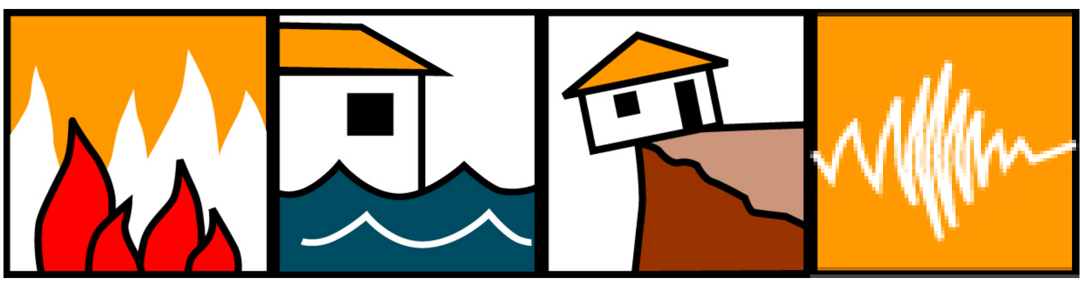
City of Carson

Natural Hazards Mitigation Plan



September 10, 2013

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

Special Recognition

Acknowledgements:

Multi-Jurisdiction Planning Team:

City of Carson
- Rocio Lopez, Planning Division, Associate Planner
- Eileen Edgerton, Public Safety, Public Safety and Community Services Manager (retired)
- Ky H. Truong, Public Safety, Public Safety and Community Services Manager
- Alex Rocco, Information Technology Services, GIS Administrator
- Sean Scully, Planning Division, Senior Planner
- Lance Burkholder, Economic Development, Business Development Manager
- Travis Hopkins, Public Works, Associate Engineer
- George Rivera, Public Safety, Emergency Preparedness Analyst
- Virginia M. Aguada, Public Safety, Senior Administrative Specialist

Compton Unified School District
- Jesse Reyes, Police Department, Police Officer
- Clarence L. Moore, Police Department, Campus Security
- Herman Stampley, Police Department, Police Officer
- Ada McCalister, Police Department, Police Captain

City of Compton
- Adrian Tatum, Fire Department, Emergency Services Coordinator
- Joseph Lim, Planning and Economic Development Department, Director
- Patrick Steward, Building and Safety, Acting Chief Building Inspector
- Gloria Falls, Community Redevelopment Agency, Deputy Director of Redevelopment
- Esmochi Enenwali, Public Works, Acting City Engineer
- Robert Burnett, General Services Department, Director
- Arlene Williams, City Manager, Assistant City Manager
- Charles Evans, Risk Manager, Risk Management
- Percy Perrodin, Municipal Law Enforcement Services, Director, M.L.E.S.
- Louis McKenzie, ICMS, Street Superintendent
- Kambiz Shoghi, Water Department, General Manager
- Marilynn Horne, City Controller, City Controller

<u>Mapping</u>
Other than Internet-sourced maps, the City of Carson provided all of the maps included in this plan.

<u>Consulting Services</u>
Emergency Planning Consultants:

Project Management and Planning Services:	Carolyn J. Harshman, CEM, President
Planning Services:	Timothy W. Harshman, Assistant

List of Mitigation Plan Tables, Figures, Matrices, Maps, and Photos

Note: The maps in this plan were provided by the City of Carson, County of Los Angeles All-Hazards Mitigation Plan, Federal Emergency Management Agency (FEMA), or were acquired from public Internet sources. Care was taken in the creation of the maps contained in this Plan, however they are provided "as is". The City of Carson 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 Carson Natural Hazards Mitigation Plan

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Part I: Mitigation Actions
Executive Summary: Hazard Mitigation Action Plan

This is the *first* Hazard Mitigation Plan as required by the Disaster Mitigation Act of 2000 for the City. The City of Carson Natural Hazards Mitigation Plan (Mitigation Plan) includes resources and information to assist City residents, public and private sector organizations, and others interested in participating in planning for natural, man-made, and technological hazards. The Mitigation Plan provides a list of activities that may assist City of Carson in reducing risk and preventing loss from future hazard events. The action items address multi-hazard issues, as well as activities for Earthquake, Flood, and Windstorm.

How is the Plan Organized?

The Mitigation Plan contains a five-year action plan matrix, background on the purpose and methodology used to develop the mitigation plan, a profile of the City of Carson, sections on five 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 Carson Mitigation Plan is the result of a collaborative planning effort between City of Carson 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. A Multi-Jurisdiction Planning Team guided the process of developing the plan and consisted of the following representatives:

Multi-Jurisdictional Planning Team	
City of Carson	
City of Carson	Rocio Lopez, Planning Division
City of Carson	Alex Rocco, Information Technology
City of Carson	Sean Scully, Planning Division
City of Carson	Lance Burkholder, Economic Development
City of Carson	Eileen Edgerton, Public Safety
City of Carson	Travis Hopkins, Public Works
City of Carson	George Rivera, Public Safety
City of Carson	Ky Truong, Public Safety
City of Carson	Virginia Aguada, Public Safety
Compton Unified School District	
Compton Unified School District	Jesse Reyes, Police Department
Compton Unified School District	Clarence L. Moore, Police Department

Multi-Jurisdictional Planning Team	
Compton Unified School District	Herman Stampley, Police Department
Compton Unified School District	Ada McCalister, Police Department
City of Compton	
City of Compton	Adrian Tatum, Fire Department
City of Compton	Joseph Lim, Planning Department
City of Compton	Patrick Steward, Building and Safety Department
City of Compton	Gloria Falls, Community Redevelopment Agency
City of Compton	Esmochi Enenwali, Public Works Department
City of Compton	Robert Burnett, Community Redevelopment Agency
City of Compton	Arlene Williams, City Manager's Office
City of Compton	Charles Evans, Risk Management Department
City of Compton	Percy Perrodin, Municipal Law Enforcement Services
City of Compton	Louis McKenzie, ICMS
City of Compton	Kambiz Shoghi, Water Department
City of Compton	Marilynn Horne, City Controller's Office

What is the Plan Mission?

The mission of the City of Carson Mitigation Plan is to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss-prevention, and identifying activities to guide the City in creating a more sustainable community.

What are the Plan Goals?

The plan goals describe the overall direction that City of Carson 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, Environment and Property

> Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to losses from natural hazards.

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.

Public Awareness

Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

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

Natural Systems

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

Preserve, rehabilitate, and enhance natural systems to serve natural hazard mitigation functions.

Partnerships and Implementation

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

Encourage leadership within public and private sector organizations to prioritize and implement local and regional hazard mitigation activities.

Emergency Services

Establish policy to ensure mitigation projects for critical facilities, services, and infrastructure.

Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

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

The Plan Maintenance Section of this document details the formal process that will ensure that the City of Carson 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 Carson 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.

Plan Adoption

Adoption of the Mitigation Plan by the City'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 Carson Natural Hazards Mitigation Plan. The governing body has the responsibility and authority to promote sound public policy regarding hazards. The local agency governing body will have the authority to periodically update the plan as it is revised to meet changes in the hazard risks and exposures in the City. The approved Mitigation Plan will be significant in the future growth and development of the City.

Coordinating Body

The City of Carson Public Safety Commission will be responsible for coordinating implementation of Plan action items and undertaking the formal review process. The City Council will assign the existing Multi-Jurisdiction Planning Team to perform the duties of the Commission. It will be within the Commission's authority to delegate responsibility for Plan maintenance and implementation to the Multi-Jurisdiction Planning Team (authors of the Plan).

Convener

The City Council will adopt the City of Carson Natural Hazards Mitigation Plan and the Public Safety Commission will take responsibility for plan maintenance and implementation. The City Manager will serve as a convener to facilitate the Public Safety Commission meetings, and will assign tasks such as updating and presenting the Plan to the members of the Commission. Plan implementation and evaluation will be a shared responsibility among all of the Public Safety Commission members.

Implementation through Existing Programs

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

Economic Analysis of Mitigation Projects

The Planning Team ranked the various mitigation actions using categories of "low, medium, high" based on the overall value of the action item. See below Table 1-1 Mitigation Actions Matrix for the action items and rankings.

The Federal Emergency Management Agency's approaches to identify costs and benefits associated with 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 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 Carson 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 agencies and organizations participating in plan evaluation. The convener will be responsible for contacting the Public Safety Commission members and organizing the annual meeting. Commission members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan.

Continued Public Involvement

The City is dedicated to involving the public directly in review and updates of the Natural Hazards Mitigation Plan. The Commission members are 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 departments in the City with assignments in the Mitigation Actions Matrix. 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 Planning Division, responsible for keeping track of public comments on the Plan.

In addition, a copy 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 Public Safety Commission. The meetings will provide the public a forum for which they can express its concerns, opinions, or ideas about the Plan. The City Public Information Officer 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.

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. Short-term action items are activities that the City may implement with existing resources and authorities within one to two years. Long-term action items may require new or additional resources or authorities, and may take between one and five years (or more) to implement.

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:

Funding Source. The action items can 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 Plan, and other funding opportunities.

Coordinating Organization. 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 other committees. No matter, the primary responsibility for implementing the action items falls to the entity shown as the "Coordinating Organization". The coordinating organization is the agency with regulatory responsibility to address 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.

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. Each action item is linked to one or more of the Plan goals:

Protect Life, Environment and Property
Public Awareness
Natural Systems
Partnerships and Implementation
Emergency Services

Ranking. Each of the mitigation action items is ranked Low, Medium, or High using the following Ranking Action Items tool:

Ranking Action Items

To assist with implementing the Hazard Mitigation Plan the Planning Team adopted the following process for ranking mitigation action items. Designations of “High”, “Medium”, and “Low” priority were assigned to each action item using the following criteria:

Does the Action:

- ☐ solve the problem?
- ☐ address Vulnerability Assessment?
- ☐ reduce the exposure or vulnerability to the highest priority hazard?
- ☐ address multiple hazards?
- ☐ benefits equal or exceed costs?
- ☐ implement a goal, policy, or project identified in the General Plan or Capital Improvement Plan?

Can the Action:

- ☐ be implemented with existing funds?
- ☐ be implemented by existing state or federal grant programs?
- ☐ be completed within the 5-year life cycle of the LHMP?
- ☐ be implemented with currently available technologies?

Will the Action:

- ☐ be accepted by the community?
- ☐ be supported by community leaders?
- ☐ adversely impact segments of the population or neighborhoods?
- ☐ require a change in local ordinances or zoning laws?
- ☐ positive or neutral impact on the environment?
- ☐ comply with all local, state and federal environmental laws and regulations?

Is there:

- ☐ sufficient staffing to undertake the project?
- ☐ existing authority to undertake the project?

During the prioritization meeting of the Task Force, department representatives were provided worksheets for each of their assigned action items. Answers to the criteria above determined the priority according to the following scale.

- 1-6 = Low priority
- 7-12 = Medium priority
- 13-18 = High priority

Table 1-1: Mitigation Actions Matrix

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed					Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
Multi-Hazard Action Items										
MH-1	Integrate the goals and action items from the City of Carson Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	Hazard Mitigation Working Groups	Ongoing				X		H	GF
MH-2	Identify and pursue funding opportunities to develop and implement mitigation activities.	Public Services, Finance and Administrative Working Groups	Ongoing				X		M	GF
MH-3	Establish a formal role for the Public Safety Commission to develop a sustainable process for implementing, monitoring, and evaluating citywide mitigation activities.	Public Safety Department	Ongoing				X		M	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Plan Goals Addressed: Public Awareness	Plan Goals Addressed: Natural Systems	Plan Goals Addressed: Partnerships and Implementation	Plan Goals Addressed: Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
MH-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.	Economic Development Working Group, PIO	Ongoing	X	X		X		L	GF
MH-5	Develop public and private partnerships to foster natural hazard mitigation program coordination and collaboration in the City.	Hazard Mitigation Working Groups	Ongoing				X		H	GF
MH-6	Develop inventories of at-risk buildings and infrastructure and prioritize mitigation projects.	Hazard Mitigation Working Groups	1-2 Years	X			X		H	GF, GR
MH-7	Strengthen emergency services preparedness and response by linking emergency services with natural hazard mitigation programs and enhancing public education on a regional scale.	Hazard Mitigation Working Groups	Ongoing					X	H	GF, CDBG
MH-8	Develop, enhance, and implement	Hazard Mitigation	Ongoing		X				M	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
	education programs aimed at mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses, and schools.	Working Groups								
MH-9	Use technical knowledge of natural ecosystems and events to link natural resource management and land use organizations to mitigation activities and technical assistance.	Hazard Mitigation Working Groups	Ongoing			X			L	GF
MH-10	Incorporate General Plan Safety Element Policies into the Carson Natural Hazards Mitigation Plan.	Public Safety Commission	Done				X		H	GF
MH-11	Adoption of Uniform Building Code by municipality.	Building and Safety	Done	X					H	GF
MH-12	Install and improve back-up power in critical facilities.	Public Services/Building and Landscape	Ongoing	X					H	GF, GR
MH-13	Provide additional sheltering facilities.	Public Safety, and Parks & Recreation	5 Years				X		M	GF
MH-14	Develop updates for the Natural Hazards Mitigation Action Plan based on new information.	Economic Development/ Planning Division	5 years	X				X	H	GF, GR

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed					Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
MH-15	Minimize suffering and disruption caused by disasters.	Public Services/ Public Safety	Ongoing				X		H	GF
MH-16	Promote public education to increase awareness of hazards and opportunities for mitigation.	Public Services/ Public Safety-Emergency Services	Ongoing				X		M	GF
MH-17	Promote business mitigation awareness to increase knowledge of public facilities managers.	Public Services, Public Safety, and Economic Development	Ongoing		X				M	GF
MH-18	Write and administer appropriate grants to enhance all agencies/departments' incident response capabilities.	Public Services, Public Safety	Ongoing					X	L	GF
MH-19	Engage the private sector to contribute to disaster preparedness and loss reduction at the local level.	Public Services, Public Safety, and Economic Development	Ongoing				X		M	GF
MH-20	Identify and pursue funding opportunities to develop and implement local mitigation activities.	Economic Services, Planning, and Public Services, Public Safety	5 years	X					L	GF
MH-21	Identify all organizations within the jurisdiction that have programs or	Public Safety	7 years		X				L	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed					Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
	interests in natural hazards mitigation.									
MH-22	Conduct benefit/cost analysis for a mitigation activity to assist the community in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later	Redevelopment	5 years	X					L	GF
MH-23	Purchase a complete GIS/GPS setup and provide training on said setup to all pertinent community personnel.	Information Technology, GIS	1 year				X		L	GF
MH-24	Minimize suffering and disruption caused by disasters by developing effective plans, community outreach, education and partnerships, practicing response capabilities and mitigating hazards.	Fire, Law Enforcement, and Public Safety	Now	X					H	GF
MH-25	Partner with other organizations and agencies in the community to identify grant programs and foundations that may support	Public Safety	7 years				X		L	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
	mitigation activities.									
MH-26	Determine how, when, and under what circumstances government will demolish structures.	Building and Safety	5 years	X					L	GF
MH-27	Educate the public about emergency sheltering and evacuation procedures.	Public Services, Public Safety	Ongoing		X				M	GF
MH-28	Educate the public about hazards prevalent to their area.	Public Services, Public Safety	Ongoing	X					L	GF
MH-29	Hold a town-sponsored hazard mitigation seminar for the community residents.	Public Services, Public Safety	5 years		X				M	GF
MH-30	Publicize the documents associated with emergency response and mitigation.	Public Services, Public Safety	1 year		X				M	GF
MH-31	Manually disperse information about the community's SEMS Plan and Hazard Mitigation Plan and the relevant emergency response actions the public can take. Develop a website posting that provides information about the	Public Safety	Ongoing		X				H	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Plan Goals Addressed: Public Awareness	Plan Goals Addressed: Natural Systems	Plan Goals Addressed: Partnerships and Implementation	Plan Goals Addressed: Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
	community's SEMS Plan and Hazard Mitigation Plan.									
MH-32	Post the community's Hazard Mitigation Plan on the website.	Information Technology Services	1 year		X				H	GF
MH-33	Develop a "how to" mitigation display booth to be used at special events. This display would include pictures and information, such as that 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.	Public Safety	2 years		X				M	GF
MH-34	Determine costs associated with dumping disaster/construction debris at landfills.	Development Services/ Public Works Division	1 year					X	L	GF
MH-35	Provide a response/reply section on the website where residents can comment on the effectiveness of the current and where they can make suggestions for future	Information Technology Services	1 year		X				L	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed					Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
	revisions of the plan.									
MH-36	Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.	Public Safety	Ongoing		X				L	GF
MH-37	The Public Safety Department website has information about disaster preparedness and related links. The plan is to expand and update the website as needed and as appropriate in a timely manner to benefit all City residents.	Public Safety	1 year		X				L	GF
MH-38	Update the City's website to include additional hazard related information that is easily accessible.	Public Safety	1 year		X				L	GF
MH-39	Involve private businesses throughout the county in mitigation planning.	Public Safety	7 years		X		X		L	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed					Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
MH-40	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.	Planning	7 years		X				H	GF
MH-41	Provide schools with seasonal disaster preparedness literature for students to take home to their families.	Public Safety	1 year		X				L	GF
MH-42	Distribute preparedness literature, such as FEMA's Emergency Management "Guide for Businesses and Industry" and "Preparing Your Business for the Unthinkable" brochure to the local Chamber of Commerce.	Public Safety	1 year		X		X		M	GF
MH #1-43	Advertise the Public Safety Department website by ensuring its address is printed on all materials and publications.	Public Safety	Ongoing		X				L	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Plan Goals Addressed: Public Awareness	Plan Goals Addressed: Natural Systems	Plan Goals Addressed: Partnerships and Implementation	Plan Goals Addressed: Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
MH-44	Hold workshops about hazard mitigation and family disaster planning with the boys and girls clubs, scouting organizations, churches, PTA, Red Cross Youth Corps, VOAD, Chamber of Commerce, Rotary, Kiwanis, and Lions Clubs.	Public Safety	5 years		X		X		M	GF
MH-45	Train in-house shelter staff to work as a shelter team with courses including the American Red Cross's Introduction to Disasters, Shelter Operations, Mass Care and Donations Management.	Parks & Recreation Division	5 years				X	X	M	GF
MH-46	Identify and prioritize needs for additional shelter supplies to include but not limited to additional cots, blankets and shelter kits.	Parks &Recreation Division	5 years					X	M	GF
MH-47	Work with the American Red Cross, Board of Education, fire	Public Safety	Ongoing				X		L	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
	departments and churches towards upgrading all shelter resources.									
MH-48	Develop and deliver the American Red Cross “Together We Prepare” presentation to homeowner associations, Parent Teacher Associations, the Boards of Education, Chamber of Commerce’s, etc. to educate on shelter in-place procedures.	Public Safety	1 year		X				L	GF
MH-49	Develop and deliver information to all county residents, through community groups and/or publications, information on how to shelter in place and when it is appropriate to do so.	Public Safety	Ongoing		X			X	L	GF
MH-50	Develop and promote a communications plan to recruit and train more volunteers for sheltering assistance.	Public Safety	5 years		X		X	X	L	GF
MH-51	Work with the American Red Cross to hold work sessions to	Parks & Recreation Division	5 years				X	X	M	GF

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				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
	share information about local shelters. Information to include the site of each shelter, how many people it can house and feed, if it has back-up power available on site, completed site survey forms and types of resources that they have or that they need. This will benefit all areas of the County in the need to open shelters.									
MH-52	Conduct annual disaster exercises with local law enforcement, emergency managers, town and county officials, the LEPC and other disaster response agencies.	Public Safety	5 years				X	X	M	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed					Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
MH-53	Incorporate the training goals and objectives used by fire/EMS, law enforcement, public works, healthcare providers and other support personnel into selected hazardous material team training. This will foster the unified command relationship that will serve as the incident management blueprint for all disaster response.	Public Safety	5 years	X			X	X	H	GF
MH-54	Ensure representatives from the Local Mitigation Planning Committee attend Planning Commission and Technical Advisory Board meetings to provide input on development in hazard areas.	Public Safety	1 year		X		X		M	GF
MH-55	Teach CERT classes to interested citizens in the County to assist their neighbors during emergencies. This course will be taught throughout the county utilizing the County's	Public Safety	7 years		X		X	X	H	GF, GR

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
	paramedics, fire fighters, American Red Cross and law enforcement personnel.									
MH-56	Form a specialized committee within the LEPC to develop strategies to increase LEPC membership and participation.	Public Safety	Ongoing				X		L	GF
MH-57	Maintain and upgrade the Emergency Operations Center (EOC) at the City Hall. In the event the primary sites must be vacated, the off-site back-up centers can be rapidly mobilized in a secured facility. Both centers will duplicate the primary points of operation.	Public Safety	Ongoing					X	H	GF
MH-58	Promote CERT through the Chamber of Commerce and Community Watch to gain business and neighborhood participation.	Public Safety, LA County Sheriff and Fire Departments	Ongoing		X		X	X	M	GF
MH-59	Work with current LEPC business and industry members to network within the community to encourage	Public Safety	Ongoing		X		X	X	L	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
	participation and new membership.									
MH-60	Develop strategies for debris management for natural disasters.	Development Services/ Public Works Division	5 years					X	L	GF
MH-61	Coordinate the maintenance of emergency transportation routes with neighboring jurisdictions and CalTrans.	Development Services/ Public Works Division	Ongoing					X	M	GF
MH-62	Determine what kinds of minor repairs and temporary protection activities (e.g., temporary roofing, protect against loss of life/injury, shoring, protect contents) can be done in the immediate aftermath of a disaster.	Development Services/Public Works, and Public Services/Parks Maintenance-Building Maintenance Section	7 years	X				X	M	GF
MH-63	Enhance response capability of county and municipal fire, police, and emergency medical services personnel to special populations.	Public Safety	7 years	X	X		X	X	H	GF
Earthquake Action Items										
EQ-1	Integrate earthquake hazard mapping data for Los Angeles	GIS/USGS	2 years	X			X		H	GF, GR

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed					Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
	County and improve technical analysis of earthquake hazards.									
EQ-2	Incorporate the Evacuation Routes developed by the Public Works Division into appropriate planning documents.	Public Works Division and Public Safety	3 years	X			X		M	GF
EQ-3	Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.	Economic Dev./Planning Division, Development Services/Building and Safety Division, and Engineering Services Division	Ongoing	X	X				M	GF
EQ-4	Educate public on the California Earthquake Insurance Program.	Hazard Mitigation Working Groups	Ongoing	X	X				M	GF
EQ-5	Encourage seismic strength evaluations of critical facilities in the City to identify vulnerabilities for mitigation of schools and university, public infrastructure, and critical facilities to meet current seismic standards.	Hazard Mitigation Working Groups	Ongoing	X	X				M	GF
EQ-6	Encourage reduction of	Hazard Mitigation	Ongoing	X	X				M	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Plan Goals Addressed: Public Awareness	Plan Goals Addressed: Natural Systems	Plan Goals Addressed: Partnerships and Implementation	Plan Goals Addressed: Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
	nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.	Working Groups								
EQ-7	Incorporate the building inventory into the hazard assessment.	EOC/GIS Department	Ongoing					X	M	GF
EQ-8	Identify activities for private sector and citizen involvement such as nonstructural seismic daycare retrofits.	Public Safety	Ongoing		X		X		L	GF
EQ-9	Seek funding to minimize earthquake damage risk by retrofitting critical facilities owned by the City.	Development Services	5 years	X			X		H	GF, GR, CDBG
EQ-10	Encourage purchase of earthquake hazard insurance.	Public Safety	7 years		X				L	GF
EQ-11	Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.	Development Services/ Building and Safety	7 years	X					L	GF
EQ-12	Integrate new earthquake hazard	Carson GIS	Ongoing				X		M	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
	mapping data for the County and improve technical analysis of earthquake hazards.									
Flood Action Items										
FLD-1	Analyze areas prone to urban flooding (ponding, etc.) and identify feasible mitigation options.	Development Services/Engineering Division, and Public Works	1-2 years	X			X		M	GF
FLD-2	Recommend revisions to requirements for development within the flood-prone areas, where appropriate.	Development Services/Public Works Division, and Economic Development/Planning Division	1-2 years	X					M	GF
FLD-3	Develop better flood warning systems.	Information Technology Services, and Public Safety	1-2 years	X	X			X	L	GF, GR
FLD-4	Enhance data and mapping for floodplain information within the City and identify and map flood-prone areas outside of designated floodplains.	Planning and GIS	3 years (as funding allows)	X				X	M	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Plan Goals Addressed: Public Awareness	Plan Goals Addressed: Natural Systems	Plan Goals Addressed: Partnerships and Implementation	Plan Goals Addressed: Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
FLD-5	Identify surface water drainage obstructions for all parts of the City.	Planning and GIS	5 years	X		X			M	GF, GR, CDBG
FLD-6	Record and maintain all tax parcel information and floodplain locations in a GIS system in order to build the community's capability to generate maps when needed.	Information Technology Services and GIS	Ongoing					X	L	GF
FLD-7	Record all structures within the floodplain, as well as, areas of repetitive losses due to flooding.	Building and Safety	5 years				X		M	GF
FLD-8	Understand the National Flood Insurance Program (NFIP) requirements for new construction and substantially improved buildings;	Building and Safety	5 years				X		M	GF
FLD-9	Distribute information on the National Flood Insurance Program to local businesses in or near the floodplain.	Public Information Office, Information Technology Services, and Public Safety	1 year		X				H	GF
Windstorm Action Items										

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed					Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services		
WS-1	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.	Public Services/Landscape & Building Maintenance Services, and Development Services/Public Works Division	2 years				X	X	H	GF
WS-2	Enhance strategies for debris management for windstorm events.	Development Services/Public Works Division	2 years				X	X	M	GF
WS-3	Map and publicize locations around the city that have the highest incidence of extreme windstorms.	Public Works and GIS	5 years	X	X		X		M	GF
WS-4	Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from windstorms.	Economic Development/Planning Division and Development Services/Engineering Services	5 years			X	X		M	GF
WS-5	Increase public awareness of windstorm mitigation activities.	Development Services/Public Works, and Public Services/Landscape & Building Maintenance	Ongoing	X	X				L	GF

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Plan Goals Addressed: Public Awareness	Plan Goals Addressed: Natural Systems	Plan Goals Addressed: Partnerships and Implementation	Plan Goals Addressed: Emergency Services	Ranking Future Actions (L=Low, M-Med., H-High, n/a=Not applicable)	Funding Source: GF=General Funds, GR=Grant Funds, CDBG
		Division								
WS-6	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.	Development Services/Public Works Division	5 years	X					M	GF

SECTION 1: INTRODUCTION

The City of Carson is located in the south-central Los Angeles County and is vulnerable to a variety of potential impacts from hazards associated with the terrain.

The City is subject to Earthquake, Flood, and Windstorm. 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. As the population of the region continues to increase, the exposure to hazards creates an even higher risk than previously experienced.

Why Develop a Mitigation Plan?

As the costs of damage from disasters continue to increase, the City realizes the importance of identifying effective ways to reduce vulnerability to disasters. Mitigation Plans assist communities in reducing risk from 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 risks from 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 hazards.

The resources and information within the Mitigation Plan:

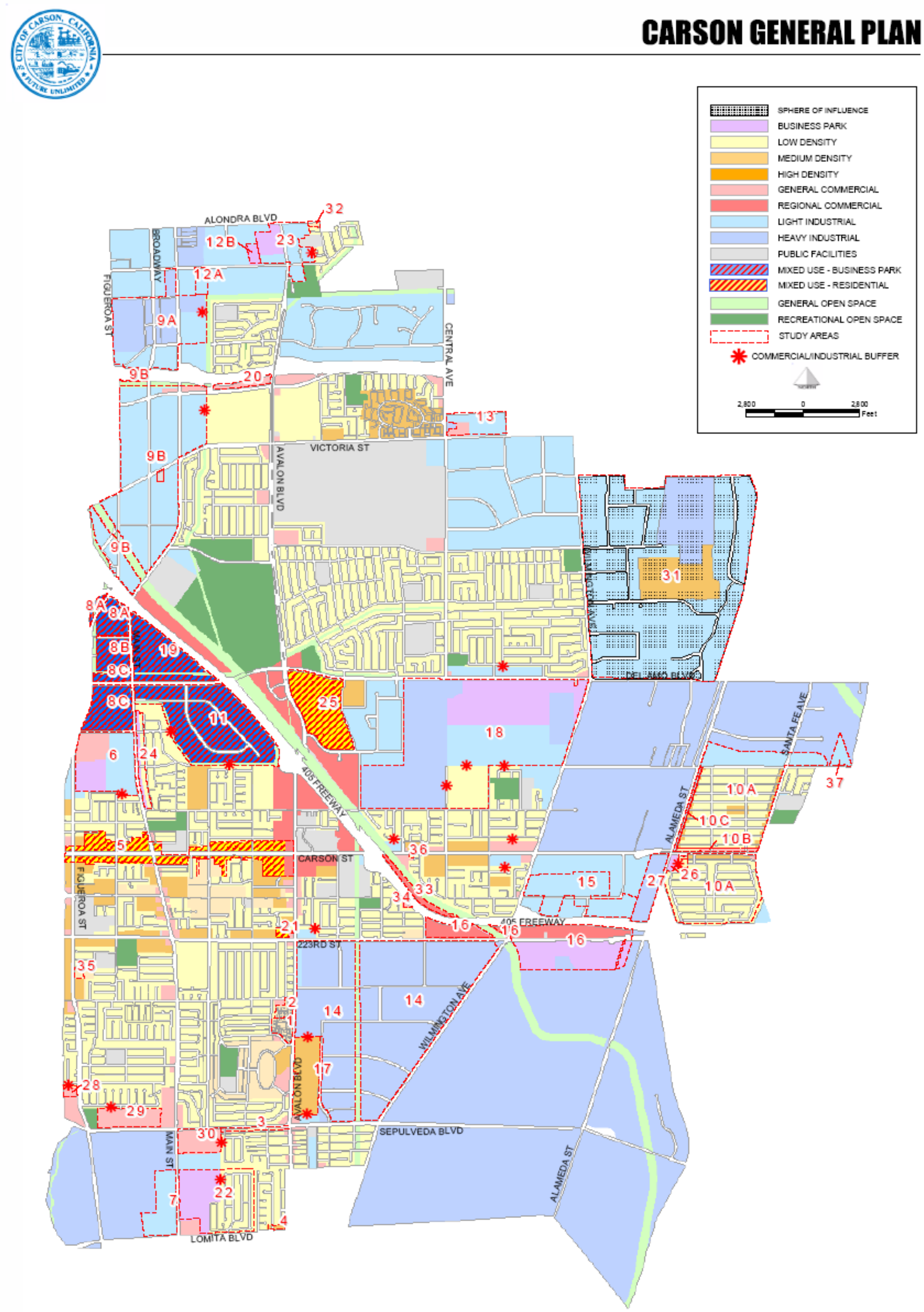
- ♦ Establish a basis for coordination and collaboration among agencies and the public of City of Carson;
- ♦ Identify and prioritize future mitigation projects; and
- ♦ Assist in meeting the requirements of federal assistance programs.

The Mitigation Plan works in conjunction with other City plans, including the Emergency Operations Plan, General Plan, and Capital Improvement Plan.

Who Does the Mitigation Plan Affect?

The City of Carson Mitigation Plan affects the entire City. Map 1-1 shows the boundaries of the City of Carson. The resources and background information in the plan are applicable City-wide. The goals and recommendations contained in this plan will lay groundwork for other local mitigation plans and partnerships.

Map 1-1: Map of City of Carson
(Source: City of Carson General Plan)



Hazard Land Use Policy in California

Planning for 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 land use 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.

Planning for hazards requires a thorough understanding of the various hazards facing the City and region as a whole. Additionally, it's important to take an inventory of the structures and contents of various City holdings. These inventories should include the compendium of hazards facing the city, 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 Hazard Mitigation

All mitigation is local and the primary responsibility for development and implementation of risk reduction strategies and policies lies with each local jurisdiction. 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 hazards and hazard mitigation. Some of the key agencies include:

- The California Emergency Management Agency (Cal EMA) 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 Department of Forestry and Fire Prevention (CAL FIRE) is responsible for all aspects of wildland fire protection on private and state properties, 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

Plan Methodology

Information in the Mitigation Plan is based on research from a variety of sources. The City of

Carson conducted data research and analysis, participated in Planning Team meetings, and developed the final mitigation plan. The research methods and various contributions to the plan include:

Stakeholder Input – Planning Team Meetings

The City of Carson representatives participated in a total of five meetings in support of developing the Hazard Mitigation Plan. See Appendix B: Public Participation for details on dates, content, and sign-in sheets from the meetings.

Multi-Jurisdictional Planning Team Meetings

The Multi-Jurisdiction Planning Team convened four times to guide development of the Mitigation Plan. The Team played an integral role in developing the mission, goals, and action items for the Mitigation Plan. The Team consisted of representatives from the City of Carson, City of Compton, and the Compton Unified School District. The multi-jurisdictional team was made up of the representatives from each of the agencies with interests and/or active involvement in mitigation activities within and around the City of Carson, City of Compton, and Compton Unified School District.

City of Carson Planning Team Meeting

During 2010 the Carson representatives to the Planning Team met again to discuss ranking of the City's Mitigation Action Items.

State and federal guidelines and requirements for mitigation plans

Following are the Federal requirements for approval of a 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, other 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 City;
- ♦ A comprehensive mitigation strategy, which describes the goals and objectives, including proposed strategies, programs and 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 Mitigation Plan into other planning mechanisms;
- ♦ Formal adoption by the City Council;
- ♦ Plan review by both Cal EMA and FEMA;
- ♦ Plan approval by 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, human-caused, and technological hazards questionnaire, and the City Disaster Council and City Council public hearings. In addition, the makeup of a Multi-Jurisdiction Planning Team ensured a constant exchange of data and input from outside organizations. 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) and the State of California Mitigation Plan Guidance.

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

City of Long Beach (California) Mitigation Plan (2004)
Los Angeles County (California) All-Hazard Mitigation Plan (2004)
State of California Natural Hazards Mitigation Plan (2007)
City of El Segundo Natural Hazards Mitigation Plan (2009)

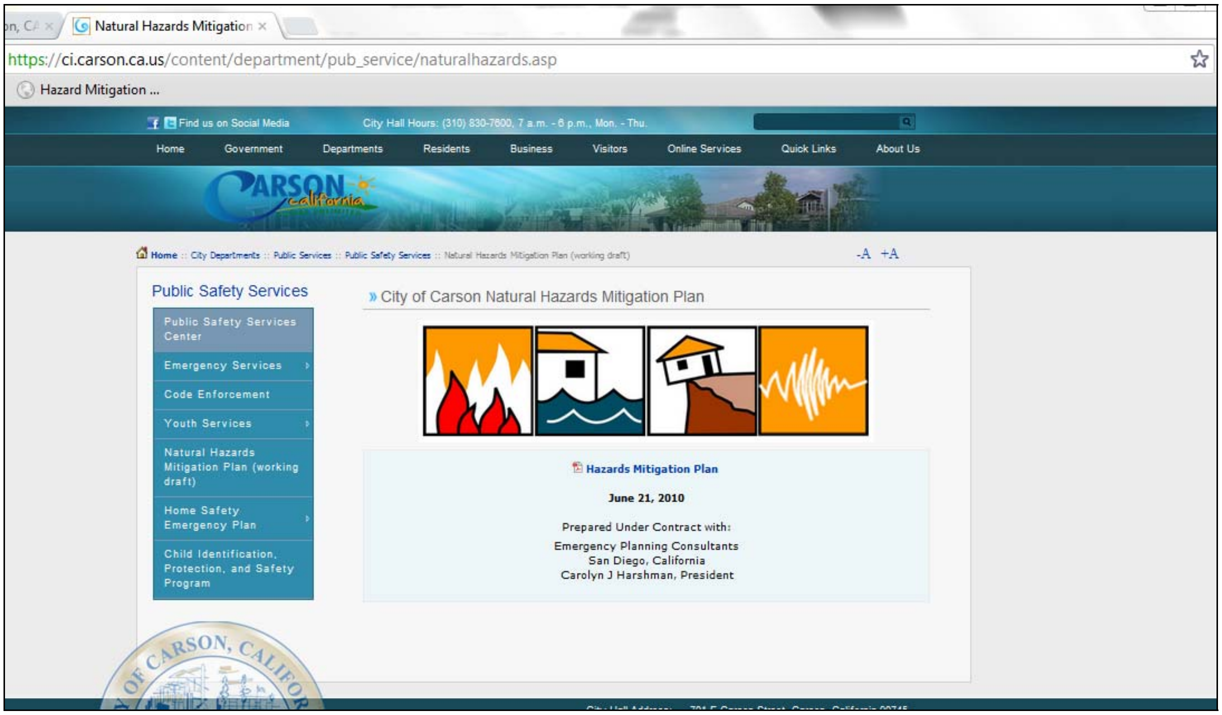
Hazard-specific research: City staff collected data and compiled research on the three hazards identified as posing the greatest threat to the City: Earthquake, Flood, and Windstorm. Research materials came from the City General Plan, the City's Threat Assessment contained in the Emergency Operations Plan, and state agencies including Cal EMA and CAL FIRE. The City of Carson staff conducted research by referencing long time City of Carson employees and locating City of Carson information in historical documents. The City of Carson staff identified current mitigation activities, resources and programs, and potential action items from research materials and stakeholder interviews.

Public Input

The City of Carson encouraged public participation and input in the Hazard Mitigation Plan by posting its activities in the local newspaper and on the internet. In addition, the City distributed via U.S. mail and internet a hazard questionnaire. During the review period for the Draft Plan, sixty (60) electronic copies of the hazard questionnaire were distributed to local businesses and other interested citizens. The Plan Draft was posted on the main page of the City's website for the duration of the project and hard copies were made available at the City Clerk's Office for public view. The public was encouraged to review public copies of the Plan Draft and participate in the Public Safety Commission public hearing (held on September 8, 2004) and the City Council public meeting which was held on October 19, 2004. In order to comply with requests from FEMA during the plan review process, the Plan was presented again to City Council on July 6, 2010 for re-adoption.

The resources and information cited in the Mitigation Plan provide a strong local perspective and help identify strategies and activities to make City of Carson more disaster resistant.

Website for Mitigation Plan



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. Combined, the sections of the plan work together to create a document that guides the mission to reduce risk and prevent loss from future hazard events.

The structure of the plan enables people to use a section of interest to them. It also allows the City 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 Mitigation Plan that remains current and relevant to the City of Carson.

The Mitigation Plan and plan maintenance is organized into three parts. Part I contains an Executive Summary, Introduction, and Plan Maintenance. Part II contains Community 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. 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 hazard events. The Executive Summary also contains the Mitigation Actions Matrix.

Section 1: Introduction

The Introduction describes the background and purpose of developing the Mitigation Plan for the City of Carson. This section also includes the Mitigation Action Items Matrix.

Section 2: Plan Maintenance

This section provides information on plan implementation, monitoring and evaluation. The Plan Maintenance Section also contains information on how the action items were ranked.

Part II: Hazard Analysis

Section 3: Community Profile

The section presents the history, geography, demographics, and socioeconomics of the City of Carson. It provides valuable information on the demographics and history of the region.

Sections 4: Risk Assessment

This section provides information on hazard identification, vulnerability and risk associated with hazards in the City of Carson.

Sections 5-7: Hazard-Specific Sections

Hazard-Specific Section on the three 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: Flood
Section 7: Windstorm

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

Part III: Resources

The plan appendices are designed to provide users of the City of Carson 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: Resource Directory

The resource directory includes City, local, regional, state, and national resources and programs that may be of technical and/or financial assistance to the City of Carson 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 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, local, regional, state, and federal agencies and organizations that may be referred to within the Mitigation Plan.

Appendix E: Glossary

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

SECTION 2: PLAN MAINTENANCE

The Plan Maintenance section of this document details the formal process that will ensure that the City of Carson 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 Carson intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the City 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 Mitigation Plan. This governing body has the authority to promote sound public policy regarding hazards. Once the plan has been adopted, the City's Public Safety and Community Services Manager (or designee) will be responsible for submitting it to the State Hazard Mitigation Officer at California Emergency Management Agency (Cal EMA). Cal EMA will then submit the plan to the Federal Emergency Management Agency (FEMA) for review and approval. This review will address the requirements set forth in 44 C.F.R. Section 201.6 (Local Mitigation Plans). Upon acceptance by FEMA, City of Carson will gain eligibility for Hazard Mitigation Grant Program funds.

Coordinating Body

The City of Carson Public Safety Commission will be responsible for coordinating implementation of plan action items and undertaking the formal review process. The City will assign representatives from City departments, divisions, and agencies, including, but not limited to, the current Multi-Jurisdiction Planning Team will consist of the following individuals:

Public Safety Commission
Ky H. Truong, Public Safety
Diane Wachi, Public Safety

In order to make the Commission as broad and useful as possible, the City Council may choose to involve other relevant organizations and agencies in hazard mitigation. These additional appointments could include:

A representative from the American Red Cross
A representative from a local government emergency response agency

The Public Safety Commission will meet at least quarterly. Meeting dates will be scheduled once the final Public Safety Commission has been established. These meetings will provide an opportunity to discuss the progress of the action items and maintain the partnerships that are essential for the sustainability of the mitigation plan.

Convener

The City Council will adopt the City of Carson Natural Hazards Mitigation Plan. Following adoption, the Public Safety Commission will take responsibility for plan implementation. The City Manager (or designee) will serve as a Convener to facilitate the Public Safety Commission meetings, and will assign tasks such as updating and presenting the Plan to the members of the Commission. Plan implementation and evaluation will be a shared responsibility among all of the Public Safety Commission members.

Implementation through Existing Programs

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

The City of Carson Planning and Building Safety Department is responsible for adhering to the State of California's Building and Safety Codes. In addition, the Public Safety Commission will work with other agencies at the state level to review, develop and ensure Building and Safety Codes that are adequate to mitigate or present damage by hazards. This is to ensure that life-safety criteria are met for new construction.

Some of the goals and action items in the Mitigation Plan may be achieved through activities recommended in the City's Capital Improvement Program (CIP). Various city departments develop the CIP and review it on an annual basis. Upon annual review of the CIP, the Public Safety Commission will work with the city departments to identify areas that the Mitigation Plan action items are consistent with CIP goals and integrate them where appropriate.

Within six months of formal adoption of the Mitigation Plan, the recommendations listed above will be incorporated into the process of existing planning mechanisms at the City level. The meetings of the Public Safety Commission will provide an opportunity for Commission members to report back on the progress made on the integration of mitigation planning elements into City planning documents and procedures.

Economic Analysis of Mitigation Projects

At the Public Safety Commission's first meeting, the Commission will utilize the rankings identified in Table 1-1 Mitigation Actions Matrix to guide the implementation of the Mitigation Plan.

FEMA's approaches to identify the costs and benefits associated with 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 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 Public Safety Commission will use a FEMA-approved benefit/cost analysis approach to identify and prioritize mitigation action items. For other projects and funding sources, the Public Safety Commission 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 City of Carson 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 agencies and organizations participating in plan evaluation. The Convener or designee will be responsible for contacting the Public Safety Commission members and organizing the annual meeting.

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

The Commission 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 Commission will also review Section 4: 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 Commission members. The designated Commission members will have three months to make appropriate changes to the Plan before submitting it to the Commission members, and presenting it to the City Council (or other authority). The Public Safety Commission will also notify all holders of the City plan when changes have been made. Every five years the updated plan will be submitted to the State Hazard Mitigation Officer at California Emergency Management Agency and the Federal Emergency Management Agency for review. The City Manager will have authority to approve updates to the Mitigation Plan.

Continued Public Involvement

The City is dedicated to involving the public directly in review and updates of the Natural Hazards Mitigation Plan. The Commission members are 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 Planning Division, 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 Commission. The meetings will provide the public a forum for which they can express its concerns, opinions, or ideas about the Plan. The City Public Information Officer 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 Hazards in City of Carson?

Hazards impact residents, property, the environment, and the economy of City of Carson. Earthquake, Flood, and Windstorm have exposed the City of Carson to the financial and emotional costs of recovering after natural, human-caused, and technological disasters. The risk associated with hazards increases as more people move to areas affected by 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 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 hazard events. Identifying the risks posed by 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 Mitigation Plan that addresses the potential impacts of hazard events.

Geography and the Environment

City of Carson has an area of 20.1 square miles and is located in south-central Los Angeles County.

The elevation of the City of Carson is 37 feet. As stated in the General Plan, the City of Carson is located in the northern section of the Los Angeles Basin. The Dominguez Hills and the Dominguez Gap are located within the city. The Dominguez Hills range from 20 to 195 feet above sea level. The Dominguez Channel is 1.6 miles wide at its narrowest point and 7 miles long.

Community Profile

Although the City of Carson has a rich history, the area comprising the City of Carson was only incorporated in 1968.

As stated in the City’s General Plan, the City is served by the Artesia Freeway (SR-91) to the north, the Harbor Freeway (I-110) to the west and the San Diego Freeway (I-405).

The Union Pacific, southern Pacific, and BNSF railroads traverse the city with tracks north-south. Passenger transportation is provided by the Metro Green and Blue Lines.

Major Rivers

According to the City’s General Plan, the Dominguez Channel runs northwest to southeast through the center of the City of Carson. The Dominguez Channel is part of the Los Angeles River Flood Control System which makes it vulnerable when the Los Angeles River Floods. The area surrounding the Dominguez Channel is designated as a 100-year flood zone.

Climate

Temperatures in the City of Carson range from an average of 56 degrees in the winter months to 70 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.

Rainfall in the city averages 11.8 inches of rain per year. But the term "average" means very little in this region 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.

Furthermore, actual rainfall in Southern California tends to fall in large amounts during sporadic and often heavy storms rather than consistently over storms at somewhat regular intervals. In short, rainfall in Southern California might be characterized as feast or famine within a single year. Because the metropolitan basin is largely built out, water originating in higher elevation communities can have a sudden impact on adjoining communities that have a lower elevation.

Minerals and Soils

The characteristics of the minerals and soils present in City of Carson indicate that potential types of hazards that may occur. Rock hardness and soil characteristics can determine whether or not an area will be prone to geologic hazards such as earthquakes, liquefaction and landslides.

According to the General Plan, soil in the City of Carson consists of holocene age alluvial deposits consisting of poorly consolidated sand, silt, clay, and gravel. Overall, the soil ranges from sand to clay loam soil types.

Other Significant Geologic Features

There are no known faults with the potential for surface fault rupture within the City of Carson, but significant ground shaking can result from rupture of a large number of nearby faults.

The major faults that have the potential to affect the greater Los Angeles region are the:

Avalon-Compton
San Andreas
Palos Verdes
Whittier
Santa Monica

Southern California has a history of powerful and relatively frequent earthquakes, dating back to the powerful magnitude 8.0+ 1857 San Andreas Earthquake which did substantial damage to the relatively few buildings that existed at the time. Paleoseismological research indicates that large magnitude (8.0+) earthquakes occur on the San Andreas Fault at intervals between 45 and 332 years with an average interval of 140 years. Other lesser faults have also caused very damaging earthquakes since 1857. Notable 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 Southern California have sandy soils that are subject to liquefaction. The City of Carson has liquefaction zones discussed in Section 5: Earthquake.

Population and Demographics

City of Carson has a population of about 89,730 in an area of 20.1 square miles. The increase of people living in City of Carson creates more community exposure, and changes how agencies prepare for and respond to natural hazards. For example, more people living on the urban fringe can increase risk of fire. Wildfire has an increased chance of starting due to human activities in the urban/rural interface, and has the potential to injure more people and cause more property damage. But an urban/wildland fire is not the only exposure to the City of Carson. In the 1987 publication, Fire Following Earthquake issued by the All Industry Research Advisory Council, Charles Scawthorn explains how a 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.

The City of Carson is experiencing a great deal of in-fill building, which is increasing the population density creating greater service loads on the built infrastructure, including roads, water supply, sewer services and storm drains.

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.

According the 2000 Census figures, the demographic make up of the City is as follows:

	City of Carson
Hispanic or Latino	34.9%
African American	25.4%
Asian	22.3%
White	12%
Native Hawaiian or Pacific Islander	3%

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

The percentage of citizens living in poverty in the City of Carson is about 9.3% according to the 2000 Census. Of those, 10.9% are under 18 years old, and 8.6% are over 65.

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

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 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 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 urbanized portions of Southern California were virtually built out. This pushed new development further and further away from the urban center.

The City of Carson 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 hazards that affect all of Southern California.

Housing and Community Development
(Source: 2000 Census)

City of Carson	
Development Type (Source: City General Plan)	
Heavy Industry	4000.2 acres
Low Density Residential	2432.9 acres
Light Industry	1496.6 acres
Housing Type	
1 unit detached	69.8%
Mobile homes	9.8%
1 unit attached	9.0%
Housing Statistics	
Total Available Housing Units	25,306 units
Owner-Occupied Housing	77.9%
Average Household Size	3.57 persons
Median Home Value	$183,200

Employment and Industry
(Source: 2000 Census)

City of Carson	
Principal Employment Activities	
Sales and Office Occupations	31.0%
Management (professional and related occupations)	26.8%
Production, Transportation, and Material Moving	20%
Service Occupations	14.4%
Construction	7.7%
Major Industries	
Education, Health & Social Services	21.0%
Manufacturing	19.0%
Retail Trade	11.3%
Transportation, Warehousing, and Utilities	9.5%
Professional, Scientific, Management, Administrative, and Waste Management Services	8.4%

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 hazard event, large and small businesses can develop strategies to prepare for hazards, respond efficiently, and prevent loss of life and property.

Transportation and Commuting Patterns

Private automobiles are the dominant means of transportation in Southern California and in the City of Carson. According to the City's General Plan, public Transportation in the City of Carson is provided by Carson Circuit, Torrance Transit, and the Los Angeles County Metropolitan Transportation Authority Bus Service. Additionally, there is limited service from Long Beach Transit and Gardena Municipal Bus Lines.

According to the 2000 Census, the City has a population of 89,730. The mean travel time to work for the residents of the City of Carson is 26.6 minutes.

As stated in the City's General Plan, the City is served by the Artesia Freeway (SR-91) to the north, the Harbor Freeway (I-110) to the west and the San Diego Freeway (I-405).

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.

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 hazard events. Specifically, the five levels of a risk assessment are as follows:

1) Hazard Identification

The City of Carson considered a range of hazards facing the region including: Earthquake, Flooding, Wildfire, Landslide, Windstorm, Tsunami, Drought, and Technological and Human-Caused Hazards. The attached Ranking Your Hazards – Attachment 1 was used by the Team to prioritize the hazards with the highest probability of impacting the City of Carson. The Team agreed that any hazard receiving a Team score higher than “3” would be included in the hazard-specific section of the Mitigation Plan. Utilizing the ranking technique, the Team identified Earthquake, Flood, and Windstorm as the most prominent hazards facing the City.

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 Carson identified three major hazards that affect this geographic area. These hazards – Earthquake, Flood, and Windstorm - were identified through an extensive process involving research of existing documents and input from the Multi-Jurisdiction Planning Team. The geographic extent of each of the identified hazards has been identified by the City of Carson utilizing the maps contained in the City’s General Plan and Emergency Operations Plan, and the Los Angeles County All-Hazard Mitigation Plan. The vulnerabilities posed by these hazards are depicted on Table 4-1.

2) Profiling Hazard Events

This process describes the causes and characteristics of each hazard and what part of the City's facilities, 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.

Table 4-1:
Vulnerability: Location, Extent, and Probability[1]

	Location (Where)	**Extent (How Big an Event)**	**Probability (How Often)[1]**
Hazard			
Earthquake (Palos Verdes Fault)	Entire Project Area	M7.1[2]	Moderate
Urban Flooding[3]	Random Intersections	10-year flood (isolated ponding at intersections)	High
Windstorm	Entire Project Area	50 miles per hour or greater	Moderate
[1] Probability is defined as: Low = 1:500 years, Moderate = 1:100 years, High = 1:10 years			
[2] Uniform California Earthquake Rupture Forecast			
[3] “Urban Flooding” is the term used to describe isolated downpours and other site-specific flood			

related impacts resulting from heavy rains. The puddles in various intersections are not related to a floodplain and are very difficult to describe in regards to "extent".

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 entities provide essential 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 4-3 at the end of this section.

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 assessment. Data was not available to make vulnerability determinations in terms of dollar losses. The Mitigation Actions Matrix (Executive Summary – Table 1) includes an action item to conduct such an assessment in the future.

5) Assessing Vulnerability/ Analyzing Development Trends

This step provides a general description of City facilities and contents in relation to the identified hazards so that mitigation options can be considered in land use planning and future land use decisions. This Mitigation Plan provides comprehensive description of the character of the City of Carson in the 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 of Carson 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 section 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 the Mitigation Actions Matrix (Executive Summary: Table 1-1). 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

Federal regulations for local hazard mitigation plans (44 C.F.R. Section 201.6(c)(2)) require a 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 three hazards profiled in the Mitigation Plan, including Earthquake, Flood, and Windstorm. The Federal criteria for risk assessment and information on how the City of Carson Natural Hazards Mitigation Plan meets those criteria is outlined in Table 4-2 below.

Table 4-2: 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 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 within the City. Each hazard section also identifies potential mitigation strategies.
Assessing Vulnerability: Estimating Potential Losses	The Risk Assessment of the Mitigation Plan identifies key critical facilities that provide services to the City and includes a map of these facilities. 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 of the Plan provides a description of the population trends and transportation patterns.

Critical and Essential Facilities

Facilities critical to government response and recovery activities (i.e., life safety and property and environmental protection) include: local government 9-1-1 dispatch centers, local government emergency operations centers, schools (hosting shelters), local police and fire stations, local public works facilities, local communications centers, hospitals, bridges and major roads, and shelters. Also, facilities that, if damaged, could cause serious secondary impacts may also be considered "critical”. A hazardous materials facility is one example of this type of critical facility.

Essential facilities are those facilities that are vital to the continued delivery of key City services or that may significantly impact the City’s ability to recover from the disaster. 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. The following Table 4-3 illustrates the critical and essential facilities providing services to the City of Carson. Note that secondary impacts associated with earthquake hazards have been included on a site-by-site basis.

Table 4-3: City of Carson Critical and Essential Facilities Vulnerable to Hazards (X = site's risk rating is "possible, likely, or highly likely", N/A = Not Applicable)

EQ	Flood	Windstorm	Facility	Address
X		X	Los Angeles County Sheriff's Station	21356 South Avalon
X		X	Fire Station 10	1860 E. Del Amo Boulevard
X		X	Fire Station 36	127 W. 223rd Street
X		X	Fire Station 116	755 E. Victoria Street
X		X	Fire Station 127	2049 E. 223rd Street
X		X	Casualty Care Center – Walnut Street Park	440 E. Walnut
X		X	Casualty Care Center – Avalon Park	700 E. Gardena Boulevard
X		X	Casualty Care Center – Anderson Park	19101 S. Wilmington Avenue
X		X	Casualty Care Center – Mills Park	1340 E. Diamondale Drive
X	X	X	Casualty Care Center – Del Amo Park	703 E. Del Amo Boulevard
X		X	Casualty Care Center – Carson Park	21411 Orrick Street
X		X	Casualty Care Center – Boxing Center	424th Carson Street
X		X	Casualty Care Center – Dolphin Park	21205 Water Street
X		X	Casualty Care Center – Calas Park	1000 E. 220th Street
X		X	Casualty Care Center – Scott Park	23410 Catskill Avenue
X		X	Casualty Care Center – Carriage Crest Park	23800 S. Figueroa Street
X		X	Casualty Care Center – Dominquez Park	21330 Santa Fe Avenue

City Assets and Potential Estimated Losses

The City owns a number of assets that could potentially be impacted by hazards however data was not available to analyze the potential impact to these assets.

Summary

Hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. 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 hazards.

Attachment 1: 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 (Palos Verdes Fault M7.1)	
Flooding (Urban Flooding - Ponding)	
Wildfire	
Landslide	
Windstorm (>40mph)	
Tsunami	
Drought	
Technological and Human-Caused Hazards	
Other	
Other	
Other	
Other	

SECTION 5: EARTHQUAKE HAZARDS

Why Are Earthquakes a Threat to the City of Carson?

According to the General Plan and the Cities representatives on the Planning Team, the City of Carson has never been significantly impacted by an earthquake.

Several major active faults exist in Los Angeles County, including the San Andres, Newport Inglewood, Elsinore, San Jacinto, Whittier, and Norwalk. The Newport Inglewood Fault and the Palos Verdes Fault are considered to be the greatest potential threat to Carson, due to its proximity to the City. (Source: Southern California Earthquake Data Center).

The most recent significant earthquake event affecting the Los Angeles region 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.

57 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.

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.”

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, 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 October 1987 Whittier Narrows Earthquake.

Although the most famous of the faults, the San Andreas, is capable of producing an earthquake with a moment magnitude of greater than 8, some of the “lesser” faults have the potential to inflict greater damage on the urban core of Southern California. Seismologists believe that local faults such as the Newport-Inglewood Fault or the Palos Verdes Fault could potentially inflict greater damage on the City of Carson than certain scenarios of ground rupture on the more distant San Andreas Fault.

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.

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. Table 5-1 describes the historical earthquake events that have affected Southern California.

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	1952	Kern County
1858	San Bernardino Region	1954	West of Wheeler Ridge
1862	Old Town San Diego	1971	San Fernando
1892	San Jacinto/Elsinore Fault	1973	Point Mugu
1893	Pico Canyon	1986	Coastal San Diego
1894	Lytle Creek Region	1986	North Palm Springs
1894	East of San Diego	1987	Whittier Narrows
1899	Lytle Creek Region	1992	Landers
1899	San Jacinto and Hemet	1992	Big Bear
1907	San Bernardino Region	1994	Northridge
1910	Glen Ivy Hot Springs	1999	Hector Mine

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 are 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 (M7.9) and the Owens Valley in 1872 (M7.6) are evidence of the tremendously damaging potential of earthquakes in Southern California. In more recent times two M7.3 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.

Impact of Earthquakes in the City of Carson

Based on the risk assessment, it is evident that Earthquakes will continue to have potentially devastating economic impacts to certain areas of the city. Impacts that are not quantified, but can be anticipated in future events, include:

- Injury and loss of life;
- Commercial and residential structural damage;
- Disruption of and damage to public infrastructure;
- Secondary health hazards e.g. mold and mildew;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) upon the community;
- Negative impact on commercial and residential property values; and
- Significant disruption to students and teachers as temporary facilities would be needed.

Measuring and Describing Earthquakes

An earthquake is a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of the Earth's tectonic plates. The effects of an earthquake can be felt far beyond the site of its occurrence. They usually occur without warning and, after just a few seconds, can cause massive damage and extensive casualties. Common effects of earthquakes are ground motion and shaking, surface fault ruptures, and ground failure. Ground motion is 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. Soft soils can further amplify ground motions. The severity of these effects is dependent on the amount of energy released from the fault or epicenter. One way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. The acceleration due to gravity is often called "g". A ground motion with a peak ground acceleration of 100%g is very severe. Peak Ground Acceleration (PGA) is a measure of the strength of ground motion. PGA is used to project the risk of damage from future earthquakes by showing earthquake ground motions that have a specified probability (10%, 5%, or 2%) of being exceeded in 50 years. These ground motion values are used for reference in construction design for earthquake resistance. The ground motion values can also be used to assess relative hazard between sites, when making economic and safety decisions. Another tool used to describe earthquake intensity is the Magnitude Scale. The Magnitude

Scale is sometimes referred to as the Richter Scale. The two are similar but not exactly the same. The Magnitude Scale was devised as a means of rating earthquake strength and is an indirect measure of seismic energy released. The Scale is logarithmic with each one-point increase corresponding to a 10-fold increase in the amplitude of the seismic shock waves generated by the earthquake. In terms of actual energy released, however, each one-point increase on the Richter scale corresponds to about a 32-fold increase in energy released. Therefore, a magnitude 7 (M7) earthquake is 100 times (10 X 10) more powerful than a M5 earthquake and releases 1,024 times (32 X 32) the energy. An earthquake generates different types of seismic shock waves that travel outward from the focus or point of rupture on a fault. Seismic waves that travel through the earth's crust are called body waves and are divided into primary (P) and secondary (S) waves. Because P waves move faster (1.7 times) than S waves they arrive at the seismograph first. By measuring the time delay between arrival of the P and S waves and knowing the distance to the epicenter, seismologists can compute the magnitude for the earthquake.

The Modified Mercalli Scale (MMI) is another means for rating earthquakes, but one that attempts to quantify intensity of ground shaking. Intensity under this scale is a function of distance from the epicenter (the closer to the epicenter the greater the intensity), ground acceleration, duration of ground shaking, and degree of structural damage. This rates the level of severity of an earthquake by the amount of damage and perceived shaking (Table 5-2).

Table 5-2: Modified Mercalli Intensity Scale

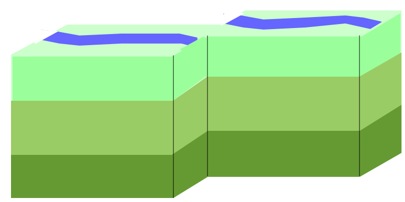
MMI Value	Description of Shaking Severity	Summary Damage Description Used on 1995 Maps	Full Description
I			Not Felt
II			Felt by persons at rest, on upper floors, or favorably placed.
III			Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.
IV			Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motorcars rock. Windows, dishes, doors rattle. In the upper range of IV, wooden walls and frame creak.
V	Light	Pictures Move	Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clock stop, start, change rate.
VI	Moderate	Objects Fall	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked.
VII	Strong	Nonstructural Damage	Difficult to stand. Noticed by drivers of motorcars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roofline. Fall of plaster, loose bricks, stones, tiles, cornices. Some cracks in masonry C. Small slides and caving in along sand or gravel banks. Concrete irrigation ditches damaged.
VIII	Very Strong	Moderate Damage	Steering of motorcars affected. Damage to masonry C, partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, and elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Cracks in wet ground and on steep slopes.
IX	Very Violent	Extreme Damage	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land.
X			Rails bent greatly. Underground pipelines completely out of services.

MMI Value	Description of Shaking Severity	Summary Damage Description Used on 1995 Maps	Full Description
XII			Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.

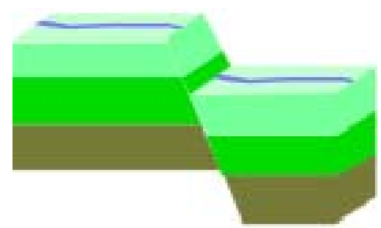
Figure 5-1: Causes and Characteristics of Earthquakes in Southern California

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.

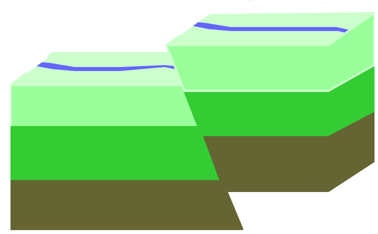
Strike-slip faults
Strike-slip faults are vertical or almost vertical rifts where the earth's plates move mostly horizontally. From the observer's perspective, if the opposite block looking across the fault moves to the right, the slip style is called a right lateral fault; if the block moves left, the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



Dip-slip faults
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
Thrust faults have a reverse fault with a dip of 45 ° or less.



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." 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 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.

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 weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures. Many communities in Southern California are built on ancient river bottoms and have sandy soil. In some cases this ground may be subject to liquefaction, depending on the depth of the water table.

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 the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk. Amplification can also occur in areas with deep sediment filled basins and on ridge tops.

Earthquake Hazard Assessment

Hazard Identification

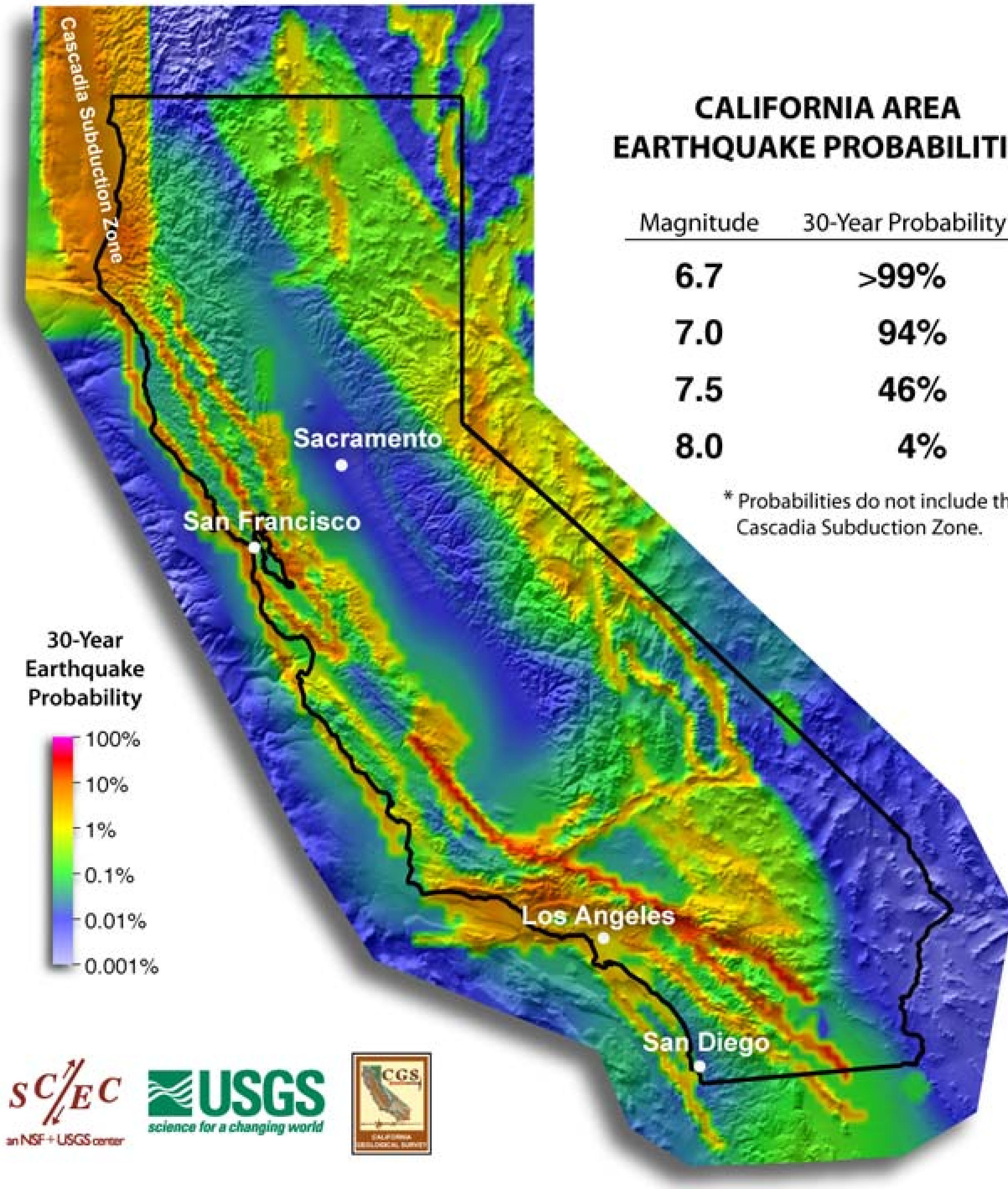
The 2007 Working Group on California Earthquake Probabilities (WGCEP 2007), a multi-disciplinary collaboration of scientists and engineers, has released the Uniform California Earthquake Rupture Forecast (UCERF), the first comprehensive framework for comparing earthquake likelihoods throughout all of California. In developing the UCERF, the 2007 Working Group revised earlier forecasts for Southern California (WGCEP 1995) and the San Francisco Bay Area (WGCEP 2003) by incorporating new data on active faults and an improved scientific understanding of how faults rupture to produce large earthquakes. It extended the forecast across the entire state using a uniform methodology, allowing for the first time meaningful comparisons of earthquake probabilities in urbanized areas such as Los Angeles and San Francisco Bay Area, as well as comparisons among the large faults in different parts of the State. The study was organized by the Southern California Earthquake Center, the U.S. Geological Survey, and the California Geological Survey, and it received major support from the California Earthquake Authority, which is responsible for setting earthquake insurance rates statewide. According to the new forecast, California has a 99.7% chance of having a magnitude 6.7 or larger earthquake during the next 30 years. The likelihood of an even more powerful quake of magnitude 7.5 or greater in the next 30 years is 46%. **Map 5-1: Earthquake Probabilities for California** illustrates the probability that an earthquake of various magnitudes will occur in California within 30 years. Such a quake is more likely to occur in the southern half of the State, 37% chance in 30 years, than in the northern half, 15% chance in 30 years. The probability of a magnitude 6.7 or larger earthquake over the next 30 years striking the greater Los Angeles area is 67%. For the entire California region, the fault with the highest probability of generating at least one magnitude 6.7 quake or larger is the southern San Andreas, 59% in the next 30 years. **Map 5-2: Earthquake Probabilities of Major California Faults** illustrates the probability that a rupture of a major fault will occur within California that will result in an earthquake of a magnitude 6.7 or greater within 30 years (Source: Southern California Earthquake Data Center).

Map 5-3: Southern California Earthquake Faults plots the various major faults in Southern California.

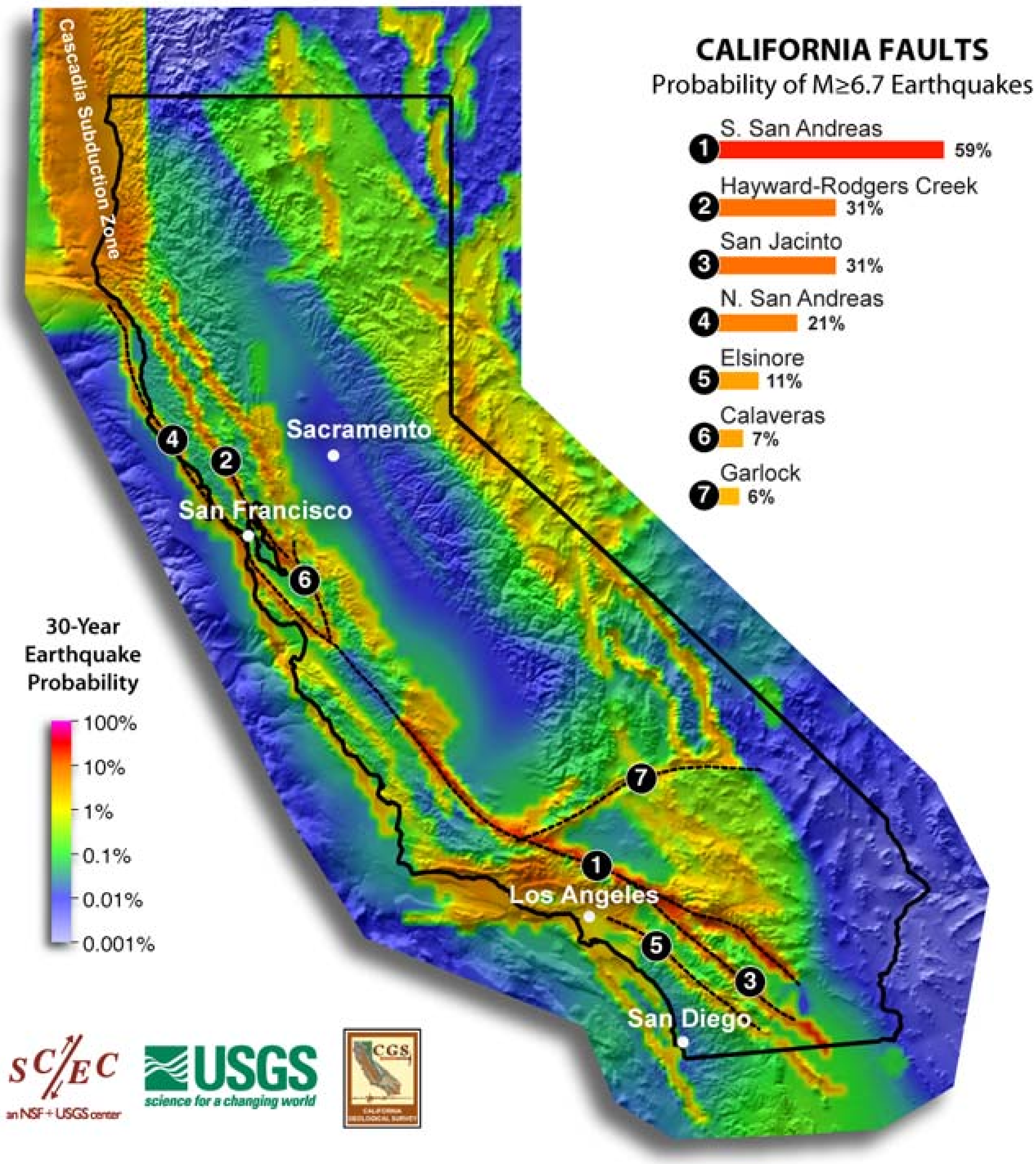
In California, many agencies are focused on seismic safety issues: the State's Seismic Safety Commission, the Applied Technology Council, California Emergency Management Agency, United States Geological Survey, Cal Tech, the California Geological Survey as well as a number of universities and private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

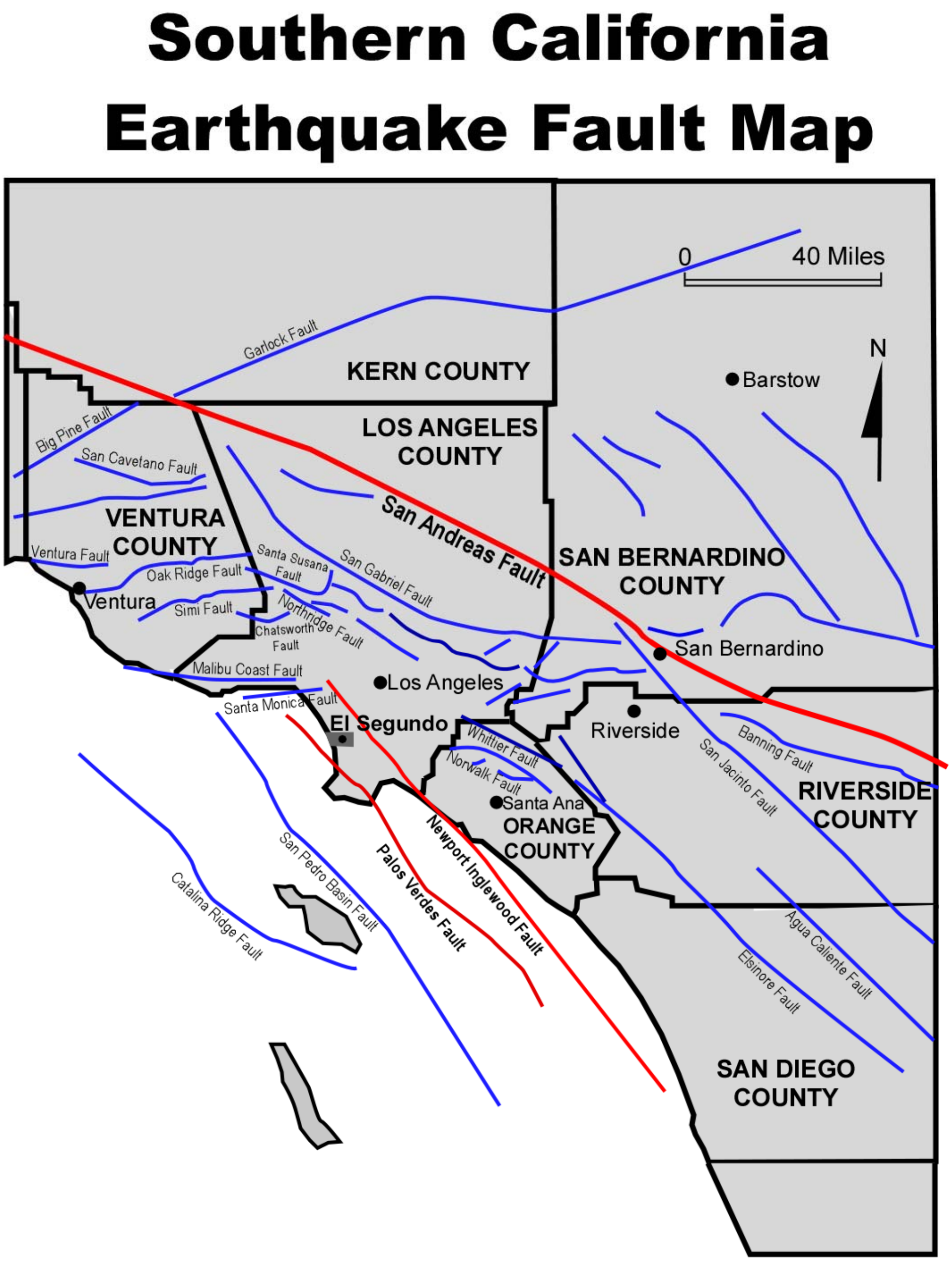
Map 5-1: Earthquake Probabilities for California
(Source: www.scec.org/ucerf)



Map 5-2: Earthquake Probabilities of Major California Faults
(Source: www.scec.org/ucerf)



Map 5-3: Southern California Earthquake Fault Map



Attachment 5-1

Earthquake Probable Events

(Source: Southern California Earthquake Data Center)

Elsinore Fault Zone
TYPE OF FAULTING: right-lateral strike-slip
LENGTH: about 180 km (not including the Whittier, Chino, and Laguna Salada Faults)
NEARBY COMMUNITIES: Temecula, Lake Elsinore, Julian
LAST MAJOR RUPTURE: May 15, 1910; Magnitude 6 -- no surface rupture found
SLIP RATE: roughly 4.0 mm/yr
INTERVAL BETWEEN MAJOR RUPTURES: roughly 250 years
PROBABLE MAGNITUDES: M6.5 - 7.5
MOST RECENT SURFACE RUPTURE: 18th century A.D.(?)

Newport-Inglewood Fault Zone
TYPE OF FAULTING: right-lateral; local reverse slip associated with fault steps
LENGTH: 75 km
NEAREST COMMUNITIES: Culver City, Inglewood, Gardena, Compton, Signal Hill, Long Beach, Seal Beach, Huntington Beach, Newport Beach, Costa Mesa
MOST RECENT MAJOR RUPTURE: March 10, 1933, M_W6.4 (but no surface rupture)
SLIP RATE: 0.6 mm/yr
INTERVAL BETWEEN MAJOR RUPTURES: unknown
PROBABLE MAGNITUDES: M6.0 - 7.4
OTHER NOTES: Surface trace is discontinuous in the Los Angeles Basin, but the fault zone can easily be noted there by the existence of a chain of low hills extending from Culver City to Signal Hill. South of Signal Hill, it roughly parallels the coastline until just south of Newport Bay, where it heads offshore, and becomes the Newport-Inglewood - Rose Canyon Fault Zone.

Palos Verdes Fault Zone
TYPE OF FAULT: right-reverse (?)
LENGTH: roughly 80 km
NEARBY COMMUNITIES: San Pedro, Palos Verdes Estates, Torrance, Redondo Beach
MOST RECENT SURFACE RUPTURE: Holocene, offshore; Late Quaternary, onshore
SLIP RATE: between 0.1 and 3.0 mm/yr
INTERVAL BETWEEN MAJOR RUPTURES: unknown
PROBABLE MAGNITUDES: M6.0 - 7.0 (or greater?); fault geometries may allow only partial rupture at any one time
OTHER NOTES: Has two main branches (see below). Continues southward as the Palos Verdes - Coronado Bank Fault Zone.

San Andreas Fault Zone
TYPE OF FAULT: right-lateral strike-slip
LENGTH: 1200 km 550 km south from Parkfield; 650km northward
NEARBY COMMUNITY: Parkfield, Frazier Park, Palmdale, Wrightwood, San Bernardino, Banning, Indio
LAST MAJOR RUPTURE: January 9, 1857 (Mojave segment); April 18, 1906 (Northern segment)

SLIP RATE: about 20 to 35 mm per year
INTERVAL BETWEEN MAJOR RUPTURES: average of about 140 years on the Mojave segment; recurrence interval varies greatly -- from under 20 years (at Parkfield only) to over 300 years
PROBABLE MAGNITUDES: M6.8 - 8.0

San Fernando Fault Zone
TYPE OF FAULTING: thrust
LENGTH: 17 km
NEAREST COMMUNITIES: San Fernando, Sunland
LAST MAJOR RUPTURE: February 9, 1971, M6.6
SLIP RATE: 5 mm/yr (?)
INTERVAL BETWEEN MAJOR RUPTURES: roughly 200 years
PROBABLE MAGNITUDES: M6.0 - 6.8
OTHER NOTES: Dip is to the north. The slip rate is not well known, but trenching studies indicate recurrence interval as between 100 and 300 years.

San Jacinto Fault Zone
TYPE OF FAULTING : right-lateral strike-slip; minor right-reverse
LENGTH: 210 km, including Coyote Creek Fault
NEARBY COMMUNITIES: Lytle Creek, San Bernardino, Loma Linda, San Jacinto, Hemet, Anza, Borrego Springs, Ocotillo Wells
MOST RECENT SURFACE RUPTURE: within the last few centuries; April 9, 1968, M6.5 on Coyote Creek segment
SLIP RATE: typically between 7 and 17 mm/yr
INTERVAL BETWEEN SURFACE RUPTURES: between 100 and 300 years, per segment
PROBABLE MAGNITUDES: M6.5 - 7.5

Sierra Madre Fault System
TYPE OF FAULTING: reverse
LENGTH: the zone is about 55 km long;
total length of main fault segments is about 75 km, with each segment measuring roughly 15 km long
NEARBY COMMUNITIES: Sunland, Altadena, Sierra Madre, Monrovia, Duarte, Glendora
MOST RECENT SURFACE RUPTURE: Holocene
SLIP RATE: between 0.36 and 4 mm/yr
INTERVAL BETWEEN SURFACE RUPTURES: several thousand years (?)
PROBABLE MAGNITUDES: M6.0 - 7.0 (?)
OTHER NOTES: This fault zone dips to the north. It was not the fault responsible for the 1991 Sierra Madre earthquake.

Whittier Fault
TYPE OF FAULTING: right-lateral strike-slip with some reverse slip
LENGTH: about 40 km
NEARBY COMMUNITIES: Yorba Linda, Hacienda Heights, Whittier
MOST RECENT SURFACE RUPTURE: Holocene
SLIP RATE: between 2.5 and 3.0 mm/yr
INTERVAL BETWEEN MAJOR RUPTURES: unknown
PROBABLE MAGNITUDES: M6.0 - 7.2
OTHER NOTES: The Whittier Fault dips toward the northeast.

In California, each earthquake is followed by revisions and improvements in the Building Codes. 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.

The Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides. 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

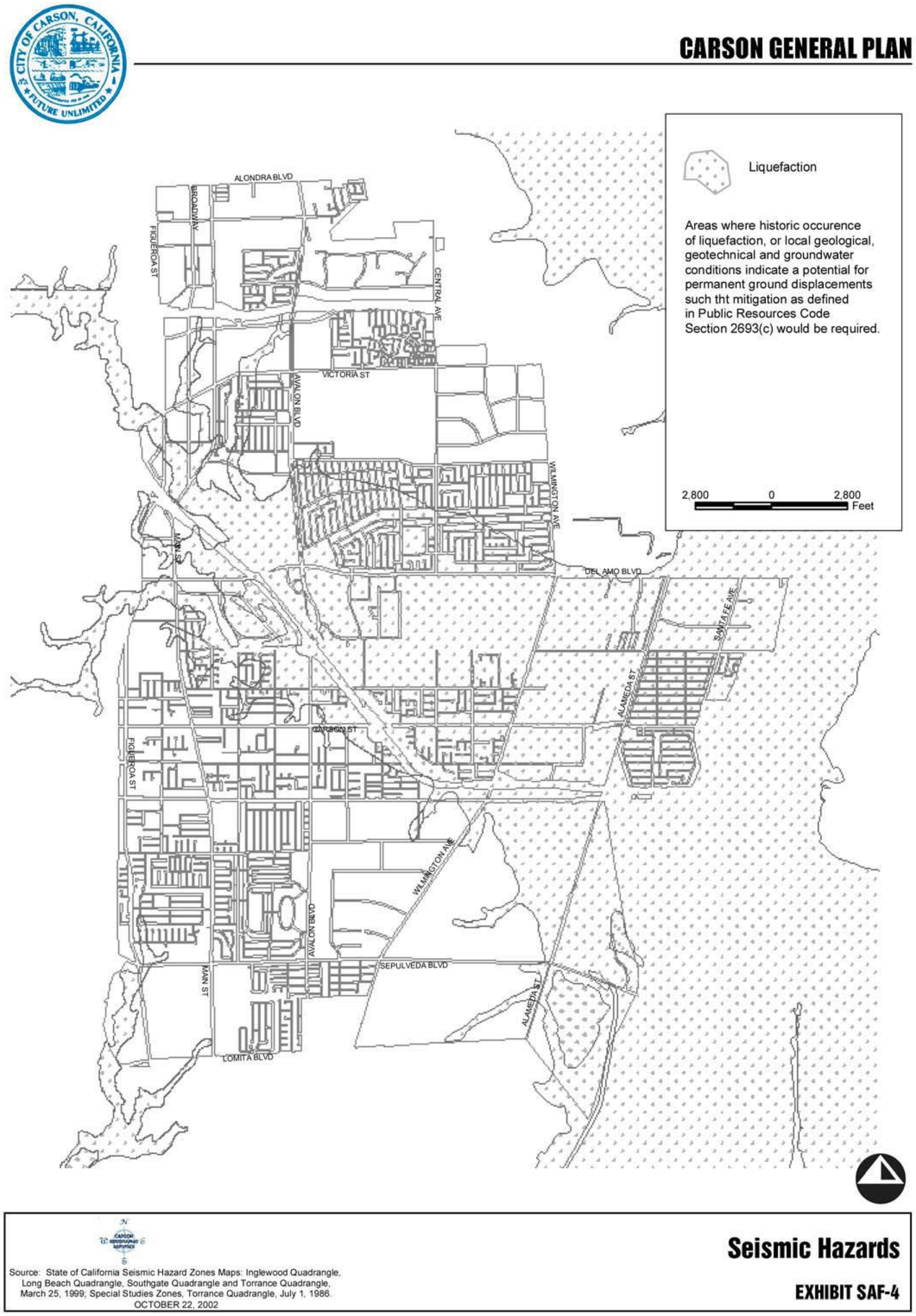
Vulnerability Assessment

The effects of earthquakes span a large area, and large earthquakes occurring in many parts of the Los Angeles 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 risk from earthquake damage are large stocks of old buildings and bridges: 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 county. The relative or secondary earthquake hazards, which are liquefaction, ground shaking, amplification, and earthquake-induced landslides, can be just as devastating as the earthquake.

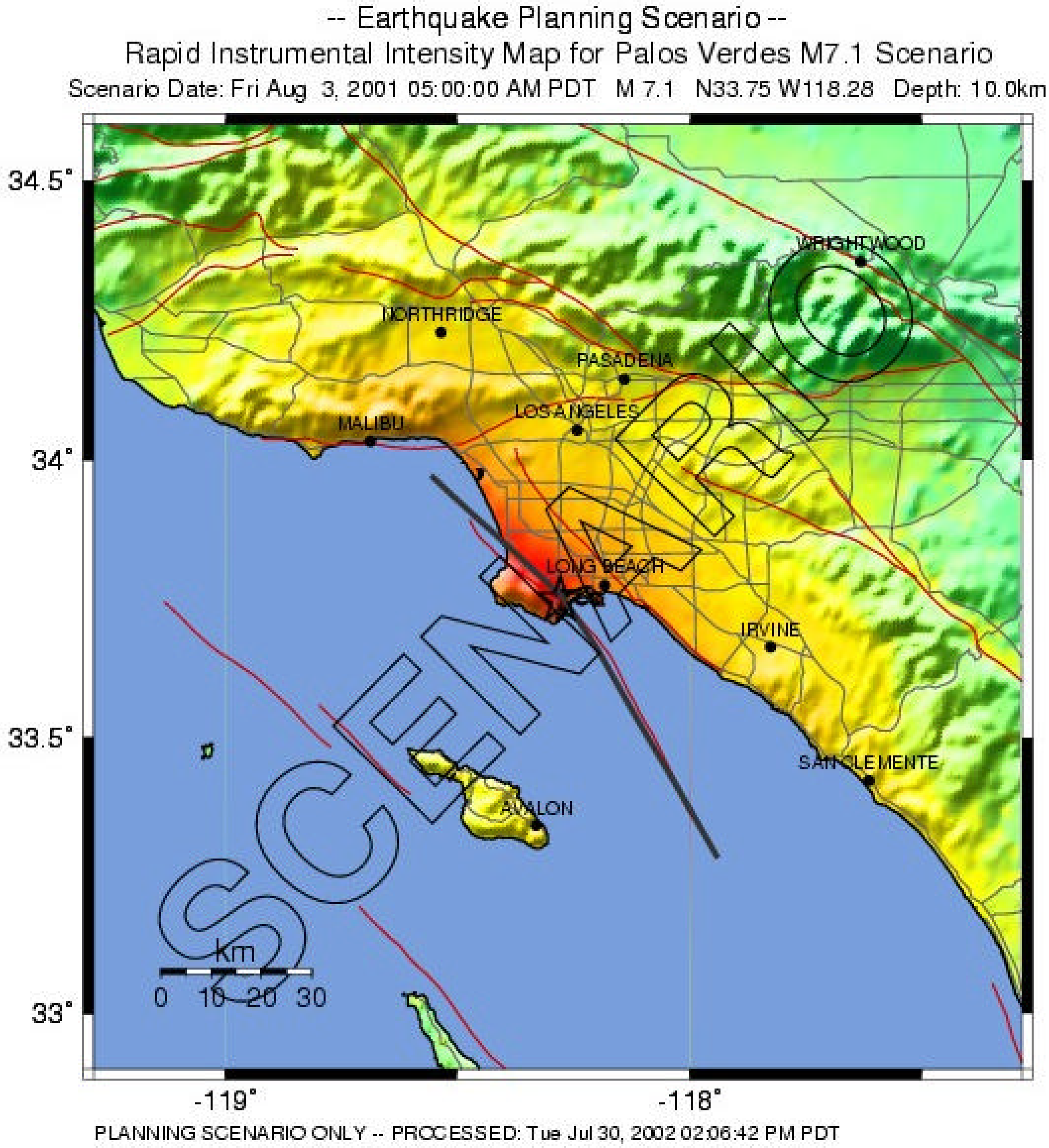
The California Geological Survey has identified areas most vulnerable to liquefaction. Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures. Map 5-4 identifies areas in the vicinity that are subject to liquefaction and landslides associated with earthquake activities.

The City of Carson has facilities near liquefaction zones as shown on **Map 5-4: Liquefaction Areas in the City of Carson**.

Map 5-4: Liquefaction Areas in the City of Carson
(Source: City of Carson General Plan)



Map 5-5: Seismic Shaking Intensities for the Palos Verdes Fault
(Source: http://www.consrv.ca.gov/cgs/rghm/loss/index.htm)



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

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. 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. 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 1994 Northridge 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 un-reinforced 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. The City of Carson does not have any un-reinforced masonry buildings.

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.

City Earthquake Issues

What is Susceptible to Earthquakes?
Earthquake damage occurs because humans have built structures that cannot withstand severe shaking. Buildings, airports, 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, 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 region.

Dams
There are a total of 103 dams in Los Angeles County, owned by various agencies. 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 signs of structural compromise, and tens of thousands of persons had to be evacuated until the dam could be drained. The dam has never been

refilled. The City's General Plan states that inundation due to dam failure is not a threat to the City of Carson.

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 Carson, many buildings were built before 1993 when building codes were not as strict. City structures are built in compliance with State of California building standards, not those controlled by the local jurisdictions.

Infrastructure and Communication

Residents in the City of Carson 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.

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 City. These facilities and their services need to be functional after an earthquake event. See Section 4: Risk Assessment for 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. These closures can also have a significant impact on local school districts.

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. These businesses could easily be providers of services to the City. These disruptions would also impact the City.

Individual Preparedness

Because the potential for earthquake occurrences and earthquake related property damage is relatively high in the City of Carson, 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 of Carson from compliance with AB 939 regulations.

SECTION 6: FLOOD HAZARDS

Why are Floods a Threat to the City of Carson?

The City of Carson was most recently affected by flooding in 1998 when localized flooding occurred in parts of the City. Although the National Flood Insurance Program ranks the majority of the City of Carson as a Zone "X", or area of minimal flood hazard outside the 0.2% annual chance floodplain, it is still susceptible to urban flooding. The main source of flooding for the City is from localized urban flooding caused by severe weather.

According to the City's General Plan, the Dominguez Channel runs northwest to southeast through the center of the City of Carson. The Dominguez Channel is part of the Los Angeles River Flood Control System which makes it vulnerable when the Los Angeles River Floods. The area surrounding the Dominguez Channel is designated as a 100-year flood zone. Flooding poses a threat to life and safety, and can cause severe damage to public and private property.

Impact of Flooding in the City of Carson

Floods and their impacts will vary by location and severity of any given flood event and will likely only affect certain areas of the county during specific times. Based on the risk assessment, it is evident that floods will continue to have potentially devastating economic impacts to certain areas of the city. Impacts that are not quantified, but can be anticipated in future events, include:

- ♦ Injury and loss of life;
- ♦ Commercial and residential structural damage;
- ♦ Disruption of and damage to public infrastructure;
- ♦ Secondary health hazards e.g. mold and mildew;
- ♦ Damage to roads/bridges resulting in loss of mobility;
- ♦ Significant economic impact (jobs, sales, tax revenue) upon the community;
- ♦ Negative impact on commercial and residential property values; and
- ♦ Significant disruption to students and teachers as temporary facilities will be needed.

Historic Flooding in Los Angeles County

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, from 1941 to 1945, the river flooded 5 times. Conversely, from 1896 to 1914, and again from 1944 to 1969, a period of 25 years, the river did not have serious floods.

Average annual precipitation in Los Angeles County ranges from 13 inches on the coast to approximately 40 inches on the highest point of the Peninsular Mountain Range that transects the county. Several factors determine the severity of floods, including rainfall intensity and duration. A large amount of rainfall over a short time span can result in flash flood conditions. A sudden thunderstorm or heavy rain, dam failure, or sudden spills can cause flash flooding. The National Weather Service's definition of a flash flood is a flood occurring in a watershed where the time of travel of the peak of flow from one end of the watershed to the other is less than six hours.

Table 6-1: Historical Records of Large Floods in Los Angeles County
(Source: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~192429)

Date	Loss Estimation	Source of Estimate	Comments
1995	$50 million	National Oceanic and Atmospheric Association	Flash Flood
1995	$50 thousand	National Oceanic and Atmospheric Association	Flood/Flash Flood
2005	$1 million	National Oceanic and Atmospheric Association	Flash Flood

Naturally, this rainfall moves rapidly downstream, 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 many 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.

Winter Rainfall
Over the last 125 years, the average annual rainfall in the region is 15 inches. But the term “average” means very little because there is a fluctuation rate in the coastal rains as high as thirty percent in forty-five out of every one hundred years, which is coupled with a highly seasonal rainfall pattern with only fifteen percent falling during the hottest six months of the year.

Monsoons
Another relatively regular source for heavy rainfall, particularly in nearby mountains and foothills 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
(Source: http://www.fema.gov/nwz97/eln_scal.shtm)

Month-Year	Date(s)	Area(s) Affected	Rainfall
July 1902	20th and 21st	Deserts and Southern Mountains	up to 2”
August 1906	18th and 19th	Deserts and Southern Mountains	up to 5”
September 1910	15th	Mountains of Santa Barbara County	2”
August 1921	20th and 21st	Deserts and Southern Mountains	up to 2”
September 1921	30th	Deserts	up to 4”
September 1929	18th	Southern Mountains and Deserts	up to 4”
September 1932	28th - Oct 1st	Mountains and Deserts, 15 Fatalities	up to 7”
August 1935	25th	Southern Valleys, Mountains and Deserts	up to 2”
September 1939	4th - 7th	Southern Mountains, Southern and Eastern Deserts	up to 7”
	11th and 12th	Deserts, Central and Southern Mountains	up to 4”
	19th - 21st	Deserts, Central and Southern Mountains	up to 3”
	25th	Long Beach, w/ Sustained Winds of 50 mph	5”
		Surrounding Mountains	6 to 12”
September 1945	9th and 10th	Central and Southern Mountains	up to 2”
September 1946	30th - Oct 1st	Southern Mountains	up to 4”
August 1951	27th - 29th	Southern Mountains and Deserts	2 to 5”
September 1952	19th - 21st	Central and Southern Mountains	up to 2”
July 1954	17th - 19th	Deserts and Southern Mountains	up to 2”
July 1958	28th and 29th	Deserts and Southern Mountains	up to 2”
September 1960	9th and 10th	Julian	3.40”
September 1963	17th - 19th	Central and Southern Mountains	up to 7”
September 1967	1st - 3rd	Southern Mountains and Deserts	2”
October 1972	6th	Southeast Deserts	up to 2”
September 1976	10th and 11th	Central and Southern Mountains. Ocotillo, CA was Destroyed, 3 Fatalities	6 to 12”
August 1977	n/a	Los Angeles	2”

Month-Year	Date(s)	Area(s) Affected	Rainfall
		Mountains	up to 8”
October 1977	6th and 7th	Southern Mountains and Deserts	up to 2”
September 1978	5th and 6th	Mountains	3”
September 1982	24th - 26th	Mountains	up to 4”
September 1983	20th and 21st	Southern Mountains and Deserts	up to 3”

Geography and Geology

The greater Southern California region 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”.

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.

As a region, the majority of buildable portions of Los Angeles County are developed. This leaves very 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 flood control systems including concrete lined river and stream beds, flooding would be a much more common occurrence. 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

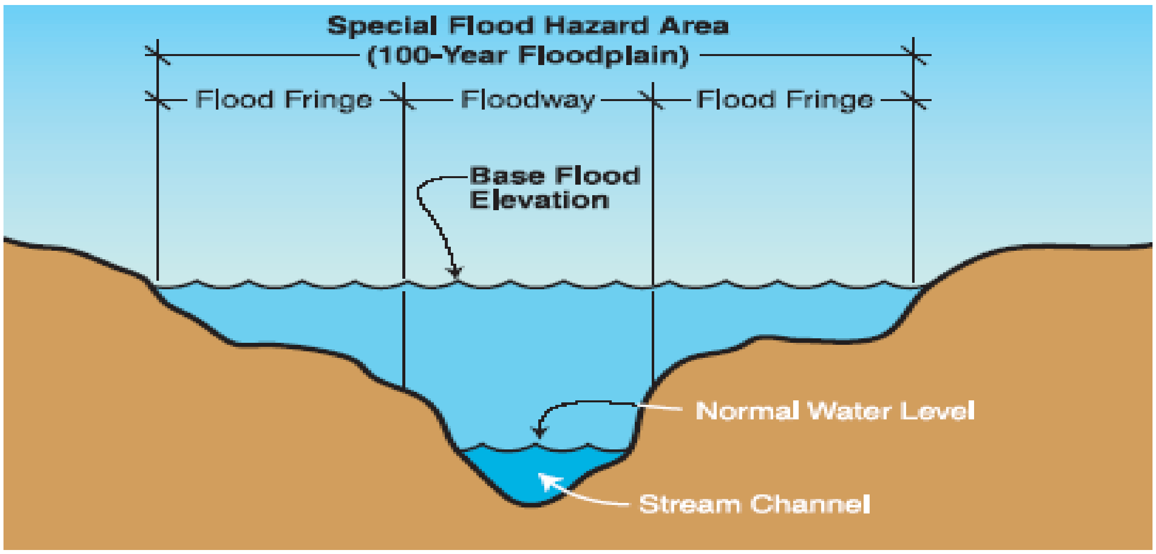
Floodplain

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.

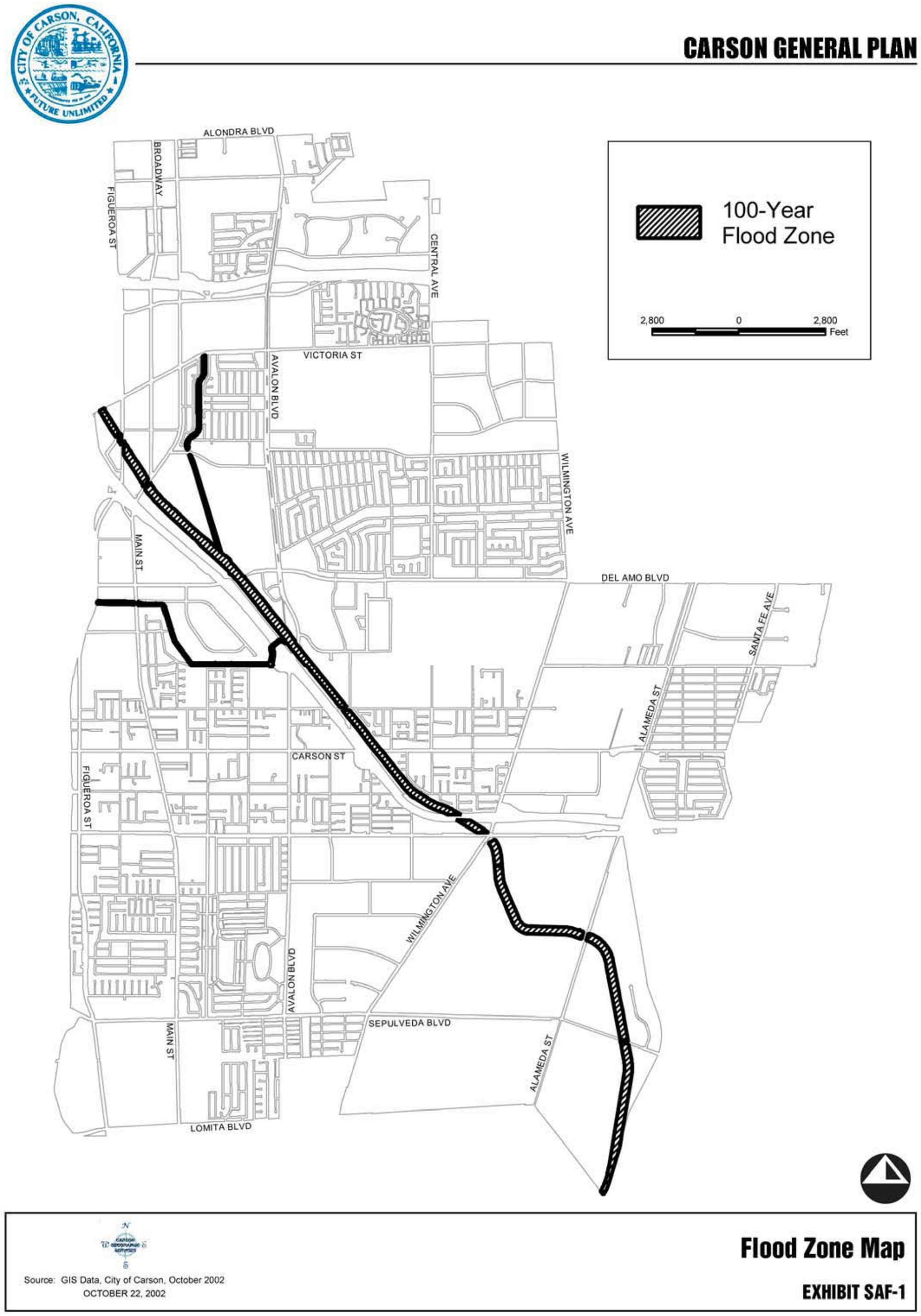
100-Year Flood

The 100-year flooding event is the flood having a 1% 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. Schematic 6-1 Floodplain and Floodway shows the relationship of the floodplain and the floodway.

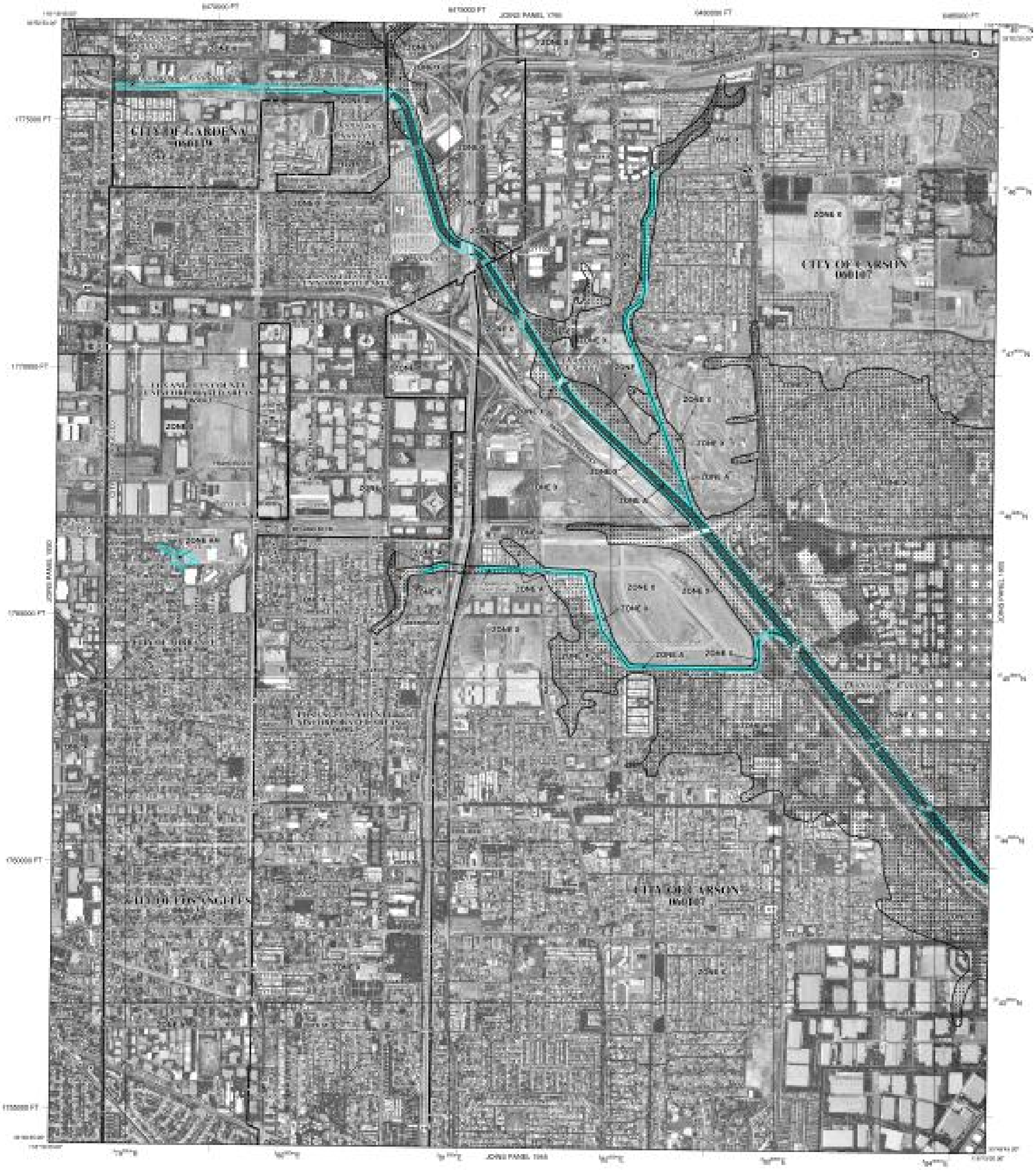
Schematic 6-1: Floodplain and Floodway
(Source: FEMA How-To-Guide Assessing Hazards)



Map 6-1: Floodplains in City of Carson
(Source: City of Carson General Plan)



Map 6-2: Flood Insurance Rate Map for City of Carson
(Source: Federal Emergency Management Agency, National Flood Insurance Program)



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 Carson regulations prohibit all development in the floodway. The NFIP floodway definition is "the channel of a river or other watercourse and adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. Floodways are not mapped for all rivers and streams but are generally mapped in developed areas.

Base Flood Elevation (BFE)
The term "Base Flood Elevation" refers to the elevation (normally measured in feet above sea level) that the base flood is expected to reach. Base flood elevations can be set at levels other than the 100-year flood. Some communities use higher frequency flood events as their base flood elevation for certain activities, while using lower frequency events for others. For example, for the purpose of storm water management, a 25-year flood event might serve as the base flood elevation; while the 500-year flood event may serve as base flood elevation for the tie down of mobile homes. The regulations of the NFIP focus on development in the 100-year floodplain.

Characteristics of Flooding
There is one type of flooding that could affect the City: urban flooding. In addition, any low-lying areas have a potential for ponding. The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system’s capability to remove it.

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.

The City’s General Plan states that 80% of the City is developed and the remaining open areas are dispersed throughout the city. Due to the high percentage of development, the City of Carson 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 vegetative debris causing additional, localized flooding.

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. 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. 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.

The City of Carson actively participates and supports the National Flood Insurance Program. This support is exemplified through review of all development projects presented to the Planning and Building and Inspection Departments. FEMA flood maps are not entirely accurate. These studies and maps represent flood risk at the point in time when FEMA completed 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 Carson was last updated on September 26, 2008. See **Map 6-2: Flood Insurance Rate Map for City of Carson** on the following page. Human-caused and natural changes to the environment have changed the dynamics of storm water run-off since then.

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.

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 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, and 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.

None of the City of Carson's facilities are located within a 100-year floodplain. There are no repetitive loss properties within the City of Carson.

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 Carson 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.

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.

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.

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 hazard events, or any type of emergency or disaster, dependable road connections are critical for providing emergency services. Roads systems in the City of Carson 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.

Storm Water Systems

Local drainage problems are common throughout the City of Carson. The City of Carson maintenance and operations staff is aware of local drainage threats. The problems are often present where storm water runoff enters culverts or goes underground into storm sewers. Inadequate maintenance can also contribute to the flood hazard in urban areas.

Water/Wastewater Treatment Facilities

As stated in the City's General Plan, there are two water companies that serve the City of Carson including the California Water Service Company and the Southern California Water Company. The Los Angeles County Department of Public Works maintains the local sewer lines. The Los Angeles County Sanitation District is responsible for the trunk sewer lines in the city. There are two small lift stations that are located in the City of Carson: the Scottsdale Pump station, and the Belshaw Pump station. The Joint Water Pollution Control Plant is located in the city providing wastewater treatment for seventeen sanitation districts in Los Angeles County. This plant is one of the largest wastewater treatment plants in the world serving approximately 3.5 million people.

Water Quality

Environmental quality problems include bacteria, toxins, and pollution.

SECTION 7: WINDSTORM HAZARDS

Why are Severe Windstorms a Threat to the City of Carson?

Although the City of Carson has not been victim to significant damage from severe windstorms, it was moderately impacted in the past by both El Nino events and Santa Ana winds.

Severe wind storms pose a significant risk to life and property in Carson 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 in and near Carson. High winds can have destructive impacts, especially to trees, power lines, and utility services.

The County of Los Angeles All-Hazard Mitigation Plan classifies "severe weather" as a moderate risk hazard and "tornadoes" as a low risk hazard. The following is an excerpt from the All-Hazards Mitigation Plan concerning the existence and impacts of Santa Ana winds:

> "The *Santana Winds* or *Santa Ana Winds*, most common in the late summer and early fall, begin with dry air moving in from the interior of the U.S. towards Southern California. As this air flows down into the Los Angeles Basin through the low gaps in the mountains (notably Cajon Pass on the east end of the San Gabriel Mountains and Soledad Pass south of Palmdale), it compresses and warms about five degrees Fahrenheit for every 1,000 feet that it descends. Though these winds are much cooler high in the mountains, they can become hot and dry and assume gale force when descending into the Los Angeles Basin. They are often the source of air turbulence for aircraft approaching Los Angeles International Airport (Note: City of Carson is located 14 miles from Los Angeles Airport)."

The National Weather Service in 2008 published Los Angeles Climate. The publication was prepared by the Weather Service Forecast Office in Oxnard, California which serves the Los Angeles metropolitan area. The goal of the document was to assemble the latest available climatological data from as many reliable sources as possible for the City of Los Angeles and surrounding communities (including Carson). Following is an excerpt concerning the National Weather Service's findings pertaining to frequency and severity of wind:

> "Winds are generally light, with frequent afternoon sea breezes of 10 to 15 miles per hour. While severe weather is uncommon, strong offshore winds, known as *Santa Anas*, can reach hurricane strength below passes and canyons. Also, passing winter storms can bring southeast winds to gale force. However, for the most part, damaging winds tend to be rare, or highly localized."

Los Angeles Climate provided the following insights concerning the frequency and severity of "tropical storms" in the region:

> "The average number of tropical storms in the eastern Pacific Ocean is 16.7 per year, of which about seven develop into hurricanes. Only once in the twentieth century did an eastern Pacific tropical storm directly impact the Los Angeles area with gale force winds and heavy rain. About once every two years, however, eastern Pacific tropical storms or hurricanes indirectly impact southern California with residual rains and/or heavy surf. A tropical storm crossed the Los Angeles County coastline in 1939. In the event, a tropical depression had developed off the coast of Panama on September 15th. The storm quickly grew into a hurricane. The lowest pressure (28.67") occurred on September 22nd, when the storm was centered approximately 300 miles southwest of Cabo San Lucas. On Sunday, September 24th the dying storm crossed Catalina Island, where southeast winds gusted to 50 miles per hour. The storm came ashore near San

> Pedro. Torrential rains fell Monday morning and again Monday night across the Los Angeles coastal plain. The Civic Center (City of Los Angeles) received 5.62 inches of rain and Mount Wilson reported 11.60 inches. Forty-five lives were lost at sea, and property losses were placed at $2 million. The 1939 tropical storm had other repercussions for Los Angeles. The Weather Bureau Forecast Office in San Francisco had been completely surprised by the storm. Largely in response to this tragedy, the Weather Bureau decided to establish a new forecast office for southern California. In February 1940, the first forecast office in southern California was opened in the Lockheed Terminal at Burbank Airport. The heaviest property damage caused by the remains of a tropical storm occurred in September 1976, when heavy rains from the remains of Tropical Storm Kathleen caused $160 million in agricultural and urban flooding damages."

Los Angeles Climate went on to point out the frequency and severity of tornadoes:

> "The south coastal region of California, including the Los Angeles Basin, has the greatest incidence of tornadoes in the state. In the period from 1950 to 1992, the basin had 99 confirmed tornadoes. According to Blier and Battan (1994), this area has a tornadic incidence similar to that of the State of Oklahoma. However, these researchers go on to point out that the size, severity and duration of California tornadoes is less than those common to the plains states, and the tornado count in the Golden State (California) may be inflated due to inaccuracies within the database. Nevertheless, the fact that tornadoes occur with great frequency in a very densely populated urban area makes the occurrence of tornadoes in the Los Angeles Basin particularly relevant. Severe storms researcher John E. Hales, Jr. (1983) stated that a tornado can hardly find a place to touch down around Los Angeles that won't hit something! That assertion notwithstanding, there is
> no record of a Los Angeles tornado ever causing a fatality. Unlike their plains counterparts, Southern California tornadoes occur mainly in the winter. Of the 99 tornadoes that were reported in the Los Angeles Basin between 1950 and 1992, the vast
> majority occurred in the months November through March. March had the highest number of incidents, with 22. The fact that few tornadoes occur in the Los Angeles Basin during the warm season is primarily due to the stabilizing effect of the marine layer, and the lack of dynamic forcing during the warmer months. Roughly a quarter of the tornadoes listed by Blier and Battan originated as waterspouts over either Santa Monica Bay or San Pedro Channel. There were many more waterspouts that never made landfall; these were not included in the tornado count. The cause of many, if not most, Los Angeles Basin tornadoes seems to be linked to the terrain layout of the basin. Hales specifically mentioned the natural curvature of the shoreline and the location of the coastal mountains. Due to frictional and barrier flow effects, a convergent cyclonic wind pattern is established in the vicinity where most Los Angeles tornadoes occur. Blier and Battan discussed several features that require further investigation, including convergence to the lee of the Palos Verdes Peninsula and Santa Catalina Island. In conjunction with topographic features which set up favorable cyclonic, low-level wind patterns, Hales further identified a number of synoptic weather features more common to the cool season that are associated with the strongest of the tornadoes that he studied. These include:
> • • Closed cyclonic circulations from the surface to 500 millibars (mb)
> • • A west-southwest oriented, 120 knot or stronger, 300 mb jet that crosses the coast near San Diego. The tornadoes always form on the cyclonic side of the jet
> • • A dewpoint at San Diego of 51or greater
> • • The 500 mb temperature on the Vandenberg sounding -5 • • (-20• •C) or
> colder
> • • A mean cold front position on the California/Arizona border. Usually, tornadoes occur well behind the surface cold front
> • • A time of occurrence between 1200 and 1500 PST, coincident with maximum solar

heating
• • A strong increase in wind speed with height similar to wind profiles in the central United States

In the 1997-98 *El Niño* episode, the Pacific storm track was located over Southern California for much of the winter season. This produced a number of days in which Hales' criteria were approximated over the Los Angeles Basin and adjacent waters. In that season, there were over twenty days in which either waterspouts, funnel clouds or tornadoes were reported including 30 separate sightings. Two tornadoes touched down within the City of Long Beach.

Following is a listing of the various tornado events in Los Angeles County from 1918-2000 (Source: www.tornadoproject.com/alltorns/catorn.htm)

Los Angeles County Tornadoes

JAN 26, 1918	001	1330	0	0	F2	037
APR 05, 1926	002		0	0	F2	037
MAR 15, 1930	001	1140	0	4	F2	037
MAR 02, 1934	001	1340	0	0	F0	037
FEB 12, 1936	001	1530	0	0	F0	037
NOV 11, 1944	001	2100	0	0	F2	037
DEC 20, 1952	001	1200	0	0	F1	037
JAN 18, 1955	001	1101	0	0	F1	037
MAY 09, 1956	002	0830	0	1	F0	037
FEB 19, 1962	002	1600	0	0	F1	037
MAY 14, 1962	004	1200	0	0	F1	037
NOV 09, 1964	003	0700	0	0	F1	037
NOV 07, 1966	003	1300	0	0	F2	037
NOV 07, 1966	004	1300	0	10	F2	037
APR 18, 1967	001	1800	0	0	F0	037
MAY 08, 1977	003	1000	0	0	F1	037
JAN 04, 1978	001	1515	0	0	F1	037
FEB 09, 1978	003	2230	0	0	F1	037
JAN 31, 1979	002	1045	0	0	F1	037
JAN 28, 1980	002	1315	0	0	F0	037
MAR 29, 1982	005	2130	0	0	F1	037
NOV 09, 1982	008	0930	0	0	F1	037
NOV 09, 1982	009	1130	0	0	F2	037
NOV 09, 1982	010	1200	0	0	F2	037
NOV 09, 1982	011	1200	0	0	F0	037
MAR 01, 1983	002	0740	0	30	F2	037
MAR 01, 1983	003	0815	0	0	F0	037
SEP 30, 1983	007	0700	0	0	F0	037
SEP 30, 1983	008	2235	0	3	F1	037
MAY 30, 1984	002	0915	0	0	F0	037
JUN 05, 1987	003	1315	0	0	F0	037
JAN 16, 1990	002	2120	0	0	F0	037
MAR 19, 1991	004	0200	0	0	F0	037
MAR 20, 1992	002	1900	0	0	F1	037
JAN 17, 1993	004	2345	0	0	F0	037
FEB 07, 1994	001	1545	0	0	F0	037
JUN 16, 1995	006	1155	0	0	F0	037
JLY 21, 1997	009	1555	0	0	F0	037
JAN 09, 1998	001	1400	0	0	F1	037
APR 01, 1999	001	1400	0	0	F0	037
AUG 28, 2000	006	1345	0	0	F0	037

The following query results were drawn from the NOAA website containing historical information on water spouts and funnel clouds in the vicinity of City of Carson:

Article I. Query Results

5 WATERSPOUT event(s) were reported in **Los Angeles County, California** between **01/01/1950** and **11/30/2008.**
Click on Location or County to display Details.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

California

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Santa Monica Bay	03/14/1996	04:45 PM	Waterspout	N/A	0	0	0	0
2 Point Fermin	01/20/1997	08:50 AM	Waterspout	N/A	0	0	0	0
3 (lax)los Angeles Int	01/12/2001	08:49 AM	Waterspout	N/A	0	0	0	0
4 (lgb)long Beach Arpt	01/12/2001	11:57 AM	Waterspout	N/A	0	0	0	0
5 Long Beach Arpt	02/11/2001	12:10 PM	Waterspout	N/A	0	0	0	0
TOTALS:					0	0	0	0

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)
National Climatic Data Center
U.S. Department of Commerce

DOC >NOAA >NESDIS >NCDC

Search Field: Search NCDC

Article II. Query Results

10 FUNNEL CLOUD event(s) were reported in **Los Angeles County, California** between **01/01/1950** and **11/30/2008.**
Click on Location or County to display Details.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

California

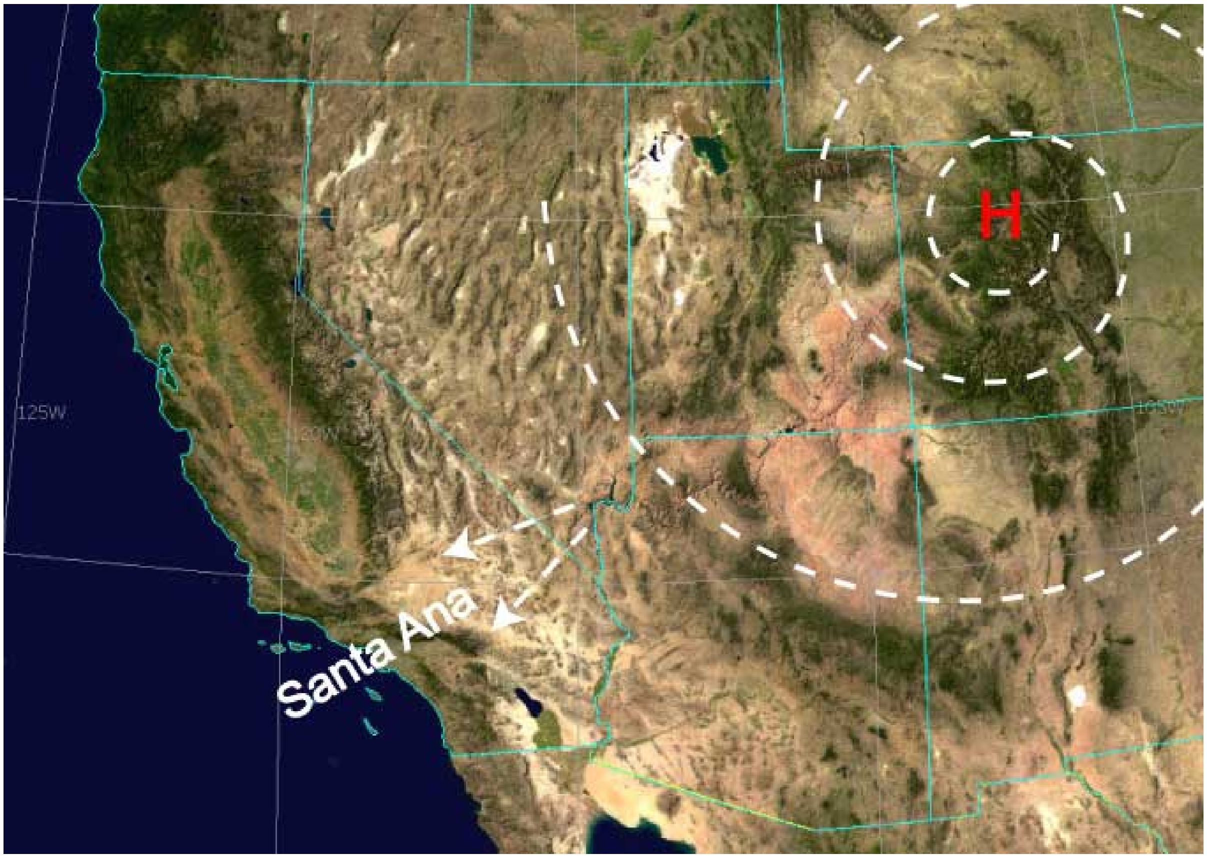
Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Los Angeles	04/27/1994	1600	Funnel Cloud	N/A	0	0	0	0
2 Century City	03/14/1996	03:10 PM	Funnel Cloud	N/A	0	0	0	0
3 Long Beach	02/24/1998	01:10 AM	Funnel Cloud	N/A	0	0	0	0
4 Long Beach	03/13/1998	07:25 PM	Funnel Cloud	N/A	0	0	0	0
5 Santa Monica	03/31/1998	01:30 PM	Funnel Cloud	N/A	0	0	0	0

6 Manhattan Beach	**05/05/1998**	**09:27 AM**	**Funnel Cloud**	**N/A**	**0**	**0**	**0**	**0**
7 Pomona	**09/02/1998**	**02:55 PM**	**Funnel Cloud**	**N/A**	**0**	**0**	**0**	**0**
8 Palos Verdes Estates	**06/03/1999**	**05:15 PM**	**Funnel Cloud**	**N/A**	**0**	**0**	**0**	**0**
9 San Pedro	**06/03/1999**	**05:30 PM**	**Funnel Cloud**	**N/A**	**0**	**0**	**0**	**0**
10 Rancho Palos Verdes	**03/04/2000**	**11:45 AM**	**Funnel Cloud**	**N/A**	**0**	**0**	**0**	**0**
TOTALS:					**0**	**0**	**0**	**0**

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Please see Section 7: Windstorm-Attachment 1 for an article entitles "The Greatest Catastrophe That Never Happened" from PBS Nova dated February 11, 1998.

Figure 7-1: Santa Ana Winds
(Source: http://upload.wikimedia.org/wikipedia/commons/f/fa/Santa_ana_wind1.jpg)



Santa Ana Winds and Tornado-Like Wind Activity
Based on local history, most incidents of high wind in the City of Carson are the result of the Santa Ana and El Nino related wind conditions. While high impact wind incidents are not frequent in the area, significant wind events and sporadic tornado activity have been known to negatively impact the city. In addition, the city is increasingly concerned with "global warming" ramifications and potential increases in wind related events.

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." 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."

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 7-1: Fujita Tornado Damage Scale
(Source: http://weather.latimes.com/tornadoFAQ.asp)

Scale	Wind Estimated (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.

Microbursts
Unlike 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.

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.

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.

“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.”

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. The second death occurred when a passenger in a vehicle was hit by a flying pickup truck cover launched by the Santa Ana Winds.

Impact of Windstorm in the City of Carson

Based on the risk assessment, it is evident that Windstorms will continue to have potentially devastating economic impacts to certain areas of the city. Impacts that are not quantified, but can be anticipated in future events, include:
- ♦ Injury and loss of life;
- ♦ Commercial and residential structural damage;
- ♦ Disruption of and damage to public infrastructure;
- ♦ Secondary Health hazards e.g. mold and mildew;

- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) upon the community;
- Negative impact on commercial and residential property values; and
- Significant disruption to students and teachers as temporary facilities will be needed.

Table 7-2: Santa Ana Wind Events during 2003 in the Vicinity

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 7-3: Major Windstorms in the Vicinity of City of Carson
(Source: http://www.wrh.noaa.gov/sandiego/research/Guide/weatherhistory.pdf)

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

Following is a glimpse of major tornado-like events to hit the City of Carson, and surrounding areas:

Table 7-4: Major Tornado-like Events in the Vicinity of City of Carson 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

Table 7-4: Major Tornado-like Events in the Vicinity of City of Carson 1958-2001	
February 24, 2001	Tornado in Orange. Damage to warehouse, 6 structures, fences, and telephone wires.

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 in the region can cause extensive damage including heavy tree stands, exposed coastal properties, road and highway infrastructure, and critical utility facilities.

Figure 7-1 shows the direction of the Santa Ana winds as they travel from the stable, high-pressure weather system called the Great Basin through the canyons and towards the low-pressure system off the Pacific. Clearly the area of the City of Carson 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 City.

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 Carson 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 city, 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 7-5: Beaufort Scale
(Source: http://www.compuweather.com/decoder-charts.html)

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.

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.

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.

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.

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.

The Greatest Catastrophe
That Never Happened
A Guest Dispatch: February 11, 1998
By meteorologist Peter R. Chaston

With all of the recent focus on storms lashing California and Peru, it's amazing to me that most people don't realize that in September, only by some last minute luck, Los Angeles avoided what would have been the costliest and most destructive weather catastrophe of all time. The bullet was in the chamber, and the gun was pointed at Los Angeles.

In the winter of 1982-83, El Niño pummeled California and the West Coast with a series of powerful storms. South of the equator, its rains transformed the coastal deserts of Peru and Ecuador into grasslands dotted with lakes and ponds; other effects led to massive bird and fish migrations away from the South American coast. So, when surface water temperatures jumped almost 10 degrees Fahrenheit above normal off Peru and Ecuador last summer, meteorologists concluded that a major El Niño was underway, and knew what to expect. Armed with new models, and given an earlier warning than ever before, meteorologists issued advisories, detailing the possible serious weather that might again plague the west coasts of both of the American continents.

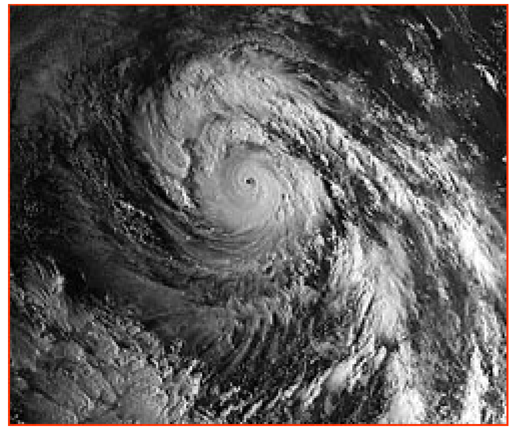
In particular, residents of southern California took the warnings to heart. Scientists feared that an eastern pacific hurricane could take a northward journey and decimate Southern California. Three key initial conditions caused by El Niño were coming together to create an ominous threat to the area from San Diego to Los Angeles:

1. The long stretch—over 1,500 miles—of heated ocean was warming the air above it, allowing the air to absorb more water vapor from the ocean. This set up a self-replenishing, long-distance source of warm, moist air to feed into any developing storms, giving a powerful kick to tropical cyclones and, in the coming winter and spring, non-tropical low pressure systems.
2. The southern branch of the jet stream was setting itself up to transport the moisture-laden air into the West Coast.
3. The normally cool waters off southern California were warming substantially, and would allow any hurricane that might approach that region to maintain much of its intensity. (In California, you only had to look at surfers to detect the warming of the sea; they stopped wearing wetsuits.)

Normally, hurricanes that form in the Pacific off Mexico strike the west coast of Mexico or, most often, move out to sea. They almost never reach the US because they must pass over cool water, which cuts off their energy source. Until this year, hurricanes had affected the American southwest only three times in the 20th century. In September of 1932 a hurricane moved up the Gulf of California, producing gusty winds and heavy rainfall in the Arizona desert. In September of 1939, a tropical storm slammed into San Diego with winds of 52 mph south of Los Angeles. And in September 1976, a hurricane gusted to 76 mph at Yuma, Arizona. Since accurate and widespread observations of sea surface temperatures were not or could not be taken until recently, we are not certain if these three years were strong El Niño periods, but collateral evidence suggests that they were.

On September 9th, 1997, Hurricane Linda formed about 700 miles south-southwest of the Baja peninsula. As the storm slowly moved north-northwestward, running along the Mexican coastline, El Niño's warm waters caused Linda to grow explosively into a large howling
hurricane, with

sustained winds on September 12th of 185 miles per hour, and gusts over 200 miles per hour! Linda had become the most powerful East Pacific hurricane in the history of weather records, big enough to cause many scientists to propose creating a new Category Six, for super hurricanes.



Hurricane Linda in the Pacific, 18N 110W, September 12, 1997. **Full-size version of the image (240k)**

As the clock ticked and the storm raged, terrifying forecasts spewed from computer models; the storm would most likely slam the coast somewhere between San Diego and Los Angeles, more probably at Los Angeles.

A hurricane requires surface water temperatures of at least 79 degrees Fahrenheit to keep growing. El Niño had made the water temperatures ideal all the way up to the California border, greasing the slide. Los Angeles' fate seemed sealed.

At almost the last moment, an upper-level trough (a fancy term for a sharp dip in higher-level winds) moved erratically, and Hurricane Linda was turned out to sea as it neared the California border.

The only time in history a hurricane with winds over 100 miles per hour has struck Los Angeles was on August 23rd, 1838, and that leveled the then-small city. In 1997, Los Angeles came incredibly close to experiencing a direct-hit assault by the most powerful Eastern Pacific hurricane in history!

I inspected the Homestead area of south Florida, along with National Hurricane Center specialists, after Hurricane Andrew smashed through in 1992, with winds of at least 140 mph, and gusts of 175 mph. Many homes there are similar in construction to southern California homes. Andrew destroyed or damaged virtually every building there, and his winds were weaker than those of Linda, his size was smaller, and his movement was faster. From my perspective, I can assure you Linda would have made the damage done by Andrew seem almost moderate. Most roofs cannot sustain continued winds in excess of 100 miles per hour. After the roof goes, the walls and rest of the house are blown apart like matchwood. I saw it in Andrew, a weaker storm than Linda; Linda would have steam-rollered Los Angeles. Clearly Linda would have the exceeded in Los Angeles the 25 billion dollars of damage that Andrew caused in Florida.

That should give you a little perspective when you watch news accounts of the rains and flooding this week. It could have been - should have been - far, far worse.

Peter Chaston is a professional meteorologist, weather consultant, and author of "Terror from the Skies" and "Hurricanes!" In 1995, Chaston predicted that the next El Niño would be abnormally strong.

APPENDIX A: RESOURCE DIRECTORY

The Resource Directory provides contact information for local, regional, state, and federal programs that are currently involved in hazard mitigation activities. The Public Safety Commission 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 Public Safety Commission will continue to add contact information for organizations currently engaged in hazard mitigation activities. This section may also be used by various city 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 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.			
CAL FIRE - California Department of Forestry and Fire Protection			
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 (CAL FIRE) protects over 31 million acres of California's privately-owned wildlands. CAL FIRE emphasizes the management and protection of California's natural resources.			

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 Department of Water Resources (DWR)			
Level: State	Hazard: Flood	http://www.dwr.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 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 Emergency Management Agency (Cal EMA)			
Level: State	Hazard: Multi	www.calema.ca.gov	
3650 Schriever Ave			
Mather, CA 95655		Ph: 916-845-8510	Fx: 916-845-8511
Notes: The California Emergency Management Agency 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.			
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 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.			
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.			
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.			
Environmental Protection Agency (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 (FEMA), 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 (FEMA), 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.			
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 I 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 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 of which provide citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.			
National Oceanic /Atmospheric Administration (NOAA)			
Level: Federal	Hazard: Multi	www.noaa.gov	
14th Street and 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 Resources Conservation Service (NRCS)			
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 Weather Service (NWS)			
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.			
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 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			
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.			

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 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.			
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.			

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 (CAL FIRE) 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.			

US Army Corps of Engineers (USACE)			
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.			
US Geological Survey (USGS)			
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.			

US Geological Survey (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-Ia.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. Public 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 City of Carson Natural Hazards Mitigation Plan integrates a cross-section of public input throughout the planning process. To accomplish this goal, the Multi-Jurisdictional Planning Team developed a public participation process through five components: (1) developing a Planning Team comprised of knowledgeable individuals representative of the City, City of Compton, and Compton Unified School District; (2) conducting a survey of "Levels of Concerns" 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 Public Safety Commission and 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 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.

Multi-Jurisdiction Planning Team

The preparation of the Mitigation Plan was the responsibility of the stakeholders gathered together to form the Multi-Jurisdiction Planning Team, which consisted of representatives from various departments from the City of Carson, City of Compton, and Compton Unified School District. The members had an understanding of how their jurisdiction's organizational structure and how the jurisdiction might be affected by hazard events. The Planning Team guided the development of the Plan, and assisted in developing plan goals and action items, identifying external stakeholders and plan reviewers, and sharing local expertise to create a more comprehensive plan.

Meetings

The following meetings were facilitated by City Consultant, Carolyn J. Harshman of Emergency Planning Consultants:

<u>Multi-Jurisdictional Planning Team Meetings</u>
Meeting #1:
Pre-Training May 3, 2004
The meeting was hosted by the City of Compton. Emergency Planning Consultants delivered pre-training to the Planning Team. 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 2 hours.

Meeting #2:
Kick-Off Meeting May 3, 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 Planning Team prepared a draft media release and discussed a public opinion survey provided by EPC. EPC committed to revising the media release and survey and distributing electronic copies to each of the Planning Team entities. The Kick-Off Meeting lasted approximately 7 hours.

Meeting #3:
Pre-Training: Mitigation July 19, 2004
The meeting was hosted by the City of Carson. EPC delivered pre-training to the Planning Team. 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 July 19, 2004
EPC delivered the Draft Hazard Analysis and the Planning Team 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 Carson, as well as identifying future mitigation actions.

A brainstorming process was then conducted to develop the goals for the Plan. The entire Multi-Jurisdictional Planning Team discussed sample goal language then broke into individual jurisdictions to finalize goal language. Following a discussion of alternative ranking techniques, the Team agreed to cluster the rankings of the Mitigation Actions by type of actions as follows: #1 Multi-Hazard, #2 Earthquakes, #3 Flooding, and #4 Windstorms.

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 Planning Team broke into individual jurisdictions to develop their own 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.

City of Carson Representatives from the Multi-Jurisdictional Planning Team

Meeting #1
Prioritizing Rankings
The Consultant presented different prioritization tools and the Planning Team selected a range of "low, medium, and high" as a way of identifying the value of each of the mitigation action items. The teleconference took place in May 2010.

Public Meetings

City of Carson conducted three public meetings where the Draft Natural Hazard Mitigation Plan was presented and discussed. Both the Public Safety Commission (September 16, 2004) and City Council (October 19, 2004) were 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 Multi-Jurisdictional Planning Team to become a Disaster Resistant Community. The results of the citizen survey were discussed and the Council commended the Planning Team for its expeditious efforts to satisfy the DMA 2000 requirements. Following initial review by FEMA, required amendments were made to the Plan and it was submitted again to City Council for re-adoption on July 6, 2010. The re-submission did not constitute an "update" to the Plan. **The Plan re-adopted on July 6, 2010 is the original (first) Hazard Mitigation Plan for the City of Carson**.

Planning Team Level of Participation

Name	Issue RFP and Process Contract (2004)	Research and Writing of 2004 Plan	Attend Both Multi-Jurisdictional Planning Team Meetings (May 2004)	Attend Both Multi-Jurisdictional Planning Team Meetings (July 2004)	Attend Meeting of City of Carson Representatives to Rank the Mitigation Action Items (May 2010)	Participate in Reviewing Draft Plan (2004)	Participate in City Council Public Meeting (2010)
City of Carson							
Rocio Lopez		X	X	X		X	
Eileen Edgerton	X	X	X	X	X	X	X
Ky H. Truong		X				X	
Alex Rocco		X		X		X	
Sean Scully		X				X	
Lance Burkholder		X		X		X	
Travis Hopkins		X				X	
George Rivera		X		X	X	X	
Virginia M. Aguada		X				X	
Compton Unified School District							
Ada McCalister			X			X	
Herman Stampley				X		X	
Jesse Reyes		X	X	X	X	X	X
Clarence L. Moore	X	X		X		X	
City of Compton							
Adrian Tatum	X	X	X	X	X	X	X
Joseph Lim		X		X		X	
Patrick Steward		X	X	X		X	
Gloria Falls		X		X		X	
Esmochi Enenwali		X		X		X	

Robert Burnett		X				X	
Arlene Williams		X				X	
Charles Evans		X				X	
Percy Perrodin		X				X	
Louis McKenzie		X				X	
Kambiz Shoghi		X				X	
Marilynn Horne		X				X	
Emergency Planning Consultants							
Carolyn Harshman		X	X	X	X	X	

Invitation Process

The Planning Team identified possible public notice sources. The City of Carson Natural Hazards Mitigation Plan was posted on the City website. The City Council Meeting Agenda was posted at Los Angeles County Regional Library at Carson, Dominguez Park, Los Angeles County Library/Dr. Martin Luther King, Jr. Library, City Offices (2), Los Angeles County Sheriff's Department – Carson Station, , and Congresswoman Juanita Millender-McDonald Community Center (2). The City Council Meeting agenda packet was posted on the City's website. The local community access cable television channels carried the meeting City Council meeting announcement.

Decision Maker Hearing

The Planning Team began the presentation to the City Council on October 19, 2004 by providing an overview of the project objectives. The Planning Team Chair, Eileen Edgerton, and Consultant presented the staff report on the Plan, including an overview of the Hazard Analysis, Mitigation Goals, and Mitigation Actions. The staff presentation concluded with a summary of the input received during the public review of the document. The meeting participants were encouraged to present their views and make suggestions on possible mitigation actions. The Chair then fielded questions from the City Council. The meeting lasted approximately thirty minutes and was aired on local community access cable television channels (Channel 35) for approximately one month. The City Council was unanimous in its adoption of the City of Carson Natural Hazards Mitigation Plan.

Due to several staffing changes and other delays, the City Council approved 2004 Hazard Mitigation Plan was not submitted for review by FEMA until February 2010. Based on input received during the FEMA review and the lapsed time since Council adoption, FEMA required the Plan be re-submitted to the City Council. The second presentation to City Council was on July 6, 2010. The City Council was unanimous in its re-adoption of the City of Carson Natural Hazards Mitigation Plan.

Approval Process

The adopted Plan was submitted to California Emergency Management Agency for an initial review. Next, the City requested the Plan be forwarded to FEMA for review and approval. Following submission of minor amendments, FEMA approved by Plan on September 10, 2013.

Appendix B-Attachment 1

Level of Concern Survey

Level of Concern for Natural Hazards

Natural Disaster	Extremely Concerned	Very Concerned	Concerned	Somewhat Concerned	Not Concerned
Earthquake	5	4	3	2	1
Flooding	5	4	3	2	1
Tsunami	5	4	3	2	1
Wildfire	5	4	3	2	1
Rain-Induced Landslide	5	4	3	2	1
Windstorm	5	4	3	2	1
Drought	5	4	3	2	1
Other ______	5	4	3	2	1
Other ______	5	4	3	2	1

(Circle the corresponding number for each hazard)

Appendix B-Attachment 2
Level of Concern Survey Results

The City of Carson distributed a survey at the Community Fair on April 24, 2004 and on the City's Website asking participants to rank their concerns about the following hazards: earthquakes, flooding, and windstorms. Approximately 60 survey responses were received and yielded the following results:

	Extremely Concerned	Very Concerned	Concerned	Somewhat Concerned	Not Concerned
Earthquake	27	13	10	5	1
Flooding	9	4	15	14	14
Windstorm	4	6	14	12	16

Appendix B – Attachment 3
List of Plan Reviewers

City of Carson - Planning Division Sean Scully, Senior Planner 701 E. Carson St. Carson, CA 90745	City of Carson - Planning Division Rocio Lopez, Associate Planner 701 E. Carson St. Carson, CA 90745
City of Carson - Information Services/GIS Alex Rocco, GIS Administrator 701 E. Carson St. Carson, CA 90745	City of Carson – Development Services Public Works Division Travis Hopkins, Associate Engineer 2390 E. Carson St. Long Beach, CA 90810
City of Carson – Economic Development Business Development Division Lance Burkeholder, Business Dev. Manager 3 Civic Plaza Drive Carson, CA 90745	City of Carson - Public Safety/Emergency Services Division Eileen Edgerton, PS & Community Services Manager 701 E. Carson St. Carson, CA 90745
City of Carson - Public Safety/Emergency Services Division George Rivera, Emergency Preparedness Analyst 701 E. Carson St. Carson, CA 90745	Area DMAC Coordinator Fan Abel - Area E Emergency Management Office 13700 La Mirada Avenue La Mirada, CA 90638
Compton Unified School District Police Department Jesse Reyes, Police Officer 501 S. Santa Fe Avenue Compton, CA 90221	Compton Unified School District Police Department Clarence L. Moore, Campus Security 501 S. Santa Fe Avenue Compton, CA 90221
City of Compton – Fire Department Adrian Tatum, Emergency Services Coordinator 205 S. Willowbrook Avenue Compton, CA 90220	City of Compton – Planning & Economic Development Department Joseph Lim, Director 205 S. Willowbrook Avenue Compton, CA 90220
City of Compton – Building & Safety Dept. Patrick Steward, Acting Chief Building Inspector 205 S. Willowbrook Avenue Compton, CA 90220	City of Compton – Community Redevelopment Agency Gloria Falls, Deputy Director 205 S. Willowbrook Avenue Compton, CA 90220
City of Compton – Public Works Dept. Esmochi Enenwali, Acting Engineer 205 S. Willowbrook Avenue Compton, CA 90220	City of Compton – General Services Dept. Robert Burnett, Director 205 S. Willowbrook Avenue Compton, CA 90220
City of Compton – General Services Dept. Robert Burnett, Director 205 S. Willowbrook Avenue Compton, CA 90220	City of Compton – General Services Dept. Robert Burnett, Director 205 S. Willowbrook Avenue Compton, CA 90220

City of Compton – City Manager's Office Arlene Williams, Assistant City Manager 205 S. Willowbrook Avenue Compton, CA 90220	City of Compton – Risk Management Charles Evans, Risk Manager 205 S. Willowbrook Avenue Compton, CA 90220
City of Compton – Municipal Law Enforcement Services Percy Perrodin, Director 205 S. Willowbrook Avenue Compton, CA 90220	City of Compton – ICMS Louis McKenzie, Street Superintendent 205 S. Willowbrook Avenue Compton, CA 90220
City of Compton – Water Department Kambiz Shoghi, General Manager 205 S. Willowbrook Avenue Compton, CA 90220	City of Compton – City Controller's Office Marilynn Horne, City Controller 205 S. Willowbrook Avenue Compton, CA 90220

Appendix B – Attachment 4
City Council Minutes
October 19, 2004

MINUTES
CARSON CITY COUNCIL
REGULAR MEETING
OCTOBER 19, 2004

ITEM NO. (8) ADOPTION OF THE CITY OF CARSON'S NATURAL HAZARD MITIGATION PLAN (PUBLIC SERVICES)

RECOMMENDATION for the City Council:

TAKE the following actions:

1. APPROVE and ADOPT the City of Carson's Natural Hazard Mitigation Plan.

2. DIRECT the Public Safety and Community Services Manager to submit the adopted plan to the State Office of Emergency Services and to the Federal Emergency Management Agency.

ACTION: This item was Approved on the New Business Consent Calendar on motion of Santarina, seconded by Ruiz-Raber and unanimously carried by the following vote:

Ayes:	Mayor Dear, Mayor Pro Tem Calas, Council Member Santarina, and Council Member Ruiz-Raber
Noes:	None
Abstain:	None
Absent:	None

Appendix B – Attachment 5
City Council Resolution
July 6, 2010

RESOLUTION NO. 10-063

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF CARSON ADOPTING THE CITY'S NATURAL HAZARDS MITIGATION PLAN

WHEREAS, every state, county, city and special district must submit to the Federal Emergency Management Agency (FEMA) a Natural Hazards Mitigation Plan designed to prevent or reduce the consequences of natural disasters, as mandated in the Disaster Mitigation Act of 2000; and

WHEREAS, any affected jurisdiction that fails to meet this deadline runs the risk of not being properly reimbursed for natural disasters by FEMA; and

WHEREAS, the required plan has been drafted, made available for public review, and a hearing has been held.

NOW, THEREFORE, the City Council of the city of Carson, California, does hereby resolve as follows:

Section 1. That the document entitled *City of Carson Natural Hazards Mitigation Plan,* attached hereto as Exhibit A, is herewith adopted in accordance with the Disaster Management Act of 2000.

Section 2. That the City Manager, or his designee, shall have the authority to make corrections and minor revisions to said document as appropriate.

Section 3. That staff shall submit said document to the Federal Emergency Management Agency and the California Emergency Management Agency.

Section 4. That the Mayor shall sign and the City Clerk shall attest to the adoption of this resolution.

PASSED, APPROVED and **ADOPTED** this 6th day of July, 2010.

Jim Dear

Mayor Jim Dear

ATTEST:

City Clerk Helen S. Kawagoe

APPROVED AS TO FORM:

City Attorney

STATE OF CALIFORNIA)
COUNTY OF LOS ANGELES) ss.
CITY OF CARSON)

I, Helen S. Kawagoe, City Clerk of the City of Carson, California, do hereby certify that the whole number of members of the City Council is five; that the foregoing resolution, being Resolution No. 10-063 was duly and regularly adopted by said Council at a regular meeting duly and regularly held on the 6th day of July, 2010, and that the same was passed and adopted by the following vote:

AYES:	COUNCIL MEMBERS:	Mayor Dear, Santarina, Gipson, Davis-Holmes and Ruiz-Raber
NOES:	COUNCIL MEMBERS:	None
ABSTAIN:	COUNCIL MEMBERS:	None
ABSENT:	COUNCIL MEMBERS:	None

City Clerk Helen S. Kawagoe

Appendix B – Attachment 6
Multi-Jurisdiction Planning Team
Sign-In Sheet (May 3, 2004)

TEAM D

X Pre-Training ___ Planning Team Workshop
5/3/04 Date of Event

NAME	AGENCY
CAROLYN HARSHMAN	EMERGENCY PLANNING CONSULTANTS
Eileen Edgerton	CITY of Carson eedgerto@carson.ca.us
PATRICK STEWARD	CITY OF COMPTON – Bldg & Safety
Gloria F. Tulle	" " " CRA
Joseph Lira	" " PLANNING DEPT.
Adrian Tatum	City of Compton
CLARENCE L. MOORE	COMPTON UNIFIED SCHOOL DISTRICT
OFFICER HERMAN STAMPLEY	COMPTON SCHOOL POLICE DEPT.
JESSE REYES	COMPTON U.S.D POLICE DEPT.
Esomchi Enenwali	CITY OF COMPTON
George River	City of Carson
Lance Burkholder	City of Carson
Alex Rocco	City of Carson
ROCIO LOPEZ	City of Carson – Planning Dept.

Emergency Planning Consultants

Appendix B – Attachment 6
Multi-Jurisdiction Planning Team
Sign-In Sheet (July 19, 2004)

X **Mitigation Actions Training** X **Mitigation Workshop**

COMPTON / CARSON / CVSD **Name of Planning Team**

7/19/04 **Date of Event**

NAME	AGENCY
CAROLYN HARSHMAN	EMERGENCY PLANNING CONSULTANTS
Eileen Edgerton	City of Carson
Adrian Patum	City of Compton
Ada McClellan	COMPTON SCHOOL POLICE
CLARENCE L. MOORE	COMPTON SCHOOL POLICE
PATRICK STEWARD	CITY OF COMPTON
ROCIO Lopez	City of Carson, Planning Div.

APPENDIX C: BENEFIT/COST ANALYSIS

Benefit/cost analysis is a key mechanism used by the state 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 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: The Interagency Hazards Mitigation Team, State Hazard Mitigation Plan, and Federal Emergency Management Agency Publication 331, Report on Costs and Benefits of 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 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 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 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 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, 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.

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 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 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 Hazard Mitigation

The estimation of economic returns, which accrue to building or land owner as a result of 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 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 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 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 hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating 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
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 Hazards 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

AandW	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 and Emergency Response
Cal ARP	California Accidental Release Prevention
Cal BO	California Building Officials
Cal EMA	California Emergency Management Agency
Cal EPA	California Environmental Protection Agency
CAL FIRE	California Department of Forestry and Fire Protection
Cal REP	California Radiological Emergency Plan
CALSTARS	California State Accounting Reporting System
Caltrans	California Department of Transportation
CBO	Community Based Organization
CD	Civil Defense
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 (of the state Office of Emergency Svcs)
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
DOE	Department of Energy (U.S.)
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
EPA	Environmental Protection Agency (U.S.)
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 and 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
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 and 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 and 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
T-T-T	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 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 Human-Caused 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.