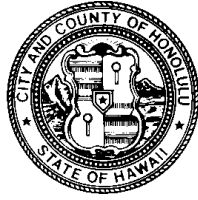


OAHU CIVIL DEFENSE AGENCY
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET HONOLULU, HAWAII 96813



1. Introduction

INTRODUCTION

Since the early 1990s, Federal Emergency Management Agency (FEMA) and the United States Congress have witnessed large increases in disaster response and recovery costs: As a result, they have provided funds to communities, counties, and states to reduce impacts from natural hazards through hazard mitigation. This marked a fundamental shift in policy; rather than placing primary emphasis on response and recovery, FEMA’s focus broadened to incorporate mitigation as the foundation of emergency management. Changes in Federal laws have resulted in pre-disaster mitigation project funding and mitigation planning requirements. Each state and county must have a mitigation plan that identifies steps to reduce the impact from hazards. If the State and Counties do not have approved plans in place and a disaster occurs, they will not be entitled to public assistance and other FEMA funding.

Hazard mitigation is action taken to permanently reduce or eliminate long-term risk to people and their property from the effects of natural hazards. As the direct and indirect costs of disasters continue to rise, it becomes particularly critical that preparing for the onslaught of damage from these events must be done in order to reduce the amount of damage and destruction. The purpose of multi-hazard mitigation is twofold: 1) to protect people and structures from harm and destruction; and 2) to minimize the costs of disaster response and recovery. Hazard mitigation planning is the process that analyzes a community’s risk from natural hazards, coordinates available resources, and implements actions to reduce risks.

Table 1-1

| Costs of Disasters in Hawaiian Islands | | | |
|---|----------------------------|-------------------------|---------------------|
| 1959 - present | | | |
| Date | Disaster | Location | Amount of Damage* |
| 9/10-11/92 | Hurricane Iniki | Kauai, Hawaiian Islands | \$1.6 billion |
| 12/11/87-1/21/88 | Flash Floods | East Oahu | \$35 million |
| 11/23/82 | Hurricane Iwa | Kauai, Oahu | \$239 million |
| 1/7-16/80 | High Surf, Winds, Flooding | Statewide | \$27.6 million |
| 1/8-10/80 | Kona Storm | Maui | \$12.9 million |
| 5/23/60 | Tsunami | Hilo, Hawaii | \$23 million |
| 8/4-6/59 | Hurricane Dot | Kauai, Hawaii, Oahu | \$6 million (Kauai) |
| 4/1946 | Tsunami | Hilo, Hawaii | \$2.6 million |

*dollars given in the year damage occurred

In clarification, there is a difference between disaster preparedness/response planning and mitigation. Both are important and constitute different phases of the disaster cycle. Response planning occurs during the preparedness phase of the disaster cycle, but the activities usually occur after the impact of a natural hazard. Mitigation should be undertaken prior to a disaster occurrence. The focus of mitigation is to reduce the impact of a hazard event on life, property, and the economy. Mitigation activities may enhance and preserve natural resource systems, and these benefits may be felt without the occurrence of a disaster.

The Stafford Act

Hazard Mitigation Planning

44 CFR Part 201, Hazard Mitigation Planning, establishes criteria for State and local hazard mitigation planning authorized by §322 of the Stafford Act, as amended by §104 of the DMA. After November 1, 2003, local governments seeking Pre-Disaster Mitigation (PDM) funds through a State application will have to have an approved local mitigation plan prior to the approval of local mitigation project grants. States will also be required to have an approved Standard State mitigation plan in order to receive PDM funds for State or local mitigation projects after November 1, 2004. The Standard State Mitigation Plan will also be required for non-emergency assistance provided under the Stafford Act, including Public Assistance restoration of damaged facilities and Hazard Mitigation Grant Program funding. Currently, any State with a FEMA-approved Enhanced State mitigation plan at the time of a disaster declaration is eligible to receive increased funds under the Hazard Mitigation Grant Program, based on 20 percent of the total estimated eligible Stafford Act assistance. Therefore, the development of State and local multi-hazard mitigation plans is key to maintaining eligibility for future FEMA mitigation and disaster recovery funding, as described below:

The Disaster Mitigation Act of 2000

The Disaster Mitigation Act of 2000 authorizes spending each year and encourages a broad accounting of benefits. Section 101 (b)(2) of Act states that the intent is:

- (1) to reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters; and
- (2) to provide a source of pre-disaster hazard mitigation funding that will assist States and local governments (including Indian tribes) in implementing effective hazard mitigation measures that are designed to ensure the continued functionality of critical services after a natural disaster.

Section 203(b) indicates that:

... The President may establish a program to provide technical and financial assistance to States and local governments to assist in the implementation of pre-disaster hazard mitigation measures that are cost-effective and are designed to reduce injuries, loss of life, and damage and destruction of property, including damage to critical services and facilities under the jurisdiction of the States or local governments.

44 CFR Part § 201.6

Local Mitigation Plans.

The local mitigation plan is the representative of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources

to reducing the effects of natural hazards. Local plans will also serve as the basis for the State to provide technical assistance and to prioritize project funding.

(a) *Plan requirements.*

(1) For disasters declared after November 1, 2004, a local government must have a mitigation plan approved pursuant to this section in order to receive HMGP project grants. Until November 1, 2004, local mitigation plans may be developed concurrent with the implementation of the HMGP project grant.

(2) By November 1, 2003, local governments must have a mitigation plan approved pursuant to this section in order to receive a project grant through the Pre-Disaster Mitigation (PDM) program, authorized under '203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5133. PDM planning grants will continue to be made available to all local governments after this time to enable them to meet the requirements of this section.

(3) Regional Directors may grant an exception to the plan requirement in extraordinary circumstances, such as in a small and impoverished community, when justification is provided. In these cases, a plan will be completed within 12 months of the award of the project grant. If a plan is not provided within this timeframe, the project grant will be terminated, and any costs incurred after notice of grant's termination will not be reimbursed by FEMA.

(4) Multi-jurisdictional plans (e.g. watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process and has officially adopted the plan. State-wide plans will not be accepted as multi-jurisdictional plans.

(b) *Planning process.* An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and

(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

(c) *Plan content.* The plan shall include the following:

(1) Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

(2) A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards. The risk assessment shall include:

- (i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
 - (ii) A description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. The plan should describe vulnerability in terms of:
 - (A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;
 - (B) An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate;
 - (C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.
 - (iii) For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.
- (3) A mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools. This section shall include:
- (i) A description of mitigation goals to reduce or avoid long- term vulnerabilities to the identified hazards.
 - (ii) A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.
 - (iii) An action plan describing how the actions identified in paragraph (c)(2)(11) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.
 - (iv) For multi- jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.
- (4) A plan maintenance process that includes:
- (i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five- year cycle.
 - (ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
 - (iii) Discussion on how the community will continue public participation in the plan maintenance process.

(5) Documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council). For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

(d) *Plan review.*

(1) Plans must be submitted to the State Hazard Mitigation Officer for initial review and coordination. The State will then send the plan to the appropriate FEMA Regional Office for formal review and approval.

(2) The Regional review will be completed within 45 days after receipt from the State, whenever possible.

(3) Plans must be reviewed, revised if appropriate, and resubmitted for approval within five years in order to continue to be eligible for HMGP project grant funding.

(4) Managing States that have been approved under the criteria established by FEMA pursuant to 42 U.S.C. 5170c(c) will be delegated approval authority for local mitigation plans, and the review will be based on the criteria in this part. Managing States will review the plans within 45 days of receipt of the plans, whenever possible, and provide a copy of the approved plans to the Regional Office.

Adoption By The Local Governing Body:

The City Council is the lawmaking body of the City and County of Honolulu. The Council is responsible for serving and advancing the general welfare, health, happiness, and safety of the people through exercising its legislative power.

As the legislative body of the City, the Council performs the following major duties and functions:

- Sets city-wide policies by enacting ordinances and adopting resolutions relating to municipal government programs and services such as police and fire protection, parks and recreation, affordable and special needs housing, sanitation and waste disposal, public transportation and other city government operations;
- Initiates new municipal programs which the City may pursue or improvements to update and refine existing programs and services;
- Adopts the annual operating and capital programs and budgets to fund the operations of the City and County and delivery of city services;
- Adopts measures that will yield sufficient moneys to balance the budget including the setting of the annual real property tax rate;
- Adopts a general plan for the City and land use laws establishing and amending the city's development plans and zoning regulations and processes;
- Conducts an annual financial audit and may conduct performance audits of any or all city agencies to determine whether laws, policies, and programs are being carried out in the most effective, efficient and economical manner;
- Determines the necessity of taking property for public purposes and authorizes condemnation proceedings;

- Confirms city department heads and board and commission members nominated and appointed by the mayor; and
- Fixes fees and charges for all city services and the use of city property;
- Authorizes settlement of claims filed against the city and against its officers and employees acting within the course of their duties;
- Establishes fines and penalties for violations of city ordinances and laws; and
- Accepts gifts and donations to and on behalf of the City of money, securities or other personal property, or real estate or interests in real estate.

All council meetings, with the exception of executive sessions, are open to the public

Post-Disaster Response and Repair

Section 404 mitigation activities are appropriated in amounts proportional to the cost of post-disaster response and repair efforts authorized by the Stafford Act. It is the largest source of funds for mitigation activities, and the one with the greatest potential to reduce future disaster losses. Section 404 provides that 15 percent, and in some cases 20 percent, of the funds spent for Public Assistance and Individual and Family Grants may be spent for a wide variety of mitigation activities. Since early 1989, FEMA has paid out \$2.63 billion under this program (about \$211 million per year). Funds are granted to the state as the "grantee" and are spent by qualified "sub grantees" on eligible projects located within the state. Priorities are set by the state and projects can be used to mitigate against losses from any hazard. Projects must be cost-effective and a non-federal match of at least 25 percent is required.

Section 406 allows for a more narrow selection of mitigation activities - physical projects on damaged facilities - than FEMA's other programs. Hazard mitigation is defined as cost-effective action taken to prevent or reduce the threat of future damage to a facility. A maximum non-federal match of 25 percent or less is required. Mitigation funded by Section 406 only applies to buildings and infrastructure damaged by a Presidentially-declared disaster and is above and beyond the work required to return the damaged facility to its pre-disaster design. Section 406 mitigation is addressed by 44CFR 206.226 (see Appendix B) and by Response and Recovery Policy 9526.1 (FEMA 1998b). Section 7(c) of the FEMA policy provides that:

1. Mitigation measures must be determined to be cost-effective. Anyone of the following means may be used to determine cost-effectiveness:
 - i. Measures may amount to up to 15 percent of the total eligible cost of the eligible repair work on a particular project.
 - ii. Certain mitigation measures (see Appendix A) will be determined to be cost-effective, as long as the mitigation measure does not exceed the eligible cost of the eligible repair work on the project.

- iii. For measures that exceed the above costs, the Grantee or Subgrantee must demonstrate through an acceptable benefit/cost analysis that the measure is cost-effective.

Appendix A of the policy defines mitigation measures as being cost-effective if they:

- Do not exceed 100 percent of the project cost
- Are appropriate to the disaster damage
- Will prevent future similar damage
- Are directly related to the eligible damaged elements
- Do not increase risks or cause adverse effects to the property or elsewhere
- Meet standards of good professional judgment

The Flood Insurance Program

The National Flood Insurance Program provides Flood Mitigation Assistance (FMA) grant funds to state and local governments for studies, research, and mitigation for structures covered by flood insurance. The funds come from flood insurance premiums.

Conducting Risk and Vulnerability Assessments

The first steps in hazard mitigation planning are to identify the hazards that affect a community, to assess the risk of disaster losses and evaluate the social, economic, and environmental vulnerability of a community.

Table 1-2
Summary of Hazards Relevant to Oahu

| Hazard | Siting Issues | Building Issues | Location | Plan Section(s) | Hazard/Loss Analysis Method |
|---------------------------------|--|--|--|-----------------|--|
| Hurricane Wind and Rain | No | Follow applicable building codes – higher standards needed for particular site based on topography. Create wind and rain resistant envelope. | Coastal areas have higher winds due to open exposure, inland areas may be affected by topography, per an on-going City mapping project for the IBC | 4 5 6 | HHRF and NASA Probabilistic |
| Landslides / Debris Flow | Yes | | | 7 | Historical |
| Earthquakes | No – Avoid unstable slopes | Follow current applicable building codes | Moderate throughout the island | 8 | USGS/HSEAC Probabilistic and HAZUS AAL |
| Tsunamis | Attempt to Avoid; for critical facilities – Avoid VE zones | Elevate, locate on higher part of lot; location of structure on lot | All coastal areas | 9 | Historical |
| Hurricane Storm Surge/ Flooding | Attempt to Avoid, for critical facilities – Avoid | Elevate, locate on highest part of lot; location of structure on lot | East and South shores at higher risk. | 5 10 | Deterministic Storm Exposure |
| Coastal Flooding - Per FIRMS | Wave Zones (V, VE zones) - Attempt to Avoid, for critical facilities – Avoid Flood zones (A, AE, Z zones) – for critical facilities – Avoid | Lowest horizontal structural member above BFE | Along coastal areas, adjacent to streams; may also be away from the coast | 10 | Probabilistic |
| High Surf | Yes | Lowest horizontal structural member above BFE | | 11 | Historical |
| Coastal Erosion | Yes – Avoid - Establish erosion zone | Location of structure on lot | Sandy coastlines. | 12 | Historical |
| Droughts | | | | 13 | Historical |
| Technological Failure Hazards | | | | 14 15 | Deterministic |

Losses linked directly to a hazard event include all damages, deaths and injuries, loss of habitation, shelter demand and employment losses due to the closure of damaged facilities. This includes physical destruction of buildings and contents, transportation and utility systems, crops, and natural resources and employment losses due directly to the closure of damaged facilities, including the cost of post-disaster cleanup.

Indirect losses include economic losses due to dislocations in the industrial or commercial sectors, banking and insurance, temporary unemployment and business interruption, loss of economic productivity and downtime in tourism, loss of tax revenues from business relocation, and long-term health expenses incurred from a permanent injury. Recovery from disasters also requires resources to be diverted from other public and private programs, adversely affecting the productivity of the economy.

Table 1-3

| Relative Hazard Severity to the City & County of Honolulu Based on Average Annual Loss Estimates | |
|---|---------------------------------|
| Hurricane | \$80 to \$110 Million / Year |
| Earthquake | \$20 Million / Year |
| Debris Flow and Rockfall | \$1 to \$5 Million / Year |
| Flood | \$1 to \$2 Million / Year |
| Coastal Erosion | \$0.75 to \$1 Million / Year |
| Tsunami | \$0.25 to \$0.50 Million / Year |

Other unquantifiable losses include environmental consequences, non-financial losses such as loss of historical resources, and psychological-social effects suffered by persons involved in a disaster.

**Table 1-4
Areas of Vulnerabilities**

| Vulnerable Area | Ownership | Natural Hazards | Primary Problems/Effects | Mitigation Benefits |
|--|------------------------|--|---|--|
| Power lines, traffic signals, power substations, highway signs | HECO | High winds, Kona storms Hurricanes | Utility and transportation disruption, navigation impeded, business interruption; social/family stress | Public safety, minimize power outages, economic recovery |
| Residential homes | Private | High winds, Kona storms Hurricanes, erosion | Damage, loss of property | Public safety, reduce costs of recovery, rebuilding & repair |
| Schools | Public/private | High winds, hurricane | Loss of life, damage to building and contents, disruption of social well-being, shelter facilities at risk | Public safety, protect structure |
| Coastal hotels/resorts | Private | Coastal erosion, storm surge, high wind & surf | Erosion removes sand and compromises structural integrity, damage to lower floors, social/economic disrupt. | Prevent costly damage, prevent impact of erosion on beaches/dune systems |
| Public beaches and facilities | Federal, County State | Coastal erosion, storm surge, high wind & surf | Flood debris deposited on beach, coastal erosion | Minimize social disruption, protect beaches and dunes |
| Port/harbor damage | Public/private | Storm surge, high surf, erosion, overwash | Facility flood inundation, hazardous materials released, foundation / structural damage, waterborne debris, interrupted intermodal commerce, loss of supplies to Island, business interruption, natural resource damage | Maximize social well-being, minimize business disruption, prevent costly damage, protect natural resources |
| Coastal roads | County, State | Overwash, erosion, storm surge, high surf | Evacuation difficulties, inter-island access difficulties, loss of safety/health services | Prevent costly road repair, business interruption, protect beaches and dunes |
| Downed trees | County, private | High winds, hurricanes, Kona Storms | Damage to buildings, cars, power outages, business interruption, transportation disruption, debris cleanup | Public safety, prevent costly debris cleanup, business interruption |
| Historical buildings | County, state, Private | High winds, storm surge | Economic & social hardship, loss of cultural resources | Protect cultural resources |
| Sewage Treatment Plants | County | Storm surge, high surf | Environmental damage, economic & social hardship | Public safety, avoid environmental damage |

Mitigation Actions

Risk management is the process by which the results of an assessment are integrated with political, economic, and engineering information to establish programs, projects and policies for reducing future losses and dealing with the damage after it occurs. (Table 1-5) Managing risks involves selecting various approaches that will reduce the vulnerability when applied to the risk area. In order to effectively evaluate the expected costs associated with natural hazards, the vulnerability of the built environment, public, health and safety, and business and natural resource vulnerabilities must be estimated. The most important criteria is whether the proposed action significantly mitigates the particular hazards or potential loss. Selection of mitigation measures can be prioritized based on some form of cost-benefit analysis. The purpose of the cost-benefits analysis is to evaluate the tradeoffs about reaching goals concerned with protection of the built and natural environments.

Benefit Cost Analysis

OMB Circular No. A-94 (Sections 6 and 6a) indicates that:

Analyses should include comprehensive estimates of the expected benefits and costs to society based on established definitions and practices for program and policy evaluation. Social net benefits, and not the benefits and costs to the Federal Government, should be the basis for evaluating government programs or policies that have effects on private citizens or other levels of government. Social benefits and costs can differ from private benefits and costs as measured in the marketplace because of imperfections arising from . . . external diseconomies . . . monopoly power. . . and taxes or subsidies. Both intangible and tangible benefits and costs should be recognized.

Costs of Mitigation Efforts in the Community

The costs for mitigation will include FEMA, other federal agency, state, local, and private dollars spent on the mitigation activities. This "dollars-spent" assessment should include administrative and maintenance costs and indirect costs. Costs also should include relevant opportunity costs, i.e. the value of alternatives foregone to achieve the mitigation activity.

The costs of mitigation include:

- Direct expenditures on relocation, construction and transportation
- Costs generated by rules and regulations setup in the name of hazard mitigation (e.g., possibly lower property values due to new zoning restrictions)
- Denial of access to economic resources due to zoning
- Increased business costs from mitigation-related safety regulations

Benefits of Mitigation Efforts in the Community

The benefits of mitigation activities are estimated. Expected benefits are the losses avoided because of a mitigation activity for hazard events of different intensities, multiplied by the probability of each of these events occurring. Losses avoided include but are not limited to: reduced loss of life, injury, and damage to property (including historic properties); reduced impacts on environmental, social, and recreational values; reduced community disruption and business interruption; and future expenditures on disaster relief. Most benefits of mitigation are costs and losses avoided through the reduction in loss probabilities and a reduction in loss amounts/value, such as reduced:

- Loss of life and injury.
- Property destruction and damage.
- Community and local infrastructure disruption.
- Business interruption, including closures, shutdowns and loss of employment.
- Loss of culturally and historically important items.
- Expenditure on disaster relief by both governments and private organizations.

Intangible benefits may include increased awareness by communities of hazards, their impacts and avoidance, leading to better decisions and future actions.

Table 1-5
Various Types of Mitigation Activities

| Type | | Types of Activity |
|---|--|--|
| I | Education/Training | Offering workshops and seminars for public officials and employees, personnel of state agencies, and the general public |
| | | Developing video tapes, pamphlets, brochures, and other literature |
| II | Commitment and Capacity Building | Organizing community groups and conducting team-building exercises |
| | | Recruiting partners to promote mitigation |
| | | Forming teams or committees for planning and conducting preparedness, response, and recovery planning |
| | | Encouraging interagency cooperation and planning |
| III | Risk Assessment, Planning, and Plan Implementation | Conducting hazard, vulnerability, and risk analyses; mapping hazards; preparing inventories of threatened facilities; and carrying out other studies |
| | | Preparing plans (e.g., risk mitigation plans, land improvements plans, harbor management plans, and beach management plans) |
| | | Supporting planning, administrative, and legislative activities |
| | | Forming planning and hazard management districts |
| | | Developing and/or strengthening zoning and building code ordinances |
| | | Enacting new risk mitigation regulations and legislation |
| | | Conducting engineering studies and designing projects |
| | | Developing mitigation incentives such as loan subsidy and/or grant programs |
| | | Providing technical assistance |
| | | Implementing risk mitigation plan |
| Coordinating risk mitigation activities | | |
| IV | Drainage Projects | Replacing and improving culverts, pipes, mains, storm water lines, drainage ditches, channels, sewer pipes, and backup valves |
| | | Constructing and stabilizing detention ponds and basins, dams, dikes, levees, barriers, berms, floodgates, and flood walls |
| | | Stabilizing riverbanks and shorelines (retaining walls, riprap) |
| | | Dredging and maintaining channels |
| | | Removing debris and vegetation |

| Type | | Types of Activity |
|------|-------------------------------------|---|
| V | Acquisition and Relocation Projects | Acquiring, demolishing, and/or relocating structures in flood zones |
| | | Purchasing land and development rights in flood and erosion zones |
| VI | Structural Improvement Projects | Improving and retrofitting buildings and structures to resist earthquakes, wind, hail, water, and waves |
| | | Floodproofing buildings and infrastructure in flood zones |
| | | Elevating buildings and other structures |
| | | Installing storm shutters and upgrading roofs to resist wind, rain, hail, and fire |
| | | Constructing hurricane walls, barriers, gates, and tidal valves |
| | | Constructing new buildings, lifelines, and other structures to meet appropriate codes |
| | | Repairing damaged buildings in ways to reduce repeated losses |
| | | Constructing and upgrading emergency shelters |
| | | Installing roll-up doors, special windows, and impact-resisting film |
| VII | Lifeline Improvement Projects | Upgrading piers and wharves |
| | | Upgrading fuel storage tanks |
| | | Anchoring and bracing equipment |
| | | Improving utilities such as storm water, wastewater, and water treatment facilities and pumping stations; and electric, gas, communications systems |
| | | Improving transportation systems (roads, bridges, etc.) |
| VIII | Land Improvement Projects | Replenishing beaches |
| | | Stabilizing and restoring sand dunes and roadway banks |
| | | Constructing and/or strengthening bulkheads and head walls |
| | | Managing vegetation |
| | | Controlling erosion (grading and vegetation) |
| | | Stabilizing slopes (grading, drainage and vegetation) |
| | | Remediating soil to reduce liquefaction potential |
| | | Clearing brush, doing controlled burns, and building fuel breaks |

Source: Derived from Godschalk et al., 1999.