrella term "flood and tornado" means a tornado was the primary incident and flood may have been a coincident manifestation of the disaster or that flood and tornado together represent the primary incident. FEMA does have a "tornado" primary incident category. As before, we
are discussing primary incidents in Table 1. It must be understood that tornados may be secondary or tertiary disaster agents in other disasters. For example, many hurricanes spawn tornados as secondary agents of devastation. So the "flood and tornado" category captures some, but not all tornadoic damage included in presidentially declared major disasters and emergencies.

Table 1 reveals that coastal states have received 71% of federal disaster relief (constant 1994 dollars) expended for "flood and tornado" primary incident declarations. This is not highly disproportionate given that coastal states are 60% of all states and 65% if coastal states and territories are combined (as they are in Table 1). Primary incident "flood and tornado" declarations for coastal states yield only 4% of total coastal federal disaster relief (constant 1994 dollars) and are 7.7% of all coastal state declarations for the 44 year period. Primary incident "flood and tornado" declarations for inland states yields a 10.7% share of total inland federal disaster relief (constant dollars) and are 8.6% of all inland state declarations for the same period.

Relatively speaking, "flood and tornado" in the context of this analysis is substantially equal for inland states and coastal states vis-a-vis declarations issued. Moreover, the share of federal disaster relief (constant dollars) attributed to "flood and tornado" primary incident declarations for coastal and inland states is similar. What is noteworthy is the 10.7% share of total inland federal disaster relief (constant dollars) stemming from "flood and tornado" primary incident declarations.

Table 2 notes that Mississippi, Alabama and Illinois (all coastal states) have won the largest number of "flood and tornado" primary incident declarations.

Severe thunderstorms are also cause for concern, especially because tornados and highly damaging winds are sometimes produced from them. THUNDERSTORMS affect relatively small areas when compared with climate events such as hurricanes and winter storms. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Nearly 1,800 thunderstorms are occurring at any moment around the world. Despite their small size, all thunderstorms are dangerous. Every thunderstorm produces lightning, which kills more people each year than tornados. Heavy rain from thunderstorms can result in flash flooding. Strong winds, hail, and tornados are also dangers associated with some thunderstorms. The National Weather Service reports that of the estimated 100,000 thunderstorms that occur each year in the U.S., only about 10 percent are classified as severe.
"Severe Storms" are a category of primary incident in the disaster declaration process. Table 1, as explained, presents all dollar amounts in 1994 constant dollar. Table 1 makes it clear that total federal disaster relief for primary incident "severe storms" ($1.73 billion) actually exceeds total federal disaster relief for "flood and tornado" primary incidents ($1.56 billion).

In the matter of coastal vs. inland states, coastal states win a disproportionately larger share of federal disaster relief funding (84%) than do inland states for severe storms. However, when it comes to the number of declarations issued for "severe storms" primary incidents, coastal and inland states have balanced shares (70%), with coastal states winning only 5% more than their proportional representation. Nevertheless, another primary incident category must be considered and that one is "Coastal Storm."

Table 1 shows that for the 9 "coastal storm" primary incident declarations, unsurprisingly all went to coastal states. If the $102 million in constant 1994 dollar federal disaster relief for these declarations is added to the coastal "severe storm" primary incident federal disaster relief category, coastal state storm disasters yield about $1.55 billion in federal relief for the interval studied. Total "storm damage" federal relief then jumps to about $1.83 billion and the coastal state share of that amount is 84.7%.

Also, if the 64 coastal state "severe storm" declarations are combined with the 9 "coastal storm" declarations, coastal states jump to 72.3% of all "storm" declarations, an amount which begins to exceed its proportional share.

This pattern of coastal state predominance is even more pronounced if "snow/ice" primary incident declarations are considered. Table 1 shows that coastal states won 79% of all snow/ice declarations issued in the 44 year period. Since no territories have won declarations for primary incident snow/ice (all are in tropical or sub-tropic zones), the pool of coastal states stands at 30 or 60% of the 50 states. About $1.17 billion in federal disaster relief (constant 1994 dollars) has been paid out on snow/ice primary incident declarations. Coastal states received 80% of this $1.17 billion sum.

If "coastal storm," "severe storm," and "snow/ice" primary incident declarations are combined, there were 198 declarations or 15.2% of the total 1299 pool of declarations. Coastal states secured 150 declarations, or 75.6% of the 198 declarations of the pool. For these 150
declarations, coastal states received (again in 1994 constant dollars) about $2.5 billion, or of the approximately $3 billion spent in this pooled category. This means coastal states secured 83% of the constant 1994 dollar federal disaster relief funding expended for "coastal storm," "severe storm," and "snow/ice" primary incident disaster declarations issued from mid-1953 to mid-1997. In other words, coastal states have won a disproportionately large share of declarations, and federal disaster relief, for the combined "storm-snow-ice" categories.

The National Weather Service (NWS), the National Severe Storm Laboratory, and FEMA's Emergency Alert System, in cooperation with state and local emergency management agencies, shoulder much of the burden for providing public warning of tornado threat. Inadequate advanced warning time, wind vulnerable structures, and an unknowing public, may expose many to tornado threat. Public education, drills, practices, siren warnings, and feasible structural mitigation (there is no such thing as a perfectly windproof building) could all help in reducing the public's vulnerability to tornado. However, strong national, state, and local leadership are needed to advance these purposes.

Given the unpredictability and physical characteristics of tornadoes, there are few mitigation issues related to tornado-caused emergencies. Based on 1995 analysis from the National Weather Service, tornadoes killed more people in permanent and mobile homes than in any other locations. Some 77% of fatalities occurred in these domiciles.

One mitigation measure which would probably save lives, but is unrealistic to adopt is to limit the use of mobile homes. Many mobile homes cannot withstand the high winds associated with tornadoes. Despite the increased risk, the 5 to 6 percent of the population who live in mobile homes and the manufactured housing industry would aggressively fight any attempt to limit the sale or location of mobile homes. As a result, much of the federal government's tornado mitigation policy is based on a program of public education. Options that local municipalities may consider include building reinforced shelters in mobile home communities where residents may go to better protect themselves in the event of a tornado.

Three issues that Loran Smith considers most important in tornado policy are:

1) the degree of preparedness,
2) the definition of disaster, and

3) the amount of federal aid that should go to individuals, state, and local governments after a disaster.

Many state and local governments are not as prepared to meet the threat of tornados as they could be. Local elected officials have difficulty determining the costs and benefits of spending public funds on tornado preparedness measures. They often seriously discount the probability that a tornado will impact their jurisdiction.

Doppler radar is a technology that can increase the warning time for those in a tornado’s path. Meteorologists rely on weather radar to provide information on developing storms. The NWS has strategically located Doppler radar equipment across the country. They are able to detect air movement toward or away from the radar. Early detection of increasing rotation aloft within a thunderstorm can allow life-saving warnings to be issued before the tornado forms. However, not all tornados are detectable or trackable on radar, Doppler or otherwise.

The increased use and coverage of Doppler radar by the National Weather Service and other organizations has done much to improve public warning time in advance of tornado strikes. Authorities claim that warnings to communities are now down to 10 minutes in advance of tornado impact. An ironic twist is that better tornado watches and warnings issued by federal agencies and by radio and television news organizations, have inadvertently alleviated some of the burden of emergency notification handled by local governments. If local governments do not maintain adequate tornado warning systems for their people as a consequence of over-dependence on tornado tracking by others, this may be a dereliction of their public responsibility.

Since tornado and severe storm disasters are of such low probability, they have low political salience outside of areas that have been recently hit. Thus, state and local officials have been justifiably weary of allocating funds to better prepare for the possibility of a tornado disaster. Measures that could be taken by local jurisdictions may include siren warning systems, building of permanent structures in the vicinity of mobile home communities, and supplying NOAA radios to residents. Many state and local elected officials have decided to perpetuate inadequate tornado preparedness measures because, in their minds, the risk of a touch down is simply not great enough to warrant doing more.
The NWS reports that on average 80 people are killed by tornados every year in the United States, and $100,000,000 of property damaged is attributed to tornados. Most tornados are classified as WEAK tornados and account for less than 5 percent of all tornado deaths. About 70% of fatalities are from VIOLENT tornados, but only some two percent of all tornados are in this class. The Fujita Scale classifies tornado severity from 0 to 5 with F-5 tornados sometimes packing wind speeds greater than 300 mph.

L. Smith considers both the unlikelihood of a tornado and the cost of adopting measures like warning sirens. In 1980, the civil defense director of Kalamazoo, Mich., estimated that only 17 percent of the city’s residents were within hearing range of city sirens. Despite this, and even though Kalamazoo had earlier that year suffered a tornado that killed five people, the city council opted not to appropriate money for additional sirens (L. Smith, 1991). Yet, many cities in “Tornado Alley” have adopted a network of warning sirens. This is only one means of warning the public however. NOAA radios may be a more suitable warning device for some.

Federal attention has been able to influence some tornado preparedness technology. After a tornado killed many parishioners attending Sunday services in an Alabama church in 1994, Vice-President Gore visited the site of the tragedy. In an expression of sympathy, he publicly lamented the lack of early radio warning. This gesture helped to move forward technological advances which now make it possible for specially designed radios to automatically turn themselves on with the broadcast of an emergency warning signal. Churches and other public facilities around the country are now acquiring these relatively low cost devices which may serve to prevent future tragedies similar to Alabama’s.

The National Weather Service asserts that NOAA WEATHER RADIO is the best way to learn of warnings by its monitoring stations and units. The NWS continuously broadcasts updated weather warnings and forecasts to NOAA Weather Radios which are sold in many stores. The average range is 40 miles, depending on topography. The NWS recommends that people purchase a radio that has both a battery backup and a tone-alert feature which automatically turns the radio on whenever a tornado watch or warning is issued. The American Red Cross has purchased 25,000 NOAA Weather Radios using a foundation grant and the agency is in the process of providing these radios to all of its chapters and facilities nationwide. Distributing these radios and educating the public on radio use and listener response may be
more cost efficient and practical for local and state authorities in order to better protect their constituents from disaster.

Defining tornado damage as a "disaster" in official terms is often controversial and an object of political dispute. Congress tends to establish and re-establish federal disaster policy in response to statistically rare major natural catastrophes. In 1960, 1965, 1969, 1970, and 1974, Congress revised and expanded federal disaster policy specifically in response to major natural catastrophes. In doing so, Congress may have inadvertently made it possible for any community, even slightly affected by a tornado or weather event, to claim that it had been struck by a "major" disaster.

What may be defined as a disaster has ramifications at the state and local levels in the way that these elected government officials handle tornado disasters. Smith remarks that the trivialization of what constitutes a disaster has several important policy consequences (L. Smith, 1991, pp. 122-123).

1. Because a presidential declaration of a major disaster will bring about a major transfer of money, goods, and services that might otherwise have to be supplied by state and local politicians, communities and state governments are encouraged to highlight their losses and underestimate their resources. [Though federal agencies often participate in damage assessment and so may determine the veracity of claims made.]

2. The large number of disaster declarations has placed tremendous pressure on the disaster relief funds available, prompting FEMA to reduce its contribution to repair the infrastructure of state and local governments. This in turn, has angered many state and local leaders who complain that they are not receiving their "fair share" of federal aid funds.

3. The expanded definition of what constitutes a disaster undermines federal efforts to encourage state and local governments to adopt mitigation and preparedness plans, because it is assumed that federal relief aid may be used to rebuild or even improve communities struck by a tornado.

Other factors also play a part in determining the justification for a presidential declaration of major disaster or emergency. One such factor is the amount of insured and uninsured losses. If
a locality devastated by a tornado has a large portion of uninsured losses, federal and state help may be proven necessary. Correspondingly, a community whose tornado losses may be replaced or recovered through private insurance has less justification in proving declaration deservedness. For example, after a summer 1997 F-5 (maximum strength) tornado devastated Jarrell, Texas, the governor applied for a presidential declaration of major disaster but his request was turned down. Apparently, disaster management officials determined that 77 percent of the homes that were destroyed were fully insured, and this may have been the basis for the rejected request (From Dr. Rocky Lopes, Community Disaster Education, American Red Cross, 7-29-97 internet communication).

The media's portrayal of a tornado's impact on a region may also have a political influence on recovery efforts.

At the time of this writing, the NWS reported that WEAK TORNADOS accounted for some 69% of all tornados and less than 5% of tornado deaths. They last approximately 1 to 10+ minutes and have winds of less than 110 mph. STRONG TORNADOS accounted for about 29% of all tornados and nearly 30% of all tornado deaths. These may last 20 minutes or longer and have winds of 110-205 mph. VIOLENT TORNADOS accounted for only 2% of all tornados, but 70% of all tornado deaths. They may last over 1 hour and produce winds greater than 205 mph.

Critical issues in tornado disaster include effective forecasting, credible announcements of tornado watch and tornado warning, tracking the general path of sighted tornados, public evacuation in advance of tornado hazard, appropriate sheltering of evacuees, de-mobilization, emergency response to damaged areas, search and rescue operations, emergency medical services, utility repair, business and residential insurance against wind and rain damage, disaster relief from public sources, and long-term recovery efforts (endnote 2).
Chapter 6
Earthquakes

This chapter explains the basis of U.S. earthquake policy, and California’s impact on national policy. It considers some of the issues which surround both the Northridge earthquake of 1995 and the Loma Prieta quake in 1989. This chapter also examines some of the barriers faced in implementing earthquake mitigation and preparedness policies.

Earthquakes, like other disasters, sometimes overwhelm the emergency response and recovery capacity of individuals, businesses, and state and local governments. The human and economic loss inflicted by an earthquake and its consequences may be so great that tremendous help must be provided by people, businesses and governments outside the damage zone. This being the case, the problem of earthquake threat and destruction has been manifested in national policy and federal law. The federal government is expected to step in to provide basic humanitarian aid to the devastated areas.

CATASTROPHIC EARTHQUAKE is a seismic event or series of events causing great numbers of deaths and injuries, extensive damage, or overwhelming demand on state and local response resources and mechanisms. It has a severe impact on national security facilities and the infrastructures that sustain them. It also has a severe long-term effect on general economic activity. It also inhibits state, local, and private sector initiatives to begin and sustain initial response activities.

Many existing federal programs in place to serve purposes unrelated to disaster, have emergency provisions and disaster response capabilities that can be marshaled and coordinated to address earthquake aftermath. Also, the president can independently issue a major disaster declaration or can grant a declaration once a governor petitions for one. Clearly, earthquakes are a legitimate public policy problem in the U.S., but there remains tremendous variability in levels of earthquake mitigation and preparedness across the nation.

No American state is more prone to earthquake activity than California. That state is also the nation’s most heavily populated and it is a coastal state with a very long coastline. The state’s earthquake politics and policies have been carried forward in national earthquake policy. The state has a U.S. House of Representatives delegation numbering fifty-two, more than twelve
percent of the chamber. The state has enough political clout to influence national policy. As the nation's most populous state, it is often a trend-setter for the nation as a whole.

The U.S. seismic safety constituency is not strong politically or economically. There are vocal and active political and administrative officials who are worried about seismic safety. However, these leaders are scattered thinly in areas that have already experienced earthquake destruction. The general public and their political leaders have paid more attention to seismic safety over the past two decades, although much of this attention has been educational or symbolic.

The Earthquake Hazards Reduction Act of 1977, P.L. 95-124, as amended in 1990 by the National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act, P.L. 101-614, 42 U.S.C. 7701 et seq., provides the framework of national earthquake policy and FEMA is the lead agency charged with coordinating that program. Through NEHRP, FEMA works with other federal agencies [U.S. Geological Survey (USGS), National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST)], the states, academia, and the private sector to minimize risk to life and property from future earthquakes. The primary goals are to make structures safer, better inform the public, press for better seismic mitigation. This entails:

- better understanding, characterizing, and predicting seismic hazards.
- improving model building codes and land-use practices.
- learning risk reduction through post-earthquake investigation and analysis.
- developing improved design and construction techniques.
- promoting the dissemination and application of research results.

NEHRP provides for research, planning, and response activities conducted within each of four specified agencies, and project grant programs funded through FEMA, USGS, and NSF. The program is currently funded at about $100 million, of which $50 million goes to USGS, $28 million to NSF, $20.5 million to FEMA and $1.5 million to NIST. FEMA is the lead agency and has about $4 million available annually for project grants (cooperative agreements) that are consistent with the approved work plan of each eligible state. The state matching requirement rises to 50 percent over a four year period and a share of federal-state funding must be used for mitigation activity.
There is a National Earthquake Mitigation Program Office within FEMA’s Mitigation Directorate. This organizational location makes it clear that policy makers assume earthquakes are a natural phenomenon whose effects the government can prepare for and help alleviate. USGS produces earth science data, promotes warning of imminent earthquakes, and supports land-use planning and engineering design as well as emergency preparedness. NSF promotes siting and fundamental geotechnical engineering design, structural analysis (in part through the National Center for Earthquake Engineering Research). NIST and FEMA together work with state and local officials, model-building code groups, architects, engineers and others to be sure that scientific and engineering research flows into building codes, standards, and practices.

Studies conducted after the 1989 Loma Prieta quake in northern California concluded that local officials dealt satisfactorily with the immediate dangers of the earthquake, but were less successful in addressing long-term aspects of the relief effort (assisting residents in filing insurance claims, providing adequate housing, directing supplies to appropriate areas). Some local officials were not familiar with their responsibilities in the event of a disaster, and many did not know the roles of government agencies after disaster. Some local officials used improper channels in requesting assistance and in doing so impeded the functions of the intergovernmental response process (U.S. GAO, Disaster Assistance, 1991). FEMA’s federal coordinating officer for Loma Prieta later said that local officials should have been included in the government’s disaster preparedness and training exercises, which would have given them a better understanding of how the entire emergency response system works.

Analysis

Table 1 discloses that from May 1953 through May 1997 there have been 17 presidential disaster declarations issued for earthquake. Fifteen have gone to coastal states and two to inland states. The same table shows that an astounding $7.675 billion in federal disaster relief (via the President’s Disaster Relief Fund) has flowed to coastal states. As before, dollar figures are in 1994 constant dollars. A paltry $2.6 million in federal relief has gone to inland states experiencing declared quake damage. Table 1-A reports that there was only one turndown for earthquake, and that was a request by Pennsylvania, a coastal state.

FEMA figures reported in June 1997 indicate that the Northridge earthquake (DR 1008)
federal relief stood at $5.6 billion and, since the books are still open in many program categories, that spending will continue to climb. As has been repeated throughout this study, other federal assistance programs outside FEMA and its Presidential Disaster Relief Fund are also added to federal spending totals for this disaster (and others).

Table 2, which depicts maximum declarations by incident type by state, illustrates that for earthquake, California received 8 declarations, Hawaii 3, and Oregon 2 in the interval studied. Alaska, Oregon, Idaho, and Nevada (to name a few) have single declarations for quake.

Table 3-C depicts in pie chart form federal disaster relief spending to coastal states, again in 1994 constant dollars and for the May 1953 through May 1997 interval. Earthquake represents the largest wedge of the pie at 28 percent. Hurricane is 26 percent and flood (primary incident only and excluding the "flood and tornado" category) is 25 percent. Table 4-C removes primary incident forms yielding less than one percent of federal relief spending. When this pie chart is examined, earthquake stands at 29 percent of federal disaster relief spending (1994 constant dollars) for May 1953 through May 1997.

Table 3-C-90 employs the same format to demonstrate federal disaster relief shares from January 1990 through May 1997. For seven and a half years of the 1990s, federal relief in 1994 constant dollars weighs in at 38 percent of all federal relief in the accounts studied. The Northridge earthquake, to date the federal government’s most costly disaster [Hurricane Andrew is arguably more costly if public and private disaster spending is combined and comparison made], skews the earthquake cost data.

Table 3-I reports that inland state federal disaster relief for earthquake is less than 1 percent of the pie chart. The same finding is apparent in Table 3-I-90 for the January 1990 through May 1997 interval. According to Table 5-I-1, Idaho and Nevada are the only inland states to have won declarations for earthquake.

Before ending our review of earthquake disaster analytic findings it is important to inspect Tables 6 and 6-A. The Northridge earthquake struck in mid-January 1994. This disaster helped create a mammoth spike in federal disaster relief spending for the 1994 through 1996. If total annual federal disaster relief (1994 constant dollar) spending is divided by the number of declarations issued respectively by year, as is done in Table 6-A, it is again obvious that
Northridge contributed mightily to the spike in spending from 1994 through 1996. Long-term pay-out of federal disaster relief for infrastructure and building replacement/renovation will continue to add to federal disaster spending totals years into the future.

Literature Analysis

Klebs & Sylves examined the Northridge earthquake providing a grassroots view of one FEMA inspector’s experiences. Klebs’ account illustrates the process by which FEMA conducts large scale recovery operations and they describe the human side of demanding and stressful disaster work. His work ascertained applicant eligibility for help under programs like EMERGENCY MINIMAL REPAIRS and INDIVIDUAL ASSISTANCE. Among the article’s recurring themes are controversies surrounding homeowner earthquake insurance coverage, ascertaining fraud, the need to be fair and yet compassionate, use of automated palm-top computing technology to conduct paperless inspections, use of geographical information systems, and the indomitable spirit of most earthquake survivors.

The way in which federal, state and local governments address earthquake policy before a seismic event, can make a difference in the magnitude of need after an event. Moreover, when one level of government does not mitigate earthquake hazards, this has consequences for other governments. California, among other states, has the ability to push for strong federal disaster relief policies. Information exchange about the problem of earthquake mitigation, as well as selected demonstration projects funded by joint federal-state arrangements, would go far in getting earthquake reinforcement on the policy agendas of each level of government.

City administrators and public officials in California often face legal and political quandaries in the aftermath of an earthquake. California’s local governments do not enjoy SOVEREIGN IMMUNITY and may be sued for mistakes they are proven to have made which cause harm, injury, private loss or commercial loss. For example, after the Coalinga earthquake, the state Seismic Safety Commission determined that Coalinga had weak, poorly enforced, building codes and lax building inspection. In turn, insurance companies sued some communities through SUBROGATION SUITS. Subrogation suits are filed by insurance firms against city governments, when those governments are demonstrated to have been negligent in fire and building code enforcement. The insurance firms seek cost recovery for claims paid out to private
property owners whose structures did not meet fire and building codes and which experience
damage during the quake (Settle, 1988, p. 257).

NEGIGENCE and PUBLIC DUTY DOCTRINE issues may also be a factor. In Coalinga, property owners filed class action suits against the city. Some property owners argued that their right to due process was violated when municipal authorities demolished their structures in the aftermath of the quake. In other words, had they been allowed a hearing before the demolition, they may have been able to prove to municipal officials that their structure was repairable. Some claims involved INVERSE CONDEMNATION (taking property from the rightful owner without just compensation).

Courts have ruled that state and local governments must sometimes pay landowners damages for zoning and other land use restrictions that reduce property value. However, state and local governments are sometimes liable if they did not stop certain development which takes place in hazardous zones, on the grounds that public authorities should have recognized the consequences of condoning such development (i.e., public duty doctrine). So in the first instance public officials are reluctant to promote disaster mitigation zoning because it opens them to claims alleging reduced property value. Yet, in the second instance, public officials are subject to lawsuits alleging that they should have curtailed development given their knowledge of a hazardous risk.

Since people tend to discount the risk and probability of earthquakes; earthquake mitigation has LOW POLITICAL SALIENCE in normal times. The structural alternatives in mitigation are often either demolition or reconstruction of existing structures, both of which are expensive and controversial.

Alesch and Petak provide an overview of the political history of earthquake mitigation in Long Beach and southern California in general. Their study depicts the political ebb and flow of quake mitigation and, explains the affect of counter forces like historic preservation, landlord resistance, and the opposition of retirees living on fixed incomes.

The article recounts the effects of the Long Beach earthquake on March 10, 1933. The disaster was responsible for 120 deaths and extensive building damage. Since half of the damaged buildings were of unreinforced masonry construction, a political movement for tougher building codes was launched in the quake’s aftermath.
Since Long Beach's building codes could not be enforced retroactively, it was difficult to compel owners of existing structures to reinforce or rebuild their buildings. Long Beach City Council was able to require building fronts to be reinforced in 1950, on the pretense of protecting the public from their collapse. The next step came in 1959, when the council defined earthquakes as nuisances. This empowered local building officials to condemn earthquake hazardous buildings and force property owners to strengthen or demolish their structures.

A 1966 state court ruling for Bakersfield, CA, which imposed similar laws, determined that California cities were authorized to use public nuisance laws to condemn unsafe buildings vulnerable to earthquakes.

In a backlash response in 1969, local property owners launched organized opposition to nuisance laws based on the PUBLIC TAKINGS clause. In response, the Long Beach City Council's legal counsel recommended adoption of a uniform building code. The council resisted until after the San Fernando Valley quake in February 1971, which killed 60 people and caused the collapse of an immense number of unreinforced structures.

Many retirees, often with low incomes, also protested. Generally speaking this socio-economic group tends to oppose mandatory building codes which force landlords to undertake expensive earthquake retrofits of their rental properties. These people fear that their landlords will raise their rents and some surmise that they will have passed away long before the feared catastrophic earthquake strikes their residence. Another source of opposition often comes from historic preservationists. In particular, many preservationists in the Los Angeles area vehemently protested proposed demolition of seismically vulnerable old movie theaters.

It is important to know who the stakeholders are in political controversies involving seismic mitigation. For example, developers, preservationists, low income retirees, and existing property owners proved to be formidable opponents of seismic mitigation in Long Beach, while advocates of mitigation in government and the insurance industry possessed relatively limited power, except after major earthquakes. The use of building codes to require reinforced structures in earthquake prone areas represents a public good since they reduce the extent of structural damage and help to save lives.

Earthquake response and recovery may be excessively difficult for a locality to manage. In
the wake of immense costs and lack of necessary support systems, mayors may petition a state governor for a state disaster declaration. The governor in turn can petition the president for a presidential disaster declaration to alleviate the financial burden of earthquake recovery.

Earthquakes of even moderate magnitude have triggered presidential disaster declarations. As mentioned above, in 1983, Coalinga, Calif., experienced a moderate quake which caused extensive property damage but no loss of life. Owing to national media attention, the mayor of Coalinga was successful in convincing Governor Deukmejian and, in turn, President Reagan to grant Coalinga a state and presidential disaster declaration respectively. Settle’s case study of "The Coalinga Earthquake" documents how the quake devastated downtown businesses and how the mayor of Coalinga skillfully used the media and his political influence to secure very substantial disaster relief aid from the federal and state government, which was then used to refashion and rebuild the downtown into a shopping plaza.

Another example of post-quake disaster rebuilding expense, which also spawned political controversy, stemmed from the costs of rebuilding Los Angeles area hospitals during the recovery from the Northridge temblor. FEMA contributes to disaster recovery costs, especially for improving health and safety facilities. In March 1996, FEMA announced that it would provide nearly $1 billion in federal funds in a new mitigation approach to strengthen the structural integrity of four local hospitals damaged by the Northridge earthquake. This decision was made after a heated dispute between FEMA officials and California officials. Initially FEMA complained that California’s post-quake building code changes, applied to public structures but waived for private structures, forced the rebuilding of many hospitals under the 90/10 federal/state share in effect for damage caused by the quake. FEMA originally argued that most of the hospitals did not need as much rebuilding as the new codes required. However, facing strong political opposition from top state officials and the embarrassment of opposing an albeit expensive mitigation effort, FEMA reversed itself and agreed to the extremely expensive hospital rebuilding effort.

Below is FEMA’s announcement on the matter. "Through its seismic hazard mitigation for hospitals effort, FEMA offered more than $831 million to Cedars Sinai Hospital, St. John’s Medical Center, Los Angeles County-USC Medical Center, and UCLA Center for Health Sciences." These hospitals will receive more than $947 million for the repair or replacement of
damaged facilities through a cost-share agreement between FEMA, the state of California and other local contributors.

FEMA Director James Lee Witt remarked that, "through comprehensive consultation with the state and the hospitals, FEMA provided the most cost-effective funding package that would ensure that these buildings will be able to operate after another major earthquake. This new mitigation effort is providing the means to repair or replace damaged buildings. More importantly, these funds will enable hospitals to build their facilities to stronger structural standards to withstand future earthquakes." By improving area hospital performance, the need to evacuate patients might be avoided and post-disaster operations would be improved since these facilities would serve victims when they need assistance most (FEMA, March 12, 1996 internet release).
Chapter 7
Structural Collapse and Failures

Structural collapse issues are extremely relevant in any study of coastal state disasters. Often the forces of nature are made more devastating by the failures of humans.

Structural collapse and functional failures seem to be on the rise in the U.S. They are attributable to such varying events as natural disasters, design and/or construction flaws, and even terrorist bombings (such as at the New York World Trade Center). Structural collapse and functional failures are addressed primarily by mitigation measures, and to a lesser extent by preparedness, rather than by response and recovery actions. The key levels of government involved are state and local rather than national. Important mitigation measures aimed at preventing structural failures are building codes and regulations, zoning laws, and land-use decisions. This section looks at the emergence of structural collapse as a matter of disaster policy. In doing so it focuses on examples of structural collapse and on the barriers to effective technical capability, problems of administrative resources, and the counter-pressures of economic growth and development.

Effective design, regulation, inspection, and enforcement combine to prevent disasters, but do not garner much positive publicity or political credit when collapses or failures DO NOT occur. They are simply taken for granted. When a structural collapse does occur, however, government regulation and the private construction industry are held accountable.

Effective disaster policy requires formal state and local action which identifies problem areas and addresses them to mitigate future disasters. Indeed, it is a critical component to successful emergency management. Despite that logic, an American aversion to regulations which constrain what owners can do with their property and strong pressures to "trade off long-term mitigation benefits against short-term recovery needs," make it difficult to find support for programs and policies that reduce risks. While much is known about hazard reduction and more is being learned after each disaster, there are serious questions about the willingness of communities to commit resources and to support regulatory programs to reduce risks to lives and property posed by structural collapse.

The establishment of building standards serves as an excellent example of this. Building
standards and codes serve as one of the oldest forms of government-mandated disaster mitigation. They have been implemented from a lessons-learned perspective in which structural and functional problems have taught people painful lessons over the centuries. Nevertheless, communities in the U.S. have generally been found to lack effective regulation and enforcement of building codes (although this is more true in certain areas of the U.S. than in others). As a consequence, there have been a few major structural failures and many minor failures in the United States. Natural disasters have also been more damaging than they might have been owing in part to the lack of effective standards and enforcement. In other words, the inadequacy of regulation and enforcement has cost thousands of human lives and billions of dollars in property losses.

Structural failures occur when a structure loses its ability to perform its intended functions because of lack of maintenance, design or construction errors, a natural disaster, or even terrorist activity. Regardless of the cause, it is important to differentiate between two types of structural failures: structural collapse and functional failures.

FUNCTIONAL FAILURES occur when a structure does not collapse but lacks the capacity to perform one or more of its intended functions. Plumbing, sanitation, heating, and electrical problems represent just a few examples. Functional failures do not normally constitute a danger to human life and are amenable to correction. A STRUCTURAL COLLAPSE, on the other hand, occurs when part or all of a structure comes apart or undergoes large and permanent deformation. As a result, it loses all capacity to perform intended functions. Although there are many more functional failures than collapses, the latter are more dramatic and receive greater media coverage because they usually involve death and injury.

Structural policies to avert structural collapses and functional failures have not been crisis-reactive. Most structural policies, in fact, are intended to provide an engineered REDUCTION IN RISK, even if they involve greater economic costs than monetary benefits. Moreover, most of these policies are quite rational taking into account many technical, social, administrative, political, legal, and economic factors. Also important is that while the federal government is involved, structural mitigation and preparedness procedures are implemented at the state and local level via building codes and zoning ordinances.
A BUILDING CODE is a series of standards and specifications designed to establish minimum safeguards in the erection, renovation, and construction of buildings. These safeguards are intended to protect persons who live and work in buildings from hazards and to constitute regulations to further protect the public’s health and welfare. Building codes usually deal with standards for building plumbing, electrical, heating, safety, sanitation, lighting, ventilation, fire prevention, etc. The primary reason for their enactment by cities and counties is for PUBLIC SAFETY. Cities and counties either write their own codes or adopt codes suggested by various national associations. Normally, localities adopt some, but not all, of the standards suggested in the model codes.

ZONING ORDINANCES are also closely linked to building codes. While building codes are used as a mitigation mechanism to prevent structural failures, zoning ordinances are used to contain risk. Zoning ordinances deal with the types of buildings that can be built in certain areas. They not only regulate the types of structures that may be built, but they also help control safety considerations, such as the height of buildings in relation to the environment, the size and depth of structural foundations, and an array of other factors dealing with structural safety.

Although efforts to avert structural collapse and functional failure are promoted primarily by the desire for public safety, other factors enter into the issue as well. Another factor which contributes to mitigation is the increasing number of, and monetary claims involved in, LIABILITY LAWSUITS. Fear and concern about liability lawsuits alleging dereliction of public safety obligations, have impelled government and building professionals to be more concerned with structural failure than they might otherwise have been. More to the point, better building safety stems in part from fear of bankruptcy by entities judged liable and by crippling insurance premiums. Owing to the impact recent major disasters have had on insurers, the U.S. insurance industry strongly endorses disaster mitigation efforts, many of which are aimed at structural reinforcement and building safety.

Yet, despite the growing support in favor of mitigation efforts such as building codes and zoning ordinances, analysis reveals that such efforts are inadequate. In effect, current regulation and enforcement mechanisms are not as effective as they could be. This is largely a consequence of opposition to government policies which allegedly restrict personal freedom and or hamper local economic growth and development. In addition, a lack of technical expertise and
administrative resources on local levels also inhibit the effective regulation and enforcement of mitigation mechanisms. Hurricane Hugo (1989) and Hurricane Andrew (1992) are offered as examples of the problems involved in effective mitigation efforts.

**HURRICANE HUGO (1989)**

One study conducted in the aftermath of Hurricane Hugo in 1989 reported that South Carolina had no statewide building code and that local adoption was optional. State law in 1972 had permitted counties, cities, and towns to mandate conformity with the current Standard Building Code and the National Fire Protection Association Standards. Those jurisdictions that adopted the standards were also required to create permanent building departments with at least one administrator. Weak building codes actually made South Carolinians more vulnerable to hurricane devastation.

When Hurricane Hugo struck, however, only about half of the cities and a third of the counties had adopted the Standard Building Code. Moreover, while the 1972 law had created a state agency to oversee and facilitate the adoption of local codes, approve modifications, and hear appeals, the agency had been given no enforcement authority over local codes. The agency's primary role was in designating responsible building officials for state buildings and schools.

There were also concerns about nonconformity with seismic design standards, poor coastal construction techniques, noncompliance with coastal wind standards, and poor design standards for manufactured housing. A 1993 study on building code enforcement found that, while larger cities had building codes, enforcement was usually extremely weak. The study disclosed that, frequently, only one of the local building inspectors had an engineering degree and most were political appointees with little training other than what they received on the job. In addition, building codes were often so newly adopted that few buildings conformed to current standards and the most vulnerable buildings were not yet identified.

In the wake of Hurricane Hugo some communities suspended enforcement of building codes, except in cases of serious structural damage, to speed the repair of needed housing. This was done because the normal administrative issuance of permits and monitoring of construction would have overwhelmed the available staff in South Carolina. In some counties, the licensing of contractors was substituted for inspection of repairs.
The 1993 study also revealed that elected officials and the public remained unconvinced of the need for better disaster mitigation. Investigation of public policy actions in South Carolina concluded that there had been a strong political opposition to mandatory state building codes in the 1980s and that the experience of Hugo did not overcome the funding and political concerns of local officials. As an example, a proposed state mandated building code, absent state funding for code enforcement, failed in the South Carolina Legislature.

HURRICANE ANDREW (1992)

Inquiries after Hurricane Andrew struck south Florida revealed that the region's building codes were among "the toughest in country." Regardless, damage caused after Hurricane Andrew was significant. The problems cited in this case were poor construction, poor building code enforcement, and wind speeds in excess of the expected 120 mph maximum. In addition, manufactured housing (such as trailers and mobile homes) did not meet federal construction standards, often failing in winds as low as 80 mph despite a standard of 110 mph.

Retrofitting, better siting, and other mitigation actions were recommended to reduce vulnerability to future disasters. As Dr. Robert Sheets, Director of the National Hurricane Center, pointed out in a 1994 conference, the larger problem was the style of many of the homes. Many were two- or three-story, wood-framed homes inappropriate for south Florida. Large cathedral ceilings, double doors opening inward rather than outward, and other design choices offered little resistance to wind and were particularly vulnerable to heavy wind gusts.

The Hurricane Andrew experience also offered a painful lesson concerning mobile homes. As many as 18,000 mobile homes were damaged or destroyed in south Florida and Louisiana during the Hurricane. Clearly one of the problems was that some mobile homes were only required to hold up under 80 mph winds and Andrew's winds were in excess of 160 mph. As a result, new federal standards were adopted in 1994 requiring that new mobile homes sold in Hawaii and 25 counties on the coast of Alaska, Louisiana, Florida, and North Carolina (hazard-prone areas) be built to withstand 110 mph winds. U.S. Housing and Urban Development officials estimate that the cost of this measure will raise the costs of mobile homes. They estimate that the 110 mph standard will increase prices $1,200 to $1,500. If the additional cost to manufacturers is passed on to consumers, the 110 mph standard may raise prices anywhere from $5,500 to $6,000.
Another frequently noted point that is made concerns the importance of building codes. Building codes are crucial to developing effective mitigation strategies: they need to be technically sound and properly enforced. Perhaps more telling is the perceived need to conduct research on how to overcome public official and public opinion resistance to mitigation programs. The National Research Council concluded that: "Building codes should be a central part of a mitigation strategy for new construction. Barriers to the adoption and enforcement of modern codes should be identified and strategies developed that include incentives and other mechanisms to overcome community and industry resistance."

The National Research Council also advocated that:

1. The federal government and professional organizations assume responsibility for providing financial and technical assistance to local and state authorities;

2. Land-use planning (zoning ordinances) be emphasized to assure that building is effectively regulated in hazard-prone areas;

3. All government financed or insured structures be required to conform to appropriate codes;

4. Mitigation training be supported by the federal government;

5. Hazard-specific research be directed to developing new mitigation strategies to strengthen existing buildings and to make new buildings safer; and

6. More and better information be provided to communities and businesses to encourage support for mitigation measures.

The issue of building codes is getting more and more attention in the face of mounting disaster losses. Hurricane Andrew alone represented more than $15.4 billion in losses to the insurance industry, with much of the loss due to property damage that could have been mitigated if building codes in south Florida had been adequately enforced. There is also considerable interest in enacting more effective building codes to further reduce damage due to disaster.

In addition to concerns for general public safety, there has been a clear indication that the
insurance industry is also interested in reducing exposure and liability, or at least defining it accurately. Some companies stopped issuing residential property insurance in south Florida following Hurricane Andrew, suggesting their considerable concern about exposure and liability. In short, insurance companies want to know about the appropriateness of building codes and the effectiveness of their enforcement. Some insurance companies may threaten to discontinue selling insurance if they are not allowed to charge premiums sufficiently large enough to cover the risks they incur. There will always be, however, some firms willing to issue policies despite the risk of failure in major disasters. Catastrophic events, such as Hurricane Andrew, can force some companies into bankruptcy and leave policyholders without coverage for their losses. This would entail greater personal and governmental liability.

Despite these concerns of public safety, and liability/exposure, strong barriers still confront the enactment and enforcement of effective building codes and zoning ordinances. These barriers involve technical, administrative, economic, and political factors that hamper mitigation efforts.

BARRIERS TO MITIGATION MECHANISMS

Henry Quarantelli points out in the U.S. Report on the International Decade for Natural Hazard Reduction (1994), that "the stringency of building codes, zoning ordinances, and other hazard abatement regulations also appears to depend more on economic and political pressures that on technical standards of community safety." The problem is how to provide local officials with state and federal fiscal and technical resources and, at the same time, encourage local action to reduce hazards.

Two of the problems involved in enacting and enforcing proper building codes is TECHNICAL CAPABILITIES and ADMINISTRATIVE RESOURCES. From a technical and administrative standpoint, it is important to recall that building codes are enforced and administered on a local level. Many localities lack the financial means necessary to employ a sufficient number of technically-trained inspectors and administrators. Some local governments have the financial means but do not choose to adequately fund and implement this public responsibility. Inspectors and administrators are often low-skilled and low-paid employees who are over-worked and under-trained. In addition, those positions are often filled by political
appointees who have no experience other than what they get on the job. In both hurricanes investigated, a lack of technical capabilities and administrative resources clearly hampered the effectiveness of building codes.

Although in some measure it is a question of administrative and fiscal capacity, it is also a question of political capacity. The South Carolina case demonstrated that there are strong state and local interests who oppose codes, regulations, and plans that might raise the costs of doing business, increase taxes, or limit use of private property. Such examples address the important political factors of PERSONAL FREEDOM and ECONOMIC GROWTH AND DEVELOPMENT.

Since building codes and zoning ordinances are issues of local government jurisdiction, they are greatly influenced by local officials, local interests and local needs. Most prominent of these are personal freedom and economic growth/development. The issue of PERSONAL FREEDOM is largely tied in with PUBLIC OPINION and PRIVATE PROPERTY. Building code and zoning ordinance efforts are tempered by traditional American opposition and resistance towards national planning and regulation. The American public does not want the government telling them what they can or cannot do with their property. Often the public sees these measures less as preventive efforts to reduce the impacts of disasters and more as government intrusions and restrictions on personal freedom.

Perhaps the most powerful barrier, however, is the interest of economic growth and development. Economic growth and development imposes a number of pressures on builders and developers (holding down costs by cutting corners, finishing work on time, designing for the convenience and aesthetics of the building’s ultimate users, etc.). Moreover, elected officials and even zoning and building officials, are also pressured by the need for economic development and augmented tax bases in their jurisdictions. The situation is then one in which elected local officials bear the burden of regulating building codes and zoning ordinances among the same groups that provide them with votes, campaign contributions, economic development and local employment. In this manner, economic growth and development pressures and interests hamper the enactment and enforcement of building codes.

Though events such as Hurricane Hugo and Hurricane Andrew have brought the issue of
standards and enforcement to public attention, it is still uncertain whether that lesson has been 
learned in the U.S. As mentioned, powerful barriers remain in the path to enacting and enforcing 
building codes and zoning ordinances, especially at the local level. In that regard, state action 
and possibly even federal intervention to mandate and standardize building codes would appear 
easier than local action. Moreover, with some fiscal support from the federal and state 
governments, at least some of the problems in enforcing and administering could be overcome as 
well. Whether more fiscal inducements would help public officials overcome the political 
opposition of those who would trade improved community safety for economic growth and 
development, is another issue entirely.

A relatively comprehensive approach to disaster mitigation through building codes might 
include the following actions:

1. Increasing the effectiveness of building standards through the National Flood Insurance 
   Program and for seismic risk areas through a national earthquake insurance program:

2. Encouraging the adoption of appropriate state and local building codes in all communities, 
   regardless of the risk of flooding or earthquake;

3. Encouraging a broadening of the emergency management role in local and state 
   governments to include assistance to public works, building, and other departments with 
   responsibilities for hazard mitigation; and

4. Increasing the capacities of state and local offices to enforce building codes, including the 
   capacities to assess the code compliance of exotic designs, new technologies, and new materials.

There are a great many manmade structures besides buildings which may be subject to 
collapse. For example, bridges, though subject more to functional than structural collapse, pose 
a serious problem for the U.S. (50 percent of U.S. bridges 20 feet or longer are in need of 
repair.) Dams and roads are other examples of manmade structures that are prone to structural 
collapse and functional failure.
Chapter 8
Conclusion

This research chronicled the increasing number of disasters and emergencies in coastal zone states, confirmed the dramatic increase in the costs of disasters, provided coastal state officials with a 44 year record of their (and other) state’s experience with disaster, and surveyed within the format of presidential disaster declarations the disaster experience of coastal states and to a limited degree their counties. U.S. commonwealth and trust territories were included in the study. This will add to our knowledge of insular disasters and emergencies.

Unfortunately the study could not take into account human and environmental impacts of disaster loss, the significance of duration of incident period and the closing date for disaster assistance programs on each event, and could only offer a modest long-term overview of disaster experience both at state and county levels in coastal zone jurisdictions.

Hypotheses which were tested include:

1. Coastal zone states receive disproportionately more presidential disaster declarations (all types) than non-coastal states, with control for population and land area.

To test this with control for population it is necessary that territorial island states be omitted. This is because the relatively small populations combined with huge hurricane or typhoon federal disaster assistance skew the findings. In other words, the island jurisdictions (with exception of Hawaii) are small area, densely populated jurisdictions which produce mammoth per capita federal relief totals. Hawaiian and territorial inhabitants are often unable to evacuate before a typhoon or hurricane makes landfall. They must shelter in place or find public shelters.

It is also important to restrict analysis to the decade of the 1990s, using the 1990 Census and only January 1990 to May 1997 cases. The per capita average for coastal states and Hawaii, excluding territories, is $52.40 as tabulated from Table 7. The same figure for inland states is $52. Thus, the hypothesis is not confirmed in per capita figures if territories are excluded. Ironically, if territories are included in the coastal state group, the coastal per capita average is $331, which is far more than inland’s $52 per capita average and in this condition the hypothesis is confirmed.
However, if total federal relief (1994 constant dollars) is considered on a spending per square mile basis, there are $184,831 per square mile spent in coastal states and territories to only $5,497 spent for inland states. On this scale coastal states do overwhelmingly better than do inland states.

Federal spending for each coastal jurisdiction divided by each jurisdiction’s population density yields a grand average of $4,742,452 for coastal states. The same measure for inland states is $3,385,348. This suggests that on this scale coastal states are still collecting relatively more federal constant dollar disaster aid than are inland states, but the gap is smaller between the two.

It is interesting to consider extreme states in Tables 7 and 7-A. Hawaii tops all per capita federal constant dollar disaster relief for January 1990 to May 1997 with $252. The next highest coastal state is California with $226 and Florida rings in with $163 after that. For inland states, North Dakota tops all per capita federal constant dollar disaster relief for the same interval with $184, owing largely to the Red River flood disaster of 1997. South Dakota follows with $143 and Iowa with $114, also due to major flooding in the 1990s.

2. Coastal zone states receive disproportionately more presidential disaster declarations for major disaster (first) and emergencies (second) than non-coastal states, with control for population and land area.

Since emergencies are only about 10 percent of the pool of declarations, it made little sense to differentiate between emergencies and major disasters in the declarations. It is important to consider total number of declarations coastal vs. inland.

With 261 declarations in the period of the 1990s (1/90-6/97), the 39 coastal jurisdictions averaged 6.7 declarations. With 98 declarations in the same period, the 21 inland jurisdictions average only 4.7. On this narrow range, coastal states do better than inland states.

Table 8 indicates that total U.S. land area is about 3.8 million square miles. Inland states including District of Columbia cover 1,497,369 square miles. Coastal jurisdictions occupy 2,295,206 square miles. Dividing the 261 declarations of coastal states into coastal state land area yields 1 declaration for every 8793 square miles parcel. Correspondingly, for inland states
and their 98 declarations for the 1990-6/97 period, if 98 is divided into inland total land area the outcome is 1 declaration for every 15,279 square mile parcel. Awkward as this may seem, it does stand as evidence that coastal states receive more declarations per square mile than do inland states. This is true even if territories are excluded.

3. Coastal zone states receive disproportionately more federal disaster relief assistance than non-coastal states, with control for population first, land area second, and both population and land area third.

This was discussed above, but bears repeating. For the interval 1/90-6/97 coastal state per capita federal disaster relief is a little over $52, if territories are excluded. Inland state per capita federal relief in the same units is also $52, so no bias exists either way. However, the incorporation of territorial disaster relief skews per capita relief to $331, thus confirming the hypothesis under these conditions.

For the interval 1/90-6/97, coastal states received $184,831 of federal relief (1994 constant dollars) p/sq mile while inland states secured only $5497 p/sq mile. The hypothesis seems confirmed on the land area score.

For the same interval, coastal states in terms of population density divided into federal relief dollars per jurisdiction summed and averaged yields $4.7 million. The same for inland jurisdictions yields $3.3 million. This shows a measureable bias but smaller gap than for land area.

4. Coastal zone states experience more flood disasters which earn presidential declarations than do non-coastal states, when controlling for population and population rank and when controlling for land area.

Table 1 shows that coastal jurisdictions (including territories) won 368 declarations for primary incident flood. Inland jurisdictions won 260 in the same category. About 58.6% of all flood declarations went to coastal jurisdictions, when coastal state jurisdictions are 3/5ths (60%) of all states and when coastal states and territories comprise 65% of all U.S. states and territories. On straight proportions, coastal states do NOT win a disproportionate number of primary incident flood declarations. It is clear that this could not be true even with control for population
since coastal states hold only about 40 million people, or about 16% of the 1990 U.S. population. Population rank and flood declarations are uncorrelated and running opposite the hypothesis.

5. For coastal zone states as a group, ocean shoreline counties are more likely to be included as disaster declared counties in presidential declarations than are inland or estuarine counties in the same state, with control for county population and county land area.

Based on ArcView map reading this would only appear valid for California, the Gulf Coast and the southeastern Atlantic only to Virginia. Control for county population and area was beyond the capacity of this project, though mapping would suggest that even were these controls added, coastal counties would NOT (except in the regions mentioned above) stand out as more declaration prone.

6. A greater percentage of gubernatorial requests for presidential declarations will be approved for coastal states, than for non-coastal states, with control for population and land area. The assumption is that coastal states, owing to greater disaster experience, are better able to fashion and expeditiously file declaration requests than are relatively less disaster experienced non-coastal states.

With 444 turndowns (Table 5-C-2) for 31 jurisdictions (TT assumed to be imbedded among Pacific trust territories), rejection average is 11.3 for coastal jurisdictions. For the 21 inland jurisdictions there were 198 turndowns in the same interval. This averages to 9.4 per jurisdiction. This refutes the hypothesis posed. Let's take out territories and the District of Columbia and ask the same question. Inland states then total 20 and experience 197 rejections yielding 9.85 rejection average for inland jurisdictions. Coastal states then total 30 and turndowns drop to 428. By dividing coastal states into coastal state turndowns it is obvious that there is a 14.26 rejection average for coastal jurisdictions. So again, coastal states are not blessed with lower turndown rates but rather with higher turndown rates. Little is gained in controlling for population or land area since the hypothesis is unconfirmed regardless.

7. Coastal states are more likely than non-coastal states to receive a disproportionate share of federal infrastructure (Public Assistance) repair and replacement funds, with control for population and land area differences, owing to greater infrastructure-damaging disaster experience in coastal states. The same hypothesis may be tested for coastal state counties based on format of hypothesis #5 above.
This proposition was impossible to test because the vast majority of disaster declarations include both Public Assistance (PA) and Individual Assistance (IA). The pool of PA only declarations was too small to permit generalizability or coastal vs inland comparisons.

8. Coastal states are more likely than non-coastal states to experience a greater variety of different types of disaster incidents, with control for population and land area differences.

This hypothesis appears quite valid given the findings of the data. Each region's state primary incident pie chart analysis seems to confirm that coastal states experience a wider variety of disasters than do inland states. Some of this is because coastal states are generally more vulnerable to hurricanes than are inland states. Moreover, the category "coastal storm" primary incident can only be held by coastal states (as no coastal storm requests have ever been approved for inland states, despite two requests). This artificially adds another category for coastal states augmenting the variety of disaster types they are likely to experience.

However, there are many legitimate reasons why coastal states experience a wider variety of disaster incident types than do inland states. Weather extremes along coastlines and along the shores of the Great Lakes produce an array of hazard threats. Lake effect snow in Michigan, Ohio, western Pennsylvania and western New York has been the source of many snow emergencies. The combination of relatively high population densities, urbanized settlement, industrial concentration, elaborate and complex infrastructure development, all compounded by immense development along coastlines, has exposed more people and property to disaster threat in coastal states.

9. Per capita federal disaster relief assistance is greater for coastal states than non-coastal states, with control for population and land area, owing to relatively greater disaster devastation and frequency in coastal states.

This was discussed twice above. However, coastal states AND territories DO receive more per capita federal disaster relief than do inland states. Clearly coastal jurisdictions do experience more declarable disasters but they also contain dense populations, especially in the territories. Remember, if territories are omitted, coastal and inland states are almost identical in terms of per capita federal disaster relief, at least for the decade of the 1990s.
10. U.S. commonwealth and trust territories are likely to have measurably greater per capita federal disaster relief costs than coastal states first, non-coastal states second, and all 50 states third, owing to greater hurricane and typhoon vulnerability.

This proposition was easily confirmed, though few Americans realize how much they assist U.S. territories and commonwealth partners after major disasters. Most of the trust territories and commonwealth nation’s eligible to receive presidential declarations of major disaster or emergency are extremely land poor and densely populated given their land area. On top of this, Puerto Rico and the U.S. Virgin Islands are often in the paths of Atlantic hurricanes, more so than even the most vulnerable Atlantic and Gulf states. Moreover, typhoons seem to strike the Pacific territories and commonwealths almost bi-annually. American Samoa, Micronesia, the Northern Marianas, the Marshall Islands and the Republic of Palau show huge per capita federal disaster relief, as do Puerto Rico and the U.S. Virgin Islands. Federal disaster relief has become a form of “foreign aid,” justly deserved and generally appreciated by recipients.

11. The longitudinal increase in gubernatorial requests for presidential declarations of all disaster types will be greater for coastal states than for non-coastal states.

Table 6 graphically and convincingly confirms this hypothesis in terms of federal disaster relief spending over time. It is unclear however whether coastal state governors will make disproportionately more requests for presidential disaster declarations than their inland counterparts.

12. Correspondingly, the longitudinal increase in federal disaster relief costs under presidential declarations of all types will be greater for coastal states than for non-coastal states.

It is necessary to consider 11 and 12 together. There has been a measurable "ramp up" in governor requests for presidential declarations of major disaster and emergency, regardless of whether governors are from coastal or inland states. There are several reasons for this. The Stafford Act of 1988 gave the president more latitude in determining what is or is not a disaster. There appears to be a legitimate rise in the number of mega-disasters (major hurricanes, earthquakes, floods, etc.) and a parallel rise in the number of smaller garden variety disasters. Governors and their states are getting better, more professional, and faster at assessing damage and making requests for presidential declarations. State officials have recognized that both the
Bush and Clinton administrations have been more reluctant than either the Carter or Reagan administrations to turn down gubernatorial requests for major disasters or emergencies. An additional force, though one that is difficult to measure, is the impact of high speed television (often real-time) news coverage of disasters or emergencies. In the past many events which would have been only local news are now portrayed as national news by the major networks. This tempts governors to seek declarations for marginal events and it induces presidents to be receptive to those requests, often for political reasons.

The graphs displayed in this report make it clear in almost every case that coastal state federal disaster relief is on the rise and following a steeper curve than inland states are on. However, the rise is not constant every single year owing to variability in disaster frequency from year to year. One remarkable surprise in the findings was that even in the year of the Great Midwest flood of 1993, a calamity impacting more inland than coastal states, coastal states won more federal disaster relief for primary incident flood than did inland states. Admittedly, Illinois, Indiana, Wisconsin and Minnesota (each impacted by the Midwest flood) are classed as coastal states. Yet Iowa, Missouri, Nebraska, Kansas, South Dakota and North Dakota arguably took the brunt of Great Midwest flood devastation.

Application of Results

By understanding and using the disaster record of coastal and insular areas, public officials will have a better appreciation of the need to protect coastal inhabitants, resources, and properties. It will also elucidate policy process information which may help governors and other officials better grasp reasons why disaster declarations may be turned down by the president. Such information may save coastal states from repeating earlier disaster declaration request mistakes and it may demonstrate circumstances in which states and counties affected by disaster agents can expect federal assistance. For example, about thirty disaster requests involve fishing losses. Most are approved, but many have been turned down. My study provides comparative evidence regarding these events and it explores factors influencing approval or turndown decisions. Ultimately, this work will educate coastal area authorities and their residents apprising them of their area's disaster experience and vulnerabilities.

These results will be circulated to coastal zone state governors, environmental managers, and
emergency managers in the National Governors Association, the National Emergency Management Association, the National Coordinating Council on Emergency Management, and the Coastal Conservation Association. Journal publications of the findings of this research will be produced. In mid-August 1998 tabular findings of this research were presented to the Aspen Institute's Global Climate Change Committee, composed largely of NOAA meteorologists and climatologists.