Chapter 1
INTRODUCTION

"An ounce of prevention is worth a pound of cure."

Natural hazards such as floods, hurricanes, tornadoes, and earthquakes can cause billions of dollars in damage when they happen. Much of the expense of this societal loss is borne by the federal government. But does "an ounce of prevention is worth a pound of cure" hold true when the federal government invests in natural hazard mitigation with the objective of reducing or eliminating losses from future natural disasters? To answer this question, the Senate Appropriations Committee, Subcommittee for the Veterans Administration, Department of Housing and Urban Development, and Independent Agencies of the 106th Congress mandated this study (Seante Report 106-161) stating:

> The Committee recognizes that investing in mitigation will yield reductions in future disaster losses, and that mitigation should be strongly promoted. However, an analytical assessment is needed to support the degree to which mitigation activities will result in future "savings." Therefore, the Committee directs FEMA to fund an independent study to assess the future savings from the various types of mitigation activities.

This document, *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, Volume 2 – Supporting Documentation*, describes how the analytical assessment was performed, documents the methods used, and explains the results. Volume 1, Findings, Conclusions, and Recommendations, presents the MMC Board's synthesis of the study results.

1.1 Purpose and Background

The Federal Emergency Management Agency (FEMA) charged the Multihazard Mitigation Council (MMC) of the National Institute of Building Sciences (NIBS) with conduct of the mandated study. The MMC explored possible approaches and issued a report presenting the parameters for the independent assessment (MMC, 2002).

The parameters report called for:

> Two interrelated studies on representative mitigation activities and communities to allow nationwide generalizations regarding future savings from mitigation. One study will involve empirical research on the savings realized through the application of specific mitigation activities in varying risk contexts and will use a nationwide statistically representative sample of commonly used mitigation activities. The other study will involve empirical research on savings realized through mitigation activities carried out in specific community contexts and will use a sample of communities selected deliberately and in a systematic way that will maximize variations in hazards and mitigation measures considered.

In conducting the study, the MMC first issued a request for qualifications, received five responses, requested full proposals from two organizations deemed to have the best

qualifications, and selected the research team organized by the Applied Technology Council to perform the research and analysis work needed for the independent assessment, the results of which are presented in this report. The research team included more than 30 experts in diverse fields including structural engineering, hazard loss estimation, regional economics, environmental economics, geographical information systems, sociology, health, and public policy (Appendix A).

1.2 Federal Mitigation Grant Programs

The Federal Emergency Management Agency (FEMA), the lead agency in providing federal disaster relief, has made natural hazard risk mitigation a primary goal in its efforts to reduce the long-term cost of disasters. During the period studied, FEMA conducted three programs in support of this goal: the post-disaster Hazard Mitigation Grant Program (HMGP) and two pre-disaster programs, Project Impact (PI) and the Flood Mitigation Assistance (FMA) Program. The Hazard Mitigation Grant Program, the oldest and largest of the three programs, was created in 1988 to assist states and communities in implementing long-term hazard mitigation measures following presidentially declared disasters. Between 1993 and 2003, FEMA obligated $3.5 billion for states and communities to invest in a variety of eligible mitigation activities selected as the most beneficial by local officials.

Project Impact was a program funded between fiscal years 1997 and 2001. Unlike the Hazard Mitigation Grant Program, which provides funding after disasters, Project Impact supported the development of pre-disaster mitigation programs. In total, 250 communities in every state and some U.S. territories received $77 million in grants ranging from $60,000 to $1,000,000 per community. The one-time Project Impact grants were considered seed money for building disaster-resistant communities and encouraged government to work in partnership with individuals, businesses, and private and nonprofit organizations to reduce the impact of likely future natural disasters.

The Flood Mitigation Assistance Program was created as part of the *National Flood Insurance Reform Act of 1994* with the specific purpose of reducing or eliminating claims under the National Flood Insurance Program (NFIP). The Flood Mitigation Assistance Program provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program. Annual funding of $20 million from the National Flood Insurance Fund is allocated to states that, in turn, obligate it to communities. Like Project Impact, the Flood Mitigation Assistance Program supports pre-disaster mitigation.

Note that the present study does not estimate the benefits of all FEMA mitigation grant expenditures during the study period. Approximately $200 million in grants were not addressed for any of several reasons but primarily because they did not address one of the three hazards (earthquake, flood, and wind) examined in this study.

1.3 Study Objectives

The objective of the independent study was to quantify the expected benefits of avoided hazard-induced losses and the potential future savings for the three FEMA hazard mitigation programs described above. The study consisted of two major components.

The first component, a benefit-cost analysis of FEMA mitigation grants, estimated the future savings from FEMA mitigation activities based on past FEMA mitigation expenditures. This study component is quantitative and was performed on a statistical sample of FEMA-funded mitigation activities selected from the National Emergency Management Information System (NEMIS) database. The unit of analysis for the benefit-cost analysis of FEMA mitigation grants is the individual FEMA-funded grant.

The second study component, community studies, assessed the future value of mitigation activities through empirical research conducted on savings realized through mitigation activities carried out in community contexts. This study component is both quantitative and qualitative and examines mitigation activities previously funded by FEMA in a purposive sample of communities. The purposive selection procedure considered criteria such as hazard and community size and included a blind draw ─ in other words, communities were not "cherry-picked" or selected because of their mitigation reputation or any other special characteristic. The unit of analysis in the community studies is the individual community.

1.3.1 Benefit-Cost Analysis of FEMA Mitigation Grants

In the benefit-cost analysis of past FEMA mitigation grants, a variety of methods was used to estimate the benefits of a sample of past FEMA-funded grants. Grants for different types of mitigation activities (project and process) and hazards (earthquake, wind, and flood) were selected. This estimate was developed using established principles of benefit-cost analysis as codified by several federal government agencies. These principles were applied to several categories of avoided losses (benefits): property damage, business interruption, casualties, negative societal and environmental impacts, and destruction of historic buildings. These losses were measured in terms of real resources lost to the nation as a whole. The analysis of FEMA mitigation grants also evaluated how various federal tax revenues and transfer payments could potentially be affected by hazard mitigation. The analysis of FEMA mitigation grants was structured to answer three questions:

1. What are the net benefits of hazard mitigation to the nation?
2. Do these benefits vary across types of hazards and mitigation activities?
3. What are the potential savings to the federal treasury from hazard mitigation?

1.3.2 Community Studies

The community studies component assessed the broad benefits from FEMA mitigation activities using empirically collected data from eight purposively selected communities. In addition to FEMA-funded activities, the community studies investigated mitigation activities funded by non-FEMA federal and state agencies that were either associated with and/or independent of FEMA-funded activities. The purpose of this wide focus was to determine the context within which

community hazard mitigation occurs. The community studies investigation was structured to answer the following questions:

1. What is the magnitude of the ratio of the benefits to costs of hazard mitigation activities funded by FEMA when evaluated within a community context?
2. What, if any, additional mitigation activities and benefits were stimulated by FEMA Hazard Mitigation Grant Program, Project Impact, and Flood Mitigation Assistance Program activities?

1.3.3 Types of Mitigation Activities

The study addresses two applications of grant funding referred to herein as project and process mitigation activities. Project activities include physical measures to avoid or reduce damage resulting from disasters. Typically they involve acquiring, elevating, or relocating buildings, lifelines or other structures threatened by floods; strengthening buildings and lifelines to resist earthquake or wind forces; and improving drainage and land conditions (MMC, 2002). Process activities lead to policies, practices, and other activities that reduce risk. These efforts typically focus on assessing hazards, vulnerability, and risk; conducting planning to identify mitigation efforts, policies, and practices and set priorities; educating decision-makers and building constituencies; and facilitating the selection, design, funding, and construction of projects (MMC, 2002).

1.4 Study Characteristics

This study was conducted independent of FEMA. Its assumptions were generally conservative — that is, where uncertainty was high, the parameters and methods chosen were those that produced lower estimates of benefits. Sensitivity analyses were conducted on key variables to determine whether the results are robust. The Multihazard Mitigation Council will maintain all data collected from FEMA regional offices and from FEMA databases for use by researchers who wish to test the results, in accordance with the confidentiality requirements of the Office of Management and Budget's Circular A-130 and the Institutional Review Board at the University of California at Los Angeles.

Independent review of this study was provided by the periodic review and input of an Internal Project Review Team (IPRT), six nationally recognized experts providing independent, broad, consensus-based input to the research team. (A letter of endorsement from the IPRT is included in Appendix A of this report.)

1.5 Organization of Report

This volume, *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, Part 2 – Supporting Documentation*, is organized into seven chapters, including this introduction, plus a series of appendices.

Chapter 2, Principles and Definitions, provides a discussion of guiding principles of this study, an overview of key methodologies that define its scope and depth, and important definitions and

delineations. The discussion lays the foundation for more detailed and complex summaries of the approach this study took to assess the benefits and costs of mitigation activities.

Chapter 3, Data Collection, Processing, and Analysis, introduces the primary datasets for both the benefit-cost analysis of FEMA mitigation grants and the community studies. These datasets are used to establish the costs of all FEMA mitigation activities, to help select the stratified sample for the benefit-cost analysis of FEMA mitigation grants and the communities evaluated in the community studies analysis, and to help support comparative analysis studies of community mitigation.

Chapter 4, Methodology, is critical to understanding the underlying methods used for both the benefit-cost analysis of FEMA mitigation grants and the community studies. In many cases, common methods are employed in both parts of the study, and HAZUS®MH (a loss estimation software) was used when possible. Estimating expected losses, impacts to buildings and infrastructure, and exposed populations from earthquake and hurricane wind used common methodologies. In some cases, the benefit-cost analysis of FEMA mitigation grants involved a more in-depth analysis of benefits by examining a wider range of impacts, especially to the environment and historic structures. At the same time, the community studies offered additional insights into mitigation effectiveness by exploring how FEMA-funded mitigation activities percolate throughout the community in the form of synergistic activities that would not have occurred had it not been for the original FEMA grant.

Chapter 5, Community Studies, contains the results of the community analysis. In total, eight communities were investigated based on the combination of FEMA-funded grants received since the start of the Hazard Mitigation Grant Program in 1988 (e.g., multiple hazard exposure), the hazard levels experienced, size of FEMA-funded grants, population of the community, and the FEMA region in which the community is located. The analysis is both quantitative and qualitative. To the extent possible, benefit-cost ratios were calculated for all "project" and "process" activities in the communities funded by FEMA grants. Project activities include physical measures to avoid or reduce damage resulting from disasters. Typically they involve elevating, acquiring, and/or relocating buildings, lifelines or other structures threatened by floods; strengthening buildings and lifelines to resist earthquake or wind forces; and improving drainage and land conditions (MMC, 2002). Process activities lead to policies, practices, and projects that reduce risk. These efforts typically focus on assessing hazards, vulnerability and risk; conducting planning to identify projects, policies, and practices and set priorities; educating decision-makers, and building constituencies and political will; and facilitating the selection, design, funding, and construction of projects (MMC, 2002). As part of the analysis, synergistic activities were also assessed.[1] Through the use of activity chronologies, variables and factors (e.g., institutionalization) that affect a community's ability to undertake and implement hazard mitigation activities are described.

[1] Synergistic activities are activities or effects that follow or accompany the award of FEMA grants for project mitigation or process mitigation activities, or the strong expectation that a grant would be awarded, that reduce risks (or increase benefits of risk-reduction activities) from floods, earthquakes, and severe winds. The synergistic activities identified were not funded by FEMA.

Chapter 6, Benefit-Cost Analysis of FEMA Mitigation Grants, contains the major findings of the grant analysis. The National Emergency Management Information Systems (NEMIS) database served as the starting point. A detailed summary of FEMA's mitigation activities ─ delineated by hazard, mitigation type, costs, etc., as documented by the NEMIS database ─ is provided. The study used a stratified sample to represent the entire population of mitigation activities funded by FEMA between 1993 and 2003. The major focus of this chapter is the analytical results. Benefit-cost ratios are calculated for six different strata: project activities for wind, flood, and earthquake and process activities for wind, flood and earthquake. In addition to delineating the net benefits of mitigation to society, this chapter also provides insights into impacts (or savings) to the federal treasury.

Chapter 7, Summary, identifies the key findings from the benefit-cost analysis of FEMA mitigation grants and the community studies. It also indicates how FEMA-funded mitigation activities have fared with respect to anticipated benefits and actual mitigation costs. From an analysis of eight communities that have received FEMA hazard mitigation funds, it is clear additional benefits accrue, in large part, as result from FEMA-funded mitigation activities. This chapter attempts to put into perspective the magnitude of these synergistic benefits and the types of linkages with FEMA-funded efforts.

A series of technical appendices contain benefit-cost analysis data collection forms, community studies field research documentation, explanations of the methods used to develop information on cost and benefits, a detailed listing of assumptions and limitations of this study, and other background information. Every attempt has been made to document assumptions, methodologies, and data to permit the reader to fully understand this study and perhaps undertake additional analyses.

A second document, *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, Volume 1 – Findings, Conclusions, and Recommendations* includes a brief overview of the study findings and the MMC Board's conclusions and recommendations based on those findings.