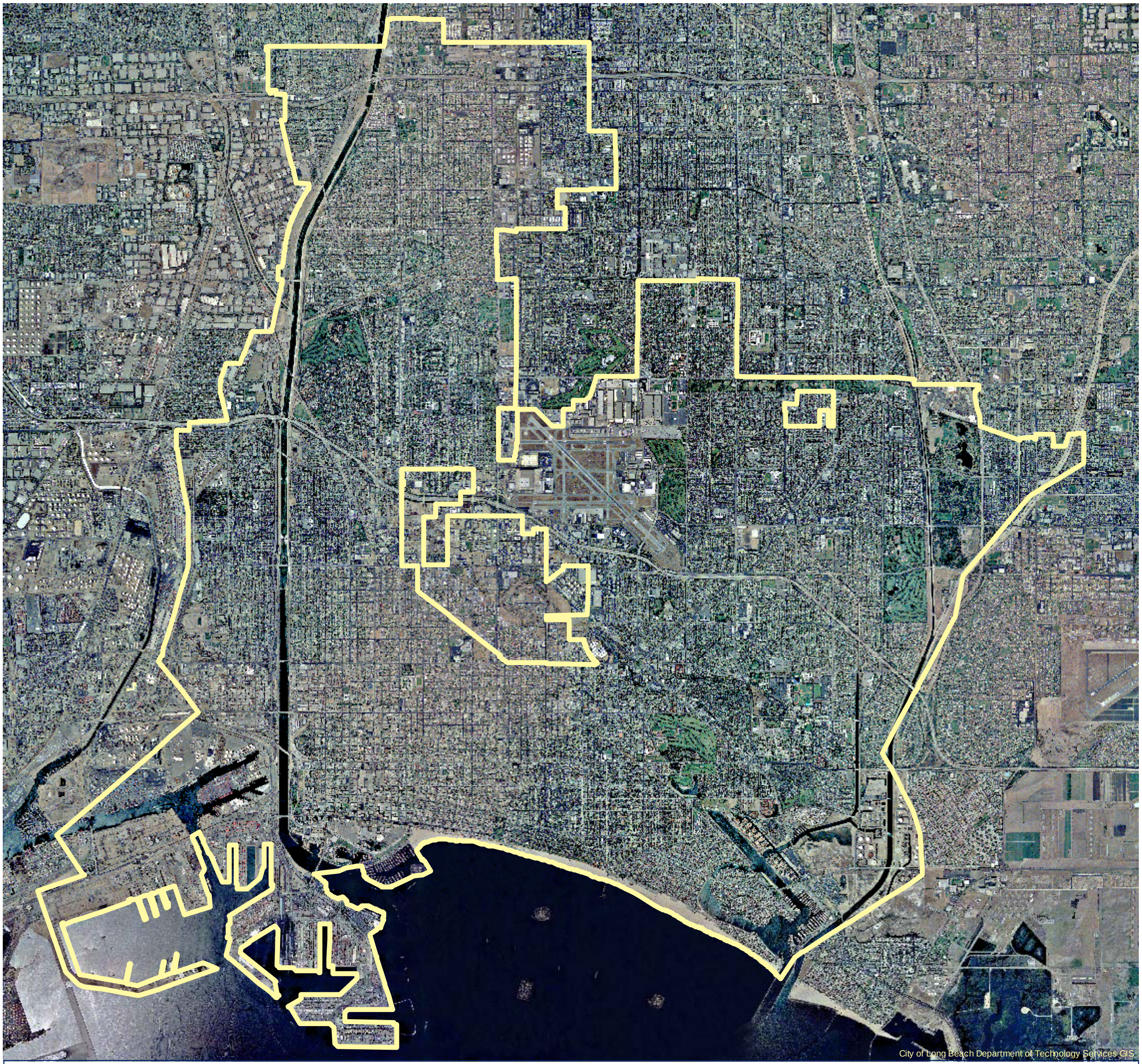

City of Long Beach Natural Hazards Mitigation Plan

Final Working Document
October 19, 2004

Prepared under contract with:

Emergency Planning Consultants
San Diego, California
Carolyn J. Harshman, President

City of Long Beach

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Special Recognition

The Disaster Management Area Coordinators (DMAC) of Los Angeles County prepared planning guidance materials that were utilized by the City of Long Beach in preparing this Natural Hazards Mitigation Plan. The City extends special recognition to AREA-G DMAC Coordinator Michael Martinet for his editing contributions to the Hazard-Specific Sections. The DMAC planning guidance materials were based on the Mitigation Plan from Clackamas County, Oregon. The City is grateful to the DMAC's and the Clackamas County Natural Hazards Mitigation Committee for their contributions to this project.

<u>**Special Thanks**</u>

City of Long Beach
- Dave Ellis, Fire Chief, Fire Department, Committee Co-Chair
- Fady Mattar, Director, Planning & Building, Committee Co-Chair
- Rich Brandt, Hazard Mitigation Coordinator, Fire Department, Committee Facilitator
- Casey Chel, Disaster Management/Area-F Coordinator
- Stephen Scott, City Manager's Office
- Diana Ambriz, Financial Management
- Tina Dickinson, Technology Services – GIS
- Janet Mullen, Technology Services - GIS
- Larry Rich, Planning & Building
- Dale Wiersma, Planning & Building
- Miguel Madrigal, Planning & Building
- Craig Chalfant, Planning & Building
- Johnny Vallejo, Community Development
- Laurie Browning, Parks, Recreation & Marine
- John Benedetti, Police Department
- Torben Beith, Police Department
- Linden Nishinaga, Public Works
- Octavius Covington, Harbor Department – Port of Long Beach Security
- Bob Berg, Water Department
- Mike Alio, Human Resources
- Margaret Shobert, Human Resources
- Hanan Obeidi, Health & Human Services

American Red Cross Response Services
- Peggy Brutsche
- Bill Clausen

Long Beach Memorial Hospital
- Ginger Alhadeff

Pacific Hospital of Long Beach
- Luis M. Gonzalez

Long Beach Unified School District
- Cathy Coy

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Mapping
Other than Internet-sourced maps, the City of Long Beach provided all of the maps included in this Plan.

Consulting Services
Project Management and Planning Services for this project were provided under contract with Emergency Planning Consultants of San Diego, California.

Project Management Services:	Carolyn J. Harshman, President
Planning Services:	Carolyn J. Harshman, President
	Eric Acacio, Assistant
	Timothy W. Harshman, Intern

List of Natural Hazards Mitigation Plan Tables, Maps, and Photos

Note: The maps in this plan were provided by the City of Long Beach or were acquired from public Internet sources. Care was taken in the creation of these maps, but they are provided "as is". The City of Long Beach cannot accept any responsibility for any errors, omissions or positional accuracy, and therefore, there are no warranties that accompany these products (the maps). Although information from land surveys may have been used in the creation of these products, in no way does this product represent or constitute a land survey. Users are cautioned to field verify information on this product before making any decisions.

City of Long Beach Natural Hazards Mitigation Plan

Index

Executive Summary: Hazard Mitigation Action Plan

The City of Long Beach Natural Hazards Mitigation Plan includes resources and information to assist City residents, public and private sector organizations, and others interested in participating in planning for natural hazards. The mitigation plan provides a list of activities that may assist City of Long Beach in reducing risk and preventing loss from future natural hazard events. The action items address multi-hazard issues, as well as activities for earthquakes, flooding, earth movement, windstorms, and tsunamis.

How is the Plan Organized?

The Mitigation Plan contains a Mitigation Actions Matrix, background on the purpose and methodology used to develop the mitigation plan, a profile of City of Long Beach, sections on five natural hazards that occur within the City, and a number of appendices. All of the sections are described in detail in Section 1, Introduction.

Who Participated in Developing the Plan?

The City of Long Beach Natural Hazards Mitigation Plan is the result of a collaborative planning effort between City of Long Beach, citizens, public agencies, non-profit organizations, the private sector, and regional and state organizations. Public participation played a key role in development of goals and action items. Interviews were conducted with stakeholders across the City, and public outreach activities were conducted to include City of Long Beach residents in plan development. The Natural Hazards Mitigation Advisory Committee guided the process of developing the plan.

The Natural Hazards Mitigation Advisory Committee was comprised of the following representatives:

City of Long Beach	Dave Ellis, Fire Chief, Committee Co-Chair
	Fady Mattar, Director of Planning & Building, Committee Co-Chair
	Rich Brandt, Hazard Mitigation Coordinator, Fire Department, Committee Facilitator
	Casey Chel, Disaster Management
	Stephen Scott, City Manager’s Office
	Diana Ambriz, Financial Management
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	Linden Nishinaga, Public Works
	Octavius Covington, Harbor Department – Port of Long Beach Security
	Bob Berg, Water Department
	Mike Alio, Human Resources
	Margaret Shobert, Human Resources
	Hanan Obeidi, Health & Human Services
American Red Cross Response Services	Peggy Brutsche
	Bill Clausen
Long Beach Memorial Hospital	Ginger Alhadeff
Pacific Hospital of Long Beach	Luis Gonzalez
Long Beach Unified School District	Cathy Coy
Department of Veterans Affairs	Theodore Gegoux
Emergency Planning Consultants	Carolyn J. Harshman, President

What is the Plan Mission?

The mission of the City of Long Beach Natural Hazards Mitigation Plan is to establish and promote a comprehensive mitigation policy and program to protect citizens, employees, businesses and industries lives, property and facilities, the infrastructure and the environment from natural hazards.

What are the Plan Goals?

The plan goals describe the overall direction that City of Long Beach agencies, organizations, and citizens can take to work toward mitigating risk from natural hazards. The goals are stepping-stones between the broad direction of the mission statement and the specific recommendations outlined in the action items.

Protect Life and Property

Identify natural hazards that threaten life and property in the City of Long Beach.

Implement programs and projects that assist in protecting lives by making infrastructure, critical facilities, and other property more resistant to losses from natural hazards.

Protect life and property by adopting state-of-the-art standards, codes and construction procedures.

Reduce losses and repetitive damages for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Improve hazard assessment information to make recommendations for discouraging new development in high hazard areas and encouraging preventative measures for existing development in areas vulnerable to natural hazards.

Increase Public Awareness

Increase public awareness of existing threats and the means to reduce these threats by conducting educational and outreach programs to all the various community groups in the City of Long Beach.

Provide information on tools; partnership opportunities, and funding resources to assist in implementing mitigation activities.

Strengthen Partnerships

Strengthen communication and coordinate participation among and within public agencies, residents, non-profit organizations, business, and industry to gain a vested interest in implementation of mitigation measures.

Encourage and support leadership within public and private sector, non-profit agencies and community based organizations to promote and implement local hazard mitigation activities.

Environmental & Historical Preservation

Balance land use planning with natural hazard mitigation to protect life, property and the environment.

City Emergency Services

Establish policy to ensure the importance of mitigation programs and projects for critical facilities, services, and infrastructure.

Continue providing emergency services with training and equipment to address all identified hazards.

Continue developing and strengthening inter-jurisdictional coordination and cooperation in the area of emergency services.

How are the Action Items Organized?

The action items are a listing of activities in which City agencies and citizens can be engaged to reduce risk. Each action item includes an estimate of the timeline for implementation.

The action items are organized within the following Matrix, which lists all of the multi-hazard and hazard-specific action items included in the mitigation plan. Data collection and research and the public participation process resulted in the development of these action items (see Appendix B: Public Participation). The Matrix includes the following information for each action item:

Coordinating Organization. The coordinating organization is the public agency with regulatory responsibility to address natural hazards, or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation. Coordinating organizations may include local, county, or regional agencies that are capable of or responsible for implementing activities and programs.

Timeline. Action items include both short and long-term activities. Each action item includes an estimate of the timeline for implementation.

Plan Goals Addressed. The plan goals addressed by each action item are included as a way to monitor and evaluate how well the mitigation plan is achieving its goals once implementation begins. The plan goals are organized into the following five areas:

Protect Life and Property
Increase Public Awareness
Strengthen Partnerships
Environmental & Historical Preservation
City Emergency Services

How Will the Plan be Implemented, Monitored, and Evaluated?

The Plan Maintenance Section (Section 2) of the Plan details the formal process that will ensure that the City of Long Beach Natural Hazards Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the Plan annually and producing a plan revision every five years. This section describes how the City will integrate public participation throughout the plan maintenance process. Finally, this section includes an explanation of how the City of Long Beach government intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the City's General Plan, Capital Improvement Plans, and Building & Safety Codes.

Plan Adoption

Adoption of the Natural Hazards Mitigation Plan by the local jurisdiction's governing body is one of the prime requirements for approval of the plan. Once the plan is completed, the City Council will be responsible for adopting the City of Long Beach Natural Hazards Mitigation Plan. The City Council has the responsibility and authority to promote sound public policy regarding natural hazards. The City Manager (or designee) will have the authority to periodically need to re-adopt the plan as it is revised to meet changes in the natural hazard risks and exposures in the community. The approved Natural Hazards Mitigation Plan will be significant in the future growth and development of the community.

Coordinating Body

The City Manager will appoint a City Manager's Executive Committee consisting of department managers. The Executive Committee will be responsible for providing leadership and guidance to the Natural Hazards Mitigation Advisory Committee (Mitigation Committee). The Mitigation Committee will be responsible for implementation of Plan action items and coordinating the formal review process.

Convener

Upon approval of the Plan by the City Council, the City Manager (or designee) will convene a joint meeting of the City Manager's Executive Committee and the Mitigation Committee. The purpose of the joint meeting will be to clarify the roles and responsibilities of the two Committees, as well as to establish an annual schedule and assign tasks for implementing the Plan. The Mitigation Committee will serve as a working committee, while the Executive Committee will be ultimately responsible for implementation and evaluation of the Natural Hazards Mitigation Plan.

Implementation through Existing Programs

City of Long Beach addresses statewide planning goals and legislative requirements through the City's General Plan, Capital Improvement Plans, and City Building & Safety Codes. The Natural Hazards Mitigation Plan provides a series of recommendations that are closely related to the goals and objectives of these existing planning programs. The City of Long Beach will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

Economic Analysis of Mitigation Projects

The Federal Emergency Management Agency's approaches to identify costs and benefits associated with natural hazard mitigation strategies or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards can provide decision makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Formal Review Process

The City of Long Beach Natural Hazards Mitigation Plan will be evaluated on an annual basis to determine the effectiveness of programs, and to reflect changes in land development or programs that may affect mitigation priorities. The evaluation process includes a firm schedule and timeline, and identifies the local agencies and organizations participating in plan evaluation. The City Manager (or designee) will be responsible for contacting the Executive Committee members and organizing the meeting for the annual review of the Plan. The Executive Committee will be responsible for monitoring and evaluating the progress of the mitigation action items identified in the Plan.

Continued Public Involvement

The City of Long Beach is dedicated to involving the public directly in the continual review and updates of the Natural Hazards Mitigation Plan. Copies of the plan will be catalogued and made available at the City Libraries, the City Clerk's Office located in City Hall and on the City website. The existence and location of these copies will be publicized in City newsletters. The Plan also includes the address and the phone number of the City's Hazard Mitigation Coordinator who is responsible for keeping track of public comments on the Plan. In addition, copies of the Plan and any proposed changes will be posted on the City website. This site will also contain an email address and phone number.

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
Multi-Hazard Action Items								
MH #1-1	Integrate the goals and action items from the Natural Hazards Mitigation Plan (Plan) into existing regulatory documents and programs, where appropriate.	Natural Hazards Mitigation Advisory Committee (Mitigation Committee)	Immediate	X	X	X	X	X
MH #1-2	Identify and pursue funding opportunities to develop and implement local mitigation activities.	Mitigation Committee	Immediate	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-3	Establish a formal role for the City Manager's Executive Committee to develop a sustainable process for implementing, monitoring, and evaluating citywide mitigation activities. Committee would likely include Fire Chief, Director of Planning & Building, Technology Services, Public Works, and Deputy City Manager.	Co-Chairs of the Mitigation Committee	Immediate	X	X	X	X	X
MH #1-4	Identify, improve, and sustain collaborative programs focusing on the real estate and insurance industries, public and private sector organizations, and individuals to avoid activity that increases risk to natural hazards.	Mitigation Committee	Ongoing	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-5	Develop public and private partnerships to foster natural hazard mitigation program coordination and collaboration in the City.	Disaster Management	Ongoing	X	X	X	X	X
MH #1-6	Expand inventories of at-risk buildings and infrastructure and prioritize mitigation projects.	Planning & Building	1-5 Years	X			X	
MH #1-7	Strengthen emergency services preparedness and response by linking emergency services with natural hazard mitigation programs and enhancing public education on a local scale.	Disaster Management	Ongoing	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-8	Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to residents, public agencies, private property owners, businesses, and schools.	Mitigation Committee	Ongoing	X	X		X	
MH #1-9	Use technical knowledge of natural ecosystems and events to link natural resource management and land use organizations to mitigation activities and technical assistance.	Planning & Building	Ongoing			X		
MH #1-10	Update Public Safety Element and Seismic Safety Element of the City's General Plan	Planning & Building	1-5 years	X	X	X	X	X
MH #1-11	Ensure SEMS-mandated plans, training and exercises are updated and implemented.	Disaster Management	Ongoing	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-12	Expand Mitigation Plan to include man-made hazards (HAZMAT, terrorism, etc.)	City Manager's Executive Committee	1-5 years	X	X	X	X	X
MH #1-13	Incorporate the building inventory into the hazard assessment.	Planning & Building	1-5 years	X	X			
MH #1-14	Ensure compliance to rebuilding in conformance with applicable codes, specifications, and standards.	Planning & Building	Ongoing	X		X		
MH #1-15	Ensure repairs or construction funded by Federal disaster assistance conform to applicable codes and standards.	Planning & Building	Ongoing	X				
MH #1-16	Review existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.	Planning & Building	1-5 years	X				

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-17	Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventative measures for existing development in areas vulnerable to natural hazards.	Planning & Building	1-5 years	X	X	X		X
MH #1-18	Use the Mitigation Plan to help the City's General Plan meet State regulations designed to protect life and property from natural disasters and hazards through planning strategies that restrict development in areas of known hazards. (California Coastal Commission, State Lands Commission)	Planning & Building	Ongoing	X	X	X		X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-19	Coordinate and integrate natural hazard mitigation activities, where appropriate, with Multi-Hazard Functional Plan (MHFP) and emergency response procedures.	Disaster Management	Ongoing	X	X	X	X	X
MH #1-20	Identify, improve, and sustain collaborative programs focusing on the real estate and insurance industries, public and private sector organizations, and individuals to avoid activity that increases risk to natural hazards.	Community Development	Ongoing	X	X	X	X	X
MH #1-21	Maintain list of critical facilities at risk from natural hazards events.	Planning & Building	Ongoing	X	X	X	X	X
MH #1-22	Recommend revisions to requirements for development within the floodplain, where appropriate.	Planning & Building	Ongoing	X			X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-23	Encourage construction and subdivision design that can be applied to steep slopes to reduce the potential adverse impacts from development.	Planning & Building	Ongoing	X	X	X		X
MH #1-24	Identify bridges at risk from flood or earthquake hazards, identify enhancements, and implement projects needed to reduce the risks.	Public Works	Ongoing	X	X	X		X
MH #1-25	Ensure communication and dissemination of natural hazard mitigation information.	Mitigation Committee	Ongoing	X	X	X	X	X
MH #1-26	Review protocol for communication between utility providers and emergency services to assure rapid restoration of transportation capabilities.	Disaster Management	Ongoing	X			X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-27	Review strategy to maintain alternative communications facilities should natural hazards events cause damages.	Technology Services	1-2 years	X	X		X	X
MH #1-28	Review Preliminary Damage Assessment process to ensure efficiency and effectiveness.	Disaster Management	1-3 years	X	X		X	X
MH #1-29	Improve communication and protocols between transportation entities (i.e. Public Works, Caltrans, LA County) to prioritize and identify strategies to deal with road problems.	Public Works	1-3 years	X	X		X	
MH #1-30	Provide new home and property buyers with information on quality redevelopment and safe housing development.	Planning & Building	1- 2 years	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-31	Review City zoning regulations to ensure adequacy of restrictions to reduce future development in high hazard areas.	Planning & Building	3 years	X	X		X	X
MH #1-32	Compile a directory of out-of-area contractors to help with repairs/reconstruction so that restoration occurs in a timely manner.	Disaster Management	3 years	X			X	
MH #1-33	Partner with other organizations and agencies in the community to identify grant programs and foundations that may support mitigation activities.	City Manager's Executive Committee	Ongoing	X			X	
MH #1-34	Allocate City resources and assistance to mitigation projects when possible.	City Manager's Executive Committee	Ongoing	X			X	

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-35	Identify all organizations within the jurisdiction that have programs or interests in natural hazards mitigation.	Mitigation Committee	1-2 years	X			X	
MH #1-36	Identify new sources of support such as philanthropic foundations, community foundations, and professional organizations such as the Urban Land Institute or American Planning Association who might be able to provide technical or financial support for recovery planning.	Mitigation Committee	1-2 years	X			X	

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-37	Identify additional opportunities for partnering with citizens, private contractors, and other jurisdictions to increase availability of equipment and manpower for efficiency of response efforts.	Mitigation Committee	1-2 years	X	X		X	X
MH #1-38	Encourage development of additional Community Emergency Response Teams (CERT).	Fire Department	Ongoing	X	X		X	X
MH #1-39	Familiarize public officials of requirements regarding public assistance for disaster response.	City Manager's Executive Committee	Immediate	X	X	X	X	X
MH #1-40	Repeat the Community Hazards Mitigation & Preparedness Questionnaire in five years (coincide with Plan update).	Mitigation Committee	5 years	X	X		X	X
MH #1-41	Develop strategies for debris management for natural disaster events.	Public Works	1 year	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-42	Enhance weather monitoring to attain earlier severe storm warnings.	Disaster Management	Ongoing	X	X	X	X	X
MH #1-43	Improve communication among the adjoining transportation entities in order to improve coordination of emergency transportation route maintenance.	Public Works	1-2 years	X	X		X	X
MH #1-44	Establish a committee representative of all areas of the City that will include vets, pet store owners, the Humane Society, animal shelters, the Animal Control Division and other interested parties to work on animal-specific evacuation and sheltering needs.	Health & Human Services	5 years	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-45	Develop informational literature on animal disaster plans and supply kits and have them available in veterinary clinics and pet stores.	Health & Human Services, American Red Cross	1-2 years	X				
MH #1-46	Incorporate the training goals and objectives used by Fire/EMS, Police, Public Works, Health and Human Services in order to foster unified command relationships.	Fire Department	1-4 years	X	X		X	X
MH #1-47	Develop mitigation strategies to protect identified at-risk historic properties.	Planning & Building	1-3 years	X	X	X	X	X
MH #1-48	Conduct a full review of the Mitigation Plan every 5 years by evaluating mitigation successes, failures, and areas that were not addressed.	City Manager's Executive Committee	5 years	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-49	Establish and implement the National Incident Management System (NIMS) in each agency/department.	Fire Department	1-3 years	X	X		X	X
MH #1-50	Identify water resources management and conservation opportunities.	Water Department	Ongoing	X	X		X	X
MH #1-51	Develop a strategy to ensure vehicle access routes to key health care facilities will be protected from blockage as a result of a disaster.	Police Department	1-2 years	X	X		X	X
MH #1-52	Develop inventory of backup power resources (generators) of City's critical facilities, hospitals, and nursing homes. Encourage upgrading of resources, as necessary.	Fire Department	1-2 years	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-53	Enhance emergency services to increase the efficiency of mutual aid wildfire response and recovery activities.	Fire Department	1-3 years	X	X		X	X
MH #1-54	Enhance response capability of City fire, police, and emergency medical services personnel to special populations.	Disaster Management	1-2 years	X	X		X	X
MH #1-55	Ensure preventive maintenance of the community's infrastructure will be done to minimize the potential for system failure because of or during a disaster.	Public Works	1-5 years	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-56	Publicize the Emergency Management Institute's Independent Study Courses available to the public to include but not limited to Emergency Preparedness USA, Hazardous Material: Citizen Orientation, Animals in Disaster, Disaster Mitigation for Homeowners.	Disaster Management	1-2 years	X	X		X	X
MH #1-57	Teach CERT classes to interested citizens in the City to assist their neighbors during emergencies. These courses will be taught in various locations throughout the City, utilizing the staff resources including EMS, Fire, Police and external resources including American Red Cross.	Fire Department	Ongoing	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-58	Conduct annual tabletop disaster exercises with police, fire, emergency management, and other disaster response departments and agencies.	Disaster Management	Yearly	X	X		X	X
MH #1-59	Pre-position first response equipment and personnel at large venues.	Fire Department, Police Department	Ongoing	X	X		X	X
MH #1-60	Work with the organizations involved in shelter management (ARC and schools) to share information about local shelters.	Mitigation Committee	1-5 years	X	X		X	X
MH #1-61	Obtain and deliver information to all City residents on "sheltering in place".	Fire Department, American Red Cross	1-2 years	X	X		X	X
MH #1-62	Utilize Neighborhood Resource Centers for distribution of natural hazard public awareness materials.	Community Development	Ongoing	X	X		X	

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-63	Develop public awareness materials that address weather-related natural hazards.	Mitigation Committee, American Red Cross	1 year	X	X			
MH #1-64	Distribute weather-related disaster preparedness literature to all property owners. Include information on tropical storms, high winds, drought, severe storms, etc.	Mitigation Committee	Ongoing	X	X			
MH #1-65	Continue to distribute letters to all property owners on the importance of water conservation and availability of water saving devices for homes.	Water Department	Ongoing	X	X		X	
MH #1-66	Provide business continuity workshops for business owners to learn the importance of disaster mitigation and how to create an emergency operations plan for their businesses.	Disaster Management	1-3 years	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-67	Train EMS, Fire, Police, Public Works, Health & Human Services and other support personnel in Unified Command using the Incident Management System identified in the City's Multi-Hazard Functional Plan. By understanding the role of each discipline will result in a cohesive performance of their assigned tasks yielding an overall emergency response that is not only effective, but rapid with optimal outcome.	Fire Department	1-5 years	X	X		X	X
MH #1-68	Distribution of information on fire safety, smoke alarms and sprinkler systems to homeowners of structures built before 1980.	Fire Department	Ongoing	X	X		X	

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-69	Maintain and publicize availability of preparedness materials at Fire Stations and City Hall. The locations will stock materials that may include: Emergency Preparedness Guidebook, FEMA's Are You Ready, and other brochures on disaster supplies kits and plans, etc.	Fire Department, American Red Cross	Ongoing	X	X			
MH #1-70	Consider expanding the Region I (Local Emergency Preparedness Committee's (LEPC) responsibilities to include mitigation planning and disaster preparedness education activities.	Disaster Management	1-2 years	X	X		X	X
MH #1-71	Utilize the media for the distribution and publication of hazard information.	All PIOs	Ongoing	X	X		X	

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-72	Strategize on merging existing preparedness booths to include "how to" mitigation materials. The new booth could include pictures and information, such as those contained in FEMA's Retrofitting for Homeowners Guide, Elevating Your Flood Prone Home, how to elevate critical structures and utilities and information on the NFIP.	Mitigation Committee	1-4 years	X	X		X	X
MH #1-73	Integrate the Mitigation Plan with the Capital Improvement Plans to ensure that development does not encroach on known hazard areas.	Public Works	Yearly	X	X	X	X	X
MH #1-74	Establish priorities for restoration of the community's infrastructure and vital public facilities following a disaster.	Mitigation Committee	Ongoing	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-75	Enhance Fire Department's Speaker's Bureau to include natural hazard topics.	Fire Department, American Red Cross	1-3 years	X	X		X	X
MH #1-76	Create a database with information to track the status of City-owned or occupied facilities repairs or reconstruction.	Public Works	Following Disaster	X	X		X	X
MH #1-77	Prepare a policy that identifies which types of repairs and/or reconstruction, if any, would be exempt from local codes, particularly zoning and land development codes.	City Manager's Executive Committee	1-5 years	X	X		X	X
MH #1-78	Determine capacity in local construction and debris landfills to absorb the estimated inflow of disaster/restoration debris.	Long Beach Energy	1-2 years	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-79	Coordinate with American Red Cross to deliver a variety of courses, including: CPR, Basic First Aid, Introduction to Disaster Services, Mass Care, Shelter Operations, babysitting, Healthcare Provider, and pet first-aid at locations throughout the City.	Fire Department	Ongoing	X	X		X	
MH #1-80	Develop a program to educate the public on existing disaster-related self-help agencies available within the City.	Mitigation Committee	1-2 years		X		X	
MH #1-81	Establish website links with outside disaster relief agencies such as the Hospital and County Social Services.	Technology Services	1 year		X		X	
MH #1-82	Post the Mitigation Plan on the City's website.	City PIO	Upon approval	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-83	Utilize the City's website for media releases and public displays to advertise agencies such as the American Red Cross, CERT, the LEPC Committee, and Volunteer Organizations Active in Disaster.	Disaster Management	1 year		X		X	
MH #1-84	Educate the public about hazards prevalent to their area.	Community Development, American Red Cross	1-2 years	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-85	Enhance, improve and create additional displays for children's programs that teach safety. Examples of information to be used would be similar to that on the FEMA for Kids CD, the Sparky Fire Safety Program, and/or the American Red Cross's Masters of Disasters program. These displays can be used in conjunction with "Safetyville", the library's children's section, etc.	Fire Department	Ongoing	X	X		X	X
MH #1-86	Enhance boater safety materials that are targeted toward severe storms. Distribute the materials at all local marinas in the City.	Parks, Recreation & Marine	1-2 years	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-87	Work with the Visitor & Convention Bureau and others to alert tourists to the potential of natural hazard areas and what to do if a natural hazard occurs during their visit to the City.	Mitigation Committee	Ongoing	X	X		X	X
MH #1-88	Develop and distribute media releases to local newspapers and radio stations about pre-disaster information.	City PIO	1-3 years	X	X		X	X
MH #1-89	Establish public service announcements on preparedness and mitigation steps and strategies.	Fire Department	1-2 years	X	X		X	X
MH #1-90	Maintain supplies and training associated with use of ATC-20 standards (building inspections following disaster).	Planning & Building	Ongoing	X	X		X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-91	Promote CERT through the Chamber of Commerce to gain business participation.	Fire Department	1-2 years	X	X		X	X
MH #1-92	Develop training on the Mitigation Plan for the Planning Commission and others involved in the development process.	Planning & Building	1-2 years	X	X		X	X
MH #1-93	Develop an e-mail list of training coordinators for Fire/EMS, Police, Public Works, and Health & Human Services staff and other support personnel to forward all training announcements and updates.	Disaster Management	Ongoing	X	X		X	X
MH #1-94	Ensure adequacy and functionality of the alternate ECOC.	City Manager's Executive Committee	11/20/03	X	X		X	X
MH #1-95	Build a new Emergency & Operations Center (ECOC).	Fire Department, Police Department	Completed	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-96	Maintain database in existing hazard GIS system of all previous loss properties in the City to be used in future mitigation activities.	Technology Services	Ongoing	X	X		X	X
MH #1-97	Continue collection of HAZMAT reports from local facilities to enhance and prepare emergency responders in the event of a “secondary impact” incident at these facilities.	Health & Human Services	Ongoing	X	X	X	X	X
MH #1-98	Determine how, when, and under what circumstances government will demolish structures.	City Manager’s Executive Committee	2 years	X	X			X
MH #1-99	Retrofit bridges and tunnels.	Public Works	Ongoing	X	X			X
MH #1-100	Incorporate new Mitigation Plan Hazard Analysis into the MHFP Threat Assessment update.	Disaster Management	1-2 years				X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-101	Update the MHFP to conform with State 3-year review requirements	Disaster Management	1 year				X	X
MH #1-102	Incorporate the mitigation activities identified in the City's General Plan into the Mitigation Plan.	Mitigation Committee	1 year				X	
MH #1-103	Continue public education activities relating to natural hazards.	Fire Department	Ongoing		X			
MH #1-104	Revise the Zoning and/or Subdivision Ordinance to require the utilization of various pervious surfaces within the floodplain in order to reduce storm water runoff. This should include utilizing the use of various pervious surfaces in parking lots in recreational areas near the floodplain.	Planning & Building	5 years	X	X			

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-105	Upgrade the existing generator and electrical systems at Long Beach Airport.	Public Works	Tentative FY 2005	X				X
MH #1-106	Install new public address system at Long Beach Airport.	Public Works	Tentative FY 2005	X				X
MH #1-107	Replace Long Beach Airport's existing 1,500 gallon Aircraft Rescue Firefighting vehicle with a 3,000 gallon vehicle and replacement of the existing rapid response fire fighting vehicle with a new rapid response vehicle.	Fire Department	Ordered FY 2004 Completed FY 2005	X				X
MH #1-108	Construct Americans with Disabilities Act (ADA) building upgrades in various locations throughout the City.	Planning & Building	1 year	X				
MH #1-109	Various structural repairs and improvements to existing critical facilities.	Public Works	1 year	X				X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-110	Design and construct Emergency Communications & Operations Center (ECOC)	Public Works	1 year	X			X	X
MH #1-111	Repair residential streets to correct drainage problems and pavement failure.	Public Works	1 year	X		X		
MH #1-112	Install Opticom units on traffic signals at prioritized intersections in order to enhance emergency vehicle response times and operational safety by allowing emergency vehicles to pre-empt signal timing.	Public Works	Ongoing	X				X
MH #1-113	Update Natural Hazards Mitigation Plan on an annual basis.	Mitigation Committee	Yearly	X	X	X	X	X
MH #1-114	Consider incorporating man-made and technological hazards in future updates to the Mitigation Plan.	Mitigation Committee	1-5 years	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-115	Identify opportunities and funding to establish a Hazardous Materials Team.	Fire Department	1-5 years	X	X	X	X	X
MH #1-116	Develop tabletop exercise with assistance from Public Safety in order to better identify mapping needs for emergency response situations and EOC activations.	Technology Services - GIS	1-2 years	X	X	X	X	X
MH #1-117	Coordinate community education activites with the American Red Cross and utilize information published by the National Disaster Education Coalition in “Talking About Disasters: Guide for Standard Messages”. http://www.disastereducation.org/	Mitigation Committee, American Red Cross	Ongoing	X	X		X	
MH #1-118	Develop a forum for interagency communication and cooperative planning and preparedness activities (Disaster Committee).	Disaster Management	Ongoing	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-119	Prepare pre-scripted messages for use in emergency response and recovery.	Health & Human Services	Ongoing	X	X	X	X	X
MH #1-120	Include Health & Human Services in all City-wide disaster exercises.	Disaster Management	Ongoing	X	X	X	X	X
MH #1-121	Identify funds for specialized equipment for public health emergency response activities.	Health & Human Services	Ongoing	X				X
MH #1-122	Conduct pharmaceutical stockpile exercise.	Health & Human Services	1 year	X	X	X	X	X
MH #1-123	Conduct regional forums on public health disasters.	Health & Human Services	1-5 years		X		X	
MH #1-124	Maintain and regularly exercise Health and Human Services staff and functions.	Health & Human Services	yearly	X				X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-125	Train Health and Human Services staff on ICS and SEMS.	Health & Human Services	1-2 years	X	X		X	X
MH #1-126	Train community on Public Health's role in a disaster.	Health & Human Services	1-2 years	X	X		X	
MH #1-127	Train first responders on Public Health's role in first responder and disaster responsibilities.	Health & Human Services	1-2 years	X	X	X	X	X
MH #1-128	Prepare Mental Health response plan to disasters.	Health & Human Services	1-5 years	X	X	X	X	X
MH #1-129	Develop a Memorandum of Understanding with the American Red Cross on mutual aid with Public Health.	Health & Human Services	1 year	X			X	
MH #1-130	Enhance public health communications to meet City's first response standards.	Health & Human Services	1-2 years	X		X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-131	Work with first responders on force protection issues for pharmaceutical distribution sites.	Health & Human Serivces	1-5 years	X		X	X	X
MH #1-132	Exercise Health Department evacuation capacity to a natural disaster event.	Health & Human Services	yearly	X			X	X
MH #1-133	Exercise Health Department's Department Operations Center in response to natural diaster evacuation exercise.	Health & Human Services	yearly	X				X
MH #1-134	Maintain Health Department Safety Committee and provide appropriate staff training as determined by City's Safety Department.	Health & Human Services	Ongoing	X				X
MH #1-135	Develop a platform for intra-departmental and inter-agency cooperation.	Disaster Management	Completed 11/2004	X	X	X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
MH #1-136	Develop a process to ensure coordination between PIOs from all City departments.	Disaster Management	Completed	X	X	X	X	X
MH #1-137	Seek funding to enhance existing USAR capabilities (done through grants).	Disaster Management	Completed FY 2004					X
MH #1-138	Upgrade existing EOC with technology to better communicate with the operational area and the public.	Disaster Management	Ongoing	X	X	X	X	X
Earthquake Action Items								
EQ #2-1	Integrate new earthquake hazard mapping data for the City and improve technical analysis of earthquake hazards.	GIS/Technology Services	Ongoing	X	X		X	X
EQ #2-2	Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.	Mitigation Committee	Immediate		X		X	

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
EQ #2-3	Conduct seismic strength evaluations of critical facilities in the City to identify vulnerabilities for mitigation of City-owned and occupied, and public infrastructure to meet current seismic standards.	Public Works	1-2 years	X	X	X	X	X
EQ #2-4	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.	Planning & Building	1-2 years	X	X		X	
EQ #2-5	Research and evaluate possibility of adopting retrofitting requirement for different classes of structures.	Planning & Building	1-5 years	X				

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
EQ #2-6	Rehabilitate bridges and coordinate seismic deficiencies noted in the Los Angeles County's Annual Bridge Inspection Report.	Public Works	Tentative FY 2008	X				X
EQ #2-7	Seek funding to update the City's Seismic Safety Element of the General Plan.	Planning & Building	Annually	X	X	X	X	X
EQ #2-8	Input historical bore locations to complete Earthquake Fault GIS data for use in future Threat Assessments.	Technology Services - GIS	Ongoing	X		X		
EQ #2-9	Identify and require seismic retrofitting of unreinforced masonry buildings.	Planning & Building	Ongoing	X				
EQ #2-10	Promote and provide technical information for voluntary retrofitting of existing structures.	Planning & Building	Ongoing	X	X			

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
Flood Action Items								
FLD #3-1	Develop better flood warning systems.	Public Works, Planning & Building	1-3 years	X	X	X	X	X
FLD #3-2	Enhance data and mapping for floodplain information within the City and identify and map flood-prone areas outside of designated floodplains.	Technology Services	Ongoing	X	X	X	X	X
FLD #3-3	Analyze each repetitive flood property within the City and identify feasible mitigation options.	Public Works, Property Management, Planning & Building	2 years	X			X	
FLD #3-4	Recommend revisions to requirements for development within the floodplain, where appropriate.	Planning & Building	2 years	X		X	X	
FLD #3-5	Identify surface water drainage obstructions for all parts of the City.	Public Works	2 years	X	X	X		X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
FLD #3-6	Continue to compile and coordinate surface water management plans and data throughout the City.	Public Works	Ongoing	X	X	X		X
FLD #3-7	Enact a local ordinance that prohibits draining, filling, or construction of buildings, roads, or other infrastructure in designated wetlands. This would help to protect the flood-control function of the wetland, preserve water quality, and ensure adequate in-stream flow.	Planning & Building	1 year	X		X	X	X
FLD #3-8	Research and prepare a policy that identifies measures intended to minimize the risk of erosion.	Planning & Building	2-4 years	X	X	X		
FLD #3-10	Distribute information on the National Flood Insurance Program to local businesses in or near the floodplain.	City PIO	2 years	X	X		X	

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
FLD #3-11	Coordinate in-house training sessions on the regulations associated with NFIP.	Public Works	1-3 years	X	X		X	
FLD #3-12	Review the City's floodplain ordinance to be sure it is in full compliance with the NFIP.	Public Works	1-3 years	X	X		X	
FLD #3-13	Encourage development of acquisition and management strategies to preserve open space for flood mitigation, bird habitats, and water quality in the floodplain.	Planning & Building	2 years			X		
FLD #3-14	Identify surface water drainage obstructions for all parts of the City.	Public Works	3 years	X		X		X
FLD #3-15	Improve drainage systems for the runways at Long Beach Airport.	Public Works	Tentative FY 2005	X				X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
FLD #3-16	Perform a feasibility study for assistance in restoring the estuarine ecosystem of the Colorado Lagoon, improving water quality, managing storm water, and supporting environmental education, safe public recreation, and coastal access.	Public Works	Tentative FY 2007	X	X	X	X	
FLD #3-17	Maintain and repair seawalls located in Downtown, Alamitos Bay and Naples Island.	Public Works	Ongoing through FY 2008	X		X		
FLD #3-18	Complete structural improvements to stormwater/urban runoff systems.	Public Works	Tentative FY 2008	X				
FLD #3-19	Regulate construction in designated floodplains via elevation of structures or flood proofing.	Planning & Building	Ongoing	X	X			

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
Earth Movement Mitigation Actions Items								
EM #4-1	Improve knowledge of earth movement hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.	Planning & Building	Ongoing	X	X	X		X
EM #4-2	Research and evaluate possible landslide warning system.	Disaster Management	3-5 years	X			X	X
EM #4-3	Limit activities in identified potential and historical landslide areas through regulations and public outreach.	Planning & Building	Ongoing	X	X			
EM #4-4	Improve knowledge of earth movement hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.	Public Works	2-4 years	X				X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
Windstorm Action Items								
WS #5-1	Continue to enhance programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.	Public Works, Parks, Recreation & Marine	Ongoing	X			X	X
WS #5-2	Encourage electrical utilities to use underground construction methods where possible to reduce power outages from windstorms.	City Manager's Executive Committee	Immediate			X	X	
WS #5-3	Increase public awareness of windstorm mitigation activities.	City PIO	1-2 years	X	X		X	
WS #5-4	Develop codes relating to wind-resistant building siting and construction.	Planning & Building	1-2 years	X	X			
Tsunami Action Items								
TSU #6-1	Secure funding to contract with a consultant to conduct a technical analysis of the tsunami threat.	Planning & Building	1 year	X		X	X	X

City of Long Beach
Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Increase Public Awareness	Environmental & Historical Preservation	Strengthen Partnerships	City Emergency Services
TSU #6-2	Implement findings of special research on tsunami threat to Long Beach coastal areas. Amend codes and regulations, as necessary.	Planning & Building	1-2 years	X			X	X
TSU #6-3	Train regulatory and response staff in tsunami threat.	Planning & Building	1-2 years	X			X	X
TSU #6-4	Develop and conduct training and exercises relating to tsunami response.	Disaster Management	3-5 years	X			X	X
TSU #6-5	Develop a warning system in the City to notify residents of impending tsunami activity.	Fire Department, Police Department	2-3 years	X	X			X
TSU #6-6	Develop a tsunami education campaign to prepare residents.	Mitigation Committee, American Red Cross	2-3 years	X	X			

Section 1

Introduction

Throughout the history of Long Beach, the residents of Long Beach have dealt with the various natural hazards affecting the area. Historical photos, journal entries, and local newspapers show that the residents of the area have experienced earthquakes, floods, earth movements, windstorms, and tsunamis.

Although early in Long Beach history there were fewer people in the area, the natural hazards adversely affected the lives of those who depended on the land and climate conditions for food and welfare. As the population of the City continued to increase, the exposure to natural hazards created an even higher risk than had ever been experienced in Long Beach history.

The City of Long Beach is located in the southwest quadrant of Los Angeles County, and offers the benefits of living in a Mediterranean type of climate. The City is characterized by the unique and attractive landscape that makes the area so popular. However, the potential impacts of natural hazards associated with the terrain make the environment and population vulnerable to natural disasters.

The City is subject to earthquakes, flooding, earth movements, windstorms, and tsunamis. It is impossible to predict exactly when these disasters will occur, or the extent to which they will affect the City. However, with careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, it is possible to minimize the losses that can result from these natural disasters.

Following is a summary of the disaster events in Long Beach history:

- 1992 Civil Unrest - $2,900,000 in federal public assistance.
- 1992 Winter Storms - $200,000 in federal public assistance.
- 1993 Winter Storms - $300,000 in federal public assistance.
- 1994 Northridge Earthquake - $90,000 in federal public assistance.
- 1995 Flooding - $597,149 in federal public assistance.
- 1998 – El Nino Storms - $204,742 in federal public assistance.

Why Develop a Mitigation Plan?

As the cost of damage from natural disasters continues to increase, the community realizes the importance of identifying effective ways to reduce vulnerability to disasters. Natural hazard mitigation plans assist communities in reducing risk from natural hazards by identifying resources, information, and strategies for risk reduction, while helping to guide and coordinate mitigation activities throughout the City.

The plan provides a set of action items to reduce risk from natural hazards

through education and outreach programs and to foster the development of partnerships, and implementation of preventative activities such as land use programs that restrict and control development in areas subject to damage from natural hazards.
The resources and information within the Mitigation Plan:

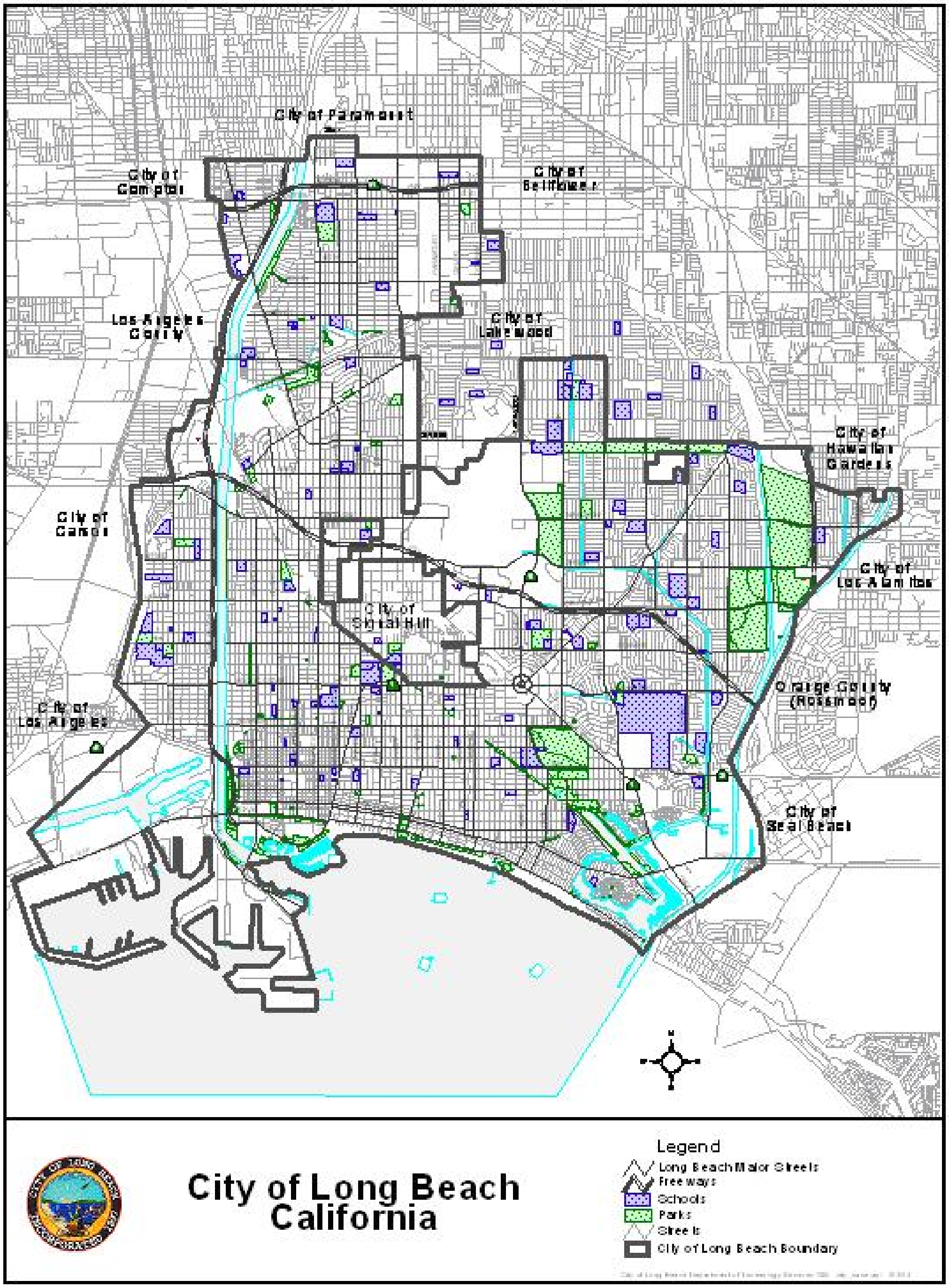
(1) Establish a basis for coordination and collaboration among agencies and the public in City of Long Beach;
(2) Identify and prioritize future mitigation projects; and
(3) Assist in meeting the requirements of federal assistance programs.

The mitigation plan works in conjunction with other city plans, including the Multi-Hazard Functional Plan.

Whom Does the Mitigation Plan Affect?

The City of Long Beach Natural Hazards Mitigation Plan affects the entire city. Map 1-1 shows major roads in the City of Long Beach. This plan provides a framework for planning for natural hazards. The resources and background information in the plan is applicable city-wide, and the goals and recommendations can lay groundwork for other local mitigation plans and partnerships.

Map 1-1: Base Map of City of Long Beach
(Source: City of Long Beach GIS)



Natural Hazard Land Use Policy in California

Planning for natural hazards should be an integral element of any city's land use planning program. All California cities and counties have General Plans and the implementing ordinances that are required to comply with the statewide planning regulations.

The continuing challenge faced by local officials and state government is to keep the network of local plans effective in responding to the changing conditions and needs of California's diverse communities, particularly in light of the very active seismic region in which we live.

This is particularly true in the case of planning for natural hazards where communities must balance development pressures with detailed information on the nature and extent of hazards.

Planning for natural hazards, calls for local plans to include inventories, policies, and ordinances to guide development in hazard areas. These inventories should include the compendium of hazards facing the community, the built environment at risk, the personal property that may be damaged by hazard events and most of all, the people who live in the shadow of these hazards.

Support for Natural Hazard Mitigation

All mitigation is local, and the primary responsibility for development and implementation of risk reduction strategies and policies lies with local jurisdictions. Local jurisdictions, however, are not alone. Partners and resources exist at the regional, state and federal levels. Numerous California state agencies have a role in natural hazards and natural hazard mitigation. Some of the key agencies include:

- The Governor's Office of Emergency Services (OES) is responsible for disaster mitigation, preparedness, response, recovery, and the administration of federal funds after a major disaster declaration;

- The Southern California Earthquake Center (SCEC) gathers information about earthquakes, integrates this information on earthquake phenomena, and communicates this to end-users and the general public to increase earthquake awareness, reduce economic losses, and save lives.

- The California Division of Forestry (CDF) is responsible for all aspects of wildland fire protection on private, state, and administers forest practices regulations, including landslide mitigation, on non-federal lands.

- The California Division of Mines and Geology (DMG) is responsible for geologic hazard characterization, public education, the development of partnerships aimed at reducing risk, and exceptions (based on science-based refinement of tsunami inundation zone delineation) to state mandated tsunami zone restrictions; and

- The California Division of Water Resources (DWR) plans, designs, constructs, operates, and maintains the State Water Project; regulates dams; provides flood protection and assists in emergency management. It also educates the public, serves local water needs by providing technical assistance.

- The California Seismic Safety Commission(CSSC) investigates and manages for the State of California earthquake related issues throughout the State through a comprehensive 11 point Loss Reduction Plan program, which serves as the State's strategic plan, guiding State executive and legislative branches with overall implementation strategies and priorities for seismic safety. The Commission's activities include but are not limited to promoting world-class earthquake research, sponsoring and/or reviewing earthquake related legislation, advising the Legislature and Governor on policies and programs needed to reduce earthquake risks throughout California, educating professionals and the general public about earthquake risk and how to better deal with them, and creating specialized committees of experts to investigate specific policy areas and recommend regulatory and policy changes.

Plan Methodology

Information in the Mitigation Plan is based on research from a variety of sources. Staff from the City of Long Beach conducted data research and analysis, facilitated Planning Team meetings and public outreach activities, and developed the final mitigation plan. The research methods and various contributions to the plan include:

Input from the Planning Team:

The Natural Hazards Mitigation Advisory Committee convened seven times to guide development of the Mitigation Plan. The Advisory Committee played an integral role in developing the mission, goals, and action items for the Mitigation Plan. The Advisory Committee consisted of representatives of 14 local agencies, including:

City of Long Beach	City Manager's Office
	Fire Department
	Disaster Management
	Technology Services – GIS

	Planning & Building
	Community Development
	Police Department
	Public Works Department
	Harbor Department
	Water Department
	Department of Health and Human Services

Stakeholder Interviews:

City staff distributed copies of the Plan draft to 23 agencies and/or specialists from organizations interested in natural hazards planning. The data and support gained from the review process was very valuable to the overall planning effort. A complete listing of all stakeholders (reviewers) is located in Appendix B: Public Participation.

State and federal guidelines and requirements for mitigation plans:

Following are the Federal requirements for approval of a Natural Hazards Mitigation Plan:

- Open public involvement, with public meetings that introduce the process and project requirements.
- The public must be afforded opportunities for involvement in: identifying and assessing risk, drafting a plan, and public involvement in approval stages of the plan.
- Community cooperation, with opportunity for other local government agencies, the business community, educational institutions, and non-profits to participate in the process.
- Incorporation of local documents, including the local General Plan, the Zoning Ordinance, the Building Codes, and other pertinent documents.

The following components must be part of the planning process:

- Complete documentation of the planning process
- A detailed risk assessment on hazard exposures in the community
- A comprehensive mitigation strategy, which describes the goals & objectives, including proposed strategies, programs & actions to avoid long-term vulnerabilities
- A plan maintenance process, which describes the method and schedule of monitoring, evaluating and updating the plan and integration of the Natural Hazards Mitigation Plan into other planning mechanisms

- Formal adoption by the City Council
- Plan Review by both State OES and FEMA

These requirements are spelled out in greater detail in the following plan sections and supporting documentation.

Public participation opportunities were created through use of local media, the City's website, distribution of a natural hazards questionnaire, and the City Council public meeting. In addition, the makeup of the plan implementation Committee insures a constant exchange of data and input from outside organizations (see Section 2: Plan Maintenance).

Through its consultant, Emergency Planning Consultants, the City had access to numerous existing mitigation plans from around the country, as well as current FEMA hazard mitigation planning standards (386 series).

Other reference materials consisted of county and city mitigation plans, including:

Clackamas County (Oregon) Natural Hazards Mitigation Plan
Six County (Utah) Association of Governments
Upper Arkansas Area Risk Assessment and Hazard Mitigation Plan
Urbandale-Polk County, Iowa Plan
Hamilton County, Ohio Plan
Natural Hazard Planning Guidebook from Butler County, Ohio

Hazard specific research: City of Long Beach staff collected data and compiled research on five hazards: earthquakes, flooding, earth movements, windstorms, and tsunamis. Research materials came from the City's General Plan, Threat Assessment contained in the Multi-Hazard Functional Plan, and state agencies including OES and CDF.

The City of Long Beach staff identified current mitigation activities, resources and programs, and potential action items from research materials and stakeholder interviews.

Public Input

The City of Long Beach encouraged public participation and input in the Natural Hazards Mitigation Plan by posting its activities in the media and on the internet. In addition, the City distributed and received over 650 natural hazards questionnaires (see Appendix B for results). During the review period for the Draft Plan, copies of the Plan were distributed to interested residents. A public meeting on the Draft Plan was held before the City Council on October 19, 2004. There was no public input gathered during the public hearing.

The resources and information cited in the mitigation plan provide a strong local perspective and help identify strategies and activities to make City of Long Beach more disaster resistant.

How Is the Plan Used?

Each section of the mitigation plan provides information and resources to assist people in understanding the City and the hazard-related issues facing citizens, businesses, and the environment. Combined, the sections of the plan work together to create a document that guides the mission to reduce risk and prevent loss from future natural hazard events.

The structure of the plan enables people to use a section of interest to them. It also allows City government to review and update sections when new data becomes available. The ability to update individual sections of the mitigation plan places less of a financial burden on the City. Decision-makers can allocate funding and staff resources to selected pieces in need of review, thereby avoiding a full update, which can be costly and time-consuming. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to City of Long Beach.

The mitigation plan is organized into three parts. Part I contains an executive summary, Mitigation Actions Matrix, introduction, and plan maintenance section. Part II contains a city profile, risk assessment, and hazard-specific sections. Part III includes the appendices. Each section of the plan is described below.

Part I: Mitigation Actions

Executive Summary: Hazard Mitigation Action Plan

The Action Plan provides an overview of the mitigation plan mission, goals, and action items.

> **Attachment 1: Mitigation Actions Matrix**
> The plan action items are included in this section, and address multi-hazard issues, as well as hazard-specific activities that can be implemented to reduce risk and prevent loss from future natural hazard events.

Section 1: Introduction

> The Introduction describes the background and purpose of developing the mitigation plan for City of Long Beach.

Section 2: Plan Maintenance

> This section provides information on plan implementation, monitoring and

evaluation.

Part II: Hazard Analysis

Section 3: Community Profile

This section presents the history, geography, demographics, and socioeconomics of the City of Long Beach. It serves as a tool to provide an historical perspective of natural hazards in the City.

Section 4: Risk Assessment

This section provides information on hazard identification, vulnerability and risk associated with natural hazards in City of Long Beach.

Sections 5-9: Hazard-Specific Sections

Hazard-Specific Sections on the five chronic hazards is addressed in this plan. Chronic hazards occur with some regularity and may be predicted through historic evidence and scientific methods. The chronic hazards addressed in the plan include:

Section 5: Earthquake
Section 6: Flooding
Section 7: Earth Movement (Debris Flow & Landslides)
Section 8: Windstorm
Section 9: Tsunami

Each Hazard-Specific Section includes information on the history, hazard causes and characteristics, and hazard assessment.

Part III: Resources

The plan appendices are designed to provide users of the City of Long Beach Natural Hazards Mitigation Plan with additional information to assist them in understanding the contents of the mitigation plan, and potential resources to assist them with implementation.

Appendix A: Plan Resource Directory

The resource directory includes City, regional, state, and national resources and programs that may be of technical and/or financial assistance to City of Long Beach during plan implementation.

Appendix B: Public Participation

This appendix includes specific information on the various public processes used during development of the plan.

Appendix C: Benefit/Cost Analysis

This section describes FEMA's requirements for benefit cost analysis in natural hazards mitigation, as well as various approaches for conducting economic analysis of proposed mitigation activities.

Appendix D: List of Acronyms

This section provides a list of acronyms for City, regional, state, and federal agencies and organizations that may be referred to within the City of Long Beach Natural Hazards Mitigation Plan.

Appendix E: Glossary

This section provides a glossary of terms used throughout the plan.

Section 2:

Plan Maintenance

The Plan Maintenance Section details the formal process that will ensure that the Natural Hazards Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the Plan annually and producing a plan revision every five years. This section describes how the City will integrate public participation throughout the plan maintenance process. Finally, this Section includes an explanation of how the City of Long Beach government intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the City's General Plan, Capital Improvement Plans, and Building and Safety Codes.

Monitoring and Implementing the Plan

Plan Adoption

The City Council will be responsible for adopting the Natural Hazards Mitigation Plan. This governing body has the authority to promote sound public policy regarding natural hazards. Once the plan has been adopted, the City's Hazard Mitigation Coordinator will be responsible for submitting it to the State Hazard Mitigation Officer at The Governor's Office of Emergency Services. The Governor's Office of Emergency Services will then submit the plan to the Federal Emergency Management Agency (FEMA) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the City will gain eligibility for Hazard Mitigation Grant Program funds.

Coordinating Body

The City Manager will appoint an Executive Committee consisting of department managers that will be responsible for providing leadership and guidance to the Natural Hazards Mitigation Advisory Committee. The City Manager's Executive Committee (Executive Committee) will likely consist of managers from the following departments:

City of Long Beach	City Manager's Office
	Fire Department
	Disaster Management
	Technology Services – GIS
	Planning & Building
	Community Development

	Police Department
	Public Works Department
	Harbor Department
	Water Department
	Department of Health and Human Services

The Executive Committee will at least once a year to conduct the annual evaluation of the Mitigation Plan. The meetings will provide an opportunity to discuss the progress made by the Natural Hazards Mitigation Advisory Committee (Mitigation Committee).

Convener

Upon approval of the Plan by the City Council, the City Manager (or designee) will convene a joint meeting of the City Manager's Executive Committee and the Mitigation Committee. The purpose of the joint meeting will be to clarify the roles and responsibilities of the two Committees, as well as to establish an annual schedule and assign tasks for implementing the Plan. The Mitigation Committee will serve as a working committee, while the Executive Committee will be ultimately responsible for implementation and evaluation of the Natural Hazards Mitigation Plan.

Implementation through Existing Programs

The City addresses statewide planning goals and legislative requirements through its General Plan, Capital Improvement Plans, and City Building and Safety Codes. The Natural Hazards Mitigation Plan provides a series of recommendations - many of which are closely related to the goals and objectives of existing planning programs. The City will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

The City's Building & Safety Department is responsible for administering the Building & Safety Codes. In addition, the Executive Committee will work with other agencies at the state level to review, develop and ensure Building & Safety Codes that are adequate to mitigate or present damage by natural hazards. This is to ensure that life-safety criteria are met for new construction.

The goals and action items in the mitigation plan may be achieved through activities recommended in the City's Capital Improvement Plans (CIP). Various City departments develop CIP plans, and review them on an annual basis. Upon annual review of the CIPs, the Executive Committee will work with the City departments to identify action items in the Natural Hazards Mitigation Plan consistent with CIP planning goals and integrate them where appropriate.

Economic Analysis of Mitigation Projects

FEMA's approaches to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis.

Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later.

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards can provide decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Given federal funding, the Executive Committee will use a FEMA-approved benefit/cost analysis approach to identify and prioritize mitigation action items. For other projects and funding sources, the Team will use other approaches to understand the costs and benefits of each action item and develop a prioritized list. For more information regarding economic analysis of mitigation action items, please see Appendix C: Benefit/Cost Analysis.

Evaluating and Updating the Plan

Formal Review Process

The Natural Hazards Mitigation Plan will be updated on an annual basis to determine the effectiveness of programs, and to reflect changes in land development or programs that may affect mitigation priorities. The convener or designee will be responsible for contacting the Executive Committee members and organizing the annual meeting.

Members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan.

The Executive Committee will review the goals and action items to determine their relevance to changing situations in the City, as well as changes in State or Federal policy, and to ensure they are addressing current and expected conditions. The Executive Mitigation Committee will also review the Risk Assessment portion of the Plan to determine if this information should be updated or modified, given any new available data. The coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised.

The convener will assign the duty of updating the plan to one or more of the Committee members. The designated members will have three months to make appropriate changes to the Plan before submitting it to the rest of the Committee and presenting it to the City Council (or other authority). The Committee will also notify all holders of the City's Plan when changes have been made. Every five years the updated Plan will be submitted to the State Hazard Mitigation Officer and the Federal Emergency Management Agency for review.

Continued Public Involvement

The City is dedicated to involving the public directly in review and updates of the Natural Hazards Mitigation Plan. The City Manager's Executive Committee members will be responsible for the annual review and update of the plan.

The public will also have the opportunity to provide feedback about the Plan. Copies of the Plan will be catalogued and kept at all of the appropriate agencies in the City. The existence and location of these copies will be publicized in the quarterly city newsletter which reaches every household in the City. The plan also includes the address and the phone number of the City's Hazard Mitigation Coordinator, responsible for keeping track of public comments on the Plan.

In addition, copies of the Plan and any proposed changes will be posted on the City's Website. This site will also contain an email address and phone number to which people can direct their comments and concerns.

A public meeting will also be held after each annual evaluation or as deemed necessary by the Executive Committee. The meetings will provide the public a forum for which they can express its concerns, opinions, or ideas about the Plan. The Committee will be responsible for using City resources to publicize the annual public meetings and maintain public involvement through the public access cable channel, website, and local newspapers.

Section 3:

Community Profile

Why Plan for Natural Hazards in City of Long Beach?

Natural hazards have the potential to impact citizens, property, the environment, and the economy of the City of Long Beach. Earthquakes, flooding, earth movement, windstorm, and tsunamis have the potential to expose the City of Long Beach residents, businesses, and visitors to the financial and emotional costs of recovering after natural disasters. Long term risks associated with realized natural hazards increases as more people move to areas affected by natural hazards.

Even in those communities that are essentially "built-out" i.e., have little or no vacant land remaining for development; population density continues to increase when low density housing is replaced with medium and high density development projects.

The inevitability of experiencing natural hazards, and the growing population and activity within the City create an urgent need to develop strategies, coordinate resources, and increase public awareness to reduce risk and prevent loss from future natural hazard events. Identifying the risks posed by natural hazards, and developing strategies to reduce the impact of a hazard event can assist in protecting life and property of citizens and communities. Local residents and businesses can work together with the City to create a natural hazards mitigation plan that addresses the potential impacts of hazard events.

Geography and the Environment

The City of Long Beach has an area of 52 square miles and overlooks San Pedro Bay on the south coast of Los Angeles County. Long Beach is 22 miles south of downtown Los Angeles and 10 miles southwest of Anaheim.

According to the City's Multi-Hazard Functional Plan, the elevation ranges from a high of 60 feet in the northern portion of the City to a low of sea level along the coast.

Community Profile

The area comprising the City of Long Beach was first settled as a community in 1880 (Willmore City) and the City itself was incorporated on December 3, 1897.

The City is served by the following major highways:

710 Long Beach Freeway (North/South)

405 San Diego Freeway (North/South)
605 San Gabriel River Freeway (North/South)
Route 1 Pacific Coast Highway (along coastline)
22 Garden Grove Freeway
47 Terminal Island Freeway (East/West)

The Alameda Corridor Railroad serves the city with tracks in the area that parallels the 710 Freeway along the western border of the City. Passenger transportation is provided by Metro Blue Line: Long Beach to Los Angeles; and Metro Green Line: northern tip of Redondo Beach to Norwalk.

Major Rivers

The nearest major rivers are the Los Angeles River and the San Gabriel River. These Rivers have the potential to impact the City of Long Beach. Flood control measures to cope with infrequent but intense rainfall have been taken throughout the entire Los Angeles Basin. These flood control activities are under the auspices of the Los Angeles County Flood Control District and the U.S. Army Corps of Engineers, which work in conjunction with local municipalities. The City of Long Beach, like other local governments, must take certain measures to qualify for the National Flood Insurance Program of the Federal Department of Federal Emergency Management Agency (see Hazard-Specific Section: Flooding).

Climate

The climate of Long Beach, which is to the south of the San Gabriel Mountains, is considered subtropical (LA Basin is considered to be in a semi-aris climatic zone). Major precipitation contributing to the Los Angeles River Basin is primarily in the form of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snowfall is common at elevations above 5,000 feet during major storms followed by rapid melting. Major storms consist of one to several frontal systems which can last up to four or more days. Precipitation is greatly intensified due to orographic lift processes. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff quantities. The average annual rainfall ranges from 13.8 inches at sea level to 28.2 inches in the San Gabriel Mountains (Source: City of Long Beach Multi-Hazard Functional Plan).

Average temperatures in the City of Long Beach range from a low of 46 degrees in the winter months to a high of 83 degrees in the summer months. However the temperatures can vary over a wide range, particularly when the Santa Ana winds blow, bringing higher temperatures and very low humidity.

Minerals and Soils

According to the City's Public Safety Element of the General Plan, the City is located on the coastal margin of the Los Angeles Basin which is underlain by up to several hundred feet of unconsolidated continental sediments and over 15,000 feet of stratified sedimentary rocks of marine origin. The marine section is composed of interbedded units of sandstone, siltstone, and shale. The central portion of Long Beach has been elevated by regional uplift and local folding and faulting.

The physiographic features within the City can be separated into six rather distinct areas:

1) The row of low hills extending from Bixby Knolls southeasterly to Seal Beach and including Signal and Reservoir Hills;

2) The broad, slightly elevated marine terrace lying south of this row of Hills;

3) The Los Angeles River floodplain, known as the Dominguez Gap, lying along the western side of Long Beach;

4) The San Gabriel River floodplain and channel, known as the Alamitos Gap, in the northeasterly portion of the City;

5) The alluvial plain lying to the north of Bixby Knolls and Signal Hill; and

6) The coastal area including the sea bluffs, beach and barrier bars across the gap areas. The latter area along the seaward portions of the gap areas have been highly modified by dredging and landfill operations associated with construction of recreational and harbor facilities. The gap areas are of particular concern because of the large landfill areas and the shallow groundwater conditions.

Mineral resources consist of major reserves of oil and gas that have played a significant role in the historical development of the City. The City of Long Beach is situated over major oil fields related to geologic structures associated with Los Angeles Basin tectonics, primarily the Newport-Inglewood Structural Zone. Oil producing zones have been found in the Wilmington, Long Beach, and Seal Beach Oil Fields. No other mineral deposits of significance are located within the City.

Soil in the City has developed naturally over the unconsolidated and consolidated parent material unless modified by human activities. Natural soils in the Long Beach area consist of various mixtures of sandy, silty and clay loams.

Other Significant Geologic Features

The City of Long Beach, like most of the Los Angeles Basin, lie over one or more known earthquake generating faults. Other potentially active faults (i.e. blind thrust faults) may extend beneath the City and could pose a substantial threat to human life and property.

The major faults that have the potential to significantly affect the City and the greater Los Angeles Basin include the:

San Andreas
Newport – Inglewood – Rose Canyon
Palos Verdes
Compton Blind Thrust
San Clemente

The Los Angeles Basin has a history of powerful and relatively frequent earthquakes, dating back to the powerful 8.0+ San Andreas earthquake of 1857 which did substantial damage to the relatively few buildings that existed at the time. Paleoseismological research indicates that large (8.0+) earthquakes occur on the San Andreas fault at intervals between 45 and 332 years with an average interval of 140 years[1]. Other lesser faults have also caused very damaging earthquakes since 1857. Notable Los Angeles Basin earthquakes include the 1933 Long Beach Earthquake, the 1971 San Fernando Earthquake, the 1987 Whittier Earthquake and the 1994 Northridge Earthquake.

In addition, many areas in the Los Angeles Basin have sandy soils that are potentially subject to liquefaction. The City of Long Beach has identified areas potentially subject to liquefaction. Those areas are discussed in Section 5: Earthquake.

The City of Long Beach has also identified areas potentially subject to earth movement (see Section 7: Earth Movement).

Population and Demographics

According to the City's General Plan 2001 Housing Element, the City has a population of 481,000 in an area of 52 square miles.

The increasing number of people living in City of Long Beach creates more community exposure, and changes how agencies prepare for and respond to natural hazards. In the 1987 publication, Fire Following Earthquake issued by the All Industry Research Advisory Council, Charles Scawthorn explains how a

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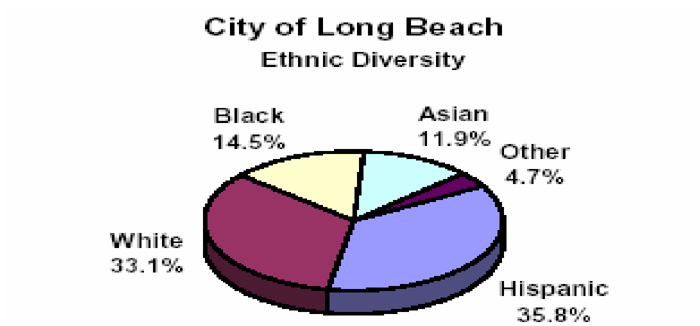
[1] Peacock, Simon M., http://aamc.geo.lsa.umich.edu/eduQuakes/EQpredLab/EQprediction.peacock.html

post-earthquake urban conflagration would develop. The conflagration would be started by fires resulting from earthquake damage, but made much worse by the loss of pressure in the fire mains, caused by either lack of electricity to power water pumps, and /or loss of water pressure resulting from broken fire mains.

Furthermore, increased density can affect risk. For example, narrower streets are more difficult for emergency service vehicles to navigate, the higher ratio of residents to emergency responders affects response times, and homes located closer together increase the chances of fires spreading.

Natural hazards do not discriminate, but the impacts in terms of vulnerability and the ability to recover vary greatly among the population. According to Peggy Stahl of the Federal Emergency Management Agency (FEMA) Preparedness, Training, and Exercise Directorate, 80% of the disaster burden falls on the public, and within that number, a disproportionate burden is placed upon special needs groups: women, children, minorities, and the poor.[2]

According the City's General Plan 2001 Housing Element, the demographic make up of the City is as follows:



The ethnic and cultural diversity suggests a need to address multi-cultural needs and services.

The percentage of residents living below poverty level in the City of Long Beach is 24.4% in 2003 according to the most recent census estimates. Out of all these residents, 37.7% are under 18 years old, and 11.0% are over 65. The overall median income in Long Beach is $36,662, compared to a national median of $43,318.

Vulnerable populations, including seniors, disabled residents, women, and children, as well as those people living in poverty, may be disproportionately impacted by natural hazards.

[2] www.fema.gov

Examining the reach of hazard mitigation policies to special needs populations may assist in increasing access to services and programs. FEMA's Office of Equal Rights addresses this need by suggesting that agencies and organizations planning for natural disasters identify special needs populations, make recovery centers more accessible, and review practices and procedures to remedy any discrimination in relief application or assistance.

The cost of natural hazards recovery can place an unequal financial responsibility on the general population when only a small proportion may benefit from governmental funds used to rebuild private structures. Discussions about natural hazards that include local citizen groups, insurance companies, and other public and private sector organizations can help ensure that all members of the population are a part of the decision-making processes.

Land and Development

Development in southern California from the earliest days was a cycle of boom and bust. The Second World War however dramatically changed that cycle. Military personnel and defense workers came to southern California to fill the logistical needs created by the war effort. The available housing was rapidly exhausted and existing commercial centers proved inadequate for the influx of people. Immediately after the war, construction began on the freeway system, and the face of southern California was forever changed. Home developments and shopping centers sprung up everywhere and within a few decades the central basin of Los Angeles County was virtually built out. This pushed new development further and further away from the urban center.

The General Plan addresses the use and development of private land, including residential and commercial areas. This Plan is one of the City's most important tools in addressing environmental challenges including transportation and air quality; growth management; conservation of natural resources; clean water and open spaces.

The environment of most Los Angeles County cities is nearly identical with that of their immediate neighbors and the transition from one incorporated municipality to another is seamless to most people. Seamless too are the exposures to the natural hazards that affect all of southern California.

Housing and Community Development
(Source: City of Long Beach General Plan, 2000 Census, and 2004 Technical Background Report for the City’s General Plan Update)

Development Type (Major Categories)	
Residential	47.4%

Commercial	8.6%
Institutional	6.6%
Industrial	6.2%
Open Space & Parks	7.5%
Housing Type	
Single-Family	46%
Multi-Residential (20+ units)	15.5%
Mobilehomes	1.3%
Housing Statistics	
Total Available Housing Units	171,632
Owner-Occupied Housing	95%
Average Household Size	2.77
Average Home Value	$375,000

Employment and Industry
(Source: 2000 Census)

Principal Employment Activities	
Management (professional and related occupations)	34.3%
Sales and Office Occupations	27.2%
Service Occupations	15.8%
Production, Transportation, and Material Moving	14.8%
Construction	7.7%
Major Industries	
Education, Health & Social Services	21.1%
Manufacturing	14.4%
Professional	10.7%

Retail Trade	10.3%
Finance, Insurance, Real Estate	9.5%

The City of Long Beach municipal government employs approximately 5,942 staff members. The largest public employer is Long Beach Unified School District with 11,096 employees. The largest private employer in the City is Boeing which manufactures commercial and military aircraft, employing approximately 10,500.

The Port of Long Beach opened in 1911 and has been developed and managed by the City of Long Beach Harbor Department with their staff of approximately 350 employees. The Board of Harbor Commissioners acts as a landlord and leases or assigns the facilities to private firms who operate the port facilities. The net income from this activity is invested in port development. These development plans for the next decade will require a $2 billion investment.

Currently, the Port provides 30,000 jobs, or one in eight jobs in Long Beach. It offers 316,000 jobs, or one in twenty-two jobs available in the five county southern California regions. Nationally, 1.4 million jobs are related to the Long Beach-generated trade. Also, the City of Long Beach is home to the second busiest container port in the Western Hemisphere. The Port processes over 65 million metric tons of cargo annually worth nearly $95.9 billion. This computation reflects the handling of more than 4.6 million containers (TEU's) which on average is equivalent of 12,000, 20-ft container (TEU) each day. Map 3-1 illustrates the location of the major employers in the City of Long Beach.

Mitigation activities are needed at the business level to ensure the safety and welfare of workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from surrounding areas to industrial and business centers. This creates a greater dependency on roads, communications, accessibility and emergency plans to reunite people with their families. Before a natural hazard event, large and small businesses can develop strategies to prepare for natural hazards, respond efficiently, and prevent loss of life and property.

Transportation and Commuting Patterns

Private automobiles are the dominant means of transportation in Long Beach. However, the City of Long Beach meets its public transportation needs through a mixture of a regional transit system (MTA), and various city contracted bus systems. MTA provides both bus and light rail service to the City of Long Beach and to the Los Angeles County metropolitan area. The Metro Blue Line runs from Long Beach to Los Angeles, while the Metro Green Line runs from the northern portion of Redondo Beach to Norwalk. In addition to this service, the City promotes alternative transportation activities.

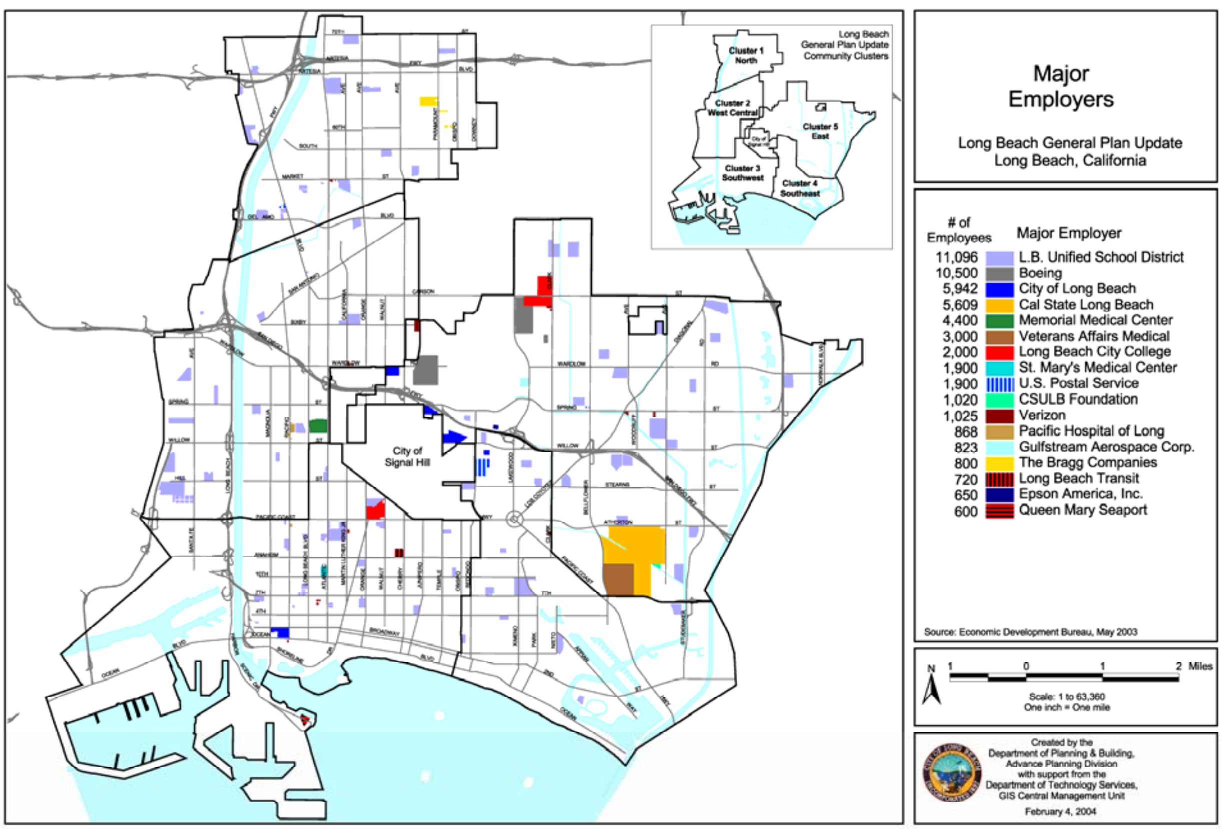
According to the 2001 Housing Element, the City has a population of 481,000 and with a daytime population around 26,729 individuals or 20% +. Within one mile of downtown Long Beach, the population is measured at 165,113. At five miles from downtown Long Beach, the population is measured greater at 363, 937. The mean travel time to work for the residents of the City of Long Beach is 28.7 minutes (2000 Census).

As stated in the City's General Plan, the City of Long Beach is served by the Interstate 5, Freeways 105, 110, 405, 605, and 710 connecting the City to adjoining parts of Los Angeles County. The City's 815 mile road system includes 259 miles of arterial highways, 556 miles of local roads, and 165 bridges.

As daily transit rises, there is an increased risk that a natural hazard event will disrupt the travel plans of residents across the region, as well as local, regional and national commercial traffic.

Localized flooding can render roads unusable. A severe winter storm has the potential to disrupt the daily driving routine of hundreds of thousands of people. Natural hazards can disrupt automobile traffic and shut down local and regional transit systems.

Map 3-1: Major Employers in the City of Long Beach (Source: City of Long Beach Department of Planning and Building-Advanced Planning)



Municipal Services

The City provides a full range of municipal services, including police and fire, public health and environmental services, library, parks, recreation and related social services, engineering and public works, sanitation, general administration, planning and community development, public improvements, and gas, water, airport and towing services. The City also operates and maintains a world-class international deep-water harbor, a nationally recognized convention center, several beaches and marinas. Long Beach is one of only three cities in California with its own Health Department and Energy Department and the only city in California with its own Oil Department, which manages close to 2,000 oil wells.

The City has 6.5 miles of beaches, 468 acres of navigable waterways, and two City- owned and operated marinas. The City of Long Beach hosts an abundance of cultural and recreational opportunities including the Convention Center, Cruise ship terminals, the Queen Mary which attracts 1.5 million visitors annually, and lastly, the Long Beach Aquarium, drawing over five million visitors a year.

Specific tourism events include:

- Toyota Grand Prix of Long Beach is held annually in April to an estimated audience of 225,000 racing enthusiasts.
- Gay Pride Parade is a 3-day event held annually in May with crowds as high as 100,000.
- Long Beach International City Marathon is held annually and attracts 10,000 participants.
- Jazz Festival is held annually in September with an audience of 6000-8000 jazz fans.
- The Sea Festival, a citywide-city sponsored annual event with 20,000+ attendees.
- Belmont Shores Christmas Parade, held in December, with an audience of 10,000 participants/viewers.
- Belmont Shores Car Show, an auto showcase that attracts 10,000 automobile enthusiasts.

Section 4:

Risk Assessment

What is a Risk Assessment?

Conducting a risk assessment can provide information: on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. Specifically, the five levels of a risk assessment are as follows:

1) Hazard Identification
This is the description of the geographic extent, potential intensity and the probability of occurrence of a given hazard. Maps are frequently used to display hazard identification data. The City of Long Beach identified five major hazards that affect this geographic area. These hazards – earthquakes, flooding, earth movement, windstorms, and tsunamis - were identified through an extensive process that utilized input from the Natural Hazards Mitigation Advisory Committee. The geographic extent of each of the identified hazards has been identified by the City utilizing the maps contained in the City's General Plan and the MHFP Threat Assessment that are illustrated in the tables, maps, and photos listed on page iii.

2) Profiling Hazard Events
The maps help to describe the causes and characteristics of each hazard and what part of the City's population, infrastructure, and environment may be vulnerable to each specific hazard. A profile of each hazard discussed in this plan is provided in each hazard section. For a full description of the history of hazard specific events, please see the appropriate hazard chapter.

3) Vulnerability Assessment/Inventorying Assets
This is a combination of hazard identification with an inventory of the existing (or planned) property development(s) and population(s) exposed to a hazard. Critical facilities are of particular concern because these facilities provide critical products and services to the general public that are necessary to preserve the welfare and quality of life in the City and fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities have been identified and are illustrated in Table 4-2 (Risk Assessment – Attachment 1).

4) Risk Analysis
Estimating potential losses involves assessing the damage, injuries, and financial costs likely to be sustained in a geographic area over a given period of time. This level of analysis involves using mathematical models. The two measurable components of risk analysis are magnitude of the harm that may result and the likelihood of the harm occurring. Describing vulnerability in terms of dollar losses provides the community and the state with a common framework in which to

measure the effects of hazards on assets. For each hazard where data was available, quantitative estimates for potential losses have been included in the Hazard-Specific Sections.

5) Assessing Vulnerability/ Analyzing Development Trends

This step provides a general description of land uses and development trends within the community so that mitigation options can be considered in land use planning and future land use decisions. This plan provides comprehensive description of the character of the City in Section 3: Community Profile. This description includes the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns. Analyzing these components of the City can help in identifying potential problem areas and can serve as a guide for incorporating the goals and ideas contained in this mitigation plan into other community development plans.

Hazard assessments are subject to the availability of hazard-specific data. Gathering data for a hazard assessment requires a commitment of resources on the part of participating organizations and agencies. Each Hazard-Specific Section of the plan includes a discussion on hazard identification using data and information from City, County or State agency sources.

Regardless of the data available for hazard assessments, there are numerous strategies the City can take to reduce risk. These strategies are described in the action items detailed in each hazard section of this Plan. Mitigation strategies can further reduce disruption to critical services, reduce the risk to human life, and alleviate damage to personal and public property and infrastructure.

Federal Requirements for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201 include a requirement for risk assessment. This risk assessment requirement is intended to provide information that will help communities to identify and prioritize mitigation activities that will reduce losses from the identified hazards. There are five hazards profiled in the mitigation plan, including earthquake, flooding, earth movement, windstorms, and tsunami. The Federal criteria for risk assessment and information on how the City's Natural Hazards Mitigation Plan meets those criteria is outlined in Table 4-1.

Table 4-1: Federal Criteria for Risk Assessment

Section 322 Plan Requirement	How is this addressed?
Identifying Hazards	Each hazard section includes an inventory of the best available data sources that identify hazard areas. To the extent data are available; the existing maps identifying the location of the hazard were utilized. The Executive Summary and the Risk Assessment sections of the plan include a list of the hazard maps.
Profiling Hazard Events	Each hazard section includes documentation of the history, and causes and characteristics of the hazard in the City.
Assessing Vulnerability: Identifying Assets	Where data is available, the vulnerability assessment for each hazard addressed in the mitigation plan includes an inventory of all publicly owned land within hazardous areas. Each hazard section provides information on vulnerable areas in the City in the Community Issues section. Each hazard section also identifies potential mitigation strategies.
Assessing Vulnerability: Estimating Potential Losses:	The Risk Assessment Section of this mitigation plan identifies key critical facilities in the City and includes a map of these facilities. Vulnerability assessments have been completed for the hazards addressed in the plan, and quantitative estimates were made for each hazard where data was available.
Assessing Vulnerability: Analyzing Development Trends	The Community Profile Section of this plan provides a description of the development trends in the City, including the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns.

Critical and Essential Facilities

Critical facilities are those critical to government response and recovery activities (i.e., life safety and property and environmental protection) including: 911 centers, emergency operations centers, police and fire stations, public works facilities, communications centers, sewer and water facilities, hospitals, bridges and roads, and shelters. Also, facilities that, if damaged, could cause serious secondary impacts may also be considered "critical."

A significant hazardous materials facility is one example of such a "secondary impact" type of critical facility.

Essential facilities are those facilities that are vital to the continued delivery of key government services or that may significantly impact the public's ability to recover from the emergency. These facilities may include: buildings such as the jail, law enforcement center, public services building, community corrections center, the courthouse, and juvenile services building and other public facilities such as schools. Table 4-2 illustrates the critical and essential facilities serving the City of Long Beach that are vulnerable to the identified natural hazards.

Summary

Natural hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. Natural hazard mitigation for industries and employers may include developing relationships with emergency management services and their employees before disaster strikes, and establishing mitigation strategies together. Collaboration among the public and private sector to create mitigation plans and actions can reduce the impacts of natural hazards.

Table 4-2: Critical Essential Facilities Vulnerable to Natural Hazards

ADDRESS	NAME	FLOOD	TSUNAMI	EQ	EM	WIND
One World Trade Center	LONG BEACH WORLD TRADE CENTER			X		X
3601 Dock Street (POLB)	DOW CHEMICAL / VOPAK	X	X	X		X
901 W. 12th Street	AIR PRODUCTS AND CHEMICAL			X		X
709 W. 16th Street	PACIFIC GAS EXCHANGE	X		X		X
6801 2nd Street	LB WATER DEPT - SEAWATER DESAL TEST FACILITY			X		X
598 E. Anaheim Street	SHELL OIL CO			X		X
2400 E. Artesia Blvd.	EDGINGTON OIL COMPANY INC			X		X
4901 E. Carson Street	LONG BEACH CITY COLLEGE			X		X
3976 Cherry Avenue	AIR GAS INDUSTRIES			X		X
4150 Donald Douglas Drive	GULFSTREAM AEROSPACE CORP.			X		X
420 Henry Ford Avenue	TIDELANDS OIL - TERMINAL ISLAND	X	X	X		X
1445 Judson Avenue	GLOBAL OIL PRODUCTION LLC	X		X		X
3495 Lakewood Blvd.	GULFSTREAM AEROSPACE			X		X
3855 Lakewood Blvd.	THE BOEING COMPANY			X		X
6605 Long Beach Blvd.	EQUILON #135454			X		X
1920 Lugger Way	PETRO DIAMOND TERMINAL CO		X	X		X
1305 E. Pacific Coast Highway	LONG BEACH CITY COLLEGE			X		X
1790 Palo Verde Avenue, #A	TEXACO REFINING AND MARKETING			X		X
5843 Paramount Blvd.	GLOBE GAS CORPORATION			X		X
5905 Paramount Blvd.	ARCO TERMINAL SERVICES CORP			X		X
230 S. Pico Avenue	TIDELANDS OIL - Z WATER INJECTION PLANT			X		X
1300 Pier B Street	ARCO TERMINAL SERVICES CORP			X		X
1850 Pier B Street	NATIONAL GYPSUM COMPANY		X	X		X
1400 Pier C Street, #B-56-57	ARCO TERMINAL SERVICES CORP	X	X	X		X
1405 Pier C Street, #C73	WORLD OIL CO	X	X	X		X
228 Pier D Avenue	TIDELANDS OIL - X&Y TANK FARM	X	X	X		X
1150 Pier E Street	TIDELANDS OIL - WATER INJECTION PLANT	X		X		X
750 Pier F Avenue	TIDELANDS OIL - MICELLAR PLANT		X	X		X
1004 Pier F Avenue	CHEMOIL LONG BEACH MARINE TERMINAL		X	X		X
1390 Pier F Avenue	TIDELANDS OIL - WATER INJECTION PLANT		X	X		X
1280 Pier J Avenue	TIDELANDS OIL - J WATER INJECTION PLANT		X	X		X
700 E. Shoreline Drive	SHORELINE MARINE FUEL			X		X
3333 E. Spring Street	GULFSTREAM AEROSPACE			X		X
692 Studebaker Road	EDISON PIPELINE & TERMINAL (EPTC)			X		X
3014 Studebaker Road	TOSCO AL-SAL OIL COMP.			X		X

Table 4-2: Critical Essential Facilities Vulnerable to Natural Hazards

ADDRESS	NAME	FLOOD	TSUNAMI	EQ	EM	WIND
300 Pier T Avenue (POLB)	BP / ARCO TERMINAL 1		X	X		X
1300 Pier B Street (POLB)	BP / ARCO TERMINAL 2			X		X
1400 West Pier C Street (POLB)	BP / ARCO TERMINAL 3	X	X	X		X
1004 Pier F Avenue Berth 209-21	CHEM-OIL MARINE TERMINAL		X	X		X
2665 W. Seaside Avenue (Pier T	NRG LONG BEACH GENERATION PLANT	X	X	X		X
1920 Lugger Way (POLB)	PETRO-DIAMOND TERMINAL COMPANY		X	X		X
949 Pier G Avenue (POLB)	TIDELANDS OIL PRODUCTION CO (TOPCO)		X	X		X
228 Pier D Avenue (POLB)	TOPKO X-Y TANK FARM	X	X	X		X
2402 E. Anaheim Street (POLB)	VALERO WILMINGTON REFINERY			X		X
1405 Pier C Street (POLB)	WORLD OIL LONG BEACH BERTH C73	X	X	X		X
3605 E. Spring St.	LONG BEACH TERMINAL II JET CENTER			X		X
5003 E 7th Street Long Beach, 90	BREITBURN			X		X
2665 W. Seaside Blvd	LONG BEACH GENERATION, LLC	X	X	X		X
6801 Westminster Avenue	HAYNES GENERATING STATION			X		X
690 N. Studebaker Rd.	AES PLANT			X		X
3605 E. Spring St.	FED EX			X		X
1200 Pier E Street (POLB)	CALIFORNIA UNITED TERMINAL		X	X		X
231 Windsor Way (POLB)	CARNIVAL CRUISE LINES		X	X		X
320 Golden Shore Drive (POLB)	CATALINA EXPRESS - CATALINA LANDING			X		X
301 Hanjin Road (POLB)	HANJIN SHIPPING	X	X	X		X
1281 Pier J Avenue (POLB)	INTERNATIONAL TRANSPORTATION SERVICE, INC.		X	X		X
1171 Pier F Avenue (POLB)	LONG BEACH CONTAINER TERMINAL		X	X		X
1521 Pier C Street (POLB)	MATSON TERMINAL	X	X	X		X
1521 Pier J Avenue (POLB)	PACIFIC CONTAINER TERMINAL		X	X		X
2401 E. Wardlow	BOEING FLIGHT SECURITY OPS, C-17			X		X
5001 Airport Plaza Drive, Suite 10	FEDERAL EXPRESS (LOADING CENTER)			X		X
4150 Donald Douglas Drive	GULFSTREAM AEROSPACE CORPORATION			X		X
1250 Bellflower Boulevard	CALIFORNIA STATE UNIVERSITY, LONG BEACH			X		X
6204 E. 2nd Street	CITY OF LONG BEACH MARINE MAINTENANCE		X	X		X
3980 E. 7th Street	VERIZON CALIFORNIA INCORPORATED			X		X
1411 W. 14th Street	NEXTEL COMMUNICATIONS	X		X		X
3333 Airport Way	LBUSD - FOOD SERVICE BRANCH			X		X
1126 Loma Avenue	SO CALIF EDISON CO (SUBSTATION)			X		X
4300 Long Beach Blvd.	NEXTEL COMMUNICATIONS			X		X
555 E. Ocean Blvd.	NEXTEL COMMUNICATIONS			X		X

Table 4-2: Critical Essential Facilities Vulnerable to Natural Hazards

ADDRESS	NAME	FLOOD	TSUNAMI	EQ	EM	WIND
415 W. Ocean Blvd.	LONG BEACH MUNICIPAL COURTS			X		X
501 W. Ocean Blvd.	GLEN ANDERSON FEDERAL BLDG. GENERAL SVS ADM.			X		X
3050 Orange Avenue	NEXTEL COMMUNICATIONS			X		X
3090 Pacific Avenue	AIRTOUCH CELLULAR			X		X
6801 Westminster Avenue	DEPT OF WATER & POWER-HAYNES			X		X
3500 Nimitz Road (POLB)	DEFENSE FUEL SUPPLY POINT, PIER T12		X	X		X
700 block of Hanjin Way (POLB)	SUB-STATION PIER A		X	X		X
2400 E Spring Street Long Beach	CNG			X		X
1800 E Wardlow Road Long Beac	CNG (WATER)			X		X
400 West Broadway Long Beach	CNG (POLICE)			X		X
120 Henry Ford Ave Long Beach	CNG (SERRF)	X	X	X		X
120 Henry Ford Ave Long Beach	SERRF	X	X	X		X
1835 Santa Fe Ave.	WEST POLICE DIVISION			X		X
1259 Pier F Avenue (POLB)	JACOBSEN PILOT SERVICE, INC.		X	X		X
2700 Nimitz Road (POLB)	SEA LAUNCH		X	X		X
2980 Nimitz Road, Pier T (POLB)	U.S. DEPARTMENT OF TRANSPORTATION		X	X		X
4100 East Donald Douglas Drive	LONG BEACH TERMINAL/DAUGHERTY FIELD			X		X
4600 East Spring St.	UNITED PARCEL SERVICE (LOADING CENTER)			X		X
2600 Temple Avenue	FLEET SERVICES REPAIR SHOP			X		X
2760 Studebaker Road	PARK MAINTENANCE/ADMINISTRATION			X		X
2400 Spring E. Street	LONG BEACH ENERGY CORPORATE YD.			X		X
700 E. Shoreline Drive	MARINA FUEL DOCK			X		X
4320 Olympic Plaza	BEACH MAINTENANCE YARD	X	X	X		X
2249 Argonne Avenue	FIRE TRAINING FACILITY			X		X
300 East Ocean Blvd.	LONG BEACH CONVENTION AND ENTERTAINMENT CENTER			X		X
401 Golden Shore 4th Floor	OFFICE OF THE CSU CHANCELLOR			X		X
4225 Donald Douglas Drive	TRANSPORTATION SECURITY ADMINISTRATION			X		X
2525 GRAND AVE	CITY OF LONG BEACH HEALTH DEPARTMENT			X		X
3820 CHERRY AVE	MILLER FAMILY HEALTH EDUCATION CENTER			X		X
1835 Santa Fe Avenue	POLICE SUBSTATION, WEST DIVISION			X		X
1725 San Francisco Avenue	PUBLIC SERVICE YARD			X		X
6204 East 2nd Street	MARINA FUEL DOCK/RESCUE BOATS		X	X		X
4100 East Donald Douglas Drive	LONG BEACH -DAUGHERTY FIELD			X		X
925 Harbour PIZ	FIRE DEPARTMENT HEADQUARTERS		X	X		X
100 Long Beach Blvd.	LONG BEACH POLICE DEPARTMENT--HEADQUARTERS			X		X

Table 4-2: Critical Essential Facilities Vulnerable to Natural Hazards

ADDRESS	NAME	FLOOD	TSUNAMI	EQ	EM	WIND
333 W. Ocean Blvd.	LONG BEACH CITY HALL			X		X
6509 GUNDRY AVE	FIRE STATION #12			X		X
225 MARINA DR	FIRE BOAT STATION #21		X	X		X
1645 E 3RD ST	FIRE STATION #2			X		X
411 LOMA AVE	FIRE STATION #4			X		X
7575 E. WARDLOW RD	FIRE STATION #5			X		X
2295 ELM AVE	FIRE STATION #7			X		X
5365 E 2ND ST	FIRE STATION #8	X	X	X		X
3917 LONG BEACH BLVD	FIRE STATION #9			X		X
PIER F, BERTH 202	FIRE BOAT STATION #15	X	X	X		X
2241 ARGONNE AVE	FIRE STATION #17			X		X
3361 PALO VERDE AVE	FIRE STATION #18			X		X
6340 ATHERTON ST	FIRE STATION #22			X		X
611 PIER T AVE	FIRE STATION #24		X	X		X
237 MAGNOLIA AVE	FIRE STATION #1			X		X
1222 DAISY AVE	FIRE STATION #3			X		X
2990 REDONDO AVE	ECOC			X		X
5580 CHERRY AVE	TELECOMMUNICATIONS FACILITY			X		X
100 N. Long Beach Blvd.	SOUTH POLICE DIVISION			X		X
3501 Lakewood Blvd.	LONG BEACH POLICE DEPT. FIELD SUPPORT			X		X
3440 California Ave.	VERIZON			X		X
5077 Lew Davis Street	VERIZON			X		X
3605 E. Spring St.	FED EX			X		X
1050 Linden Ave, Box 887	ST. MARY MEDICAL CENTER (TRAUMA CENTER)			X		X
2776 Pacific Avenue	PACIFIC HOSPITAL OF LONG BEACH			X		X
100 East Wardlow Road	HARBOR VIEW HOSPITAL			X		X
1200 Pier E Street (POLB)	CALIFORNIA UNITED TERMINAL		X	X		X
231 Windsor Way (POLB)	CARNIVAL CRUISE LINES		X	X		X
320 Golden Shore Drive (POLB)	CATALINA EXPRESS - CATALINA LANDING			X		X
301 Hanjin Road (POLB)	HANJIN SHIPPING	X		X		X
1281 Pier J Avenue (POLB)	INTERNATIONAL TRANSPORTATION SERVICE, INC.		X	X		X
1259 Pier F Avenue (POLB)	JACOBSEN PILOT SERVICE, INC.		X	X		X
1171 Pier F Avenue (POLB)	LONG BEACH CONTAINER TERMINAL		X	X		X
1521 Pier C Street (POLB)	MATSON TERMINAL	X		X		X
1521 Pier J Avenue (POLB)	PACIFIC CONTAINER TERMINAL		X	X		X

Table 4-2: Critical Essential Facilities Vulnerable to Natural Hazards

ADDRESS	NAME	FLOOD	TSUNAMI	EQ	EM	WIND
925 Harbor Plaza (POLB)	PORT OF LONG BEACH ADMINISTRATION BLDG.		X	X		X
2700 Nimitz Road (POLB)	SEA LAUNCH		X	X		X
2980 Nimitz Road, Pier T (POLB)	U.S. DEPARTMENT OF TRANSPORTATION		X	X		X
4100 East Donald Douglas Drive	LONG BEACH TERMINAL/DAUGHERTY FIELD			X		X
2401 E. Wardlow	BOEING FLIGHT SECURITY OPS, C-17			X		X
5001 Airport Plaza Drive, Suite 10	FEDERAL EXPRESS (LOADING CENTER)			X		X
4150 Donald Douglas Drive	GULFSTREAM AEROSPACE CORPORATION			X		X

Section 5: Earthquake Hazards in the City of Long Beach

Why Are Earthquakes a Threat to the City of Long Beach?

The most recent significant earthquake event affecting southern California was the January 17th 1994 Northridge Earthquake. At 4:31 A.M. on Monday, January 17, a moderate but very damaging earthquake with a magnitude of 6.7 struck the San Fernando Valley. In the following days and weeks, thousands of aftershocks occurred, causing additional damage to affected structures.

Fifty-seven people were killed and more than 1,500 people seriously injured. For days afterward, thousands of homes and businesses were without electricity; tens of thousands had no gas; and nearly 50,000 had little or no water. Approximately 15,000 structures were moderately to severely damaged, which left thousands of people temporarily homeless. 66,500 buildings were inspected. Nearly 4,000 were severely damaged and over 11,000 were moderately damaged. Several collapsed bridges and overpasses created commuter havoc on the freeway system. Extensive damage was caused by ground shaking, but earthquake triggered liquefaction and dozens of fires also caused additional severe damage. This extremely strong ground motion in large portions of Los Angeles County resulted in record economic losses.

However, the earthquake occurred early in the morning on a holiday. This circumstance considerably reduced the potential effects. Many collapsed buildings were unoccupied, and most businesses were not yet open. The direct and indirect economic losses ran into the 10's of billions of dollars.

The City of Long Beach is situated in the southern portion of the Los Angeles Basin. The Los Angeles Basin is a depositional basin that has been filled with clastic sediments for the last fifteen million years. The basin was opened by the tectonic forces of the Pacific plate moving against the North American plate. The primary tear in the rocks that marks this boundary is the San Andreas Fault (transform fault). The break is not just one simple tear but occurs in a broad swath across southern California that includes numerous right lateral strike slip, reverse, normal and thrust faults. The tectonic plate movements are shared by these faults. One of the faults, the Newport-Inglewood Fault diagonally crosses Long Beach. It was on this fault that the famous 1933 Long Beach Earthquake occurred. This fault is still considered the most probable source for an earthquake in the Long Beach area but recent studies suggest other faults might also be considered strong candidates to produce damaging earthquakes to the City and surrounding area. The California Geological Survey has estimated that an earthquake of Magnitude 7.0 is credible on the Newport-Inglewood Fault in the Long Beach area. Because of this, residents of Long Beach must expect to feel earthquakes. These earthquakes can be very destructive. California Geological Survey Special Bulletin 99 details an earthquake scenario for an earthquake that occurs in Long Beach. Damage to Long Beach and the infrastructure are estimated.

The history of fault activity in Long Beach is more complex than just the Newport-Inglewood Fault. This is evident by the oil fields in Long Beach. The Long Beach, Airport, Recreation Park and Seal Beach oil fields occur along the Newport-Inglewood Fault. The super-giant Wilmington Oil Field occurs between the Newport-Inglewood Fault and the Palos Verdes Fault. Each oil field is formed by rock deformations producing folded geologic strata and by the faulting. Each oil field has numerous faults. Only the faults within the Newport-Inglewood Fault Zone are considered active (movement within the last 11,000 years). The Palos Verdes Fault, just offshore of Long Beach, may be active but it has not been designated so by the California Geological Survey. The many faults within the Wilmington Oil Field are not considered active and have not shown any activity in the Holocene (11,000 years). The areas of active faulting have been designated by the California Geological Survey (Special Publication 42) as fault hazard areas and are subject to detailed investigation prior to development. The Earthquake Fault Zones for Long Beach are indicated on the Long Beach and Seal Beach Quadrangles as issued by the California Geological Survey. The evaluation work is administered by the City of Long Beach through the Planning and Building Department. Investigations are performed by geotechnical consultants retained by the developers and reviewed and approved by a representative of the Planning and Building Department. Actual site inspections of the investigations are performed by a Registered Geologist or a Certified Engineering Geologist representing Long Beach. The reports are filed at the City of Long Beach for reference.

Historical and geological records show that California has a long history of seismic events. Southern California is probably best known for the San Andreas Fault, a 400 mile long fault running from the Mexican border to a point offshore, west of San Francisco. “Geologic studies show that over the past 1,400 to 1,500 years large earthquakes have occurred at about 130 year intervals on the southern San Andreas Fault. As the last large earthquake on the Southern San Andreas occurred in 1857, that section of the fault is considered a likely location for an earthquake within the next few decades.”[1]

But San Andreas is only one of dozens of known earthquake faults that crisscross southern California. Some of the better known faults include the Newport-Inglewood, Whittier Narrows, Chatsworth, Elsinore, Hollywood, Los Alamitos, Puente Hills, and Palos Verdes Faults. Beyond the known faults, there are a potentially large number of “blind” faults that underlie the surface of southern California. One such blind fault was involved in the 1987 Whittier Narrows Earthquake. Recent studies suggest that a blind thrust fault extends, at least partially, beneath the City of Long Beach. The fault is referred to as the Compton Blind Thrust and is considered potentially active by the State of California.

Although the most famous of the faults, the San Andreas, is capable of producing an earthquake with a magnitude of 8+ on the Richter Scale, some of the “lesser” faults have the potential to inflict an even greater damage on the urban core of the Los Angeles Basin. Seismologists believe that a 6.0 earthquake on the Newport-Inglewood Fault would result in far more death and destruction than a “great” quake on the San Andreas, because the San Andreas is relatively remote from the urban centers of southern California. The Newport-Inglewood Fault, on the other hand, runs along the or near the coastline of Los Angeles and Orange Counties and directly through the heart of Long Beach. The rupture of this fault was the cause of the 1933 Long Beach Earthquake that killed 115 people.

For decades, partnerships have flourished between the USGS, Cal Tech, the California Geological Survey and universities to share research and educational efforts with Californians. Tremendous earthquake mapping and mitigation efforts have been made in California in the past two decades, and public awareness has risen remarkably during this time. Major federal, state, and local government agencies and private organizations support earthquake risk reduction, and have made significant contributions in reducing the adverse impacts of earthquakes. Despite the progress, the majority of California communities remain unprepared because there is a general lack of understanding regarding earthquake hazards among Californians.

Table 5-1: Earthquake Events in the Southern California Region

Southern California Region Earthquakes with a Magnitude 5.0 or Greater			
1769	Los Angeles Basin	1916	Tejon Pass Region
1800	San Diego Region	1918	San Jacinto
1812	Wrightwood	1923	San Bernardino Region
1812	Santa Barbara Channel	1925	Santa Barbara
1827	Los Angeles Region	1933	Long Beach
1855	Los Angeles Region	1941	Carpenteria
1857	Great Fort Tejon Earthquake	1952	Kern County
1858	San Bernardino Region	1954	W. of Wheeler Ridge
1862	San Diego Region	1971	San Fernando
1892	San Jacinto or Elsinore Fault	1973	Point Mugu
1893	Pico Canyon	1986	North Palm Springs
1894	Lytle Creek Region	1987	Whittier Narrows
1894	E. of San Diego	1992	Landers
1899	Lytle Creek Region	1992	Big Bear
1899	San Jacinto and Hemet	1994	Northridge
1907	San Bernardino Region	1999	Hector Mine

1910 Glen Ivy Hot Springs	

Source:
http://geology.about.com/gi/dynamic/offsite.htm?site=http%3A%2F%2Fpasadena.wr.usgs.gov%2Finfo%2Fcahist_eqs.html

To better understand the earthquake hazard, the scientific community has looked at historical records and accelerated research on those faults that are the sources of the earthquakes occurring in the southern California region. Historical earthquake records can generally be divided into records of the pre-instrumental period and the instrumental period. In the absence of instrumentation, the detection of earthquakes is based on observations and felt reports, and is dependent upon population density and distribution. Since California was sparsely populated in the 1800s, the detection of pre-instrumental earthquakes is relatively difficult. However, two very large earthquakes, the Fort Tejon in 1857 (7.9) and the Owens Valley in 1872 (7.6) are evidence of the tremendously damaging potential of earthquakes in southern California. In more recent times two 7.3 earthquakes struck southern California, in Kern County (1952) and Landers (1992). The damage from these four large earthquakes was limited because they occurred in areas which were sparsely populated at the time they happened. The seismic risk is much more severe today than in the past because the population at risk is in the millions, rather than a few hundred or a few thousand persons.

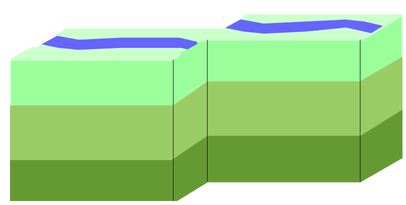
History of Earthquake Events in Southern California

Since seismologists started recording and measuring earthquakes, there have been tens of thousands of recorded earthquakes in southern California, most with a magnitude below three. No community in southern California is beyond the reach of a damaging earthquake. Figure 5-1 describes the historical earthquake events that have affected southern California.

Figure 5-1: Causes and Characteristics of Earthquakes in Southern California

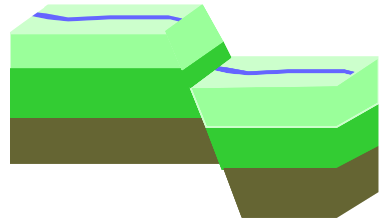
Earthquake Faults

A fault is a fracture along between blocks of the earth's crust where either side moves relative to the other along a parallel plane to the fracture.



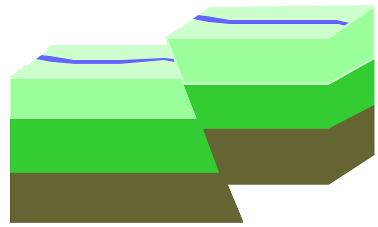
Strike-slip

Strike-slip faults are vertical or almost vertical rifts where the earth's plates move mostly horizontally. From the observer's perspective, if the opposite block looking across the fault moves to the right, the slip style is called a right lateral fault; if the block moves left, the shift is called a left lateral fault.



Dip-slip

Dip-slip faults are slanted fractures where the blocks mostly shift vertically. If the earth above an inclined fault moves down, the fault is called a normal fault, but when the rock above the fault moves up, the fault is called a reverse fault. Thrust faults have a reverse fault with a dip of 45 ° or less. Blind thrust faults are low angle thrusts that have no surface expression.



Dr. Kerry Sieh of Cal Tech has investigated the San Andreas Fault at Pallett Creek. "The record at Pallett Creek shows that rupture has recurred about every 130 years, on average, over the past 1500 years. But actual intervals have varied greatly, from less than 50 years to more than 300. The physical cause of such irregular recurrence remains unknown." [2] Damage from a great quake on the San Andreas would be widespread throughout Southern California.

Earthquake Related Hazards

Ground shaking, landslides, liquefaction, and amplification are the specific hazards associated with earthquakes. The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, earthquake magnitude, and the type of earthquake.

Ground Shaking

Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick unconsolidated soils will typically see more damage than buildings on consolidated soils and bedrock.

Earthquake-Induced Landslides

Earthquake-induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy the roads, buildings, utilities, and other critical facilities necessary to respond and recover from an earthquake. Many communities in southern California have a high likelihood of encountering such risks, especially in areas with steep slopes. Of particular importance to the City of Long Beach are earthquake induced submarine landslides that could be induced offshore on the edge of the continental shelf. The landslides would produce a tsunami that has the potential to cause significant damage along the coast, particularly in the harbor and marinas.

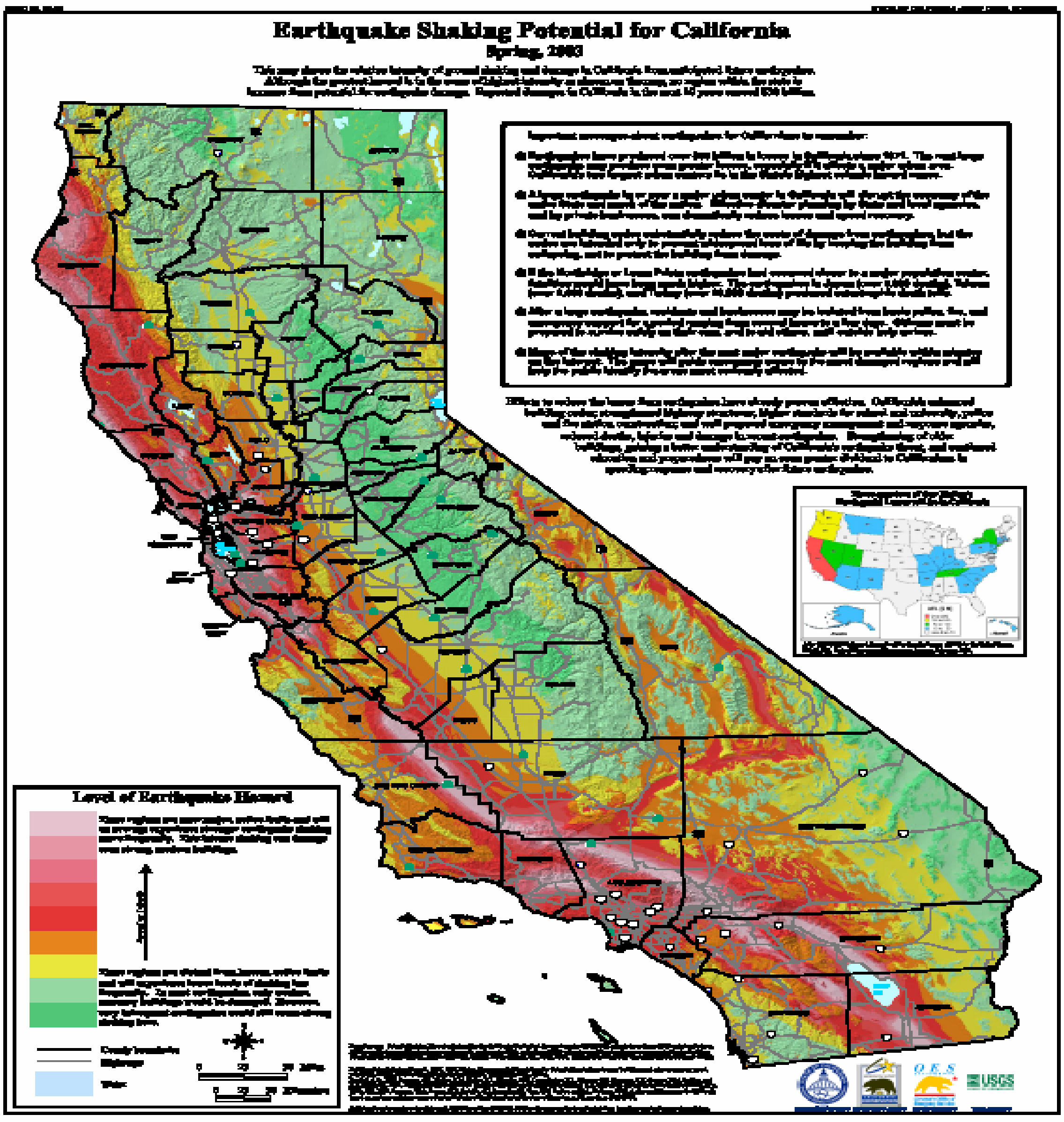
Liquefaction

Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support overlying weight. Buildings and their occupants are at risk when the ground can no longer support these structures. Many communities in southern California are built on ancient river floodplains and have groundwater saturated sandy soil. In some cases this ground may be subject to liquefaction, depending on the depth of the water table and specific makeup of the soil.

Amplification

Soils and soft sedimentary rocks near the earth's surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. The amount of amplification is influenced by surrounding geologic features, distance of the epicenter from the site, magnitude of the earthquake, the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk.[3] Amplification can also occur in areas with deep sediment filled basins and on ridge tops.

Map 5-1: Seismic Zones in California
(Source: State of California)



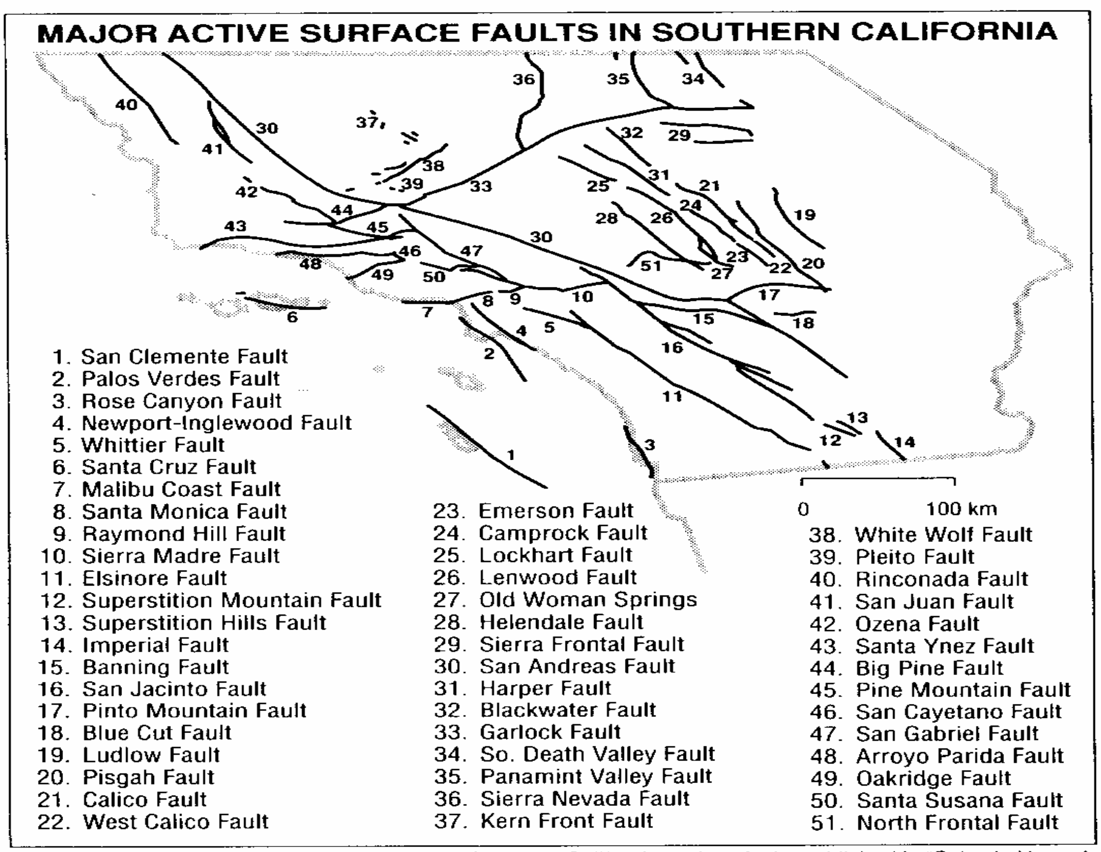
Earthquake Hazard Assessment

Hazard Identification

In California, many agencies are focused on seismic safety issues: the State's Seismic Safety Commission, the Applied Technology Council, Governor's Office of Emergency Services, United States Geological Survey, Cal Tech, the California Geological Survey as well as a number of universities and private foundations.

These organizations, in partnership with other state and federal agencies, have undertaken a rigorous program in California to identify seismic hazards and risks including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. Seismic hazard maps have been published and are available for many communities in California through the State Division of Mines and Geology. Map 5-2 illustrates the known earthquake faults in southern California.

Map 5-2: Major Active Surface Faults in Southern California (Source: City's Multi-Hazard Functional Plan)



Source: Adapted from the map of major active Southern California surface faults published in "Seismic Hazards in Southern California: Probable Earthquakes, 1994-2024," Southern California Earthquake Center.

In California, each major earthquake is followed by revisions and improvements in the Building Codes. The 1933 Long Beach Earthquake resulted in the Field Act, affecting school construction. The 1971 Sylmar Earthquake brought another set of increased structural standards. Similar re-evaluations occurred after the 1989 Loma Prieta Earthquake and 1994 Northridge Earthquake. These Code changes have resulted in stronger and more earthquake resistant structures.

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This state law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. Surface rupture is the most easily avoided seismic hazard.[4]

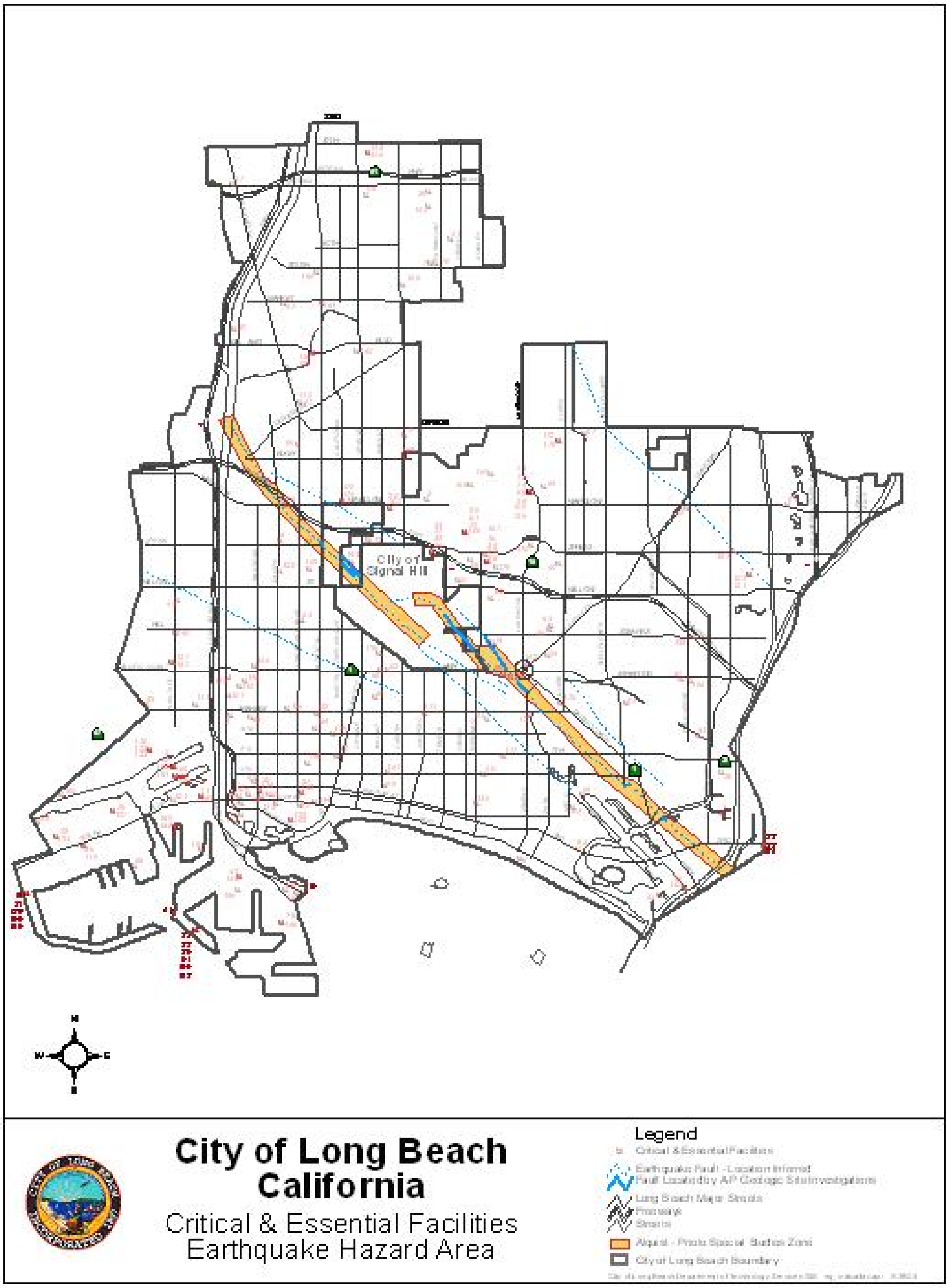
The Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides.[5] The State Department of Conservation operates the Seismic Mapping Program for California. Extensive information is available at their website: http://gmw.consrv.ca.gov/shmp/index.htm

Vulnerability Assessment

The effects of earthquakes span a large area, and large earthquakes occurring in many parts of the southern California region would probably be felt throughout the region. However, the degree to which the earthquakes are felt, and the damages associated with them may vary. At significant risk from a large nearby earthquake are older buildings and bridges (especially those predating the 1971 and 1933 earthquakes): many high tech and hazardous materials facilities: extensive sewer, water, and natural gas pipelines; earth dams; petroleum pipelines; and other critical facilities and private property located in the City. The relative or secondary earthquake hazards, which are liquefaction, ground shaking, amplification, and earthquake-induced landslides, can be just as devastating as the earthquake.

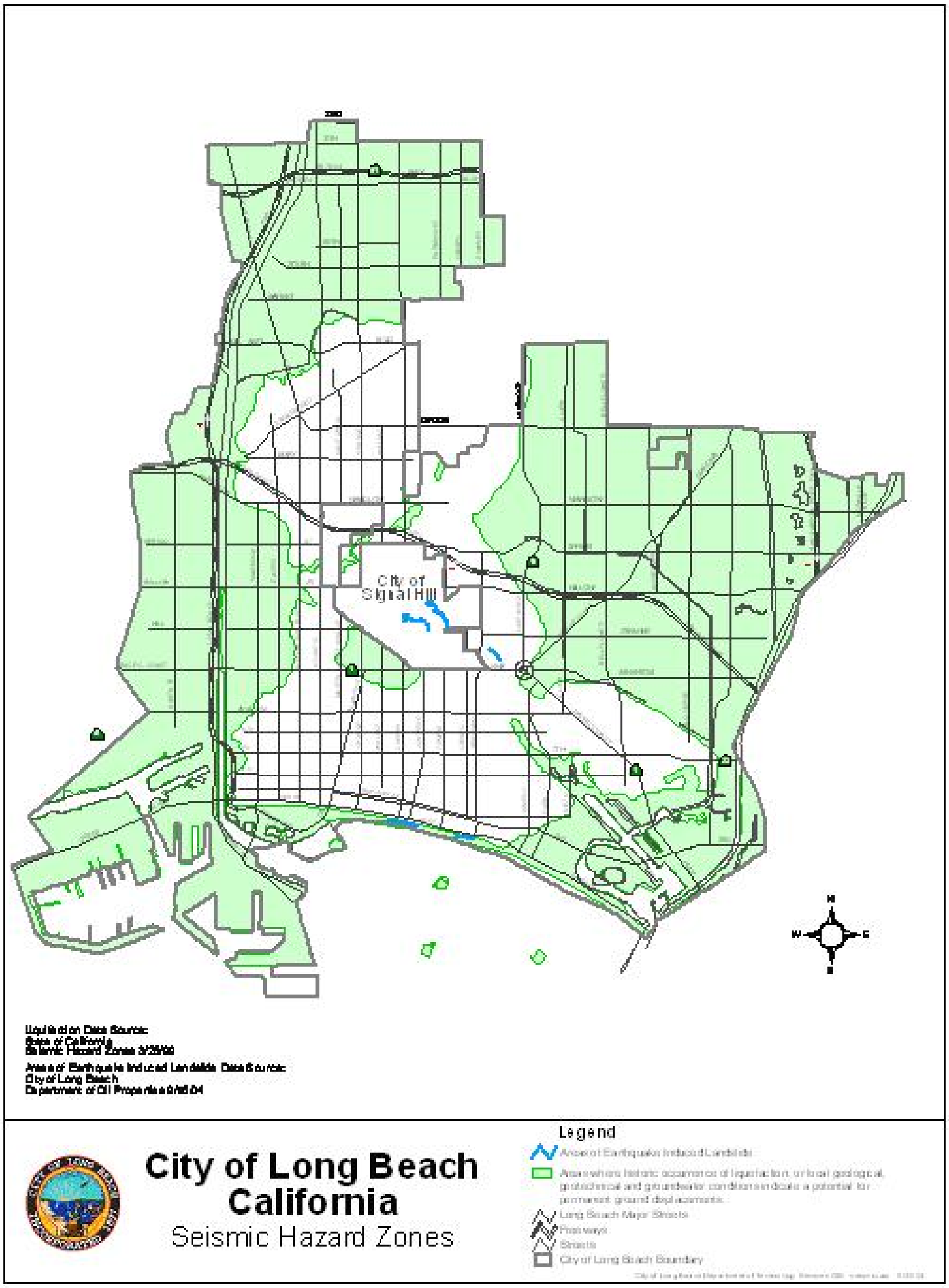
The California Geological Survey has identified areas most vulnerable to liquefaction. Locations in the City that have been identified by the California Geological Survey to have geologic hazards or are potentially susceptible to them are presented on the following pages.

Map 5-3 Earthquake Faults in the City of Long Beach
(Source: City of Long Beach General Plan – Public Safety Element/GIS)



The City has liquefaction zones as shown on Map 5-4: Liquefaction and EQ-Induced Landslide Area in the City of Long Beach. The majority of the City is susceptible to damages from liquefaction.

Map 5-4: Seismic Hazard Zones in Long Beach
(Source: City of Long Beach)



Risk Analysis

Risk analysis is the third phase of a hazard assessment. Risk analysis involves estimating the damage and costs likely to be experienced in a geographic area over a period of time[6]. Factors included in assessing earthquake risk include population and property distribution in the hazard area, the frequency of earthquake events, landslide susceptibility, buildings, infrastructure, and disaster preparedness of the region. This type of analysis can generate estimates of the damages to the region due to an earthquake event in a specific location. FEMA's software program, HAZUS, uses mathematical formulas and information about building stock, local geology and the location and size of potential earthquakes, economic data, and other information to estimate losses from a potential earthquake.[7] The HAZUS software is available from FEMA at no cost.

For greater southern California there are multiple worst case scenarios, depending on which fault might rupture, and which communities are in proximity to the fault. But damage will not necessarily be limited to immediately adjoining communities. Depending on the hypocenter of the earthquake, seismic waves may be transmitted through the ground to unsuspecting communities. In the Northridge 1994 Earthquake, Santa Monica suffered extensive damage, even though there was a range of mountains between it and the origin of the earthquake.

Damages for a large earthquake almost anywhere in southern California are likely to run into the billions of dollars. Although building codes are some of the most stringent in the world, ten's of thousands of older existing buildings were built under much less rigid codes. California has laws affecting unreinforced masonry buildings (URM's) and although many building owners have retrofitted their buildings, hundreds of pre-1933 buildings still have not been brought up to current standards.

In the 1980's, the City of Long Beach began a program to compel owners to retrofit their unreinforced masonry building. Of the original 936, only five buildings are not yet retrofitted.

Non-structural bracing of equipment and contents is often the most cost-effective type of seismic mitigation. Inexpensive bracing and anchoring may be the most cost effective way to protect expensive equipment. Non-structural bracing of equipment and furnishings will also reduce the chance of injury for the occupants of a building.

Community Earthquake Issues

What is Susceptible to Earthquakes?

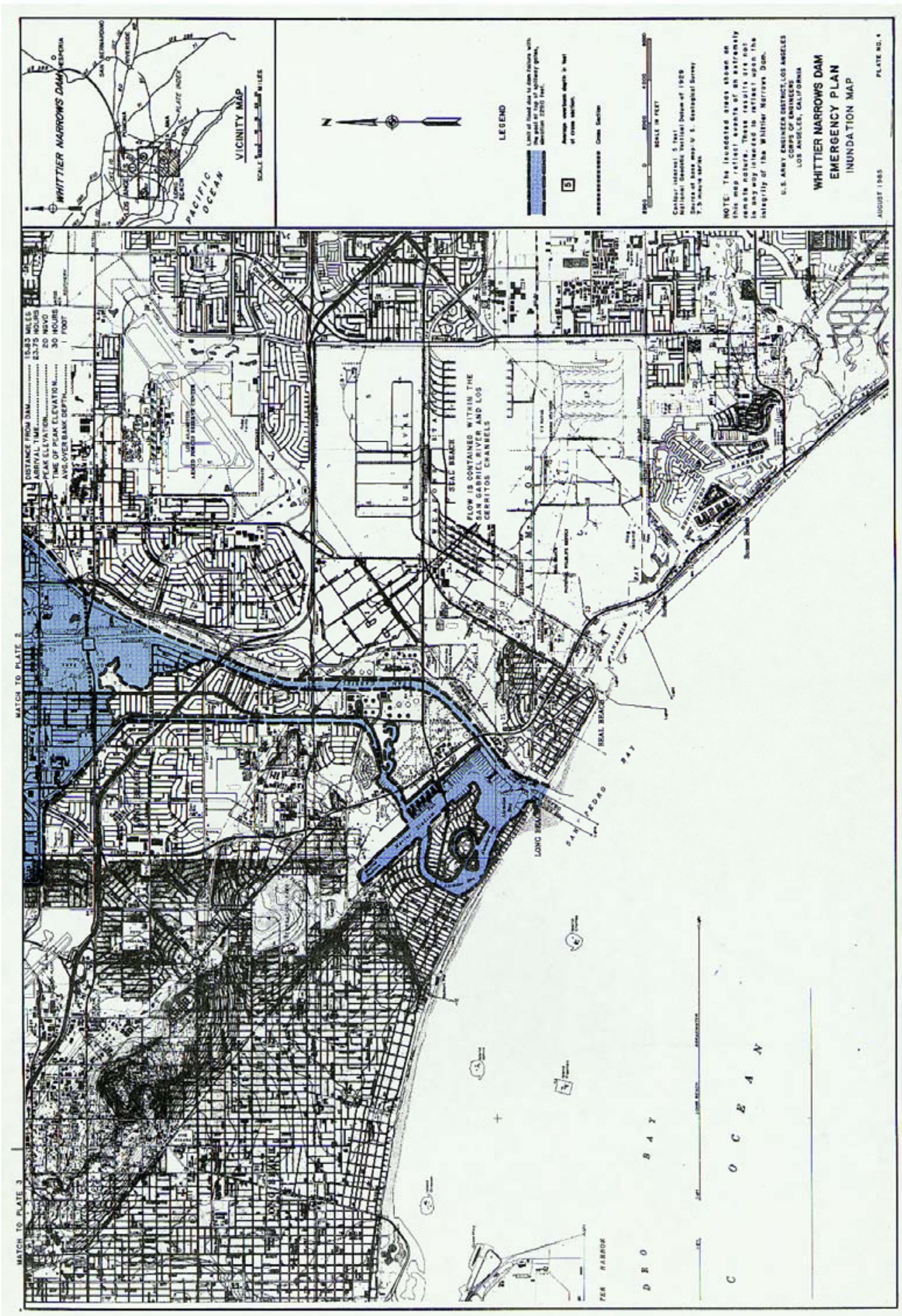
Earthquake damage occurs because humans have built structures that cannot withstand severe shaking. Buildings, airports, hospitals, schools, and lifelines (highways and utility lines) suffer damage in earthquakes and can cause death or injury to humans. The welfare of homes, major businesses, critical facilities, and public infrastructure is very important. Addressing the reliability of buildings, critical facilities, and infrastructure, and understanding the potential costs to government, businesses, and individuals as a result of an earthquake, are challenges faced by the city.

Dams

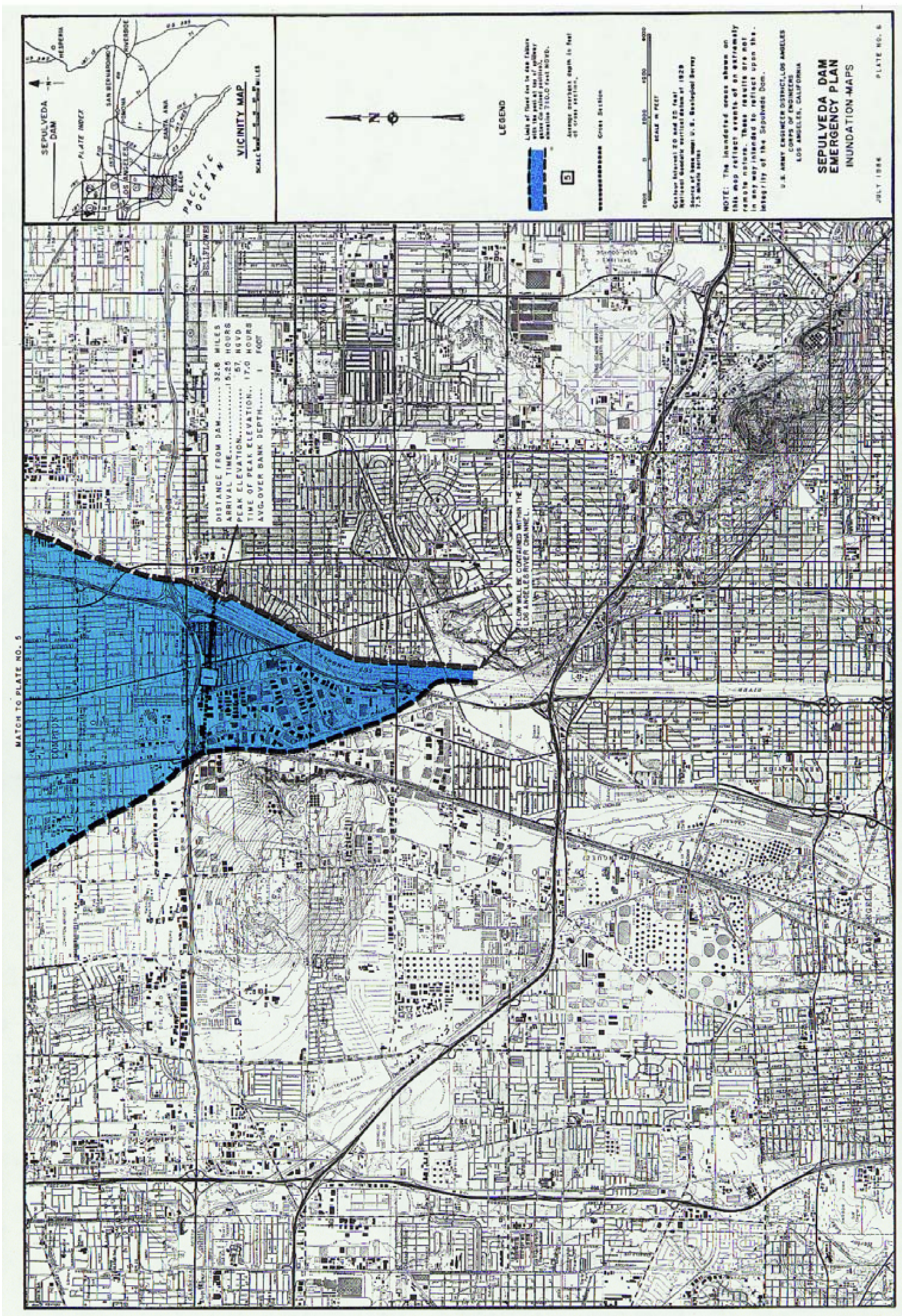
There are a total of 103 dams in Los Angeles County, owned by 23 agencies or organizations, ranging from the Federal government to Homeowner's Associations.[8] These dams hold billions of gallons of water in reservoirs. Releases of water from the major reservoirs are designed to protect Southern California from flood waters and to store domestic water. Seismic activity can compromise the dam structures, and the resultant flooding could cause catastrophic flooding. Following the 1971 Sylmar Earthquake the Lower Van Norman Dam showed imminent signs of structural compromise, and came within several feet of being overtopped and/or breached. Tens of thousands of persons had to be evacuated until the dam could be drained. The dam has never been refilled.

According to the City's General Plan Public Safety Element, three flood control dams lie upstream from the City: Sepulveda Basin, Hansen Basin, and Whittier Narrows Basin. The Sepulveda and Hansen Basins lie more than 30 miles upstream from where the Los Angeles River passes through the City. Due to the intervening low and flat ground and the distance involved, flood waters resulting from a dam failure at either of these locations would be expected to dissipate before reaching Long Beach. In the event of failure of the Whittier Narrows Dam while full, flooding could occur along both sides of the San Gabriel River where it passes through Long Beach but would probably be most severe on the east side of the river channel. Due to river flow, the probability of flooding as a result of seismically induced failure of these temporary flood retaining structures is considered to be very low.

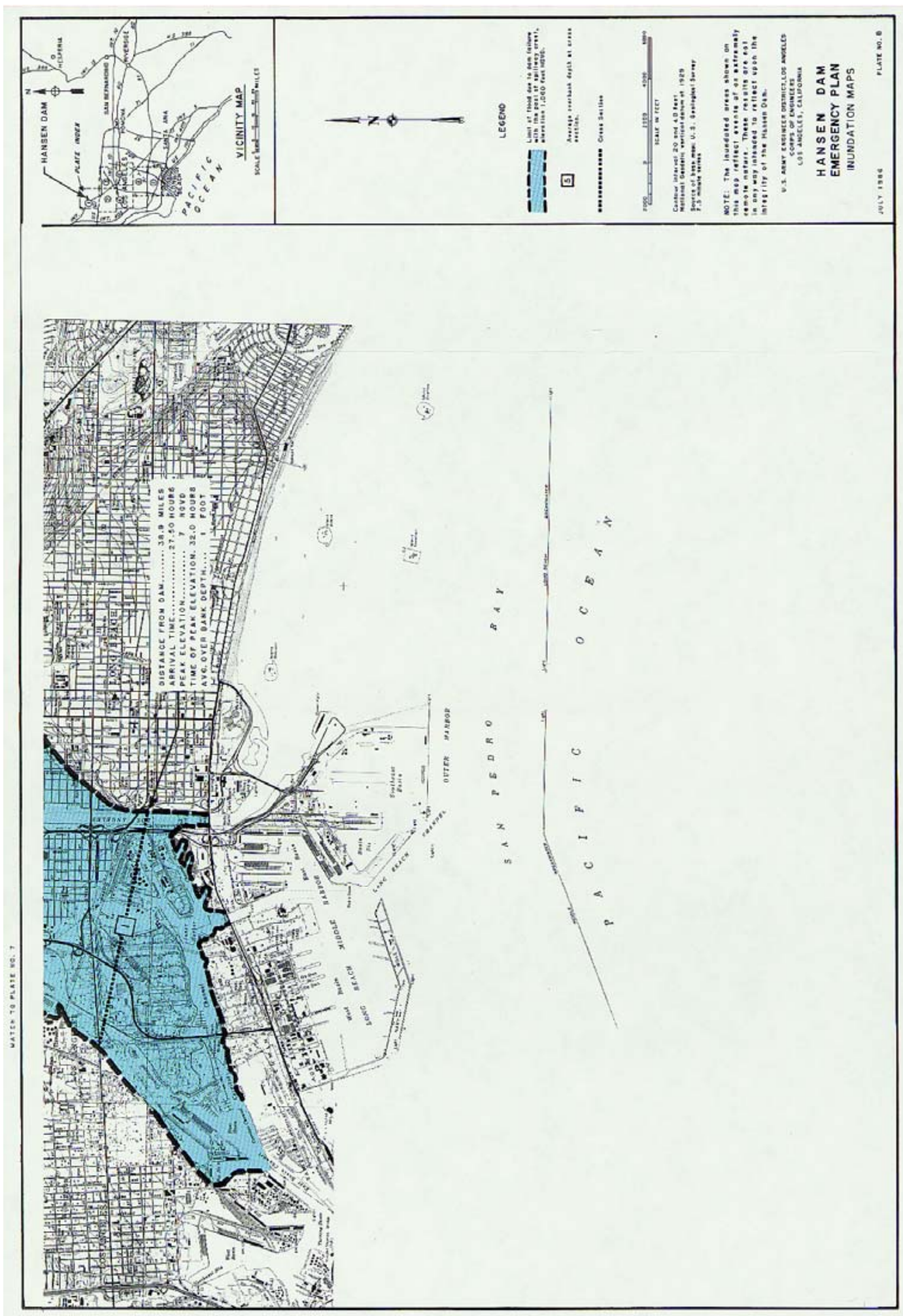
Map 5-5: Whittier Narrows Dam Failure Inundation Map
(Source: U.S. Army Corps of Engineers)



Map 5-6: Sepulveda Dam Failure Inundation Map
(Source: U.S. Army Corps of Engineers)



Map 5-7: Hansen Dam Failure Inundation Map
(Source: U.S. Army Corps of Engineers)



Buildings
The built environment is susceptible to damage from earthquakes. Buildings that collapse can trap and bury people. Lives are at risk and the cost to clean up the damages is great. In most California communities, including the City of Long Beach, many buildings were built before 1993 when building codes were not as strict. In addition, retrofitting is not required except under certain conditions and can be expensive. Therefore, the number of buildings at risk remains high. The California Seismic Safety Commission makes annual reports on the progress of the retrofitting of unreinforced masonry buildings.

Infrastructure and Communication
Residents in the City commute frequently by automobiles and public transportation such as buses and light rail. An earthquake can greatly damage bridges and roads, hampering emergency response efforts and the normal movement of people and goods. Damaged infrastructure strongly affects the economy of the community because it disconnects people from work, school, food, and leisure, and separates businesses from their customers and suppliers.

Bridges
Bridges are key points of concern during flood events because they are important links in road networks, river crossings, and they can be obstructions in watercourses, inhibiting the flow of water during flood events. The bridges in the City of Long Beach are state, county, city, or privately owned. A state-designated inspector must inspect all state, county, and city bridges every two years; but private bridges are not inspected, and can be very dangerous.

The inspections are rigorous, looking at everything from seismic capability to erosion and scour.

The highest priority bridges in the City of Long Beach are currently being upgraded by replacing the earthquake resistant bearing pads using county funds. These bridges include:

Table 5-2: Major Road Bridges of Los Angeles County

Bridge	City	Year Built	Span
Vincent Thomas Bridge	Los Angeles	1964	6,500 Ft.
Gerald Desmond Bridge	Long Beach	1968	5,134 Ft.
Commodore Schuyler F. Heim Lift Bridge	Long Beach	1946	3,976 Ft.

Bridge Damage

Even modern bridges can sustain damage during earthquakes, leaving them unsafe for use. Some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link - with even minor damages making some areas inaccessible. Because bridges vary in size, materials, location and design, any given earthquake will affect them differently. Bridges built before the mid-1970' s have a significantly higher risk of suffering structural damage during a moderate to large earthquake compared with those built after 1980 when design improvements were made.

Much of the interstate highway system was built in the mid to late 1960's. The bridges in the City are state, county or privately owned (including railroad bridges). Caltrans has retrofitted most bridges on the freeway systems; however there are still some county maintained bridges that are not retrofitted. The FHWA requires that bridges on the National Bridge Inventory be inspected every 2 years. Caltrans checks when the bridges are inspected because they administer the Federal funds for bridge projects. See Section 5: Earthquake Attachments for details on bridge retrofitting efforts.

Damage to Lifelines

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity, and communication networks. Ground shaking and amplification can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. Lifelines need to be usable after earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public.

Disruption of Critical Services

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after an earthquake event. Many critical facilities are housed in older buildings that are not up to current seismic codes. See Risk Assessment – Attachment 1 for a table showing critical and essential facilities vulnerable to earthquakes.

Businesses

Seismic activity can cause great loss to businesses, both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Seismic activity can create economic loss that presents a burden to large and small shop owners who may have difficulty recovering from their losses.

Forty percent of businesses do not reopen after a disaster and another twenty-five percent fail within one year according to the Federal Emergency Management Agency (FEMA). Similar statistics from the United States Small Business Administration indicate that over ninety percent of businesses fail within two years after being struck by a disaster.[9]

Individual Preparedness

Because the potential for earthquake occurrences and earthquake related property damage is relatively high in the City of Long Beach, increasing individual preparedness is a significant need. Strapping down heavy furniture, water heaters, and expensive personal property, as well as being earthquake insured, and anchoring buildings to foundations are just a few steps individuals can take to prepare for an earthquake.

Death and Injury

Death and injury can occur both inside and outside of buildings due to collapsed buildings falling equipment, furniture, debris, and structural materials. Downed power lines and broken water and gas lines can also endanger human life.

Fire

Downed power lines or broken gas mains may trigger fires. When fire stations suffer building or lifeline damage, quick response to extinguish fires is less likely. Furthermore, major incidents will demand a larger share of resources, and initially smaller fires and problems will receive little or insufficient resources in the initial hours after a major earthquake event. Loss of electricity may cause a loss of water pressure in some communities, further hampering fire-fighting ability.

Debris

After damage to a variety of structures, much time is spent cleaning up bricks, glass, wood, steel or concrete building elements, office and home contents, and other materials. Developing a strong debris management strategy is essential in post-disaster recovery. Disasters do not exempt the City from compliance with AB 939 regulations.

Existing Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that are being implemented by county, regional, state, or federal agencies or organizations.

City of Long Beach Codes

Implementation of earthquake mitigation policy most often takes place at the local government level. The City of Long Beach Department of Planning and Building enforces building codes pertaining to earthquake hazards.

The following sections of the California Building Code (CBC) address the earthquake hazard:

1605.2.1 (Distribution of Horizontal Shear);
1605.2.2 (Stability against Overturning);
1605.2.3 (Anchorage); and
1626-1635 (Earthquake Design);

The City of Long Beach Department of Planning and Building enforces the zoning and land use regulations relating to earthquake hazards.

Generally, these codes seek to discourage development in areas that could be prone to flooding, landslide, wildfire and/or seismic hazards; and where development is permitted, that the applicable construction standards are met. Developers in hazard-prone areas may be required to retain a qualified professional engineer to evaluate level of risk on the site and recommend appropriate mitigation measures
.

Coordination among Building Officials
The City's Building Code sets the minimum design and construction standards for new buildings. On September 12, 2002, the City adopted the most recent seismic standards in its building code, which requires that new buildings be built at a higher seismic standard.

Since the mid-1980's, the City of Long Beach has required that site-specific seismic hazard investigations be performed for new essential facilities, major structures, hazardous facilities, and special occupancy structures such as schools, hospitals, and emergency response facilities.

Businesses/Private Sector
Natural hazards have a devastating impact on businesses. In fact, of all businesses which close following a disaster, more than 43% never reopen, and an additional twenty-nine percent close for good within the next two years.[10] The Institute of Business and Home Safety has developed "Open for Business", which is a disaster planning toolkit to help guide businesses in preparing for and dealing with the adverse affects natural hazards. The kit integrates protection from natural disasters into the company's risk reduction measures to safeguard employees, customers, and the investment itself. The guide helps businesses secure human and physical resources during disasters, and helps to develop strategies to maintain business continuity before, during, and after a disaster occurs.

Hospitals
"The Alfred E. Alquist Hospital Seismic Safety Act ("Hospital Act") was enacted in 1973 in response to the moderate Magnitude 6.6 1971 Sylmar Earthquake when four major hospital campuses were severely damaged and evacuated. Two hospital buildings collapsed killing forty seven people. Three others were killed in another hospital that nearly collapsed.

In approving the Act, the Legislature noted that: "Hospitals, that house patients who have less than the capacity of normally healthy persons to protect themselves, and that must be reasonably capable of providing services to the public after a disaster, shall be designed and constructed to resist, insofar as practical, the forces generated by earthquakes, gravity and winds." (Health and Safety Code Section 129680)

When the Hospital Act was passed in 1973, the State anticipated that, based on the regular and timely replacement of aging hospital facilities, the majority of hospital buildings would be in compliance with the Act's standards within 25 years. However, hospital buildings were not, and are not, being replaced at that anticipated rate. In fact, the great majority of the State's urgent care facilities are now more than 40 years old.

The moderate Magnitude 6.7 Northridge Earthquake in 1994 caused $3 billion in hospital-related damage and evacuations. Twelve hospital buildings constructed before the Act were cited (red tagged) as unsafe for occupancy after the earthquake. Those hospitals that had been built in accordance with the 1973 Hospital Act were very successful in resisting structural damage. However, nonstructural damage (for example, plumbing and ceiling systems) was still extensive in those post-1973 buildings.

Senate Bill 1953 (“SB 1953”), enacted in 1994 after the Northridge Earthquake, expanded the scope of the 1973 Hospital Act. Under SB 1953, all hospitals are required, as of January 1, 2008, to survive earthquakes without collapsing or posing the threat of significant loss of life. The 1994 Act further mandates that all existing hospitals be seismically evaluated, and retrofitted, if needed, by 2030, so that they are in substantial compliance with the Act (which requires that the hospital buildings be reasonably capable of providing services to the public after disasters). SB 1953 applies to all urgent care facilities (including those built prior to the 1973 Hospital Act) and affects approximately 2,500 buildings on 475 campuses.

SB 1953 directed the Office of Statewide Health Planning and Development (“OSHPD”), in consultation with the Hospital Building Safety Board, to develop emergency regulations including “…earthquake performance categories with sub gradations for risk to life, structural soundness, building contents, and nonstructural systems that are critical to providing basic services to hospital inpatients and the public after a disaster.” (Health and Safety Code Section 130005)

The Seismic Safety Commission Evaluation of the State’s Hospital Seismic Safety Policies

In 2001, recognizing the continuing need to assess the adequacy of policies, and the application of advances in technical knowledge and understanding, the California Seismic Safety Commission created an Ad Hoc Committee to re-examine the compliance with the Alquist Hospital Seismic Safety Act. The formation of the Committee was also prompted by the recent evaluations of hospital buildings reported to OSHPD that revealed that a large percentage (40%) of California’s operating hospitals are in the highest category of collapse risk.”.[11]

California Earthquake Mitigation Legislation

California is painfully aware of the threats it faces from earthquakes. Dating back to the 19th Century, Californians have been killed, injured, and lost property as a result of earthquakes. As the State’s population continues to grow, and urban areas become even more densely developed, the risk will continue to increase. For decades the legislature has passed laws to strengthen the built environment and protect the citizens. Table 5-2 provides a sampling of some of the 200 plus laws in the State’s codes.

Table 5-3: Partial List of the Over 200 California Laws on Earthquake Safety

Government Code Section 8870-8870.95	Creates Seismic Safety Commission.
Government Code Section 8876.1-8876.10	Established the California Center for Earthquake Engineering Research.
Public Resources Code Section 2800-2804.6	Authorized a prototype earthquake prediction system along the Central San Andreas Fault near the City of Parkfield.
Public Resources Code Section 2810-2815	Continued the Southern California Earthquake Preparedness Project and the Bay Area Regional Earthquake Preparedness Project.
Health and Safety Code Section 16100-16110	The Seismic Safety Commission and State Architect, will develop a state policy on acceptable levels of earthquake risk for new and existing state-owned buildings.
Government Code Section 8871-8871.5	Established the California Earthquake Hazards Reduction Act of 1986.
Health and Safety Code Section 130000-130025	Defined earthquake performance standards for hospitals.
Public Resources Code Section 2805-2808	Established the California Earthquake Education Project.
Government Code Section 8899.10-8899.16	Established the Earthquake Research Evaluation Conference.
Public Resources Code Section 2621-2630 2621.	Established the Alquist-Priolo Earthquake Fault Zoning Act.
Government Code Section 8878.50-8878.52 8878.50.	Created the Earthquake Safety and Public Buildings Rehabilitation Bond Act of 1990.
Education Code Section 35295-35297 35295.	Established emergency procedure systems in kindergarten through grade 12 in all the public or private schools.
Health and Safety Code Section 19160-19169	Established standards for seismic retrofitting of unreinforced masonry buildings.
Health and Safety Code Section 1596.80-1596.879	Required all child day care facilities to include an Earthquake Preparedness Checklist as an attachment to their disaster plan.
Source: http://www.leginfo.ca.gov/calaw.html	

Earthquake Education

Earthquake research and education activities are conducted at several major universities in the Southern California region, including Cal Tech, USC, UCLA, UCSB, UCI, and UCSB. The local clearinghouse for earthquake information is the Southern California Earthquake Center located at the University of Southern California, Los Angeles, CA 90089, Telephone: (213) 740-5843, Fax: (213) 740-0011, Email: SCEinfo@usc.edu, Website: http://www.scec.org. The Southern California Earthquake Center (SCEC) is a community of scientists and specialists who actively coordinate research on earthquake hazards at nine core institutions, and communicate earthquake information to the public. SCEC is a National Science Foundation (NSF) Science and Technology Center and is co-funded by the United States Geological Survey (USGS).

In addition, Los Angeles County along with other southern California counties, sponsors the Emergency Survival Program (ESP), an educational program for learning how to prepare for earthquakes and other disasters. Many school districts have very active emergency preparedness programs that include earthquake drills and periodic disaster response team exercises.

End Notes

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[1] http://pubs.usgs.gov/gip/earthq3/when.html

[2] http://www.gps.caltech.edu/~sieh/home.html

[3] Planning for Natural Hazards: The California Technical Resource Guide, Department of Land Conservation and Development (July 2000)

[4] http://www.consrv.ca.gov/CGS/rghm/ap/

[5] Ibid

[6] Burby, R. (Ed.) Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities (1998), Washington D.C., Joseph Henry Press.

[7] FEMA HAZUS http://www.fema.gov/hazus/hazus2.htm (May 2001).

[8] Source: Los Angeles County Public Works Department, March 2004

[9] http://www.chamber101.com/programs_committee/natural_disasters/DisasterPreparedness/Forty.htm

[10] Institute for Business and Home Safety Resources (April 2001),

[11] http://www.seismic.ca.gov/pub/CSSC_2001-04_Hospital.pdf

Attachment 5-1: Bridge Seismic Retrofit Request

COUNTY OF LOS ANGELES

DEPARTMENT OF PUBLIC WORKS

900 SOUTH FREMONT AVENUE
ALHAMBRA, CALIFORNIA 91803-1331
Telephone: (626) 458-5100
www.ladpw.org

JAMES A. NOYES, Director

ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1460
ALHAMBRA, CALIFORNIA 91802-1460

May 23, 2002

IN REPLY PLEASE REFER TO FILE: PD-2

The Honorable Board of Supervisors
County of Los Angeles
383 Kenneth Hahn Hall of Administration
500 West Temple Street
Los Angeles, CA 90012

Dear Supervisors:

REQUEST FOR JURISDICTION
BRIDGE SEISMIC RETROFIT PROGRAM
WILLOW STREET OVER COYOTE CREEK
CITY OF LONG BEACH
SUPERVISORIAL DISTRICT 4
4 VOTES

IT IS RECOMMENDED THAT YOUR BOARD:

Find that the project to retrofit the bridge on Willow Street over Coyote Creek to seismic structural standards is exempt from the California Environmental Quality Act, and adopt the enclosed Resolution declaring the portion of Willow Street over Coyote Creek in the City of Long Beach to be a part of the County System of Highways.

PURPOSE/JUSTIFICATION OF RECOMMENDED ACTION

Jurisdiction is requested in order that the County may administer a project to retrofit the bridge on Willow Street over Coyote Creek to seismic structural standards. Willow Street at this location is jurisdictionally shared between the Cities of Long Beach and Los Alamitos. Sections 1700-1702 of the California Streets and Highways Code provide that the board of supervisors of any county may, by a resolution adopted by a four-fifths vote of its members, declare any highway in the county lying in whole or part within a city to be a county highway.

The governing body of the affected city may consent to the establishment of such included portion as part of the county highway system. Thereafter, the board of supervisors of the county may acquire rights of way, construct, maintain, improve, or repair such highway in the same manner as other county highways, and may pay for such work with county funds.

Implementation of Strategic Plan Goals

This action meets the County's Strategic Plan Goal of Service Excellence. By retrofitting the bridge on Willow Street over Coyote Creek, residents of the County who travel on this bridge will benefit and their quality of life will be improved.

FISCAL IMPACT/FINANCING

Your Board's adoption of the enclosed Resolution will not directly result in any fiscal impact on the County. We will submit the project to your Board for approval to advertise a construction contract for the seismic retrofit improvements in August 2002. It should be noted that this project will be constructed as a Federal-aid project under the State Seismic Retrofit Program administered by the State of California. Under this program, the entire cost of the project will be financed with Federal and State funds. Funding for this project will be included in the proposed Fiscal Year 2002-03 Road Fund Budget.

FACTS AND PROVISIONS/LEGAL REQUIREMENTS

The Resolution has been approved as to form by County Counsel.

ENVIRONMENTAL DOCUMENTATION

The California Environmental Quality Act requires public agency decision makers to document and consider the environmental implications of their actions. The proposed project is statutorily exempt from the provisions of the California Environmental Quality Act pursuant to Section 21080 (b) (4) of the Public Resources Code and Section 180.2 of the Streets and Highways Code.

IMPACT ON CURRENT SERVICES (OR PROJECTS)

Following the Loma Prieta earthquake in the San Francisco Bay Area in October 1989, emergency State legislation known as Senate Bill 36X was enacted, which requires that all existing publicly-owned bridges in the State be inspected and that those found to have a seismic structural deficiency be upgraded and retrofitted to conform with specific structural standards. The bill further provides for the County of Los Alamitos to be the lead agency for inspecting and retrofitting all non-State highway bridges within Los Angeles County.

Willow Street is on the County's Highway Plan, and the proposed improvements are needed and of general County interest. The project is tentatively scheduled to be advertised for construction bids in September 2002, pending the City's consent to jurisdiction and the County obtaining the necessary State and Federal approvals. A "no-fee" construction permit will be obtained from the City of Los Angeles for work within their jurisdiction.

This jurisdiction will be relinquished after the completion of the project.

CONCLUSION

Upon the adoption of this Resolution, please return one certified copy to Public Works for transmittal to the City.

Respectfully submitted,

JAMES A. NOYES
Director of Public Works

ESC:yr
C012148
A:\WILLOW ST OVER COYOTE CK.wpd

Enc.

cc: Chief Administrative Office, County Counsel

RESOLUTION DECLARING THE PORTION OF WILLOW STREET OVER COYOTE CREEK IN THE CITY OF LONG BEACH TO BE A PART OF THE COUNTY SYSTEM OF HIGHWAYS

WHEREAS, by reason of its location and travel thereon, the portion of Willow Street over Coyote Creek, within the City of Long Beach, County of Los Angeles, State of California, should be a part of the County System of Highways, for the limited purpose of performing a seismic safety retrofit of the bridge at the aforementioned location; and

WHEREAS, it is the purpose of the Board of Supervisors of said County to construct the above-stated improvements and perform appurtenant work thereon provided the consent of the governing body of the City shall first be given.

NOW, THEREFORE, BE IT RESOLVED, by the Board of Supervisors of the County of Los Angeles, State of California, that the portion of Willow Street over Coyote Creek, within the City of Long Beach, is hereby declared to be a part of the System of Highways of said County as provided in Sections 1700 and 1704 inclusive of the Streets and Highways Code of the State of California for the purpose of, and limited to, the aforementioned work.

BE IT FURTHER RESOLVED, by the Board of Supervisors of the County of Los Angeles, State of California, that the County agrees:

1. That the County of Los Angeles shall not be responsible for any damage or liability occurring by reason of any roadway condition on the aforementioned street, within the City of Long Beach, existing prior to the start of construction by the County or following the completion and field acceptance of said construction.

2. That the work be performed by the County shall not include roadway maintenance activities on Willow Street over Coyote Creek, within the City of Long Beach, prior to the start of construction by the County or following the completion and field acceptance of said construction. The City of Long Beach shall be responsible for all roadway maintenance activities within its jurisdiction, except during the construction of improvements by the County.

The foregoing resolution was on the ______ day of ___________, 2002, adopted by the Board of Supervisors of the County of Los Angeles and ex-officio the governing body of all other special assessment and taxing districts, agencies, and authorities for which said Board so acts.

VIOLET VARONA-LUKENS
Executive Officer of the
Board of Supervisors of the
County of Los Angeles

By______________________________
Deputy

APPROVED AS TO FORM:

LLOYD W. PELLMAN
County Counsel

By______________________
Deputy

Attachment- 5-2: Seismic Retrofit Notice

August 15, 2002

NEWS -- Office of Supervisor Don Knabe

For release Aug. 20, subject to Board approval of Agenda Item 51
(Project I.D. No.CC6412)

For Immediate Release:

SEISMIC RETROFIT PLANNED FOR THE CITY OF LONG BEACH

SAN PEDRO (Aug. 20) -- Los Angeles County Supervisor Don Knabe announced plans to contract for seismic retrofitting of the Second Street bridge over the Alamitos Bay Channel in the City of Long Beach. This project is part of an ongoing program to retrofit city and county bridges to reduce the potential for failure during an earthquake.

This project is entirely within the City of Long Beach and will be constructed as a Federal-aid project under the State Seismic Retrofit Program. Under this program, the entire cost of the project will be financed with Federal and State funds.

Bids on a contract to perform the work will be opened September 17 by the County Department of Public Works. The project is expected to take 160 working days, starting in January and ending in August. Once work begins, two traffic lanes for each direction will be maintained at all times on Second Street.

# # # #

4-6412TAP

Attachment 5-3: PWC Contracts Award

COUNTY OF LOS ANGELES

DEPARTMENT OF PUBLIC WORKS

"Enriching Lives"

JAMES A. NOYES, Director

900 SOUTH FREMONT AVENUE
ALHAMBRA, CALIFORNIA 91803-1331
Telephone: (626) 458-5100
www.ladpw.org

ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1460
ALHAMBRA, CALIFORNIA 91802-1460

IN REPLY PLEASE
REFER TO FILE: C-1

December 30, 2003

The Honorable Board of Supervisors
County of Los Angeles
383 Kenneth Hahn Hall of Administration
500 West Temple Street
Los Angeles, CA 90012

Dear Supervisors:

AWARD OF PUBLIC WORKS CONSTRUCTION CONTRACTS
SUPERVISORIAL DISTRICTS 2 AND 4
3 VOTES

IT IS RECOMMENDED THAT YOUR BOARD:

Award and authorize the Director of Public Works or his designee to prepare the construction and maintenance services contracts in the form previously approved by County Counsel, execute the contracts, and establish the effective dates following receipt of approved Faithful Performance and Labor and Material bonds filed by the contractors for the following:

Project ID No. RDC0011416 - Carson Street Pedestrian Overcrossing at Long Beach City College, City of Long Beach (4), to PK Construction, in amount of $215,405.70.

Project ID No. RMD3246027 - Parkway Tree Planting, MD 3, 2003/04, vicinity of Baldwin Hills (2), to International Environmental Corporation, in amount of $94,495.88.

PURPOSE/JUSTIFICATION OF RECOMMENDED ACTION

We are recommending that your Board award these construction and maintenance services contracts and authorize the Director of Public Works or his designee to execute the contracts and establish the effective contract dates following receipt of approved bonds and insurance filed by contractors for each of these projects.

The enclosure for each project includes the project description, the call for bids and bid opening dates, a tabulation of bids, and financial information. The certified record of receipt of bids and the original bid proposals for each project are also enclosed, including addenda to the contract specifications for Project ID No. RMD3246027.

The recommended construction and maintenance services contracts are necessary to execute Board-directed and approved Public Works projects in support of operational missions. Your Board's approval of the recommended contract awards and our subsequent execution of the contracts will ensure the timely completion of the projects.

Implementation of Strategic Plan Goals

The award of these construction and maintenance services contracts is consistent with the County Strategic Plan Goal of Service Excellence since these contracts will provide improved infrastructure to better serve the public.

FISCAL IMPACT/FINANCING

The enclosure for each project includes the amount of the recommended contract as compared with the engineer's estimate and the other bids received.

These projects are included in the 2003-04 Department of Public Works Budget. The enclosure for each project includes more detailed fiscal and financial information.

FACTS AND PROVISIONS/LEGAL REQUIREMENTS

Recommended contract awards are to the lowest responsible bidders in accordance with the California Public Contract Code and your Board's directives.

On October 27, 1981, your Board adopted a program for the use of small Minority and Women-owned Businesses (MWBEs) on Federal- and State-funded highway construction contracts. Companies meeting these requirements are certified by the State as Disadvantaged Business Enterprises (DBEs). An overall goal for subcontracting portions of the work to DBEs is established for each project. Contracts are recommended for award to the lowest responsible bidder who meets the goal or documents a good faith effort to do so in conformance with the program.

We have also developed an outreach program to encourage all qualified contractors to participate in the bidding and contracting process on our projects. Under this program, we place notices of upcoming bids in local and minority newspapers throughout the County. These notices indicate that copies of plans and specifications are available at specified libraries and the Public Works Headquarters building. This allows interested contractors to view the plans and specifications at convenient locations. We also provide telephone numbers (including one for Spanish-speaking contractors) to obtain further information on bidding and subcontracting opportunities.

To further increase contractor awareness of contracting opportunities with Public Works, each of these projects was listed on the County website for upcoming bids.

The State Labor Code requires contractors to pay prevailing wage rates to all persons employed on public works construction contracts. These rates are determined by the Department of Industrial Relations and include contributions for fringe benefits such as vacations, pension funds, training, and health plans for each employee.

As required by your Board, language has been incorporated into the project specifications stating that the contractor shall notify its employees, and shall require each subcontractor to notify its employees, that they may be eligible for the Federal Earned Income Credit under the Federal income tax laws.

The contracts will be in the form previously approved by County Counsel. We will also review and approve the faithful performance and payment bonds filed by the contractors.

ENVIRONMENTAL DOCUMENTATION

Each of these projects was found to be categorically exempt from the provisions of the California Environmental Quality Act at the time your Board called for bids. The specifics of these findings are included in the enclosure for each project.

CONTRACTING PROCESS

The contracts were solicited on an open competitive basis in accordance with the provisions of the Public Contract Code.

The project specifications contain provisions requiring the contractor to report solicitations of improper consideration by County employees and allowing the County to terminate the contract if it is found that the contractor offered or gave improper consideration to County employees.

Public Works has confirmed that all of the respective contractors are in compliance with the County's Child Support Compliance Program and the requirements of the Contractor Employee Jury Service Program. In addition, the contracts will include language requiring compliance with the Newborn Abandonment Law (Safely Surrendered Baby Law).

The project specifications also contain a provision that, should the contractor require additional or replacement personnel to fill employment openings, consideration shall be given to hiring qualified participants in the County's Greater Avenues for Independence or General Relief Opportunities for Work Programs.

To ensure that the contracts are awarded to responsible contractors with satisfactory performance histories, bidders are required to report violations of the False Claims Act, their civil litigation history, and information regarding prior criminal convictions. The information reported by all of the respective contractors was considered before making this recommendation to approve execution of the contracts.

AWARD OF CONTRACT
December 30, 2003

PROJECT ID NO. RDC0011416, CARSON STREET PEDESTRIAN OVERCROSSING AT LONG BEACH CITY COLLEGE (City of Long Beach), Supervisorial District 4

TYPE OF WORK: Seismic retrofitting of the Carson Street Pedestrian Overcrossing bridge at Long Beach City College.

CALL FOR BIDS DATE: November 4, 2003 (Synopsis 56)

BID OPENING DATE: December 2, 2003

BID SUMMARY:

Low	+*PK Construction 2126 North Fair Oaks Avenue Altadena, California 91001 (626) 794-0800	$215,405.70
2	Giffith Company	$239,195.60
3	*4-Con Engineering, Inc.	$268,796.50
4	Dalaj International Corp.	$269,261.00
5	Allied Building Contractors, Inc.	$272,062.00
6	GB Cooke, Inc.	$277,692.08
7	Excel Paving Company	$307,279.10
8	PPC Construction, Inc.	$290,929.00
9	T. T. Polich & Associates	$294,272.44
10	Metro Builders & Engineers Group, Inc.	$366,813.36

*MWBE
+SBE

FINANCIAL INFORMATION:

Amount of estimate	$199,338.24
Amount of recommended contract	$215,405.70
Amount of recommended contract above estimate	$ 16,067.46

The amount of the recommended contract is 8 percent above the estimate.

The project will be administered under the State Seismic Safety Retrofit Program as a Federal-Aid Project covered by Agreement 71078 with the State of California. Under this program, the entire cost of the project will be financed with Federal and State funds. This project is included in the Fiscal Year 2003-04 Road Fund Budget.

MINORITY/WOMEN-OWNED BUSINESS ENTERPRISE DATA:

PK Construction, an MBE, has no MWBE subcontractors/suppliers under this contract, yielding a proposed DBE participation of 100 percent. This contract has a Federal DBE goal of 9 percent.

ENVIRONMENTAL IMPACT:

This project is categorically exempt pursuant to Class 1, Subsection (x)(11), of the revised County Environmental Document Reporting Procedures and Guidelines adopted by your Board on November 17, 1987.

CONSTRUCTION SCHEDULE:

The contract specifications require the work to be completed in 40 working days. It is estimated that the work will start in March and be completed in April 2004.

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AWARD OF CONTRACT
December 30, 2003

PROJECT ID NO. RMD3246027, PARKWAY TREE PLANTING MD 3, 2003/04
(in the vicinity of Baldwin Hills), Supervisorial District 2

TYPE OF WORK: Planting of parkway trees.

CALL FOR BIDS DATE: November 4, 2003 (Synopsis 56)

BID OPENING DATE: December 2, 2003

BID SUMMARY:

Low	*International Environmental Corporation P.O. Box 4218 Panorama City, California 91412 (818) 892-9341	$ 94,495.88
2	*Azteca Landscape	$101,280.00
3	Reyco, Smith and Reynolds	$103,550.00
4	Pierre Sprinker and Landscape	$105,860.00
5	Tropical Creations, Inc.	$108,969.00
6	Travers Tree Service, Inc.	$117,845.00
7	Marina Landscape, Inc.	$121,800.00
8	*ABC Lawn Sprinkler, Co. Inc.	$136,496.00
9	American Landscape, Inc.	$145,586.50
10	West Coast Arborists, Inc.	$189,225.00
11	*Ryco Construction, Inc.	$315,400.00

*MWBE

FINANCIAL INFORMATION:

Amount of estimate	$123,225.00
Amount of recommended contract	$ 94,495.88
Amount of recommended contract below estimate	$ 28,729.12

The amount of the recommended contract is 23 percent below the estimate.

This project is included in the 2003-04 Road Fund Budget.

-2A-

Section 6: Flooding Hazards in the City of Long Beach

Why are Floods a Threat to the City of Long Beach?

The City of Long Beach is adjacent to the Los Angeles River and the San Gabriel River, both of which are susceptible to flooding events. Flooding poses a threat to life and safety, and can cause severe damage to public and private property.

The Los Angeles River originates at the west end of the San Fernando Valley. The channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built to minimize flooding in the County. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach to the Pacific Ocean.

Coastal flooding in Long Beach due to ocean-related events remains a possibility. This flooding can be attributed to the following mechanisms:

1) Swell runup from intense offshore winter storms in the Pacific.
2) Tsunamis from the Aleutian-Alaskan and Peru-Chile Trenches (see Hazard-Specific Section: Tsunami).
3) Runup from wind waves generated by landfalling storms.
4) Swell runup from waves generated off Baja California by tropical cyclones.
5) Effects of landfalling tropical cyclones.

The southern California coastline is exposed to waves generated by winter and summer storms originating in the Pacific Ocean. It is not uncommon for these storms to cause 15-foot breakers. The occurrence of such a storm event, in combination with high astronomical tides and strong winds can cause a significant wave runup and allow storm waves to attack higher than normal elevations along the coastline. When this occurs, shoreline erosion and coastal flooding frequently results in damage to inadequately protected structures and facilities located along low-lying portions of the shoreline.

Tsunamis are considered highly unlikely due to geographical and geological features of the coastal region. However, on May 22, 1960, seismic-triggered ocean waves caused significant damage in Long Beach harbor (see Hazard-Specific Section: Tsunami).

History of Flooding in the City of Long Beach

The City of Long Beach is susceptible to flooding from two sources: overflow of flood control channels and earthquake-related flood events. Major floods have affected the citizens of the City since as early as the 1800s.

There are a number of rivers in the southern California region, but the river with the best recorded history is the Los Angeles River. The flood history of the Los

Angeles River is generally indicative of the flood history of much of southern California.

Los Angeles County Flood Control District (LACFCD) flood overflow maps for Long Beach indicate a history of flooded streets, sumps, and general flooding along the San Gabriel River, which resulted from the major storms of March, 1938, February 1941, and January 1956. According to the City's MHFP, the City Engineer has indicated that the tropical storm of September 25, 1939 caused extensive coastal flooding. During the storm, 50 homes on the south side of Ocean Boulevard between Granada Avenue and San Gabriel River were seriously damaged or destroyed either by direct wave damage or by erosion of the sand foundations.

On January 20, 1969, the high-intensity rainfall, which coincided with a high tide, prevented an existing storm drain from functioning properly, causing flooding of several residences on Appian Way, in the Belmont Shore area. Commercial buildings in Long Beach were inundated along the Pacific Coast Highway near Pacific Avenue and near the intersection of Orange Avenue and Wardlow Road. Significant erosion damage occurred to the Los Angeles River outlet due to high-velocity flows and floating debris.

On January 5, 1995 flooding occurred in various parts of the City due to heavy rain.

Historic Flooding in Los Angeles County
Records show that since 1811, the Los Angeles River has flooded 30 times, on average once every 6.1 years. But averages are deceiving, for the Los Angeles basin goes through periods of drought and then periods of above average rainfall. Between 1889 and 1891 the river flooded every year, and from 1941 to 1945, the river flooded 5 times. Conversely, from 1896 to 1914, a period of 18 years, and again from 1944 to 1969, a period of 25 years, the river did not have serious floods.[1]

Table 6-1: Major Floods of the Los Angeles River

Major Floods of the Los Angeles River	
1811	Flooding
1815	Flooding
1825	L.A. River changed its course back from the Ballona wetlands to San Pedro
1832	Heavy flooding
1861-62	Heavy flooding. Fifty inches of rain falls during December and January.
1867	Floods create a large, temporary lake out to Ballona Creek.
1876	The Novician Deluge

1884	Heavy flooding causes the river to change course again, turning east to Vernon and then southward to San Pedro.
1888-1891	Annual floods
1914	Heavy flooding. Great damage to the harbor.
1921	Flooding
1927	Moderate flood
1934	Moderate flood starting January 1. Forty dead in La Canada.
1938	Great County-wide flood with 4 days of rain. Most rain on day 4.
1941-44	L.A. River floods five times.
1952	Moderate flooding
1969	One heavy flood after 9 day storm. One moderate flood.
1978	Two moderate floods
1979	Los Angeles experiences severe flooding and mudslides.
1980	Flood tops banks of river in Long Beach. Sepulveda Basin spillway almost opened.
1983	Flooding kills six people.
1992	15 year flood. Motorists trapped in Sepulveda basin. Six people dead.
1994	Heavy flooding
Sources: http://www.lalc.k12.ca.us/target/units/river/tour/hist.html and (http://www.losangelesalmanac.com/topics/History/hi01i.htm)	

While the City of Long Beach is 20 miles south of downtown Los Angeles, it is not so far away as to not be affected by the heavy rains that brought flooding to Los Angeles. In addition, the towering mountains that give the Los Angeles region its spectacular views also wring a great deal of rain out of the storm clouds that pass through. Because the mountains are so steep, the rainwater moves rapidly down the slopes and across the coastal plains on its way to the ocean.

> "The Santa Monica, Santa Susana and Verdugo Mountains, which surround three sides of the valley, seldom reach heights above three thousand feet.

> The Western San Gabriel Mountains, in contrast, have elevations of more than seven thousand feet. These higher ridges often trap eastern-moving winter storms. Although downtown Los Angeles averages just fifteen inches of rain a year, some mountain peaks in the San Gabriels receive more than forty inches of precipitation annually"[2]

Naturally, this rainfall moves rapidly down stream, often with severe consequences for anything in its path. In extreme cases, flood-generated debris flows will roar down a canyon at speeds near 40 miles per hour with a wall of mud, debris and water tens of feet high.

In southern California, stories of floods, debris flows, persons buried alive under tons of mud and rock and persons swept away to their death in a river flowing at thirty-five miles an hour are without end.

What Factors Create Flood Risk?
Flooding occurs when climate, geology, and hydrology combine to create conditions where water flows outside of its usual course. In the City of Long Beach, geography and climate combine to create chronic seasonal flooding conditions.

Winter Rainfall
Over the last 125 years, the average annual rainfall in Los Angeles is 14.9 inches. But the term "average" means very little as the annual rainfall during this time period has ranged from only 4.35 inches in 2001-2002 to 38.2 inches in 1883-1884. In fact, in only fifteen of the past 125 years, has the annual rainfall been within plus or minus 10% of the 14.9 inch average. And in only 38 years has the annual rainfall been within plus or minus 20% of the 14.9 inch average. This makes the Los Angeles basin a land of extremes in terms of annual precipitation.

According to the MHFP, the climate of Long Beach, which is to the south of the San Gabriel Mountains, is considered subtropical. Major storms consist of one to several frontal systems which can last up to four or more days. Precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. The average annual rainfall ranges from 13.8 inches at sea level to 28.2 inches in the San Gabriel Mountains.

Monsoons
Another relatively regular source for heavy rainfall, particularly in the mountains and adjoining cities is from summer tropical storms. Table 6-2 lists tropical storms that have had significant rainfall in the past century, and the general areas affected by these storms. These tropical storms usually coincide with El Niño years.

Table 6-2: Tropical Cyclones of Southern California

Tropical cyclones that have affected Southern California during the 20th Century			
Month-Year	**Date(s)**	**Area(s) Affected**	**Rainfall**
July 1902	20th & 21st	Deserts & Southern Mountains	up to 2"
Aug. 1906	18th & 19th	Deserts & Southern Mountains	up to 5"
Sept. 1910	15th	Mountains of Santa Barbara County	2"
Aug. 1921	20th & 21st	Deserts & Southern Mountains	up to 2"
Sept. 1921	30th	Deserts	up to 4"
Sept. 1929	18th	Southern Mountains & Deserts	up to 4"
Sept. 1932	28th - Oct 1st	Mountains & Deserts, 15 Fatalities	up to 7
Aug. 1935	25th	Southern Valleys, Mountains & Deserts	up to 2"
Sept. 1939	4th - 7th	Southern Mountains, Southern & Eastern Deserts	up to 7
	11th & 12th	Deserts, Central & Southern Mountains	up to 4"
	19th - 21st	Deserts, Central & Southern Mountains	up to 3"
	25th	Long Beach, W/ Sustained Winds of 50 Mph	5"
		Surrounding Mountains	6 to 12"
Sept. 1945	9th & 10th	Central & Southern Mountains	up to 2"
Sept. 1946	30th - Oct 1st	Southern Mountains	up to 4"
Aug. 1951	27th - 29th	Southern Mountains & Deserts	2 to 5"
Sept. 1952	19th - 21st	Central & Southern Mountains	up to 2"
July 1954	17th - 19th	Deserts & Southern Mountains	up to 2"
July 1958	28th & 29th	Deserts & Southern Mountains	up to 2"
Sept. 1960	9th & 10th	Julian	3.40"
Sept. 1963	17th - 19th	Central & Southern Mountains	up to 7"
Sept. 1967	1st - 3rd	Southern Mountains & Deserts	2"
Oct. 1972	6th	Southeast Deserts	up to 2"
Sept. 1976	10th & 11th	Central & Southern Mountains. Ocotillo, CA was Destroyed 3 Fatalities	6 to 12"
Aug. 1977	n/a	Los Angeles	2"
		Mountains	up to 8"
Oct. 1977	6th & 7th	Southern Mountains & Deserts	up to 2
Sept. 1978	5th & 6th	Mountains	3"

Tropical cyclones that have affected Southern California during the 20th Century			
Sept. 1982	24th - 26th	Mountains	up to 4"
Sept. 1983	20th & 21st	Southern Mountains & Deserts	up to 3"
http://www.fema.gov/nwz97/eln_scal.shtm			

Geography and Geology

The greater Los Angeles Basin is the product of rainstorms and erosion for millennia. “Most of the mountains that ring the valleys and coastal plain are deeply fractured faults and, as they (the mountains) grew taller, their brittle slopes were continually eroded. Rivers and streams carried boulders, rocks, gravel, sand, and silt down these slopes to the valleys and coastal plain....In places these sediments are as much as twenty thousand feet thick”[3]

Much of the coastal plain rests on the ancient rock debris and sediment washed down from the mountains. This sediment can act as a sponge, absorbing vast quantities of rain in those years when heavy rains follow a dry period. But like a sponge that is near saturation, the same soil fills up rapidly when a heavy rain follows a period of relatively wet weather. So even in some years of heavy rain, flooding is minimal because the ground is relatively dry. The same amount of rain following a wet period of time can cause extensive flooding.

The greater Los Angeles Basin is for all intents and purposes developed. This leaves precious little open land to absorb rainfall. This lack of open ground forces water to remain on the surface and rapidly accumulate. If it were not for the massive flood control system with its concrete lined river and stream beds, flooding would be a much more common occurrence. And the tendency is towards even less and less open land. In-fill building is becoming a much more common practice in many areas. Developers tear down an older home which typically covers up to 40% of the lot size and replacing it with three or four town homes or apartments which may cover 90-95% of the lot.

Another potential source of flooding is “asphalt creep.” The street space between the curbs of a street is a part of the flood control system. Water leaves property and accumulates in the streets, where it is directed towards the underground portion of the flood control system. The carrying capacity of the street is determined by the width of the street and the height of the curbs along the street. Often, when streets are being resurfaced, a one to two inch layer of asphalt is laid down over the existing asphalt. This added layer of asphalt subtracts from the rated capacity of the street to carry water. Thus the original engineered capacity of the entire storm drain system is marginally reduced over time. Subsequent re-paving of the street will further reduce the engineered capacity even more.

Flood Terminology

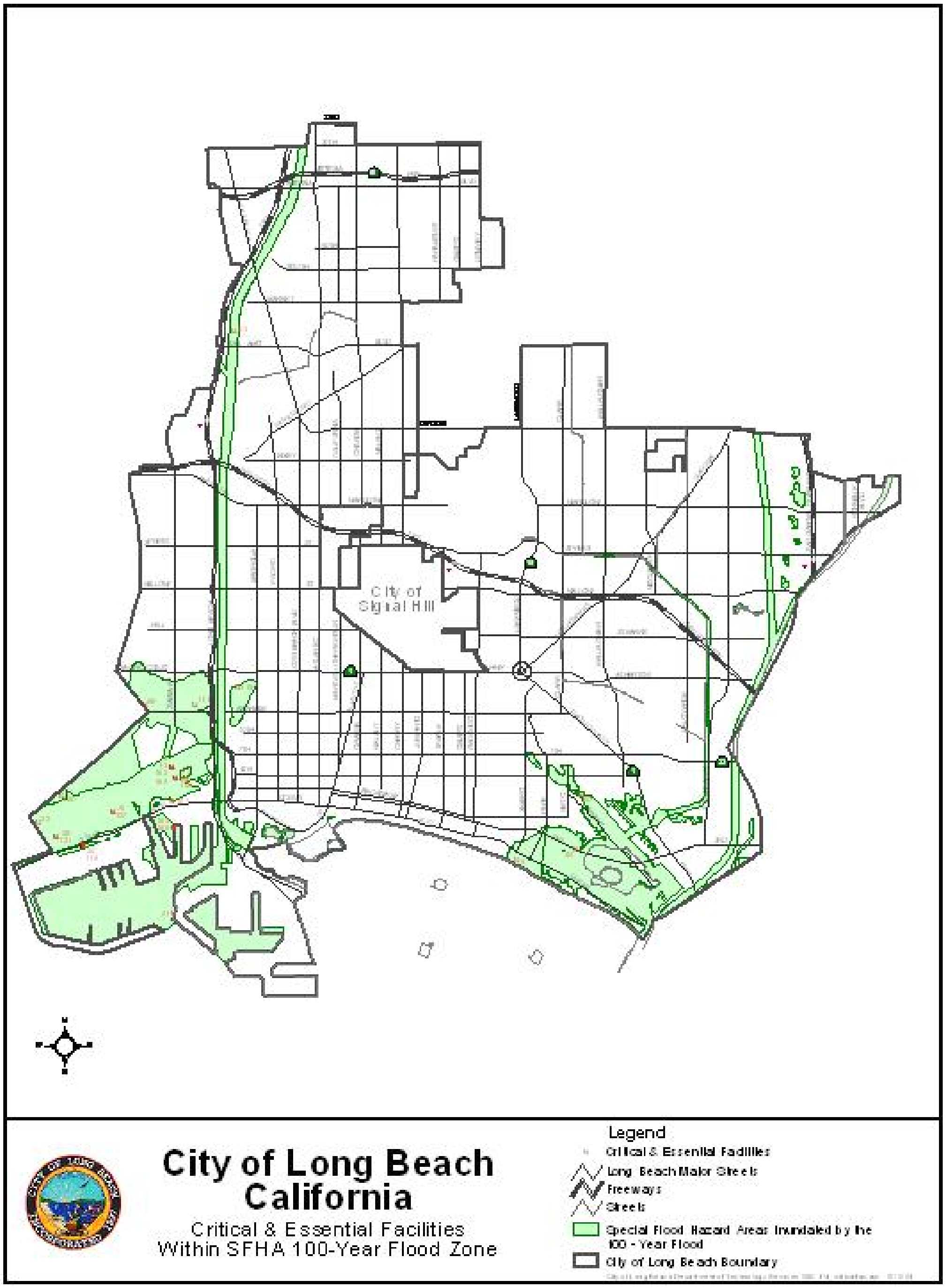
Floodplain

A floodplain is a land area adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding. This area, if left undisturbed, acts to store excess flood water. The floodplain is made up of two sections: the floodway and the flood fringe.

100-Year Flood

The 100-year flooding event is the flood having a one percent chance of being equaled or exceeded in magnitude in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years. The 100-year floodplain is the area adjoining a river, stream, or watercourse covered by water in the event of a 100-year flood. Map 6-1 illustrates the 100-year floodplain in the City of Long Beach.

Map 6-1: 100-Year Floodplains in the City of Long Beach
(Source: City of Long Beach GIS)



Floodway
The floodway is one of two main sections that make up the floodplain. Floodways are defined for regulatory purposes. Unlike floodplains, floodways do not reflect a recognizable geologic feature. For NFIP purposes, floodways are defined as the channel of a river or stream, and the overbank areas adjacent to the channel. The floodway carries the bulk of the flood water downstream and is usually the area where water velocities and forces are the greatest. NFIP regulations require that the floodway be kept open and free from development or other structures that would obstruct or divert flood flows onto other properties.

The City of Long Beach Zoning Ordinance definitions relating to flooding are contained in Chapter 21.62 Flood Damage Prevention. Refer to the Zoning Code for definitions and regulations concerning development in and around the 100-year floodplain.

Characteristics of Flooding
A potential flooding hazard in the City of Long Beach could be caused by two primary sources – rains or earthquakes.

Riverine Flooding
Riverine flooding is the overbank flooding of rivers and streams. The natural processes of riverine flooding add sediment and nutrients to fertile floodplain areas. Flooding in large river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams, which then drain into the major rivers. Map 6-1 shows the various river basins (or flood zones) in the City of Long Beach.

Shallow area flooding is a special type of riverine flooding. FEMA defines shallow flood hazards as areas that are inundated by the 100-year flood with flood depths of only one to three feet. These areas are generally flooded by low velocity sheet flows of water.

Urban Flooding
As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization of a watershed changes the hydrologic systems of the basin. Heavy rainfall collects and flows faster on impervious concrete and asphalt surfaces. The water moves from the clouds, to the ground, and into streams at a much faster rate in urban areas. Adding these elements to the hydrological systems can result in flood waters that rise very rapidly and peak with violent force.

Almost 100% of the area in the City of Long Beach has a high concentration of impermeable surfaces that either collect water, or concentrate the flow of water in unnatural channels. During periods of urban flooding, streets can become swift moving rivers and basements can fill with water. Storm drains often back up with debris causing additional, localized flooding.

Dam Failure Flooding

Loss of life and damage to structures, roads, and utilities may result from a dam failure. Economic losses can also result from a lowered tax base and lack of utility profits. These effects would certainly accompany the failure of one of the major dams upstream from the City of Long Beach. There are a total of 3 dams upstream of the City of Long Beach holding millions (or billions) of gallons of water. Because dam failure can have severe consequences, FEMA requires that all dam owners develop Emergency Action Plans (EAP) for warning, evacuation, and post-flood actions. Although there may be coordination with county officials in the development of the EAP, the responsibility for developing potential flood inundation maps and facilitation of emergency response is the responsibility of the dam owner. For more detailed information regarding dam failure flooding, and potential flood inundation zones for a particular dam in the county, refer to the individual Dam Emergency Action Plan.

There have been a total of 45 dam failures in California, since the 19^{th} century. The significant dam failures in southern California are listed in Table 6-3.

Table 6-3: Dam Failures in Southern California

Dam Failures in Southern California			
Sheffield	Santa Barbara	1925	Earthquake slide
Puddingstone	Pomona	1926	Overtopping during construction
Lake Hemet	Palm Springs	1927	Overtopping
Saint Francis	San Francisquito Canyon	1928	Sudden failure at full capacity through foundation, 426 deaths
Cogswell	Monrovia	1934	Breaching of concrete cover
Baldwin Hills	Los Angeles	1963	Leak through embankment turned into washout, 3 deaths
http://cee.engr.ucdavis.edu/faculty/lund/dams/Dam_History_Page/Failures.htm			

The two most significant dam failures are the St. Francis Dam in 1928 and the Baldwin Hills Dam in 1963.

> “The failure of the St. Francis Dam, and the resulting loss of over 500 lives in the path of a roaring wall of water, was a scandal that resulted in the almost complete destruction of the reputation of its builder, William Mulholland.
>
> Mulholland was an immigrant from Ireland who rose up through the ranks of the city's water department to the position of chief

engineer. It was he who proposed, designed, and supervised the construction of the Los Angeles Aqueduct, which brought water from the Owens Valley to the city. The St. Francis Dam, built in 1926, was 180 feet high and 600 feet long; it was located near Saugus in the San Francisquito Canyon.

The dam gave way on March 12, 1928, three minutes before midnight. Its waters swept through the Santa Clara Valley toward the Pacific Ocean, about 54 miles away. 65 miles of valley was devastated before the water finally made its way into the ocean between Oxnard and Ventura. At its peak the wall of water was said to be 78 feet high; by the time it hit Santa Paula, 42 miles south of the dam, the water was estimated to be 25 feet deep. Almost everything in its path was destroyed: livestock, structures, railways, bridges, and orchards. By the time it was over, parts of Ventura County lay under 70 feet of mud and debris. Over 500 people were killed and damage estimates topped $20 million."[4]

The Baldwin Hills dam failed during the daylight hours, and was one of the first disaster events documented by a live helicopter broadcast.

"The Baldwin Hills Dam collapsed with the fury of a thousand cloudbursts, sending a 50-foot wall of water down Cloverdale Avenue and slamming into homes and cars on Dec. 14, 1963.

Five people were killed. Sixty-five hillside houses were ripped apart, and 210 homes and apartments were damaged. The flood swept northward in a V-shaped path roughly bounded by La Brea Avenue and Jefferson and La Cienega Boulevards.

Photo 6-1: Baldwin Hills Dam

Baldwin Hills Dam - Dark spot in upper right hand quadrant shows the beginning of the break in the dam.

The earthen dam that created a 19-acre reservoir to supply drinking water for West Los Angeles residents ruptured at 3:38 p.m. As a pencil-thin crack widened to a 75-foot gash, 292 million gallons surged out. It took 77 minutes for the lake to empty. But it took a generation for the neighborhood below to recover. And two decades passed before the Baldwin Hills ridge top was reborn.

The cascade caused an unexpected ripple effect that is still being felt in Los Angeles and beyond. It foreshadowed the end of urban-area earthen dams as a major element of the Department of Water and Power's water storage system. It prompted a tightening of Division of Safety of Dams control over reservoirs throughout the state.

The live telecast of the collapse from a KTLA-TV helicopter is considered the precursor to airborne news coverage that is now routine everywhere.”[5]

Debris Flows

Another flood related hazard that can affect certain parts of the southern California region are debris flows. Most typically debris flows occur in mountain canyons and the foothills against the San Gabriel Mountains. However, any hilly or mountainous area with intense rainfall and the proper geologic conditions may experience one of these very sudden and devastating events.

“Debris flows, sometimes referred to as mudslides, mudflows, lahars, or debris avalanches, are common types of fast-moving landslides. These flows generally occur during periods of intense rainfall or rapid snow melt. They usually start on steep hillsides as shallow landslides that liquefy and accelerate to speeds that are typically about 10 miles per hour, but can exceed 35 miles per hour. The consistency of debris flow ranges from watery mud to thick, rocky mud that can carry large items such as boulders, trees, and cars. Debris flows from many different sources can combine in channels, and their destructive power may be greatly increased. They continue flowing down hills and through channels, growing in volume with the addition of water, sand, mud, boulders, trees, and other materials. When the flows reach flatter ground, the debris spreads over a broad area, sometimes accumulating in thick deposits that can wreak havoc in developed areas."[6]

Coastal Flooding

Low lying coastal communities of southern California have one other source of flooding, coastal flooding. This occurs most often during storms which bring higher than normal tides. Storms, the time of year and the tidal cycle can sometimes work to bring much higher than normal tides which cause flooding in low lying coastal areas. This hazard however is limited to those areas.

What is the Effect of Development on Floods?

When structures or fill are placed in the floodway or floodplain water is displaced. Development raises the river levels by forcing the river to compensate for the flow space obstructed by the inserted structures and/or fill. When structures or materials are added to the floodway or floodplain and no fill is removed to compensate, serious problems can arise. Flood waters may be forced away from historic floodplain areas. As a result, other existing floodplain areas may experience flood waters that rise above historic levels. Local governments must require engineer certification to ensure that proposed developments will not adversely affect the flood carrying capacity of the Special Flood Hazard Area (SFHA). Displacement of only a few inches of water can mean the difference between no structural damage occurring in a given flood event, and the inundation of many homes, businesses, and other facilities. Careful attention should be given to development that occurs within the floodway to ensure that structures are prepared to withstand base flood events. In highly urbanized areas, increased paving can lead to an increase in volume and velocity of runoff after a rainfall event, exacerbating the potential flood hazards. Care should be taken in the development and implementation of storm water management systems to ensure that these runoff waters are dealt with effectively.

How are Flood-Prone Areas Identified?

Flood maps and Flood Insurance Studies (FIS) are often used to identify flood-prone areas. The NFIP was established in 1968 as a means of providing low-cost flood insurance to the nation's flood-prone communities. The NFIP also reduces flood losses through regulations that focus on building codes and sound floodplain management. In the City of Long Beach, the NFIP and related building code regulations went into effect on September 15, 1983. NFIP regulations (44 Code of Federal Regulations (CFR) Chapter 1, Section 60, 3) require that all new construction in floodplains must be elevated at or above base flood level.

Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies (FIS) Floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A Flood Insurance Rate Map (FIRM) is the official map produced by FEMA which delineates SFHA in communities where NFIP regulations apply. FIRMs are also used by insurance agents and mortgage lenders to determine if flood insurance is required and what insurance rates should apply.

Water surface elevations are combined with topographic data to develop FIRMs. FIRMs illustrate areas that would be inundated during a 100-year flood, floodway areas, and elevations marking the 100-year-flood level. In some cases they also include base flood elevations (BFEs) and areas located within the 500-year floodplain. Flood Insurance Studies and FIRMs produced for the NFIP provide assessments of the probability of flooding at a given location. FEMA conducted many Flood Insurance Studies in the late 1970s and early 1980s. These studies and maps represent flood risk at the point in time when FEMA completed the studies. However, it is important to note that not all 100-year or 500-year floodplains have been mapped by FEMA.

FEMA flood maps are not entirely accurate. These studies and maps represent flood risk at the point in time when FEMA revised the studies, and does not incorporate planning for floodplain changes in the future due to new development. Although FEMA is considering changing that policy, it is optional for local communities. The FEMA FIRM map for the City of Long Beach was completed on January 11, 2002.

Nearly all of the areas designated as Zone X, which is in the 500-year flood area, is residential. Zone AE, which is the 100-year flood hazard area, includes the Peninsula, Naples and Belmont Shore east of Park Avenue. Less than 10% of the City's population is in the 100-year flood hazard area (Source: Long Beach Public Works).

Flood Mapping Methods and Techniques

Although many communities rely exclusively on FIRMs to characterize the risk of flooding in their area, there are some flood-prone areas that are not mapped but remain susceptible to flooding. These areas include locations next to small creeks, local drainage areas, and areas susceptible to manmade flooding.

Communities find it particularly useful to overlay flood hazard areas on tax assessment parcel maps. This allows a community to evaluate the flood hazard risk for a specific parcel during review of a development request. Coordination between FEMA and local planning jurisdictions is the key to making a strong connection with GIS technology for the purpose of flood hazard mapping.

FEMA and the Environmental Systems Research Institute (ESRI), a private company, have formed a partnership to provide multi-hazard maps and information to the public via the Internet. ESRI produces GIS software, including ArcViewC9 and ArcInfoC9. The ESRI web site has information on GIS technology and downloadable maps. The hazards maps provided on the ESRI site are intended to assist communities in evaluating geographic information about natural hazards. Flood information for most communities is available on the ESRI web site. Visit www.esri.com for more information.

Hazard Assessment

Hazard Identification

Hazard identification is the first phase of flood-hazard assessment. Identification is the process of estimating: (1) the geographic extent of the floodplain (i.e., the area at risk from flooding); (2) the intensity of the flooding that can be expected in specific areas of the floodplain; and (3) the probability of occurrence of flood events. This process usually results in the creation of a floodplain map. Floodplain maps provide detailed information that can assist jurisdictions in making policies and land-use decisions.

Vulnerability Assessment

Vulnerability assessment is the second step of flood-hazard assessment. It combines the floodplain boundary, generated through hazard identification, with an inventory of the property within the floodplain. Understanding the population and property exposed to natural hazards will assist in reducing risk and preventing loss from future events. Because site-specific inventory data and inundation levels given for a particular flood event (10-year, 25-year, 50-year, 100-year, 500-year) are not readily available, calculating a community's vulnerability to flood events is not straightforward. The amount of property in the floodplain, as well as the type and value of structures on those properties, should be calculated to provide a working estimate for potential flood losses.

Disruption of Critical Services

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after a flooding event. Vulnerability of these facilities is indicated on Table 4-2 in Section 4, Risk Assessment.

Risk Analysis

Risk analysis is the third and most advanced phase of a hazard assessment. It builds upon the hazard identification and vulnerability assessment. A flood risk analysis for the City of Long Beach should include two components: (1) the life and value of property that may incur losses from a flood event (defined through the vulnerability assessment); and (2) the number and type of flood events expected to occur over time. Within the broad components of a risk analysis, it is possible to predict the severity of damage from a range of events. Flow velocity models can assist in predicting the amount of damage expected from different magnitudes of flood events. The data used to develop these models is based on hydrological analysis of landscape features. Changes in the landscape, often associated with human development, can alter the flow velocity and the severity of damage that can be expected from a flood event.

Using GIS technology and flow velocity models, it is possible to map the damage that can be expected from flood events over time. It is also possible to pinpoint the effects of certain flood events on individual properties. At the time of publication of this plan, data was insufficient to conduct a risk analysis for flood events in the City of Long Beach. However, the current mapping projects will result in better data that will assist in understanding risk.

Community Flood Issues

What is Susceptible to Damage during a Flood Event?

The largest impact on communities from flood events is the loss of life and property. During certain years, property losses resulting from flood damage are extensive. Development in the floodplains of the City of Long Beach will continue to be at risk from flooding because flood damage occurs on a regular basis throughout the county. Property loss from floods strikes both private and public property.

Property Loss Resulting from Flooding Events

The type of property damage caused by flood events depends on the depth and velocity of the flood waters. Faster moving flood waters can wash buildings off their foundations and sweep cars downstream. Pipelines, bridges, and other infrastructure can be damaged when high waters combine with flood debris. Extensive damage can be caused by basement flooding and landslide damage related to soil saturation from flood events. Most flood damage is caused by water saturating materials susceptible to loss (i.e. wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances). In many cases, flood damage to homes renders them unlivable.

Mobilehomes

Statewide, the 1996 floods destroyed 156 housing units. Of those units, 61% were mobilehomes and trailers. Many older mobilehome parks are located in floodplain areas. Mobilehomes have a lower level of structural stability than stick-built homes, and must be anchored to provide additional structural stability during flood events. Because of confusion in the late 1980s resulting from multiple changes in NFIP regulations, there are some communities that do not actively enforce anchoring requirements. Lack of enforcement of mobilehome construction standards in floodplains can contribute to severe damages from flood events.

According to the 2002 FIRM map, none of the City's mobilehome parks are located in the 100-year flood hazard area.

Business/Industry

Flood events impact businesses by damaging property and by interrupting business. Flood events can cut off customer access to a business as well as close a business for repairs. A quick response to the needs of businesses affected by flood events can help a community maintain economic vitality in the face of flood damage. Responses to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

Public Infrastructure

Publicly owned facilities are a key component of daily life for all citizens of the county. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Government can take action to reduce risk to public infrastructure from flood events, as well as craft public policy that reduces risk to private property from flood events.

Roads

During natural hazard events, or any type of emergency or disaster, dependable road connections are critical for providing emergency services. Roads systems in the City of Long Beach are maintained by multiple jurisdictions. Federal, state, county, and city governments all have a stake in protecting roads from flood damage. Road networks often traverse floodplain and floodway areas. Transportation agencies responsible for road maintenance are typically aware of roads at risk from flooding.

Stormwater Systems

The following information comes from Section 5.4 Flood Control/Stormwater of March 2004 Technical Background Report for the City's Update to the General Plan)

"The Long Beach Stormwater system outlets to the following regional drains: Los Angeles River, San Gabriel River, Coyote Creek, Los Cerritos Channel, Heather Channel, Los Cerritos Line E, and the Artesia-Norwalk Drain. The City of Long Beach was divided into thirty major drainage basins. Within each major basin there are sub-basins for major drains 36 inches in diameter or larger that have their outfall to a regional drain, regional retention basin or the Harbor. Many major basins contain two or more sub-basins. The sub-basins are further subdivided into drainage areas contributing to a drainage node. There are five storm waste storage basins for Long Beach: Dominguez Basin, Dominguez Gap Basin, California Bowl, Hamilton Bowl, and Colorado Lagoon. There are over 40 stormwater pump stations in Long Beach. Most of the larger capacity stations outfall to the Los Angeles River."

Water/Wastewater Treatment Facilities
The Long Beach Water Department is responsible for water distribution and waste water treatment.

Water Quality
Environmental quality problems include bacteria, toxins, and pollution.

End Notes

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1. http://www.lalc.k12.ca.us/target/units/river/tour/hist.html

2. Gumprecht, Blake, 1999, Johns Hopkins University Press, Baltimore, MD.

3. Ibid

4. http://www.usc.edu/isd/archives/la/scandals/st_francis_dam.html

5. http://www.latimes.com/news/local/surroundings/la-me-surround11dec11,0,1754871.story?coll=la-adelphia-right-rail

6. http://www.fema.gov/rrr/talkdiz/landslide.shtm#what

Section 7:
Earth Movement
(Landslides &
Debris Flow)
in the
City of Long Beach

Why are Landslides a Threat to the City of Long Beach?

Landslides are a serious geologic hazard in almost every state in the United States. Nationally, landslides cause 25 to 50 deaths each year.[1] The best estimate of direct and indirect costs of landslide damage in the United States range between $1 and $2 billion annually.[2] As a seismically active region, California has had a significant number of locations impacted by earthquake induced landslides. Landslides may result in damage to public and private property, transportation corridors, fuel and energy conduits, and communication facilities. They can also pose a serious threat to human life.

Landslides can be broken down into two categories: (1) rapidly moving (most commonly known as debris flows), and (2) slow moving. Rapidly moving landslides or debris flows present the greatest risk to human life, and people living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Slow moving landslides can cause significant property damage, but are less likely to result in serious human injuries.

Historic Southern California Landslides

1928 St. Francis Dam Failure

Los Angeles County, California. The dam gave way on March 12, and its waters swept through the Santa Clara Valley toward the Pacific Ocean, about 54 miles away. Sixty five miles of valley was devastated, and over 500 people were killed. Damages were estimated at $672.1 million (year 2000 dollars).[3]

1956 Portuguese Bend, California

Cost, $14.6 million (2000 dollars) California Highway 14, Palos Verdes Hills. Land use on the Palos Verdes Peninsula consists mostly of single-family homes built on large lots, many of which have panoramic ocean views. All of the houses were constructed with individual septic systems, generally consisting of septic tanks and seepage pits. Landslides have been active here for thousands of years, but recent landslide activity has been attributed in part to human activity. The Portuguese Bend landslide began its modern movement in August 1956, when displacement was noticed at its northeast margin. Movement gradually extended downslope so that the entire eastern edge of the slide mass was moving within 6 weeks. By the summer of 1957, the entire slide mass was sliding towards the sea.[4]

1958-1971 Pacific Palisades, California

Cost, $29.1 million (2000 dollars) California Highway 1 and house damaged.[5]

1961 Mulholland Cut, California

Cost, $41.5 million (2000 dollars) Interstate 405, 11 miles north of Santa Monica, Los Angeles County.[6]

1963 Baldwin Hills Dam Failure
On December 14, the 650 foot long by 155 foot high earth fill dam gave way and sent 360 million gallons of water in a fifty foot high wall cascading onto the community below, killing five persons, and damaging $50 million (1963 dollars) of dollars in property.

1969 Glendora, California
Cost, $26.9 million (2000 dollars) Los Angeles County, 175 houses damaged, mainly by debris flows.[7]

1969 Seventh Avenue, Los Angeles County, California
Cost, $14.6 million (2000 dollars) California Highway 60.[8]

1970 Princess Park, California
Cost, $29.1 million (2000 dollars) California Highway 14, 10 miles north of Newhall, near Saugus, northern Los Angeles County.[9]

1971 Upper and Lower Van Norman Dams, San Fernando, California
Earthquake-induced landslides Cost, $302.4 million (2000 dollars). Damage due to the February 9, 1971, magnitude 7.5 San Fernando, California, earthquake. The earthquake of February 9 severely damaged the Upper and Lower Van Norman Dams.[10]

1971 Juvenile Hall, San Fernando, California
Landslides caused by the February 9, 1971, San Fernando, California, earthquake Cost, $266.6 million (2000 dollars). In addition to damaging the San Fernando Juvenile Hall, this 1.2 km-long slide damaged trunk lines of the Southern Pacific Railroad, San Fernando Boulevard, Interstate Highway 5, the Sylmar, California, electrical converter station, and several pipelines and canals.[11]

1977-1980 Monterey Park, Repetto Hills, Los Angeles County, California
Cost, $14.6 million (2000 dollars) 100 houses damaged in 1980 due to debris flows.[12]

1978 Bluebird Canyon Orange County, California
California October 2, cost, $52.7 million (2000 dollars) 60 houses destroyed or damaged. Unusually heavy rains in March of 1978 may have contributed to initiation of the landslide. Although the 1978 slide area was approximately 3.5 acres, it is suspected to be a portion of a larger, ancient landslide.[13]

1979 Big Rock, California, Los Angeles County
Cost, approximately $1.08 billion (2000 dollars) California Highway 1 rockslide.[14]

1980 Southern California Slides
$1.1 billion in damage (2000 dollars) Heavy winter rainfall in 1979-90 caused

damage in six southern California counties. In 1980, the rainstorm started on February 8. A sequence of 5 days of continuous rain and 7 inches of precipitation had occurred by February 14. Slope failures were beginning to develop by February 15 and then very high-intensity rainfall occurred on February 16. As much as 8 inches of rain fell in a 6 hour period in many locations. Records and personal observations in the field on February 16 and 17 showed that the mountains and slopes literally fell apart on those 2 days.[15]

1983 San Clemente, California, Orange County
Cost, $65 million (2000 dollars), California Highway 1. Litigation at that time involved approximately $43.7 million (2000 dollars).[16]

1983 Big Rock Mesa, California
Cost, $706 million (2000 dollars) in legal claims condemnation of 13 houses, and 300 more threatened rockslide caused by rainfall [17]

1978-1979, 1980 San Diego County, California
Experienced major damage from storms in 1978, 1979, and 1979-80, as did neighboring areas of Los Angeles and Orange County, California. One hundred and twenty landslides were reported to have occurred in San Diego County during these 2 years. Rainfall for the rainy seasons of 78-79 and 79-80 was 14.82 and 15.61 inches (37.6 and 39.6 cm) respectively, compared to a 125-year average (1850-1975) of 9.71 inches (24.7 cm). Significant landslides occurred in the Friars Formation, a unit that was noted as slide-prone in the Seismic Safety Study for the City of San Diego. Of the nine landslides that caused damage in excess of $1 million, seven occurred in the Friars Formation, and two in the Santiago Formation in the northern part of San Diego County.[18]

1994 Northridge, California Earthquake Landslides
As a result of the Magnitude 6.7 Northridge Earthquake, more than 11,000 landslides occurred over an area of 10,000 km. Most were in the Santa Susana Mountains and in mountains north of the Santa Clara River Valley. Destroyed dozens of homes, blocked roads, and damaged oil-field infrastructure. Caused deaths from Coccidioidomycosis (valley fever) the spore of which was released from the soil and blown toward the coastal populated areas. The spore was released from the soil by the landslide activity.[19]

March 1995 Los Angeles and Ventura Counties, Southern California
Above normal rainfall triggered damaging debris flows, deep-seated landslides, and flooding. Several deep-seated landslides were triggered by the storms, the most notable was the La Conchita landslide, which in combination with a local debris flow, destroyed or badly damaged 11 to 12 homes in the small town of La Conchita, about 20 km west of Ventura. There also was widespread debris-flow and flood damage to homes, commercial buildings, and roads and highways in areas along the Malibu coast that had been devastated by wildfire 2 years before.[20]

Landslide Characteristics

What is a landslide?

"A landslide is defined as, the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting" which denotes any down slope movement of soil and rock under the direct influence of gravity. The term "landslide" encompasses events such as rock falls, topples, slides, spreads, and flows. Landslides can be initiated by rainfall, earthquakes, volcanic activity, changes in groundwater, disturbance and change of a slope by man-made construction activities, or any combination of these factors. Landslides can also occur underwater, causing tidal waves and damage to coastal areas. These landslides are called submarine landslides."[21]

The size of a landslide usually depends on the geology and the initial causes of land movement. Landslides vary greatly in their volume of rock and soil, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, dip of the near-surface geologic units, moisture content, and the nature of the weakest underlying materials. Landslides are given different names, depending on the type of failure and their composition and characteristics.

Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface, and translational slides where movement occurs along a flat surface. These slides are generally slow moving on gentle slopes and can be deep. Slumps are small rotational slides that are generally shallow. Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious injuries than rapidly moving landslides.[22]

"Failure of a slope occurs when the force that is pulling the slope downward (gravity) exceeds the strength of the earth materials that compose the slope. They can move slowly, (millimeters per year) or can move quickly and disastrously, as is the case with debris-flows. Debris-flows can travel down a hillside of speeds up to 200 miles per hour (more commonly, 30 – 50 miles per hour), depending on the slope angle, water content, and type of earth and debris in the flow. These flows are initiated by heavy, usually sustained, periods of rainfall, but sometimes can happen as a result of short bursts of concentrated rainfall in susceptible areas. Burned areas charred by wildfires are particularly susceptible to debris flows, given certain soil characteristics and slope conditions."[23]

What is a Debris Flow?

A debris or mud flow is a river of rock, earth and other materials, including vegetation that is saturated with water. This high percentage of water gives the debris flow a very rapid rate of movement down a slope. Debris flows often with speeds greater than 20 mile per hour, and can often move much faster.[24] This high rate of speed makes debris flows extremely dangerous to people and property in its path.

Landslide Events and Impacts

Landslides are a common hazard in California. Weathering and the decomposition of geologic materials produces conditions conducive to landslides and human activity further exacerbates many landslide problems. Many landslides are difficult to mitigate, particularly in areas of large historic movement with weak underlying geologic materials. As communities continue to modify the terrain and influence natural processes, it is important to be aware of the physical properties of the underlying soils as they, along with climate, create landslide hazards. Even with proper planning, landslides will continue to threaten the safety of people, property, and infrastructure, but without proper planning, landslide hazards will be even more common and more destructive.

The increasing scarcity of build-able land, particularly in urban areas, increases the tendency to build on geologically marginal land. Additionally, hillside housing developments in southern California are prized for the view lots that they provide.

Rock falls occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving with the materials free falling or bouncing down the slope. In falls, material is detached from a steep slope or cliff. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage.

Earth flows are plastic or liquid movements in which land mass (e.g. soil and rock) breaks up and flows during movement. Earthquakes often trigger flows.[25] Debris flows normally occur when a landslide moves downslope as a semi-fluid mass scouring, or partially scouring soils from the slope along its path. Flows are typically rapidly moving and also tend to increase in volume as they scour out the channel.[26] Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances.

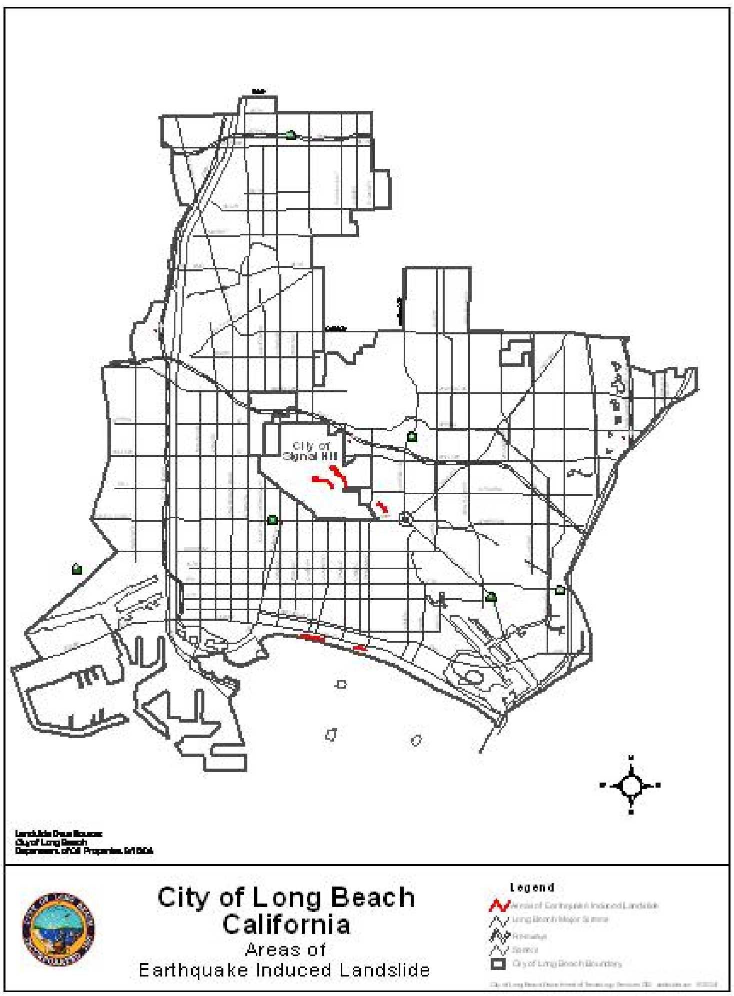
Landslide Conditions

Landslides are often triggered by periods of heavy rainfall. Earthquakes, subterranean water flow man-made or stream induced excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Human activities, including locating development near steep slopes, can increase susceptibility to landslide events. Landslides on steep slopes are more dangerous because movements can be rapid.

Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities. Grading for road construction and development can increase slope steepness. Grading and construction can decrease the stability of a hill slope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Other human activities effecting landslides include: excavation, drainage and groundwater alterations, and changes in vegetation.[27]

Wildland fires in hills covered with chaparral are often a precursor to debris flows in burned out canyons. The extreme heat of a wildfire can create a soil condition in which the earth becomes impervious to water by creating a waxy-like layer just below the ground surface. Since the water cannot be absorbed into the soil, it rapidly accumulates on slopes, often gathering loose particles of soil in to a sheet of mud and debris. Debris flows can often originate miles away from unsuspecting persons, and approach them at a high rate of speed with little warning.

Map 7-1: Earthquake Induced Landslide Areas (Source: City of Long Beach GIS)



Natural Conditions

Natural processes can cause landslides or re-activate historical landslide sites. The removal or undercutting of shoreline-supporting material along bodies of water by currents and waves produces countless small slides each year. Seismic tremors can trigger landslides on slopes historically known to have landslide movement. Earthquakes can also cause additional failure (lateral spreading) that can occur on gentle slopes above steep streams and riverbanks.

Particularly Hazardous Landslide Areas

Locations at risk from landslides or debris flows include areas with one or more of the following conditions:

1. On or close to steep hills;
2. Steep road-cuts or excavations;
3. Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground);
4. Steep areas where surface runoff is channeled, such as below culverts, V -shaped valleys, canyon bottoms, and steep stream channels; and
5. Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons.
6. Canyon areas below hillside and mountains that have recently (within 1-6 years) been subjected to a wildland fire.

Impacts of Development

Although landslides are a natural occurrence, human impacts can substantially affect the potential for landslide failures in the City of Long Beach. Proper planning and geotechnical engineering can be exercised to reduce the threat of safety of people, property, and infrastructure.

Excavation and Grading

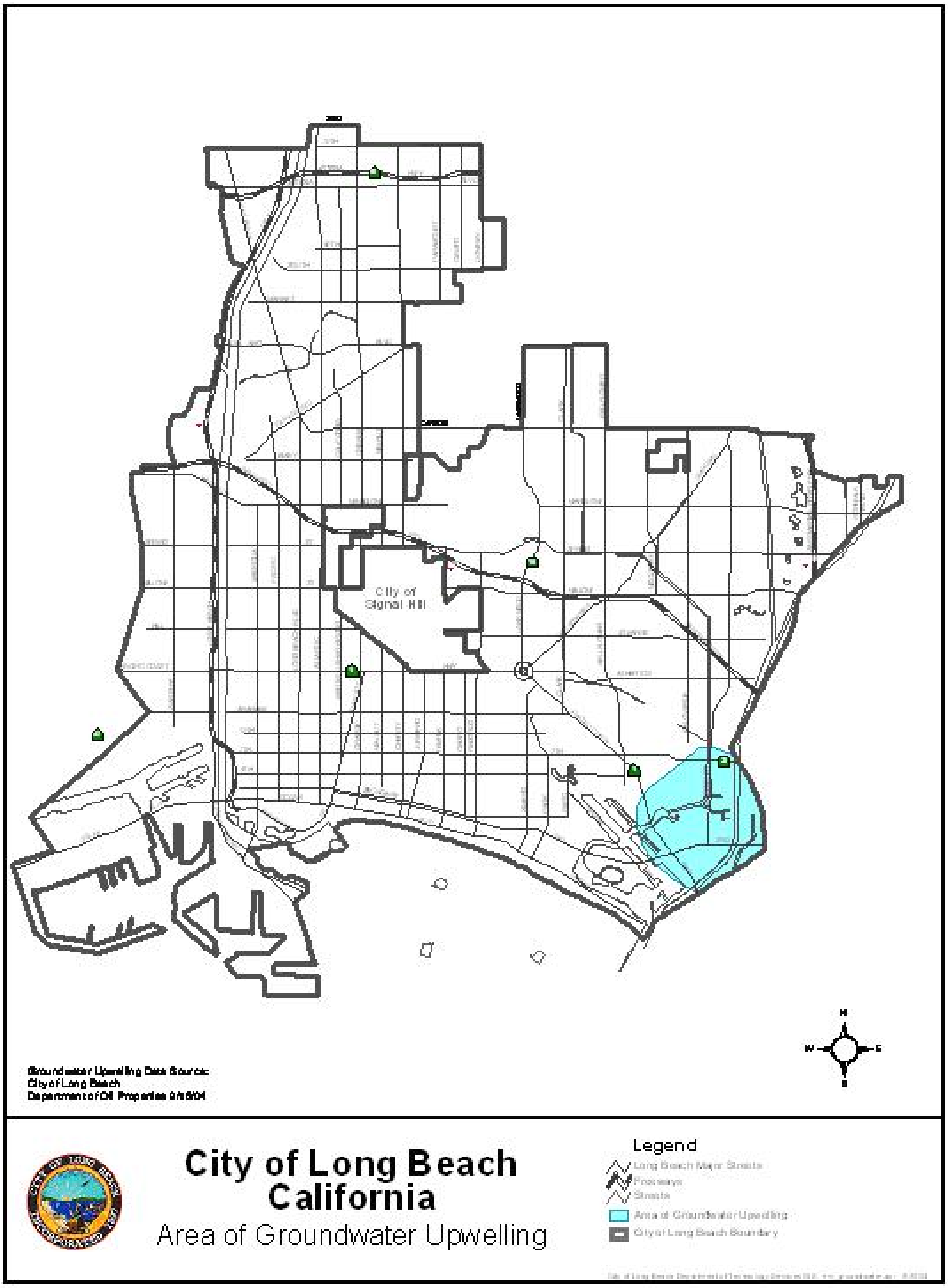
Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at an increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill. Landslides occurring below new construction sites are indicators of the potential impacts stemming from excavation.

Drainage and Groundwater Alterations

Water flowing through or above ground is often the trigger for landslides. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. However, even lawn irrigation in landslide prone locations can result in damaging landslides. Ineffective storm water management and excess runoff can also cause erosion and increase the risk of landslide hazards. Drainage can be affected naturally by the geology and topography of an area; Development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. Channels, streams, ponding, and erosion on slopes all indicate potential slope problems.

Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides.[28]

Map 7-2: Area of Groundwater Upwelling
(Source: City of Long Beach GIS)



Changes in Vegetation

Removing vegetation from very steep slopes can increase landslide hazards. Areas that experience wildfire and land clearing for development may have long periods of increased landslide hazard. Also, certain types of ground cover have a much greater need for constant watering to remain green. Changing away from native ground cover plants may increase the risk of landslide.

Earth Movement Hazard Assessment

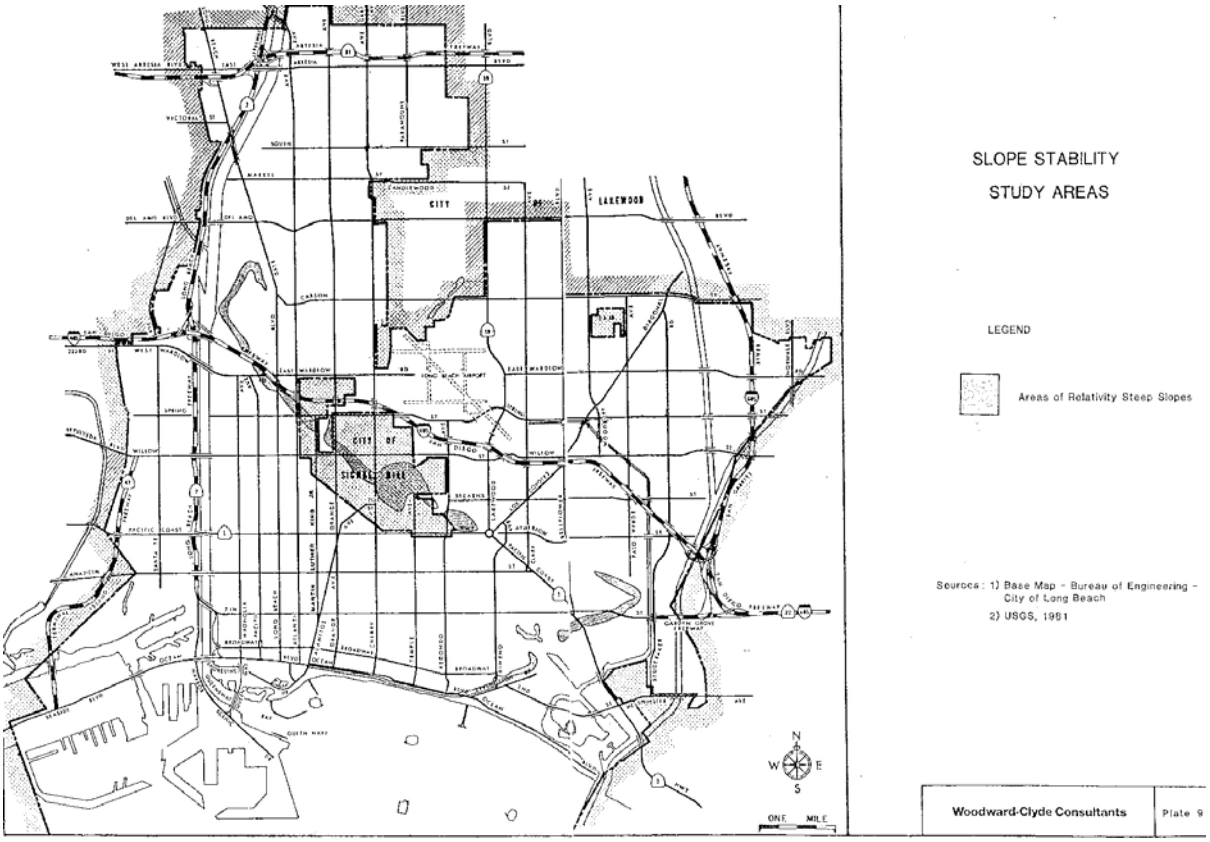
Hazard Identification

Identifying hazardous locations is an essential step towards implementing more informed mitigation activities.

According to the City's General Plan Public Safety Element, mudslides and landslides can be generally categorized under the heading of slope instability. State-wide, such slope instability is a major threat, estimated to cause nearly 10 billion dollars worth of damage between 1970 and the year 2000. The areas most susceptible to this condition are those where: a) slopes are steep, b) soils or soil lenses are weak, cohesionless, or not cemented, c) bedding dips out of the slope, and d) groundwater is present. In Long Beach, slope instability is not a major problem as slopes generally are neither high nor steep. While slope instability is not a major consideration in overall land planning, it is a factor in designing individual sites. Chapter 33 of the California Building Code addresses grading on sites where safety hazards may be created. As Chapter 33 has been adopted and is enforced in the City, slope instability is not a significant or imminent threat to public safety.

The City's 1989 Seismic Safety Element states that the slopes within the City are not high (slopes greater than 50 feet) or steep (generally sloping flatter than 1-1/2:1, horizontal to vertical), and that slope instability has not been a significant problem in the past. The Seismic Safety Element also states that there were only minor slope failures noted during the 1933 Long Beach Earthquake. The Element goes on to state that "the potential for seismically induced slope instability that is not associated with liquefaction or dikes should not be considered as a major consideration in land planning concepts. However, certain areas have been identified where slope stability should be considered for the development of individual sites." The Section 7.4 of the Element recommends soil stabilization measures for those situations.

Map 7-3: Slope Stability Study Areas
(Source: The City's General Plan Seismic Safety Element)



Vulnerability and Risk

Vulnerability assessment for landslides will assist in predicting how different types of property and population groups will be affected by a hazard.[29] Data that includes specific landslide-prone and debris flow locations in the city can be used to assess the population and total value of property at risk from future landslide occurrences.

At this time, the City of Long Beach Zoning Ordinance does not identify any specific standards for steep slope development.

While a quantitative vulnerability assessment (an assessment that describes number of lives or amount of property exposed to the hazard) has not yet been conducted for the City of Long Beach landslide events, there are many qualitative factors that point to potential vulnerability. Landslides can impact major transportation arteries, blocking residents from essential services and businesses.

Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow occurrences, slope steepness, soil characteristics, and precipitation intensity.

This type of analysis could generate estimates of the damages to the city due to a specific landslide or debris flow event. At the time of publication of this plan, data was insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available.

Community Landslide Issues

What is Susceptible to Earth Movement?

Earth movement can affect utility services, transportation systems, and critical lifelines. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from earth movements as small as an inch or two.

Roads and Bridges

Losses incurred from earth movement hazards in the City of Long Beach have been associated with the roads. The City contracts with the Los Angeles County Public Works Department for responding to slides that inhibit the flow of traffic or are damaging a road or a bridge. The roads department does its best to communicate with residents impacted by landslides, but can usually only repair the road itself, as well as the areas adjacent to the slide where the city has the right of way.

It is not cost effective to mitigate all slides because of limited funds and the fact that some historical slides are likely to become active again even with mitigation measures. The City's Public Works Department alleviates problem areas by grading slides, and by installing new drainage systems on the slopes to divert water from the landslides. This type of response activity is often the most cost-effective in the short-term, but is only temporary. Unfortunately, many property owners are unaware of slides and the dangers associated with them.

Lifelines and Critical Facilities

Lifelines and critical facilities should remain accessible, if possible, during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is critical for hospitals and other emergency facilities. Therefore, inspection and repair of critical transportation facilities and routes is essential and should receive high priority. Losses of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas. Flood events can also cause landslides, which can have serious impacts on gas lines that are located in vulnerable soils.

Community Issues Summary
Earth movement continues to be a potential problem in the City of Long Beach.

End Notes

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Section 8: Windstorm Hazards in the City of Long Beach

Why are Severe Windstorms a Threat to the City of Long Beach?
Severe wind storms pose a significant risk to life and property in the region by creating conditions that disrupt essential systems such as public utilities, telecommunications, and transportation routes. High winds can and do occasionally cause tornado-like damage to local homes and businesses. High winds can have destructive impacts, especially to trees, power lines, and utility services.

Figure 8-1: Santa Ana Winds (Source: NASA's "Observatorium")

Two wind patterns occurring over south coastal California, the Catalina Eddy and the Santa Ana Winds, are locally famous effects of a special combination of terrain and atmospheric pressure gradients. Phenomena similar to these occur in a few other areas of the world, but nowhere do they affect such a large number of people and almost nowhere else do they so impact local climatic conditions.

Santa Ana Winds and Tornado-Like Wind Activity
Based on local history, most incidents of high wind in the City of Long Beach are the result of the Santa Ana wind conditions. While high impact wind incidents are not frequent in the area, significant Santa Ana Wind events and sporadic tornado activity have been known to negatively impact the local community.

Windstorm Characteristics

What are Santa Ana Winds?
"Santa Ana winds are generally defined as warm, dry winds that blow from the east or northeast (offshore). These winds occur below the passes and canyons

of the coastal ranges of southern California and in the Los Angeles basin. Santa Ana winds often blow with exceptional speed in the Santa Ana Canyon (the canyon from which it derives its name). Forecasters at the National Weather Service offices in Oxnard and San Diego usually place speed minimums on these winds and reserve the use of "Santa Ana" for winds greater than 25 knots."[1] These winds accelerate to speeds of 35 knots as they move through canyons and passes, with gusts to 50 or even 60 knots.

"The complex topography of southern California combined with various atmospheric conditions create numerous scenarios that may cause widespread or isolated Santa Ana events. Commonly, Santa Ana winds develop when a region of high pressure builds over the Great Basin (the high plateau east of the Sierra Mountains and west of the Rocky Mountains including most of Nevada and Utah). Clockwise circulation around the center of this high pressure area forces air downslope from the high plateau. The air warms as it descends toward the California coast at the rate of 5 degrees F per 1000 feet due to compressional heating. Thus, compressional heating provides the primary source of warming. The air is dry since it originated in the desert, and it dries out even more as it is heated."[2]

These regional winds typically occur from October to March, and, according to most accounts are named either for the Santa Ana River Valley where they originate or for the Santa Ana Canyon, southeast of Los Angeles, where they pick up speed.

What are Tornados?

Tornadoes are spawned when there is warm, moist air near the ground, cool air aloft, and winds that speed up and change direction. An obstruction, such as a house, in the path of the wind causes it to change direction. This change increases pressure on parts of the house, and the combination of increased pressures and fluctuating wind speeds creates stresses that frequently cause structural failures.

In order to measure the intensity and wind strength of a tornado, Dr. T. Theodore Fujita developed the Fujita Tornado Damage Scale. This scale compares the estimated wind velocity with the corresponding amount of suspected damage. The scale measures six classifications of tornadoes with increasing magnitude from an "F0" tornado to a "F6+" tornado.

Table 8-1: Fujita Tornado Damage Scale

Scale	Wind Estimate (mph)	Typical Damage
F0	< 73	**Light damage.** Some damage to chimneys and TV antennas; breaks twigs off trees; pushes over shallow-rooted trees.
F1	73-112	**Moderate damage.** Peels surface off roofs; windows broken; light trailer houses pushed or overturned; some trees uprooted or snapped; moving automobiles pushed off the road. 74 mph is the beginning of hurricane wind speed.
F2	113-157	**Considerable damage.** Roofs torn off frame houses leaving strong upright walls; weak buildings in rural areas demolished; trailer houses destroyed; large trees snapped or uprooted; railroad boxcars pushed over; light object missiles generated; cars blown off highway.
F3	158-206	**Severe damage.** Roofs and some walls torn off frame houses; some rural buildings completely demolished; trains overturned; steel-framed hangar-warehouse-type structures torn; cars lifted off the ground; most trees in a forest uprooted snapped, or leveled.
F4	207-260	**Devastating damage.** Whole frame houses leveled, leaving piles of debris; steel structures badly damaged; trees debarked by small flying debris; cars and trains thrown some distances or rolled considerable distances; large missiles generated.
F5	261-318	**Incredible damage.** Whole frame houses tossed off foundations; steel-reinforced concrete structures badly damaged; automobile-sized missiles generated; trees debarked; incredible phenomena can occur.
F6-F12	319 to sonic	**Inconceivable damage.** Should a tornado with the maximum wind speed in excess of F5 occur, the extent and types of damage may not be conceived. A number of missiles such as iceboxes, water heaters, storage tanks, automobiles, etc. will create serious secondary damage on structures.

Source: http://weather.latimes.com/tornadoFAQ.asp

Microbursts

Like tornados, microbursts, are strong, damaging winds which strike the ground and often give the impression a tornado has struck. They frequently occur during intense thunderstorms. The origin of a microburst is downward moving air from a thunderstorm's core. But unlike a tornado, they affect only a rather small area.

University of Chicago storm researcher Dr Ted Fujita first coined the term “downburst” to describe strong, downdraft winds flowing out of a thunderstorm cell that he believed were responsible for the crash of Eastern Airlines Flight 66 in June of 1975.[3]

A downburst is a straight-direction surface wind in excess of 39 mph caused by a small-scale, strong downdraft from the base of convective thundershowers and thunderstorms. In later investigations into the phenomena he defined two sub-categories of downbursts: the larger macrobursts and small microbursts.[4]

Macrobursts are downbursts with winds up to 117 mph which spread across a path greater than 2.5 miles wide at the surface and which last from 5 to 30 minutes. The microburst, on the other hand is confined to an even smaller area, less than 2.5 miles in diameter from the initial point of downdraft impact. An intense microburst can result in damaging winds near 270 km/hr (170 mph) and often last for less than five minutes.[5]

> "Downbursts of all sizes descend from the upper regions of severe thunderstorms when the air accelerates downward through either exceptionally strong evaporative cooling or by very heavy rain which drags dry air down with it. When the rapidly descending air strikes the ground, it spreads outward in all directions, like a fast-running faucet stream hitting the sink bottom.
>
> When the microburst wind hits an object on the ground such as a house, garage or tree, it can flatten the buildings and strip limbs and branches from the tree. After striking the ground, the powerful outward running gust can wreak further havoc along its path. Damage associated with a microburst is often mistaken for the work of a tornado, particularly directly under the microburst. However, damage patterns away from the impact area are characteristic of straight-line winds rather than the twisted pattern of tornado damage."[6]

Tornados, like those that occur every year in the Midwest and Southeast parts of the United States, are a rare phenomenon in most of California, with most tornado-like activity coming from micro-bursts.

Local History of Windstorm Events

While the effects of Santa Ana Winds are often overlooked, it should be noted that in 2003, two deaths in southern California were directly related to the fierce condition. A falling tree struck one woman in San Diego.[7] The second death occurred when a passenger in a vehicle was hit by a flying pickup truck cover launched by the Santa Ana Winds.[8]

Table 8-2: Santa Ana Wind Events in 2003

The following Santa Ana wind events were featured in news resources during 2003:	
January 6, 2003 OC Register	"One of the strongest Santa Ana windstorms in a decade toppled 26 power poles in Orange early today, blew over a mobile derrick in Placentia, crushing two vehicles, and delayed Metrolink rail service." This windstorm also knocked out power to thousands of people in northeastern Orange County.
January 8, 2003 CBSNEWS.com	"Santa Ana's roared into Southern California late Sunday, blowing over trees, trucks and power poles. Thousands of people lost power."
March 16, 2003 dailybulletin.com	Fire Officials Brace for Santa Ana Winds - - "The forest is now so dry and so many trees have died that fires, during relatively calm conditions, are running as fast and as far as they might during Santa Ana Winds. Now the Santa Ana season is here. Combine the literally tinder dry conditions with humidity in the single digits and 60-80 mph winds, and fire officials shudder."

Table 8-3: Major Windstorms in the Vicinity of the City of Long Beach

Date	Location and Damage
November 5-6, 1961	Santa Ana winds. Fire in Topanga Canyon
February 10-11, 1973	Strong storm winds: 57 mph at Riverside, 46 Newport Beach. Some 200 trees uprooted in Pacific Beach alone
October 26-27, 1993	Santa Ana winds. Fire in Laguna Hills
October 14, 1997	Santa Ana winds: gusts 87 mph in central Orange County. Large fire in Orange County
December 29, 1997	Gusts 60+ mph at Santa Ana
March 28-29, 1998	Strong storm winds in Orange County: sustained 30-40 mph. Gust 70 mph at Newport Beach, gust 60 Huntington Beach. Trees down, power out, and damage across Orange and San Diego Counties. 1 illegal immigrant dead in Jamul.
September 2, 1998	Strong winds from thunderstorms in Orange County with gusts to 40mph. Large fires in Orange County
December 6, 1998	Thunderstorm in Los Alamitos and Garden Grove: gust 50-60 mph called “almost a tornado”
December 21-22, 1999	Santa Ana winds: gust 68 mph at Campo, 53 Huntington Beach, 44 Orange. House and tree damage in Hemet.
March 5-6, 2000	Strong thunderstorm winds at the coast: gust 60 mph at Huntington Beach Property damage and trees downed along the coast
April 1, 2000	Santa Ana winds: gust 93 mph at Mission Viejo, 67 Anaheim Hills
December 25-26, 2000	Santa Ana winds: gust 87 mph at Fremont Canyon. Damage and injuries in Mira Loma, Orange and Riverside Counties
February 13, 2001	Thunderstorm gust to 89 mph in east Orange
Source:http://www.wrh.noaa.gov/sandiego/research/Guide/weatherhistory.pdf	

The following is a glimpse of major tornado-like events to hit the City of Long Beach or surrounding areas:

Table 8-4: Major Tornado-like Events in the Vicinity of the City of Long Beach

Major Tornado-like Events in the Orange County Area 1958-2001	
Date	**Location and Damage**
April 1, 1958	Tornado: Laguna Beach
February 19, 1962	Tornado: Irvine
April 8, 1965	Tornado: Costa Mesa
November 7, 1966	Newport Beach and Costa Mesa: Property Damage
March 16, 1977	Tornado skipped from Fullerton to Brea Damage to 80 homes and injured four people
February 9, 1978	Tornado: Irvine. Property damage and 6 injured
January 31, 1979	Tornado Santa Ana Numerous power outages
November 9, 1982	Tornadoes in Garden Grove and Mission Viejo. Property damage
January 13, 1984	Tornado: Huntington Beach. Property damage
March 16, 1986	Tornado: Anaheim. Property damage
February 22-24, 1987	Tornadoes and waterspouts: Huntington Beach
January 18, 1988	Tornadoes: Mission Viejo and San Clemente. Property damage
February 28, 1991	Tornado: Tustin
March 27, 1991	Tornado: Huntington Beach
December 7, 1992	Tornadoes: Anaheim and Westminster Property damage
January 18, 1993	Tornado: Orange County Property damage
February 8, 1993	Tornado: Brea. Property damage
February 7, 1994	Tornado from Newport Beach to Tustin. Roof and window damage. Trees were also knocked down
December 13, 1994	Two waterspouts about 0.5 mile off Newport Beach
December 13, 1995	Funnel cloud near Fullerton Airport
March 13, 1996	Funnel cloud in Irvine
November 10-11, 1997	Waterspout came ashore at Newport Pier on the 10th and dissipated over western Costa Mesa. Tornadoes in Irvine on the 11th and a funnel cloud developed. 10th: Winds estimated at 60-70 mph. 11th: Minor power outages occurred with little property damage. A fisherman was blown from one end of Newport Pier to the other. Property and vehicle damage in Irvine from flying debris. Ten cars were thrown a few feet.
December 21, 1997	Waterspout and tornado in Huntington Beach. Damage to boats, houses, and city property
February 24, 1998	Tornado in Huntington Beach. Property damage with a power outage, roof flew ¼ mile

March 13-14, 1998	Numerous waterspouts between Long Beach, Huntington Beach, and Catalina
March 31-April 1, 1998	Numerous funnel clouds reported off Orange County coastline, two of which became waterspouts off Orange County. One waterspout briefly hit the coast off the Huntington Beach pier.
June 6, 1998	Two funnel clouds off Dana Point
December 31, 1998	Funnel clouds in Santa Ana. Waterspout off Costa Mesa coast
February 21, 2000	Tornado: Anaheim Hills. Property damage
October 28, 2000	Funnel clouds around Newport Beach and Costa Mesa
January 10, 2001	Funnel cloud at Orange County airport and Newport Beach
February 24, 2001	Tornado in Orange. Damage to warehouse, 6 structures, fences, and telephone wires.
Source: http://www.wrh.noaa.gov/sandiego/research/Guide/weatherhistory.pdf	

Windstorm Hazard Assessment

Hazard Identification

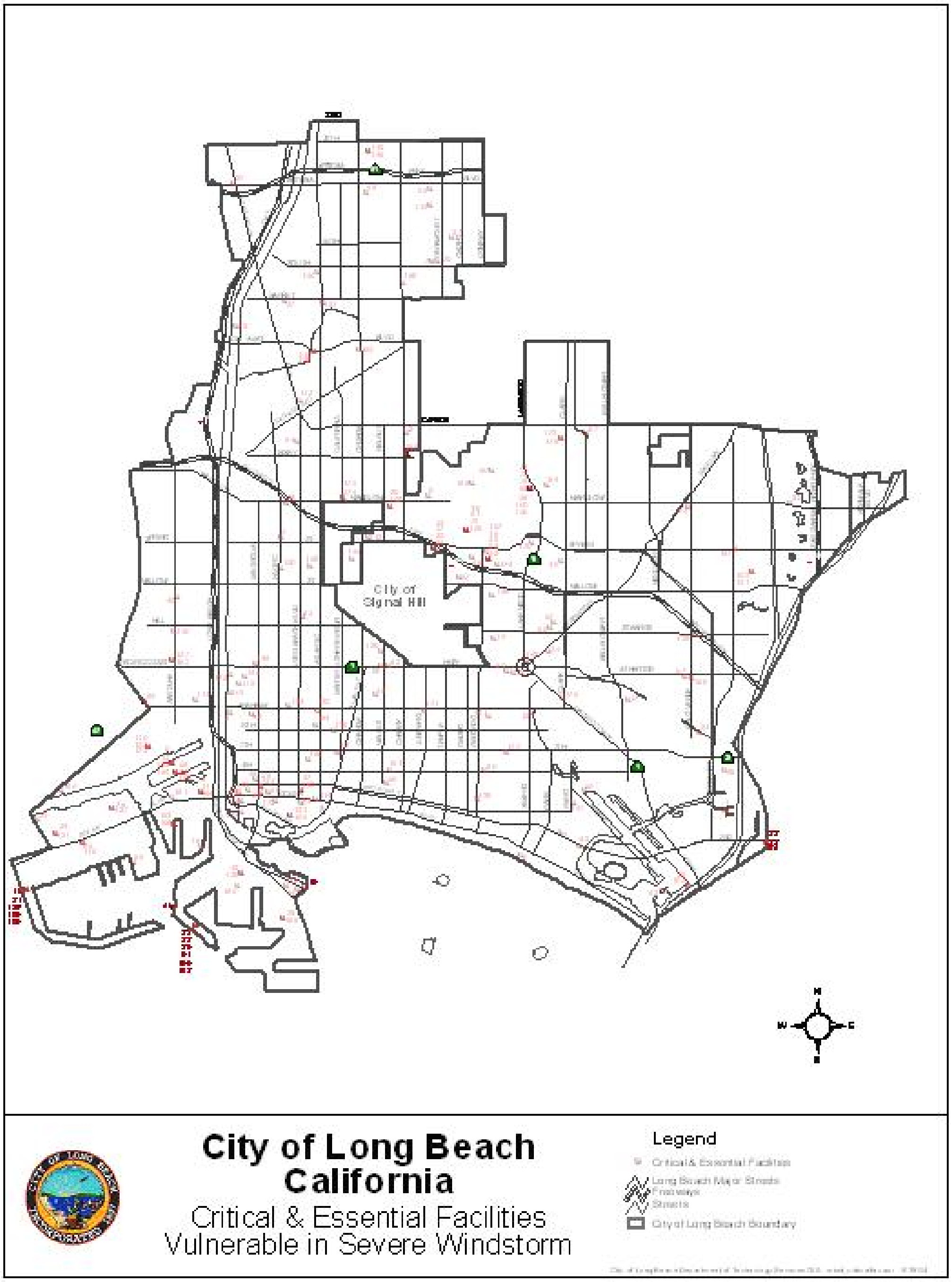
A windstorm event in the region can range from short term microburst activity lasting only minutes to a long duration Santa Ana wind condition that can last for several days as in the case of the January 2003 Santa Ana wind event. Windstorms can cause extensive damage including heavy tree stands, exposed coastal properties, road and highway infrastructure, and critical utility facilities. Heavy tourist traffic on the State and Local beach property is at great risk during windstorm activity.

Map 8-1 shows clearly the direction of the Santa Ana winds as they travel from the stable, high-pressure weather system called the Great Basin High through the canyons and towards the low-pressure system off the Pacific. Clearly the area of the City of Long Beach is in the direct path of the ocean-bound Santa Ana winds.

Vulnerability and Risk

With an analysis of the high wind and tornado events depicted in the "Local History" section, we can deduce the common windstorm impact areas including impacts on life, property, utilities, infrastructure and transportation. Additionally, if a windstorm disrupts power to local residential communities, the American Red Cross and City resources might be called upon for care and shelter duties. Displacing residents and utilizing City resources for shelter staffing and disaster cleanup can cause an economic hardship on the community.

Map 8-1: Facilities Map - Severe Windstorm
(Source: City of Long Beach GIS)



Community Windstorm Issues

What is Susceptible to Windstorms?

Life and Property

Based on the history of the region, windstorm events can be expected, perhaps annually, across widespread areas of the region which can be adversely impacted during a windstorm event. This can result in the involvement of City of Long Beach emergency response personnel during a wide-ranging windstorm or microburst tornadic activity. Both residential and commercial structures with weak reinforcement are susceptible to damage. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift suction forces that pull building components and surfaces outward. With extreme wind forces, the roof or entire building can fail causing considerable damage.

Debris carried along by extreme winds can directly contribute to loss of life and indirectly to the failure of protective building envelopes, siding, or walls. When severe windstorms strike a community, downed trees, power lines, and damaged property can be major hindrances to emergency response and disaster recovery.

The Beaufort Scale below, coined and developed by Sir Francis Beaufort in 1805, illustrates the effect that varying wind speed can have on sea swells and structures:

Table 8-5: Beaufort Scale

BEAUFORT SCALE		
Beaufort Force	Speed (mph)	Wind Description - State of Sea - Effects on Land
0	Less 1	Calm - Mirror-like - Smoke rises vertically
1	1-3	Light - Air Ripples look like scales; No crests of foam - Smoke drift shows direction of wind, but wind vanes do not
2	4-7	Light Breeze - Small but pronounced wavelets; Crests do not break - Wind vanes move; Leaves rustle; You can feel wind on the face
3	8-12	Gentle Breeze - Large Wavelets; Crests break; Glassy foam; A few whitecaps - Leaves and small twigs move constantly; Small, light flags are extended
4	13-18	Moderate Breeze - Longer waves; Whitecaps - Wind lifts dust and loose paper; Small branches move
5	19-24	Fresh Breeze - Moderate, long waves; Many whitecaps; Some spray - Small trees with leaves begin to move

6	25-31	Strong Breeze - Some large waves; Crests of white foam; Spray - Large branches move; Telegraph wires whistle; Hard to hold umbrellas
7	32-38	Near Gale - White foam from breaking waves blows in streaks with the wind - Whole trees move; Resistance felt walking into wind
8	39-46	Gale - Waves high and moderately long; Crests break into spin drift, blowing foam in well marked streaks - Twigs and small branches break off trees; Difficult to walk
9	47-54	Strong Gale - High waves with wave crests that tumble; Dense streaks of foam in wind; Poor visibility from spray - Slight structural damage
10	55-63	Storm - Very high waves with long, curling crests; Sea surface appears white from blowing foam; Heavy tumbling of sea; Poor visibility - Trees broken or uprooted; Considerable structural damage
11	64-73	Violent Storm - Waves high enough to hide small and medium sized ships; Sea covered with patches of white foam; Edges of wave crests blown into froth; Poor visibility - Seldom experienced inland; Considerable structural damage
12	>74	Hurricane - Sea white with spray. Foam and spray render visibility almost non-existent - Widespread damage. Very rarely experienced on land.

Source: http://www.compuweather.com/decoder-charts.html

Disruption of Critical Services

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after an earthquake event.

Utilities

Historically, falling trees have been the major cause of power outages in the region. Windstorms such as strong microbursts and Santa Ana Wind conditions can cause flying debris and downed utility lines. For example, tree limbs breaking in winds of only 45 mph can be thrown over 75 feet. As such, overhead power lines can be damaged even in relatively minor windstorm events. Falling trees can bring electric power lines down to the pavement, creating the possibility of lethal electric shock. Rising population growth and new infrastructure in the region creates a higher probability for damage to occur from windstorms as more life and property are exposed to risk.

Infrastructure

Windstorms can damage buildings, power lines, and other property and infrastructure due to falling trees and branches. During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds.

Windstorms can result in collapsed or damaged buildings or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Roads blocked by fallen trees during a windstorm may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric services and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from windstorms related to both physical damages and interrupted services.

Increased Fire Threat
Perhaps the greatest danger from windstorm activity in southern California comes from the combination of the Santa Ana winds with the major fires that occur every few years in the urban/wildland interface. With the Santa Ana winds driving the flames, the speed and reach of the flames is even greater than in times of calm wind conditions. The higher fire hazard raised by a Santa Ana wind condition requires that even more care and attention be paid to proper brush clearances on property in the wildland/urban interface areas.

Transportation
Windstorm activity can have an impact on local transportation in addition to the problems caused by downed trees and electrical wires blocking streets and highways. During periods of extremely strong Santa Ana winds, major highways can be temporarily closed to truck and recreational vehicle traffic. However, typically these disruptions are not long lasting, nor do they carry a severe long term economic impact on the region.

End Notes:

1http://nimbo.wrh.noaa.gov/Sandiego/snawind.html

2Ibid

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4Ibid

5Ibid

6Ibid

7www.cbsnews.com, January 8, 2003

8www.cbsnews.com/stories/2003/01/06/national/

Special Thanks to Jacob Green, Assistant to the Emergency Services Coordinator, City of Fountain Valley/Huntington Beach Hazard Mitigation Planning Committee

Section 9:
Tsunami Hazards
in the
City of Long Beach

Why Are Tsunamis a Threat to Southern California?
Based on the historic record, the probability of a tsunami striking the City's coastal area is a very low threat. However, geologically the historic record is very short and recent studies of nearby offshore faults and marine landslide potential indicate that such events are likely to occur sometime in our future. If a tsunami should occur, the consequences would be great. The impact could cause loss of life, destroy thousands of high priced homes and greatly affect the City's downtown, port, marinas, coastal businesses, and impact tourism. Even if all residents and visitors were safely evacuated, the damage to property in this densely populated, high property value area would still be tremendous. In addition, certain areas within the City could be vulnerable to a seiche (inland tsunami) including Naples, the Port, and marinas.

California's Tsunamis
"Since 1812, the California coast has had 14 tsunamis with wave heights higher than three feet; six of these were destructive. The Channel Islands were hit by a big tsunami in the early 1800s. The worst tsunami resulted from the 1964 Alaskan earthquake and caused 12 deaths and at least $17 million in damages in northern California."[1]

What are Tsunamis?
The phenomenon we call "tsunami" (soo-NAH-mee) is a series of traveling ocean waves of extremely long length generated primarily by vertical movement on a fault (earthquake) occurring along the ocean floor. Underwater volcanic eruptions and landslides can also generate tsunamis. In the deep ocean, the tsunami waves move across the deep ocean with a speed exceeding 500 miles per hour, and a wave height of only a few inches. Tsunami waves are distinguished from ordinary ocean waves by their great length between wave crests, often exceeding 60 miles or more in the deep ocean and by the fact the wave extends from the bottom of the ocean to the surface. Typical waves are wind-generated and are near surface phenomena. Local tsunamis can be much shorter in wave length and much higher in amplitude.

As a tsunami reaches the shallow waters of the coast, the waves slow down and the water can pile up into a wall of destruction up to 30 feet or more in height. The effect can be amplified where a bay, harbor or lagoon funnels the wave as it moves inland. Large tsunamis have been known to rise over 100 feet. Even a tsunami 1-3 feet high can be very destructive and cause many deaths and injuries, especially within Port and harbor facilities.

What causes Tsunami?
There are many causes of tsunamis but the most prevalent is vertical fault movement during an earthquake at the surface of the ocean floor. In addition, marine landslides, underwater volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites, can generate tsunamis.

Plate Tectonics
Plate Tectonic theory is based on an earth model characterized by a small number of lithospheric plates, 40 to 150 miles thick, which float on a viscous under-layer called the asthenosphere. These plates, which cover the entire surface of the earth and contain both the continents and sea floor, move relative to each other at rates of up to several inches per year. The region where two plates come in contact is called a plate boundary, and the way in which one plate moves relative to another determines the type of boundary: spreading, where the two plates move away from each other; subduction, where the two plates move toward each other and one slides beneath the other; and transform, where the two plates slide horizontally past each other. Subduction zones are characterized by deep ocean trenches, and the volcanic islands or volcanic mountain chains associated with the many subduction zones around the Pacific Rim are sometimes called the Ring of Fire. Southern California is part of the Ring of Fire. Major faults in the region are a consequence of the collision of the Pacific Plate and the North American Plate.

Tsunamis
In general, tsunamis may be generated by sea flood faulting or marine landslides.

Faulting
Not all active faults generate tsunamis. To generate a tsunami, the fault where the fault on which the earthquake occurs must be underneath or near the ocean, and cause vertical movement of the sea floor over a large area, hundreds or thousands of square miles. "By far, the most destructive tsunamis are generated from large, shallow earthquakes with an epicenter or fault trace on the ocean floor."[2] The amount of vertical motion of the sea floor, the area over which it occurs, and the efficiency with which energy is transferred from the earth's crust to the ocean water are all part of the tsunami generation mechanism.

Marine Landslides
Alternatively, "Less frequently, tsunami waves can be generated from displacements of water resulting from rock falls, icefalls and sudden submarine landslides of slumps. Such events may be caused impulsively from the instability and sudden failure of submarine slopes, which are sometimes triggered by the ground motions of a strong earthquake. For example in the 1980's, earth moving and construction work of an airport runway along the coast of Southern France, triggered an underwater landslide, which generated destructive tsunami waves in the harbor of Thebes." This latter category of tsunami generation may be the greatest long term threat to Southern California. Recent studies at the University of Southern California Tsunami Research Center suggest the potential for the generation of large tsunamis from marine landslides off the Southern California coast as a result of earthquake shaking.

Tsunami Earthquakes

The September 2, 1992 Nicaragua Earthquake (magnitude 7.2) was barely felt by residents along the coast of Nicaragua. Located well off-shore, the severity of shaking on a scale of I to XII, was mostly II along the coast, and reached III at only a few places. Twenty to 70 minutes after the earthquake occurred, a tsunami struck the coast of Nicaragua with wave amplitudes up to 13 feet above normal sea level in most places and a maximum run-up height of 35 ft. The waves caught coastal residents by complete surprise and caused many casualties and considerable property damage.

This tsunami was caused by an earthquake on a fault in the ocean that produced an unusually large tsunami relative to the earthquake magnitude. Tsunami earthquakes are characterized by a very shallow focus, fault dislocations greater than several meters, and fault surfaces that are smaller than for a normal earthquake.

Two other destructive and deadly tsunamis from tsunami earthquakes have occurred in recent years in Java, Indonesia (June 2, 1994) and Peru (February 21, 1996).

Tsunami Characteristics

How Fast?

Unnoticed tsunami waves can travel at the speed of a commercial jet plane, over 500 miles per hour in the open ocean. They can move from one side of the Pacific Ocean to the other in less than a day. It has been recently estimated, that a locally generated tsunami could move across San Pedro Bay in one hour. This great speed makes it important to be aware of the tsunami as soon as it is generated. Scientists can predict when a tsunami will arrive at various places by knowing the source characteristics of the earthquake or marine landslide that generated the tsunami, real time data on the waves sent by instruments on the ocean floor by satellite to tracking stations and the characteristics of the sea floor along the paths to those places. Tsunamis travel much slower in more shallow coastal waters where their wave heights begin to increase dramatically.

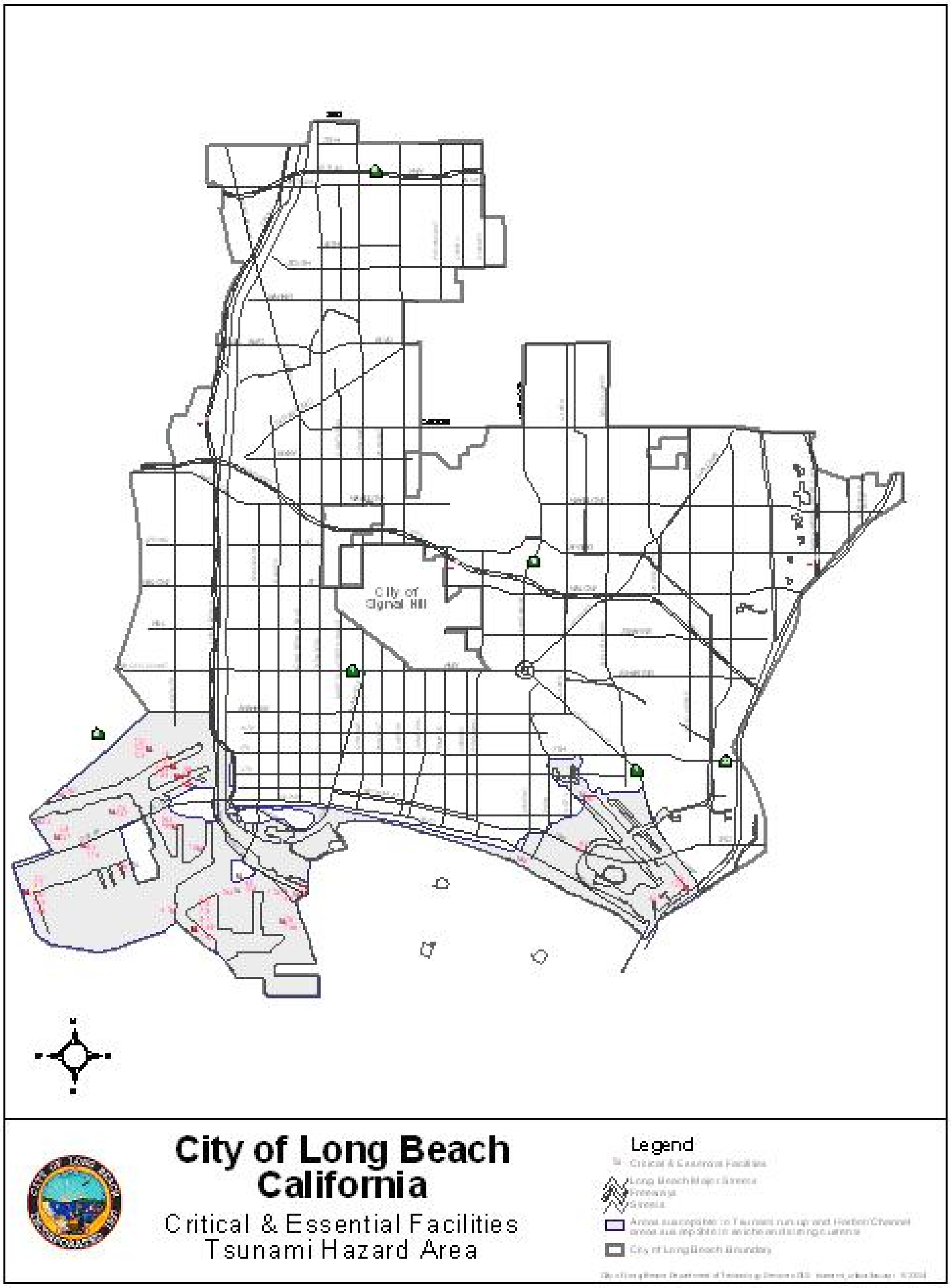
How Big?

Offshore and coastal features can determine the size and impact of tsunami waves. Reefs, bays, entrances to rivers, undersea features and the slope of the beach all help to modify the tsunami as it attacks the coastline. When the tsunami reaches the coast and moves inland, the water level can rise many feet. In extreme cases, water level has risen to more than 50 feet for tsunamis of distant origin and over 100 feet for tsunami waves generated near the earthquake's epicenter. The first wave may not be the largest in the series of waves. Some predictions reveal that there could be 4 or more destructive waves over a period of 30 minutes or more. One coastal community may see no damaging wave activity while in another nearby community destructive waves can be large and violent. The flooding can extend inland by 1000 feet or more, covering large expanses of land with water and debris.

How Frequent?

Since scientists cannot predict when earthquakes will occur, they cannot determine exactly when a tsunami will be generated. However, by looking at past historical tsunamis and run-up maps, scientists know where tsunamis are most likely to be generated. Past tsunami height measurements are useful in predicting future tsunami impact and flooding limits at specific coastal locations and communities.

Map 9-1: Facilities Map - Tsunami Hazard Area
(Source: City of Long Beach GIS)



Types of Tsunamis

Pacific-wide and Regional Tsunamis

Tsunamis can be categorized as “local” and Pacific-wide. Typically, a Pacific-wide tsunami is generated by major vertical ocean bottom movement in offshore deep trenches. A ”local” tsunami can be a component of the Pacific-wide tsunami in the area of the earthquake or a wave that is confined to the area of generation within a bay or harbor and caused by movement of the bay itself or landslides.

The last large tsunami that caused widespread death and destruction throughout the Pacific was generated by an earthquake located off the coast of Chile in 1960. It caused loss of life and property damage not only along the Chile coast but also in Hawaii and as far away as Japan. The Great Alaskan Earthquake of 1964 killed 106 people and produced deadly tsunami waves in Alaska, Oregon and California.

In July 1993, a tsunami generated in the Sea of Japan killed over 120 people in Japan. Damage also occurred in Korea and Russia but spared other countries since the tsunami wave energy was confined within the Sea of Japan. The 1993 Japan Sea tsunami is known as a “regional event” since its impact was confined to a relatively small area. For people living along the northwestern coast of Japan, the tsunami waves followed the earthquake within a few minutes.

During the 1990's, destructive regional tsunamis also occurred in Nicaragua, Indonesia, the Philippines, Papua New Guinea, and Peru, killing thousands of people. Others caused property damage in Chile and Mexico. Some damage also occurred in the far field in the Marquesas Islands (French Polynesia) from the July 30, 1995, Chilean and February 21, 1996, Peruvian tsunamis.

In less than a day, tsunamis can travel from one side of the Pacific to the other. However, people living near areas where large earthquakes occur may find that the tsunami waves will reach their shores within minutes of the earthquake. For these reasons, the tsunami threat to many areas such as Alaska, the Philippines, Japan and the United States West Coast can be immediate (for tsunamis from nearby earthquakes which take only a few minutes to reach coastal areas) or less urgent (for tsunamis from distant earthquakes which take from three to 22 hours to reach coastal areas).

History of Regional Tsunamis

Local

The local tsunami may be the most serious threat as it strikes suddenly, sometimes before the earthquake shaking stops. Alaska has had six serious local tsunamis in the last 80 years and Japan has had many more.

Local History of Tsunamis

Tsunamis have been reported since ancient times. They have been documented extensively in California since 1806. Although the majority of tsunamis have occurred in Northern California, Southern California has been impacted as well. In the 1930's, four tsunamis struck the Los Angeles and Orange Counties, as well as along San Diego's coastal areas. In Orange County the tsunami wave reached heights of 20 feet or more above sea level. In 1964, following the Alaska 8.2 earthquake, tidal surges of approximately 4 feet to 5 feet hit the Huntington Harbor area causing moderate damage.

Personal Interview
Name: Bill Richardson
Title: City of Huntington Beach Lifeguard
Year: 1964 – Alaska Good Friday Earthquake and Tsunami
(paraphrased by Glorria Morrison)
I was on the lifeguard in the tower on the pier. We received warning by phone from the Fire Department who had received information from the National Weather Service. We were told to tell folks on the pier and beach that if the situation escalated they would be advised to evacuate the area and that they should be prepared to move quickly.

I witnessed heavy tidal surges on the beaches. The tide changed in 10 minutes from what it normally was to a very different tide. Normally it takes six hours to change and in 10 minutes it sucked water out and when it came in, it went over the berm, ¾ of the way across the beach. The accelerated tide within one hour came and went twice. The highs were extreme and the lows were extreme, very like our astronomical tides. I monitored the radio and heard of all the docks breaking loose in the harbor. The current was so strong and movement of water that the radio was being overwhelmed with calls for response. Only the two islands of Admiralty and Gilbert existed at the time.

Bill Richardson referred me to Walt Snyder, a Lifeguard Lt. at the time. Walt was in Huntington Harbor during this event.

Personal Interview
Name: Walt Snyder
Title: City of Huntington Beach City Lifeguard, Lt. in the Harbor
Year: 1964 – Alaska Good Friday Earthquake and Tsunami
(paraphrased by Glorria Morrison)

I was called out at daybreak due to the tidal surges in the Huntington Harbor. I got in the City's only rescue boat. The tidal surges were huge and making whirlpools. They were moving at a much faster and higher rate than normal tide.

When the surges would come in, they would tear the boats away from their moorings. Then when the surges would go out, they would take the boats *through the bridge at Pacific Coast Highway to the Seal Beach (Anaheim Landing Bridge) and when they hit the pilings it would tear the boats apart. The high tides were carrying the boats into the weapons station. When surges retreated, the boats would end up on dry land at the weapons station --- high and dry and broken up.*

In 1964 there were only about 200-300 boats in the harbor and today Walt estimated there are 3,500 plus boats. There were only 300-400 homes then and now he estimates an excess of 5,000. This occurred during a low tide. The sea wall in Huntington Harbor is 9'. Had this occurred during a high tide, Walt stated the surges would have easily gone over the sea walls and damaged many homes.

Table 9-1 Tsunami Events in California 1930-2004

Tsunami Events In California 1930-2004			
Date	Location	Maximum Run up*(m)	Earthquake Magnitude
08/31/1930	Redondo Beach	6.10	5.2
08/31/1930	Santa Monica	6.10	5.2
08/31/1930	Venice	6.10	5.2
03/11/1933	La Jolla	0.10	6.3
03/11/1933	Long Beach	0.10	6.3
08/21/1934	Newport Beach	12.00	Unknown
02/09/1941	San Diego	Unknown	6.6
10/18/1989	Monterey	0.40	7.1
10/18/1989	Moss Landing	1.00	7.1
10/18/1989	Santa Cruz	0.10	7.1
04/25/1992	Arena Cove	0.10	7.1
04/25/1992	Monterey	0.10	7.1
09/01/1994	Crescent City	0.14	7.1
11/04/2000	Point Arguello	5.00	
Source: Worldwide Tsunami Database www.ngdc.noaa.gov			

* Maximum Run-Up (M)-The maximum water height above sea level in meters. The run- up is the height the tsunami reached above a reference level such as mean sea level. It is not always clear which reference level was used.

Tsunami Hazard Assessment

Hazard Identification

According to the City's General Plan Public Safety Element, the threat of significant damage associated with a tsunami is considered to be low to moderate. The Element includes the following section on the topic of tsunamis:

> "A tsunami is a sea wave usually generated by a large submarine earthquake. A seiche is similar to a tsunami, but is generated in an enclosed body of water such as a harbor, lake, or swimming pool. The potential damage, of course, is much greater from a tsunami than a seiche. Tsunamis travel across the ocean as long, low waves.
>
> Traveling at almost 500 mph in the Pacific, such a wave in the open causes no problems, and, in fact, the slope of the wave front may be imperceptible to a ship at sea. However, as the tsunami approaches the coastline, it is affected by shallow bottom topography and the configuration of the coastline which transform it into very high and potentially devastating waves. If large waves do not occur, strong currents can cause extensive damage. By comparison to many other areas of southern California, Long Beach is somewhat protected by the surrounding geography and the breakwater. As a substantial warning time of perhaps as much as 6 to 12 hours would be anticipated, the potential for death or injury from a tsunami is not considered great. Substantial shoreline property damage would likely occur, however. Major damage would be to boats, harbor facilities and sea-front structures. In terms of probability, published estimates of recurrence intervals indicate maximum wave heights of 3 to 6 feet for 50 and 100 year recurrence intervals."

It's important to note that the General Plan's Public Safety Element was last updated when the scientific community felt a tsunami could not be generated locally offshore. This concept is now being reexamined. Warning times and magnitudes could be considerably greater than those posed by a distant tsunami. As an example, the warning time for coastal areas would be measured in minutes, not hours.

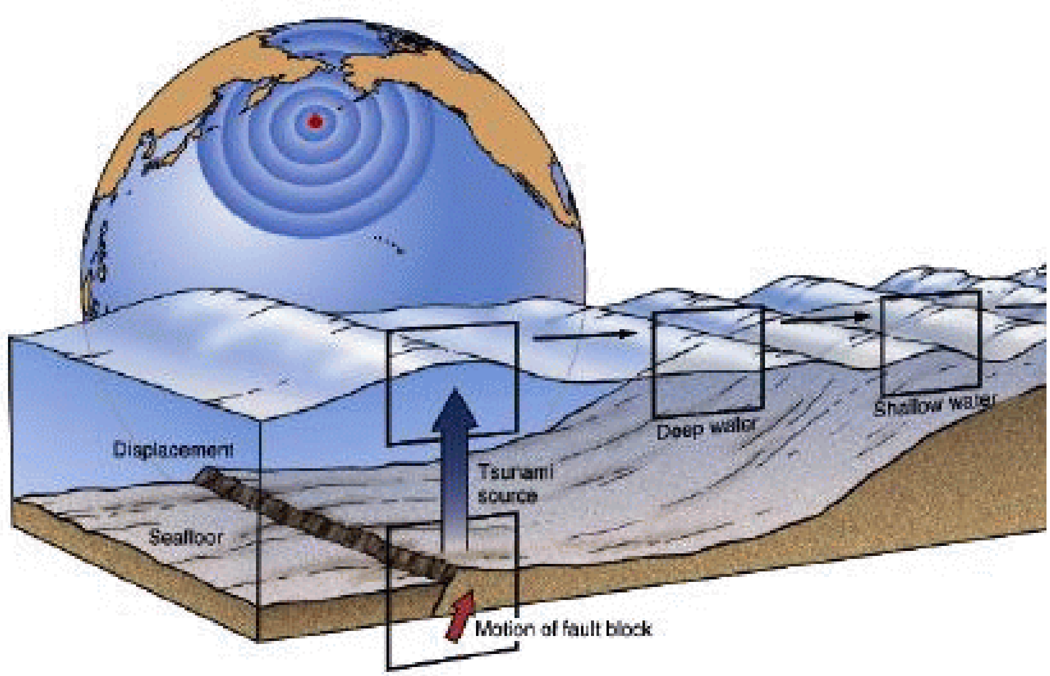
Damage Factors of Tsunamis

Tsunamis cause damage in three ways: inundation, wave impact on structures, structural fires, and erosion.

> "Strong, tsunami-induced currents lead to the erosion of foundations and the collapse of bridges and sea walls. Flotation and drag forces move houses and overturn railroad cars. Considerable damage is caused by the resultant floating debris, including boats and cars that become dangerous projectiles that may crash into buildings, break power lines, and may start fires. Fires from damaged ships in ports or from ruptured coastal oil storage tanks and refinery facilities can cause damage greater than

that inflicted directly by the tsunami. Of increasing concern is the potential effect of tsunami draw down, when receding waters uncover cooling water intakes of nuclear power plants."[3]

Figure 9-1: Tsunami Formation



According to the Tsunami Run-up Maps for nearby coastal communities, the entire coastline would be significantly to severely impacted by a tsunami. During the summer months (August), the City of Long Beach can attract over 17,000 people a day. In addition there are approximately 100 shipping lines in its harbor. If a tsunami were to occur it could devastate the entire coastal area.

Tsunami Watches and Warnings

Warning System

The tsunami warning system in the United States is a function of the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service. Development of the tsunami warning system was impelled by the disastrous waves generated in Alaska in April 1946, which surprised Hawaii and the U.S. West Coast, taking a heavy toll in life and property.

The disastrous 1964 tsunami resulted in the development of a regional warning system in Alaska. The Alaska Tsunami Warning Center is in Palmer, Alaska. This facility is the nerve center for an elaborate telemetry network of remote seismic stations in Alaska, Washington, California, Colorado, and other locations. Tidal data is also telemetered directly to the ATWC from eight Alaskan locations. Tidal data from Canada, Washington, Oregon, and California are available via telephone, teletype, and computer readout.

Notification

The National Warning System (NAWAS) is an integral part of the Alaska Tsunami Warning Center. Reports of major earthquakes occurring anywhere in the Pacific Basin that may generate seismic sea waves are transmitted to the Honolulu Observatory for evaluation. An Alaska Tsunami Warning Center is also in place for public notification of earthquakes in the Pacific Basin near Alaska, Canada, and Northern California. The Observatory Staff determines action to be taken and relays warnings over the NAWAS circuits to inform and warn West Coast states. The State NAWAS circuit is used to relay the information to the Los Angeles County Operational Area warning center which will in turn relay the information to local warning points in coastal areas. The same information is also transmitted to local jurisdictions over appropriate radio systems, teletype, and telephone circuits to ensure maximum dissemination.

Los Angeles County will use the Emergency Alert System (EAS) and Emergency News Network (ENN) to warn the public about an anticipated tsunami.

A Tsunami Watch Bulletin is issued if an earthquake has occurred in the Pacific Basin and could cause a tsunami. A Tsunami Warning Bulletin is issued when an earthquake has occurred and a tsunami is spreading across the Pacific Ocean. When a threat no longer exists, a Cancellation Bulletin is issued.

Vulnerability and Risk
With an analysis of tsunami events depicted in the "Local History" section, we can deduce the common tsunami impact areas will include impacts on life, property, infrastructure and transportation.

Community Tsunami Issues

What is Susceptible to Tsunami?

The possibility of a tsunami impacting the City of Long Beach has not been fully examined. A thorough investigation of the likelihood and impacts of a tsunami on the Long Beach coastline is worthy of consideration. Once the vulnerabilities are better understood, the City should consider updating its emergency response plans and re-train its response staffs, as needed.

Life and Property
Based on the "local" history events of tsunamis we can conclude that approximately 1% of the City would be heavily impacted. The largest impact on the community from a tsunami event would be from loss of and property damage to infrastructure.

Using the Tsunami Warning and Watch Bulletin would provide time to allow coastal residents to evacuate and seek higher ground for shelter. This would greatly reduce injuries and loss of life.

Development
The most significant impacts would be in the following areas:
- ✓ Port and surrounding commercial facilities at or near sea level.
- ✓ Downtown Marina and structures in the Old Pike area.
- ✓ Naples and Belmont Shore area.
- ✓ Coastal bridges and exposed infrastructure
- ✓ Power plants near the shoreline

Coastal Property
Property along the coast could also be devastated. City of Long Beach coastal area is home to millions of dollars worth of industrial and commercial structures. In addition, the area is scattered with infrastructure that serves the entire coastal region. A large tsunami could potentially destroy or damage hundreds of commercial and industrial facilities. A tsunami could have a catastrophic impact on the Port of Long Beach and the overall economy.

Industrial properties in and near the Port of Long Beach would be significantly impacted – perhaps for an extended period of time. Additionally, the ships in the harbor and the supportive facilities on shore could be damaged and negatively impacted.

During summer months up to tens of thousands people a day come into the community to stay in the hotels and shop at coastal shopping facilities. The local government relies heavily on tourism and sales tax. A tsunami event could impact businesses by damaging property and by interrupting business and services. Any residential or commercial structure with weak reinforcement could be susceptible to damage.

The lack of an adequate local warning system could further jeopardize loss of lives and property.

Infrastructure
Tsunamis (and earthquakes) can damage buildings, power lines, and other property and infrastructure due to flooding. Tsunamis can result in collapsed or damaged buildings or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Damage to public water and sewer systems, transportation networks, and flood channels would greatly impact daily life for residents.

Roads blocked by objects during a tsunami may have severe consequences to people who are attempting to evacuate or who need emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric services and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from tsunamis related to both physical damages and interrupted services.

End Notes

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1. http://education.sdsc.edu/optiputer/htmlLinks/california_tsunami.html

2. http://www.prh.noaa.gov/itic/library/about_tsu/faqs.html#1

3. Ibid

Appendix A:
Master Resource Directory

The Resource Directory provides contact information for local, regional, state, and federal programs that are currently involved in hazard mitigation activities. The City Manager's Executive Committee may look to the organizations on the following pages for resources and technical assistance. The Resource Directory provides a foundation for potential partners in action item implementation.

The City Manager's Executive Committee will continue to add contact information for organizations currently engaged in hazard mitigation activities. This section may also be used by various community members interested in hazard mitigation information and projects.

American Public Works Association			
Level: National	Hazard: Multi	http://www.apwa.net	
2345 Grand Boulevard		Suite 500	
Kansas City, MO 64108-2641		Ph: 816-472-6100	Fx: 816-472-1610
Notes: The American Public Works Association is an international educational and professional association of public agencies, private sector companies, and individuals dedicated to providing high quality public works goods and services.			
Association of State Floodplain Managers			
Level: Federal	Hazard: Flood	www.floods.org	
2809 Fish Hatchery Road			
Madison, WI 53713		Ph: 608-274-0123	Fx:
Notes: The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning and recovery			
Building Seismic Safety Council (BSSC)			
Level: National	Hazard: Earthquake	www.bssconline.org	
1090 Vermont Ave., NW		Suite 700	
Washington, DC 20005		Ph: 202-289-7800	Fx: 202-289-109
Notes: The Building Seismic Safety Council (BSSC) develops and promotes building earthquake risk mitigation regulatory provisions for the nation.			

California Department of Transportation (CalTrans)			
Level: State	Hazard: Multi	http://www.dot.ca.gov/	
120 S. Spring Street			
Los Angeles, CA 90012		Ph: 213-897-3656	Fx:
Notes: CalTrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries. Alone and in partnership with Amtrak, Caltrans is also involved in the support of intercity passenger rail service in California.			

California Resources Agency			
Level: State	Hazard: Multi	http://resources.ca.gov/	
1416 Ninth Street		Suite 1311	
Sacramento, CA 95814		Ph: 916-653-5656	Fx:
Notes: The California Resources Agency restores, protects and manages the state's natural, historical and cultural resources for current and future generations using solutions based on science, collaboration and respect for all the communities and interests involved.			

California Division of Forestry (CDF)			
Level: State	Hazard: Multi	http://www.fire.ca.gov/php/index.php	
210 W. San Jacinto			
Perris CA 92570		Ph: 909-940-6900	Fx:
Notes: The California Department of Forestry and Fire Protection protects over 31 million acres of California's privately-owned wildlands. CDF emphasizes the management and protection of California's natural resources.			

California Division of Mines and Geology (DMG)			
Level: State	Hazard: Multi	www.consrv.ca.gov/cgs/index.htm	
801 K Street		MS 12-30	
Sacramento, CA 95814		Ph: 916-445-1825	Fx: 916-445-5718
Notes: The California Geological Survey develops and disseminates technical information and advice on California’s geology, geologic hazards, and mineral resources.			

California Environmental Resources Evaluation System (CERES)			
Level: State	Hazard: Multi	http://ceres.ca.gov/	
900 N St.		Suite 250	
Sacramento, Ca. 95814		Ph: 916-653-2238	Fx:
Notes: CERES is an excellent website for access to environmental information and websites.			

California Department of Water Resources (DWR)			
Level: State	Hazard: Flood	http://wwwdwr.water.ca.gov	
1416 9th Street			
Sacramento, CA 95814		Ph: 916-653-6192	Fx:
Notes: The Department of Water Resources manages the water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance the natural and human environments.			

California Department of Conservation: Southern California Regional Office			
Level: State	Hazard: Multi	www.consrv.ca.gov	
655 S. Hope Street		#700	
Los Angeles, CA 90017-2321		Ph: 213-239-0878	Fx: 213-239-0984
Notes: The Department of Conservation provides services and information that promote environmental health, economic vitality, informed land-use decisions and sound management of our state's natural resources.			

California Planning Information Network			
Level: State	Hazard: Multi	www.calpin.ca.gov	
		Ph:	Fx:
Notes: The Governor's Office of Planning and Research (OPR) publishes basic information on local planning agencies, known as the California Planners' Book of Lists. This local planning information is available on-line with new search capabilities and up-to-the- minute updates.			

EPA, Region 9			
Level: Regional	Hazard: Multi	http://www.epa.gov/region09	
75 Hawthorne Street			
San Francisco, CA 94105		Ph: 415-947-8000	Fx: 415-947-3553
Notes: The mission of the U.S. Environmental Protection Agency is to protect human health and to safeguard the natural environment through the themes of air and global climate change, water, land, communities and ecosystems, and compliance and environmental stewardship.			

Federal Emergency Management Agency, Region IX			
Level: Federal	Hazard: Multi	www.fema.gov	
1111 Broadway		Suite 1200	
Oakland, CA 94607		Ph: 510-627-7100	Fx: 510-627-7112
Notes: The Federal Emergency Management Agency is tasked with responding to, planning for, recovering from and mitigating against disasters.			

Federal Emergency Management Agency, Mitigation Division			
Level: Federal	Hazard: Multi	www.fema.gov/fima/planhowto.shtm	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has of a number of programs and activities of which provide citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.			

Floodplain Management Association			
Level: Federal	Hazard: Flood	www.floodplain.org	
P.O. Box 50891			
Sparks, NV 89435-0891		Ph: 775-626-6389	Fx: 775-626-6389
Notes: The Floodplain Management Association is a nonprofit educational association. It was established in 1990 to promote the reduction of flood losses and to encourage the protection and enhancement of natural floodplain values. Members include representatives of federal, state and local government agencies as well as private firms.			

Gateway Cities Partnership			
Level: Regional	Hazard: Multi	www.gatewaycities.org	
7300 Alondra Boulevard		Suite 202	
Paramount, CA 90723		Ph: 562-817-0820	Fx:
Notes: Gateway Cities Partnership is a 501 C 3 non-profit Community Development Corporation for the Gateway Cities region of southeast LA County. The region comprises 27 cities that roughly speaking extends from Montebello on the north to Long Beach on the South, the Alameda Corridor on the west to the Orange County line on the east.			

Governor's Office of Emergency Services (OES)			
Level: State	Hazard: Multi	www.oes.ca.gov	
P.O. Box 419047			
Rancho Cordova, CA 95741-9047		Ph: 916 845- 8911	Fx: 916 845- 8910
Notes: The Governor's Office of Emergency Services coordinates overall state agency response to major disasters in support of local government. The office is responsible for assuring the state's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for assisting local governments in their emergency preparedness, response and recovery efforts.			

Greater Antelope Valley Economic Alliance			
Level: Regional	Hazard: Multi		
42060 N. Tenth Street West			
Lancaster, CA 93534		Ph: 661-945-2741	Fx: 661-945-7711
Notes: The Greater Antelope Valley Economic Alliance, (GA VEA) is a 501 (c)(6) nonprofit organization with a 501(c)(3) affiliated organization the Antelope Valley Economic Research and Education Foundation. GA VEA is a public-private partnership of business, local governments, education, non-profit organizations and health care organizations that was founded in 1999 with the goal of attracting good paying jobs to the Antelope Valley in order to build a sustainable economy.			

Landslide Hazards Program, USGS			
Level: Federal	Hazard: Landslide	http://landslides.usgs.gov/index.html	
12201 Sunrise Valley Drive		MS 906	
Reston, VA 20192		Ph: 703-648- 4000	Fx:
Notes: The NLIC website provides good information on the programs and resources regarding landslides. The page includes information on the National Landslide Hazards Program Information Center, a bibliography, publications, and current projects. USGS scientists are working to reduce long-term losses and casualties from landslide hazards through better understanding of the causes and mechanisms of ground failure both nationally and worldwide.			
Los Angeles County Economic Development Corporation			
Level: Regional	Hazard: Multi	www.laedc.org	
444 S. Flower Street		34th Floor	
Los Angeles, CA 90071		Ph: 213-236-4813	Fx: 213- 623-0281
Notes: The LAEDC is a private, non-profit 501 (c) 3 organization established in 1981 with the mission to attract, retain and grow businesses and jobs in the Los Angeles region. The LAEDC is widely relied upon for its Southern California Economic Forecasts and Industry Trend Reports. Lead by the renowned Jack Kyser (Sr. Vice President, Chief Economist) his team of researchers produces numerous publications to help business, media and government navigate the LA region's diverse economy.			
Los Angeles County Public Works Department			
Level: County	Hazard: Multi	http://ladpw.org	
900 S. Fremont Ave.			
Alhambra, CA 91803		Ph: 626-458-5100	Fx:
Notes: The Los Angeles County Department of Public Works protects property and promotes public safety through Flood Control, Water Conservation, Road Maintenance, Bridges, Buses and Bicycle Trails, Building and Safety, Land Development, Waterworks, Sewers, Engineering, Capital Projects and Airports			
National Wildland/Urban Interface Fire Program			
Level: Federal	Hazard: Wildfire	www.firewise.org/	
1 Batterymarch Park			
Quincy, MA 02169-7471		Ph: 617-770-3000	Fx: 617 770-0700
Notes: FIREWISE maintains a Website designed for people who live in wildfire- prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences.			

National Resources Conservation Service			
Level: Federal	Hazard: Multi	http://www.nrcs.usda.gov/	
14th and Independence Ave., SW		Room 5105-A	
Washington, DC 20250		Ph: 202-720-7246	Fx: 202-720-7690
Notes: NRCS assists owners of America's private land with conserving their soil, water, and other natural resources, by delivering technical assistance based on sound science and suited to a customer's specific needs. Cost shares and financial incentives are available in some cases.			

National Interagency Fire Center (NIFC)			
Level: Federal	Hazard: Wildfire	www.nifc.gov	
3833 S. Development Ave.			
Boise, Idaho 83705-5354		Ph: 208-387- 5512	Fx:
Notes: The NIFC in Boise, Idaho is the nation’s support center for wildland firefighting. Seven federal agencies work together to coordinate and support wildland fire and disaster operations.			

National Fire Protection Association (NFPA)			
Level: National	Hazard: Wildfire	http://www.nfpa.org/catalog/home/index.asp	
1 Batterymarch Park			
Quincy, MA 02169-7471		Ph: 617-770-3000	Fx: 617 770-0700
Notes: The mission of the international nonprofit NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating scientifically-based consensus codes and standards, research, training and education			

National Floodplain Insurance Program (NFIP)			
Level: Federal	Hazard: Flood	www.fema.gov/nfip/	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has of a number of programs and activities providing citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.			

National Oceanic /Atmospheric Administration			
Level: Federal	Hazard: Multi	www.noaa.gov	
14th Street & Constitution Ave NW		Rm 6013	
Washington, DC 20230		Ph: 202-482-6090	Fx: 202-482-3154
Notes: NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.			

National Weather Service, Office of Hydrologic Development			
Level: Federal	Hazard: Flood	http://www.nws.noaa.gov/	
1325 East West Highway		SSMC2	
Silver Spring, MD 20910		Ph: 301-713-1658	Fx: 301-713-0963
Notes: The Office of Hydrologic Development (OHD) enhances National Weather Service (NWS) products by: infusing new hydrologic science, developing hydrologic techniques for operational use, managing hydrologic development by NWS field office, providing advanced hydrologic products to meet needs identified by NWS customers			

National Weather Service			
Level: Federal	Hazard: Multi	http://www.nws.noaa.gov/	
520 North Elevar Street			
Oxnard, CA 93030		Ph: 805-988- 6615	Fx:
Notes: The National Weather Service is responsible for providing weather service to the nation. It is charged with the responsibility of observing and reporting the weather and with issuing forecasts and warnings of weather and floods in the interest of national safety and economy. Briefly, the priorities for service to the nation are: 1. protection of life, 2. protection of property, and 3. promotion of the nation's welfare and economy.			

San Gabriel Valley Economic Partnership			
Level: Regional	Hazard: Multi	www.valleynet.org	
4900 Rivergrade Road		Suite A310	
Irwindale, CA 91706		Ph: 626-856-3400	Fx: 626-856-5115
Notes: The San Gabriel Valley Economic Partnership is a non-profit corporation representing both public and private sectors. The Partnership is the exclusive source for San Gabriel Valley-specific information, expertise, consulting, products, services, and events. It is the single organization in the Valley with the mission to sustain and build the regional economy for the mutual benefit of all thirty cities, chambers of commerce, academic institutions, businesses and residents.			

Sanitation Districts of Los Angeles County			
Level: County	Hazard: Flood	http://www.lacsd.ora/	
1955 Workman Mill Road			
Whittier, CA 90607		Ph:562-699-7411 x2301	Fx:
Notes: The Sanitation Districts provide wastewater and solid waste management for over half the population of Los Angeles County and turn waste products into resources such as reclaimed water, energy, and recyclable materials.			

Santa Monica Mountains Conservancy			
Level: Regional	Hazard: Multi	http://smmc.ca.gov/	
570 West Avenue Twenty-Six		Suite 100	
Los Angeles, CA 90065		Ph: 323-221-8900	Fx:
Notes: The Santa Monica Mountains Conservancy helps to preserve over 55,000 acres of parkland in both wilderness and urban settings, and has improved more than 114 public recreational facilities throughout Southern California.			

South Bay Economic Development Partnership			
Level: Regional	Hazard: Multi	www.southbaypartnership.com	
3858 Carson Street		Suite 110	
Torrance, CA 90503		Ph: 310-792-0323	Fx: 310-543-9886
Notes: The South Bay Economic Development Partnership is a collaboration of business, labor, education and government. Its primary goal is to plan an implement an economic development and marketing strategy designed to retain and create jobs and stimulate economic growth in the South Bay of Los Angeles County.			

South Coast Air Quality Management District (AQMD)			
Level: Regional	Hazard: Multi	www.aqmd.gov	
21865 E. Copley Drive			
Diamond Bar, CA 91765		Ph: 800-CUT-SMOG	Fx:
Notes: AQMD is a regional government agency that seeks to achieve and maintain healthful air quality through a comprehensive program of research, regulations, enforcement, and communication. The AQMD covers Los Angeles and Orange Counties and parts of Riverside and San Bernardino Counties.			

Southern California Earthquake Center (SCEC)			
Level: Regional	Hazard: Earthquake	www.scec.org	
3651 Trousdale Parkway		Suite 169	
Los Angeles, CA 90089-0742		Ph: 213-740-5843	Fx: 213/740-0011
Notes: The Southern California Earthquake Center (SCEC) gathers new information about earthquakes in Southern California, integrates this information into a comprehensive and predictive understanding of earthquake phenomena, and communicates this understanding to end-users and the general public in order to increase earthquake awareness, reduce economic losses, and save lives.			

Southern California Association of Governments (SCAG)			
Level: Regional	Hazard: Multi	www.scag.ca.gov	
818 W. Seventh Street		12th Floor	
Los Angeles, CA 90017		Ph: 213-236-1800	Fx: 213-236-1825
Notes: The Southern California Association of Governments functions as the Metropolitan Planning Organization for six counties: Los Angeles, Orange, San Bernardino, Riverside, Ventura and Imperial. As the designated Metropolitan Planning Organization, the Association of Governments is mandated by the federal government to research and draw up plans for transportation, growth management, hazardous waste management, and air quality.			

State Fire Marshal (SFM)			
Level: State	Hazard: Wildfire	http://osfm.fire.ca.gov	
1131 "S" Street			
Sacramento, CA 95814		Ph: 916-445-8200	Fx: 916-445-8509
Notes: The Office of the State Fire Marshal (SFM) supports the mission of the California Department of Forestry and Fire Protection (CDF) by focusing on fire prevention. SFM regulates buildings in which people live, controls substances which may, cause injuries, death and destruction by fire; provides statewide direction for fire prevention within wildland areas; regulates hazardous liquid pipelines; reviews regulations and building standards; and trains and educates in fire protection methods and responsibilities.			

The Community Rating System (CRS)			
Level: Federal	Hazard: Flood	http://www.fema.gov/nfip/crs.shtm	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Community Rating System (CRS) recognizes community floodplain management efforts that go beyond the minimum requirements of the NFIP. Property owners within the County would receive reduced NFIP flood insurance premiums if the County implements floodplain management practices that qualify it for a CRS rating. For further information on the CRS, visit FEMA's website.			

United States Geological Survey			
Level: Federal	Hazard: Multi	http://www.usgs.gov/	
345 Middlefield Road			
Menlo Park, CA 94025		Ph: 650-853-8300	Fx:
Notes: The USGS provides reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.			

U.S. Army Corps of Engineers			
Level: Federal	Hazard: Multi	http://www.usace.army.mil	
P.O. Box 532711			
Los Angeles CA 90053- 2325		Ph: 213-452- 3921	Fx:
Notes: The United States Army Corps of Engineers work in engineering and environmental matters. A workforce of biologists, engineers, geologists, hydrologists, natural resource managers and other professionals provide engineering services to the nation including planning, designing, building and operating water resources and other civil works projects.			

USDA Forest Service			
Level: Federal	Hazard: Wildfire	http://www.fs.fed.us	
1400 Independence Ave. SW			
Washington, D.C. 20250-0002		Ph: 202-205-8333	Fx:
Notes: The Forest Service is an agency of the U.S. Department of Agriculture. The Forest Service manages public lands in national forests and grasslands.			

USGS Water Resources			
Level: Federal	Hazard: Multi	www.water.usgs.gov	
6000 J Street		Placer Hall	
Sacramento, CA 95819-6129		Ph: 916-278-3000	Fx: 916-278-3070
Notes: The USGS Water Resources mission is to provide water information that benefits the Nation's citizens: publications, data, maps, and applications software.			

Western States Seismic Policy Council (WSSPC)			
Level: Regional	Hazard: Earthquake	www.wsspc.org/home.html	
125 California Avenue		Suite D201, #1	
Palo Alto, CA 94306		Ph: 650-330-1101	Fx: 650-326-1769
Notes: WSSPC is a regional earthquake consortium funded mainly by FEMA. Its website is a great resource, with information clearly categorized - from policy to engineering to education.			

Westside Economic Collaborative C/O Pacific Western Bank			
Level: Regional	Hazard: Multi	http://www.westside-la.or	
120 Wilshire Boulevard			
Santa Monica, CA 90401		Ph: 310-458-1521	Fx: 310-458-6479
Notes: The Westside Economic Development Collaborative is the first Westside regional economic development corporation. The Westside EDC functions as an information gatherer and resource center, as well as a forum, through bringing business, government, and residents together to address issues affecting the region: Economic Diversity, Transportation, Housing, Workforce Training and Retraining, Lifelong Learning, Tourism, and Embracing Diversity.			

Appendix B:
Public Participation

Public participation is a key component to any strategic planning process. It is very important that such broad-reaching plans not be written in isolation. Agency participation offers an opportunity for impacted departments and organizations to provide expertise and insight into the planning process. Citizen participation offers citizens the chance to voice their ideas, interests, and opinions. The Federal Emergency Management Agency also requires public input during the development of mitigation plans.

The Natural Hazards Mitigation Plan integrates a cross-section of public input throughout the planning process. To accomplish this goal, the Natural Hazards Mitigation Committee developed a public participation process through five components: (1) developing an Mitigation Committee comprised of knowledgeable individuals representative of several City departments and outside agencies; (2) distributing and analyzing a questionnaire to verify the primary concerns of citizens and business owners as relates to natural hazards; (3) soliciting the assistance of local media representatives and community newsletters to announce the progress of the planning activities and to announce the availability of the Draft Natural Hazards Mitigation Plan; (4) creating opportunities for the citizens and public agencies to review the Draft Natural Hazards Mitigation Plan; (5) conducting a public meeting at the City Council where the public had an opportunity to express their views concerning the Draft Natural Hazards Mitigation Plan.

Integrating public participation during the development of the Natural Hazards Mitigation Plan has ultimately resulted in increased public awareness. Through public involvement, the mitigation plan reflects community issues, concerns, and new ideas and perspectives on mitigation opportunities and plan action items.

Natural Hazards Mitigation Committee

Hazard mitigation in the City of Long Beach has been overseen by the Mitigation Committee, which consisted of representatives from various City departments and outside agencies. The members have an understanding of how the community is structured and how residents, businesses, and the environment may be affected by natural hazard events. The Mitigation Committee guided the development of the Plan, and assisted in developing plan goals and action items, identifying stakeholders and plan reviewers, and sharing local expertise to create a more comprehensive plan.

Summary of Activities

January 9, 2004 - Casey Chel, Disaster Manager LBFD sends a brief to Fire Chief Terry Harbour outline DMA 2000.

January 12, 2004 - Fire Chief Terry Harbour contact Deputy City Manger Reginald Harrison and advises him of the DMA 2000 requirements and recommends that the City send representatives to the January 15th DMA 2000 Workshop.

January 15, 2004 - The City of Long Beach sends three representatives to the workshop: Jeri Snow, Disaster Management; Tom Modica, City Manager's Office; and a representative of Community Development.

January 22, 2004 - Deputy City Manger Harrison assigns Fire Chief as chairman of DMA 2000 project.

January 28, 2004 - Fire Chief Terry Harbour attends 4 hour DMA 2000 presentation in San Marino.

February 2, 2004 - The Fire Chief meets with the City Manager, defines plan, magnitude of project and November 1, 2004 deadline.

February 11, 2004 - The Fire Chief and Casey Chel (Disaster Management) meet with all City Department Heads to explain project, timeline and criticality of project.

March 22, 2004 - Captain Brandt, LBFD appointed as City of Long Beach Natural Hazard Coordinator and the process of forming a team and gathering information begins.

April 1, 2004 - Requests sent to all City Departments & Outside Agencies for participation on the Natural Hazard Mitigation Committee.

April 26, 2004 - Kick-off meeting for Natural Hazard Mitigation Committee - Introduction of members present, overview of project & timeline, requests for city documents and needs for the project.

June 1, 2004 - 2nd meeting of Committee - gathering of requested documents, status of council resolution(June 15th, 2004), status of questionnaire on city website, status of questionnaires at high traffic areas(police community centers, libraries, senior centers).

June 28, 2004 - 3rd meeting of the Committee - gathering of required documents, Council resolution passed June 15, 2004, questionnaires continue to come in, website updated and refreshed, status of consultant contract - EPC.

Facilitations by Emergency Planning Consultants

Meeting #1: Pre-Training July 26, 2004
The meeting was held at the Long Beach Emergency Communication and Operations Center. Emergency Planning Consultants (EPC) delivered pre-training to the Natural Hazard Mitigation Advisory Committee. The pre-training consisted of the history of the Disaster Mitigation Act of 2000, the purpose and role of hazard mitigation, and the planning process. The Pre-Training lasted approximately 1 hour.

Meeting #2: Kick-Off Meeting July 26, 2004
EPC facilitated a workshop where participants had an opportunity to learn about various natural hazards, assess and rank the local threats, examine hazard maps, and complete the FEMA Worksheets contained in FEMA 386-2 Understanding Your Risks. Part of the discussion included a presentation by EPC of historical disaster events across the country. Those slides served as a backdrop for discussing potential mitigation activities.

There was an extensive discussion on various methods of engaging the public in the mitigation process. The Mitigation Committee prepared a draft media release and discussed a public opinion survey that the Mitigation Committee had already distributed to City staff. EPC committed to revising the media release. The Kick-Off Meeting lasted approximately 4 hours.

Meeting #3 Pre-Training: Mitigation August 30, 2004
The meeting was held at Long Beach Emergency Operations Center. EPC delivered pre-training to the Mitigation Committee. The pre-training consisted of the concepts and issues related to developing mitigation actions. The pre-training lasted approximately 1 hour.

Meeting #4 Mitigation Actions August 30, 2004
EPC delivered the Draft Hazard Analysis and the Mitigation Committee discussed missing information, data, and maps. EPC distributed copies of the Mitigation Actions Planning Tools to assist the Team in developing Goals and Action Items appropriate to their natural hazards. The Planning Tools provided a process for collecting the mitigation actions presently in practice in the City of Long Beach, as well as identifying future mitigation actions.

A brainstorming process was conducted to develop the goals for the Plan. The Mitigation Committee agreed on goals for the Mitigation Plan. Throughout the planning process and workshops, the City's consultant reminded the Planning Team of the importance of considering benefit/cost issues. Following a discussion of alternative ranking techniques, the Mitigation Committee agreed to cluster the rankings of the Mitigation Actions by type of actions as follows: #1 Multi-Hazard, #2 Earthquake, #3 Flooding, #4 Earth Movement, #5 Windstorm, and #6 Tsunami.

The next task was to examine a FEMA-approved Mitigation Plan to get an idea of how mitigation actions are written. Each of the jurisdictions was pleased to announce the broad range of mitigation actions already being practiced. The Planning Tools, developed by EPC, consisted of nearly 300 mitigation actions gathered from dozens of Mitigation Plans across the country.

The Mitigation Committee broke into pairs to develop mitigation actions, utilizing the sample plans and Planning Tools list. Because of the plan samples and Tools, the process of identifying appropriate mitigations actions was accomplished in a very efficient manner.

Public Meetings

City of Long Beach conducted one public meeting where the Draft Natural Hazards Mitigation Plan was presented and discussed. The City Council (October 19, 2004) was particularly impressed with the range of mitigation actions already in practice throughout the City. The City Council was very supportive of the overall goal established by the Mitigation Committee to become a Disaster Resistant Community. The results of the questionnaire were discussed and the City Council commended the Mitigation Committee for its expeditious efforts to satisfy the DMA 2000 requirements.

Invitation Process

The Mitigation Committee identified possible public notice sources. A press release was submitted to the local daily and weekly print media. The local community access cable television channel also carried the meeting announcement. A notice was also placed in the quarterly city newsletter that is mailed to all residents.

Results of Public Meetings

The Mitigation Committee Chair was prepared to present an overview of the planning process and mitigation actions. However, the Council was pleased with the Plan and the Mayor asked for a motion for adoption of the Plan. The meeting was broadcast live on cable television and will be looped for approximately one month.

The City Council was unanimous in their adoption of the City of Long Beach Natural Hazards Mitigation Plan on October 19, 2004.

Attachments: Questionnaire Results
Media Releases
Hazard and Vulnerability Assessment Tool – Memorial Health Services

Appendix B – Attachment 1
City Council Resolutions

Directing Preparation of Mitigation Plan

RESOLUTION NO. C-28386

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LONG BEACH IN SUPPORT OF DEVELOPMENT OF A NATURAL HAZARD MITIGATION PLAN IN ACCORDANCE WITH THE FEDERAL DISASTER MITIGATION ACT OF 2000 (PUBLIC LAW 106-390)

WHEREAS, in the Fall of 2003, Southern California experienced the most costly fire in the State's history, burning over 3,500 homes and over 750,000 acres of wildland, resulting in damage from which it will take communities years to recover; and

WHEREAS, in December 2003, a large 6.5 magnitude earthquake devastated Paso Robles, California, in the Central Coast region, and had this event occurred in an urbanized area such as Long Beach, California, it would have resulted in significant loss of life and billions of dollars in damages; and

WHEREAS, disaster resiliency, the ability to "bounce back" quickly from an extreme natural event (such as earthquake, flood or winds) without permanent, intolerable damage or disruption of natural, economic, social or structural systems and without massive amount of outside assistance, is more often being included as another component of community sustainability; and

WHEREAS, sustainability emphasizes planning as a primary approach to involve local citizens, obtain broad input, and develop real goals and action plans on how to mitigate against damage caused by the natural hazards facing every California community; and

WHEREAS, there are actions that can be undertaken to address hazards, no matter how large or small, that can support disaster resiliency and sustainability in

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NOW, THEREFORE, the City Council of the City of Long Beach resolves as follows:

Section 1. That the City Council of the City of Long Beach does hereby authorize and support the development of a Natural Hazard Mitigation Plan, establishing goals and objectives to ensure the health, safety and welfare of its citizens, even in the event of a natural disaster.

Sec. 2. That the Natural Hazard Mitigation Plan shall be a collection of analyses, policies, and actions on how the community will grow and change in the future and will serve as a blueprint for how it can achieve sustainability and disaster resiliency.

The plan will be the result of a process involving city departments, local agencies, business people, landowners, developers, and citizens and will reflect local values and concerns.

Sec. 3. That the Natural Hazard Mitigation Plan shall meet the program criteria of the Stafford Act as amended (Disaster Mitigation Act of 2000) in order that the City of Long Beach will be eligible for future pre-disaster and post-disaster mitigation program funds to ensure the health, safety and welfare of its citizens.

Sec. 4. This resolution shall take effect immediately upon its adoption by the City Council, and the City Clerk shall certify to the vote adopting this resolution.

I hereby certify that the foregoing resolution was adopted by the City Council of the City of Long Beach at its meeting of ____June 15____, 2004,

/

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by the following vote:

Ayes:	Councilmembers:	Lowenthal, Baker, Colonna, Kell, Richardson, Reyes Uranga, Lerch.
Noes:	Councilmembers:	None.
Absent:	Councilmembers:	Carroll, Webb.

[signature]
City Clerk

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City Attorney of Long Beach
333 West Ocean Boulevard
Long Beach, California 90802-4664
Telephone (562) 570-2200

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City Council Adoption Resolution

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RESOLUTION NO. C-28469

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LONG BEACH TO ADOPT THE NATURAL HAZARD MITIGATION PLAN IN ACCORDANCE WITH THE FEDERAL DISASTER MITIGATION ACT OF 2000 (PUBLIC LAW 106-390)

WHEREAS, the Disaster Management Act of 2000, which amended the Robert T. Stafford Disaster Relief and Emergency Services Act, requires every local, county and state government to submit a Natural Hazard Mitigation Plan to the Federal Emergency Management Agency by November 1, 2004 in order to be eligible for pre- and post-disaster grants and funding; and

WHEREAS, disaster resiliency, the ability to "bounce back" quickly from an extreme natural event (such as earthquake, flood or winds) without permanent, intolerable damage or disruption of natural, economic, social or structural systems and without massive amounts of outside assistance, is more often being included as another component of community sustainability; and

WHEREAS, sustainability emphasizes planning as a primary approach to involve local citizens, obtain broad input, and develop real goals and action plans on how to mitigate against damage caused by the natural hazards facing every California community; and

WHEREAS, there are actions that can be undertaken to address hazards, no matter how large or small, that can support disaster resiliency and sustainability in our community; and

WHEREAS, the City of Long Beach's Plan focuses on potential impacts of earthquake, flood, earth movement, windstorm and tsunami, and includes an assessment of these natural hazards, a plan to mitigate them, and methods of monitoring, evaluating, and updating the Plan.

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City Attorney of Long Beach
333 West Ocean Boulevard
Long Beach, California 90802-4664
Telephone (562) 570-2200

NOW, THEREFORE, the City Council of the City of Long Beach resolves as follows:

Section 1. That the City Council of the City of Long Beach does hereby authorize and support the adoption of the Natural Hazard Mitigation Plan, establishing goals and objectives to ensure the health, safety and welfare of its citizens in the event of a natural disaster.

Sec. 2. That the City Manager will be granted the authority to amend and update the plan annually and submit an updated Plan every five years to the City Council for its review, prior to submission to the Federal Emergency Management Agency.

Sec. 3. This resolution shall take effect immediately upon its adoption by the City Council, and the City Clerk shall certify to the vote adopting this resolution.

I hereby certify that the foregoing resolution was adopted by the City Council of the City of Long Beach at its meeting of October 19, 2004, by the following vote:

Ayes:	Councilmembers:	Colonna, O'Donnell, Kell, Richardson, Reyes Uranga, Gabelich, Lerch.
Noes:	Councilmembers:	None.
Absent:	Councilmembers:	Lowenthal, Baker.

CERTIFIED AS A TRUE AND CORRECT COPY
CITY CLERK OF THE CITY OF LONG BEACH
DATE: OCT 2 0 2004

City Clerk

04-04550 L:\APPS\CtyLaw32\WPDOCS\D007\P003\00065904.WPD 2

Appendix B-Attachment 2
Questionnaire Results

The City of Long Beach distributed a questionnaire to the City's employees and residents through the various departments. The questionnaire asked participants a wide range of questions. Although all of the data gathered will be utilized in future public awareness campaigns and other outreach activities, the following table summarized the "concerns" expressed about the following natural hazards: earthquakes, flooding, earth movement, windstorms, and tsunami. A total of approximately 700 employees and residents participated in the questionnaire, yielding the following results:

	Very Concerned	Moderately Concerned	Somewhat Concerned	Not Concerned
Earthquake	274	161	47	20
Flooding	63	105	125	174
Earth Movement	18	36	73	335
Windstorm	48	86	143	80
Tsunami	36	42	88	297

Appendix B-Attachment 3
Media Releases

Press-Telegram September 11, 2004

L.B. readies emergency plan

By Tracy Manzer
Staff writer

Long Beach may not flood as often as a Mississippi river town, and it certainly is lucky not to be hammered by hurricanes and tornadoes like the South and Midwest.

Nonetheless, planning for natural disasters remains crucial and city is asking for the public's two cents.

The new Natural Hazards Mitigation Plan identifies key areas that could be affected by a number of natural disasters, including earthquakes, floods, tsunamis, wind storms and landslides, and what can be done in advance to either avoid the problem, or reduce threats, said Richard Brandt, the city's hazard mitigation coordinator and a Long Beach Fire Department captain.

The plan – required by the Federal Emergency Management Agency – was created with the help of several city departments and spearheaded by the Long Beach Fire Department. All municipal entities and special school districts were told to create a plan by Nov. 1, Brandt said.

Agencies that do not comply will not qualify for FEMA disaster funds, Brandt said.

"FEMA would rather give pre-disaster funds than post-disaster funds because in the long run it would be more cost-effective," Brandt said.

For example, if thecity has 10 buildings that need to be retrofitted in case of an earthquake, it can note those structures in the plans and qualify for federal funds to complete the retrofit work before disaster strikes. Such federally funded work includes the retrofit job being done on the Long Beach Fire Station No. 1 and Long Beach Police Department Headquarters.

This does not mean, however, that in the event of a disaster, the city would not qualify for further assistance, Brandt said.

"What's happened in the past, on the East Coast now with the hurricanes and in Mississippi where people keep building houses in floodplains, the river rises and wipes out that town," Brandt said. "FEMA then goes in and rebuilds the town, and the next year they go through it all over again. They would rather give that town the money now to move houses from the floodplains onto the high plains. They're starting to force these cities not to build on floodplains, not to build right on the oceanfront or on an urban interface."

On Tuesday, the Long Beach plan will be available for public review at all city libraries and the City Clerk's Office at City Hall, 333 W. Ocean Blvd and online at **www.longbeach.gov**. Users cn click on the Fire Department link and then click on the disaster management link.

Residents and business owners are encouraged to send in comments over the following two weeks. Public feedback will be included in the document and presented to the City Council for adoption in early October, Brandt said.

For information, call Brandt at **(562) 570-2547**.

Appendix B – Attachment 4
Hazard and Vulnerability Assessment Tool
Memorial Health Services

HAZARD AND VULNERABILITY ASSESSMENT TOOL
NATURALLY OCCURRING EVENTS

EVENT	PROBABILITY	SEVERITY = (MAGNITUDE - MITIGATION)						RISK
		HUMAN IMPACT	PROPERTY IMPACT	BUSINESS IMPACT	PREPARED-NESS	INTERNAL RESPONSE	EXTERNAL RESPONSE	
	Likelihood this will occur	*Possibility of death or injury*	*Physical losses and damages*	*Interuption of services*	*Preplanning*	*Time, effectivness, resouces*	*Community/ Mutual Aid staff and supplies*	*Relative threat**
SCORE	*0 = N/A 1 = Low 2 = Moderate 3 = High*	*0 = N/A 1 = Low 2 = Moderate 3 = High*	*0 = N/A 1 = Low 2 = Moderate 3 = High*	*0 = N/A 1 = Low 2 = Moderate 3 = High*	*0 = N/A 1 = High 2 = Moderate 3 = Low or none*	*0 = N/A 1 = High 2 = Moderate 3 = Low or none*	*0 = N/A 1 = High 2 = Moderate 3 = Low or none*	*0 - 100%*
Hurricane	0	0	0	0	0	0	0	0%
Tornado	0	0	0	0	0	0	0	0%
Severe Thunderstorm	1	1	2	1	3	3	3	24%
Snow Fall	0	0	0	0	0	0	0	0%
Blizzard	0	0	0	0	0	0	0	0%
Ice Storm	0	0	0	0	0	0	0	0%
Earthquake	3	3	3	3	2	2	2	83%
Tidal Wave	1	1	1	1	0	0	0	6%
Temperature Extremes	2	2	2	2	1	1	1	33%
Drought	1	1	1	1	3	3	3	22%
Flood, External	2	2	2	2	1	3	3	48%
Wild Fire	1	1	1	1	0	3	0	11%
Landslide	0	0	0	0	0	0	0	0%
Dam Inundation	0	0	0	0	0	0	0	
Volcano	0	0	0	0	0	0	0	0%
Epidemic	2	2	1	1	1	1	1	26%
AVERAGE SCORE	0.81	0.81	0.81	0.75	0.69	1.00	0.81	7%

**Threat increases with percentage.*

RISK =	PROBABILITY *	SEVERITY
0.07	0.27	0.27

Appendix B – Attachment 5
List of Plan Reviewers:

Orange County Fire Authority 1 Fire Authority Road Irvine, CA 92602	Long Beach Unified School District Emergency Preparedness Supervisor Cathy Coy 5250 Los Coyotes Diagonal Long Beach, CA 90815-1925
Aquarium of the Pacific Safety Supervisor Matt Ankley 100 Aquarium Way Long Beach, CA 90802	City of Signal Hill Signal Hill Police Department Sgt. Peterson 2175 Cherry Avenue Signal Hill, CA 90755
City of Seal Beach Director of Public Works 211 8th Street Seal Beach, CA 90740	City of Los Alamitos Emergency Preparedness 3201 Katella Avenue Los Alamitos, CA 90720
City of Lakewood Emergency Preparedness 5050 Clark Avenue Lakewood, CA 90712	City of Compton 205 South Willowbrook Ave. Compton, CA 90220
City of Bellflower Public Safety Department 16600 Civic Center Drive Bellflower, CA 90706	City of Carson Hazard Mitigation Attn: Eileen Edgerton 701 East Carson Street Carson, CA 90745
City of Los Angeles Emergency Preparedness Department 200 N. Spring Street Room 1533 Los Angeles, CA 90012	Los Angeles County Hazard Mitigation 1275 N. Eastern Avenue Los Angeles, CA 90053
City of Hawaiian Gardens 21815 Pioneer Blvd. Hawaiian Gardens, CA 90716	City of Paramount Assistant Director Christopher S. Cash Public Works Department 16400 Colorado Avenue Paramount, CA 90723
City of Huntington Beach Emergency Services Coordinator Gloria Morrison 2000 Main Street Huntington Beach, CA 92647	Long Beach Area Chamber of Commerce Randy Gordon, President 1 World Trade Center, Suite 206 Long Beach, CA 90831

<table>
<tr><td>Image Cat, Inc.
Attn: Charles Huyat
400 Oceangate Ste. 1050
Long Beach, CA 90802</td><td>El Dorado Realty, Inc.
Attn: Ron Beeler
3810 Orange Avenue
Long Beach, CA 90807</td></tr>
<tr><td>Jeffery Reardon
Consulting Geologist
8136 Foxhall Drive
Huntington Beach, CA 92646</td><td>Phil Watts
Applied Fluids Engineering
5710 East 7th Street
Long Beach, 90803</td></tr>
<tr><td>Area DMAC Coordinator
Brenda Hunemiller - Area D
Office of Disaster Management
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Azusa, CA 91702</td><td>Area DMAC Coordinator
Fan Abel – Area E
Office of Emergency Planning
13700 LaMirada Blvd.
LaMirada, CA 90638</td></tr>
<tr><td colspan="2" align="center">Area DMAC Coordinator
Mike Martinet – Area G
Emergency Management Office
320 Knob Hill
Redondo Beach, CA 90277</td></tr>
<tr><td>Long Beach Fire Department
Deputy Chief Patalano
Operations</td><td>Long Beach Fire Department
Deputy Chief Wilson
Support</td></tr>
<tr><td>Long Beach Fire Department
Deputy Chief Giles
Fire Prevention</td><td>Long Beach Fire Department
Annete Hough
Administration Officer</td></tr>
</table>

Appendix C:
Benefit/Cost Analysis

Benefit/Cost Analysis is a key mechanism used by the California Office of Emergency Services (OES), the Federal Emergency Management Agency, and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

This Appendix outlines several approaches for conducting economic analysis of natural hazard mitigation projects. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies. Information in this section is derived in part from: Federal Emergency Management Agency Publication 331, Report on Costs and Benefits of Natural Hazard Mitigation.

This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to provide the details of economic analysis methods that can be used to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?
Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred.

Evaluating natural hazard mitigation provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, police, utilities, and schools.

Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars. Third, many of the impacts of such events produce “ripple-effects” throughout the community, greatly increasing the disaster’s social and economic consequences.

While not easily accomplished, there is value, from a public policy perspective, in assessing the positive and negative impacts from mitigation activities, and obtaining an instructive benefit/cost comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

What are Some Economic Analysis Approaches for Mitigation Strategies?
The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. The distinction between the two methods is the way in which the relative costs and benefits are measured. Additionally, there are varying approaches to assessing the value of mitigation for public sector and private sector activities.

Benefit/Cost Analysis
Benefit/Cost Analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster related damages later. Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoided future damages, and risk.

In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented (i.e., if net benefits exceed net costs, the project is worth pursuing). A project must have a benefit/cost ratio greater than 1 in order to be funded.

Cost-Effectiveness Analysis
Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in public sector mitigation activities
Evaluating mitigation strategies in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions that involve a diverse set of beneficiaries and non-market benefits.

Investing in private sector mitigation activities
Private sector mitigation projects may occur on the basis of one of two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether

a private entity or a public agency, are required to conform to a mandated standard may consider the following options:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. Evaluate the most feasible alternatives and initiate the most cost effective hazard mitigation alternative.

> Estimating the costs and benefits of a hazard mitigation strategy can be a complex process.
>
> Employing the services of a specialist can assist in this process.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective purchasers. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of a sale regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

How can an Economic Analysis be conducted?

Benefit/cost analysis and cost-effectiveness analysis are important tools in evaluating whether or not to implement a mitigation activity. A framework for evaluating alternative mitigation activities is outlined below:

1. Identify the Alternatives: Alternatives for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation project can assist in minimizing risk to natural hazards, but do so at varying economic costs.

2. Calculate the Costs and Benefits: Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate alternative. Potential economic criteria to evaluate alternatives include:

- **Determine the project cost.** This may include initial project development costs, and repair and operating costs of maintaining projects over time.

- Estimate the benefits. Projecting the benefits or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.

- Consider costs and benefits to society and the environment. These are not easily measured, but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.

- Determine the correct discount rate. Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision maker's time preference and also a risk premium. Including inflation should also be considered.

3. Analyze and Rank the Alternatives: Once costs and benefits have been quantified, economic analysis tools can rank the alternatives. Two methods for determining the best alternative given varying costs and benefits include net present value and internal rate of return.

- Net present value. Net present value is the value of the expected future returns of an investment minus the value of expected future cost expressed in today's dollars. If the net present value is greater than the project costs, the project may be determined feasible for implementation. Selecting the discount rate, and identifying the present and future costs and benefits of the project calculates the net present value of projects.

- Internal Rate of Return. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project.

Once the mitigation projects are ranked on the basis of economic criteria, decision-makers can consider other factors, such as risk; project effectiveness; and economic, environmental, and social returns in choosing the appropriate project for implementation.

How are Benefits of Mitigation Calculated?

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owner as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices
- Availability of resource supplies
- Commodity and resource demand changes
- Building and land values
- Capital availability and interest rates
- Availability of labor
- Economic structure
- Infrastructure
- Regional exports and imports
- Local, state, and national regulations and policies

- Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. Many communities are looking towards developing multi-objective projects. With this in mind, opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

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Appendix D:
Acronyms

Federal Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ATC	Applied Technology Council
b/ca	benefit/cost analysis
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BSSC	Building Seismic Safety Council
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CRS	Community Rating System
DOE	Department of Energy
EDA	Economic Development Administration
EPA	Environmental Protection Agency
ER	Emergency Relief
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance (FEMA Program)
FTE	Full Time Equivalent
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences (International)
GSA	General Services Administration
HAZUS	Hazards U.S.
HMGP	Hazard Mitigation Grant Program
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (United States, Department of)
IBHS	Institute for Business and Home Safety
ICC	Increased Cost of Compliance
IHMT	Interagency Hazard Mitigation Team
NCDC	National Climate Data Center
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHMP	Natural Hazard Mitigation Plan (also known as "409 Plan")
NIBS	National Institute of Building Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWS	National Weather Service

SBA	Small Business Administration
SHMO	State Hazard Mitigation Officer
TOR	Transfer of Development Rights
UGB	Urban Growth Boundary
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFA	United States Fire Administration
USFS	United States Forest Service
USGS	United States Geological Survey
WSSPC	Western States Seismic Policy Council

California Acronyms

A&W	Alert and Warning
AA	Administering Areas
AAR	After Action Report
ARC	American Red Cross
ARP	Accidental Risk Prevention
ATC20	Applied Technology Council20
ATC21	Applied Technology Council21
BCP	Budget Change Proposal
BSA	California Bureau of State Audits
CAER	Community Awareness & Emergency Response
CalARP	California Accidental Release Prevention
CalBO	California Building Officials
CalEPA	California Environmental Protection Agency
CalREP	California Radiological Emergency Plan
CALSTARS	California State Accounting Reporting System
CalTRANS	California Department of Transportation
CBO	Community Based Organization
CD	Civil Defense
CDF	California Department of Forestry and Fire Protection
CDMG	California Division of Mines and Geology
CEC	California Energy Commission
CEPEC	California Earthquake Prediction Evaluation Council
CESRS	California Emergency Services Radio System
CHIP	California Hazardous Identification Program
CHMIRS	California Hazardous Materials Incident Reporting System
CHP	California Highway Patrol
CLETS	California Law Enforcement Telecommunications System
CSTI	California Specialized Training Institute
CUEA	California Utilities Emergency Association
CUPA	Certified Unified Program Agency
DAD	Disaster Assistance Division (California Office of Emergency

	Services)
DFO	Disaster Field Office
DGS	California Department of General Services
DHSRHB	California Department of Health Services, Radiological Health Branch
DO	Duty Officer
DOC	Department Operations Center
DOF	California Department of Finance
DOJ	California Department of Justice
DPA	California Department of Personnel Administration
DPIG	Disaster Preparedness Improvement Grant
DR	Disaster Response
DSA	Division of the State Architect
DSR	Damage Survey Report
DSW	Disaster Service Worker
DWR	California Department of Water Resources
EAS	Emergency Alerting System
EDIS	Emergency Digital Information System
EERI	Earthquake Engineering Research Institute
EMA	Emergency Management Assistance
EMI	Emergency Management Institute
EMMA	Emergency Managers Mutual Aid
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPEDAT	Early Post Earthquake Damage Assessment Tool
EPI	Emergency Public Information
EPIC	Emergency Public Information Council
ESC	Emergency Services Coordinator
FAY	Federal Award Year
FDAA	Federal Disaster Assistance Administration
FEAT	Governor's Flood Emergency Action Team
FEMA	Federal Emergency Management Agency
FFY	Federal Fiscal Year
FIR	Final Inspection Reports
FIRESCOPE	Firefighting Resources of Southern California Organized for Potential Emergencies
FMA	Flood Management Assistance
FSR	Feasibility Study Report
FY	Fiscal Year
GIS	Geographical Information System
HAZMAT	Hazardous Materials
HAZMIT	Hazardous Mitigation
HAZUS	Hazards United States (an earthquake damage assessment prediction tool)
HAD	Housing and Community Development

HEICS	Hospital Emergency Incident Command System
HEPG	Hospital Emergency Planning Guidance
HIA	Hazard Identification and Analysis Unit
HMEP	Hazardous Materials Emergency Preparedness
HMGP	Hazard Mitigation Grant Program
IDE	Initial Damage Estimate
IA	Individual Assistance
IFG	Individual & Family Grant (program)
IRG	Incident Response Geographic Information System
IPA	Information and Public Affairs (of state Office of Emergency Services)
LAN	Local Area Network
LEMMA	Law Enforcement Master Mutual Aid
LEPC	Local Emergency Planning Committee
MARAC	Mutual Aid Regional Advisory Council
MHFP	Multi-Hazard Functional Plan
MHID	Multi-Hazard Identification
MOU	Memorandum of Understanding
NBC	Nuclear, Biological, Chemical
NEMA	National Emergency Management Agency
NEMIS	National Emergency Management Information System
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Association
NPP	Nuclear Power Plant
NSF	National Science Foundation
NWS	National Weather Service
OA	Operational Area
OASIS	Operational Area Satellite Information System
OCC	Operations Coordination Center
OCD	Office of Civil Defense
OEP	Office of Emergency Planning
OES	California Governor's Office of Emergency Services
OSHPD	Office of Statewide Health Planning and Development
OSPR	Oil Spill Prevention and Response
PA	Public Assistance
PC	Personal Computer
PDA	Preliminary Damage Assessment
PIO	Public Information Office
POST	Police Officer Standards and Training
PPA/CA	Performance Partnership Agreement/Cooperative Agreement (FEMA)
PSA	Public Service Announcement
PTAB	Planning and Technological Assistance Branch
PTR	Project Time Report
RA	Regional Administrator (OES)
RADEF	Radiological Defense (program)

RAMP	Regional Assessment of Mitigation Priorities
RAPID	Railroad Accident Prevention & Immediate Deployment
RDO	Radiological Defense Officer
RDMHC	Regional Disaster Medical Health Coordinator
REOC	Regional Emergency Operations Center
REPI	Reserve Emergency Public Information
RES	Regional Emergency Staff
RIMS	Response Information Management System
RMP	Risk Management Plan
RPU	Radiological Preparedness Unit (OES)
RRT	Regional Response Team
SAM	State Administrative Manual
SARA	Superfund Amendments & Reauthorization Act
SAVP	Safety Assessment Volunteer Program
SBA	Small Business Administration
SCO	California State Controller's Office
SEMS	Standardized Emergency Management System
SEPIC	State Emergency Public Information Committee
SLA	State and Local Assistance
SONGS	San Onofre Nuclear Generating Station
SOP	Standard Operating Procedure
SWEPC	Statewide Emergency Planning Committee
TEC	Travel Expense Claim
TRU	Transuranic
TTT	Train the Trainer
UPA	Unified Program Account
UPS	Uninterrupted Power Source
USAR	Urban Search and Rescue
USGS	United States Geological Survey
WC	California State Warning Center
WAN	Wide Area Network
WIPP	Waste Isolation Pilot Project

Appendix E: Glossary

Acceleration	The rate of change of velocity with respect to time. Acceleration due to gravity at the earth's surface is 9.8 meters per second squared. That means that every second that something falls toward the surface of earth its velocity increases by 9.8 meters per second.
Asset	Any manmade or natural feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.
Base Flood	Flood that has a 1 percent probability of being equaled or exceeded in any given year. Also known as the 100-year flood.
Base Flood Elevation (BFE)	Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The Base Flood Elevation is used as the standard for the National Flood Insurance Program.
Bedrock	The solid rock that underlies loose material, such as soil, sand, clay, or gravel.
Building	A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.
Coastal High Hazard Area	Area, usually along an open coast, bay, or inlet that is subject to inundation by storm surge and, in some instances, wave action caused by storms or seismic sources.
Coastal Zones	The area along the shore where the ocean meets the land as the surface of the land rises above the ocean. This land/water interface includes barrier islands, estuaries, beaches, coastal wetlands, and land areas having direct drainage to the ocean.
Community Rating System (CRS)	An NFIP program that provides incentives for NFIP communities to complete activities that reduce flood hazard risk. When the community completes specified activities, the insurance premiums of policyholders in these communities are reduced.
Computer-Aided Design And Drafting (CADD)	A computerized system enabling quick and accurate electronic 2-D and 3-D drawings, topographic mapping, site plans, and profile/cross-section drawings.

Contour	A line of equal ground elevation on a topographic (contour) map.
Critical Facility	Facilities that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, and hospitals.
Debris	The scattered remains of assets broken or destroyed in a hazard event. Debris caused by a wind or water hazard event can cause additional damage to other assets.
Digitize	To convert electronically points, lines, and area boundaries shown on maps into x, y coordinates (e.g., latitude and longitude, universal transverse mercator (UTM), or table coordinates) for use in computer applications.
Displacement Time	The average time (in days) which the building's occupants typically must operate from a temporary location while repairs are made to the original building due to damages resulting from a hazard event.
Duration	How long a hazard event lasts.
Earthquake	A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.
Erosion	Wearing away of the land surface by detachment and movement of soil and rock fragments, during a flood or storm or over a period of years, through the action of wind, water, or other geologic processes.
Erosion Hazard Area	Area anticipated being lost to shoreline retreat over a given period of time. The projected inland extent of the area is measured by multiplying the average annual long-term recession rate by the number of years desired.
Essential Facility	Elements important to ensure a full recovery of a community or state following a hazard event. These would include: government functions, major employers, banks, schools, and certain commercial establishments, such as grocery stores, hardware stores, and gas stations.
Extent	The size of an area affected by a hazard or hazard event.

Extratropical Cyclone	Cyclonic storm events like Nor'easters and severe winter low-pressure systems. Both West and East coasts can experience these non-tropical storms that produce gale-force winds and precipitation in the form of heavy rain or snow. These cyclonic storms, commonly called Nor'easters on the East Coast because of the direction of the storm winds, can last for several days and can be very large – 1,000-mile wide storms are not uncommon.
Fault	A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are differentially displaced parallel to the plane of fracture.
Federal Emergency Management Agency (FEMA)	Independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery.
Fire Potential Index (FPI)	Developed by USGS and USFS to assess and map fire hazard potential over broad areas. Based on such geographic information, national policy makers and on-the-ground fire managers established priorities for prevention activities in the defined area to reduce the risk of managed and wildfire ignition and spread. Prediction of fire hazard shortens the time between fire ignition and initial attack by enabling fire managers to pre-allocate and stage suppression forces to high fire risk areas.
Flash Flood	A flood event occurring with little or no warning where water levels rise at an extremely fast rate.
Flood	A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.
Flood Depth	Height of the flood water surface above the ground surface.
Flood Elevation	Elevation of the water surface above an established datum, e.g. National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or Mean Sea Level.
Flood Hazard Area	The area shown to be inundated by a flood of a given magnitude on a map.
Flood Insurance Rate Map (FIRM)	Map of a community, prepared by the Federal Emergency Management Agency that shows both the special flood hazard areas and the risk premium zones applicable to the community.

Flood Insurance Study (FIS)	A study that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.
Floodplain	Any land area, including watercourse, susceptible to partial or complete inundation by water from any source.
Frequency	A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1 percent chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.
Fujita Scale of Tornado Intensity	Rates tornadoes with numeric values from F0 to F5 based on tornado wind speed and damage sustained. An F0 indicates minimal damage such as broken tree limbs or signs, while and F5 indicated severe damage sustained.
Functional Downtime	The average time (in days) during which a function (business or service) is unable to provide its services due to a hazard event.
Geographic Area Impacted	The physical area in which the effects of the hazard are experienced.
Geographic Information Systems (GIS)	A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.
Ground Motion	The vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter, but soft soils can further amplify ground motions
Hazard	A source of potential danger or adverse condition. Hazards in this how to series will include naturally occurring events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.
Hazard Event	A specific occurrence of a particular type of hazard.
Hazard Identification	The process of identifying hazards that threaten an area.

Hazard Mitigation	Sustained actions taken to reduce or eliminate long-term risk from hazards and their effects.
Hazard Profile	A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.
HAZUS (Hazards U.S.)	A GIS-based nationally standardized earthquake loss estimation tool developed by FEMA.
Hurricane	An intense tropical cyclone, formed in the atmosphere over warm ocean areas, in which wind speeds reach 74-miles-per-hour or more and blow in a large spiral around a relatively calm center or "eye." Hurricanes develop over the north Atlantic Ocean, northeast Pacific Ocean, or the south Pacific Ocean east of 160°E longitude. Hurricane circulation is counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.
Hydrology	The science of dealing with the waters of the earth. A flood discharge is developed by a hydrologic study.
Infrastructure	Refers to the public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, and includes an area's transportation system such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, dry docks, piers and regional dams.
Intensity	A measure of the effects of a hazard event at a particular place.
Landslide	Downward movement of a slope and materials under the force of gravity.
Lateral Spreads	Develop on gentle slopes and entail the sidelong movement of large masses of soil as an underlying layer liquefies in a seismic event. The phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.
Liquefaction	Results when the soil supporting structures liquefies. This can cause structures to tip and topple.

Lowest Floor	Under the NFIP, the lowest floor of the lowest enclosed area (including basement) of a structure.
Magnitude	A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.
Mitigation Plan	A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the state and includes a description of actions to minimize future vulnerability to hazards.
National Flood Insurance Program (NFIP)	Federal program created by Congress in 1968 that makes flood insurance available in communities that enact minimum floodplain management regulations in 44 CFR §60.3.
National Geodetic Vertical Datum of 1929 (NGVD)	Datum established in 1929 and used in the NFIP as a basis for measuring flood, ground, and structural elevations, previously referred to as Sea Level Datum or Mean Sea Level. The Base Flood Elevations shown on most of the Flood Insurance Rate Maps issued by the Federal Emergency Management Agency are referenced to NGVD.
National Weather Service (NWS)	Prepares and issues flood, severe weather, and coastal storm warnings and can provide technical assistance to Federal and state entities in preparing weather and flood warning plans.
Nor'easter	An extra-tropical cyclone producing gale-force winds and precipitation in the form of heavy snow or rain.
Outflow	Follows water inundation creating strong currents that rip at structures and pound them with debris, and erode beaches and coastal structures.
Planimetric	Describes maps that indicate only man-made features like buildings.
Planning	The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.
Probability	A statistical measure of the likelihood that a hazard event will occur.
Recurrence Interval	The time between hazard events of similar size in a given location. It is based on the probability that the given event will be equaled or exceeded in any given year.

Repetitive Loss Property	A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1000 each have been paid within any 10-year period since 1978.
Replacement Value	The cost of rebuilding a structure. This is usually expressed in terms of cost per square foot, and reflects the present-day cost of labor and materials to construct a building of a particular size, type and quality.
Richter Scale	A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.
Risk	The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.
Riverine	Of or produced by a river.
Scale	A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.
Scarp	A steep slope.
Scour	Removal of soil or fill material by the flow of flood waters. The term is frequently used to describe storm-induced, localized conical erosion around pilings and other foundation supports where the obstruction of flow increases turbulence.
Seismicity	Describes the likelihood of an area being subject to earthquakes.
Special Flood Hazard Area (SFHA)	An area within a floodplain having a 1 percent or greater chance of flood occurrence in any given year (100-year floodplain); represented on Flood Insurance Rate Maps by darkly shaded areas with zone designations that include the letter A or V.
Stafford Act	The Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-107 was signed into law November 23, 1988 and amended the Disaster Relief Act of 1974, PL 93-288. The Stafford Act is the statutory authority for most Federal disaster response activities, especially as they pertain to FEMA and its programs.

State Hazard Mitigation Officer (SHMO)	The representative of state government who is the primary point of contact with FEMA, other state and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.
Storm Surge	Rise in the water surface above normal water level on the open coast due to the action of wind stress and atmospheric pressure on the water surface.
Structure	Something constructed. (See also Building)
Substantial Damage	Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceeds 50 percent of the market value of the structure before the damage.
Super Typhoon	A typhoon with maximum sustained winds of 150 mph or more.
Surface Faulting	The differential movement of two sides of a fracture – in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults.
Tectonic Plate	Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.
Topographic	Characterizes maps that show natural features and indicate the physical shape of the land using contour lines. These maps may also include manmade features.
Tornado	A violently rotating column of air extending from a thunderstorm to the ground.
Tropical Cyclone	A generic term for a cyclonic, low-pressure system over tropical or subtropical waters.
Tropical Depression	A tropical cyclone with maximum sustained winds of less than 39 mph.
Tropical Storm	A tropical cyclone with maximum sustained winds greater than 39 mph and less than 74 mph.
Tsunami	Great sea wave produced by submarine earth movement or volcanic eruption.

Typhoon	A special category of tropical cyclone peculiar to the western North Pacific Basin, frequently affecting areas in the vicinity of Guam and the North Mariana Islands. Typhoons whose maximum sustained winds attain or exceed 150 mph are called super typhoons.
Vulnerability	Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct ones.
Vulnerability Assessment	The extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.
Water Displacement	When a large mass of earth on the ocean bottom sinks or uplifts, the column of water directly above it is displaced, forming the tsunami wave. The rate of displacement, motion of the ocean floor at the epicenter, the amount of displacement of the rupture zone, and the depth of water above the rupture zone all contribute to the intensity of the tsunami.
Wave Run-up	The height that the wave extends up to on steep shorelines, measured above a reference level (the normal height of the sea, corrected to the state of the tide at the time of wave arrival).
Wildfire	An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.
Zone	A geographical area shown on a Flood Insurance Rate Map (FIRM) that reflects the severity or type of flooding in the area.

Appendix F:
Critical and Essential Facilities Map ID Index
(Source: City of Long Beach GIS)

ID	Name
1	AES PLANT
2	AIR GAS INDUSTRIES
3	AIR PRODUCTS AND CHEMICAL
4	AIRTOUCH CELLULAR
5	ARCO TERMINAL SERVICES CORP
6	ARCO TERMINAL SERVICES CORP
7	ARCO TERMINAL SERVICES CORP
8	BEACH MAINTENANCE YARD
9	BOEING FLIGHT SECURITY OPS, C-17
10	BP / ARCO TERMINAL 1
11	BP / ARCO TERMINAL 2
12	BP / ARCO TERMINAL 3
13	BREITBURN
14	CA ARMY NATIONAL GUARD
15	CA ARMY NATIONAL GUARD
16	CALIFORNIA NATIONAL GUARD
17	CALIFORNIA STATE UNIVERSITY, LONG BEACH
18	CALIFORNIA UNITED TERMINAL
19	CARNIVAL CRUISE LINES
20	CATALINA EXPRESS - CATALINA LANDING
21	CHARTER HOSPITAL
22	CHEM-OIL MARINE TERMINAL
23	CHEMOIL LONG BEACH MARINE TERMINAL
24	CITY OF LONG BEACH - GAS DEPARTMENT
25	CITY OF LONG BEACH MARINE MAINTENANCE
26	CITY OF LONG BEACH-WATER DEPT
27	CNG
28	CNG (POLICE)
29	CNG (SERRF)
30	CNG (WATER)
31	DEFENSE FUEL SUPPLY POINT, PIER T12
32	DEPT OF WATER & POWER-HAYNES
33	DOW CHEMICAL / VOPAK
34	EAST POLICE DIVISION
35	EDGINGTON OIL COMPANY INC
36	EDISON PIPELINE & TERMINAL (EPTC)
37	EQUILON #135454
38	F A A - TRAFFIC CONTROL TOWER
39	FED EX
40	FEDERAL EXPRESS (LOADING CENTER)
41	FIRE BOAT STATION #15
42	FIRE BOAT STATION #21
43	FIRE DEPARTMENT HEADQUARTERS
44	FIRE STATION # 6
45	FIRE STATION #1
46	FIRE STATION #10
47	FIRE STATION #11
48	FIRE STATION #12
49	FIRE STATION #13
50	FIRE STATION #14
51	FIRE STATION #16
52	FIRE STATION #17
53	FIRE STATION #18
54	FIRE STATION #19
55	FIRE STATION #2
56	FIRE STATION #20
57	FIRE STATION #22
58	FIRE STATION #24
59	FIRE STATION #3
60	FIRE STATION #4
61	FIRE STATION #5
62	FIRE STATION #7
63	FIRE STATION #8
64	FIRE STATION #9
65	FIRE TRAINING FACILITY
66	FIREBOAT STATION #20
67	FLEET SERVICES REPAIR SHOP
68	GLEN ANDERSON FEDERAL BLDG. GENERAL SVS ADM.
69	GLOBAL OIL PRODUCTION LLC
70	GLOBE GAS CORPORATION
71	GULFSTREAM AEROSPACE
72	GULFSTREAM AEROSPACE
73	GULFSTREAM AEROSPACE CORP.
74	GULFSTREAM AEROSPACE CORPORATION
75	HANJIN SHIPPING
76	HARBOR VIEW HOSPITAL
77	HAYNES GENERATING STATION
78	INTERNATIONAL TRANSPORTATION SERVICE, INC.
79	JACOBSEN PILOT SERVICE, INC.
80	KAISER PERMANENTE
81	L A COUNTY PUBLIC WORKS
82	L A COUNTY PUBLIC WORKS
83	L A COUNTY PUBLIC WORKS MARKET PUMP STATION
84	LB WATER DEPT - SEAWATER DESAL TEST FACILITY
85	LBUSD - FOOD SERVICE BRANCH
86	LONG BEACH -DAUGHERTY FIELD
87	LONG BEACH CITY COLLEGE
88	LONG BEACH CITY COLLEGE
89	LONG BEACH CITY HALL
90	LONG BEACH COMMUNITY HOSPITAL
91	LONG BEACH CONTAINER TERMINAL
92	LONG BEACH CONVENTION AND ENTERTAINMENT CENTER
93	LONG BEACH ENERGY
94	LONG BEACH ENERGY CORPORATE YD.
95	LONG BEACH GENERATION, LLC
96	LONG BEACH MUNICIPAL COURTS
97	LONG BEACH POLICE DEPARTMENT--HEADQUARTERS
98	LONG BEACH POLICE DEPT. FIELD SUPPORT
99	LONG BEACH TERMINAL II JET CENTER
100	LONG BEACH TERMINAL/DAUGHERTY FIELD
101	LONG BEACH TRAFFIC SIGNAL CONTROL
102	LONG BEACH WATER - OPERATIONS CENTER
103	LONG BEACH WATER RECLAMATION PLANT
104	LONG BEACH WORLD TRADE CENTER
105	LOS ANGELES SHERIFF'S AERO BUREAU
106	MARINA FUEL DOCK
107	MARINA FUEL DOCK/RESCUE BOATS
108	MATSON TERMINAL
109	MEMORIAL MEDICAL CENTER (TRAUMA CENTER)
110	NATIONAL GYPSUM COMPANY
111	NEXTEL COMMUNICATIONS
112	NEXTEL COMMUNICATIONS
113	NEXTEL COMMUNICATIONS
114	NEXTEL COMMUNICATIONS
115	NORTH POLICE DIVISION
116	NRG LONG BEACH GENERATION PLANT
117	OFFICE OF THE CSU CHANCELLOR
118	PACIFIC CONTAINER TERMINAL
119	PACIFIC GAS EXCHANGE
120	PACIFIC HOSPITAL OF LONG BEACH
121	PARK MAINTENANCE/ADMINISTRATION
122	PETRO DIAMOND TERMINAL CO
123	PETRO-DIAMOND TERMINAL COMPANY
124	POLICE HEADQUARTERS
125	POLICE HELIPORT
126	POLICE SUBSTATION, NORTH DIVISION
127	POLICE SUBSTATION, WEST DIVISION
128	PORT OF LONG BEACH ADMINISTRATION BLDG.
129	PUBLIC SERVICE YARD
130	SEA LAUNCH
131	SERRF
132	SHELL OIL CO
133	SHORELINE MARINE FUEL
134	SO CALIF EDISON CO (SUBSTATION)
135	SO CALIF EDISON CO (SUBSTATION)
136	SO CALIF EDISON CO (SUBSTATION)
137	SO CALIF EDISON CO (SUBSTATION)
138	SO CALIF EDISON CO (SUBSTATION)
139	SO CALIF EDISON CO (SUBSTATION)
140	SO CALIF EDISON CO (SUBSTATION)
141	SO CALIF EDISON CO (SUBSTATION)
142	SO CALIF EDISON CO (SUBSTATION)
143	SO CALIF EDISON CO (SUBSTATION)
144	SO CALIF EDISON CO (SUBSTATION)
145	SO CALIF EDISON CO (SUBSTATION)
146	SO CALIF EDISON CO (SUBSTATION)
147	SO CALIF EDISON CO (SUBSTATION)
148	SO CALIF EDISON CO (SUBSTATION)
149	SO CALIF EDISON CO (SUBSTATION)
150	SO CALIF EDISON CO (SUBSTATION)
151	SO CALIF EDISON CO (SUBSTATION)
152	SO CALIF EDISON CO (SUBSTATION)
153	SOUTH POLICE DIVISION
154	ST. MARY MEDICAL CENTER (TRAUMA CENTER)
155	SUB-STATION PIER A
156	TEXACO REFINING AND MARKETING
157	THE BOEING COMPANY
158	TIDELANDS OIL - J WATER INJECTION PLANT
159	TIDELANDS OIL - MICELLAR PLANT
160	TIDELANDS OIL - TERMINAL ISLAND
161	TIDELANDS OIL - WATER INJECTION PLANT
162	TIDELANDS OIL - WATER INJECTION PLANT
163	TIDELANDS OIL - X&Y TANK FARM
164	TIDELANDS OIL - Z WATER INJECTION PLANT
165	TIDELANDS OIL PRODUCTION CO (TOPCO)
166	TOPKO X-Y TANK FARM
167	TOSCO AL-SAL OIL COMP.
168	TRANSPORTATION SECURITY ADMINISTRATION
169	U.S. DEPARTMENT OF TRANSPORTATION
170	UNITED PARCEL SERVICE (LOADING CENTER)
171	VALERO WILMINGTON REFINERY
172	VERIZON
173	VERIZON
174	VERIZON CALIF. INCORP.
175	VERIZON CALIF. INCORP.
176	VERIZON CALIFORNIA INCORPORATED
177	VERIZON CALIFORNIA INCORPORATED
178	VERIZON CALIFORNIA INCORPORATED
179	VERIZON CALIFORNIA INCORPORATED
180	VERIZON CALIFORNIA INCORPORATED
181	VERIZON CALIFORNIA INCORPORATED
182	WEST POLICE DIVISION
183	WORLD OIL CO
184	WORLD OIL LONG BEACH BERTH C73
185	CITY OF LONG BEACH HEALTH DEPARTMENT
186	MILLER FAMILY HEALTH EDUCATION CENTER
187	ECOC
188	CITY OF LONG BEACH TELECOMMUNICATIONS FACILITY

City of Long Beach
California

Critical & Essential Facilities
Map ID Index

City of Long Beach Department of Technology Services GIS critical_fac_index.apr 9/28/04

City of Long Beach
ADDENDUM TO HAZARD MITIGATION PLAN

Following is a list of the additions/corrections/clarifications that were prepared to address the items identified on the recent FEMA Crosswalk. Since the revisions are scattered throughout the document, we have chosen to issue this Addendum. Once we receive approval from FEMA, the Plan will be updated to include the matters addressed in the Addendum. At that point, the Natural Hazards Mitigation Plan will become a final document.

The attached Crosswalk will serve as a guide through the contents of the Addendum.

EXECUTIVE SUMMARY

<u>How are the Action Items Organized?</u>
<u>Add a subsection called "Funding Source"</u>
"The actions items will be funded through a variety of sources, possibly including: operating budget/general fund, development fees, Community Development Block Grant (CDBG), Hazard Mitigation Grant Program (HMGP), other Grants, private funding, Capital Improvement Program (CIP), and other funding opportunities."
<u>Coordinating Organization</u>
Add the following to the beginning of the subsection: "The Mitigation Actions Matrix assigns primary responsibility for each of the action items. The hierarchies of the assignments vary – some are positions, others departments, and others Committees. No matter, the primary responsibility for implementing the action items falls to the entity shown as the "Coordinating Organization".

<u>Attachment 1 – Mitigation Actions Matrix</u>
Add the following action item to the Multi-Hazard list: "Conduct a detailed vulnerability assessment in the future in order to accurately identify the extent of damages to vulnerable buildings, infrastructure, and critical facilities".

SECTION 3: PLAN MAINTENANCE

<u>Economic Analysis of Mitigation Projects</u>
Insert the following at the beginning of this section: "At the Hazard Mitigation Advisory Committee's first implementation meeting, the STAPLEE Tool (Plan Maintenance – Attachment 1) or some other prioritizing tool will be utilized to prioritize the action items identified in the Mitigation Actions Matrix (Executive Summary – Attachment 1). In addition, appropriate funding sources will be identified for the "top ten" priority action items.

SECTION 4: RISK ASSESSMENT

<u>1) Hazard Identification</u>
Begin this subsection with the following: "The Planning Team considered a range of natural hazards facing the region including: Earthquakes, Flooding, Earth Movement, Windstorms, Wildfire, Tsunami, and Drought. The attached Ranking Your Hazards - Attachment 1 handout guided the Team in prioritizing the natural hazards with the highest probability of significantly

impacting the City of Long Beach. The Team agreed that any hazards receiving a Team average score of "3" or higher would be included in the Natural Hazards Mitigation Plan. Utilizing the ranking technique, the Team identified: Earthquakes, Flooding, Earth Movement, Windstorms, and Tsunamis as the most prominent hazards facing the community.

2) Profiling Hazard Events
Revise as follows: "This process describes the causes and characteristics of each hazard…"
At end of paragraph, refer to Risk Assessment – Attachment 2 Vulnerability: Location, Extent, & Probability:

Risk Assessment – Attachment 2
Vulnerability: Location, Extent, and Probability*

	Location (Where)	**Extent (How Big)**	**Probability (How Often)***
Hazard			
Earthquake	Entire Project Area	According to USGS, there is a 60% chance in the next 30 years of an earthquake measuring greater than 6.7 occurring in southern California.	Moderate
Flood	Southeastern and Southwestern corners of the City	FEMA Zone B – minimal flood risk	Low
Earth Movement	Southeastern corner of the City	Groundwater Upwelling prone area shown in Earth Movement – Page 11. Data not available on extent of hazard.	Data not available
Windstorm	Entire Project Area	50 miles per hour or greater	Moderate
Tsunami	Southern boundary – Port of Long Beach	Maximum Run-Up (meters) 12 (see Tsunami – Page 8 for complete data)	Low
* Probability is defined as: Low = 1:500 years, Moderate = 1:100 years, High = 1:10 years			

4) Risk Analysis
Last sentence should be revised to read: "Data was not available to make vulnerability determinations in terms of dollar losses. The Mitigation Actions Matrix (Executive Summary – Attachment 1) includes an action item to conduct such an assessment in the future.

Table 4-2
Add an asterisk to the title and the following: (*data not available to determine the extent of damages to the critical and essential facilities).

APPENDIX B
Toward the end of page 2 following the list of Meetings, insert the following: "Throughout the planning process, the consultant reminded the Planning Team of the importance of considering Benefit/Cost issues including: social issues, political realities, economic benefits, and environmental concerns. During Meeting #4, the consultant introduced the Planning Team to the STAPLEE Tool (Social, Technical, Administrative, Political, Legal, Economic, and

Environmental) as one of many means available to prioritize mitigation actions. Following a discussion of a range of benefit/cost issues, the Planning Team voted to cluster the action items by hazard as follows: #1 Multi-Hazard, #2 Earthquake, #3 Flooding, #4 Earth Movement, #5 Windstorms, and #6 Tsunamis. The Team was unanimous in its belief that the "Multi-Hazard" actions would yield the greatest benefit to the jurisdiction."

Plan Maintenance – Attachment 1: Simplified STAPLEE Worksheet

Simplified STAPLEE Worksheet – Prioritizing Mitigation Actions
(Social, Technical, Administrative, Political, Legal, Economic, Environmental)

1. Fill in the goal. Use a separate worksheet for each goal. The considerations under each criterion are suggested ones to use; you can revise these to reflect your own considerations.
2. Fill in the action items associated with the goal.
3. **Scoring:** For each action item, indicate a plus (+) for favorable, and a negative (-) for less favorable.

When you complete the scoring, add up the positives to establish your priorities. For STAPLEE categories that do not apply, fill in N/A for not applicable. Only leave a blank if you do not know an answer – seek the input of an expert.

Goal: ____

STAPLEE Category	S (Social)		T (Technical)			A (Administrative)			P (Political)		
Categories (right) Action Items (below)	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support
1.											
2.											
3.											
4.											
5.											
6.											

STAPLEE Categories	L (Legal)			E (Economic)				E (Environmental)				
Categories (right) Action Items (below)	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/ Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Community Environmental Goals	Consistent with Federal Laws
1.												
2.												
3.												
4.												
5.												
6.												

Ranking Your Hazards

It is important to keep in mind that your rankings should be based on a hazard event that would overwhelm your jurisdiction's ability to respond effectively.

For each hazard listed assign a score. Place a number in the appropriate box.

Hazard Scoring	
1	An event of that magnitude is not likely to occur
2	There is a slight chance that an event of that magnitude will occur
3	It is possible that an event of that magnitude will occur
4	An event of that magnitude has occurred here in the past and is likely to occur again
5	There is a high probability that an event of that magnitude will occur

Identify any additional hazards for the jurisdiction at the end of the list labeled as "Other Hazard."

Hazard	***Score***
Earthquake	
Flooding	
Wildfire	
Windstorm	
Earth Movement (Landslide/Debris Flow)	
Tsunami	
Drought	
Other Hazard ___________________________	
Other Hazard ___________________________	
Other Hazard ___________________________	
Other Hazard ___________________________	
Other Hazard ___________________________	
Other Hazard ___________________________	