5.2.2 Comprehensive Environmental Response, Compensation and Liability Act

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) is a regulatory or statute law developed to protect the water, air, and land resources from the risks created by past chemical disposal practices. This act is also referred to as the Superfund Act and contains the National Priority List (NPL) of sites, which are referred to as Superfund sites. Superfund is the name of the environmental program and fund established by CERCLA to address abandoned hazardous waste sites. The fund allows the EPA to clean up these sites and compel responsible parties to do the cleanup or to reimburse the government for the EPA-led cleanup. There are two main types of response actions authorized under CERCLA: 1) removal actions, and 2) remedial actions. Removal actions are short-term responses, often to address emergency situations that require a prompt response, such as the finding of abandoned drums containing hazardous materials or soils contaminated with a substance that poses an acute risk to human health or the environment. Remedial actions are typically long-term responses at sites in the National Priorities List (NPL) with the objective of permanently and significantly reducing the risk associated with the past release of hazardous substances at these sites.

According to the EPA (http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm), there are no Superfund sites in the City of Coachella General Plan Area.

5.2.3 Emergency Planning and Community Right-To-Know Act

The primary purpose of the Federal Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 is to inform communities and citizens of chemical hazards in their area. Sections 311 and 312 of EPCRA require businesses to report the locations and quantities of chemicals stored on-site to state and local agencies. These reports help communities prepare to respond to chemical spills and similar emergencies.

The EPA maintains and publishes a database that contains information on toxic chemical releases and other waste management activities that are reported annually by certain industry groups and federal facilities. The database is referred to as the Toxics Release Inventory (TRI), and it was first established under the EPCRA and expanded by the Pollution Prevention Act of 1990. EPCRA's power has allowed for the mandate that Toxic Release Inventory (TRI) reports be made public. TRI reports provide information about potentially hazardous chemicals and their uses in an attempt to give the community more power to hold companies accountable and to make informed decisions about how such chemicals should be managed.

Section 3131 of EPCRA requires manufacturers to report releases to the environment of more than 600 designated toxic chemicals. These reports are submitted to the EPA and State agencies. The EPA compiles these data into an on-line, publicly available national digital TRI. These data are readily available on the EPA website at http://www.epa.gov/tri/. The facilities are required to report on releases of toxic chemicals to the air, soil, and water. They are also required to report on off-site transfers of waste for treatment or disposal at separate facilities. Pollution prevention measures and activities and chemical recycling must also be reported. All reports must be submitted on or before July 1 of every year and must cover all activities that occurred at the facility during the previous year. Reporting by facilities is based on the following factors:

- If the facility has ten or more full-time employees;

- If the facility manufactures or processes over 25,000 pounds of approximately 600 designated chemicals, or 28 chemical categories specified in the regulations, or uses more than 10,000 pounds of any designated chemical or category; and
- If the facility engages in certain manufacturing operations in the industry groups specified in the U.S. Government Standard Industrial Classification Codes (SIC) 20 through 39; or
- If the facility is a Federal facility.

There is one facility in Coachella listed in the most recent TRI database released to the public based on data extracted on April 1, 2014. *This TRI facility is the ARMTEC Defense Products Company (TRI Facility No. 92236RMTCD85901), an ordnance and accessories manufacturer located at 85-901 Avenue 53, in Coachella 92236.* In 2012, the facility reported the total on-site release of 4,288 pounds of chemicals, including 930 pounds of ethylbenzene, 110 pounds of n-hexane, and 3,248 pounds of xylene (mixed isomers). This site is also listed in the GeoTracker database maintained by the California Water Regional Control Board (http://geotracker.swrcb.ca.gov/), where it is listed as a land disposal site (see Table 5-5).

The EPA web site (http://www.epa.gov/tri/) should be reviewed periodically for updates to this information, including the potential future presence of other TRI sites in the Coachella area.

5.2.4 Resources Conservation and Recovery Act

The Resources Conservation and Recovery Act (RCRA) is the principal Federal law that regulates the generation, management and transportation of waste materials. Hazardous waste management includes the treatment, storage, or disposal of hazardous waste. Treatment is defined as any process that changes the physical, chemical, or biological character of the waste to make it less of an environmental threat. Treatment can include neutralizing the waste, recovering energy or material resources from the waste, rendering the waste less hazardous, or making the waste safer to transport, dispose of, or store. Storage is the holding of waste for a temporary period of time. The waste is treated, disposed of, or stored at a different facility at the end of the storage period. Disposal is the permanent placement of the waste into or on the land. Disposal facilities are usually designed to contain the waste permanently and to prevent the release of harmful pollutants to the environment.

Many different types of businesses can be producers of hazardous waste. Small businesses like dry cleaners, auto repair shops, medical facilities or hospitals, photo processing centers, and metal plating shops are usually generators of small quantities of hazardous waste. The EPA (Title 40 of the Code of Federal Regulations) defines a small quantity generator as a facility that produces between 100 and 1,000 kilograms (Kg) of hazardous waste per month (approximately equivalent to between 220 and 2,200 pounds, or between 27 and 275 gallons). A "conditionally exempt" small quantity generator is a business that generates 220 pounds (27 gallons) or less of hazardous waste per month.

Since these facilities are often small, start-up businesses that come and go, the list of small-quantity generators in a particular area typically changes over time. Sometimes, a facility remains, but the name of the business changes with new ownership. As of May 2011, there were 21 locations in the City of Coachella study area reported as small-quantity generators. These facilities are included in Table 5-1, below, and their locations are depicted on Plate 5-1. Two of these are listed as "conditionally exempt," meaning that they generate 100 kilograms or less per month of hazardous waste, or 1 kilogram or less per month of acutely hazardous waste. In addition, two Circle K store locations are listed on the RCRA database as "unspecified inactive." A more recent (2014) list of these facilities is not available from the Environmental Protection Agency, and thus, the data on Table 5-1 was not updated for this 2014 version of the report.

Larger businesses are sometimes generators of large quantities of hazardous waste. These generally include some gas stations, chemical manufacturers, large electroplating facilities, petroleum refineries, and military installations. The EPA defines a large-quantity generator as a facility that produces over 1,000 Kg (2,200 pounds or about 275 gallons) of hazardous waste per month. Large-quantity generators are fully regulated under RCRA. The EPA identified three large-quantity generators in the Coachella area as of May 2011 (see bottom of Table 5-1 and Plate 5-1).

Table 5-1: EPA-Registered Small- and Large-Quantity Generators of Hazardous Materials in the Coachella General Plan Area (2011)

Facility Name, Address	EPA ID	Type Facility
Amigo Mini Mart (Fuel Station) 85-509 Highway 111, Coachella 92236	CAD982411449	Small-Quantity Generator
Arco Facility No. 05826 48-055 Grapefruit Blvd., Coachella 92236	CAR000102608	Small-Quantity Generator
Bulk Plant No. 0104 50-021 Highway 86, Coachella 92236	CAR000051730	Small-Quantity Generator
Cakota Dunes (general rental center) 85-200 Avenue 50, Coachella 92236	CAC002611320	Small-Quantity Generator
Circle K Store No. 330 85-101 Avenue 52, Coachella 92236	CAD981680283	Small-Quantity Generator
Coachella Valley USD Transportation Department 83-800 Airport Blvd., Coachella 92236	CA0000133421	Small-Quantity Generator
Coachella Valley Water District Avenue 52 and Highway 111, Coachella 92236	CAD982446056	Small-Quantity Generator
Desert Cottonseed Products Co. Inc. 86-600 Avenue 54, Coachella 92236	CAD126792191	Small-Quantity Generator
Ernie Ball Inc. 53973 Polk Street, Coachella 92236	CAR000171678	Small-Quantity Generator
Foster Manufacturing Inc. 1577 First Street, Coachella 92236	CAD063129456	Small-Quantity Generator
Garner Implement Company 49-980 Highway 86, Coachella 92236	CAR000069625	Small-Quantity Generator
General Telephone of California 723 Vine Street, Coachella 92236	CAD980889786	Small-Quantity Generator
Lee Escher Oil Company, Inc. 85-119 Avenue 50, Coachella 92236	CAD982374514	Small-Quantity Generator
McCalla Division of Layne Western 381 Highway 111, Coachella 92236	CAD982002842	Small-Quantity Generator
R and S Auto Wrecking 84-811 Avenue 48, Coachella 92236	CAD983600651	Small-Quantity Generator
Santa Fe Pacific Pipeline Coachella Site 85-985 Avenue 52, Coachella 92236	CAR000032789	Small-Quantity Generator
Shell Service Station 45800 Dillon Road, Coachella 92236	CAR000110528	Small-Quantity Generator
Sun World 87-951 Avenue 73, Coachella 92236	CAR000071498	Small-Quantity Generator
Travel Centers of America	CAR000069369	Small-Quantity Generator

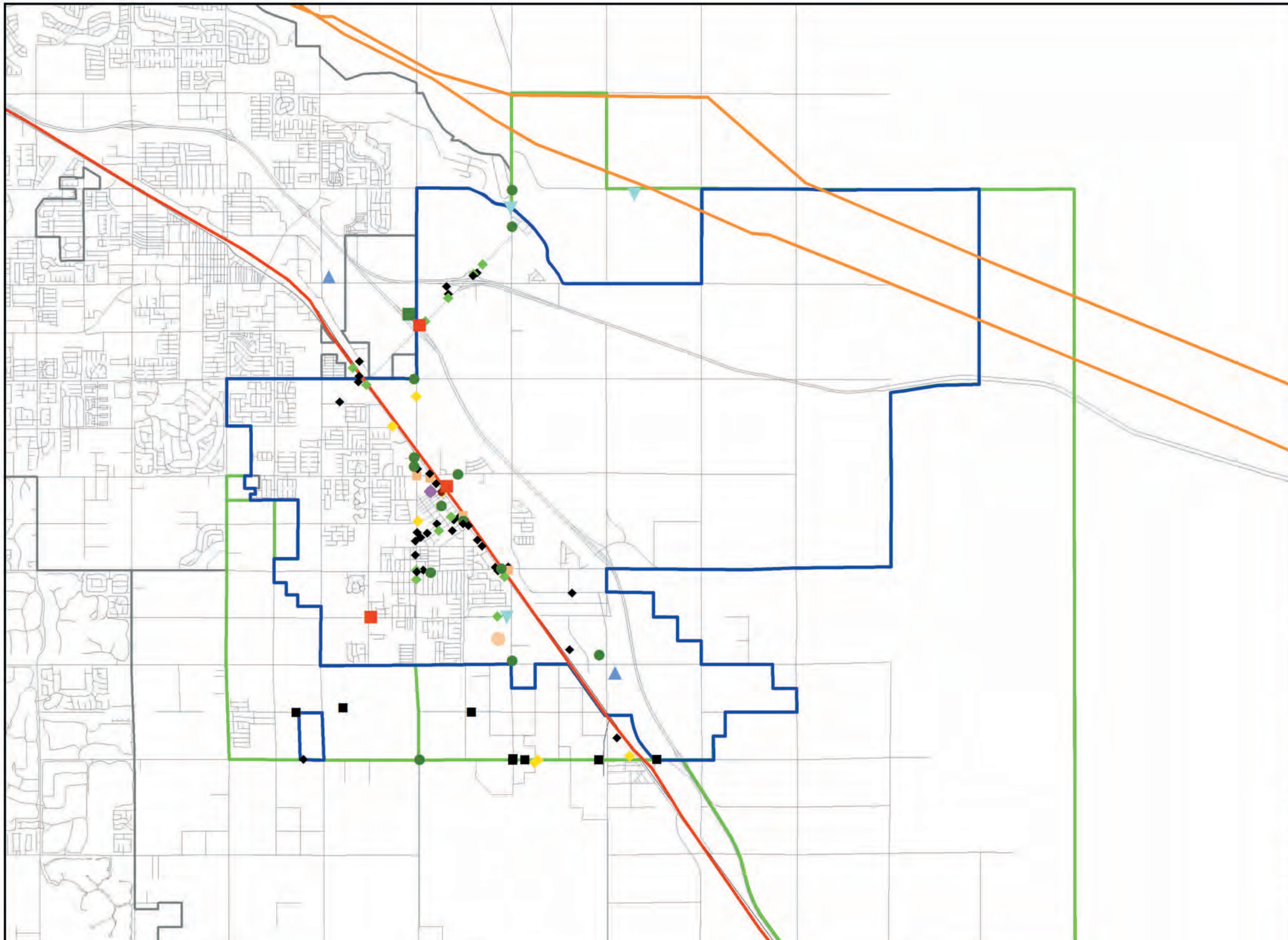
Facility Name, Address	EPA ID	Type Facility
46-145 Dillon Road, Coachella 92236		
Rite Aid 5678 51-101 Harrison Street, Coachella 92236	CAR000209676	Conditionally Exempt Small Generator
Spotlight 29 Casino 46-200 Harrison Place, Coachella 92236	CAR000168658	Conditionally Exempt Small Generator
Circle K Store No. 1303 4-9989 Grapefruit Street, Coachella 92236	CAD981681208	Unspecified - Inactive
Circle K Store No. 529 50-898 Grapefruit Street, Coachella 92236	CAD981680333	Unspecified - Inactive
Amazing Coachella Inc. DBA Peter Rabbit Farms 85-810 Peter Rabbit Lane, Coachella 92236-1897	CAL000028217	Large-Quantity Generator
Armtec Defense Products Company 85-901 Avenue 53, Coachella 92236	CAD008252157	Large-Quantity Generator
Chevron 355918 46-651 Dillon Road, Coachella 92236	CAR000201608	Large-Quantity Generator

Source: http://iaspub.epa.gov/enviro/, based on data extracted May 10, 2011, and searches performed on June 9 and June 15, 2011.

The Department of Toxic Substances Control (DTSC) has an official database of hazardous waste transporters in the state of California. All transporters of hazardous waste have to be registered with the DTSC in order to operate in the state. As of 2014, there are no transporters of hazardous waste based in Coachella that are registered in the DTSC database of hazardous waste transporters (http://www.dtsc.ca.gov/database/Transporters/trans_city.cfm). Although there are no transporters of hazardous waste registered in Coachella, hazardous waste is being transported through the area by transporters registered or based elsewhere (there is, for example, one registered transporter in Indio and one in La Quinta). This is discussed further in Section 5.6.

Hazardous Materials Site Map

Coachella, California



Base Map: City of Coachella
Sources: http://iaspub.epa.gov/enviro/, http://www.dtsc.ca.gov/database/Transporters/trans_cnty.cfm;http://iaspub.epa.gov/enviro/, http://oaspub.epa.gov/enviro/, http://www.burrtec.com/coachella, http://www.rivcowm.org, http://geotracker.swrcb.ca.gov/, http://www.epa.gov/tri/, and http://www.calepa.ca.gov/sitecleanup/corteselist/Background.htm

Earth Consultants International

Project Number: 3106/3218
Date: 2014

Plate 5-1

NOTES:

This map is intended for general land use planning only. Information on this map is not sufficient to serve as a substitute for detailed geologic investigations of individual sites, nor does it satisfy the evaluation requirements set forth in geologic hazard regulations.

Earth Consultants International (ECI) makes no representations or warranties regarding the accuracy of the data from which these maps were derived. ECI shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to any claim by any user or third party on account of, or arising from, the use of this map.

5.2.5 Cortese List

This California legislation (Government Code § 65962.5) was originally enacted in 1985, and became effective on January 1, 1992. The code required several different State agencies to compile and update annually a list of hazardous materials sites as indicated below, and submit these lists to the Secretary for Environmental Protection. The Secretary was to consolidate all the information received and then forward the complete list of sites to each city and county with sites on the composite list.

1. The California Department of Toxic Substances Control (DTSC) [Subsection 65962.5. (a)] was to compile information on:
   - All hazardous waste facilities subject to corrective action pursuant to Section 25187.5 of the Health and Safety Code;
   - All land designated as hazardous waste property or border zone property pursuant to Article 11 (commencing with Section 25220) of Chapter 6.5 of Division 20 of the Health and Safety Code;
   - All information received by the Department of Toxic Substances Control pursuant to Section 25242 of the Health and Safety Code on hazardous waste disposals on public land;
   - All sites listed pursuant to Section 25356 of the Health and Safety Code; and
   - All sites included in the Abandoned Site Assessment Program.
2. The State Department of Health Services [Subsection 65962.5. (b)] was to compile data on:
   - All public drinking water wells that contain detectable levels of organic contaminants and that are subject to water analysis pursuant to Section 116395 of the Health and Safety Code.
3. The State Water Resources Control Board [Subsection 65962.5. (c)] was to compile:
   - All underground storage tanks for which an unauthorized release report is filed pursuant to Section 25295 of the Health and Safety Code (this list is now available from GeoTracker, see Section 5.3);
   - All solid waste disposal facilities from which there is a migration of hazardous waste and for which a California regional water quality control board has notified the Department of Toxic Substances Control pursuant to subdivision (e) of Section 13273 of the Water Code; and
   - All cease and desist orders issued after January 1, 1986, pursuant to Section 13301 of the Water Code, and all cleanup or abatement orders issued after January 1, 1986, pursuant to Section 13304 of the Water Code, that concern the discharge of wastes that are hazardous materials.
4. The local enforcement agency, as designated pursuant to Section 18051 of Title 14 of the California Code of Regulations, shall submit to the California Integrated Waste Management Board [Subsection 65962.5. (d]:

- All solid waste disposal facilities from which there is a known migration of hazardous waste.

Most of this information is now available directly from the various individual state agencies that make the data available on their respective websites. Furthermore, some of the activities required under this code are no longer being implemented, and in some cases, the information to be contained in the Cortese list does not exist (http://www.calepa.ca.gov/sitecleanup/corteselist/Background.htm).

There is, however, one facility in Coachella listed in the Cortese List that is not included with the same level of detail in other, more current databases. The *Foster-Gardner site located at 1577 1st Street*, is a 2.79-acre site that has been on the active state list since 8/30/1992. The company purchased the pesticide and fertilizer business from Shell in 1958, and between 1959 and the early 1970s, formulated base fertilizer and mixed and re-packaged pesticides and fertilizers. The company ceased mixing pesticides in the 1970s, however, between the 1960s and early 1990s, they formulated aqueous ammonia by mixing anhydrous ammonia and water. The company still stores and sells herbicides, soil and grain fumigants, insecticides, nematocides, fungicides, and fertilizers (http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=33280137).

Contaminants of concern as a result of past uses of the site include pesticide wastes resulting from production, organochlorine pesticides, volatile organics, and ammonia. These compounds have been detected in the water samples collected from the shallow groundwater (not suitable for drinking purposes) underlying the site. Groundwater quality under the site has been monitored since August 1991, when the first monitoring wells onsite and immediately offsite were installed (Hargis + Associates, Inc., 2010). The concentration of the contaminants in the groundwater is being monitored to determine whether or not natural attenuation (a remediation method that relies on in-situ, naturally occurring physical, chemical and biological processes to reduce the mass or concentration of contaminants) is working at this site. There are several land use restrictions imposed on this property: the site cannot be used to raise food, nor can it be used as a day care center, elder care center, hospital, residential area, or as either a public or private school for persons under 21 years of age. For more information regarding this property, including future groundwater monitoring reports and review documents from the Department of Toxic Substances Control, refer to http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=33280137.

5.2.6 Hazardous Materials Disclosure Program

Both the Federal government (Code of Federal Regulations, EPA, SARA and Title III) and the State of California (California State Health and Safety Code, Division 20, Chapter 6.95, Sections 25500–25520; California Code of Regulations, Title 19, Chapter 2, Sub-Chapter 3, Article 4, Sections 2729-2734) require all businesses that handle more than a specified amount of hazardous materials or extremely hazardous materials, termed a reporting quantity, to submit a Hazardous Materials Business Plan to its local Certified Unified Program Agency (CUPA). The CUPA with responsibility for the City of Coachella is the Riverside County Department of Environmental Health, Hazardous Materials Division (RCDEH-HMD). The Business Plan includes the Business Owner/Operator Identification page, Hazardous Materials Inventory – Chemical Description page, and an Emergency Response Plan and Training Plan.

According to the RCDEH-HMD guidelines, the preparation, submittal and implementation of a Business Activity Form is required by all businesses that handle a hazardous material or a mixture containing a hazardous material in quantities equal to, or greater than, those outlined below:

- All hazardous waste generators, regardless of quantity generated.
- Any business that uses, generates, processes, produces, treats, stores, emits, or discharges a hazardous material in quantities at or exceeding:
  - 55 gallons or more of a liquid;
  - 500 pounds or more of a solid; or
  - 200 cubic feet (compressed) of gas at any one time in the course of a year.
- Any business that recycles more than 100 kg per month of excluded or exempted recyclable materials per Health and Safety Code (HSC) §25143.2.
- Any business that handles, stores, or uses Category (I) or (II) pesticides, as defined by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), regardless of amount.
- Any business that handles Department of Transportation (DOT) Hazard Class 1 (explosives, found in Title 49 of the Code of Federal Regulations).
- Any business that handles extremely hazardous substances in quantities exceeding the threshold planning quantity, as listed in Title 40 of the Federal Code of Regulations, Part 355, Appendix A or B.
- Any business subject to the EPCRA (also known as SARA Title III; see Section 5.2.2 above). EPCRA generally includes facilities that handle hazardous substances above threshold planning quantities.
- Any business that owns or operates an underground storage tank that contains hazardous substances as defined in the Health and Safety Code (HSC) §25316.
- Any business that handles radioactive materials in quantities for which an emergency plan is required pursuant to Parts 30, 40 or 70 of Chapter 10, Title 10, Code of Federal Regulations (CFR), or equal to or greater than the amounts specified above, whichever amount is less.

Within 30 days of any one of the following events, businesses are required to submit an amendment to their business plan to the CUPA:

- A 100-percent or more increase in the quantity of a previously disclosed hazardous material;
- Any handling of a previously undisclosed hazardous material subject to the inventory requirements of this chapter;
- Change of mailing address, phone number or location; change of emergency contact person;
- Change of ownership; or
- Change of business name.

Business plans must include an inventory of the hazardous materials at the facility. If no changes have been made to the facility's inventory, a written certification suffices for the update; however, if changes have been made, those changes must be submitted to the Riverside County

Department of Environmental Health – Hazardous Materials Division (RCDEH-HMD). Businesses are required to update their business plan at least once every three years and the chemical inventory portion of their plan every year. They must certify in writing to the RCDEH-HMD that a review was conducted and all necessary changes were made. A copy of all changes must be submitted as part of the certification. Also, business plans are required to include emergency response plans and procedures to be used in the event of a significant or threatened significant release of a hazardous material. These plans need to identify the procedures to follow for immediate notification to all appropriate agencies and personnel of a release, identification of local emergency medical assistance appropriate for potential accident scenarios, contact information for all emergency coordinators of the business, a listing and location of emergency equipment at the business, an evacuation plan, and a training program for business personnel. Additional information regarding business plans and the CUPA forms required in the County of Riverside, including the City of Coachella, is available at http://www.rivcoeh.org/opencms/rivcoeh/Forms_Guidelines/#CUPA. They can also be contacted by phone at (888) 722-4234 (888-RC-CHA-EH).

Business plans are designed to be used by responding agencies, such as the Riverside County Fire Department, during a release or spill to allow for a quick and accurate evaluation of each situation for appropriate response. Businesses that handle hazardous materials are required by law to provide an immediate verbal report of any release or threatened release of hazardous materials if there is a reasonable belief that the release or threatened release poses a significant present or potential hazard to human health and safety, or to property or the environment. Fines of up to $25,000 per day and one year in prison may be awarded to an individual or business if a release or threatened release is not reported. If a release involves a hazardous substance listed in Title 40 of the Code of Federal Regulations in an amount equal to or exceeding the reportable quantity for that material, a notice must be filed with the California Office of Emergency Services within 15 days of the incident.

The Riverside County Department of Environmental Health, Hazardous Materials Division is charged with the responsibility of conducting compliance inspections of regulated facilities in Riverside County. Specialists are assigned countywide to address the wide variety of complex issues associated with hazardous substances. For example, all new installations of underground storage tanks require an inspection, along with the removal, under strict chain-of-custody protocol, of the old tanks (see Section 5.3 below).

5.2.7 Hazardous Materials Incident Response

There are thousands of different chemicals available today, each with unique physical characteristics; what might be an acceptable mitigation practice for one chemical could be totally inadequate for another. Therefore it is essential that agencies responding to a hazardous material release have as much available information as possible regarding the type of chemical released, the amount released, and its physical properties to effectively and quickly evaluate and contain the release. The EPA-required business plans are an excellent resource for this type of information. Other sources of information are knowledgeable facility agents or employees present onsite.

In 1986, Congress passed the Superfund Amendments and Reauthorization Act (SARA). Title III of this legislation requires that each community establish a Local Emergency Planning Committee (LEPC) that is responsible for developing an emergency plan to prepare for and respond to chemical emergencies in their community.

This emergency plan must include the following:

- An identification of local facilities and transportation routes where hazardous materials are present;
- The procedures for immediate response in case of an accident (this must include a community-wide evacuation plan);
- A plan for notifying the community that an incident has occurred;
- The names of response coordinators at local facilities; and
- A plan for conducting exercises to test the plan.

The plan is reviewed by the State Emergency Response Commission (SERC) and publicized throughout the community. The LEPC is required to review, test, and update the plan each year.

The Riverside County Office of Emergency Services (OES), the Riverside County Department of Environmental Health – Hazardous Materials Division, the Riverside County Fire Department, and the City of Coachella's Emergency Services Coordinator are responsible for coordinating hazardous material and disaster preparedness planning and appropriate response efforts with City departments, as well as local and State agencies. The goal is to improve public and private sector readiness, and to mitigate local impacts resulting from natural or man-made emergencies. The OES is a branch of the Riverside County Fire Department that deals with the planning for and response to the natural and technological disasters in the County, whereas the Riverside County Department of Environmental Health – Hazardous Materials Division deals with the coordination and inspection of hazardous materials facilities in the County and in the City of Coachella. The Riverside County Fire Department has developed and teaches a Community Emergency Response Team (CERT) training program to help county residents prepare for potential disasters. The CERT course, which is taught as a series of modules that combined add to about 20 hours of instruction over three consecutive days, is certified by the Federal Emergency Management Agency (FEMA) and the State OES. For more information on the CERT program, contact the County's CERT Program at (951) 955-4700 or visit http://rivcocert.webs.com/. Information on CERT training held locally in Coachella is also available at Coachella's City Hall (Photo 5-1).

The Riverside County Fire Department has an Incident Command System (ICS) Type I Hazardous Materials Response Team that is divided and housed at three different locations, allowing them to quickly respond to hazardous materials incidents anywhere within the county. The response team closest to Coachella is Hazardous Materials Support Team 81 (HMS81) located in Bermuda Dunes (North Bermuda Dunes Fire Station #81, located at 37-955 Washington Street, Palm Desert). The other two units are located in Beaumont (HM20) and Winchester (HMS34), respectively. The Bermuda Dunes unit is equipped with a 4x4 support unit and a decontamination trailer.

According to the Riverside County Fire Department, all hazardous materials team members receive extensive training, including Hazardous Materials Incident Commander, Railcar Specialist, Cargo Tank Specialist, Weapons of Mass Destruction, Assistant Safety Officer, Clandestine Drug Lab, Clandestine Drug Lab Cylinder Safety, Clandestine Drug Lab Waste, HazMat 2 Unknown

Chemical Identification, Reference Material Identification, and Confined Space Rescue. All team members also participate in continuous specialty monthly training exercises.

Figure 5-1: Community Emergency Response Team (CERT) Classes Are Held Regularly at Coachella's City Hall

The Hazardous Materials Team Members have a cooperative working relationship with the Riverside County Health Agency, Department of Environmental Health. An Emergency Response Hazardous Materials Management Specialist from the Riverside County Health Agency responds with Hazardous Materials team members to all hazardous materials incidents. The Health Agency member arranges for clean up of the chemical emergency incident and assist with proper notifications. Health Agency Hazardous Materials personnel also enhance the Hazardous Materials Teams with expanded knowledge regarding technical referencing.

Riverside County Fire Department Hazardous Materials Team members are capable of monitoring unknown atmospheres, identifying unknown chemicals, plugging, patching and intervening in large chemical leaks, conducting mass decontamination, and handling confined space entry rescue operations. The Hazardous Materials Team members often also assist the local fire stations with medical emergencies, structural fires and mass casualty incidents (http://www.rvcfire.org/opencms/functions/hazmat/index.html).

5.2.8 Hazardous Material Spill/Release Notification Guidance

All significant spills, releases, or threatened releases of hazardous materials must be immediately reported. **To report all significant releases or threatened releases of hazardous materials, first call 911** (or the local emergency response agency), and then call the Governor's OES Warning Center at 1-800-852-7550.

This guidance summarizes pertinent emergency notification requirements and applies to all significant releases of hazardous materials. Requirements for immediate notification of all significant spills or threatened releases cover: Owners, Operators, Persons in Charge, and Employers. Notification is required regarding significant releases from facilities, vehicles, vessels, pipelines and railroads.

State notification requirements for a spill or threatened release include (at a minimum):

- Identity of caller,
- Location, date and time of spill, release, or threatened release,
- Substance and quantity involved,
- Chemical name (if known; also report whether or not chemical is extremely hazardous), and
- Description of what happened.

Federal notification requires additional information for spills (CERCLA chemicals) that exceed Federal-reporting requirements. This information includes:

- Medium or media impacted by the release,
- Time and duration of the release,
- Proper precautions to take,
- Known or anticipated health risks, and
- Name and phone number for more information.

Many State statutes require emergency notification of a hazardous chemical release. These statutes include:

- Health and Safety Codes §25270.7, 25270.8, and 25507,
- Vehicle Code §23112.5,
- Public Utilities Code §7673, (PUC General Orders #22-B, 161),
- Government Code §51018, 8670.25.5 (a),
- Water Codes §13271, 13272, and
- California Labor Code §6409.1 (b)10.

In addition, all releases that result in injuries, or workers harmfully exposed, must be immediately reported to Cal/OSHA (CA Labor Code §6409.1 (b)). For additional reporting requirements, also refer to the Safe Drinking Water and Toxic Enforcement Act of 1986, better known as Proposition 65, and §9030 of the California Labor Code.

The California Accidental Release Prevention Program (CalARP) became effective on January 1, 1997 in response to Senate Bill 1889. The CalARP replaced the California Risk Management and Prevention Program (RMPP). Under the CalARP, the Governor's Office of Emergency Services must adopt implementing regulations and seek delegation of the program from the EPA. The

CalARP aims to be proactive and therefore requires businesses to prepare Risk Management Plans (RMPs), which are detailed engineering analyses of:

- The potential accident factors present at a business, and
- The mitigation measures that can be implemented to reduce this accident potential.

In most cases, local governments have the lead role in working directly with businesses in this program. The County of Riverside Department of Environmental Health – Hazardous Materials Division is designated as the Administering Agency for hazardous materials in the City of Coachella.

5.3 Leaking Underground Storage Tanks

Leaking underground storage tanks (LUSTs) have been recognized since the early 1980s as the primary cause of groundwater contamination by gasoline compounds and solvents. In California, regulations aimed at protecting against underground storage tank (UST) leaks have been in place since 1983, one year before the Federal Resource Conservation and Recovery Act (RCRA) was amended to add Subtitle I requiring UST systems to be installed in accordance with standards that address the prevention of future leaks. These Federal laws are found in the Code of Federal Regulations (CFR), parts 280-281. The State law and regulations are found in the California Health and Safety Code, Division 20, Chapter 6.7, and in the California Code of Regulations Title 23, Division 3, Chapter 16, commonly referred to as the "Underground Tank Regulations." Federal and State programs include leak reporting and investigation regulations, and standards for clean up and remediation. UST cleanup programs are available to fund the remediation of contaminated soil and ground water caused by leaking tanks. California's program is more stringent than the Federal program, requiring that all tanks be double walled, and prohibiting gasoline delivery to non-compliant tanks. The State Water Resources Control Board (SWRCB) is the lead regulatory agency in the development of UST regulations and policy.

Most older tanks were typically single-walled steel tanks. Many of these leaked as a result of corrosion and detached fittings. As a result, the state of California required the replacement of older tanks with new double-walled, fiberglass tanks with flexible connections and monitoring systems. UST owners were given a ten-year period to comply with the new requirements, and the deadline came due on December 22, 1998. However, many UST owners did not act by the deadline, so the State granted an extension for the Replacement of Underground Storage Tanks (RUST) program to January 1, 2002. Nevertheless, in that RUST loan funds are still available in 2014 indicates that there are still UST owners, typically small, independent operators that have yet to comply with the RUST requirements. RUST loans, ranging from $10,000 to $750,000 (maximum per person or entity), can be used to finance up to 100 percent of the costs to upgrade USTs by installing containment sumps, double-walled piping, dispensers, under-dispenser containment boxes or pans, electronic monitoring systems, and enhanced vapor recovery systems. The funds can also be used to conduct enhanced leak detection tests. For additional information on this program, refer to http://www.swrcb.ca.gov/water_issues/programs/ustcf/rust.shtml. The RUST program is scheduled to sunset on January 1, 2016.

The California legislature established the Barry Keene Underground Storage Tank Cleanup Fund Act of 1989 to provide a means for petroleum UST owners and operators to meet the Federal and state requirements, and to assist small businesses and individuals by providing reimbursement for unexpected and catastrophic expenses associated with the cleanup of leaking petroleum USTs. The fund also provides money to the Regional Water Quality Control Boards to cleanup abandoned sites or abate emergency situations that pose a threat to human health, safety and the environment as a result of a petroleum release from an UST (http://www.swrcb.ca.gov/water_issues/programs/ustcf/). Revenues for the Fund are generated by a storage fee for every gallon of petroleum product placed into a UST. The State Board of Equalization collects these fees on a quarterly basis from owners of active USTs. In the last few years, the fund has experienced a cash shortage. As a result, in May 2009, the State Water Resources Control Board passed Resolution No. 2009-0042 that defines specific actions that the Regional Boards are to take to improve administration of the UST Cleanup Fund and the UST Cleanup Program. The most significant decision in this resolution is that the Regional Boards are to review the open UST cleanup cases and identify those where continued investigation, remediation or monitoring poses little to no environmental benefit. Those sites open for more than five years that are found to not pose a threat to water quality or sensitive receptors, are recommended for closure.

In 2009 the State Water Resources Control Board received a federal grant from the U.S. Environmental Protection Agency using American Recovery and Reinvestment Act funds to cleanup leaks from underground storage tanks. The funds are available to eligible applicants under a new program called the Orphan Site Cleanup Fund (OSCF) or Orphan Site Fund. Orphan sites are sites contaminated by leaking petroleum underground storage tanks where there is no financially responsible party. Additional information on this program, including eligibility requirements and copies of the application for funding can be obtained at http://www.waterboards.ca.gov/water_issues/programs/ustcf/oscf.shtml.

The California Regional Water Quality Control Board (CRWQCB), in cooperation with the Office of Emergency Services, maintains an inventory of leaking underground storage tanks (LUSTs) in a Statewide database called GeoTracker, which is available at http://geotracker.waterboards.ca.gov/. The database lists 37 reported LUST cases in the Coachella area. Of these, according to the LUST database, 33 sites have been remediated and closed, leaving four (4) cases still open (the **open** cases are listed first, in **bold**). All 37 cases are listed in Table 5-2, below, and their approximate location is shown on Plate 5-1. Please note, however, that the ongoing assessment and remediation of the current open cases will eventually get these sites signed off by the reviewing agencies. Furthermore, given that there are at least 16 permitted underground storage tank (UST) locations in the General Plan area (see Plate 5-1), new leaks from these USTs could be reported in the future. Therefore, the GeoTracker list should be reviewed periodically to determine the status of the currently open sites, and for information regarding any new leaks.

Because of the relatively shallow ground water table in several parts of the Coachella area, sixteen of the leaks listed in Table 5-2 reportedly impacted groundwater in an aquifer used for drinking water purposes, and eleven impacted other groundwater not used for drinking purposes. Two of these leaks impacted both types of aquifers, meaning that the petroleum hydrocarbon (gasoline in both cases) migrated down through the layer that separates the shallow, non-potable aquifer to the deeper aquifer. Groundwater monitoring wells were and/or are being used at most of these sites to study the areal distribution and concentration of the contaminants as part of the site assessment and remediation phases. At ten (possibly eleven) sites, soil was reportedly impacted by the leaked contaminant. In these cases, the stained soils are typically excavated and replaced with clean soil; the contaminated soil is then shipped to a facility that accepts hazardous materials. Specific information about each of these sites, including reports submitted to the Regional Board by the consultants conducting the studies and remediation, is available from the GeoTracker site at http://geotracker.swrcb.ca.gov/.

Table 5-2: Leaking Underground Fuel Tanks Reported in the Coachella Area

Site Name	Address	State Case No.	Case Type	Status, Contaminant (Date Case Closed)	Date Leak Discovered
Amigo Minimart	**85509 Highway 111**	**T0606500931**	**G**	**Open Inactive, G**	**5/20/1986**
Quail Oil	**48487 Highway 86**	**T0606500954**	**U, S**	**2, D,G**	**4/26/1993**
Soco Apple Market #4	**50980 Highway 86**	**T0606500945**	**O, G**	**3, G**	**6/5/1990**
Sossa's Market #7	**48975 Grapefruit Blvd.**	**T0606500937**	**O**	**6** (2/21/2014), **G**	**1/5/2000**
Arco #9924	48055 Grapefruit Blvd.	T0606500950	G	5, G (4/21/2011)	10/18/1990
Autos del Valle	51890 Highway 86	T0606500951	G	5, G (10/28/1998)	1/2/1979
Burns Brothers Travel Stop	46155 Dillon Road	T0606500958	O, S	5, G (1/7/2005)	8/7/1998
Chevron Coachella	49975 Harrison Street	T0606500941	G	5, G (7/9/1998)	2/7/1989
Chevron Dillon Road	45760 Dillon Road	T0606570130	O	5, G (7/17/2008)	1/22/2003
Circle K#330	85-101 Avenue 52	T0606500934	O, G	5, G (1/8/2014)	7/2/1992
Circle K #1303	49989 Grapefruit Blvd.	T0606500949	G	5, G (11/13/2000)	3/27/1991
Circle K (Former)	51989 Grapefruit Blvd.	T0606500955	O	5, G (12/12/2002)	6/22/1993
Coachella City Fire Station	1377 Sixth Street	T0606500940	G	5, O (1/17/2003)	10/3/1986
Coachella City Yard	1670 Second Street	T0606500932	S	5, D (12/8/1999)	10/1/1986
Coachella Sanitary District	Avenue 56 and Van Buren	T0606500959	S	5, D (1/28/2000)	4/26/1999
Coachella Travel Center	46155 Dillon Road	T0606557357	O	5, D (7/28/2010)	5/4/2006
Coachella Valley USD Transportation	83800 Airport Blvd.	T0606500957	G	5, G (5/4/1999)	10/24/1996
Coachella Valley Water District	85820 Coachella Heights	T060657197	S	5, G (4/29/2005)	12/04/2001
Coachella Valley Water District	85820 Coachella Heights	T0606500943	G	5, G (8/26/1996)	4/13/1989
Coachella Valley Water District	85995 Avenue 52	T10000002057	S	5, O (1/13/2011)	4/15/2010
Coachella Valley School District – Coachella Valley High School	83800 Airport Blvd.	T0606501077	O	5, D, G (8/17/1994)	12/1/1987
Coachella Valley School District – Palm View Maintenance	1101 Orchard Street	T0606500935	G	5, G (1/13/1997)	12/1/1987
Cox Oil Company	1121 Highway 111	T0606500936	S	5, D (7/24/1992)	4/9/1987

Site Name	Address	State Case No.	Case Type	Status, Contaminant (Date Case Closed)	Date Leak Discovered
DeLeon's Service	51298 Harrison Street	T0606500953	O	5, G (2/11/2014)	10/8/1990
El Super Toro Loco #3	52051 Grapefruit Ave.	T0606555198	O	5, G (7/7/2006)	2/25/2004
Frank (Abandoned)	51655 Highway 86	T0606500938	S	5, G (8/2/1992)	2/17/1987
Koolco	52112 Industrial Way	T0606500956	G	5, G (12/21/1994)	4/26/1994
Lee Escher Oil	85119 Avenue 50	T0606500939	G	5, G (1/27/1997)	7/10/1988
Lucky's Auto Service	51229 Harrison Street	T0606500948	S	5, O (8/21/1995)	12/22/1989
Old Builders Supply	85220 Avenue 50	T0606500944	S?	5, G (4/1/1992)	11/17/1989
Rancho Coachella (Lusardi)	54000 Highway 111	T0606500942	G	5, G (5/15/1998)	3/13/1989
Red Dragon Restaurant	85981 Grapefruit Blvd.	T0606500933	S	5, G (11/7/1986)	9/1/1986
Sanchez MiniMart	1003 Grapefruit Ave.	T0606599289	S	5, G (8/22/2007)	6/6/2001
Valley Gas	45800 Dillon Road	T0606536453	S	5, G (5/23/2008)	6/10/2005
W C Hancock	85289 Highway 111	T0606500947	G	5, G (1/30/1997)	5/13/1987
Walter Oversen	84540 Mitchell	T0606500946	G	5, G (4/23/1993)	12/9/1989
White's Black Gold #133	52138 Harrison Street	T0606500952	O	5, G (5/2/2008)	5/14/1990

Source: GeoTracker (http://geotracker.swrcb.ca.gov/) checked on May 22, 2014.

Abbreviations Used for Case Type: S = Soil contaminated, groundwater not impacted; **G** = Aquifer used for drinking water supply impacted; **O** = Other groundwater (uses other than drinking water); **U** = Under investigation.
Abbreviations Used for Status: 1 = Case Opened; **2** = Site Assessment; **3** = Remediation; **4** = Assessment and Interim Remedial Action; **5** = Case Closed; 6 = Eligible for Closure as of date in parenthesis..
Abbreviations Used for Contaminant: D = Diesel; **G** = Gasoline; **S** = Other Solvent or Non-Petroleum Hydrocarbon; **O** = Waste Oil / Motor / Hydraulic / Lubricating; **P** = Petroleum / Fuels / Oils, Volatile Organic Compounds.

5.4 Drinking Water Quality

Most people in the United States take for granted that the water that comes out of their kitchen taps is safe to drink. In most areas, this is true, thanks to the efforts of hundreds of behind-the-scene individuals that continually monitor the water supplies for contaminants, in accordance with the drinking water standards set by the EPA. Primary authority for EPA water programs was established by the 1986 amendments to the Safe Drinking Water Act (SDWA) and the 1987 amendments to the Clean Water Act (CWA).

The National Primary Drinking Water Standard protects drinking water quality by limiting the levels of specific contaminants that are known to occur or have the potential to occur in water and can adversely affect public health. All public water systems that provide service to 25 or more individuals are required to satisfy these legally enforceable standards. Water purveyors must monitor for these contaminants on fixed schedules and report to the EPA when a Maximum Contaminant Level (MCL) has been exceeded. MCL is the maximum permissible level of a contaminant in water that is delivered to any user of a public water system. Drinking water supplies are tested for a variety of contaminants, including organic and inorganic chemicals (minerals), substances that are known to cause cancer (carcinogens), radionuclides (such as uranium and radon), and microbial contaminants. The contaminants for which the EPA has established MCLs are listed at http://water.epa.gov/drink/contaminants/index.cfm. Changes to the MCL list are typically made every three years, as the EPA adds new contaminants or, based on new research or new case studies, revised MCLs for some contaminants are issued.

5.4.1 Contaminants of Concern

5.4.1.1 Coliform

One of the contaminants checked for on a regular basis is the coliform count. Coliform is a group of bacteria primarily found in human and animal intestines and wastes. These bacteria are widely used as indicator organisms to show the presence of such wastes in water and the possible presence of pathogenic (disease-producing) bacteria. Pathogens in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with compromised immune systems. One of the fecal coliform bacteria that water samples are routinely tested for is Escherichia coli (E. coli). To fail the monthly Total Coliform Report (TCR), the following must occur:

- For systems testing more than 40 samples, more than 5 percent tested positive for Total Coliform, or
- For those systems testing less than 40 samples, more than one sample tested positive for Total Coliform.

The City of Coachella Water Department (also referred to as the Coachella Municipal Water Department) provides drinking water to most residents of the City. Unincorporated areas in the General Plan study region are serviced by the Coachella Valley Water District. The City of Coachella serves a population of approximately 42,591, whereas the Coachella Valley Water District (under three separate water system names including Cove Community, I.D. No. 10, and I.D. No. 8) serves a population estimated at nearly 211,000 (http://oaspub.epa.gov/enviro/ based on data extracted on February 10, 2014). Several smaller water systems that serve less than 100 people, such as the Coachella Valley Public Cemetery and the Coachella Valley Facility, and private wells, may occur in unincorporated parts of the study area. Groundwater is the primary water source type for all of these water systems. The City of Coachella owns and operates four wells, with a water production capacity from all wells of 5,000 gallons per minute (gpm). The wells tap groundwater from deep aquifers at depths of between 400 and 1,000 feet (ESA, 2009).

According to the EPA Safe Drinking Water Information System, available at www.epa.gov/enviro /html/sdwis/sdwis_ov.html, the City of Coachella has had five monitoring and reporting violations in the last 14 years, since 2000. These violations are listed in Table 5-3 below. Although having any violations is a concern, this is in fact a good record, as the EPA indicates that in 2005, the last fiscal year for which the EPA has complete data, 24 percent of all water purveyors had a reporting/monitoring violation, 6.1 percent reported a MCL violation, and 1.5

percent reported a treatment technique violation. During the same time period, the Coachella Valley Water District has had no health violations, or monitoring and reporting violations.

Table 5-3: Violations Reported by the City of Coachella Water Department for 2000-2011

Type of Violation	Sampling Period	Contaminant	Comments
Monitoring and Reporting	April 1 – June 30, 2009	Chlorine	Issued a formal Notice of Violation on August 20, 2009
Monitoring and Reporting	Jan 1 – March 31, 2009	Chlorine	Issued a formal Notice of Violation on August 20, 2009
Monitoring Repeat Major	May 1 – May 31, 2004	Coliform	Issued an Action Order without penalty on July 2, 2004 Achieved compliance on July 2, 2004
Monitoring and Reporting	Jan 1 – March 31, 2004	Chlorine	Issued a formal Notice of Violation on August 20, 2009
Initial Tap Sampling for Lead and Copper	June 30, 1993 to March 1, 2000	Lead and Copper Rule	Achieved Federal Compliance on March 1, 2000

Source: Environmental Protection Agency website webpage, at http://oaspub.epa.gov/enviro/, data search made on May 24, 2014, with results based on data extracted on February 10, 2014.

5.4.1.2 Perchlorate

A contaminant that California water agencies are increasingly testing for is perchlorate. Perchlorates are negatively charged molecules that are highly persistent in the environment, lasting decades under typical groundwater and surface conditions. Perchlorate salts are used extensively in several industries. For example, ammonium perchlorate is used as a booster or oxidant for solid fuel powering rockets and missiles, in explosives, and for chemical processes and pyrotechnics. Ammonium perchlorate typically constitutes 60 to 75 percent of missile propellant and about 70 percent of space shuttle rocket motors. Potassium perchlorate is also used as a solid rocket fuel oxidizer, and in flares and pyrotechnics. Sodium perchlorate is used as a precursor to potassium and ammonium perchlorate, and in explosives. Magnesium perchlorate is used in military batteries (Rogers, 1998). Perchlorate salts are used in automobile air bags, as a component of air bag inflators, and in nuclear reactors and electronic tubes. Other commercial and industrial uses of perchlorate salts include: as additives in lubricating oils; as fixatives (mordants) for fabrics and dyes, in the production of paints and enamels, tanning and finishing of leathers; electroplating; aluminum refining; and the manufacture of rubber (Siddiqui et al., 1998).

Humans exposed to perchlorate are likely to absorb this compound primarily through ingestion, either by drinking water with perchlorate, or possibly by ingesting produce (such as lettuce or other vegetables that store water) that has been irrigated with water containing perchlorate. Although studies indicate that most ingested perchlorate is eliminated rapidly in the urine without being metabolized (Eichler and Hackenthal, 1962; Anbar et al., 1959), small amounts of perchlorate can displace iodide in the thyroid gland. In adults, this can lead to hypothyroidism and goiter (enlarged thyroid). Symptoms and effects of hypothyroidism include depression and slow metabolism. In children, the thyroid plays a major role in proper development. Impairment of thyroid function in expectant mothers and newborns can result in delayed development and decreased learning capability. Even temporary disruptions in thyroid function can cause permanent physical and mental impairment, including mental retardation, speech impairments, deafness and/or mutism, impaired fine motor skills, delayed reflexes and gait disturbances.

In 2004, the California's Office of Environmental Health Hazard Assessment (OEHHA) established a public health goal (PHG) of 6.0 micrograms per liter (µg/L) for perchlorate (www.dhs.ca.gov/ps/ddwem/
chemicals/perchl/perchlorateMCL.htm). Effective October 2007, perchlorate became a regulated drinking water contaminant in California, with a maximum contaminant level (MCL) of 6 µg/L. In January 2011, and following the review of new data on environmental exposures to and possible effects of perchlorate primarily on infants, the OEHHA submitted a proposal to reduce perchlorate's Public Health Goal (PHG) from 6 µg/L to 1 µg/L. In December 2012, the OEHHA released a revised draft of the 2011 document, again supporting the reduction of perchlorate's PHG to 1 µg/L.

Perchlorate in relatively small amounts was detected in the early 2000s in water samples from a few wells in the Coachella Valley, including one well in La Quinta, one well in Palm Springs, and at least three wells in the Torres Martinez Indian Reservation (The Desert Sun, January 10, 2003; B. Spillman, The Desert Sun, January 11, 2005). Then, in February and March 2007, the U.S. Geological Survey, in cooperation with the State Water Resources Control Board, sampled 35 wells in the Coachella Valley Study Unit as part of the Groundwater Ambient Monitoring and Assessment (GAMA) Program. Of the 35 wells sampled, 19 were spatially distributed, selected based on a randomized grid-based method to provide a statistical representation of the study region. The other 16 wells were selected to evaluate changes in water chemistry along a specific groundwater flow path, to evaluate land-use impacts on water quality, or to collect groundwater data where little data was previously available. Of the 35 wells sampled, twelve (34%) were found to contain perchlorate, although in most wells, the concentration of perchlorate was less than 1 µg/L. Only two of the water wells sampled had concentrations above the PHG of 6.0 µg/L; one well in La Quinta (9.0 µg/L), and one well southwest of Mecca (6.1 µg/L) (Goldrath et al., 2009).

Perchlorate contamination of some of the Coachella Valley groundwater is thought to be the result of irrigation with Colorado River water. In 1997, Colorado River water was found to be impacted with perchlorate that had been released from the Kerr-McGee Chemical LLC (now Tronox LLC) manufacturing facility and from the former Pacific Electrochemical Production Company, both in Nevada. Groundwater and surface water contaminated with perchlorate released from these facilities entered the Las Vegas Wash upstream of Lake Mead, which feeds the Colorado River. Mitigation measures implemented since 1999 have reportedly significantly reduced the concentration of perchlorate entering the Las Vegas Wash. As a result, reportedly the concentration of perchlorate in Lower Colorado River water has also steadily decreased (Coachella Valley District 2010 Urban Water Management Plan, May 2011 Draft). Still, water samples collected from several wells in and around Coachella have reportedly tested positive for perchlorate, with concentrations less than 4 µg/L (RMC, 2013).

5.4.1.3 Hexavalent Chromium

Hexavalent chromium has been detected in hundreds of wells in the Coachella Valley at levels below the 50 µg/L for total chromium established by California in 1977. In December 2010, the California Office of Environmental Health Hazard Assessment proposed a Public Health Goal for hexavalent chromium (chromium-6) of 0.02 µg/L. In January 2011, the U.S. Environmental Protection Agency recommended that public water systems conduct enhanced testing and monitoring for hexavalent chromium, in addition to total chromium, to better inform their users (the consumers) about the presence of chromium-6 in their drinking water, "evaluate the

degree to which other forms of chromium are transformed into chromium-6 in their drinking water and assess the degree to which existing treatment is affecting the levels of chromium-6" (http://water.epa.gov/drink/info/chromium/
guidance.cfm). Since then, the California Department of Public Health submitted a regulation package establishing a Maximum Contaminant Level for hexavalent chromium in drinking water of 10 µg/L.

There are several wells in the Coachella Valley region with hexavalent chromium groundwater concentrations exceeding a concentration of 10 µg/L, including wells in and around La Quinta, Indio, Coachella, Indian Wells and north Palm Springs (RMC, 2013).

5.4.1.4 Nitrate and Nitrite

Nitrate and nitrite are nitrogen-oxygen combinations that occur in several organic and inorganic compounds. Nitrates are used extensively in fertilizers and are thus found in agricultural areas and landscaped areas where fertilizers are used extensively. Other sources of nitrates include leaks from septic tanks and leaching fields, and erosion of natural deposits. Nitrate does not bind well with soil and typically makes its way into the groundwater where it can impact the drinking aquifers. Drinking water with high concentrations of nitrates can have a serious health hazard, especially to infants. The Maximum Contaminant Level for nitrate is 10 parts per million (ppm or mg/L) as nitrogen, and 45 ppm as nitrate (http://water.epa.gov/drink/contaminants/ basicinformation/nitrate.cfm; Coachella Valley Water District 2010 Urban Water Management Plan, May 2011 Draft). Nitrate at concentrations above the MCL has been detected in some wells in the Cove Communities area (Coachella Valley Water District 2010 Urban Water Management Plan, May 2011 Draft, Goldrath et al., 2009). Several mitigation measures have been proposed to reduce the risk of nitrate migration into the deep, drinking-water bearing aquifers.

Other quality issues of concern, or constituents of special interest in the Coachella Valley that are being monitored, and where necessary, remediated for, include salinity (in the form of high Total Dissolved Solids), arsenic, and solvents with carcinogenic properties. Concentrations of naturally occurring **arsenic** have been detected in several wells in the Coachella Valley at levels above the State-adopted Maximum Contaminant Level of 10 µg/L. As a result, the Coachella Valley Water District has built and is operating facilities that reduce, via an ion-exchange process, the amount of arsenic present in those municipal water wells that exceed the MCL. Arsenic at relatively high concentrations has reportedly also been detected in water wells in Coachella, Mecca, Oasis and Thermal (Coachella Valley Water District 2010 Urban Water Management Plan, May 2011 Draft).

5.5 Household Hazardous Waste and Recycling

According to The American Red Cross (1994), most victims of chemical accidents are injured at home. These accidents usually result from ignorance or carelessness in using flammable, combustible or corrosive materials. This is not surprising considering that households do use environmentally significant quantities of hazardous materials. For example, FEMA has estimated that in an average city of 100,000 residents, 23.5 tons of toilet bowl cleaner, 13.5 tons of liquid household cleaners, and 3.5 tons of motor oil are discharged into the sewer and storm drain systems each month (http://www.fema.gov/hazard /hazmat/backgrounder.shtm). However, with the development of new, "greener" products, and recognizing that sensitive individuals can react to many of the chemicals used in these products, many people find themselves with unused household hazardous waste that they need to dispose off properly. Good, usable leftovers of these products can be donated to willing recipients, such as family members, neighbors and community organizations like churches. But others will want to deliver these substances to an appropriate collection center.

The Riverside County Waste Management Department has adopted a Household Hazardous Waste and Oil-Recycling program free to residents, in accordance with the California Integrated Solid Waste Management Act of 1989 (AB 939). The County has established several permanent and temporary regional household hazardous waste collection centers, in addition to Regional Antifreeze, Batteries, Oil (and Filters), and Paint (Latex only) (ABOP) Only Collection Centers. Those permanent and temporary facilities within approximately 25 miles of the City of Coachella are listed in Table 5-4 below. Personnel who have been trained in hazardous waste handling and emergency response procedures operate these facilities.

At the permanent waste collection centers, a variety of household toxics are accepted, including: chlorine bleach, disinfectants, hair dyes, mercury devices, fiberglass and epoxy resins, paint stripper, paint thinner and turpentine, chemicals used in photo processing, insecticides, pesticides and herbicides, motor oils, rodent poisons, pool/spa chemicals, camp propane tanks, etc. The waste needs to be in its original container or labeled properly. Containers also need to be in good condition, sealed, and not leaking, and the total amount of waste cannot exceed 5 gallons or 50 pounds per trip. Proof of residency in Riverside County is generally required. **For a complete list of acceptable and non-acceptable materials and tips on how to transport these materials, refer to http://www.rivcowm.org/, or call the Household Hazardous Waste Information Hotline at (800) 304-2226**. At the ABOP Only centers, they accept only Antifreeze, Batteries (various kinds, including vehicle batteries), Oil (used motor oil and oil filters), and Paint (latex only).

Several other businesses in and around the City of Coachella, such as The Home Depot, UPS Mailing Centers, Office Depot and similar stores may receive and recycle certain kinds of materials such as used batteries, spent light bulbs, and old electronics. To obtain additional information regarding these facilities, their hours of operation, and the types of waste that they receive, call them directly.

Table 5-4: Regional Household Hazardous Waste Collection Centers

Type	Name	Address	Other Information
Permanent Site	Palm Springs	1100 Vella Road, Palm Springs, CA 92264	City Parking Lot Non-holiday Saturdays only: October – May: 9:00 AM to 2:00 PM June – September: 7:00 AM to Noon
Temporary Site	Coachella	84625 Bagdad Avenue, Coachella, CA 92236	Bagdouma Park Parking Lot Check for event dates and times at http://www.rivcowm.org/HHW_Schedule.htm
Temporary Site	Indio	46-350 Arabia Street, Indio, CA 92201	Date Festival Grounds, Gate 6 Check for event dates and times http://www.rivcowm.org/HHW_Schedule.htm
Temporary Site	La Quinta	78495 Calle Tampico, La Quinta, CA 92253	South City Hall Parking Lot Check for event dates and times http://www.rivcowm.org/HHW_Schedule.htm
Temporary Site	Rancho Mirage	69-825 Highway 111, Rancho Mirage, CA 92270	City Hall Parking Lot Check for event dates and times http://www.rivcowm.org/HHW_Schedule.htm
Temporary Site	Oasis	84-505 84th Avenue, Oasis, CA 92274	Oasis Landfill Check for event dates and times http://www.rivcowm.org/HHW_Schedule.htm

Type	Name	Address	Other Information
Regional ABOP Collection Center	East Coachella Coachella Valley Transfer Station	87-011A Landfill Road, Coachella, CA 92236	Monday – Friday: 8:00 AM to 5:00 PM Saturdays: 8:00 AM to Noon (760) 863-4094
Regional ABOP Collection Center	North-West Coachella Valley Area	Edom Hill Transfer Station 70-100 Edom Hill Road Cathedral City, CA 92235	Non-holiday Saturdays only: 8:00 AM to 4:30 PM (760) 340-2113

Waste collection, in the form of curbside pick-up and recycling services, in the City of Coachella is provided by **Burrtec**. Their phone number is **(760) 393-0635**, and their website is http://www.burrtec.com/coachella. Burrtec has a series of programs designed to reduce the amount of waste that is taken to the landfill. Their waste reduction and recycling programs include separate containers for grass and composting materials, recyclable materials (paper, glass, aluminum, cardboard, etc.), and non-recyclable trash. Additional residential services provided by Burrtec include pick-up of bulky items, Christmas tree recycling, pick-up of electronic waste, and used motor oil collection. Information on which items are recyclable and which are non-recyclable, motor oil recycling and the recycling of electronic waste is provided on Burrtec's website.

Burrtec operates the two transfer stations closest to Coachella, including the Coachella Valley Transfer Station and the Edom Hill Transfer Station (see Table 5-5). Transfer stations are facilities that serve as local collection points prior to the final disposal site, where waste is separated into types, and sent to the appropriate final destinations. Burrtec operates several landfills in the southern California area. Those closest to Coachella include the Salton City Landfill (Highway 86, Salton City) and the Landers Landfill (59200 Winters Road, Landers). Riverside County has several other active landfills in the region. Those closest to Coachella include Meca II, Oasis, and Lamb Canyon Road (see Table 5-5).

There are three land disposal sites in the Coachella General Plan area listed in GeoTracker. These are also summarized in Table 5-5 below.

Table 5-5: Transfer Stations, Active Landfills and Land Disposal Sites In and Near the Coachella General Plan Area

Name	Address	Status with Geotracker	GeoTracker ID No.	Comments
Coachella Valley Transfer Station	87-011 Landfill Road, Coachella, CA 92236	Not in GeoTracker		Operated by Burrtec. Accepts solid waste, household refuse, yard trimmings, furniture, appliances, televisions and computers, and electronic waste.
Edom Hill Transfer Station	70-100 Edom Hill Road Cathedral City, CA 92235	Not in GeoTracker		Operated by Burrtec. Accepts solid waste, household refuse, yard trimmings, furniture, appliances, televisions and computers, and electronic

Name	Address	Status with Geotracker	GeoTracker ID No.	Comments
				waste.
Mecca II Sanitary Landfill	95250 66th Avenue, Mecca, CA 92254	Not in GeoTracker		Owned and operated by the Riverside County Waste Management Department. Accepts solid waste, household refuse, yard trimmings, furniture, tires, appliances, televisions and computers, and electronic waste.
Oasis Landfill	84-505 84th Avenue, Oasis, CA 92274	Not in GeoTracker.		Owned and operated by the Riverside County Waste Management Department. Accepts solid waste, household refuse, yard trimmings, furniture, tires, appliances, televisions and computers, and electronic waste.
Lamb Canyon Sanitary Landfill	16411 Lamb Canyon Road, Beaumont, CA 92223	Not in GeoTracker		Owned and operated by the Riverside County Waste Management Department. Accepts solid waste, household refuse, yard trimmings, furniture, tires, appliances, televisions and computers, and electronic waste.
Coachella Class III WMF 01-098 (non-hazardous residential, agricultural, construction, industrial, mixed municipal and dead animals).	87011 44th Avenue, Coachella, CA 92236	Open Case. Contamination associated with a diesel fuel area was reported in 2000. Groundwater samples from monitoring wells have tested positive for nitrate, tetrachloroethene, and trichloroethene. Site is equipped with a landfill gas collection system, and semi-annual groundwater sampling and monitoring reports are submitted to the RWQCB.	L10003659217	The facility, which is owned and maintained by the Riverside County Waste Management Department, is closed and no longer receives refuse. The site opened in 1972; approximately 67 acres of the 640-acre site was filled with refuse. Last load of trash received in May 1997. Closure construction was completed in August 1999.
Armtec Defense Products 02-106	85901 Avenue 53, Coachella	Open Case.	L10007426352	Classified as a Land Disposal Site; open case as of 1/1/1965, although no site history is available in GeoTracker.
California	83109 Avenue 62,	Open Case.	L10005617105	Classified as a Land

Name	Address	Status with Geotracker	GeoTracker ID No.	Comments
Biomass 02-118	Thermal, CA 92274			Disposal Site; open case as of 1/1/1965, although no site history is available in GeoTracker.

Sources: http://www.burrtec.com/coachella; http://www.rivcowm.org; http://geotracker.swrcb.ca.gov/

5.6 Releases due to Transportation Accidents and Pipeline Failures

Interstate 10 traverses the northern half of the city and planning area in an approximately east-west direction. According to the National Hazardous Materials Route Registry maintained by the Federal Motor Carrier Safety Administration, a division of the U.S. Department of Transportation, the only major route in the Coachella area prescribed or permitted to carry hazardous materials is Interstate 10. All types of hazardous materials are permitted on this road, and it is recommended for the transport of Class 1 Explosives, Class 7 highway road-controlled quantity (HRCQ) radioactive, and toxic inhalation hazard (TIH) materials. The sections of State Routes 86 and 111 that extend through Coachella are not on the registry.

As a result, Interstate 10 poses a potential for spills or leaks from non-stationary sources to occur within the area. Vehicles carrying hazardous materials are required to have placards that indicate at a glance the chemicals being carried, and whether or not they are corrosive, flammable or explosive. The conductors are required to carry detailed "material data sheets" for each of the substances on board. These documents are designed to help emergency response personnel assess the situation immediately upon arrival at the scene of an accident, and take the appropriate precautionary and mitigation measures. The California Highway Patrol is in charge of spills that occur in or along freeways, with Caltrans, and local sheriffs and local fire departments responsible for providing additional enforcement and routing assistance.

Railroad tracks of the Union Pacific extend across the Coachella planning area on their way from San Bernardino to Yuma, Arizona. These tracks serve two Amtrak trains in addition to Union Pacific's traffic to and from Arizona, Texas and the southeastern U.S. The Union Pacific freight trains carry a variety of cargo, including hazardous materials that may consist of flammable liquids and gases, toxic substances that may react if exposed to air or water, and explosives (Byers, 2008). A train accident, for example, as a result of a collision between a locomotive and a vehicle attempting to cross the tracks at the same time, could result in the derailment of the train, and the release of hazardous substances. Given that the railroad tracks extend across the business section of Coachella, a hazardous release from an overturned or derailed train could result in a serious public threat. As with trucks on the interstate, cargo trains transporting hazardous materials are required to carry detailed paperwork indicating the substances on board, in addition to placards on the cars carrying the hazardous materials. Agencies responding to such an incident would include the Riverside County Fire Department's Hazmat Team, the Riverside County Department of Environmental Health – Hazardous Materials Division, the California Highway Patrol and local police department to control traffic around the accident location and conduct and enforce evacuations if necessary, and Union Pacific contractors to right the derailed or overturned train and fix the track. It is important to note that less than 2 percent of train accidents or incidents result in a hazardous material release. For example, according to statistics compiled by the Federal Railroad Administration, only 21 of the 1,868 (1.2%) train accidents reported in the United States in 2010 resulted in a release of hazardous materials. Forty railroad cars were implicated in the releases, and 1,682 people were evacuated as a result of these incidents. Between January and April 2011, only seven of the 635 (1.07%) train accidents resulted in a release of hazardous materials, resulting in the evacuation of 145 people. Similarly, in calendar year 2013, 1,781 train accidents occurred in the United

States. Of those, 18 (1%) resulted in the release of hazardous materials (http://safetydata.fra.dot.gov/OfficeofSafety/).

In the Coachella planning area the railroad tracks run sub-parallel to, and approximately 2 to 2.5 miles east of the San Andreas fault zone, and as a result, should the San Andreas fault rupture, this section of railroad track will not be impacted by surface ground rupture, although ground deformation as a result of liquefaction may occur along some sections traversed by the railroad (see Chapter 1). Sections of the railroad track extend immediately along or cross the San Andreas fault to the south, in the Desert Beach and Bombay Beach areas respectively, and to the north of Palm Springs, where the Garnet Hill fault is mapped. Trains can derail if they attempt to run over tracks that have been damaged by surface fault rupture or some other kind of earthquake-induced ground failure. This is what happened to Amtrak's Southwest Chief passenger train on October 16, 1999, immediately following the Hector Mine earthquake in the Mojave Desert. The westbound passenger train, en route from Chicago to Los Angeles, derailed near Ludlow, California about 24 minutes after the earthquake occurred, when it reached a section of track that had been damaged by ground deformation. The train was running at reduced speed, in accordance with the American Railway Engineering and Maintenance-of-Way Association (AREMA, 2009 as reported in Byers, 2011) guidelines that require trains within 100 miles of a location reporting earthquake shaking to operate at restricted speed, and as a result, only four out of the 155 passengers on board suffered minor injuries.

Trains running at the time of the earthquake near the epicenter could also derail as a result of strong ground shaking, although this does not occur always. For example, trains running in areas shaken intensely during the 1999 Izmit, Turkey and 2001 Bhuj, India, earthquakes, did not derail (Byers, 2008). The mechanisms required for trains to derail or overturn as a result of ground shaking are not well understood, but the direction of shaking, the magnitude of the earthquake, and the duration of the acceleration are all thought to be part of the equation. The probability of an earthquake-induced derailment of a train carrying hazardous materials through the City of Coachella is considered low. The same agencies identified above would be responsible for responding if such an incident occurred, but their response times would be greatly impacted by the damage to the roads, freeways and railroad tracks, in addition to competing requests for assistance from many other incidents throughout the region. For additional information regarding the potential impacts as a result of a local earthquake on the San Andreas fault, refer to Chapter 1, Section 1.9.

Two Southern California Gas transmission pipelines and one hazardous liquid (Kinder-Morgan's 20-inch diesel) pipeline extend across and near the city of Coachella (https://www.npms.phmsa.dot.gov/searchp/Application.asp; Ballantyne, 2008) (see Plate 5-1). Other smaller product and gas pipelines extend through the area. Rupture of any portion of these pipelines could adversely impact the surrounding area. Leaks from pipelines extending across the region have been reported in the past (see Table 5-6).

Pipeline operators are responsible for the continuous maintenance and monitoring of their pipelines to evaluate and repair, when necessary, corroded sections of pipe that no longer meet pipeline-strength criteria. All excavations or drilling operations near pipelines, or anywhere else, for that matter, should be conducted only after proper clearance by the appropriate utility agencies or companies. California law requires that all excavations be cleared in advance. This is done locally by the **Underground Service Alert of Southern California,** or **DigAlert** (http://www.digalert.com or www.call811.com). Their telephone number is **8-1-1.** Calls need to be made at least two (2) working days before digging, and the proposed excavation area needs to be delineated or marked.

Table 5-6: Pipeline and Equipment Releases That Have Been Reported in the Coachella Area

Site Name	Address	State Case No.	Case Type	Status, Contaminant	Date Leak Discovered
Escher Oil Company	85-119 Avenue 50	SL0606529297	O	2, D, G	10/1/1986
Former Unocal/Tosco Bulk Plant	50-021 Harrison Street	SL0606515826	O	4, D, G (closed 12/17/13)	3/15/1991
Kinder Morgan Energy Partners	85989 Avenue 52	SL0606535159	O	3, O	6/14/1990
Santa Fe Pacific Pipeline Partners	Avenue 52 and Highway 111	SL20703104	O	3, P	4/1/1994

Source: GeoTracker (http://geotracker.swrcb.ca.gov/)

Abbreviations Used for Case Type: O = Other groundwater (uses other than drinking water).
Abbreviations Used for Status: 1 = Case Opened; **2** = Site Assessment; **3** = Remediation; 4 = Case Closed.
Abbreviations Used for Contaminant: D = Diesel; **G** = Gasoline; **O** = Waste Oil / Motor / Hydraulic / Lubricating; **P** = Petroleum / Fuels / Oils, Volatile Organic Compounds.

Pipeline and power line failures during an earthquake are more often the result of permanent ground deformations, including fault rupture, liquefaction, landslides, and consolidation of loose granular soils. Tectonic uplift or subsidence can also impact a pipeline. Seismic shaking typically has less of an impact on buried utilities than it does on aboveground structures. The city of Coachella is bisected by the San Andreas fault, so the hazard of surface fault rupture and its potential impact on the city's utilities distribution system is high (see Chapter 1, Section 1.9.6). In addition, Coachella is located near several other major seismic sources, such as the Anza segment of the San Jacinto fault to the west, the Pisgah-Bullion Mountain-Mesquite Lake fault to the north-northeast, and the Pinto Mountain fault, also to the north, any of which could generate significant ground shaking in the area. Liquefaction and earthquake-induced settlement as a result of an earthquake on any of these seismic sources have the potential to locally impact pipelines, power lines, communication towers, and other lifelines that service Coachella.

The gas transmission pipelines mentioned above and shown on Plate 5-1 extend along and across the San Andreas fault zone to the north and northwest of the General Plan study area. Given the large displacements expected along the San Andreas fault when this section of the fault ruptures next, the pipelines are expected to rupture where they cross or overlie the fault. Gas would be spewed into the air, and if there are ignition sources nearby, a fire can ensue. Although the hazardous fluid pipeline that extends across Coachella does not cross the San Andreas fault in the planning area, strong ground shaking is expected to cause several breaks of the pipeline, in addition to a significant break of the line in the Palm Springs area, where it crosses the San Andreas fault (Ballantyne, 2008). Cleanup of the spilled petroleum product will be required at all breaks along the pipeline.

5.7 Earthquake-Induced Releases of Hazardous Materials

Isolated unauthorized releases of hazardous materials can occur at any time, but natural disasters, such as an earthquake or flood, have the potential to cause several incidents at the same time. Strong seismic shaking can lead to the release of hazardous materials by damaging storage facilities and transport infrastructure. During an earthquake, chemical storage tanks could buckle or, if improperly secured and fastened, could easily be punctured and/or tipped over. Improperly segregated chemicals could react forming a toxic gas cloud. Even small amounts of chemicals, if kept in breakable containers and stored together (like in the same chemical closet at a high school chemistry lab or the same aisle at the grocery store), could result in a potentially hazardous situation if the containers break and the chemicals react with each other. As discussed in the section above, pipelines are especially vulnerable to damage as they can be pulled apart or ruptured by strong ground motion and surface ground deformation. Natural gas lines pose a significant hazard due to the high number of pipelines in urban environments and because gas leaks from ruptured lines can lead to secondary fires. Train derailment during an earthquake can also lead to significant hazardous materials release.

As a result of the Northridge earthquake, 134 locations reported hazardous materials issues, 60 of which required emergency responses. The majority of these events occurred where structural damage was minimal or absent (Perry and Lindell, 1995). The earthquake caused 1,377 breaks in the natural gas pipeline system and half a dozen leaks in a 10-inch crude oil pipeline (Hall, 1994). A train derailment following the Northridge earthquake included a train with 29 cars and one locomotive. One of the cars spilled an estimated 2,000 gallons of sulfuric acid, and 1,000 gallons of diesel fuel spilled from the locomotive.

The M5.9 Whittier Narrows earthquake in 1987 was nearly 100 times smaller than the ShakeOut earthquake scenario on the San Andreas fault discussed at length in Chapter 1 (see Section 1.9), and yet, 22 hazardous materials release incidents were reported as a result of the shaking. The most significant of these incidents was the release, from a collapsed tank in a chlorine re-packaging facility, of nearly one ton of chlorine gas (FEMA, 1997; Eguchi and Ghosh, 2008). This leak caused the evacuation of a neighborhood in Santa Fe Springs. The Whittier Narrows earthquake also caused over 1,400 natural gas leaks, three of which caused subsequent fires. At least 5,000 pounds of anhydrous ammonia were released in 1989, during the Loma Prieta earthquake, at a food processing plant in Watsonville (ABAG, 1990; Seligson et al., 1992).

The facilities listed in previous sections of this report that manufacture, use or store hazardous materials are for the most part using chemical substances that occur in a liquid or solid state at normal temperatures and pressures. A leak of any of these substances (such as ethylbenzene, n-hexane and xylene reportedly used by ARMTEC Defense Products) would impact the underlying soils and have the potential to impact the groundwater under the site. While such a release and subsequent contamination would be unfortunate and would require extensive resources to cleanup, it would not pose an immediate danger to the surrounding population. Past studies of hazardous materials release scenarios as a result of an earthquake have concentrated on the two substances that are thought to pose the biggest threat to a community during an earthquake: Chlorine and anhydrous ammonia. These substances, under normal temperature and pressures, occur in a gas state, and thus if released to the atmosphere, form clouds that can spread to adjacent areas, posing a threat to the surrounding community.

Chlorine is one of the products most often used as a disinfectant by swimming pool, drinking water and wastewater facilities, making chlorine one of the most prevalent extremely hazardous substances. Chlorine is typically found in the form of a colorless to amber-colored liquid, or as a greenish-yellow gas with a characteristic odor. The liquid solutions are generally very unstable, reacting with acids to release chlorine gas (such as bleach mixed with vinegar or toilet bowl cleaner containing hydrochloric acid). Mixing bleach with other products is the largest single source of inhalation exposure reported to poison control centers (http://www.emedicine.com/EMERG/topic851.htm). Chlorine gas is heavier than air and therefore stays close to the ground, where it can impact individuals. Exposure to chlorine gas generally impacts the respiratory system, with cough, shortness of breath, chest pain, and burning sensation in the throat reported as the most common symptoms. Respiratory distress can occur at even low concentrations of less than 20 parts per million (ppm). At high concentrations (> 800 parts per million – ppm) chlorine gas is lethal.

Ammonia is a compound of hydrogen and nitrogen that is used extensively, either directly or indirectly, in several different types of applications, including the manufacture of pharmaceuticals, fertilizers, and commercial cleaning products. The colorless gas has a strong pungent odor, an unlike chlorine gas, is lighter than air. Exposure to high concentrations of ammonia can lead to lung damage and death. Solutions of ammonia can be irritating to the eyes and mucous membranes, and to a lesser extent, the skin. Mixture of an ammonia solution with a chlorine-containing compound, such as bleach, can result in the formation of a highly poisonous gas.

Chlorine pellets, chlorine solutions and ammonia solutions can be found at supermarkets, hardware stores and other locations that sell pool supplies and cleaning products. Bleach and ammonia solutions can be found in almost every household and in commercial and industrial facilities, including hotels, hospitals, medical and veterinary facilities, etc. Proper storage and usage practices are required at all of these locations to reduce or eliminate the potential for a toxic release of chlorine, ammonia, or even worse, a mixture of the two. Chlorine and ammonia are used in or near the Coachella planning area, at the two wastewater treatments plants (the Coachella Sanitary District Wastewater Treatment Plant in Coachella, and the Valley Sanitary District Wastewater Treatment Plant in Indio, less than a mile to the northwest of Coachella) (http://www.epa.gov/enviro/index.html; search for chlorine and ammonia users in the Coachella area). Chlorine is also likely to be used by the City at its water storage facilities to treat the municipal supply of drinking water. Proper operations and maintenance procedures are required to prevent equipment and process failures that could lead to the unauthorized release of these substances at concentrations that could impact the surrounding areas. These facilities are required to maintain a comprehensive program of personnel training, security enforcement and equipment monitoring to reduce the risk of an accidental or intentional (terrorist) release.

A key point to remember regarding the management of hazardous materials spills in the aftermath of an earthquake is that it is substantially more difficult to do so than under non-earthquake conditions. Hazardous material response teams responding to a release as a result of an earthquake have to deal with potential structural and non-structural problems of the buildings housing the hazardous materials, potential leaks of natural gas from ruptured pipes, and/or downed electrical lines or equipment that could create sparks and cause a fire. When two hazards with potentially high negative consequences happen coincidently, the challenges of managing each are greatly increased. During an earthquake response, hazardous material emergencies become an additional threat that must be integrated into the response management system.

5.8 Other Potential Hazardous Materials Release Incidents

Petroleum contains several components that are considered hazardous by the state of California, such as benzene, a known carcinogen. Oil field activities often include the use of hazardous materials like fuels and solvents. Day-to-day practices in some of the earlier oil fields were not environmentally sensitive, and oil-stained soils and other contaminants can often be found in and around oil fields. This typically becomes an issue when the oil field is no longer economically productive, and the property is developed, usually for residential purposes. Assessing the feasibility of developing an oil field property requires comprehensive site investigations in order to accurately identify and characterize any soil and groundwater contamination that may have resulted from the oil field operations. These site investigations are required by local and/or regional environmental laws and regulations, and vary in scope according to applicable government regulations, generally accepted standards of practice, and site-specific conditions (Fakhoury and Patton, 1992).

According to records from the California Division of Oil, Gas and Geothermal Resources (CDOGGR; http://www.conservation.ca.gov/dog/maps/Pages/index_map.aspx), no oil or geothermal wells have been drilled in the Coachella area. Thus issues associated with oil and gas production are not anticipated to be significant in the region.

5.9 Hazard Analysis

The primary concern associated with a hazardous materials release is the short- and/or long-term effect to the public from exposure to the hazardous substance, especially if a toxic gas is involved. The best way to reduce the risk posed by a hazardous material release is enforcement of stringent regulations governing the storage, use, manufacturing, and handling of hazardous materials.

The City of Coachella observes the most current version of the California Fire Code (currently the 2013 edition that was adopted in January 2014) for usage, storage, handling and transportation requirements for hazardous materials. Risk minimization criteria include secondary containment, segregation of chemicals to reduce reactivity during a release, sprinkler and alarm systems, monitoring, venting and auto shutoff equipment, and treatment requirements for toxic gas releases.

There are four reported Significant Hazardous Materials Sites in the Coachella General Plan area. A Significant Hazardous Materials Site, as used herein, includes facilities identified in Federal and/or State databases as Superfund-Active or Archived Sites (CERCLIS), Cortese List, RCRA/RCRIS-EPA registered Large-Quantity Hazardous Waste Generators, and Toxic Release Inventory Sites (TRIs). As of 2011, there were also 21 reported Small-Quantity Generators of hazardous materials in the Coachella General Plan area. Compared to other cities in southern California, Coachella at this time has a relatively small number of facilities that use or store hazardous materials. Nevertheless, several of the existing significant hazardous sites are located within about 1 mile of schools in the community (see Plate 5-1). Furthermore, this is a snapshot in time, and as the city continues to grow, more, especially small-quantity generators of hazardous materials are expected to be located in the area. City planners are advised to encourage the establishment of future significant hazardous materials sites in the city in areas far away from critical facilities with evacuation constraints, such as schools and nursing homes. Facilities that use, store, generate or transport hazardous materials are also expected to come and go; so these lists, or comparable lists, should be updated at least once a year. Residents and property and business owners that are interested in obtaining current data for a particular area or site should request it from the Riverside County Department of Environmental Health, Hazardous Materials Division, or by visiting the appropriate websites referenced herein.

The Coachella area is bisected by the San Andreas fault, and is located about 20 miles of the Anza segment of the San Jacinto fault. The San Andreas and San Jacinto faults are both thought to have a relatively high probability of generating an earthquake in the next 30 years (see Chapter 1). Therefore, all hazardous materials sites in Coachella could be subject to moderate to severe seismic shaking. Their business plans should address, provide and implement mitigation measures designed to reduce the potential for releases of hazardous materials during an earthquake. It has been shown in previous urban earthquakes that hazardous materials spills can occur even when the building does not suffer significant damage. Hazardous material containers not properly secured and fastened could easily be punctured and/or tipped over, pipes may rupture, and storage tanks may fail. Containers may also explode if subject to high temperatures, such as those generated by a fire. Improperly segregated chemicals could react forming a toxic gas cloud. In a worst-case scenario, several hazardous materials releases could occur simultaneously. Comparison of Plate 5-1 with Plates 1-1 and 1-2 shows that two small-quantity generators of hazardous waste and a disposal facility are located very close to the mapped traces of the San Andreas fault. Surface fault rupture at these facilities could result in structural damage and release of the chemical substances stored therein.

Most of the hazardous materials facilities shown on Plate 5-1 are located within the 500-year floodplain (see Plate 3-1), but none are located within the 100-year flood zones defined by either FEMA or the California Department of Water Resources. Avoidance of the 100-year flood zones by facilities using or storing hazardous materials should be continued in the future. Exceptions may be possible in the 100-year zones defined by the Department of Water Resources if all standards of elevation, anchoring, and flood proofing have been satisfied, and hazardous materials are stored in watertight containers designed to not float.

5.10 Summary of Findings

The primary concern associated with a hazardous materials release is the short- and/or long-term effect to the public from exposure to the hazardous materials released. The best way to reduce the possibility for a hazardous material release is by implementing and enforcing stringent regulations governing the storage, use, manufacturing and handling of hazardous materials. Given that the San Andreas fault extends across the Coachella General Plan area, the hazards of surface fault rupture, ground deformation and strong ground shaking, and the impact that these geologic conditions may have on the structural integrity of the storage containers and pipelines carrying hazardous materials need to be considered and planned for.

The entire area will be subjected to intense ground shaking as a result of an earthquake on the southern segment of the San Andreas fault that extends across the planning area (for more information refer to Chapter 1). It has been observed in previous urban earthquakes that hazardous materials spills can occur even when the building housing the materials does not suffer significant damage. Hazardous material containers not properly secured and fastened can easily be punctured and/or tipped over. Improperly segregated chemicals could react, forming a toxic gas cloud. In a worst-case scenario, several hazardous materials releases could occur simultaneously. Therefore, hazardous material sites in Coachella should be designed with secondary containment systems, tank bracing systems, and other engineering solutions to reduce the potential for tanks and containers to tip over during an earthquake. All business plans for sites within the city should address the hazard of intense ground shaking and identify specific measures to be taken to reduce this hazard to an acceptable level.

Most of the significant hazardous materials sites identified in Coachella are located within the 500-year flood zone. None of the sites are located within the 100-year flood zones defined by either FEMA or the California Department of Water Resources. It is recommended that future hazardous materials sites established in Coachella not be located in the 100-year floodplain, unless very specific containment measures are implemented to reduce the potential for hazardous materials to leak during a flood. Furthermore, street flooding as a result of intense storms and inadequate storm drain capacity could result in the flooding of some of the hazardous materials facilities, and rupture of the Coachella Canal due to surface fault rupture or strong ground shaking could also result in the flooding of hazardous materials facilities located in the inundated zones. Therefore, the business plans for all hazardous materials businesses should address the hazards of flooding and of strong ground shaking during an earthquake, and provide for mitigation measures to be implemented to reduce the potential for hazardous materials to leak during a natural disaster.

Several of the existing significant hazardous materials sites are also located within 1 mile of schools and other facilities with populations with special evacuation needs (such as nursing homes). It is advisable to encourage the establishment of any future significant hazardous materials sites in areas far away from critical facilities with evacuation concerns. Furthermore, these critical facilities should have plans that include protocol to be followed in the event of a leak of hazardous materials that would require them to evacuate.

5.10.1 National Pollutant Discharge Elimination System (NPDES)

Urban runoff from the urbanized sections of Coachella discharge into the Whitewater River watershed that is under the Colorado River Regional Board (Region 7) jurisdiction. The city, together with all other incorporated cities in the Coachella Valley, is regulated by a municipal separate storm sewer system (MS4) permit issued by the Regional Board. Under this permit, the County of Riverside and the Riverside County Flood Control and Water Control District are the Principal Permittees, and the Coachella Valley Water District, together with the incorporated cities of Banning, Cathedral City, Coachella, Desert Hot Springs, Indian Wells, Indio, La Quinta, Palm Desert, Palm Springs, and Rancho Mirage, are Co-Permittees. The City of Coachella, as Co-Permittee, has several responsibilities defined by the NPDES permit orders.

5.10.2 Superfund, Hazardous Waste, and Toxic Release Inventory Sites

According to EPA data, there are no Superfund (CERCLIS) sites in the Coachella General Plan area. In 2011, the EPA reported three permitted Large Quantity Generators of hazardous materials in Coachella. One of these sites (ARMTEC Defense Products) is also listed as the only Toxic Release Inventory (TRI) site in the Coachella General Plan area. One site (the Foster-Gardner site) is included in the CORTESE list, in addition to being identified, under a different name, as a Small-Quantity Generator. As of May 10, 2011, there were 21 permitted Small-Quantity Generators of hazardous materials located throughout the city. This figure is expected to increase as the city grows. As of 2014, there are no businesses in Coachella listed in the Department of Toxic Control Substances official database of registered transporters of hazardous waste in California.

5.10.3 Hazardous Materials Disclosure Program

Both the Federal government and the State of California require businesses that handle more than a specified amount of hazardous materials or extremely hazardous materials, termed a reporting quantity, to submit a business plan to the local Certified Unified Program Agency (CUPA). In Coachella, the local CUPA is the Riverside County Department of Environmental Health, Hazardous Materials Division, (RCDEH-HMD); they are responsible for reviewing the annually submitted business plans. For more information refer to their website (http://www.rivcoeh.org/), or contact them by phone at (888) 722-4234 (888-RC-CHA-EH).

5.10.4 Leaking Underground Fuel Tanks

According to data from the State Water Quality Control Board, 37 leaking underground storage tank (LUST) sites were reported in Coachella between 1979 and 2013. Thirty-three of these LUST sites have been remediated and/or considered to not pose a risk to human health and the environment; their cases have been closed by the appropriate regulatory agency. The remaining four are in various states of assessment and/or remediation. Fifteen of these sites reportedly impacted the groundwater in an aquifer used for drinking water purposes, and eleven impacted groundwater in an aquifer not used for drinking purposes. Ten to eleven leaks reportedly impacted the surrounding soil (see the Statewide database, GeoTracker, which is available at http://geotracker.swrcb.ca.gov/). The California Regional Water Quality Control Board (CRWQCB), in cooperation with the County of Riverside Department of Environmental Health – Hazardous Materials Division provides oversight and conducts inspections of all underground tank removals and installation of new ones (http://www.rivcoeh.org/opencms/rivcoeh/ProgServices/EPO_Division/EPO_Home.html). Given that there are at least 16 permitted underground storage tanks in the city, future leaks could be reported. The GeoTracker database should be reviewed periodically for updates.

5.10.5 Water Quality

The City of Coachella Water Department (also known as the Coachella Municipal Water Department) provides drinking water to the residents of the City of Coachella. Residents of the unincorporated areas within the General Plan study area are serviced by the Coachella Valley Water District (with the exception of those residents that have their own water wells). According to the EPA Safe Drinking Water Violation Report, the Coachella Valley Water District has not had any violations reported in the last ten years, whereas the City of Coachella Water Department has had five monitoring and reporting violations in the last fourteen years. These violations have been for the monitoring and reporting of chlorine (two sampling periods in 2009, one in 2004), a monitoring violation of coliform (in 2004), and sampling of lead and copper (in 2000; the water department achieved compliance in March 2000). Compared to State statistics for drinking water violations, the City of Coachella Water Department's record is good.

Perchlorate at relatively low concentrations of less than 4 μg/L (equivalent to parts per billion) has been detected in some wells in the Coachella Valley, including some in and around the city of Coachella (RCM, 2013). Only two of the wells (one in La Quinta and one in southwest of Mecca) tested with concentrations of perchlorate that exceed the current Maximum Contaminant Level established by California of 6 μg/L.

Other substances that have the potential to impact the drinking water aquifers that provide water to the residents of the City of Coachella include naturally occurring arsenic, salinity (in the form of Total Dissolved Solids), hexavalent chromium, nitrates and nitrites, and other man-made contaminants such as solvents and pharmaceuticals. All of these compounds and conditions are being monitored by both the City of Coachella Water Department and the Coachella Valley Water District.

5.10.6 Household Hazardous Waste

Riverside County has adopted a Household Hazardous Waste and Oil-Recycling program that is free to county residents, in accordance with the California Integrated Solid Waste Management Act of 1989. There are a few permanent and temporary facilities in the region where residents from Coachella can drop off their unwanted household hazardous waste. For a list of collection sites, schedules, and types of materials accepted, refer to the Riverside County Waste Management Department at http://www.rivcowm.org/ or call the Household Hazardous Waste Information Hotline at (800) 304-2226. The City of Coachella, together with Burrtec, their trash hauler, have programs designed to reduce the amount of waste taken to the landill. Waste reduction and recycling programs include: curb-side collection service with separate containers for grass clippings and composting materials, recyclables, and non-recyclable trash. For additional information regarding the services provided by Burrtec refer to their website at http://www.burrtec.com/coachella, or call (760) 393-0635.

There is one transfer station in Coachella (Coachella Valley Transfer Station) operated by Burrtec. There is also a now closed landfill in the Coachella General Plan area, the Coachella Class III Waste Management Facility landfill. This facility operated as a municipal solid waste landfill between 1972 and 1997. Several groundwater wells onsite and offsite, near the landfill, are monitored semi-annually for the presence of nitrate, tetrachloroethane and trichloroethene, inorganic compounds that may be leaking out of the landfill and impacting the local water resources. The California Regional Water Control Board has an open file on this site that can be accessed on the GeoTracker website. Two other land disposal sites in the General Plan area are identified by the Regional Water Board, but there is little information regarding these sites with the exception of their name and address.

5.10.7 Releases due to Transportation Accidents and Pipeline Failures

Interstate 10 is the only major route through Coachella that is permitted to transport hazardous materials, including Class I explosives, radioactive and toxic-inhalation hazard materials. Other internal roads may also be used to transport hazardous materials. Hazardous materials are also transported by rail, on the Union Pacific tracks that extend across the business section of Coachella. Both the Interstate 10 and the railroad tracks pose a potential for spills or leaks from a non-stationary source in the event of an accident involving a vehicle carrying hazardous substances. All transportation of hazardous materials needs to be conducted under strict protocol. Material data sheets for each substance being transported need to be carried by the conductor. These data sheets are designed to help emergency response personnel identify the most appropriate action to contain the specific substances involved in the spill. The California Highway Patrol is in charge of spills that occur in or along freeways, with Caltrans, the local sheriffs and fire departments providing additional resources as needed. The Riverside County Department of Environmental Health – Hazardous Materials Division would also provide assistance.

Two gas transmission lines and one hazardous liquid line extend across and near the Coachella General Plan area. Rupture of any portion of these pipes could adversely impact the surrounding area. Rupture of sections of these pipelines could occur if there is significant ground failure, in the form of liquefaction or slope failure, as a result of a large regional earthquake. Pipeline operators are responsible for the continuous maintenance and monitoring of their pipelines, including the repair, when necessary, of corroded sections of pipe. All excavations or drilling operations near pipelines should be conducted only after proper clearance by the appropriate utility agencies or companies. California law requires that all excavations be cleared – this is done by the Underground Service Alert of California or DigAlert (http://www.digalert.com or www.call811.com). Their telephone number is **8-1-1.** Calls need to be made at least two (2) working days before digging, and the proposed excavation area needs to be delineated or marked.

5.10.8 Oil Fields

There are no oil or gas fields in or near Coachella. Environmental issues associated with oil and gas fields are not anticipated in the study area.

CHAPTER 6: SEVERE WEATHER HAZARDS

Severe weather, including high winds, hail, excessive precipitation, wildfires, blizzards, snowstorms and ice storms, dust storms, heat spells and drought, have the potential to cause significant damage to property and infrastructure, cause serious social disruption, and result in injuries and/or loss of life. Many of these hazards can create conditions that disrupt essential systems such as public utilities, telecommunications, and transportation routes. Flooding associated with excessive precipitation and wildfires are discussed in other chapters, although wildfires fanned by winds are also included herein. This chapter discusses primarily high winds, dust storms, hail, temperature extremes, and drought. Historical occurrences of these conditions in the Coachella Valley are summarized as background information, and definitions and terminology associated with each condition are also provided. Climate variability and its effects on regional weather patterns and increased potential for severe weather hazards is also discussed.

6.1 High Winds

This section discusses the specific hazards associated with unusual and potentially damaging wind activity based on scientific data and historical records. In southern California, strong winds may be associated with Santa Ana conditions, thunderstorm-related strong winds and tornadoes, and macrobursts and microbursts. Each of these strong wind conditions is discussed further in the subsections below. In addition, strong wind activity combined with loose soil in an arid or semi-arid environment such as southern California's can result in dust storms. These are also discussed below.

6.1.1 Definitions and Setting

Wind is air that is in motion relative to the earth. It generally has both horizontal and vertical components, but the horizontal component normally dominates (National Research Council, Committee on Natural Disasters, NRC-CND, 1993). Due to friction, wind speed drops off at the ground surface, with approximately 50 percent of the transition in wind speed due to the frictional forces exerted by the ground surface occurring in the first six feet above the ground. As a result, "near-surface wind is the most variable of all meteorological events" (NRC-CND, 1993), and it commonly consists of a combination of high-frequency oscillations in both speed and direction superimposed on a more consistent flow with a prevailing speed and direction. With an increase in wind speed, the high-frequency oscillations can become more abrupt and of greater amplitude – these are referred to as wind gusts. Because wind speeds vary as a function of height, time and the terrain upwind, it is difficult to obtain a value that is representative of the wind speeds over a large region. The recommended convention for measuring wind speed is at a height of 33 feet (10 m), in flat, open terrain, such as that provided by an airport field. Temporal variations are taken into account by averaging speed and direction over a given time, typically 1-minute averages for sustained wind, and 2- to 5-second averages for peak or extreme winds. The mean annual wind speed for the contiguous 48 states is 8 to 12 miles per hour (mph), with most areas of the country frequently experiencing 50-mph winds (NRC-CND, 1993).

To better appreciate the impact that wind has on the sea and land, and the wind speeds required to move different objects, refer to the Beaufort Scale in Table 6-1, below. This scale was developed by Sir Francis Beaufort in 1805 to illustrate and measure the effect that varying wind speed can have on sea swells and structures. Note that the highest wind speeds in the Beaufort Scale approach the lowest wind speed on the Fujita Scale presented in Table 6-2.

Table 6-1: The Beaufort Scale

Beaufort Force	Wind Speed (mph/ knots)	*Wind Description* – State of Sea – Effects on Land
0	< 1 / <1	*Calm* – Mirror-like – Smoke rises vertically.
1	1 - 3 / 1 - 3	*Light* – Scaly ripples; no foam crests – Smoke drifts show direction of wind, but wind vanes do not.
2	4 - 7 / 4 - 6	*Light Breeze* – Small but pronounced wavelets; crests do not break – Wind vanes move; leaves rustle; you can feel wind on face.
3	8 - 12 / 7 - 10	*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 / 11 - 16	*Moderate Breeze* – Small (1-4 ft) waves; numerous whitecaps – Wind lifts dust and loose paper; small tree branches move.
5	19 - 24 / 17 - 21	*Fresh breeze* – Moderate (4-8 ft) waves taking longer to form; many whitecaps; some spray – Small trees with leaves begin to move.
6	25 - 31 / 22 - 27	*Strong Breeze* – Some large (8-13 ft) waves; crests of white foam; spray – Large branches move; wires whistle.
7	32 - 38 / 28 - 33	*Near Gale* – Sea heaps up; waves 13-20 ft; white foam from breaking waves blows in streaks with the wind – Whole trees move; resistance felt walking into the wind.
8	39 - 46 / 34 - 40	*Gale* – Moderately high (13-20 ft) waves of greater length; crests break into spin drift, blowing foam in well-marked streaks; Twigs and small branches break off trees; difficult to walk.
9	47 - 54 / 41- 47	*Strong Gale* – High waves (20 ft) with wave crests that tumble; dense streaks of foam in wind; poor visibility from spray – Slight structural damage; shingles blow off roofs.
10	55 - 63 / 48 - 55	*Storm* – Very high (20-30 ft) 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 / 56 - 63	*Violent Storm* – Waves high enough (30-45 ft) 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 / > 64	*Hurricane* – Sea white with spray; foam and spray render visibility almost non-existent; waves over 45 ft high – Widespread damage; very rarely experienced on land.

Sources: www.spc.noaa.gov/faq/tornado/beaufort.html; http://www.stormfax.com/beaufort.htm

6.1.2 Types of High Winds in Southern California

6.1.2.1 Santa Ana Winds

Most incidents of high wind in southern California are the result of **Santa Ana wind** conditions. Santa Ana winds are generally dry, often dust-bearing winds that blow from the east or northeast toward the coast, and offshore (Figure 6-1). These winds commonly develop when a region of high atmospheric pressure builds over the Great Basin – the arid high plateau that covers most of Nevada and parts of Utah, between the Sierra Mountains on the west and the Rocky Mountains to the east. Clockwise circulation around the center of this high-pressure area forces air downslope from the plateau. As the air descends toward the California coast, it warms at a rate of about 5 degrees Fahrenheit per 1,000 feet elevation. Since the air originates in the high deserts of Utah and Nevada, it starts out already very low in moisture; as it is heated, it dries out even further. The wind picks up speed as it is squeezed through the canyons and passes in the coastal ranges of southern California, blowing with exceptional speed through the Santa Ana Canyon (from where these strong winds derive their name). Forecasters at the National Weather Service usually reserve the use of "Santa Ana" winds for those with sustained speeds over 25 knots (1 knot = 1.15 mph); as they move through canyons and passes, these winds may reach speeds of 35 knots, with gusts of up to 50 to 60 knots (see Table 6-1).

Santa Ana winds commonly occur in the southern California area, with Santa Ana conditions expected yearly in the region, typically in the fall through early spring. For the most part these winds are a nuisance, bringing dust indoors, breaking tree branches, and causing minor damage. For people with respiratory ailments, however, Santa Ana winds often result in headaches, sinus pain, difficulty breathing, and even asthma attacks. Strong Santa Ana winds can cause extensive damage to trees, utility poles, vehicles and structures, and can even be deadly. In 2003, for example, two deaths were blamed on these strong winds: a downed tree struck and killed a woman in San Diego, and a passenger in a vehicle was struck by a flying pickup truck cover (http://cbsnews.com/ January 8, 2003 article). Wildfires in the region often occur during Santa Ana wind conditions, when the air humidity is low to very low. Because the winds fan and help spread these fires, Santa Ana wind conditions always are serious concerns to fire fighters.

6.1.2.2 Thunderstorm-Related Tornadoes

A variety of mechanisms give rise to **thunderstorms**, but most often these develop when warm, moist air meets a cold front, producing strong winds, and sometimes tornadoes, and hail. More than 100,000 thunderstorms occur every year in the United States, and more than 10,000 of these are considered severe, resulting in annual property losses in excess of $1 billion (NRC-CND, 1993). Most of these occur in the central Great Plains and the southeastern coastal states, but thunderstorms do occur in every state. A thunderstorm is officially labeled as severe if: 1) it produces a tornado, 2) has winds in excess of 58 mph, or 3) produces surface hail greater than 0.75 inch in diameter. An exceptionally severe thunderstorm can generate several tornadoes and downbursts.

Tornadoes are "violently rotating columns of air extending from a thunderstorm to the ground" (http://www.nssl.noaa.gov/edu/safety/tornadoguide.html; see Figure 6-2). Although tornadoes occur in many parts of the world, they are most common during the spring and summer months in the Central Plains of the United States, east of the Rocky Mountains. In the spring, tornadoes often form where warm, moist air from the east meets hot, dry air from the west (this boundary is called a "dryline"). In the winter and early spring, tornadoes can form when strong frontal weather systems originating in the Central states move eastward. Thunderstorms, and associated tornadoes, can also form at the range front, where near-ground air is forced to move "upslope" along the ascending mountain slopes. In California, tornadoes are occasionally generated by strong storms. Although the number of tornadoes reported in California is only a fraction of those reported in the central states, California does get its share of these. In the 30 years between 1959 and 1988, 133 tornadoes were reported in California, for an average of 4 tornadoes a year (NRC-CND, 1993).

Tornadoes can also accompany tropical storms and hurricanes as they move on land, where they usually occur ahead of the path of the storm center as it comes onshore (http://www.nssl.noaa.gov/edu/safety/tornadoguide.html). Weak tornadoes that form over warm water are called **waterspouts**. Occasionally, waterspouts can move on land and become tornadoes. **Funnel clouds** are cone-shaped or needle-like clouds that extend downward from the main cloud base but do not extend to the ground surface. If a funnel cloud touches the ground, it becomes a tornado; if it touches or moves across water, it is a waterspout. Waterspouts that have moved onto land are more often reported in southern California in the fall and winter, but some have also been reported in the spring. For example, on April 6, 1926, a waterspout that came on land at National City, near San Diego, unroofed several homes and injured eight people; one on February 12, 1936 unroofed two homes, blew down five oil derricks and injured six people.

Figure 6-1:
View From Space of Smoke from the October 2003 Fires in Southern California, Carried Offshore by Strong Santa Ana Winds

Source: Image by Jacques Descloitres, MODIS Rapid Response Team at NASA/GSFC, obtained from the archives at http://visibleearth.nasa.gov/

Figure 6-2:
View of a Tornado

Source:
http://www.photolib.noaa.gov/700s/nssl0123.jpg

To measure the intensity, area and strength of a tornado, in 1973 Dr. Ted Fujita (then with the University of Chicago) and Allen Pearson (at the time director of the National Severe Storm Forecast Center) introduced the Fujita-Pearson Tornado Intensity Scale (see Table 6-2). An improvement over the scale first published by Dr. Fujita in 1971, this scale compared the estimated wind velocity with the corresponding amount of damage to human-built structures and vegetation (a component first introduced by Fujita) and the width and length of the tornado path (the component added by Pearson). The scale classified tornadoes into six levels (from F0 to F5) with larger numbers indicating more damaging and larger tornadoes (the Fujita scale smoothly divided wind speed between the highest Beaufort level and Mach 1.0 (the speed of sound) into 12 levels – F0 through F12, but recognized that an F6 tornado would be inconceivable, and indeed no tornado above F5 has ever been measured. The Fujita-Pearson scale was used to classify all tornadoes reported after its introduction, in addition to retroactively classify all tornadoes reported since 1950 that were listed in the National Oceanic and Atmospheric Administration's (NOAA) national tornado database.

Table 6-2: The Fujita-Pearson Tornado Damage Scale

Scale	Wind Speed Estimate (mph)	Average Damage Path Width (feet)	Typical Damage
F0	40 – 72	30 - 150	**Light** damage (gale tornado). Some damage to chimneys and television antennas; twigs and branches break off trees; winds push over shallow-rooted trees; sign boards are damaged.
F1	73 – 112	100 - 500	**Moderate** damage (weak tornado). Winds peel off roofs; windows break; light trailer homes are pushed off their foundations or overturned; some trees are uprooted or snap; moving autos are pushed off the road; attached garages may be destroyed. Hurricane speed starts at 74 mph.
F2	113 – 157	360 - 820	**Considerable** damage (strong tornado). Roofs are torn off frame houses, leaving strong walls upright; weak rural buildings are demolished; trailer homes are destroyed; large trees snap or are uprooted; railroad boxcars are pushed over; light objects become airborne missiles; cars are blown off highways.
F3	158 – 206	650 – 1,650	**Severe** damage (severe tornado). Roofs and some walls are torn off well-constructed frame structures; some rural buildings are completely demolished; trains are overturned; steel-framed hangars and warehouse-type structures are torn; cars are lifted off the ground; most trees are uprooted, snapped or leveled.
F4	207 – 260	1,300 – 3,000	**Devastating** damage (devastating tornado). Well-constructed frame houses are leveled, leaving piles of debris; steel structures are badly damaged; trees are de-barked by small flying objects; cars and trains are thrown some distances or roll considerable distances; large objects become missiles.
F5	261 – 318	~ 3,600	**Incredible** damage (incredible tornado). Strong, whole-frame houses are lifted off their foundations and carried considerable distances; steel-reinforced concrete structures are badly damaged; automobile-sized missiles are generated and carried through the air >100 meters; trees are debarked.
F6	319 –379		**Inconceivable** damage: These winds are unlikely. Should a tornado with maximum speed in excess of F5 occur, the extent and type of damage may not be conceived. A number of airborne missiles, such as refrigerators, water heaters, storage tanks, automobiles, etc. create serious secondary damage on structures.

Fujita's wind estimates have since been found to be inaccurate, with the original wind speed estimates higher than the wind speeds actually required to incur the damage described in each category, especially for tornadoes classified as F3 or larger. In response to these criticisms, a new **Enhanced Fujita** (EF) **Scale** for tornado damage was developed between 2004 and 2006. The EF scale, which was officially implemented in the United States on February 1, 2007, is considered an improvement over the old scale: engineers and meteorologists estimated the wind speeds in the new scale (although actual speed winds have not been empirically measured), and records of past tornadoes were reviewed to better equate the wind speeds with the storm damage reported. The new scale also includes more types of structures and vegetation in the damage assessment, and better accounts for differences in construction quality. Similar to the original Fujita scale, the EF Scale has six levels of tornado damage, EF-0 to EF-5 (see Table 6-3). A researcher assigning a level of damage to a tornado using the EF scale needs to refer to a list of 28 different damage indicators (DI) or types of structures and vegetation, and then the degree of damage (DoD) for each. Damage indicators include barns or farm outbuildings, residences, manufactured homes (with distinctions made for single-wide and double-wide), apartments, masonry buildings, strip malls, automobile lots, elementary schools, low-, middle- or high-rise buildings (each a different category of indicator), electrical transmission lines, free-standing towers, and softwoods or hardwood trees. The new scale is likely to be modified or updated as new tornado data become available.

Table 6-3: Enhanced Fujita Scale

Scale	Wind Speed Estimate		Relative Frequency (%)
	mph	Km/h	
EF-0	65 - 85	105 - 137	53.5
EF-1	86 - 110	138 - 178	31.6
EF-2	111- 135	179 – 218	10.7
EF-3	136 – 165	219 – 266	3.4
EF-4	166 – 200	267 – 322	0.7
EF-5	> 200	> 322	< 0.1

6.1.2.3 Macrobursts and Microbursts

Storm researcher Dr. Ted Fujita first coined the term "**downburst**" to describe a strong, straight-direction surface wind in excess of 39 miles per hour (mph) caused by a small-scale, strong downdraft from the base of a thundershower and thunderstorm cell. Unlike tornadoes, the origin of a downburst is downward-moving air from a thunderstorm's core (as opposed to the upward movement of air associated with tornadoes). Downbursts are further classified into macrobursts and microbursts.

Macrobursts are downbursts with winds up to 117 mph that spread across a path greater than 2.5 miles wide at the surface, and which last from five to 30 minutes. **Microbursts** are confined to smaller areas, less than 2.5 miles in diameter from the initial point of downdraft impact. An intense microburst can result in winds near 170 mph but often lasts less than five minutes. Like tornadoes, microbursts can do significant damage: When a microburst hits a tree, the winds strip the limbs and branches off it; a microburst that hits a house has the potential to flatten the structure. After striking the ground, a powerful outward-running gust can generate significant damage along its path. Damage associated with a microburst appears to have been caused by a tornado, except that the damage pattern away from the impact area is characteristic of straight-line winds, rather than the twisted pattern typical of tornado damage.

Microbursts are particularly dangerous to aircraft landing or taking off, and have caused several planes to crash, with resultant loss of life. Microbursts have also been responsible for capsizing and sinking ships, causing structural damage in many communities, lifting roofs off structures, downing electrical lines, and generally causing millions of dollars in damage.

Most of the microbursts reported have occurred in the northeastern and central parts of the United States, including New York, New Jersey, Massachusetts, Ohio, and Kansas, but microbursts have also been reported in Arizona and Utah (http://en.wikipedia.org/wiki/Microburst#Danger_to_aircraft), and in southern California. On March 29, 1998, in a Lake Elsinore neighborhood, an apparent microburst uprooted a tree and ripped two 20-foot sections of roofing tiles from a home. A funnel cloud was also spotted that afternoon near Dulzura, to the east-southeast of San Diego. On August 12, 2012 a microburst damaged the roofs of homes near Lake Elsinore, as well as downed nearby power lines and tree limbs (http://latimesblogs.latimes.com/lanow/2012/08/microburst-blamed-tornado-type-activity-riversidecounty.html; http://www.pe.com/localnews/riversidecounty/riverside/riverside-headlines-index/20120812-lake-elsinore-tornado-touches-down-more-expected.ece?ssimg=677704#ssStory677446).

6.1.2.4 Dust Storms

Dust storms are high wind events common in arid and semi-arid regions. Strong winds pick up sand and other particulates and transport them by saltation and suspension to another location, where they are deposited. Dust storms are significant erosive agents, with both short- and long-term impacts on people, structures and other property, and on the environment. In the short-term, a dust storm causes reduced visibility, which can affect motorists and aircraft. Fine particulates in the air will enter the respiratory pathways and can cause serious health conditions, including nose, ear and eye infections, sinus infections, asthma, dry eyes (a condition that if left untreated can led to blindness), silicosis, and even premature death. Dust storms can also spread virus spores and contaminants that can result in skin rashes and other infections. Long-term impacts of dust storms include loss of productivity from agricultural fields that have had their organic-rich, topsoil removed, whereas the deposition of sand and dirt elsewhere can bury and destroy crops and landscaping. Sandblasting of buildings, signs, fences, and vehicles can have both an aesthetic and structural impacts; in the long term the damage due to continuous pitting may require the replacement of a structure. For additional information regarding blowing sand refer to Chapter 2.

6.1.3 Historic Southern California Windstorms

As mentioned above, Santa Ana winds are common in the southern California region, typically in the fall through spring. Some of the strong winds in the winter are associated with storms emanating from Alaska and Canada. The desert areas are also subject to high winds associated with short-duration tropical thunderstorms emanating from the south. These storms typically occur in the summer months, between July and September.

As of the writing of this document, the National Climatic Data Center (NCDC) listed 49 thunderstorm-generated wind events in Riverside County between January 1, 2000 and January 31, 2014, with 17 of those events in the Coachella Valley. In addition, for the same time period, the NCDC database included 58 high wind and 6 strong wind events in the Coachella Valley (http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms). Table 6-4 below includes these wind events specific to the Coachella Valley area, in addition to other exceptional historical storms that impacted the southern California area, causing extensive damage either directly, or indirectly. Please note that this list is not likely to include all damaging windstorms that have impacted the city of Coachella, as some events may have been so localized as to have not made it into the National Climatic Data Center database.

Table 6-4: Major Southern California Windstorms (1858 - 2012) and Strong Winds Reported in the Coachella Valley Area (January 2000 – January 2014)

Date	Description, Including Location and Damage Reported
October 2, 1858	Category 1 hurricane hits San Diego. Sustained winds to 75 mph are estimated based on the extensive damage to property reported.
May 23, 1932	Strong winds and low humidity; 12 serious brush fires, blackening nearly 2,000 acres in San Diego County were reported. The biggest fire was in Spring Valley.
September 24-25, 1939	Tropical storm that lost hurricane status shortly before moving onshore at San Pedro had sustained winds of 50 mph. At least 48 people died from sinking boats.
November 19-29, 1956	Strong and prolonged Santa Ana winds fanned a fire north of Descanso that burned 44,000 acres and killed 11. Two wooden bridges and a power plant were destroyed. A 100 mph

Date	Description, Including Location and Damage Reported
	gust was recorded on November 20 at a forest lookout near Saugus.
November 21-22, 1957	Extremely destructive Santa Ana winds fan a 28,000-acre brush fire west of Crystal Lake. Flying debris forced people indoors in some areas. Extreme turbulence due to a downdraft injured 12 out of 33 people on an airplane near Ontario.
November 5-6, 1961	Strong Santa Ana winds fan fires in Topanga Canyon, Bel Air and Brentwood; 103 firemen are injured; $100 million in economic losses, including 484 buildings (mostly residential) and 6,090 acres scorched.
January 18-28, 1969	Strong storm winds cause power outages and falling trees in southern California; 4 killed by downed trees.
September 26-29, 1970	Gusts to 60 mph in Cuyamaca Rancho State Park. Fires from Cuyamaca to Alpine, including the Laguna Fire, resulted in 400 homes destroyed, 185,000 acres burned, and 8 killed.
September 10, 1976	Hurricane Kathleen brought to the Southwest US the highest sustained winds associated with an eastern Pacific tropical cyclone; sustained winds of 57 mph at Yuma, Arizona.
November 30 – December 1, 1982	Widespread strong winds associated with a big storm result in 1.6 million homes without power.
January 20, 1987	Wind gusts to 80 mph below Cajon Pass, 70 mph in San Bernardino, 60 mph in Mt. Laguna, and 40 mph at El Toro. Winds cause thick dust clouds; trucks blown over; trees toppled. 100 power poles downed in the Inland Empire. Numerous power outages force school closures. Brush fires started.
March 15, 1987	Widespread strong storm winds; winds of 25-35 mph sustained all day, gusts to 40 mph in San Diego. Result in power outages all over the San Diego metropolitan area; motor homes toppled in the desert; light standard fell over onto cars in Coronado; boats flipped over in harbors; a 22-foot boat turned over at Mission Beach jetty; Catalina cruise ships delayed, stranding 1,200 tourists there.
December 12-13, 1987	Strong Santa Ana winds in San Bernardino with 60-80 mph gusts. 38-mph winds recorded in San Diego. 80 power poles blown down within a ½-mile stretch in Fontana and Rancho Cucamonga; downed tree limbs damaged cars, homes and gardens; 1 injured when tree fell on truck; power poles and freeway signs damaged; parked helicopter blown down a hillside in Altadena; trees downed and power outages in San Diego County. In Spring Valley, 1 dead when eucalyptus tree fell on truck.
January 21-22, 1988	Strong offshore winds following major Pacific storm with gusts to 80 mph at the Grapevine, 60 mph in Ontario, and 80 mph in San Diego County. Power poles, road signs and big rigs knocked down in the Inland Empire. In San Diego County, 6 injured; roofs blown off houses, trees toppled, and crops destroyed. Barn demolished and garage crushed by tree in Pine Valley; 20 buildings damaged or destroyed at Viejas; avocado and flower crops destroyed at Fallbrook and Encinitas, respectively, with 5 greenhouses damaged in Encinitas.
February 16-19, 1988	Very strong Santa Ana winds with gusts to 90 mph in Newport Beach, 70+ mph in the San Gabriel Mountain foothills; gusts to 76 mph at Monument Peak – Mt. Laguna; 63 mph at Ontario, and 50 mph at Rancho Cucamonga. Numerous trees and power lines downed resulting in power outages along the foothills of the San Gabriel and San Bernardino mountains. Mobile home overturned and shingles torn off roofs in Pauma Valley; Fontana schools closed due to wind damage; 3 killed when truck overturned and burned; 1 killed when stepped on downed power line. Power outages impacted 200,000 customers in Los Angeles and Orange counties. Grass fires. Roof damage widespread in communities around Glendale and Burbank, and at John Wayne Airport. Boats torn from moorings at Newport Harbor.
December 8, 1988	Strong Santa Ana winds across southern California, with gusts to 92 mph at Laguna Peak. Winds fanned several major fires; buildings were unroofed; trees and power lines downed. $20 million in estimated damages.
December 11, 1989	Strong Santa Ana winds with gusts to 100 mph near the Grapevine. Winds reduced visibility to near zero in the **desert areas** and closed major interstate highways east of

Date	Description, Including Location and Damage Reported
	Ontario.
October 26-27, 1993	Strong Santa Ana winds with gusts to 62 mph at Ontario. Twenty fires in the southern California area, including the Laguna Hills Fire. 4 dead, 162 injured, $1 billion in property losses alone; 194,000 acres destroyed.
December 14, 1996	Strong Santa Ana winds with gusts to 111 mph at Fremont Canyon and 92 mph in Rialto, toppled trees and electric poles, smashed windows, knocked out power to tens of thousands across southern California. Two deaths in Fontana; one man killed by a live power line that was blown on him; the second died when a tree branch fell onto his van. Minor injuries (3 total) in Orange and San Diego counties. In Crestline, a radio tower was blown down and the roof blown off the transmitter building. I-15 near Devore closed for 15 hours where two trailers flipped.
December 17, 1996	Santa Ana winds with gusts to 66 knots downed trees and power poles. In Rancho Cucamonga, winds toppled a 500,000 kilovolt electric power, sparking a fire that burning 250 acres and forced evacuation of 80 homes.
January 6, 1997	High winds to 86 knots throughout southern California injured four: Three students at the CSU campus at San Bernardino, and a man that suffered cuts when his trailer overturned. Fourteen tractor trailer rigs tipped over in the I-15 between Devore and Corona forcing closure of the freeway; over 900,000 customers lost power; vehicle pile-ups in the **Coachella Valley**.
February 13, 1997	Strong Santa Ana winds uprooted trees, downed power lines and toppled rigs. One firefighter suffered minor injuries when the winds blew boards off a truck and onto him while he was trying to extinguish a fire. The Interstate 10/15 transition roads were closed for hours. Sporadic power outages were reported due to downed power lines.
February 24-25, 1997	Gusty Santa Ana winds occurred below selected passes and canyons, with gusts to 80 mph measured in Fremont Canyon. The winds knocked down power lines, fanned several small fires, and forced closure of the I-215 in San Bernardino County for one hour. One of the fires destroyed an abandoned house in San Bernardino.
October 13-14, 1997	Santa Ana winds of 30-40 mph with frequent gusts over 60 mph developed below Cajon Pass, in Orange County, and valley areas of San Bernardino County. Fire in Orange County burned almost 6,000 acres and destroyed two buildings. Trees and power lines blown down in Rialto and Fontana; a shed was destroyed at the Banning/Beaumont border.
December 10-12, 1997	Santa Ana winds with gusts to 96 mph at Pine Valley; 87 mph in Upland. Flying debris killed 2 construction workers, one in Riverside, another in Irvine. Fish farm in Sun City reported more than $1 million in structural damages; extensive damage to the avocado crop; boats damaged and sunk at Coronado and Avalon.
December 18-22, 1997	Gusts to 60 mph in Rialto; 67 mph at Idyllwild and below Cajon Pass. Driver near Pedley killed when he lost control of his van because of strong wind gust; his passenger was injured. Fires; downed trees; and widespread wind damage. More than 9,500 homes and businesses without power in Ontario, Rancho Cucamonga, Fontana, and Chino. On the 22nd, strong winds toppled at least 6 trucks on the I-15 and 60 freeways. In the **Coachella Valley**, winds uprooted many trees in Palm Desert and overturned several big-rig trucks near Indio. Several trees and signs downed in Desert Hot Springs.
December 28, 1997	Santa Ana winds with gusts to 80 mph snapped a dozen power poles near Corona, cutting power to dozens of rural customers. A downed tree crushed a car in Riverside. In Mira Loma, a dozen power poles were downed, leaving hundreds without power and closing Hamner Avenue for two days. Heavy blowing dust and restricted visibility created hazardous driving conditions on the Interstate 15.
February 3-4, 1998	Strong storm winds with gusts to 60 mph and heavy downpours. The strongest winds were clocked in Orange County and the mountains of San Bernardino County in advance of the storm. Wind gusts to 60 mph downed trees and caused scattered power outages. Moderate to heavy rain flooded intersections in coastal areas; snow fell as low as 4,500 feet. Two young illegal immigrants near Campo died, and 12 others suffered from exposure to strong winds, cold temperatures and rain.

Date	Description, Including Location and Damage Reported
December 9-10, 1998	Santa Ana winds with 101-mph gusts at Modjeska Canyon, 93-mph gusts at Fremont Canyon, 52-mph gusts in Santa Ana, and 83-mph gusts at Ontario disrupted transportation, power and daily activities. Winds toppled trees and power lines, overturned vehicles, and caused property damage. 180,000 customers without electric power; 17 trucks were blown over along I-15 and Highway 60. 7 students at CSU in San Bernardino were knocked down and injured. Trees fell on passing motorists in Fontana. A total of 24 injuries reported, with property damage amounting to $1.1 million.
January 20-21, 1999	80-mph gust in the Salton Sea area; 70-mph gust in the **Coachella Valley**; 47-mph gust in Palm Springs; and 36-mph gust in Thermal.
February 10-12, 1999	Santa Ana winds with gusts to 85 mph at Rialto; gusts to 80 mph on the I-8, forcing the closure of several major roads and interstates. Extensive property damage throughout and west of San Gorgonio Pass. Freshly plowed field west of San Gorgonio Pass was stripped of its topsoil; 30 Beaumont residents treated for breathing problems and skin rashes associated with the dust storm. Trees and signs were blown down; large commercial building in Lake Elsinore was blown down; 150-foot tall tree was blown over and crushed a trailer home. $950K in property damages reported.
April 8, 1999	Strong winds to 54 knots reported in Apple and Yucca valleys, the **Coachella Valley**, San Bernardino County mountains, San Diego County mountains, and Santa Ana mountains and foothills. $10K in property damage reported.
October 17, 1999	Santa Ana winds caused wind damage in the mountains and valleys of Orange, Riverside, and San Bernardino counties. In San Bernardino, 40 mph wind gusts caused a fire that damaged 11 houses and a 12-plex apartment building; other fires in the Inland Empire fanned by the gust winds. $30K in property damage reported.
November 21-22, 1999	Santa Ana winds with gusts to 54 knots caused power outages throughout the Inland Empire and the Santa Ana mountains and foothills. A semi-tractor trailer was toppled over at the I-15 and Highway 60 intersection. Farther south on I-15, tumbleweeds caused traffic hazards. $190K in property damage and 1 injury reported.
December 3-4, 1999	Strong Santa Ana winds with gusts to 90 mph at San Bernardino and 68 mph in Fontana. Ten power poles knocked down just below Cajon Pass, and in Muscoy, Rialto, Fontana, Murrieta and Lake Elsinore. Most major highways in the Inland Empire and through the Santa Ana Mountains were closed due to semi-tractor trailers overturned, blowing dust reduced visibility and road signs and debris blown around. Two barns were destroyed when their roofs were lifted off; six horses received minor injuries. $210K in property damages reported.
December 10-11, 1999	Strong winds in the **Coachella Valley**, valleys in Riverside and San Bernardino counties, and Santa Ana mountains and foothills. Winds downed power lines and traffic signs. Gust to 60 mph clocked in Palm Springs. Blowing sand and dust caused poor visibility and forced road closures and cancellation of outdoor events. Several trees were knocked over. $50K in property damage, $10K in crop damages, and one injury reported.
December 21-22, 1999	Strong Santa Ana winds; 68-mph gust at Campo, 53-mph gust at Huntington Beach; 44-mph gust in Orange. Widespread power and phone outages due to fallen trees knocking down lines and snapped poles. Large dust cloud over the San Jacinto Valley that reached height of 500 feet closed highways and sandblasted cars. Gusty winds spread a fire in Glendale to an adjacent house, causing two injuries and $50K in damages. Three wildfires in San Diego County. $227K in property damage reported throughout the region.
January 5-6, 2000	Santa Ana winds with 93-mph gust at Fremont Canyon; 60-mph gust at Ontario; 58-mph gust at Devore. Winds blew over four semi-tractor trailer rigs on I-10, I-15, I-215 and Highway 60 causing 10-hour delay between Apple Valley and the Inland Empire. Elsewhere in the Inland Empire, blowing sand and dust reduced visibilities to near zero. Roof damage in Rialto. Power outages to 10,000 customers due to downed power lines and poles. Two injuries and $400K in property damage reported.
March 5, 2000	Sustained 40-knot winds associated with a winter storm caused damage to trees and power lines. Participants in outdoor athletic events developed hypothermia. Later outdoor events were cancelled. As reinforcing cold air arrived at night, the snow level lowered dramatically,

Date	Description, Including Location and Damage Reported
	trapping at least 30 people in the wilderness areas of the San Diego Mountains, closing highways and freeways with seven inches of snow in the passes. Three people died and another thirteen were hospitalized for hypothermia. Blizzard conditions were reported throughout the southwestern California mountains. $20K in damage in the **Coachella Valley**.
March 20-21, 2000	Santa Ana winds in the **Coachella Valley**, valleys in Riverside and San Bernardino counties, San Diego County and Santa Ana Mountains and foothills. Winds downed power poles, felled trees on cars and houses, knocked fruit off trees, and blew sand and dust, lowering visibility to near zero. Semi-tractor trailer was blown over near Pedley. $100K in property damage and $30K in crop damage reported in the Coachella Valley.
March 31- April 1, 2000	Strong Santa Ana winds caused $375K in property damage in the Inland Empire area. Twenty-five power poles were toppled in the Sun City area; several others fell in Yucaipa. A large tree was blown down in Beaumont. Blowing dust reduced visibility along most highways.
August 29, 2000	Thunderstorms that formed over the Santa Rosa Mountains moved slowly toward the northeast across the lower end of the **Coachella Valley**. Large boulders washed down onto Highway 74, and flooding was reported along the Whitewater Wash at several locations in Palm Desert, Indian Wells and Indio. A downdraft to 50 knots toppled a large tree near the College of the Desert. $5K in property damage due to winds.
November 7, 2000	Santa Ana winds with 82-mph gust at Fremont Canyon caused damage in Orange, San Bernardino and Riverside counties. In San Bernardino County, strong winds knocked power lines together causing them to spark; the sparks ignited wildfires. In Colton, blowing sand covered the I-215. Two semi-tractor trailers overturned at the intersection of the I-15 and Highway 60. $167K in property damages reported.
December 25-26, 2000	Santa Ana winds; 87-mph gust at Fremont Canyon. Damage and injuries reported in Mira Loma, and in Orange and Riverside counties. 50-mph winds in northern Orange County toppled utility poles leaving about 25,000 customers in Tustin, Garden Grove, Orange, Santa Ana and Westminster without power for a few hours. Across the Inland Empire, winds knocked down power poles, trees, signs and fences at 23 separate locations. Many trees were uprooted. Power disrupted to 9,000 homes and businesses. Four injuries and $665K in property damage reported.
February 7, 2001	High winds across the San Jacinto Mountains generated lee mountain waves that touched in the **Coachella Valley** between Palm Springs and Thermal. Power lines were knocked down in Rancho Mirage. In La Quinta, trees were uprooted and tents, fences, and banners set up for a golf tournament were blown down and damaged. Blowing sand reduced visibility to 15 feet in several areas. $250K in property damage and $30K in crop damage reported.
September 30, 2001	An outflow boundary from thunderstorms associated with tropical depression Juliette over the northern Gulf of California moved northwest across Riverside County. Wind gusts to 39 mph were measured at the Palm Springs International Airport. Trees and power lines were knocked down across the Coachella Valley. Blowing dust reduced visibility to zero. $50k in property damage was reported.
December 7-8, 2001	Santa Ana winds with gust to 87-mph at Fremont Canyon affected most of southern California. Trees, power lines and signs were toppled. Two construction workers were injured when a 20-foot-high brick wall they were working next to collapsed. Several major freeways were closed to high profile vehicles. Power outages affected about 40,000 customers. Three injuries and $250K in property damage. Winds fanned the Potrero Fire.
January 23-24, 2002	Santa Ana winds throughout the mountains and valleys of Riverside, San Bernardino, San Diego and Orange counties. Semi-tractor trailer rig blown over in Fontana. Strong winds fanned several wildfires. In San Bernardino, one house was damaged and a few outlying structures were destroyed by the wind-fanned flames. $190K in property damage.
February 8-13, 2002	Santa Ana winds with 80-mph gust at Descanso, 78-mph gust at Fremont Canyon, and 76-mph gust at San Bernardino. Blown-over semi-tractor trailer rigs forced closure of I-15, I-215 and I-8 for a day. Twelve million pounds of avocados blown off of trees. Winds fanned

Date	Description, Including Location and Damage Reported
	several fires caused by downed power lines. In Orange County, fire that started in Corona burned 2,400 acres. In Tijuana, fire destroyed 50 buildings, and killed one woman. Gavilan fire spread from Fallbrook to Camp Pendleton, torching 5,783 acres, destroying 44 houses and damaging 14 others, destroying 40 vehicles and injuring 19. $2 million in property damage and $7.8 million in crop damage.
March 13, 2002	High winds whipped up dust across the deserts, reducing visibility to zero along all major highways. The winds also flipped over a semi-tractor trailer in the Coachella Valley and tore a roof off a Community College building. $150K in property damage.
March 18, 2002	Thunderstorm-related winds to 56 knots in San Bernardino County valleys; whiteout conditions in the High Desert areas with snow down to the 2,500 foot level; hail in Apple Valley; lightning in San Diego struck an aircraft on final approach to the San Diego International Airport.
August 18, 2002	Gusts associated with a thunderstorm knocked down several power lines in Indio. Dust raised by the wind reduced visibility to less than a mile in the Coachella Valley.
November 8, 2002	Strong winds associated with the first winter storm of the season reported in Apple and Yucca valleys, Coachella Valley, and San Bernardino mountains and valleys. Winds downed power lines and caused damage to roofs and signs. $550K in property damage; $100K of that in the Coachella Valley.
December 16, 2002	Strong winds in San Bernardino County mountains, and San Diego coastline. Car windows blown out at Cajon Pass; power lines and trees blown down at Arrowhead and Big Bear City; motor home blown over in Hesperia. Tractor-trailer blown over west of Phelan. Visibility reduced to zero due to blowing dust in local highways. Two injuries and $750K in property damage reported.
January 5-7, 2003	Strong, widespread Santa Ana winds throughout southern California blew down numerous trees and power poles. At least 60 communities affected. Interstate 8, 10, and 15 were blocked for several hours by large trucks blown over. Winds toppled power poles in Orange; blew over a mobile derrick in Placentia, crushing two vehicles; and delayed Metrolink rail service. Dust storms forced closure of I-215. One commercial plane sustained damage at Ontario Airport; others had to be diverted. Two dead, 11 injured. Widespread property damage, road closures, wildfires, 20 million pounds of avocado lost. $3.3 million in property damage and $28 million in crop damage. $30K in damages in the Coachella Valley.
February 2, 2003	High winds blew down trees in Redlands, Jurupa and Riverside. Blowing sand and dust disrupted traffic in the Coachella Valley.
March 26, 28-29, 2003	Area of low pressure off the California coast brought strong winds to portions of the Mojave Desert. Winds with gusts to nearly 50 mph blew shingles off several roofs in Twentynine Palms, causing $5K in property damage. Elsewhere, wind blew trees over, falling on cars and power lines. A semi-tractor trailer was blown over in I-8 in the San Diego County mountains. A total of $140K in property damages reported.
October 25-27, 2003	Strong Santa Ana winds; 45-mph at Ontario, 43-mph at Fremont Canyon. Extensive wildfires consumed hundreds of thousands of acres; killed more than 20 people, and caused more than $1 billion in damage.
November 22-23, 2003	High winds knocked down trees, power lines and signs, causing about $175K in damages, $35K in the Coachella Valley.
February 26, 2004	Winter storm moving southeasterly from the Gulf of Alaska picked up moisture before moving onshore. Strong winds occurred in the mountains, and heavy rains reported throughout southern California. Most roads along the foothills of the San Bernardino Mountains, both on the north and south sides were closed due to flooding and mudslides.
September 11, 2004	Thunderstorm winds toppled at least 138 trees at "The Palms" golf course in La Quinta. One tree fell onto a maintenance building causing structural damage. Other golf courses in the area reported downed trees. A building at Avenue 58 and Madison Street had its roof tiles blown off, causing minor water damage to the interior. Nine utility poles were blown over, and four transformers were lost due to the winds. Gust of 46 mph was reported at

Date	Description, Including Location and Damage Reported
	Thermal Airport, but winds gusts to 70 mph were probably occurring in the La Quinta area at that time. $100K in property damage was reported.
December 16, 2004	Santa Ana winds with sustained speeds of 51 mph and 78-mph gusts at Fremont Canyon; gusts to 69-mph northwest of San Bernardino and 66 mph near Pine Valley. At least five big rigs were blown over in Inland Empire roads; the I-15 was closed temporarily. Trees were blown over and power lines were downed. $150K in property damage reported.
January 7, 2005	Strong winds and thunderstorms throughout the southern California area. Very saturated soils and wind gusts in excess of 50 mph knocked down hundreds of trees. The felled trees knocked out power, blocked roads, and damaged many cars and property. One woman injured when tree fell onto her car. $600K in property damage reported throughout the region.
February 3, 2005	Strong storm-related winds to 70-mph impacted the region. At least 15 homes in Idyllwild were damaged by felled trees; downed power lines in the Inland Empire; big rig was overturned on the I-8. $1 million in property damage.
August 4, 2005	Gusty winds produced by a severe thunderstorm uprooted trees and damaged property in the Coachella Valley. The highest wind gust measured at the Palm Springs Airport was 54 mph, but gusts in some areas were estimated at greater than 60 mph. $25K in property damage.
August 6, 2005	Thunderstorm-related winds caused $15K in damage to mobile homes in Sky Valley, near Desert Hot Springs.
August 9, 2005	This was the 21st consecutive day with thunderstorms in the region. A storm moved out of Nevada during the morning hours and swept across the San Bernardino, Riverside and San Diego deserts in the afternoon, bringing flash flooding to Yucca Valley. The thunderstorm complex continued southward into the Coachella Valley area where blowing dust reduced visibility to near zero and the strong winds blew down trees. Heavy rains caused sporadic flooding problems and lightning sparked several palm tree fires. A 63 mph gust was reported at Desert Hot Springs. $5K in property damage reported.
January 2, 2006	Post-frontal 50+-mph winds widespread throughout the region. Winds downed trees, power lines, and power poles onto houses and cars. In Crestline, 20 houses were so damaged as to be uninhabitable. In San Diego Bay, boats broke loose from their moorings. In Apple Valley, winds toppled power poles, downed trees and caused damage to numerous homes. A trailer home was knocked off its supports in Hesperia. $210K in property damage reported.
January 22-24, 2006	Santa Ana winds; peak winds of 71 mph at Fremont Canyon on the 24th; gusts exceeded 60 mph on 19 hourly observations. Seven big rigs overturned in Fontana; downed power lines and trees caused power outages and property damage. Dust storm closed the Ramona Expressway. One fatality when spooked horse threw off its rider. $80K in property damage.
September 2, 2006	A severe thunderstorm north of the Santa Rosa Mountains produced heavy rain, localized flash flooding and damaging wind gusts in western **Coachella Valley**. Downed power lines affected 3,000 Southern California Edison customers from Palm Springs to Cathedral City. $20K in property damage reported.
October 26, 2006	Offshore winds blew to 40-mph in the Banning Pass. An arsonist started the Esperanza Fire; it burned 40,200 acres from Cabazon to San Jacinto, destroying 43 homes and killing 5 firefighters.
November 29, 2006	Offshore winds with sustained speeds of 54 mph and 73-mph gust at Fremont Canyon; 58-mph gust at Ontario, caused widespread property damage and power outages as a result of downed power lines, poles and trees. Caltrans reported more than 100 calls in 4 hours reporting downed street signs, trees and power lines. About 15,000 people lost power in Orange County. $30K in property damage.

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January 5 & 7, 2007	Strong winds across southern California. Damaged or downed power poles; damage to trees or tree limbs; blowing dust reduced visibility to near zero along I-215 and the Ramona Expressway; small, wind-driven wildfires along I-15. In the mountains, high winds forced vehicles to slide across icy stretches of road near Rim Forest. Large trees fell on homes and cars in the Lake Arrowhead area. $700K in property damage.
February 27, 2007	Widespread wind activity on the desert slopes of the San Bernardino Mountains and eastward; strong winds caused property damage to three homes in Palm Springs. One house had its roof ripped off; the others reported broken fences, damaged solar panels and downed trees. Poor visibility due to blowing dust forced closure of several roads in the Coachella Valley. Gust to 52 mph recorded at Thermal Airport; gust to 57 mph recorded at a golf course in La Quinta. $75K in property damage.
March 20, 2007	Strong winds caused extensive damage in **North Palm Springs,** where 14 power poles were knocked down; several snapped in half. This affected nearly 500 Southern California Edison customers. Isolated gust at 81 mpg was measured at the Burns Canyon Remote Automated Weather Station (RAWS) located a few miles to the northwest of Yucca Valley while a peak wind gust of 38 mph was observed at the Palm Springs airport. $150K in property damage.
March 27, 2007	Strong down-slope winds and mountain wave activity caused a palm tree to fall on a home in Indian Wells and leaving 79,000 customers in the Coachella Valley without power. Peak wind of 53 mph was measured in Thermal, and gust to 48 mph was measured in Palm Springs. It is likely that high wind occurred in some of the more unpopulated areas of the **Coachella Valley**, especially considering how widespread the reports were of wind gusts in excess of 40 mph; a 60 mph wind gust was measured to the north at Burns Canyon. $40K in property damage.
October 21-22, 2007	Strong Santa Ana winds caused widespread damage across the Inland Empire, with gusts in excess of 70 mph snapping power poles, toppling trees, overturning big rigs and damaging roofs. Sustained winds over 50 mph were recorded at several locations for several hours. Winds fanned the flames of several large wildfires. $35 million in property damage reported.
January 17, 2008	Strong Santa Ana winds caused widespread tree and property damage in the Inland Empire area. Numerous tractor-trailers were blown over, one hangar at Corona airport sustained major damage; power was knocked out, $250K in property damages reported.
February 3, 2008	Strong wind gusts associated with a winter storm downed power lines, toppled trees, and caused areas of thick blowing dust. Fallen trees damaged homes and vehicles, and one small airplane at **Palm Springs International Airport** was blown over. A 61-mph wind gust was measured at Whitewater, and a 55-mph wind gust was measured by the Palm Springs ASOS (Automatic Surface Observation System). A weather spotter in the **Coachella Valley** estimated a wind gust in excess of 70 mph. $375K in property damage.
June 4, 2008	Strong onshore pressure gradients caused a period of gusty winds in the mountains and deserts. The high winds downed power poles causing outages, broke tree limbs, and blew dust in the **Coachella Valley**. A 59-mph wind gust was measured in Thousand Palms. $25K in property damage.
August 8, 2008	An active day of monsoon thunderstorms over the mountains and deserts resulted in large hail, gusty winds, and flash flooding. Wind gusts to 63 mph were measured in the south La Quinta Cove area.
September 11, 2008	A low-pressure system moved down the California coast, causing severe thunderstorms to develop across the region's mountains and deserts. A trained spotter measured a 67 mph wind gust in **La Quinta**, the result of outflow from a thunderstorm nearly 30 miles to the southeast.
December 25, 2008	Strong onshore flow brought gusty Northwest winds to the **Coachella Valley**. These winds ripped off part of the roof and a balcony at the Cambridge Inn in Palm Springs. Twenty-six out of 66 rooms in the hotel were closed due to damage. Several cars in a nearby parking lot suffered minor damage due to flying debris. $500K in property damage.
March 22, 2009	High winds reported in the **Coachella Valley**; a peak wind gust of 62 mph was measured

Date	Description, Including Location and Damage Reported
	in Whitewater. The high winds resulted in an overturned car along Interstate 10 in Indio, as well as numerous downed trees and power lines. Approximately 13,400 customers were without power. High winds were also observed at Thermal Regional Airport. About a dozen flights into Palm Springs International Airport were diverted due to the winds. $50K in property damage.
April 3, 2009	A large upper level low moving over northern California, combined with a strong onshore surface pressure gradient led to strong and high winds in the mountains and deserts of southern California. Numerous reports of damage throughout the **Coachella Valley**. Several power lines and traffic signals were downed in the high winds, causing power outages to approximately 1,900 customers. Many trees suffered broken limbs; about 40 trees were uprooted. Two tractor-trailers overturned on Interstate 10. A small fire fueled by strong winds burned at least two homes in Palm Springs. Damage to structures included roofs being torn off buildings and damaged bleachers at the Palm Springs Stadium. $100K in property damage.
April 14, 2009	An upper-level trough of low pressure and a surface cold front with a strong northwest flow brought high winds to the Coachella Valley. Wind gusts in excess of 58 mph, with a peak gust of 72 mph, were measured by the Whitewater RAWS. The winds downed power lines and overturned a tractor-trailer in the **Coachella Valley**. $5K in property damage.
July 19, 2009	Isolated thunderstorms developed in the afternoon over the San Bernardino and Riverside County deserts. A storm in **La Quinta** produced winds to 61 mph near the southern part of the cove. The storm also produced frequent lightning and brief heavy rain.
October 27, 2009	Strong onshore flow behind a cold front brought gusty winds to the mountains and deserts of southern California. The wind blew down several eucalyptus trees and caused a few power outages in the region. In the **Coachella Valley**, the wind gusts were clocked at 59 knots. No property or crop damage reported in Coachella.
December 7, 2009	A strong onshore flow behind a cold front brought high winds to the mountains and deserts. Peak wind gust of 68 mph measured at the Whitewater RAWS. The winds blew down several eucalyptus trees and caused power outages.
December 22, 2009	A strong onshore flow associated with a winter storm produced strong to high winds in the mountains and deserts. Multiple wind gusts of 66 mph were measured by the Whitewater RAWS; a peak wind gust of 63 mph was measured at **Palm Springs Airport**. Blowing dust and downed palm fronds were reported.
January 19-21, 2010	A strong southerly jet stream ahead of a cold front contributed to moderate low-level wind shear with high winds and a peak wind gust of 73 mph measured at Burns Canyon RAWS. The thunderstorms brought in waterspouts, at least one tornado, and hurricane-force winds in Orange County. In San Diego County, the winds contributed to structural damage and one fatality.
April 5, 2010	An upper level trough of low pressure brought light to moderate showers and gusty winds, especially in the mountains and deserts. Wind gusts in excess of 58 mph, with a peak gust of 64 mph, were measured by the Whitewater RAWS.
April 27-29, 2010	Multiple upper-level low-pressure areas brought winter-like weather to southern California during the last part of April. Rain and mountain snow were common, with strong gusty winds. Wind gusts between 58 and 71 mph were measured at the Whitewater RAWS between the 28th and the 29th. A trained spotter reported blowing dust with visibility down to 1/8 mile and some large tree branches down in **Thousand Palms** where gusts were as high as 55 mph.
October 24-25, 2010	Strong onshore flow brought gusty winds to the mountains and deserts. High winds began in Whitewater between 2050 and 2150 PST, with a peak gust of 58 mph measured by the Whitewater RAWS. Winds caused area of blowing dust and local power outages.
November 20, 2010	A cold trough digging down the California coast brought precipitation and gusty winds to the mountain and desert areas. High winds began in the **Coachella Valley** between 0050 and 0150 PST and continued through 0350 PST. Peak wind gusts of 60 and 61 mph were measured by the Whitewater RAWS.

Date	Description, Including Location and Damage Reported
November 28, 2010	Fast-moving storm produced gust west winds in the mountains and deserts. High winds began in the **Coachella Valley** between 0250 and 0350 PST and continued until approximately 0400 PST. A peak wind gust of 58 mph was measured by the Whitewater RAWS.
January 14, 2011	Moderately high Santa Ana winds estimated at between 40 and 50 mph downed three power lines and a transformer in San Bernardino. Three residents that stepped outside to try to extinguish spot fires caused by sparks were electrocuted and died. A water line also ruptured in one of the houses and 2,700 customers lost power because of the downed lines. Gusty winds were also reported in the mountains.
February 2-4, 2011	A strong cold upper level, low-pressure system moved southward from the Four Corners region into northern Mexico. A strong surface high pressure settled over the region and brought strong offshore winds. The winds knocked over a 70- to 75-foot tall tree with a 30-inch diameter trunk over three units in an apartment development in Glen Avon. No injuries were reported, but the units were declared uninhabitable and the residents were relocated. Strong winds were also helpful in knocking over five big rigs near the Interstate 10-15 interchange and contributed to a crash on Highway 60 near the Interstate 15. No injuries were reported. Other downed trees and power lines were reported. About $60K in property damage reported.
March 7, 2011	A strong westerly jet brought strong winds to the mountains and deserts and light rain to the coastal areas. High winds in the **Coachella Valley**, with a peak gust of 72 mph measured by the Whitewater RAWS, downed a power pole that forced closure of a portion of **Indian Canyon Drive**. A tractor-trailer overturned near the intersection of Interstate 10 and Highway 111, but no injuries were reported. $7.5K in property damage.
April 7, 2011	A very cold late-season winter storm brought rain and mountain snow, as well as strong winds. Gusty winds were responsible for moderate damage in the **Coachella Valley**. A power line fell in an alley in the city of **Coachella**, causing six homes to be evacuated as a precaution while power was restored. Two trees fell in the Indian Springs area, one landing on the hood of an SUV, the other blocking traffic in Palm Desert. No injuries or fires were reported with any of the incidents. The Palm Springs Tramway closed its mountain station early due to high winds. $1K in property damage.
April 21, 2011	A series of storm systems moving through the Pacific Northwest brought windy conditions to the southern California area. The **Palm Springs Airport** measured a peak wind gust of 45 mph. Wind gusts were responsible for blowing over a single-engine Cessna 172 aircraft after it landed. The pilot, the only passenger, was not injured. **Indian Canyon Drive** was closed due to large amounts of blowing sand near the Whitewater Wash; it had recently been reopened after a couple of days of closure due to blowing sand. $8K in property damage.
May 8-9, 2011	Deepening low pressure and strong onshore flow brought gusty winds to the mountains and deserts. Strong winds toppled 35-40 mature, 15- to 20-foot tall trees at the **Rancho Mirage** Public library. The winds toppled at least one power pole that caused a small brush fire in Palm Springs, near Via Monte Vista and Stevens Road. Power was out for around 400 customers in the area for about a day. No one was injured. $30K in property damage.
June 15-17, 2011	A strong thermal gradient (105 degrees at Thermal, 60s near the coast), combined with an upper low over Utah allowed for significant pressure falls, producing strong westerly winds. These strong winds were responsible for two overturned big rigs along **Highway 111** just south of Overture Drive. No one was injured, but officers asked high profile vehicles to avoid the wind-prone area of Hwy 111 and even began turning them away from the area. Hwy 111 was eventually shut down for a time from Interstate 10 past Overture Drive for about four hours. On the 16th, strong winds in **Coachella** kicked up a cloud of dust that was blamed for a pile-up involving 5 vehicles and 3 semi-trucks. Visibility was reported to be near zero at the time of the crash. Several people were taken to the hospital for non-serious injuries. Highway 86 was shutdown between Avenues 50 and 52 for several hours. On the 17th, gusty winds caused a small experimental plane to flip onto its nose just after landing, while turning to taxi off the runway at the Palm Springs Airport. The pilot, the only

Date	Description, Including Location and Damage Reported
	passenger, was not injured. $155K in property damage.
November 19, 2011	A closed upper level low-pressure system brought two days of heavy rainfall, mountain snow and gusty winds. High winds occurred in the **Coachella Valley** for about three hours during the morning. During that time, two gusts of 58 mph were measured at the Whitewater RAWS.
January 21, 2012	A powerful jet stream brought two storm systems to southern California, with very strong west-northwest winds in all mountain and desert areas. High winds were reported in the **Coachella Valley** all afternoon, with gusts over 60 mph, and sustained winds of 30 to 45 mph. Three major roadways through Palm Springs were closed due to zero visibility caused by blowing dust and sand: Indian Avenue, Gene Autry Trail and Vista Chino. Bridges and wash crossings were closed at Washington and Adams Streets due to reduced visibility from blowing dust and sand. Reduced visibility from blowing sand is believed to have caused a crash between a bus, a truck and a sedan on I-10 westbound near the Gene Autry Trail exit. Four people were taken to the hospital for injuries from the crash. Power poles were knocked down on Gene Autry Trail as well as Palm Canyon Drive at Linden Way (also closed). Carports were knocked over by winds and crushed cars at an apartment complex at Highway 111 and Escoba. Numerous power lines and approximately 400 trees were also damaged or knocked down in the Palm Springs area. The Humana Challenge Golf Tournament at the La Quinta Country Club was stopped due to the high winds. The main tent in the Bob Hope Square fan area collapsed. There was also damage to the vendor and event tents. No injuries were reported. Several trees were knocked over or uprooted on the **La Quinta** course, while a few other courses had only cosmetic damage and blowing debris. $600K in property damage.
February 11, 2012	An amplified ridge over the eastern Pacific allowed a few upper-level short wave troughs to move over the region, bringing strong gusty winds, widespread rain and mountain snow. Sustained winds to 30 mph, with gusts to 47 mph, were reported in **La Quinta**. Blowing dust reduced visibility to only about 1/10 of a mile, or less.
March 1-3, 2012	High pressure system off the west coast led to strong and gusty N to NE winds in the mountains and deserts. In the **Coachella Valley**, winds to 63 knots reported.
March 6, 2012	A closer upper-level system brought a strong cold front to southern California that caused very strong winds in the mountains and deserts. Strong winds in the **Coachella Valley** caused several instances of blowing dust as well as some traffic sign damage and trees down. A street sign was partially knocked down from its supporting pole on Sunrise Way, near Gene Autry Trail. Palm Springs police also closed Gene Autry Trail between Via Escuela and Interstate 10 for much of the day. $2K in property damage.
March 17, 2012	A strong, cold upper-level low developed over the north Pacific, with a deep trough and strong, embedded jet extending into southern California. Moderate to heavy precipitation occurred over and west of the mountains. The Coachella Valley received 1/10 to ¼-inch of rain. Strong, gusty winds accompanied the system, with winds to 62 knots reported in the area. This resulted in power outages, blowing dust and traffic signs blown down.
April 10-11, 2012	An upper-level trough swung through southern California bringing moderate to heavy precipitation to the coastal and mountain front areas, and strong thunderstorm-related winds inland. High winds were measured at the **Whitewater** RAWS between the evening of the 10th and early morning on the 11th. During that time, sustained winds of 35-40 mph occurred, with a peak gust of 64 mph.
April 23-26, 2012	Gusty southwesterly winds occurred in the mountains and desert slopes in southern California and northern Baja. High winds were measured at the **Whitewater** RAWS with a peak gust of 60 mph occurring on the 23rd, and another gust to 59 mph on the 25th. No damage was reported, however.
May 2-4, 2012	An upper-level trough over southern California caused gusty surface winds in the mountains and deserts. High winds occurred at the **Whitewater** RAWS on the 2nd with a peak gust of 65 mph. Sustained winds 35-40 mph with gusts in the 50s continued through the early afternoon on the 3rd. No damage was reported.
May 17-18, 2012	An upper-level, low-pressure system caused strong, gusty westerly to northwesterly winds

Date	Description, Including Location and Damage Reported
	in the mountains, passes and canyons. Winds first gusted over 45 mph at the Whitewater RAWS and Edom Hill station on the 17th and continued through at least the early morning on the 18th. A peak gust of 63 mph was measured at Whitewater around 10 o'clock at night on the 17th.
May 22-24, 2012	An area of low pressure began building south along the coast, resulting in a deep marine layer, scattered showers along and west of the mountains, below-normal temperatures and strong, gusty winds in the mountains, deserts, passes and canyons. Wind gusts over 45 mph, with a few to 60 mph, were measured at the Whitewater RAWS.
June 4, 2012	An upper-level, low-pressure system brought gusty west to southwest winds to the mountains and deserts. Peak wind gusts of 57 and 59 mph were measured at the **Edom Hill** station and the Whitewater RAWS, respectively, during this period. No damage was reported.
June 8-9, 2012	Another upper-level, low-pressure system caused gusty westerly winds in the mountains and deserts. The **Edom Hill** station recorded a peak gust of 58 mph on the 9th.
June 19-20, 2012	Upper-level, low-pressure system moved eastward through the area bringing strong onshore flow and gusty west to northwest winds to the mountains and deserts during the night and early morning. A peak wind gust of 59 mph was recorded at the Edom Hill station.
September 9, 2012	Monsoonal moisture in an easterly flow aloft brought showers and thunderstorms to the mountains and deserts. Outflow boundaries from the storms created winds that picked up dust and lowered visibility in the **Coachella Valley** and near Borrego Springs. Visibility lowered to near zero at times in these areas. Wind gusts over 45 mph were measured at the Thermal ASOS, with a peak gust of 61 mph. Visibility was between ¾ of a mile and 3 miles.
November 8-9, 2012	A cold low-pressure system from Alaska moved through California bringing light to moderate precipitation with strong, gusty west to northwest winds. Sustained winds of between 35 and 48 mph, with gusts over 59-80 mph were measured at the Whitewater RAWS. On the 9th, the station measured sustained winds of 31-41 mph, with a peak gust of 61 mph. No damage was reported.
December 23-26, 2012	A weak trough moved through southern California late on the 23rd, bringing light to moderate precipitation, and strong winds in the mountains and desert slopes. High winds were measured at the Whitewater RAWS in the very early morning of the 24th, with a peak gust of 60 mph. Winds over 50 mph were also reported on the 26th, with peak gusts of 59 and 64 mph in the late evening of the 26th.
January 10, 2013	A cold trough of low pressure dropped down the West Coast and into southern California, bringing light to moderate showers to most areas except the Coachella Valley, snow in the mountains, and gusty west winds. Blowing dust reported in the **Coachella Valley** where measured gusts to 66 knots were reported.
January 14, 2013	The trough slowly moved eastward, bringing dry and warmer offshore flow to develop, bringing gusty, northerly winds through the passes and canyons. Local damage in the form of downed power lines and road signs reported. In the **Coachella Valley**, gusts to 56 knots were reported.
February 7-10, 2013	A very cold trough of low pressure moved through southern California, bringing significant cooling. Low snow levels, gusty west winds, and light to moderate precipitation along and west of the mountains. Winds up to 62 knots were measured in the **Coachella Valley** on the afternoon of the 8th.
February 19, 2013	Strong, cold low pressure system from the Gulf of Alaska came down the West Coast and over southern California. Storm was accompanied by thunderstorms with localized hail, moderate rain showers, snow above 2,300 feet elevation, and very strong wind gusts along and below the ridges and desert slopes. A big (but empty) rig overturned on Highway 111 at Overture Drive, near Windy Point. A fuel spill cleanup forced the closure of the northbound lanes for more than 2 hours. Property damage in the **Coachella Valley** reported at $5K.

Date	Description, Including Location and Damage Reported
February 24, 2013	A surface high pressure over the Great Basin brought strong gusty northeast winds to southern California. A power line was downed at the intersection of Twentynine-Palms Highway and North Indian Canyon Drive, just south of Morongo Valley. $7K in property damage reported in the **Coachella Valley**.
March 3, 2013	An upper level low-pressure trough brought gusty winds to the area, with gusts to 58 knots measured in the **Coachella Valley** area. No damage was reported.
April 8, 2013	A deep trough of low pressure from the Northwest moved through southern California, bringing minor cooling, light to moderate precipitation west of the mountains, and damaging west winds to the mountains and deserts. Damage to trees and structures, as well as blowing dust and sand, was reported in the Borrego Springs and **Palm Springs** areas. A big rig was blown over along I-10 in Palm Springs, near Date Pam Drive. A power pole was downed near Whitewater Wash and Vista Chino in Palm Springs, along with several downed palm trees across the valley. Vista Chino Road was closed while crews fixed the pole, and two of the eastbound lanes on the I-10 were also closed for 2 hours while the overturned rig was removed and the investigation was concluded. Winds to 70 knots were measured in the area, and $30K in property damage was reported.
April 14-16, 2013	Large upper-level low over the Pacific Northwest swung through the Great Basin, driving strong, gusty westerly winds across the mountains and deserts. Winds resulted in widespread blowing dust in the Coachella Valley, limiting visibility to less than 1/8 of a mile, accumulating sand and closing main roadways. The winds impacted the Coachella Music Festival. Gene Autry Trail, between I-10 and Via Escuela, and Indian Canyon Road, from Palm Springs Train Road to Tramway Road were closed until the 16th due to blowing sand and reduced visibility, and downed trees. . Gust to 68 knots were measured in the area, and $10K in property damage was reported.
September 1-7, 2013	Isolated to scattered thunderstorms over the mountains, deserts and portions of the Inland Empire caused flash flooding in some areas. On the 3rd, the hot spots included the **Coachella Valley**. Palm Springs experienced flooding due to runoff from storms in the adjacent mountains, closing Araby Drive. Flash flooding and debris flows were also reported in Tahquitz Creek and through the Tahquitz Creek golf resort, closing Cathedral Canyon Drive at the Whitewater Wash. Additional flash floods and a debris flow 2 feet deep and 20 feet wide across Golf Club Drive in Cathedral City reported on the 4th and 5th. The same road was closed on the 7th due to additional flooding from Whitewater Wash. $100K in property damage reported in Cathedral City.
September 9, 2013	A monsoon thunderstorm with gusty downdraft winds downed nine power lines and poles in the Coachella Valley, in the **Bermuda Dunes** area. Wind gusts were estimated at 50-55 mph. $100K in property damage reported.
September 21-22, 2013	Broad trough of low pressure moved through the desert bringing strong, gusty winds to the mountains and deserts, especially the **Coachella Valley**. Winds gusts to 56 knots were measured.
October 4, 2013	Large area of surface high pressure built over the Great Basin, bringing strong gusty winds over the mountain ridges and canyons. In the **Coachella Valley**, the winds were clocked at 52 knots.
October 8, 2013	Strong, upper-level low pressure system moved through southern California, bringing gusty westerly winds to the mountain ridges and desert slopes. Visibility was reduced in the Coachella Valley due to blowing sand and dust. No damage reported, however. Rain was responsible for 318 accidents in southern California, exceeding by far the 75 that occur on average every day.
October 27, 2013	Strong, upper-level low moved down the West Coast bringing strong to severe pre-frontal SW to W winds to the northern desert slopes. A 130-knot jet moved around the backside of the low, increasing westerly winds in the mountains and lower deserts. Wind gusts to 74 knots were reported in the Coachella Valley.
December 4, 2013	Cold, upper-level trough of low pressure brought gusty west winds and scattered rain. Snow dropped to about 3000 feet elevation, with a trace to 2 inches of snow measured from I-8 to Big Bear. High winds to 64 knots reported in the Coachella Valley.

Date	Description, Including Location and Damage Reported
December 7, 2013	A deep trough of low pressure that dug through the Great Basin brought gusty winds, rain and mountain snow to the southern California area. Winds of up to 63 knots were reported in the Coachella Valley.
December 14, 2013	A surface high pressure over western Utah resulted in moderate to strong Santa Ana winds in southern California. In the **Coachella Valley**, gusts to 63 knots were reported.
December 19, 2013	Strong, upper level trough brought cold weather, along with rain, mountain snow and SW to W winds to the area. The strongest winds were reported in the **Coachella Valley** in the early morning of the 19th.
January 14, 2014	Strong surface high pressure over the Great Basin resulted in high winds in southern California. In the **Coachella Valley**, winds with gusts to 50 knots were reported.

Sources: NCDC database (http://www.ncdc.noaa.gov/stormevents/), a compilation by the National Weather Service in San Diego (http://www.wrh.noaa.gov/sgx/document/weatherhistory.pdf).

As discussed above, although most tornado activity in the United States occurs in the Midwest states, **tornadoes** can and do occur in California. The Tornado Project, an organization that researches, compiles and makes tornado information available on the web at www.tornadoproject.com, indicates that in Riverside County, there were nine tornadoes between 1955 and 1998; NOAA includes an additional nine tornadoes and eleven funnel clouds between 2000 and January 2014, with the majority of these near Hemet and Perris. A list compiled by the San Diego office of the National Weather Service includes several additional tornadoes in and near Riverside County, including several in the Hemet area. Table 6-5 lists the tornadoes reported in Riverside County, and a couple in northern San Diego and Imperial counties. The data available indicate that in the last about 60 years, tornadoes have caused at least two injuries and about $4 million in property damage in Riverside County, with most, but not all, of these between Elsinore and Moreno Valley. The Coachella Valley can be impacted by tornadoes and funnel clouds, but the historical record suggests that these meteorological events do not occur often in the area.

Table 6-5: Tornadoes and Funnel Clouds Reported In and Near Riverside County Between 1955 and January 2014

Date and Location	Time	Dead	Injured	Fujita Scale	Damage Description
April 6, 1955, near Moreno Valley	13:30	0	0	F1	The tornado in the hills near Moreno Valley was reportedly 1 mile long and about 50 yards wide. No damage was reported.
August 16, 1973, just west of Blythe	19:00	0	0	F2 or F3	$25K in property damage
July 20, 1974, in Hemet	13:49	0	1	F1	The tornado was reportedly 1 mile long and about 20 yards wide. $25K in property damage
January 20, 1982, in Riverside	02:05	0	0	F0	Of unknown length, its width was estimated at 60 yards. No damage or injuries reported.
September 18, 1985, along the NE shore of the **Salton Sea**	09:55	0	0	F0	10 yards wide, of unknown length. No damage or injuries reported.
March 20, 1991, in Riverside	11:30	0	0	F0	10 yards wide, of unknown length. No damage or injuries reported.
January 18, 1993 in Hemet	NA	0	0	F0	Funnel cloud reported.

Date and Location	Time	Dead	Injured	Fujita Scale	Damage Description
March 26-28, 1993, various	NA	0	0	F0	Funnel clouds near Temecula and a funnel cloud in Moreno Valley.
August 12, 1994, in Valley Vista, just east of Hemet	13:00	0	0	F0	The tornado touched down causing a tree to smash onto the living room of a residence. Several other funnel clouds reported in the area at the time, which uprooted trees and blew over utility poles. A trailer was also destroyed.
March 13, 1996, various	NA	0	0	F0	Two funnel clouds were observed southwest of Moreno Valley, one northwest of Hemet, and one in Irvine.
December 22, 1996 in Cabazon	09:00	0	0	F1	Tornado moved northeastward for about 700 feet before dissipating. Lifted a 5-ton mobile home and deposited it 30 feet from its foundation, its roof and contents removed. Six other mobile homes suffered minor damage.
May 20, 1997 near Borrego Springs	NA	0	0	NA	Tornado 7 miles east of Borrego Springs.
May 13, 1998 in Homeland	14:45	0	0	F0	Tornado touched down in the Highland Palms mobile home park, ripping awnings from several trailers. Funnel clouds in Homeland and Moreno Valley.
February 13, 2001 In **Palm Desert**	NA	0	0	NA	Funnel clouds reported.
August 15, 2001 in Menifee	NA	0	0	F0-F1	Dust devil that damaged a shed.
October 26, 2002 near Borrego Springs	NA	0	0	F0	Funnel cloud 5 miles northeast of Borrego Springs.
November 12, 2003 in Temecula	15:00	0	0	NA	Funnel cloud reported.
January 9, 2005 near Hemet	17:11	0	0	F0	Tornado touched down in the Diamond Valley area, where it picked up a metal storage shed and tossed it onto a power pole. $5K in property damage
January 9, 2005 near Mira Loma	15:18	0	0	F0	Funnel cloud observed near Mira Loma.
February 19, 2005 in Temecula	09:35	0	0	F1	The most devastating of two tornadoes that occurred in southern California that day, this tornado touched down in the Temecula Creek Golf Course Inn and Rainbow Canyon Villages. At least 100 trees, many more than 100 years old, were blown over. In the residential area of Rainbow Canyon Villages most fences and trees were blown over, and several homes lost roof shingles. $100K in property damage.
February 20, 2005 near **Palm Springs**	16:00	0	0	F0	A funnel cloud was spotted in Palm Springs around Indian Avenue and Gene Autry Trail. The funnel cloud was also seen from Interstate 10. Motorists stopped to take pictures. No injuries or damages reported.
February 22, 2005 near Mira Loma	15:18	0	0	F0	Funnel cloud reported near Mira Loma.

Date and Location	Time	Dead	Injured	Fujita Scale	Damage Description
February 26, 2005 in Lake Elsinore	15:00	0	0	F0	Tornado witnessed over Nichols Road in Lake Elsinore. It lasted about 5 minutes and developed under a cumulus cloud cover in the Elsinore Convergence Zone. It caused no damages or injuries.
April 28, 2005 in Hemet and Carlsbad	12:18	0	0	F0	Several funnel clouds were reported in these areas.
July 23, 2005 in Hemet	13:06	0	0	F0	The tornado was first spotted near the intersection of Highways 74 and 79; it then traveled westward toward the Hemet-Ryan airport, causing mostly broken tree limbs. Caused about $1.5K in property damage.
April 5, 2006 near Riverside	11:20	0	0	F0	A funnel cloud was spotted in Riverside near Highway 60 and I-215.
July 23, 2006 in Menifee	15:15	0	0	F0	A thunderstorm produced a tornado that blew over a dozen pine trees and a few palm trees at the Menifee Lakes Country Club. A few homes were damaged by the fallen trees. $25K in property damage
May 22, 2008 near March Air Force Base	15:30	0	0	EF0	Observations indicate tornado touched down approximately four miles southeast of the ARB and was on the ground for six minutes. No reports of damage were received. Its exact path is unknown.
May 22, 2008 near March Air Force Base	15:42	0	1	EF2	This tornado traveled approximately three miles in a west-southwest direction for 21 minutes, and had a max width of 75 yards. As the tornado crossed Interstate 215, a semi-truck was lifted 30 to 40 feet into the air and nine empty BNSF railroad cars were derailed. The driver of the semi had to be extricated and was hospitalized for over a month due to moderate head injuries. The tornado also damaged the roofs of several homes and a trailer. Another tornado developed nearby while this tornado was in progress. Damage to the rail cars was consistent with wind gusts up to 120 mph, or an EF-2 tornado (first EF-2 tornado in California since the new scale was implemented in February 2007, and the first F2 tornado in California since the 1998 Sunnyvale tornado). $350k in property damage.
May 22, 2008 near March Air Force Base and Val Verde	15:50	0	0	EF-0	Photos and video of the tornado described above show a separate tornado occurring in its vicinity at the same time. Based on photographic evidence and eyewitness accounts, this separate tornado would be the third tornado produced by the storm. Its exact path is not known, however several videos indicate that this tornado was just west of Interstate 215 in close proximity to the Riverside National Cemetery. No reports of damage were received.
May 22, 2008 in Lake Elsinore area	16:40	0	0	EF0	A trained weather spotter captured video of this tornado in an unpopulated area near the Gavilan Hills between Woodcrest and Lake Elsinore, however the exact path is unknown. This was the fourth and final tornado produced by the storm. No reports of damage were received.
January 21, 2010 in and	15:10	0	0	EF0	Motorists reported a tornado crossing Interstate 10 near Intake Blvd, where two semi trucks were blown over.

Date and Location	Time	Dead	Injured	Fujita Scale	Damage Description
around Blythe					Numerous power poles were downed, and considerable damage to homes and other structures. Roofs were blown off some homes. The rain-wrapped tornado had peak wind gusts estimated at 80 mph as it moved toward the northeast. Nearby Blythe airport recorded a peak gust of 55 mph, with thunderstorms in the area. Record low pressure of 29.02 inches was observed at Blythe. $3M in property damage.
October 2, 2010 in Calimesa	16:10	0	0	F0	Funnel cloud observed. No damage reported.
September 13, 2011 near Perris	14:15	0	0	F0	Funnel cloud observed. No damage reported.
August 12, 2012 near Nuevo and Perris	14:30	0	0	EF0	A tornado and funnel cloud associated with and southwest of the parent thunderstorm occurred over Nuevo, on the east side of Perris. Separate wind damage from the parent thunderstorm was observed to the northeast over Nuevo on Menifee Road. There was no damage reported from the tornado.
September 9, 2012 in Perris	13:30	0	0	EF0	A land spout was observed along Interstate 215 and Hwy. 74 near Perris. No funnel was observed at the cloud base. The land spout remained nearly stationary.
September 7, 2013 in Perris	13:00	0	0	EF0	Radio operator reported two funnel clouds over Perris.
Totals 37		0	2		About $4 million in damages

Sources: NCDC database (http://www.ncdc.noaa.gov/stormevents/), The Tornado Project (http://www.tornadoproject.com/), compilation by the National Weather Service office in San Diego (http://www.wrh.noaa.gov/sgx/document/weatherhistory.pdf).

The NCDC database lists nine **dust storm** events in the Coachella Valley area between 2000 and January 2014 that combined caused at least $90 thousand in property damage. At least 38 more events were culled from the windstorm descriptions provided in Table 6-4. Given the many instances of strong winds reported in the region, this list is very likely under-representing the hazard of dust storms in the Coachella Valley.

Table 6-6: Dust Storms Reported in the Coachella Valley Between 1987 and January 2014

Date	Description, Including Location and Damage Reported
January 20, 1987	Wind gusts to 80 mph below Cajon Pass, 70 mph in San Bernardino, 60 mph in Mt. Laguna, and 40 mph at El Toro. Winds cause thick dust clouds..
December 28, 1997	Santa Ana winds with gusts to 80 mph cause heavy blowing dust and restricted visibility, creating hazardous driving conditions on the Interstate 15.
February 11, 1999	Santa Ana winds with gusts to 85 mph forced the closure of several major roads and interstates. Winds stripped the topsoil off a freshly plowed field west of San Gorgonio Pass and tracked it downstream for 15 miles; 30 Beaumont residents were treated for breathing problems and skin rashes associated with the dust storm.
December 3-4, 1999	Strong Santa Ana winds with gusts to 90 mph; blowing dust reduced visibility.
December 10-11, 1999	Strong winds with gusts to 60 mph resulted in blowing sand and dust. Forced the closure of roads and cancellation of outdoor events in the **Coachella Valley** and

Date	Description, Including Location and Damage Reported
	other areas.
December 21-22, 1999	Strong Santa Ana winds caused a large dust cloud that closed the San Jacinto Valley highways, sand-blasted cars, and reached a height of 500 feet. Winds carrying sand and dirt, and cross winds forced the cancellation of three flights and re-routing of two commercial airplanes from Ontario International Airport.
January 5-6, 2000	Santa Ana winds blew sand and dust, reducing visibilities to near zero in the Inland Empire.
March 20-21, 2000	Santa Ana winds in the **Coachella Valley**, valleys in Riverside and San Bernardino counties, San Diego County and Santa Ana Mountains and foothills. Winds downed power poles, felled trees on cars and houses, knocked fruit off trees, and blew sand and dust, lowering visibility to near zero.
March 31- April 1, 2000	Strong Santa Ana winds blew dust, reducing visibility along most highways in southern California.
August 11, 2000	A thunderstorm gust front caused a dust storm that lowered visibilities in the **Palm Springs International Airport** area. During a period of more than one hour, several flights had to be delayed or diverted to Ontario, until visibility improved. Peak wind gust at the airport was 28 mph.
February 7, 2001	High winds across the San Jacinto Mountains generated lee mountain waves that touched in the Coachella Valley between Palm Springs and Thermal. Blowing sand reduced visibility to 15 feet in several areas.
August 17, 2001	Thunderstorms moved northwest across the Imperial Valley and Salton Sea. The 30-mph sustained winds caused a dust storm that reduced visibility to less than 1 mile over eastern San Diego County, the **Coachella Valley** and the Banning Pass.
September 30, 2001	An outflow boundary from thunderstorms associated with tropical depression Juliette over the northern Gulf of California moved northwest across Riverside County. Trees and power lines were knocked down across the Coachella Valley. Blowing dust reduced visibility to zero.
February 10, 2002	Santa Ana winds blew dust and sand, disrupting traffic by reducing visibility to near zero and sandblasting windshields. Signs, trees, power poles and fences were blown down in several communities in the Inland Empire.
March 13, 2002	High winds in the **Coachella Valley** stirred up dust across the desert, reducing visibility to near zero along all major highways. Dust storms caused an estimated $40k in property damage, whereas the high winds caused about $150K in property damage.
March 16, 2002	High winds caused a dust storm in the **Coachella Valley** and fanned a brush fire the next day in the Corona area. More than 100 acres burned before the fire was controlled.
August 18, 2002	Gusts associated with a thunderstorm knocked down several power lines in **Indio**. Dust raised by the wind reduced visibility to less than a mile in the **Coachella Valley**.
November 22, 2002	High winds throughout the region. In the **Coachella Valley**, the winds picked up sand causing a dust storm. About $35K in property damage reported.
November 25, 2002	Blowing dust caused visibility to be near zero from Perris to Moreno Valley; small rocks were blown across Highway 74 in the San Jacinto Valley. Strong winds reported throughout the southern California area.
December 16, 2002	Strong winds in Apple and Yucca valleys, San Bernardino Mountains and San Diego coastline. Visibility reduced to zero in local highways due to blowing dust.
January 5-7, 2003	Strong, widespread Santa Ana winds throughout southern California blew down numerous trees and power poles, impacting at least 60 communities. Dust storms forced closure of I-215. One commercial plane sustained damage at Ontario Airport; others had to be diverted.
February 2, 2003	High winds caused blowing sand in the **Coachella Valley**. The dust storm disrupted traffic and outdoor activities. About $15K in property damage reported.
August 24, 2003	Thunderstorm downdraft winds caused a dust storm in eastern Moreno Valley, north

Date	Description, Including Location and Damage Reported
	of Highway 60, with sustained winds to 40 mph.
August 12, 2004	Dust storm reduced visibility to near zero on the Interstate 10 between Blythe and Desert Center.
August 9, 2005	A thunderstorm brought blowing dust to the Coachella Valley. Reduced visibility to near zero and several downed trees were reported.
January 22-24, 2006	Santa Ana winds downed power lines and trees, caused power outages and property damage. Dust storm closed the Ramona Expressway.
January 5 & 7, 2007	Strong winds across southern California. Damaged or downed power poles; damage to trees or tree limbs; blowing dust reduced visibility to near zero along I-215 and the Ramona Expressway; small, wind-driven wildfires along I-15.
February 27, 2007	Widespread wind activity on the desert slopes of the San Bernardino Mountains. Poor visibility due to blowing dust forced closure of several roads in the **Coachella Valley**.
February 3, 2008	Winds associated with a winter storm caused areas of thick blowing dust in the Coachella Valley region.
June 4, 2008	Strong onshore pressure gradients caused a period of gusty winds in the mountains and deserts. The high winds downed power poles causing outages, broke tree limbs, and blew dust in the **Coachella Valley**. $25K in property damage.
March 22, 2009	Visibility of 0.25 miles due to blowing dust was observed at **Thermal Regional Airport** from 0823 to 0852 PST. No property damage reported.
December 22, 2009	A strong onshore flow associated with a winter storm produced strong to high winds in the mountains and deserts. Blowing dust and downed palm fronds were reported in the **Palm Springs** area.
April 27-29, 2010	Multiple upper-level low-pressure areas brought winter-like weather to southern California in late April. A trained spotter reported blowing dust with visibility down to 1/8 mile and some large tree branches down in **Thousand Palms** where gusts were as high as 55 mph.
October 24-25, 2010	Strong onshore flow brought gusty winds to the mountains and deserts. Winds caused area of blowing dust and local power outages.
April 21, 2011	A series of storm systems moving through the Pacific Northwest brought windy conditions to the southern California area. **Indian Canyon Drive** was closed due to large amounts of blowing sand near the Whitewater Wash; it had recently been reopened after a couple of days of closure due to blowing sand.
June 16, 2011	Strong winds in **Coachella** kicked up a cloud of dust in the evening of the 16th. The winds, coupled with the dust, were blamed for a pile-up involving 5 vehicles and 3 semi-trucks. Visibility was reported to be near zero at the time of the crash around 1610 PST. Several people were taken to the hospital for non-serious injuries. Highway 86 was shutdown between Avenues 50 and 52 for several hours, reopening around 2000 PST that night.
January 21, 2012	A powerful jet stream brought two storm systems to southern California, with very strong west-northwest winds in all mountain and desert areas. Three major roadways through **Palm Springs** were closed due to zero visibility caused by blowing dust and sand: Indian Avenue, Gene Autry Trail and Vista Chino. Bridges and wash crossings were closed at Washington and Adams Streets due to reduced visibility from blowing dust and sand. Reduced visibility from blowing sand is believed to have caused a crash between a bus, a truck and a sedan on I-10 westbound near the Gene Autry Trail exit. Four people were taken to the hospital for injuries from the crash.
February 11, 2012	An amplified ridge over the eastern Pacific allowed a few upper-level short wave troughs to move over the region, bringing strong gusty winds, widespread rain and mountain snow. Blowing dust reduced visibility to only about 1/10 of a mile, or less.
February 13, 2012	A spotter in **La Quinta**, near Thermal, reported blowing dust, reducing visibility to one tenth of a mile or less. Winds at the time were sustained 30 mph and gusting to 47 mph. No property damage reported as a result of the dust storm.

Date	Description, Including Location and Damage Reported
March 6, 2012	Strong winds in the **Coachella Valley** caused several instances of blowing dust as well as some traffic sign damage and trees down. A street sign was partially knocked down from its supporting pole on Sunrise Way, near Gene Autry Trail. Palm Springs police also closed Gene Autry Trail between Via Escuela and Interstate 10 for much of the day.
March 17, 2012	A strong, cold upper-level low pressure system brought precipitation and strong gusty winds to the southern California area. In the Coachella Valley, the winds caused power outages, blowing dust, and downed traffic signs.
September 9, 2012	Monsoonal moisture in an easterly flow aloft brought showers and thunderstorms to the mountains and deserts. Outflow boundaries from the storms created winds that picked up dust and lowered visibility in the **Coachella Valley** and near Borrego Springs. Visibility lowered to near zero at times in these areas.
January 10, 2013	Blowing dust was reported in the Coachella Valley area as a result of a trough of low pressure that extended into southern California, bringing showers and snow to other areas.
April 8, 2013	Blowing dust and sand was reported in the Borrego Springs and Palm Springs areas. A dust devil, combined with strong and gusty winds, produced damage at the Salton City RV Resort in **Salton City**. The winds downed several awnings, ripped off some siding, and broke a water pipe, for a total of about $9K in property damage. No injuries were reported.
April 14, 2013	Large upper-level low over the Pacific Northwest swung through the Great Basin bringing gusty westerly winds to the mountains and deserts. Widespread blowing dust reported in the Coachella Valley, with visibilities down to 1/8- mile or less at times, sand accumulating and closing main roadways. Large quantities of sand reported near Vamer Road and Monterey Avenue. Police closed sections of Gene Autry Trail and Indian Canyon Road due to blowing sand and poor visibility.
October 8, 2013	Gusty westerly winds picked up sand and dust, reducing visibility in the Coachella Valley.

Sources: NCDC database (http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms), compilation by the National Weather Service office in San Diego (http://www.wrh.noaa.gov/sgx/document/weatherhistory.pdf), and data presented in Table 6-4 above.

6.2 Other Extreme Weather Events

6.2.1 Hail

Hail is solid precipitation consisting of fragments of water ice called hailstones. These can be irregular in shape, oval or rounded, and can vary in size from 0.2 inch (5 mm) in diameter, to nearly 8 inches (20 cm), although hail more than 4 inches in diameter is unusual. The stones can range from soft to very hard. Hail is produced in thunderstorms with strong upward motion of the air, similar to a tornado, and freezing levels at relatively low elevations. A hailstone forms as a result of super-cooled water that freezes around an ice-condensing particle, such as a grain of sand, a bit of compacted snow, or even a particle of pollen or other debris carried up into the atmosphere by the thunderstorm updrafts. The resulting hailstone may be carried upward into colder sections of the atmosphere, all the while collecting additional super-cooled water droplets. Once it gets too heavy for the wind to keep it aloft, it falls to the ground as hail. Hailstones have rings like an onion, with translucent ice layers alternating with white, opaque layers. It is believed that the translucent layers are formed in those sections of clouds where water occurs as droplets, whereas the opaque, white sections form in areas where water vapor predominates. Hailstones also form by accretion, with smaller stones sticking together to form larger, irregular stones. These are often lumpy or even spiky on the outside.

With current weather detection methods, such as weather satellites and radar, it is possible to detect thunderstorms that will produce hail. Severe weather warnings are generally issued in the United States for hail that is more than about 1 inch (2.5 cm) in diameter.

The NCDC website lists nine hail events in Riverside County between 2000 and January 2014; these are listed in Table 6-7 below. The list compiled by the San Diego office of the National Weather Service, although not considered comprehensive, includes several hailstone events in San Bernardino and San Diego counties, but none in Riverside County. Of the events in Table 6-7, only one occurred in the Coachella Valley, impacting the nearby community of La Quinta. Thus, the data available suggest that hailstorms are rare in the region, and have a low probability of impacting the city of Coachella.

Table 6-7: Hail Events In Riverside County Between 2000 and January 2014

Date	Description, Including Location and Damage Reported
July 24, 2004	A thunderstorm dropped nickel-sized (0.88 inch diameter) in the Anza area near the intersection of Highways 371 and 74. No injuries or damages were reported.
September 9, 2004	A heavy monsoonal thunderstorm dropped ¾-inch in diameter hail in the Idyllwild - Pine Cove area. No injuries or damages reported.
July 23, 2005	A severe thunderstorm developed along the Elsinore Convergence Zone northeast of Hemet. The storm produced a tornado, damaging straight-line winds to 70 mph, dime- to nickel-sized (1/4 to ¾-inch in diameter) hail, and flash flooding. Hail was reported in Hemet at 13:21 and 14:05 PST in Hemet, and at 13:25 in San Jacinto. The storm traveled southwestward and dissipated near Interstate 15 in Murrieta. No damage was reported due to the hail, but the heavy winds, tornado and flash flooding combined caused about $67.5K in property damage.
April 5, 2006	Hail to ¾-inch in diameter was reported in the Corona area of Riverside County at 11:18 PST.
May 22, 2008	A severe thunderstorm produced ¾-inch in diameter hail in Murrieta. No reports of damage were received.
May 22, 2008	A thunderstorm left a swath of hail up to several inches deep from north of Moreno Valley to Perris. Snowplows were called out to clear the hail from Interstate 10. While most of the hailstones were pea-size, several reports of marble- to nickel-sized hail were received from Moreno Valley just prior to the tornadoes. The larger hailstones left holes in awnings and stripped leaves from trees. $5K in property damage.
August 4, 2008	The public reported dime- to nickel-sized hail from a thunderstorm that started in Indio and moved into the south **La Quinta Cove** area during an active day of monsoon thunderstorms. In addition to hail, the storms brought gusty winds and flash flooding.
August 30, 2008	A severe thunderstorm developed over the Fern Valley (Idyllwild) area and significantly interfered with an ongoing search and rescue operation involving two injured climbers at Suicide Rock. Several eyewitness accounts from climbers on Suicide and Tahquitz Rocks, as well as from people involved in the ongoing search and rescue mission, describe hailstones ranging in size from marbles to walnuts. A helicopter was forced to abort a rescue attempt of the climbers and make an emergency landing after the thunderstorm moved into the area. One of the injured climbers suffered additional contusions from the hail while another person received cuts. Please note that the severe thunderstorm did not move into the area until nearly two hours after the initial (non-weather related) rock climbing accident.
August 24, 2013	Significant amounts of tropical moisture streamed northward into southeastern California ahead of dissipating tropical storm Ivo. The atmosphere in the area became very moist and unstable; scattered thunderstorms developed that generated copious amounts of rain, with rain rates exceeding 3 inches per hour in some areas. Large hail up to 1-inch in diameter fell in Eagle Mountain for about 30 minutes. No damage was reported.

Date	Description, Including Location and Damage Reported
September 3, 2013	Isolated to scattered thunderstorms occurred throughout the mountains, deserts and portions of the Inland Empire September 1-7. Hail up to ½-inch fell in the Idyllwild/ Pine Cove area on the 3rd. Other areas in Riverside County reported small hail. Pea to dime-sized hail accompanied storms on the 6th that caused flooding near the Highway S2 and SR79 intersection.

Source: NOAA database (http://www.ncdc.noaa.gov/stormevents).

6.2.2 Heavy Snow and Ice

Snow and ice normally do not come to mind at the mention of southern California, but some of the mountain communities do receive substantial precipitation in the form of snow and ice during the winter months. Sudden drops in temperature, combined with reduced visibility due to the snow, have stranded hikers in the mountains of San Diego, Riverside and San Bernardino counties. The low elevations in the Coachella Valley, combined with its location in the rainshadow provided by the San Jacinto Mountains, limits the historical occurrences of snow and ice in the area. However, several instances of snow have been reported at the northern end of the valley, in Palm Springs, which is approximately 450 feet higher in elevation than downtown Coachella, but at about the same elevation as the easternmost portions of the General Plan area. The snow falls historically reported in Palm Springs and other low-lying areas in the southern California region are summarized in Table 6-8 below.

Table 6-8: Historical Snowfalls Reported in the Low-Lying Areas of Southern California

Date	Event Description, including Location
December 1847	Light snow reported in the hills above Old Town San Diego. Greater amounts of snow reported to the east.
1848	Several feet of snow covered the San Bernardino Valley, staying on the ground for a long time. Several thousand head of cattle died.
April 21-22, 1908	0.6 inch of snow fell in Santa Ana.
January 11, 1930	2 inches of snow fell at **Palm Springs**.
January 15, 1932	Up to 2 inches of snow fell all over the Los Angeles Basin, including 1 inch at the Los Angeles Civic Center; the beaches at Santa Monica whitened.
January 21, 1937	Snow flurries reported in San Diego, with trace amounts of sticking snow in the northern and eastern parts of the city.
February 11, 1946	Snow flurries reported in many parts of San Diego.
January 9-11, 1949	Snow reported in many lowlands, including 1 inch in Laguna Beach and Long Beach. A trace in San Diego, with light covering in La Jolla, Point Loma, Escondido, and even El Centro.
December 13-19, 1967	Light snow covering reported in low-lying areas, including many San Diego mesas, Carlsbad, and even 4.5 inches at Anza Borrego State Park.
January 4, 1974	Snow flurries reported in **Palm Springs.**
January 31, 1979	Snow fell in many parts of southern California, including at least 2 inches at **Palm Springs**. The snow shut down Interstate 10 on both sides of Palm Springs, isolating the city. Schools were closed down and hundreds of cars were abandoned in the roadways.
February 2, 1985	2 inches of snow reported at **Palm Springs**.
March 2, 1985	Snow fell briefly in Escondido, with ice pellets reported in Coronado, La Mesa and Escondido, and hail reported in Linda Vista and downtown San Diego.

Date	Event Description, including Location
February 22-25, 1987	2-3 inches of snow pellets reported in Huntington Beach. Sleet and hail reported at the San Diego Bay front. 2.25 inches of snow recorded in Tarzana, Northridge, Torrance, Fontana and Redlands.
December 16, 1987	Snow fell for two minutes at Malibu Beach.
December 24, 1987	Snow flurries recorded throughout the San Diego metro area, but not in the downtown area proper.
February 7-9, 1989	Snow fell at the beaches in Los Angeles and in the desert, in **Palm Springs**. Numerous accidents and road closures reported throughout the region.
January 16-17, 1990	Snow flurries reported in the San Diego city limits.
February 14, 1990	Snowflakes reported all over the San Diego metro area.
March 28-29, 1998	The coldest storm of the year brought ice pellets and hail 1-inch deep to some coastal and foothill areas. Serious traffic accidents and considerable damage to crops reported.
January 12-13, 2007	Trace amounts of snow reported in areas as low as 500 feet in elevation in the Inland Empire. On the 13th, a trace of snow was reported in coastal San Diego County.

Sources: NCDC database (http://www.ncdc.noaa.gov/stormevents/), and compilation by the National Weather Service office in San Diego (http://www.wrh.noaa.gov/sgx/document/weatherhistory.pdf).

6.2.3 Temperature Extremes

Temperature extremes are responsible for more deaths in the United States on a yearly basis than all other extreme weather events combined, including flooding. Based on data collected by the Centers for Disease Control and Prevention (CDC, as reported in Goklany, 2007), between 1979 and 2002, an average of 358 people were killed annually by excessive heat. Extreme cold is even more deadly; an average of 680 people died in the United States each year due to cold weather between 1979 and 2002 (Goklany, 2007). In addition to the significant loss of life and injuries, temperature extremes also cause significant economic losses in agricultural production, and in transportation, energy and infrastructure costs.

Heat waves, which are periods of excessive heat, typically exceeding 95 degrees Fahrenheit, often with high levels of humidity, and lasting more than three days, can be deadly by pushing the human body beyond its limits. The heat itself is not deadly, but dehydration and loss of salts through sweating can lead to blood clots that can result in heart attacks or strokes; people with weak hearts may not be able to deal with the increased blood flow necessary to keep the body cool. Sensitive populations include older adults, children, and those that are sick or overweight. Those at greatest risk of dying during a heat wave are city-dwelling seniors that do not have access to an air-conditioned environment for at least part of the day. [Urban areas, due to the heat-absorbing properties of asphalt and concrete, are generally hotter than rural areas.] Athletes that do not take extra precautions or do not decrease their usual exercise routine in response to the high heat can also be impacted by a life-threatening, heat-induced illness such as heat exhaustion or heat stroke. These heat-induced illnesses can also impact outdoor workers, such as those in the agricultural or construction fields, that are not acclimatized, and do not have access to water and shade, or do not slow down and take cool-down breaks in the shade. Poor air quality often occurs during heat waves if a stagnant atmospheric condition develops, trapping dust and air contaminants near the ground surface. The resulting brown haze can cause serious respiratory problems in the elderly, infants, asthmatics, and others with compromised immune systems.

In addition to the potential injuries and loss of life brought on by heat waves, excessive heat can impact agricultural production, both of livestock and crops. Poultry, in particular, do poorly during heat waves. Millions of birds died during a severe heat wave that impacted the Midwestern states in 1980. Crops can also be adversely impacted by excessive heat and/or drought. Increased irrigation, with concurrent increased production costs, is generally necessary to prevent permanent damage to certain crops, such as vegetables and leafy greens.

High heat and **excessive heat** events that have occurred historically in the southern California area and that are known or inferred to have impacted the Coachella Valley are listed in Table 6-9. High heat events are periods of high heat that either did not last for at least three days, or where the heat and/or humidity levels were not sufficiently high to be defined as an excessive heat event. The data provided in Table 6-9 is most likely not comprehensive, but it does show that periods of temperature extremes have occurred historically in the region, and thus, that periods of excessive heat can be anticipated in the future.

The definition and effects of **extreme cold** vary across different areas of the country. In southern California, where we are not generally accustomed to cold weather, temperatures near freezing are considered "extreme cold." A cold wave, where temperatures drop rapidly within a 24-hour period, can be devastating to susceptible and unprotected populations, crops, livestock and wildlife. Frost, that is, the deposition of ice crystals directly on the surface of an exposed object, can occur even when air temperatures are several degrees above freezing.

Exposure to extreme cold can lead to several life-threatening health conditions, including frostbite and hypothermia. **Frostbite** is an injury to the body, typically to the extremities such as fingers, toes, ear lobes or nose, caused by freezing body tissue. The main symptoms include a loss of feeling in the affected area, often combined with a pale, gray, white or yellow, and possibly waxy, appearance. Immediate medical attention is generally required, and the affected area should be slowly re-warmed to avoid further tissue damage. **Hypothermia** is an abnormally low body temperature (typically below 95 degrees Fahrenheit). Warning signs include uncontrollable shivering, disorientation, memory loss, slurred speech, drowsiness, and apparent exhaustion. Medical attention should be provided immediately if at all possible, and the body should be warmed to normal temperature levels in a slow and controlled manner to prevent further tissue damage.

Populations vulnerable to cold weather include (but are not limited to) the homeless, older adults, persons with medical conditions, including heart disease, diabetes, high blood pressure, mental illness, and cognitive disorders, infants and small children under the age of five, pregnant women, persons of limited economic resources that cannot afford to keep their homes warm, people who are socially isolated, and people who are caught outside in the storm, unprepared. The use of space heaters, barbeques, and fireplaces to keep structures warm increase the potential for structural fires and the risk of carbon monoxide poisoning.

Crop damage and livestock kills due to cold weather have historically cost the southern California area billions of dollars. For example, the December 1990 winter storms cost the state of California $3.4 billion in direct and indirect losses, whereas the 2002 winter caused more than $2 million in crop and property damage to the southern California area alone. Extreme cold events that are known or inferred to have impacted the Coachella Valley area are listed in Table 6-9.

Table 6-9: Historical High Heat, Excessive Heat, Extreme Cold Events and Frost Warnings Reported in Southern California that Impacted or Are Inferred to Have Impacted the Coachella Valley Area

Date	Description, Including Location and Damage Reported
June 11, 1877	**High heat:** A high of 112 degrees was observed in Los Angeles. It would be considered the all-time record, but official records did not begin until 20 years later.
March 28-29, 1879	**Excessive heat:** 95 degrees reported on the 28th, and 99 degrees on the 29th in San Diego. 99 degrees in Los Angeles on the 29th.
January 9, 1888	**Extreme cold:** Cold wave with freezing temperatures impacted the citrus-growing areas with substantial loss of the citrus crop.
July 25, 1891	**High heat:** 109 degrees in Los Angeles.
December 23-30, 1891	**Extreme cold:** Cold wave impacted the southern California area; 1-inch thick ice on oranges on trees in Mission Valley, 1/2-inch thick ice in San Diego pools.
May 27, 1896	**High heat:** 124 degrees at **Salton City**, the national maximum temperature for May.
April 25, 1898	**High heat:** 118 degrees at **Volcano Springs**, on the east side of where the Salton Sea later formed, the national maximum temperature for June. 127 degrees measured at Salton City.
June 23, 1902	**High heat:** 129 degrees at **Volcano Springs**, 127 at **Salton City**. The reading at Volcano Springs was the national maximum temperature for June.
November 12, 1906	**High heat:** 105 degrees at Craftonville, now Crafton Hills near Redlands. This was the national maximum temperature for November.
April 23, 1910	**High heat:** 100 degrees in Los Angeles, a record for April.
January 6-7, 1913	**Extreme cold:** 25 degrees at San Diego on the 7th, the lowest temperature on record. Killing freeze that caused extreme damage to the citrus crop all over California. Many other crops lost. Water pipes frozen, trolley lines disrupted. The damage directly led to the establishment of the U.S. Weather Bureau's Fruit Frost forecast program.
July 10, 1913	**High heat:** 134 degrees at Death Valley, the hottest reading on record for the Western Hemisphere, and the nation's highest temperature on record for July. The heat was accompanied by sandstorm conditions.
September 17, 1913	**High heat:** 110 degrees at San Diego, the highest temperature on record until September 26, 1963. An unofficial report of 127 degrees at San Bernardino. One man died, a carpenter working outside. Few small fires reported in San Diego, including one downtown that destroyed a house.
June 16, 1917	**Excessive heat:** A destructive heat wave in California history climaxes at **Mecca** with a temperature of 124 degrees.
July 6-August 17, 1917	**Excessive heat:** A prolonged hot spell hit Death Valley with 43 consecutive days of temperatures of 120 degrees or higher.
January 22, 1937	**Extreme cold:** 19 degrees at **Palm Springs**.
September 18-22, 1939	**Excessive heat:** Heat wave with 95-degree plus readings in San Diego, 106 degrees on the 21st. Los Angeles experienced 100-degree weather for seven consecutive days, with a peak of 107 degrees on the 20th. Eight heat-related deaths.
September 2, 1950	**High heat:** 126 degrees at Mecca, the national maximum temperature for September.
August 31 to September 7, 1955	**Excessive heat:** On September 1st, it was 110 degrees in Los Angeles, and all-time record, and 104 degrees in San Diego.
July 17, 1960	**High heat:** 101 degrees in Idyllwild.
October 14, 1961	**High heat:** Hot Santa Ana winds drove the temperature to 110 degrees in Long Beach, the hottest in the nation, 107 degrees in San Diego, 105 degrees in Los Angeles, and over 100 degrees in many coastal and inland areas.
September 26, 1963	**High heat:** Hot weather throughout the southern California region, including the coastline, with 112 degrees at El Cajon, 109 degrees at Imperial Beach, 113 degrees at El Toro (the hot spot in the nation for that date), 108 degrees in Carlsbad. Crop damage and animal deaths reported. Schools dismissed; workers sent home early.

Date	Description, Including Location and Damage Reported
October 20-29, 1965	**Excessive heat:** Very long heat wave, with a peak of 104 degrees in San Diego on the 22nd. Los Angeles had ten consecutive days with afternoon highs reaching 100 degrees.
November 1, 1966	**High heat:** 101 degrees at the Los Angeles airport, 100 in Los Angeles, and 97 degrees in San Diego. Santa Ana winds fanned several fires, including one that killed 16 firefighters.
August 22, 1969	**High heat:** 110 degrees at Cuyamaca.
September 25-30, 1970	**Excessive heat:** Drought in southern California came to a climax, with hot Santa Ana winds that sent the temperature soaring to 105 degrees in Los Angeles, and 97 degrees in San Diego on the 25th. The Laguna Fire consumed entire communities in eastern San Diego County. Half a million acres burned, with $50 million in property damage.
January 29, 1979	**Extreme cold: -**25 degrees in Big Bear Lake, the lowest temperature ever recorded in southern California.
July 10, 1979	**High heat:** 123 degrees at **Palm Springs**.
September 4-19, 1984	**High heat:** Tropical air from weakening hurricane Marie brought hot temperatures and high humidity to the region. 100 degrees in San Diego on the 8th and 9th. Numerous health problems reported due to the poor air quality and high humidity.
January 16-18, 1987	**Extreme cold:** Very cold air mass remained over the region, 22 degrees at Valley Center, 24 degrees in Poway, 26 degrees in El Cajon, 36 degrees in San Diego. Substantial avocado crop loss in the millions of dollars. Two homeless men died of hypothermia on the 17th.
October 3-4, 1987	**High heat:** Dry, hot weather, with 108 degrees both days in Los Angeles (a record for October), 109 degrees in El Cajon, 106 degrees in Chula Vista, Fallbrook and Santee, 104 degrees in San Diego on the 3rd. The dry weather and winds fueled the Palomar Mountain fire.
December 25-26, 1987	**Extreme cold:** Low temperatures caused extensive damage to the avocado and citrus crop. 9 degrees at Mt. Laguna and 22 degrees in Valley Center on the 25th; 15 degrees in Julian and Mt. Laguna, 16 degrees in Campo, 26 degrees in El Cajon, 30 degrees in Del Mar and 37 degrees in San Diego on the 26th.
March 25-26, 1988	**High heat:** Santa Ana conditions brought temperatures into the 90s all over the region, with record heat, and fanning of several brush fires. 102 degrees reported in Santee on the 25th, 97 degrees throughout the San Diego valleys, 95 degrees in Los Angeles and Santa Maria, 90 degrees in San Diego.
December 24-30, 1988	**Extreme cold:** A week of sub-freezing temperatures in southern California; 5 people died directly from the cold weather.
April 6-7, 1989	**Excessive heat:** Record high heat reported at all recording stations in southern California, including 112 degrees in **Palm Springs,** 106 degrees in Los Angeles, 104 degrees in Riverside, 103 degrees in Escondido, 101 degrees in Tustin, 95 degrees in Victorville, and 76 degrees in Big Bear Lake. Part of a major heat wave that lasted from late March into early April.
December 21-23, 1990	**Extreme cold:** An artic air mass produced record cold temperatures in the region, such as a low of 29 degrees at Redondo Beach on the 22nd. Throughout the state, December 1990 brought record-low temperatures to many areas, causing $3.4 billion in damages to public buildings, utilities, residential burst pipes, and especially, crop and fruit tree damage. Thirty-three counties were included in a disaster declaration, and as a result, the State established the State Agency Freeze Disaster Task Force, and the development of the State Agency Freeze Disaster Action Plan of 1991.
July 28, 1991	**High heat:** 120 degrees at Borrego Springs, 100 degrees in Campo.
August 17, 1992	**High heat:** Tropical air brought high temperatures and heat index values to Los Angeles and vicinity the entire week. On the 17th, it was 99 degrees, with a heat index of 110 degrees.
August 1, 1993	**High heat:** 123 degrees in **Palm Springs**.
July 27-29, 1995	**Excessive heat:** Heat wave in the region; 123 degrees at Palm Springs on the 28th and 29th, 120 degrees in **Coachella**, 113 degrees in San Jacinto, 112 degrees in Riverside, 111 degrees in Banning, Moreno Valley and Sun City; 110 degrees in Yucaipa on the 27th.
August 2-7, 1997	**Excessive heat**: Dangerously hot weather across all of southern California except in the

Date	Description, Including Location and Damage Reported
	coastal areas. Riverside and Ontario both peaked at 110 degrees Fahrenheit. Intense heat also felt at higher elevations. Beaumont hit 113 degrees, Julian hit 101 degrees, 121 degrees at **Thermal**. Five deaths were directly attributed to hyperthermia. One woman died near Dulzura on the 5th; an elderly female collapsed in her yard in Cabazon on the 6th. On the 7th, a man collapsed in a parking lot in Riverside, and another died at a residence in Flowing Wells. A woman from Campo was hospitalized on the 8th and died several days later. The heat made brush fires difficult to control.
December 26, 1997	**Extreme cold:** 0 degrees reported at Big Bear Lake, 4 degrees at Big Bear Airport.
July 16, 1998	**High heat:** 120 degrees at **Palm Springs**, 118 degrees at Borrego Springs, 127 degrees at Death Valley.
July 27, 1998	**High heat:** 123 degrees at **Thermal**, 118 degrees at Borrego Springs, 118 degrees at **Palm Springs**.
August 29-31, 1998	**Excessive heat:** Record heat in the region, with 112 degrees in Yorba Linda and the Wild Animal Park, 110 degrees at El Cajon, Hemet and Riverside; 108 degrees at Ramona, 106 degrees in Vista and Escondido, over 100 degrees in most of Orange County, 114 degrees in Dulzura on the 29th. Blazes at Camp Pendleton and Lake Jennings.
June 3, 1999	**Extreme cold:** Unseasonably cold air mass brings record low temperatures this late in the season to the southern California area. The high temperature of 38 degrees at Mt. Wilson became the lowest high temperature on record for June.
May 7-9, 2001	**Excessive heat:** Heat wave with 109 degrees at **Palm Springs**, **Thermal** and Borrego Springs, 103 degrees at Hemet, 102 degrees in San Bernardino. On the 11th, emergency crews rescued 19 people on a freight train near the city of Cabazon. They were suffering from heat exhaustion and dehydration. The train was en route to Los Angeles from Palm Springs, and it is unclear when the people had boarded the train. On the 13th, a man's body was discovered in Palm Canyon, near the Dos Cabezas mine in extreme eastern San Diego County.
July 01, 2001	**Heat:** A female hiker and a male softball umpire suffered heat exhaustion as the temperature rose to 115 degrees over the Coachella Valley.
January 28-February 3, 2002	**Extreme cold**: Very cold weather reported throughout the southern California area caused water pipes to freeze and burst, damaged vegetable and flower crops, and caused homeless shelters to fill to capacity. $230K in property damage and $1.8M in crop damage reported. One death directly attributed to cold spell. Most freezing damage occurred in January, but the hard freezes continued in the valleys and deserts into early February. Overnight lows in the single digits were common at mountain resort locations.
July 8-11, 2002	**Excessive heat**: Temperatures over 100 degrees Fahrenheit reported in the San Bernardino Mountains for three days. On the third day nine people were admitted to local hospitals for heat exhaustion. A smog alert was also issued due to the hot stagnant air over the area.
September 1, 2002	**High heat:** Tropical heat wave; 118 degrees in Dulzura, 113 degrees in Temecula, 112 degrees in Riverside and Menifee. Sharp temperature gradients, with areas adjacent to the coastline 10 to 30 degrees cooler than areas slightly farther inland (77 degrees at Newport Beach vs. 107 degrees in Santa Ana, 10 miles away; 72 degrees at Oceanside Harbor vs. 87 degrees at Oceanside Airport, 2 miles away).
July 20, 2003	**High heat**: A truck a man and a woman were riding in became stuck near the Twentynine Palms Air-Ground Combat Center. They tried to walk for help, but were overcome by the heat and died.
April 26-27, 2004	**High heat:** Record highs for April set, with 103 degrees at the Wild Animal Park, 100 degrees at Yorba Linda on the 26th, 85 degrees at Idyllwild on the 27th.
December 1-3, 2004	**Extreme cold:** 30s in the coast, 20s in the inland valleys and deserts, teens and single digits in the mountains, 8 degrees on all three mornings at Big Bear. Wrightwood reported a low of 9 degrees. Crop damage.
July 10-20, 2005	**Excessive heat**: Record heat reported throughout the area due to a strong high pressure,

Date	Description, Including Location and Damage Reported
	with temperatures soaring to 121 degrees at **Indio** and **Thermal**, 120 degrees at **Palm Springs**, and 116 degrees at Hesperia. No relief was to be found in the mountains either, where even at elevations above 7,000 feet temperatures reached into the mid and upper 90s. Big Bear Lake tied an all-high record high of 94 degrees on the 18th, while Idyllwild hit a high of 98 degrees. Daytime temperatures in the inland valleys hit 100 degrees or higher on most days, with a slew of record high minimums reported. One teen died of heat exposure when he and his father went looking for help after their dune-buggy broke down in Anza-Borrego Desert State Park. Near record high power consumption. Desert locations reported the all-time warmest month on record.
July 21-27, 2006	**Excessive heat**: A strong high pressure centered over the southwest US and monsoon moisture during the second half of July led to numerous daily high minimums and high maximum temperature records. Desert locations reported the all-time warmest month on record. Heat wave reached its peak on the 22nd; several highs were tied or broken that day. Temperature rose to 105 degrees in Julian, 114 degrees at Ontario, 120 degrees at Indio and Thermal, and 121 degrees at Palm Springs. Palm Springs experienced 10 consecutive days with a minimum temperature of 85 degrees or greater, breaking the previous record of 5 days in 1917. There were at least 16 deaths and 27 injuries reported as a result of the heat wave, but these numbers, especially the injuries, are thought to be underestimated. Some power outages occurred.
January 12-18, 2007	**Extreme cold:** A cold snap peaked on the 15th with -7 degrees at Fawnskin, -2 degrees at Big Bear Lake and Wrightwood, 5 degrees at Hesperia, 6 degrees at Mt. Laguna, 18 degrees at **Thermal**, 19 degrees in Hemet, and 20 degrees at Camp Pendleton. San Diego, Riverside and San Bernardino counties declared disaster areas. Except for right along the immediate coastline, the freeze lasted for a week or longer. $68.85 million in crop damage in the **Coachella Valley**, $86 million in Riverside County, and $11.1 million in San Bernardino County. $600K in damage from frozen pipes in San Bernardino County's mountains and deserts, $100K in property damage in the **Coachella Valley**. Golf courses in Palm Springs were affected by the freeze.
July 3-6, 2007	**Excessive heat**: A significant heat wave occurred in the mountains and the **Coachella Valley**, with high temperatures generally around 115 degrees reported in the lower deserts, 105 degrees in the mountains between 3,000 and 5,000 feet, 100 degrees between 5,000 and 6,000 feet, and 95 degrees between 6,000 and 7,000 feet. 119 degrees at Ocotillo Wells, 116 degrees in **Palm Springs** and **Indio**. Most valleys and coastal cities west of the mountains were not affected because of a persistent marine layer, and as a result, there was little media coverage regarding the heat wave. The heat wave likely made many people ill, but the number is unknown.
September 1-4, 2007	**Excessive heat**: A strong high pressure and easterly flow brought hot, humid weather to much of southern California. Temperatures exceeded 110 degrees in the Inland Empire and high deserts, and 115 degrees in the **lower deserts**. Humidity levels were quite high for the region. At least 6 people died of heat-related causes; the actual number is probably higher.
June 20, 2008	**High heat**: High temperatures were recorded in the Inland Empire area, including 105-111 degrees in the valleys and 115-118 degrees in the **lower deserts**. High temperatures reached 115 degrees at **Indio**, 117 at **Palm Springs**, and 118 at **Thermal**. The relatively short duration of the heat spell and the lack of humidity kept this episode from meeting the excessive heat criteria. News reports indicated that several people were treated for heat-related illnesses, but no specifics were provided.
May 17-19, 2011	**Cold/Wind Chill:** On both the 17th and 18th, numerous low temperatures (both maximum and minimum) were recorded in the **Coachella Valley**. Palm Springs and Thermal both broke records with high temperatures of 76 and 77 degrees respectively. These temperatures are about 25-20 degrees below normal for that time of year.
May 12, 2012	**Heat:** A low of high pressure over the area created a warming trend with inland temperatures 5 to 15 degrees above normal. Temperatures in the **lower deserts** ranged from 97 to 105 degrees. An 86-year old male was hospitalized for heat-related illness near

Date	Description, Including Location and Damage Reported
	Mecca. On the 18th, the Health Department confirmed his death as heat-related.
June 28-29, 2013	**Excessive Heat:** A record setting ridge of high pressure brought extreme high temperatures to the Coachella Valley area. Palm Springs reported a high of 118 degrees, tying the previous record set on 6/28/1979. Indio also tied its previous high record of 118 set in 2003.
July 1-3, 2013	**Excessive Heat:** A record setting ridge of high pressure brought several record high temperatures, with highs well over 100 degrees. In Cathedral Canyon a high of 115 degrees was recorded; in Indian Wells, 122 degrees.

Sources: NOAA database (http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms), and compilation by the National Weather Service office in San Diego (http://www.wrh.noaa.gov/sgx/document/weatherhistory.pdf), for events through January 31, 2014.

6.2.4 Drought

Drought is defined as an extended period of below-average precipitation relative to levels normal for that region. Given this definition, drought can occur almost anywhere in the world, and has impacted human populations throughout history. Extended drought periods, posing a severe impact on ecosystems and agriculture, have been responsible for damaged local economies, political unrest, many mass migrations, and even the collapse of civilizations. Because drought occurs over a lengthy period of time, measured in months to years (and even decades), rather than in seconds to days (such as earthquakes, tornadoes, hurricanes and floods), its impacts are generally difficult to recognize until severe damage has occurred. It is also difficult to predict when a drought will pass. As a result of climate change and global warming, some regions of the world are expected to experience drought more often, or possibly even change permanently to a more arid condition, impacting local populations severely (additional information on climate change is presented in the Sustainability and the Natural Environment Element.)

In the southwestern United States, variations in precipitation levels are often tied to oceanic and atmospheric weather cycles such as the El Niño – Southern Oscillation (ENSO) and La Niña events. These are natural climate phenomena related to annual differences in the sea-surface temperature (SST) and air pressure in the equatorial Pacific Ocean that affect climate the world over. The El Niño conditions occur when warming of the Pacific Ocean SST occurs in concert with an oscillation in air pressure, referred to as the Southern Oscillation, between the eastern and western Pacific Ocean. La Niña conditions are associated with a cooling of the Pacific Ocean SST in the same area off the western coast of South America. These warming (El Niño) or cooling (La Niña) episodes affect the climate in North America during the winter and early spring months (typically between December and February, but can last through multiple seasons). These conditions are often modulated by other climate cycles, such as the Pacific Decadal Oscillation, the North Atlantic Oscillation, and the Atlantic Multidecadal Oscillation. The Pacific Decadal Oscillation, in particular, impacts the southwestern United States in a cycle that lasts 20 to 30 years characterized by warming or cooling of the surface water in the Pacific Ocean facing the western coast of North America. The interaction of all of these climate cycles makes it difficult to forecast the strength and length of El Niño and La Niña events.

During El Niño events, a widened Pacific jet stream draws tropical moisture over southern California, causing an increase in precipitation and storms. El Niño episodes thus increase the likelihood of extreme winter storms, storm-related high winds and flash flooding in the region, including the Coachella Valley. During La Niña events, the jet stream stays up in the Pacific Northwest, causing increased precipitation in Washington and Oregon, and less precipitation in the southwestern and southeastern states. Thus, La Niña episodes increase the likelihood of drought and Santa Ana wind conditions in southern California, including in the Coachella Valley. Most severe weather episodes reported historically in southern California can be associated with El Niño and La Niña events.

In the period between the years 2000 and January 2014, the Coachella Valley area was impacted by drought conditions during three consecutive years, between 2007 and 2009. By the end of the 2006-2007 rainfall season, most of southern California had received 30 percent or less of normal precipitation, with most major reservoirs reporting water storage at about 80 percent of their 30-year average. By July 2007, extreme drought conditions, with more than $4 million in crop damage, prompted the Governor to declare a state of emergency for Riverside County. Many wells in the county began to dry up, forcing rural communities to truck in extra water or get hooked up to city water systems. A fairly inactive monsoon season provided no drought relief to the area. By August and September 2007, local agencies were using radio and television announcements to encourage water conservation, especially after a court-ordered reduction in water supplies from the Sacramento River Delta raised concerns about a possible water crisis in the region. Rainstorms at the end of November, in December, and January 2008 helped downgrade the situation from severe drought to abnormally dry levels.

The dry spring that followed resulted in a moderate drought classification for the southern California area. In June 2008 the Governor issued a state-wide drought declaration due in great part because of the dry conditions reported in the northern part of the state. Voluntary water conservation was encouraged through public broadcasts and in printed media. Mandatory conservation measures were put in place for farmers in San Diego County. Moderate drought conditions continued in the month of July, despite thundershowers and monsoonal flow in the lower deserts. The northwestern portion of the upper deserts was declared a severe drought area. Although rain fell in November, it was not enough to make a difference. That month, the U.S. Department of Agriculture (USDA) granted a Secretarial Disaster Designation for San Diego, Orange and Riverside counties due to the drought-induced losses in the agricultural sector. Losses to range lands were classified at greater than 40 percent.

December 2008 was wet, but January 2009 was dry. As a result, the state-wide drought declaration remained in effect. Municipalities and water districts in the region, including the entire Coachella Valley, instituted water conservation measures. Although several storms brought rain to the area in February 2009, at the end of the month the Governor issued a State of Emergency for all of California, calling for all residents to decrease their water use. Very small amounts of precipitation were measured between March and June, 2009. By the end of June, the desert areas had received 70 percent to 100 percent of their average annual precipitation. The State of Emergency for continued drought remained in effect, with water cuts required for certain agricultural activities, mainly the avocado and citrus farmers in San Diego and southern Riverside counties. The deserts were considered to be in a moderate drought condition, whereas the rest of the southern California area was classified as in a severe drought condition. Summer thunderstorms added little to the overall rainfall numbers, and on September 17, 2009, the USDA granted a Secretarial Disaster designation for several parts of California, including Orange, San Bernardino, San Diego and Riverside counties, primarily for agricultural losses due to the drought. Several storms brought rain to the region in October and November, and by December 2009, most of the region had received between 150 percent and 250 percent of normal precipitation levels, except for the high deserts, which had received only 50 percent of their normal level.

During 2010 and the first half of 2011, the Coachella Valley area was not impacted by drought. In June 2011, the area began to experience some dryness, and for the rest of the year, the valley was abnormally dry. The year 2012 began abnormally dry, and by February, the Coachella Valley area was deemed to be experiencing moderate drought conditions. Reduced precipitation levels characteristic of a moderate drought remained in effect for the remainder of 2012, and during the first four months of 2013. Severe drought conditions prevailed from May through October 1, 2013, when the intensity was down-sized to moderate drought. Moderate drought conditions were reported in the Coachella Valley area through the end of 2013 and into the first week of February 2014. Since then, and through the first weeks of May 2014, when this report was finalized, the Coachella Valley region have been mapped as within a severe drought condition (http://droughtmonitor.unl.edu/archive.html).

6.3 Summary: Coachella's Vulnerability to Severe Weather Damage

6.3.1 Hazards Assessment

The previous sections describe the various extreme weather conditions that have impacted and are likely to impact again the Coachella Valley area. By reviewing the historical record we can better understand the geographic extent of the hazard, the intensity of the events likely to impact the study area, and their probability of occurrence. Each of the hazards covered above is discussed further in the paragraphs below, addressing these issues, with an emphasis on how they pertain specifically to the Coachella Valley area, including the city of Coachella.

6.3.1.1 Windstorms

Windstorms are significant chronic events that cumulatively cause extensive damage, with property losses in the millions of dollars, in addition to injuries and loss of life. A windstorm event in the region can range from a short-term microburst or high wind lasting a few hours, to either Santa Ana or thunderstorm-related wind conditions that can last for several days.

The data in Table 6-4 show that high winds can occur in Coachella Valley almost any time during the year, but primarily in the months of January, February, March, April, November and December. More specifically, **Santa Ana wind** conditions occur most often in the winter months, occurring as early as October, and as late as April, but mostly between December and January. These winds tend to impact a large geographic area. Similarly, high winds accompanying **winter storms** approaching from the north or northeast also occur most often between November and April, with most winter storms occurring in November, February and April. **Tropical storms** that make landfall in Baja California and move north into Arizona and California generally occur between July and September, with most of these taking place in August and September.

The data presented in Table 6-4 may give the impression that windstorm events have increased in frequency over time. However, this is most likely the result of an incomplete historical record rather than a change in wind frequency. The records are likely missing data because: 1) there were less people in the area that would be impacted by these natural hazards, and 2) only unusually damaging storms would be recorded in newspapers, journals and other sources. Using the record from between 2000 and 2012 only, the study area appears to be impacted by windstorms approximately six times per year, on average, but there is significant variability from year to year. For example, in the years 2001 and 2004, only three high wind events were reported in the area, whereas in 2012, there were 14 wind events, in 2011, eight, and in 2000 and 2002, seven events.

The records (see Table 6-5) indicate that **tornadoes** can occur in Riverside County at almost any time of the year, but that they do occur more often in January, February, and August. The only month with no tornado activity reported in Table 6-5 is June. The tornado numbers also vary significantly from year to year. Using only the records between 2000 and 2012, which are deemed to be more complete than those for previous decades, we find that in some years there is substantial tornado activity, while in others, there is none. For example, several tornadoes were reported in the region in 2005, but no tornadoes were reported in 2000, 2007 and 2009. Tornadoes and microbursts usually impact a relatively small geographic area. Tornadoes in the southern California area have for the most part been size F0 or F1, but even these tornadoes are capable of causing property damage, injuries and potentially, loss of life. Table 6-5 also shows that most tornado activity in Riverside County occurs in the Moreno Valley – Hemet area, with only a few funnel cloud incidents historically reported within about 50 miles of Coachella. These events have occurred predominantly in the Palm Springs area.

Based on the data presented in Table 6-6, winds in Riverside County producing **dust storms** are often caused by Santa Ana conditions and winter storms, occurring primarily between December and March. Summer thunderstorms can also cause dust storms in the region, with several of these events occurring in August. For dust storms to occur, there has to be a source of sand, dirt, or ash present, generally the result of vegetation stripping either as a result of man-made activities (such as farming, grading during construction), an antecedent natural disaster (drought, forest fire, a flood event depositing loose sand and silt), or a natural condition (desert). Depending on the availability of sand and other debris, and the regional extent of the wind event responsible for picking up and transporting the dust, a dust storm will be either local or regional in extent. Santa Ana wind conditions, given their regional extent and their wind strength, have the capacity to move large amounts of dust, if there is a source available, great distances (see the Photo on Figure 6-1 showing ash and smoke from wildfires being transported hundreds of miles out to sea). Based on the data in Table 6-6, dust storms are significant events in the Coachella Valley area, typically impacting vehicular and air traffic, and causing significant property and crop damage.

Unlike flooding hazards, which are generally confined to a discrete area that can be mapped, windstorms may travel in any direction, and are only partly affected by topography (with stronger winds usually observed in canyons and passes, where the winds are funneled by the surrounding topographic highs). Given that we cannot predict when or where a windstorm will occur, nor its intensity, the conservative approach is to assume that a windstorm event can take place anywhere in the Coachella Valley area anytime during the year, but preferentially in the late summer, fall and winter (August through April).

6.3.1.2 Hail

The data presented in Table 6-7 suggest that hail events occur very infrequently in the Coachella Valley. The only reported hail event, in the south La Quinta Cove area on August 4, 2008, was the result of a summer thunderstorm. Most hail events that have been reported in the county occur in the region referred to as the Elsinore Convergence Zone, an area that extends eastward between Elsinore Lake and the San Jacinto Valley. In this region, air moving inland from the Pacific Coast that is funneled through a low spot in the Santa Ana Mountains meets (converges) with air coming from the northwest, funneled through the Santa Ana River Canyon. The convergence of these airstreams results in some unusual weather in the area around Temecula, Menifee, Perris, and Hemet, where a large percentage of the tornadoes and hail events in Riverside County occur.

Based on the damage descriptions, these hailstorm events are typically localized, impacting a relatively small area, and the hailstones produced by these storms are relatively small in diameter, generally less than 1 inch. Most events have not caused any injuries and only minor property damage. The only exception is the two injuries caused by the hail storm reported in the Idyllwild area on August 30, 2008. It is noteworthy to mention a thunderstorm reported in 1960 that impacted a large regional area, with hail reported in San Diego, Riverside, and San Bernardino. The large hailstones produced by this storm (2.75 inches in diameter and over 1 pound in weight) caused significant property damage, although a dollar amount was not assigned. This particular event indicates that the southern California area can be affected by severe but very unusual (low probability) thunderstorms if the atmospheric conditions are just right to produce large hailstones.

6.3.1.3 Heavy Snow and Ice

Winter storms that bring snow and ice to the San Bernardino and San Jacinto Mountains occur on a yearly basis, with most storms occurring between December and April. The storms that impact the mountains and high deserts tend to be regional in scale, generally affecting a large portion of southern California. These events have the potential to impact city of Coachella residents indirectly, if they travel or commute out of and into the valley when a winter storm has hit the area, as traffic accidents caused by unsafe road conditions and road closures due to slope failures and snowdrifts can be expected. Most property losses reported to date for an individual storm event vary between a few thousands dollars to hundreds of thousands of dollars. When these storms impact agricultural areas, the losses to crops and livestock can amount to millions of dollars.

6.3.1.4 Temperature Extremes

Table 6-9 includes fifteen **extreme cold** and **cold/wind chill** events that have impacted or are inferred to have impacted the Coachella Valley area between 1888 and 2012. Since 1987, at least eight deaths have been directly attributed to cold weather in the southern California area. Most of these events, as expected, occurred in December, January and February, during the winter months. Property and crop damages are often not fully accounted for, but it can be in the millions of dollars; the January 2007 freeze alone caused $100 thousand in property damage and $68.85 million in crop damage in the Coachella Valley. One extreme cold event reported occurred in early June (1999), when a winter storm brought unseasonably low temperatures to the southern California area, with up to 3 inches of snow reported in the mountains above the 5,500-foot elevation in San Bernardino, Los Angeles, Riverside and San Diego counties.

Table 6-9 also includes 17 **extreme heat** and 29 **high heat** events between 1877 and 2012. At least 32 people reportedly died from high heat between 1997 and 2012, although this number is likely to be underestimated; dozens more were hospitalized for heat-related illnesses. Most extreme and high heat events occurred between July and September, but at least one extreme heat and one high heat events were reported in March, three high heat and one extreme heat events have occurred in April, and two high heat events have been reported as late in the year as November. Property and crop losses associated with these events amount to billions of dollars, especially if the damage as a result of the fires associated with these heat waves is included in the loss count.

Temperature extreme events tend to be regional in scale, although to some extent they are controlled by elevation, with high and extreme heat impacting low-lying inland areas preferentially, and extreme cold more likely to impact the higher elevation areas. The city of Coachella has significant relief, with the valley areas located at or below sea level, and the highlands along its eastern border reaching heights of more than 1,000 feet above sea level. The more extensively developed valley portion of the city is impacted by extreme heat and high heat events preferentially, with mild winters being the norm. However, the eastern part of the General Plan area that is being proposed for development may experience both extreme heat and extreme cold events.

6.3.1.5 Drought

Drought is one of the most devastating natural hazards; history abounds with examples of civilizations that have been wiped out or have been forced to migrate and be assimilated by other groups as a result of drought. Reduced precipitation can cause the collapse of the agricultural tradition in an area, setting the stage for famine, and bringing social, economic, political and cultural unrest. Drought occurs over a long period of time, and is thus not readily apparent at first. This makes planning for and mitigating for drought more difficult, but not impossible. Nowadays, the impacts of drought need not be catastrophic, especially in developed countries. Constant, weekly monitoring and recording of potential drought conditions throughout the United States is conducted by a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. This monitoring allows for early detection of patterns that can suggest a long-term drought period to come. With this information, government officials, policy makers, farmers, and the public in general can be provided with the necessary information to enforce water conservation measures and implement other mitigation as needed to reduce the impact of drought. Increased communication and transportation links between regions allow for the transport of water and food resources into drought-affected areas. Several large water storage reservoirs and associated aqueducts have been constructed or expanded in the southern California area in the past two decades. The Eastside Valley reservoir near Hemet alone stores sufficient water to serve the entire southern California region for at least six months. Of course, in arid and semi-arid areas like the Coachella Valley and southern California in general, water conservation should be a priority always, not only during drought periods.

6.3.2 Damage Assessment

As past events show, storms and other severe weather hazards in the Coachella Valley area and elsewhere have the potential to impact life, property, utilities, infrastructure and transportation systems, causing damage to trees, power lines, utility poles, road signs, cars, trucks, and building roofs and windows. Structures and facilities can be impacted directly by high winds and/or can be struck by air-borne debris or downed trees and power poles. Windstorms can disrupt power to facilities and disrupt land-based communications as well. In fact, historically, trees downed during a windstorm have been the major cause of power outages in the southern California area. Uprooted trees and downed utility poles can also fall across public right-of-ways disrupting transportation.

High winds, especially those associated with Santa Ana conditions and dust storms, pose a significant impact to delicate crops, such as leafy greens and vegetables, as the winds draw moisture from the plants. High heat, extreme heat, extreme cold, and drought can also harm or destroy most crops. High winds, extreme temperatures and drought can have a severe impact on livestock. Given that agriculture is an important component of the region's economy, damage to crops and livestock can have a severe negative effect.

Extreme cold is typically only one of the hazards associated with winter storms. Thus, in addition to cold temperatures, residents and visitors to the area impacted by a storm have to deal with other potential hazards including icy roadways, strong winds, and power outages. Vehicular accidents and falls on icy sidewalks are two leading causes of injuries during winter storms.

Hail can and will cause significant damage to structures, vehicles, aircraft, and livestock (not to mention people that don't find cover). Hail can also cause significant damage to crops. The structural components most often damaged by hail include roofs (including glass roofs and roof-mounted solar panels), skylights, window awnings, and windows. Vehicular accidents as a result of reduced visibility, and hail stones on the pavement acting as ball bearings, can be expected during these kinds of storms.

These events can be major hindrances to emergency response and disaster recovery. For example, if transportation routes are compromised by fallen debris, and loss of power occurs in the area, emergency response facilities like hospitals, fire stations, and police stations may find it difficult to function effectively. Falling or flying debris, downed trees and power lines can also injure or kill motorists and pedestrians. As discussed previously, windstorms, are often also associated with wildfires, which, if they occur in or near a populated area, can result in enormous losses to property, in addition to injuries and loss of life. Such an event may require the involvement of city and county maintenance personnel responding to cleanup and repairs during and following the windstorm. Similarly, maintenance crews may be required to secure certain facilities ahead of a potential storm, provided sufficient advanced notice is available and if municipal crews are available to respond on short notice.

6.3.2.1 Structural Damage

Depending on its age, condition, and structural design, any structure may be susceptible to windstorm damage. However, buildings with weak reinforcements are most susceptible. 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 and/or upward. Under extreme wind forces, the roof or entire building can fail or sustain considerable damage. Mobile homes are particularly susceptible to windstorm damage. Debris carried by the wind may also contribute to loss of life and, indirectly, to the failure of building envelopes, sidings or walls.

A windstorm also has the potential to displace residents, which may require the city of Coachella to provide short-term and/or long-term shelters to accommodate these individuals, in addition to providing for other emergency response activities such as cleanup and repair. This has the potential to impact the city economically, as Coachella's general funds would have to be tapped into to respond adequately to the needs of the impacted members of the community.

6.3.2.2 Lifelines and Critical Facilities

Historically, downed trees have been a major cause of power outages in the region during windstorms and winter storms. Some tree limbs can break in winds of about 45 mph, and the broken limbs can be carried by the wind more than 75 feet from their source. Thus, overhead power lines can be damaged even in relatively minor windstorm events. Downed trees can also bring electric power lines down to the pavement or ground, where they become serious, life-threatening, sources of electric shock. Similar damage can be caused by winds associated with winter storms, with broken tree branches and fallen trees that in turn down power and telephone lines.

Lifelines and critical facilities should remain accessible, if at all possible, during a natural hazard event. The impact of closed transportation arteries is particularly severe if a blocked road or bridge is critical to access a hospital or other emergency facilities. Population growth and new infrastructure in the region could result in a higher probability for damage to occur from windstorms and winter storms as more lives and property are exposed to these hazards.

Cold waves can cause poorly insulated water pipes to freeze, which in turn can result in substantial property damage. Fires can become more hazardous in extreme cold conditions, especially if the water supply has become unreliable due to water main breaks that hinder firefighting efforts.

6.3.2.3 Infrastructure

As mentioned above, windstorms may damage buildings, power lines, and other property and infrastructure due to falling trees and branches. Windstorms can also result in damaged or collapsed buildings, blocked roads and bridges, damaged traffic signals and streetlights, and damaged park facilities. Roads blocked by fallen trees during a windstorm may severely impact people attempting to access emergency services. Emergency response operations can be compromised when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric services and from extended road closures. They can also sustain direct losses to buildings, personnel and other vital equipment.

In addition to the problems caused by downed trees and electrical wires blocking streets and highways, storms can also force the temporary closure of roads to vehicular traffic. This is especially true during extremely strong Santa Ana winds and winter storms, and as a result of microbursts or tornadoes associated with summer thunderstorms.

The high demand for air-conditioning during a heat wave has a significant impact on the electric transmission system. The heat itself can cause overhead electric lines to sag and short-out. As a result of demand exceeding supply, in addition to the physical damage to the electric transmission lines, it is not uncommon for electric companies to institute or be forced to establish rolling black-outs during periods of excessive heat. Excessive heat can buckle roads, stress engines, and distort rail lines. Hot weather can also impact the goods being transported, especially produce and livestock. All of these conditions add up, increasing the costs of transporting goods. Heat waves also have an impact on the water resources and water infrastructure, with increased demand for water. If wildfires occur during a heat wave, there will be increased use of water for fire-fighting purposes, which can tax the available resources, reducing water supply and water pressure.

Widespread weather observation stations and networks, in addition to great advancements in computer modeling and a better, if not yet comprehensive understanding of atmospheric processes, have greatly facilitated the forecasting of meteorological events such as winter storms, windstorms, and extreme temperature events. Weather forecasts, combined with an increased use of the internet and media resources, permit the wide dissemination of weather warnings in real time, with the potential to greatly reduce the effect of extreme weather events on people and property. Utility companies, relief organizations, and government officials can and should use weather warnings to anticipate an increase in demand for electricity, heating oil or gas, shelters for the homeless, and maintenance and emergency response personnel.

CHAPTER 7: DISASTER PREPAREDNESS, RESPONSE AND RECOVERY

A disaster is a sudden and dramatic emergency. When a disaster occurs, the impacted community strives to: 1) protect its residents, 2) care for victims, and 3) restore basic services as soon as feasible. To do this, a community needs to respond quickly, dynamically, and as effectively as possible. This requires preparation at all levels, from individual neighborhoods, families and businesses, up to the Federal government (for large-scale disasters). Emergency managers note, however, that it is difficult to sustain interest in disaster preparedness at the local level because most of us are too preoccupied with the day-to-day details of work, school and family to worry about a potential disaster that may or may not occur in our lifetime. Having said this, history shows that people impacted by a disaster generally respond actively to the situation, seeking safety for themselves, their families and others, improvising as necessary to respond to changing conditions. Some basic level of preparedness, however, can be very helpful.

To that end, emergency managers realize the need to regularly educate and/or remind the public about these potential hazards, and encourage individuals, families and businesses to be prepared. Agencies responsible for emergency response should review and update their preparedness plans and emergency operations plan as new conditions and requirements develop – this is a continuous process. Emergency response personnel need to be familiar with the preparedness plans by reviewing these documents regularly and practicing their assigned roles during drills held frequently. Since January 1, 2008, jurisdictions have been required to adopt a Local Hazard Mitigation Plan (or Disaster Mitigation Plan) as part of their Safety Element. The City of Coachella is a participant member of the Riverside County Operational Area Multi-Jurisdictional Hazard Mitigation Plan (HMP) approved by FEMA in March 2005 and ongoing updates to that document. Given that this multi-jurisdictional document covers the entire County of Riverside, it has to be relatively general in its scope and implementation actions. The City can opt to prepare a single-jurisdiction Hazard Mitigation Plan in the future, with that document addressing in greater depth the hazards that are specific to Coachella. Data provided in the new Safety Element of the General Plan for the City of Coachella, including in this Technical Background Report to the Safety Element, can be used extensively for this endeavor. The Hazard Mitigation Plan, either as part of the County's Multi-Jurisdictional effort, or as a single jurisdiction, should be adopted as an addendum to the Safety Element.

Planning issues pertaining to emergency response, disaster preparedness, and disaster recovery require an assessment of the hazards, identification of functions and resources to handle both short-term and long-term response, and development of recovery procedures. Planning can help speed the response to an emergency, while ensuring that the response is appropriate to the situation. Coordination between all levels of responders is critical. Direct, clear updates on the situation, provided in a timely manner by public officials, are important as this engenders cooperation from the public. Emergency preparedness includes having an alerting system that can be put to use immediately to warn the community of impending danger, and to transfer information post-disaster. It is also essential to have provisions in place to deal with handicapped individuals, and people that do not understand or speak English and need to be notified of the disaster preparedness, response and recovery efforts in their native language. Recognizing and being sensitive to cultural differences are also important for effective emergency preparedness and response in multi-ethnic communities.

7.1 Risk Analysis

Earthquakes typically pose the greatest challenge because they occur with little or no warning, and can set into motion a number of linked events, but other natural and man-made hazards also have the potential to cause damage to the community. Analysis conducted for the City of Coachella shows that an earthquake on the section of the San Andreas fault that extends through the city would be the worst-case scenario for this community. In most parts of the city, shaking will be severe, whereas in those areas within about ½ mile from the fault zone, ground shaking is expected to be violent.

The HazUS analyses conducted for Coachella suggest that a magnitude 7.8 earthquake on the southern San Andreas fault, including the section of the fault that extends through the General Plan area, will impact several of the critical facilities in and near the city. Significantly, the buildings that comprise JFK Memorial Hospital in Indio, the closest hospital to Coachella, are expected to experience moderate to complete damage as a result of this earthquake. The hospital is expected to be non-functional immediately after and for at least one month after the earthquake, with only about 30 percent functionality 90 days after. A smaller magnitude 7.1 earthquake on the San Andreas fault is also expected to cause significant damage to this facility, with only 12 percent functionality immediately after and for the next three days after the event. By day 30, the hospital is expected to be only about 30 percent functional.

Other critical facilities in and near Coachella are expected to perform better than the local hospital, but will still be impaired. None of the local schools is expected to be more than 50 percent functional the day after the earthquake. The same is expected for the primary Emergency Operations Center (EOC) and the local police stations. Only one of the local fire stations is expected to be more than 50 percent functional after a magnitude 7.8 earthquake on the San Andreas fault. On the other hand, after a smaller 7.1 earthquake on the San Andreas fault, the primary EOC, the police stations and the fire stations are all expected to be more than 50 percent functional. For more information, refer to Chapter 1, Section 1.9.3.

Coachella is susceptible to several types of hazards other than seismic. The risk that the various hazards discussed in the Safety Element and accompanying Technical Background Report pose to essential facilities, schools and other critical facilities in and near Coachella are summarized in Table 7-1. Some of these hazards, like liquefaction, only occur in response to seismic shaking. Other hazards can be triggered by seismic shaking but can also happen in response to some other cause not related to an earthquake. These include slope instability (which can occur in response to storms, man-made activities, or shaking), hazardous materials releases (which can occur due to an accident, an intentional release, flooding, seismic shaking or earthquake-induced ground deformation), and flooding (due to storms, or the catastrophic failure of a water retention facility, such as a channel levee). Wildfires are not prevalent in this area, occurring very rarely in or near the developed areas in the valley floor. While urban fires are not included in Table 7-1, it is important to remember that an earthquake can be followed by fires ignited by fallen and arcing electric lines, gas leaks, chemical reactions, and toppled water heaters and other appliances. Several fires after an earthquake can quickly overwhelm the local fire department if personnel are engaged in search and rescue operations. Urban fires are particularly dangerous in heavily developed, older areas, where unsprinklered buildings not constructed of fire-resistant materials are located close together.

Table 7-1: Risk Analysis of Essential Facilities and Schools in and Near Coachella

(based on their location and relative to the hazards described in the Technical Background Report only; located in Coachella unless address says differently)

Map Identifier	Essential / Critical Facility	Ground Shaking	Surface Fault Rupture	Liquefaction	Slope Instability	Wildfire Susceptibility	Flooding, Inundation	Near Hazmat Site or Pipeline
***Essential Facilities** – for locations, refer to Plate 7-1*								
CH / EOC1	City Hall and Primary EOC 1515 Sixth Street	Se	N	Y	N	N	Y	Y
PS-1	Coachella Police Substation 790 Vine Avenue	Se	N	Y	N	N	Y	Y
PS-Indio	Indio Sheriff Station 82-695 Dr. Carreon Blvd., Indio	Se	N	Y	N	N	Y	Y
EOC2	Alternate EOC 53-462 Enterprise Way	Se	N	Y	N	N	Y	Y
FS-79	Fire Station #79 1377 Sixth Street	Se	N	Y	N	N	Y	Y
FS-86	Fire Station #86 46-990 Jackson Street, Indio	Se	N	Y	N	N	Y	Y
FS-39	Fire Station #39 86-911 Avenue 58, Thermal	Se	N	Y	N	N	Y	N
FS-70	Fire Station #70 54-001 Madison Avenue, La Quinta	Se	N	Y	N	N	N	N
JFK	JFK Memorial Hospital 47111 Monroe Street, Indio	Se	N	Y	N	N	Y	Y
CMdP	Clínicas Médicas del Pueblo 49-111 Grapefruit Boulevard	Se	N	Y	N	N	Y	Y
FSPN	First Steps Pre-Natal Care 1490 Sixth Street	Se	N	Y	N	N	Y	Y
CMdV	Clínica Médica del Valle 52-665 Harrison Street	Se	N	Y	N	N	Y	Y
CSdP	Clínicas de Salud del Pueblo 53-990 Enterprise Way	Se	N	Y	N	N	Y	Y
SRdVM	Santa Rosa del Valle Medical 1293 Sixth Street	Se	N	Y	N	N	Y	Y
WRP	Water Reclamation Plant 54th Avenue and Polk Street	Se	N	Y	N	N	Y	Y
***Schools** – for locations, refer to Plates 7-1and 7-2*								
S1	Valley View Elementary 85-270 Valley Road	Se	N	Y	N	N	Y	Y
S2	Palm View Elementary 1390 Seventh Street	Se	N	Y	N	N	Y	Y

Map Identifier	Essential / Critical Facility	Ground Shaking	Surface Fault Rupture	Liquefaction	Slope Instability	Wildfire Susceptibility	Flooding, Inundation	Near Hazmat Site or Pipeline
S3	Cesar Chavez Elementary 49-601 Avenida de Oro	Se	N	Y	N	N	Y	Y
S4	Peter Pendleton Elementary 84-750 Calle Rojo	Se	N	Y	N	N	Y	Y
S5	Valle del Sol Elementary 51-433 Education Way	Se	N	Y	N	N	Y	Y
S6	Coral Mountain Academy 51-375 Van Buren	Se	N	Y	N	N	Y	N
S7	Bobby Duke Middle 85-358 Bagdad Avenue	Se	N	Y	N	N	Y	Y
S8	Cahuilla Desert Academy 82-489 Avenue 52	Se	N	Y	N	N	Y	N
S9	Coachella Valley High 83-800 Airport Boulevard	Se	N	Y	N	N	N	N
S10	Olive Crest & Nova Academies 52-780 Frederick Street	Se	N	Y	N	N	Y	Y
S11	Adult School 1099 Orchard Avenue	Se	N	Y	N	N	Y	Y
S12	Jordan Christian Academy 50-930 Calhoun Street	Se	N	Y	N	N	Y	N
S13	Tlaquepaque Head Start 51-354 Tyler Street	Se	N	Y	N	N	Y	Y
S14	Las Casas Head Start 51-500 Tyler Street	Se	N	Y	N	N	Y	Y
Parks and Community Centers that can be used as Shelters – *for their locations, refer to Plate 7-2; for additional information regarding these sites, refer to Table 7-2*								
P1	Bagdouma Park 51-723 Douma Street	Se	N	Y	N	N	Y	Y
P2	Dateland Park 85-421 Bagdad Avenue	Se	N	Y	N	N	Y	Y
P3	De Oro Park 49-801 Avenida de Oro	Se	N	Y	N	N	Y	Y
P4	Sierra Vista Park Calle Mendoza and Avenue 50	Se	N	Y	N	N	Y	Y
P5	Vietnam Veterans Park 4th Street, between Orchard Street and Vine Avenue	Se	N	Y	N	N	Y	Y
Churches that can be used as Shelters – *for their locations, refer to Plate 7-2; for additional information regarding these sites, refer to Table 7-2*								
C1	Pentecostal Church of Philadelphia 84-542 Avenue 49	Se	N	Y	N	N	Y	Y
C2	Islamic Society of Palm Springs 84-650 Avenue 49	Se	N	Y	N	N	Y	Y

Map Identifier	Essential / Critical Facility	Ground Shaking	Surface Fault Rupture	Liquefaction	Slope Instability	Wildfire Susceptibility	Flooding, Inundation	Near Hazmat Site or Pipeline
C3	Calvary Landmark Baptist Church 85-120 Bagdad Street	Se	N	Y	N	N	Y	Y
C4	Latin Assembly of God 1491 Third Street	Se	N	Y	N	N	Y	Y
C5	Our Lady of Soledad Catholic Church 52-555 Oasis Palms Avenue	Se	N	Y	N	N	Y	Y
C6	Primera Iglesia Bautista 85-246 Valley Road	Se	N	Y	N	N	Y	Y
C7	Centro Libre Cristiano 83-246 Avenue 50, Indio	Se	N	Y	N	N	Y	N
C8	Coachella Valley Christian Church 50-100 Jackson Street, Indio	Se	N	Y	N	N	Y	N
C9	Church of Christ of Latter Day Saints 81-870 Avenue 48, Indio	Se	N	Y	N	N	Y	Y
C10	Las Palmas Community Church 47-783 Monroe Street, Indio	Se	N	Y	N	N	Y	Y

Explanation for Table 7-1:
Se = Severe; **Y** = Yes; **N** = No.
The entire Coachella General Plan area can experience severe to violent ground shaking as a result of a regional earthquake on the San Andreas fault.
Refer to Figure 1-4 in Chapter 1 of the Technical Background Report. Also refer to Plates 1-1 (faults), 2-2 for slopes, 3-1 for flooding, and 4-1 for fire hazards.
A site marked "Yes" for Hazardous Materials is located within about 1 mile of a facility that handles significant hazardous materials or a Toxic Release Inventory TRI) site, or is located within ½ mile of a high-pressure gas or hazardous liquid pipeline (see Plate 5-1 in the Technical Background Report).

7.2 Emergency Shelters

Earthquakes, flooding, wildland fires and other disasters can cause loss of function or habitability of buildings that provide housing. Displaced households may need alternate short-term shelter provided by family, friends, temporary rentals, or public shelters established by relief organizations such as the Red Cross in facilities around the city.

Potential shelter locations in and near Coachella include parks, schools and churches. These are short-term shelter facilities to be used for a few hours to a few days. These locations are generally ideal as shelters because they have: 1) open space where people can set up tents, 2) restroom facilities and possibly kitchens or barbeque pits, and 3) fairly large parking lots where displaced families can park their cars and, if they have them, recreational vehicles, which can be used for housing. Given that not all of these facilities may be available or fully functional after a disaster, it is preferable to have several options.

Table 7-2 includes several potential shelter locations distributed throughout Coachella, and in Indio, immediately to the north and west. Many of these facilities are located in areas susceptible to liquefaction and flooding, and all facilities will be impacted by strong ground shaking. Thus, the selection of which sites to open during an emergency should be made after consideration of the hazard involved, whether or not the potential shelter location has been damaged (such as by ground shaking), and the potential for the hazard of concern to progress into the area where a shelter has been established (flooding or wildfire). We have considered all parks in Coachella that have restroom facilities. There are three additional parks in the City's list of parks (Shady Lane Park, Tot Lot Park and Ye'we'vichem Park; http://www.coachella.org/index.aspx?NID=72), but these are small, don't appear to have restroom facilities, barbeque pits, or other amenities that would be desirable when using the park as a shelter location. Given the limited number of parks in the city of Coachella, we have also included some parks in Indio, immediately north and west of Coachella. Because an earthquake on the San Andreas fault would also severely impact the city of Indio, the shelter locations included here may be overwhelmed by residents from Indio looking for alternate, short-term housing after an earthquake.

Table 7-2: Potential Emergency Shelters In and Near Coachella
(For locations, refer to Plate 7-2;
in the city of Coachella unless indicated otherwise in the address)

Parks and Community Centers				
Map Identifier	***Name***	***Address***	***Size (Approx. Acres)***	***Amenities***
P1	Bagdouma Park	51-723 Douma Street	34	Restrooms, pavilion, tables, benches, parking, open grass, soccer/football and baseball/softball fields, swimming pool, drinking fountains, playground, parking.
P2	Dateland Park	85421 Bagdad Avenue	4.1	Skate park with restroom facilities, open grassy areas and shaded areas.
P3	De Oro Park	49801 Avenida de Oro	4.6	Restrooms, tables, open grass, BBQ/grill area, playground. Limited parking.
P4	Sierra Vista Park	Tyler Street, between Calle Mendoza and Avenue 50	2	Open grass, playground, restrooms(?), no parking except along street. Park is adjacent to Whitewater River – likely to flood if river overflows.
P5	Vietnam Veterans Park	4th Street, between Orchard St. and Vine Ave.	1.5	Restrooms, drinking fountain, tables and benches, open grass, playground, pool (water source), limited parking on street and in the City Hall parking lot to the south.
P6	South Jackson Park	Jackson and Date Streets, Indio	9	Shaded picnic tables with BBQ grills, restrooms, grass areas, playground facilities, drinking fountain; parking; next to pool (water source).
P7	Dr. Carreon Park	Dr. Carreon Blvd. east of Monroe Street, Indio	3	Shaded areas with tables, BBQ areas, grass areas, restrooms; limited parking. Open space to the east.
P8	Riverside County Fairgrounds	82-503 Hwy. 111, Indio	71	Large open areas, extensive parking, holding areas for large animals.

Churches			
Map Identifier	**Church Name**	**Address**	**Amenities, Opportunities**
C1	Pentecostal Church of Philadelphia	84-542 Avenue 49, Coachella	Parking lot, 1 building, open space to the north of the property.
C2	Islamic Society of Palm Springs	84-650 Avenue 49, Coachella	Parking lot, 1 building, open space to the north and west of lot.
C3	Calvary Landmark Baptist Church	85-120 Bagdad Street	Building complex with parking lot to the east and north, grass areas to the east and north, between buildings and parking lot; vacant lot to the west.
C4	Latin Assembly of God	1491 Third Street	Building, limited parking, no grass areas or vacant lots nearby.
C5	Our Lady of Soledad Catholic Church	52-555 Oasis Palms Avenue	Building complex, large parking lot to the north, west and south sides; no grass areas or vacant lots nearby.
C6	Primera Iglesia Bautista	85-246 Valley Road	2 buildings, grass area in between, parking lot to the north and east, vacant open space to the west, south and east.
C7	Centro Libre Cristiano	83-246 Avenue 50, Indio (at border with Coachella)	Small parking lot and larger paved area to the north, 1 large building and 1 smaller, open grass area to the north and west of main building, with playground, open space to the north, east and west.
C8	Coachella Valley Christian Church	50-100 Jackson Street, Indio (near Coachella)	2 buildings with a central, grass courtyard, parking lot to the west and north of buildings, open space in the northeastern portion of lot.
C9	Church of Christ of Latter Day Saints	81-870 Avenue 48, Indio	1 building, large parking lot to the east and west of building; vacant lots to the east and west
C10	Las Palmas Community Church	47-783 Monroe Street, Indio	1 building, parking on the north side, grass area to the east and potentially west of building

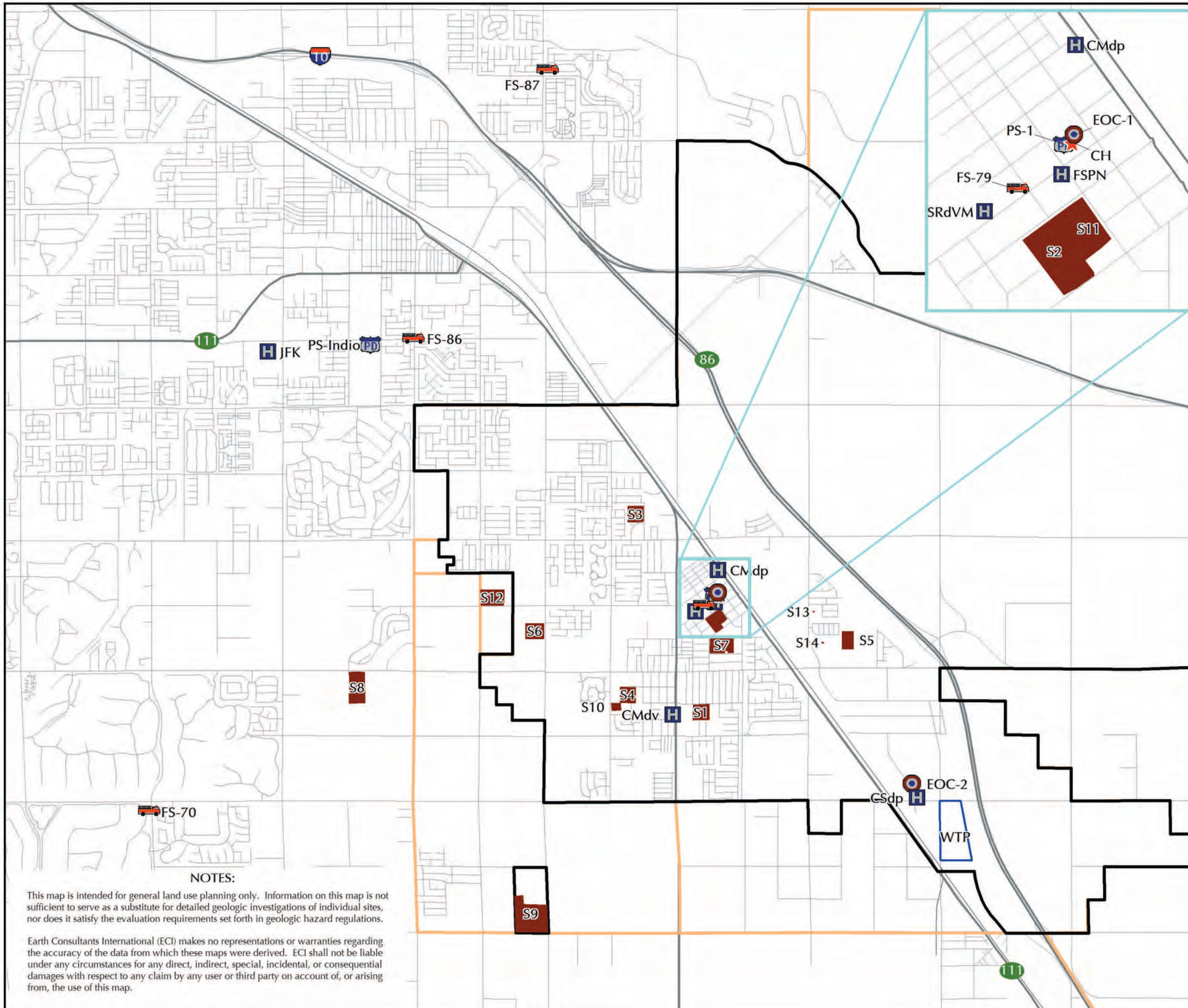
Long-term alternative housing may require import of manufactured homes, occupancy of vacant units, net emigration from the impacted area, and, eventually, the repair or reconstruction of new private and public housing.

7.3 Evacuation Routes

Evacuation refers to the movement of people that are at risk of being impacted by a disaster to a safer location, using routes that do not pose a significant danger to the evacuees. Thus, both the destination and the route need to be scrutinized, preferably before the evacuation orders are issued. This involves making a decision as to which of the potential temporary shelters identified in the previous section will be opened, based on the shelters' locations relative to the approaching disaster, and their ease of accessibility from the routes identified as safest.

Critical and Essential Facilities

Coachella, California



Explanation

- S14 School Property
- Police Department
- Fire Station
- EOC
- Hospital
- City Hall
- Water Treatment Plant
- Coachella City Boundary
- Coachella Planning Area Boundary

For additional information regarding these facilities refer to Tables SE-1 & SE-2.

N / S / E / W

Scale: 1:72,000

6000 0 6000 Feet

2000 0 2000 Meters

Base Map: City of Coachella
Sources: www.google.com, http://www.cde.ca.gov, http://www.greatschools.org/california/, and http://www.coachella.org

Earth Consultants International

Project Number: 3106/3218
Date: 2014

Plate 7-1

NOTES:

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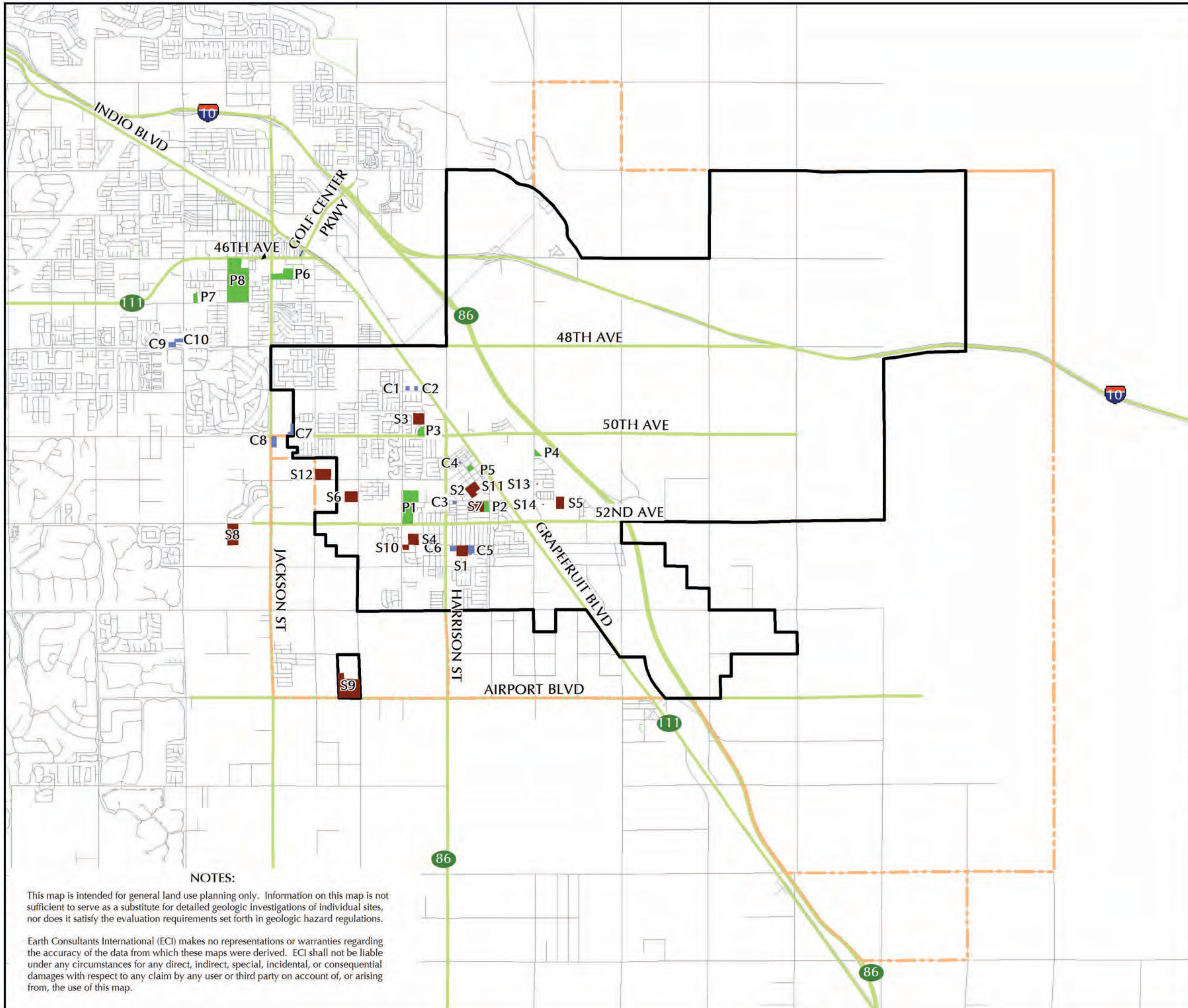
Potential Emergency Shelters and Evacuation Routes

Coachella, California



Explanation

- S14 School Property
- P8 Park
- C10 Church Property
- Evacuation Routes
- Coachella City Boundary
- Coachella Planning Area Boundary

For additional information regarding these facilities refer to Tables SE-1 & SE-2.

N
W E
S

Scale: 1:72,000

6000 0 6000
Feet
2000 0 2000
Meters

Base Map: City of Coachella
Sources: www.google.com, http://www.cde.ca.gov, http://www.greatschools.org/california/, and http://www.coachella.org

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Plate 7-2

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The Police Department typically serves as the lead organization in carrying out evacuations, supported by the Fire Department as appropriate. The Public Works Department typically assists in the identification of the best evacuation routes and in barricading the evacuated areas.

Plate 7-2 identifies several potential evacuation routes, mostly trending east-west, and north-south. Notice that several of the evacuation routes identified were selected because they lead to the potential emergency shelters discussed above. Which routes should be used will depend on the specific disaster:

1. Earthquakes occur suddenly and for the most part without warning. Evacuation may be necessary post-disaster if the ground shaking or fault rupture causes a secondary disaster, such as the failure of a levee or water tank, or the release of a toxic cloud from ruptured containers of hazardous materials. Post-earthquake fires may also require the evacuation of certain areas, but these are generally localized areas with a limited number of affected individuals. Which evacuation routes to use will depend on which area is at risk from any of these secondary hazards.

2. Wildfires in the Coachella region typically start in the mountains or foothills to the east, and in the San Jacinto mountains to the west. Minor vegetation fires have also occurred to the south, in the Thermal area. These fires have historically not impacted the city of Coachella proper. With the future development of the hillsides in the eastern portion of the General Plan area, however, there will be an increased potential for wildfires to impact development, especially if the prevailing winds at the time fan the fires so that they spread onto the urban-wildland fire interface. If this happens, evacuation of the potentially affected neighborhoods may be required. In general, evacuees would take roads leading toward the more developed areas of the city, to the west and south of the hillsides.

3. Flooding and inundation in Coachella can impact the central, western and southern portions of the city preferentially. Localized flooding due to storm events can occur throughout the planning area, both in the valley, as shallow, but extensive flooding, and in the foothills, as sheet flow and runoff concentrated in the washes and gullies. The appropriate evacuation routes to use in response to this hazard will therefore depend on where localized flooding is more severe, and on the destination (i.e., shelter location). In general, routes leading west, away from the Whitewater River, would be preferred. In the hillside areas, evacuation may involve merely getting out of the washes and onto higher ground.

   In the event of a breach of the Coachella Canal as a result of rupture of the San Andreas fault, the areas to the west and south of the canal would be flooded. Most of this area is currently undeveloped, used primarily as farmland. However, several residential neighborhoods have been permitted in the area, and are likely to be built as the housing market improves. Evacuating to higher ground to the east of the canal would be preferable, however that is expected to be unfeasible given that currently very few roads cross easterly across the canal, and those that do would be damaged by faulting. The developed part of the city is expected to be spared inundation if the canal fails, as the resulting runoff would eventually make its way into the channel of the Whitewater River if it floods that far west and south. Thus, evacuation of the affected areas would entail taking the west-trending routes into the center of town, where most of the potential shelters are located.

4. Releases of hazardous materials, either as a result of a leak in one of the facilities that handle these substances in the city, a leak from a gas line, or as a result of an accident-caused spill on the freeway or railroad tracks, generally will require the evacuation of a relatively small area, possibly within a 1- to 2-mile radius of the release. The evacuation routes to follow would be designated by the Sheriff Department based on an assessment of prevailing wind directions, traffic flow and location of the emergency shelter(s) opened for that event.

7.4 Recovery

Many communities do well in preparing for a disaster but are ill-prepared for the recovery phase, possibly in part because they hope that if their pre-disaster planning is effective, their long-term damages will be relatively small. This is certainly what an emergency planning organization aims for. However, some post-disaster, recovery efforts may be necessary to restore community life. This includes the re-establishment of essential services and the rebuilding and repair of impacted properties. Recovery is an opportunity to improve the community so that it becomes more sustainable and less likely to be impacted by a future, similar disaster. Examples include avoiding reconstruction projects in areas susceptible to ground rupture, slope instability, and flooding. Having a recovery plan in place can help with the decision-making process of reconstruction, by improving communication with other levels of government that were involved in the disaster response phase and now have a vested interest in the recovery process, and possibly most importantly, by engendering support for mitigation efforts. If plans for a major mitigation effort exist prior to a disaster, public and government support (at the State and Federal levels) for such a project, including the appropriation of money to fund such a project, may become available. An example of this would be the reconstruction of the Coachella Canal so as to avoid the San Andreas fault as much as possible, with fewer crossings of the fault.

The Federal Emergency Management Agency (FEMA) encourages the development and regular update of emergency preparedness documents by providing grant money to communities that have approved and adopted Local Hazard Mitigation Plans. Similarly, the State of California, through the California Disaster Assistance Act, limits the State share for an eligible project that is in response to a fire disaster to no more than 75 percent of total state eligible costs, except if the local agency has adopted a Local Hazard Mitigation Plan as part of their Safety Element, and complies with several requirements imposed by the State Fire Marshal (Senate Bill 1764, 2008). If the community complies with all requirements, the state share may be up to 100 percent of the cost.

TECHNICAL BACKGROUND REPORT to the SAFETY ELEMENT of the GENERAL PLAN for the CITY OF COACHELLA

In RIVERSIDE COUNTY, CALIFORNIA

SEISMIC HAZARDS
GEOLOGIC HAZARDS
FLOODING HAZARDS
FIRE HAZARDS
HAZARDOUS MATERIALS MANAGEMENT
SEVERE WEATHER HAZARDS
DISASTER PREPAREDNESS

Prepared by:

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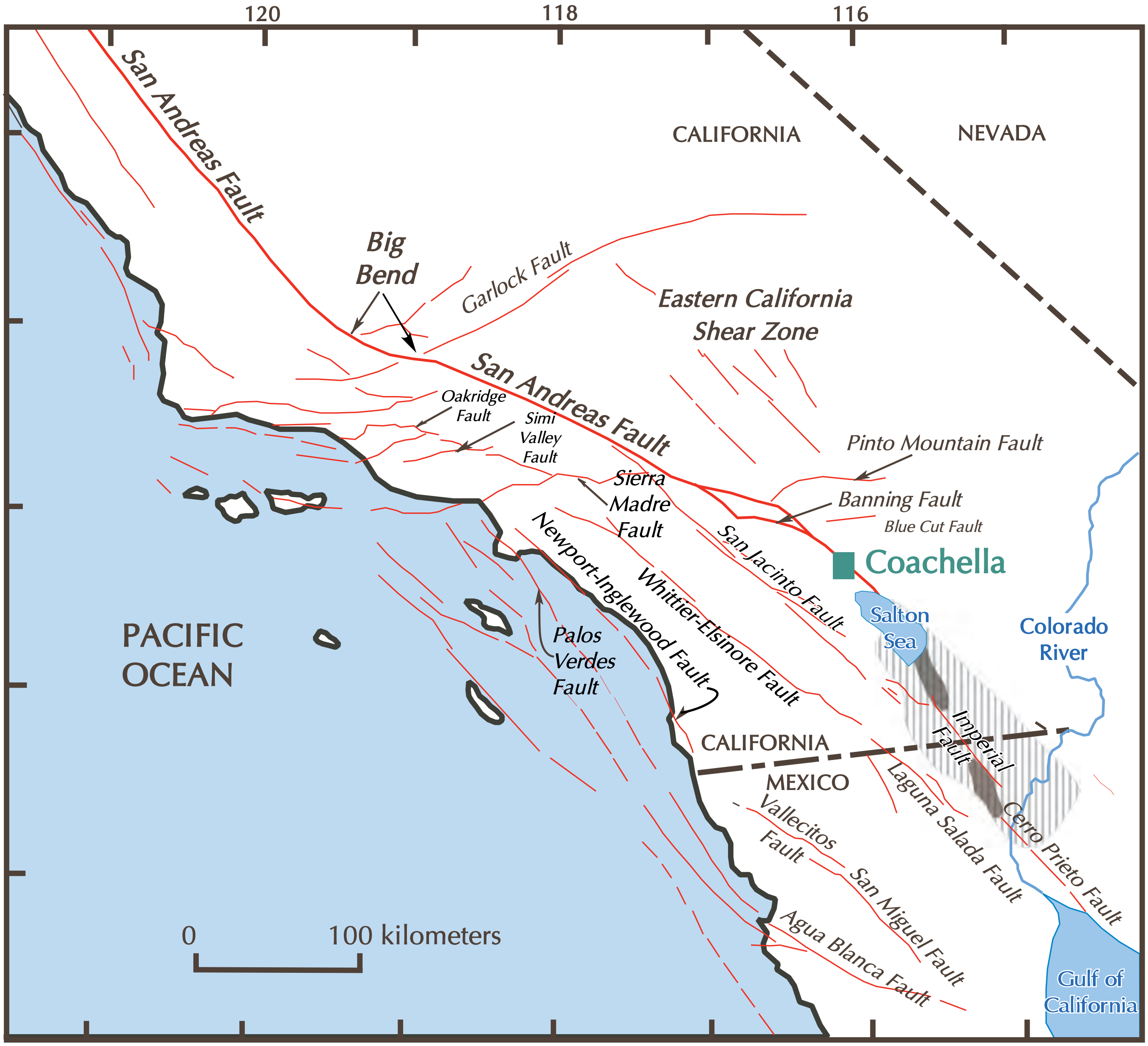
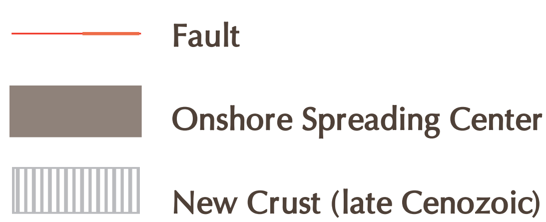
(714) 544-5321 & (714) 412-2654

Final - May 2014



Source: Modified from Fuis and Mooney, 1990.

MAP EXPLANATION



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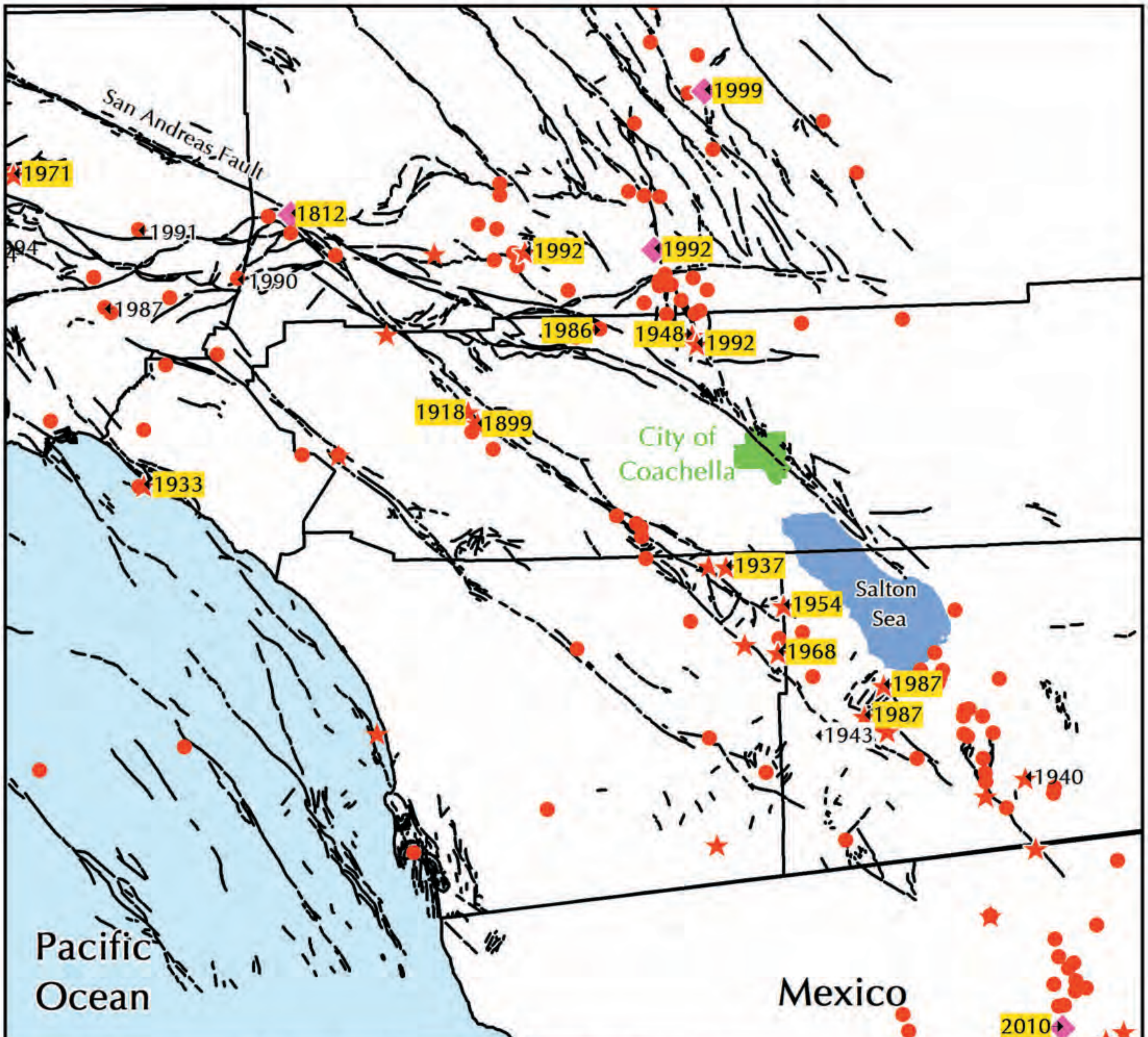
Project Number: 3106
Date: 2011

Regional Fault Map

Figure 1-1



Source: Jennings, 1994; SCEC earthquake catalog; NEIC earthquake catalog

N W E S

0 20 Miles

Explanation

- Magnitude 7+
- Magnitude 6 - 7
- Magnitude 5 - 6
- Quaternary faults
- 1899 Earthquakes discussed further in the text

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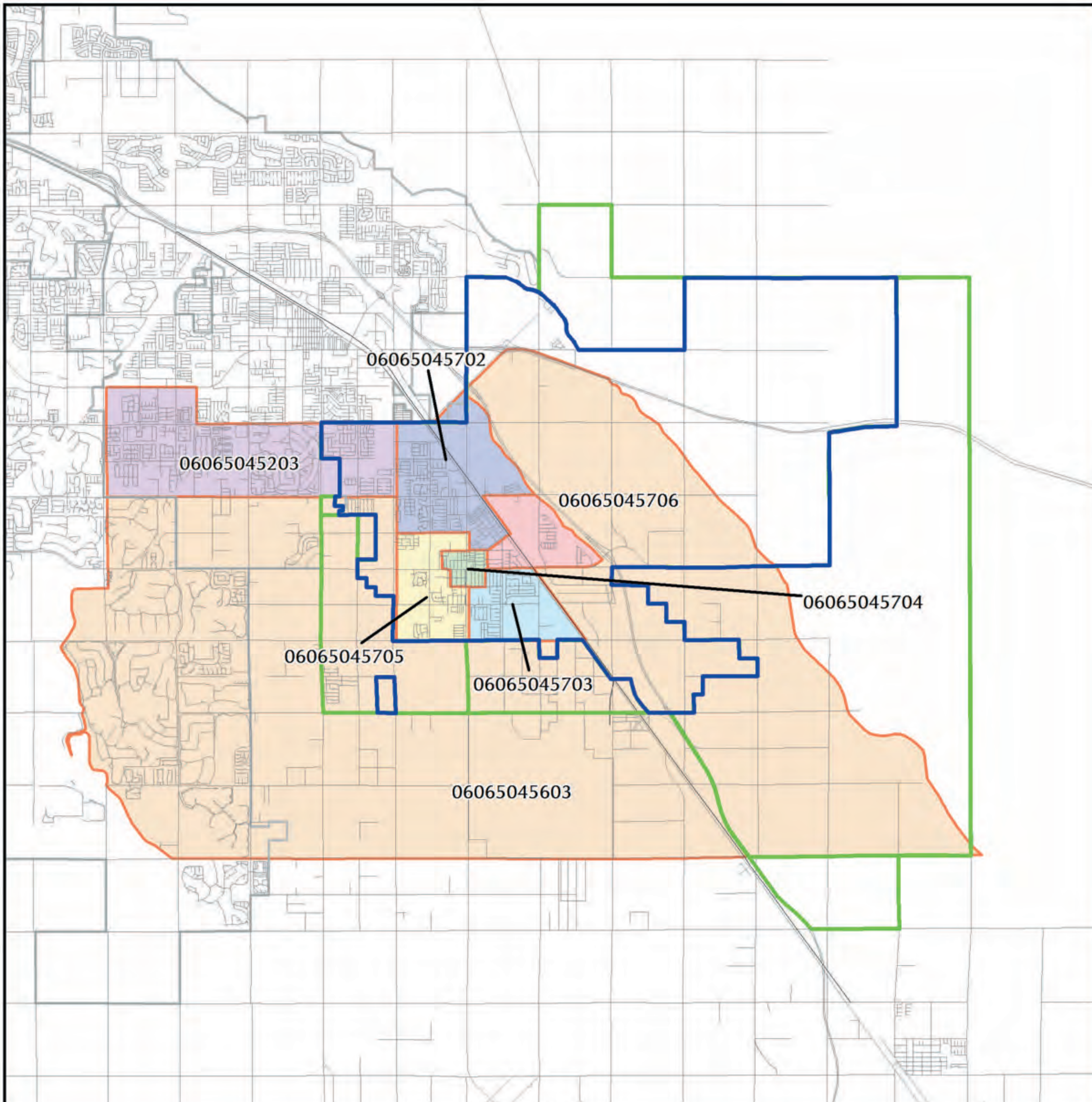
Date: 2014

Notable Regional Earthquakes

Figure 1-2



N
W E
S

10000 0 10000
Feet
2400 0 2400
Meters
Scale: 1:120,000

Explanation

06065045603	Census Tract Boundaries with Census Tract Number
	Coachella City Boundary
	Coachella Planning Area Boundary

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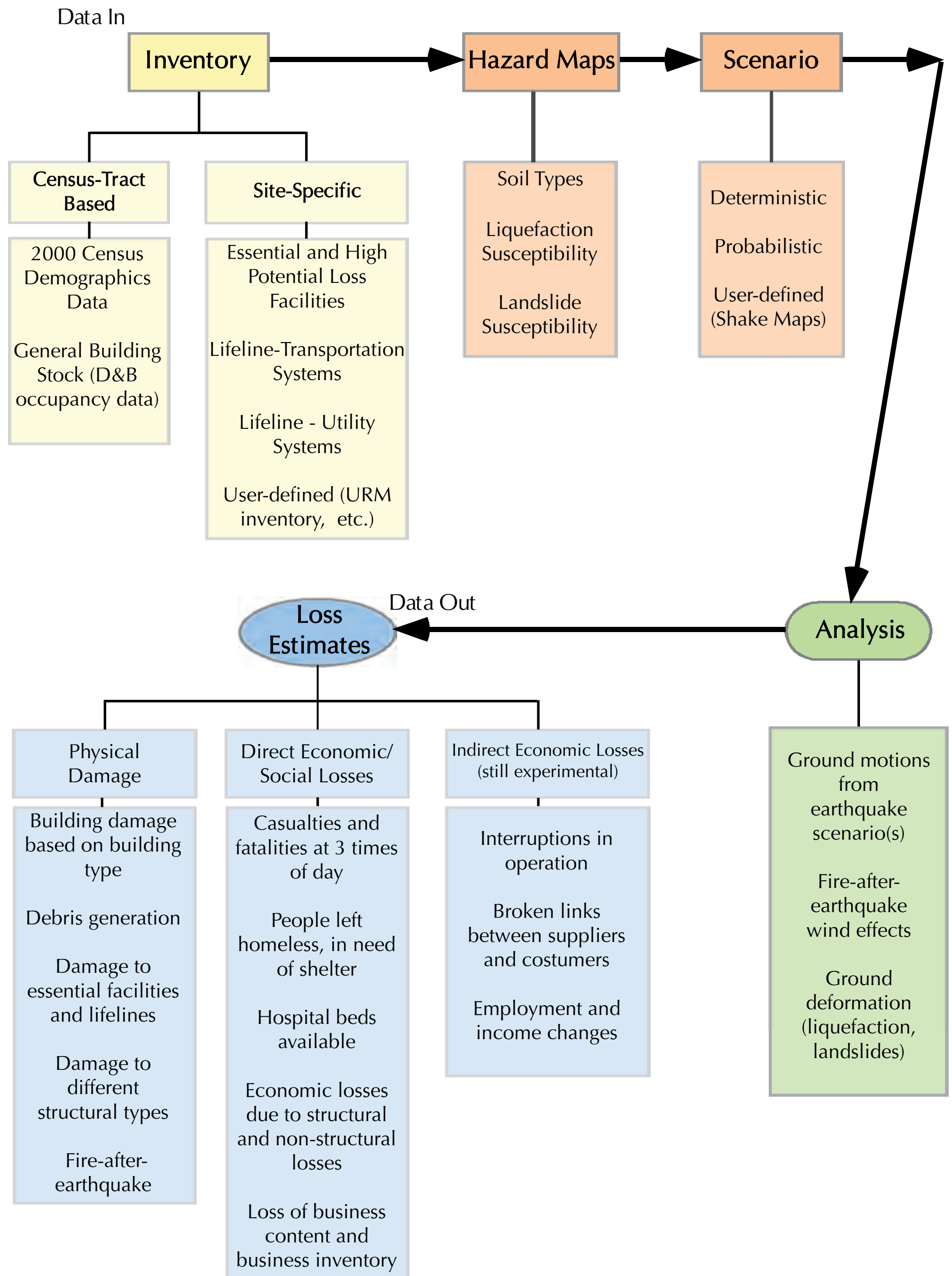
Date: 2014

Census Tracts Used in the HazUS Analyses

Figure 1-5



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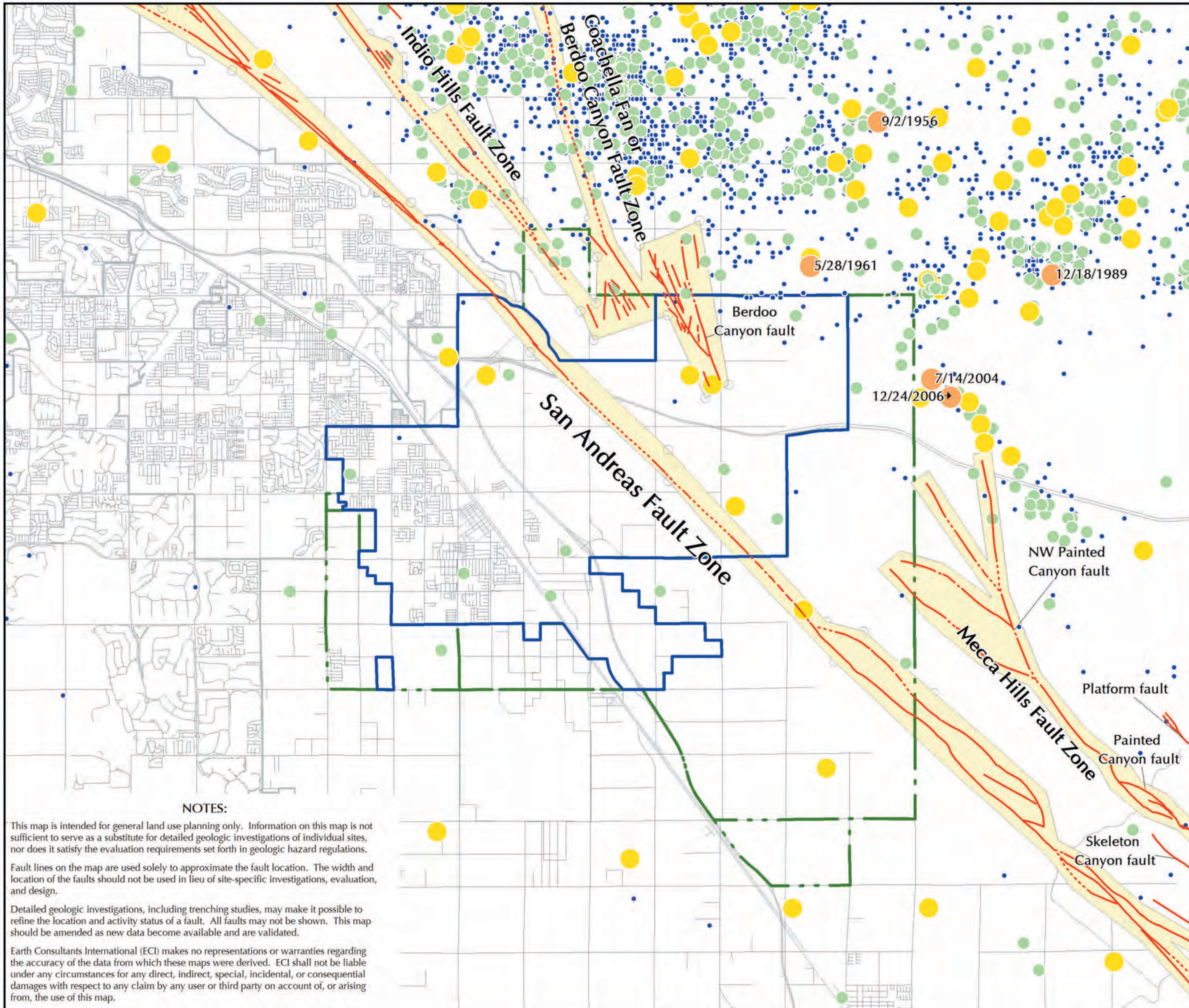
Date: 2014

Generalized Flow Chart Summarizing the HazUS Methodology

Figure 1-6

Faults and Historical (1800-2014) Seismicity Map
Coachella, California



NOTES:

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Fault lines on the map are used solely to approximate the fault location. The width and location of the faults should not be used in lieu of site-specific investigations, evaluation, and design.

Detailed geologic investigations, including trenching studies, may make it possible to refine the location and activity status of a fault. All faults may not be shown. This map should be amended as new data become available and are validated.

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Explanation

Earthquake Magnitude

- 4 to 5
- 2 to 3
- 3 to 4
- <2

Quaternary Fault; solid where well located, dashed where approximately located, dotted where concealed or inferred.

1974 Alquist-Priolo Earthquake Fault Zone; boundaries delineated as straight-line segments that connect encircled turning points. (The CGS is in the process of revising these zones.)

Coachella City Boundary

Coachella Planning Area Boundary

N W E S

8000 0 8000 Feet

2000 0 2000 Meters

Scale: 1:96,000

Base Map: From City of Coachella.
Sources: Southern California Earthquake Center (January 1932 to April 2014); National Earthquake Information Center (1800 to 1931); Alquist-Priolo Earthquake Fault Zones [Reproduced with permission CGS CD-ROM 2001-05 (2002)]; US Geological Survey (2011); Philibosian et al. (2011); location of main San Andreas fault from Petra (2006, 2007).

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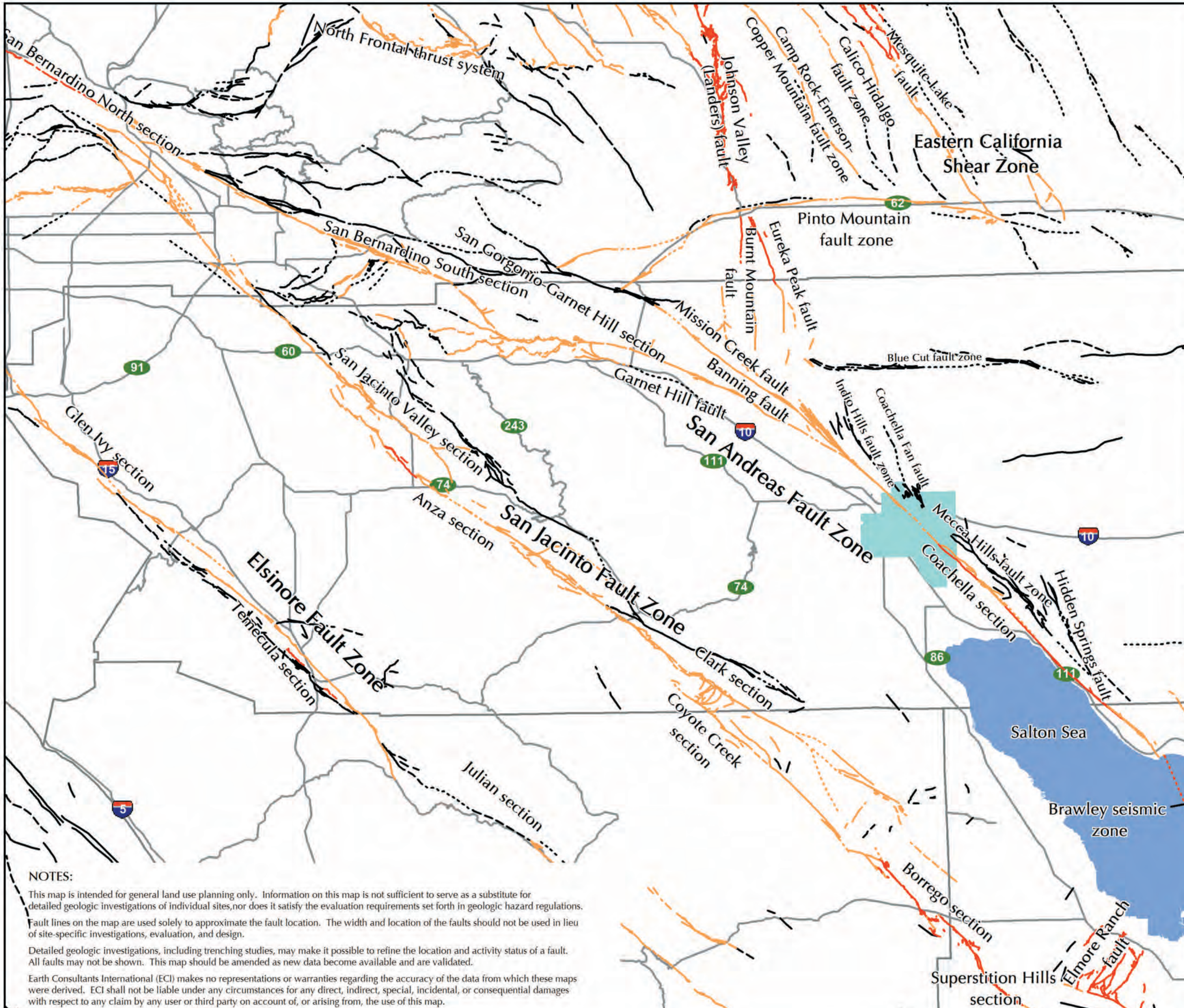
Date: 2014

Plate 1-1

Active and Potentially Active Faults

Within about 50 miles of Coachella, California



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Explanation

Fault; solid where location known, dashed where approximate, dotted where concealed. Color indicates age of movement on fault.

Age of last fault displacement.

Fault Showing Evidence of Historic Rupture (Active).

Fault Showing Evidence of Holocene Rupture (Active).

Fault Showing Evidence of Quaternary and Late Quaternary Rupture (Potentially Active).

Coachella General Plan Area

N S W E

50000 0 50000

Feet

15000 0 15000

Meters

Scale: 1:600,000

Base Map: From the City of Coachella.
Sources: U.S. Geological Survey and California Geological Survey, 2010, Quaternary fault and fold database for the United States, accessed June 2011, from USGS web site: http//earthquakes.usgs.gov/regional/qfaults/.

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Project Number: 3106/3218
Date: 2014

Plate 1-2

Seismic Hazard Zones

Coachella, California

NOTES:

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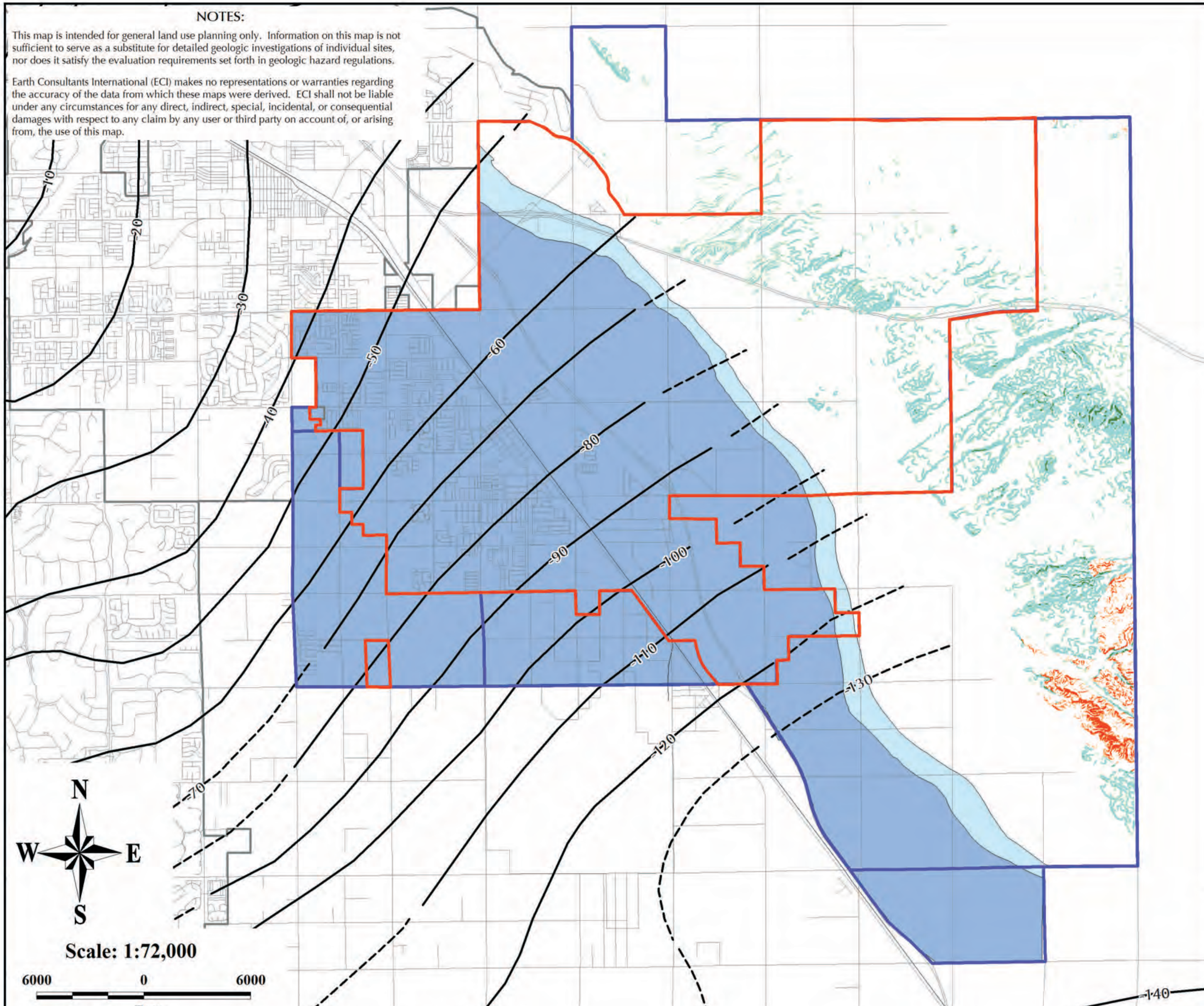

Base Map: From the City of Coachella.

Sources: Groundwater levels from California Department of Water Resources (1964); geological data derived from Dibble (2008) and Rogers (1965) - See Plate 2-1a; California Geological Survey (2004, 2008); Keefer and Wilson (1989); recent groundwater information obtained from various sites in the GeoTracker database (http://geotracker.swrcb.ca.gov/), and from geotechnical and fault evaluation studies in the City of Coachella files. Slope gradients used in the slope instability analysis derived from the USGS 10m Digital Elevation Model.

Explanation

Earthquake-Induced Slope Instability

Rock Falls / Rock Slides — Areas underlain by bedrock where the local topographic, geological, and geotechnical conditions indicate a potential for permanent ground displacements, such that mitigation may be required. Refer to text for additional information.

Soil Falls / Soil Slides / Soil Slumps — Areas underlain by Holocene and Pleistocene sediments where the local topographic, geological, and geotechnical conditions indicate a potential for earthquake-induced soil block slides or soil slumps. Mitigation measures may be required if these areas are developed. Refer to text for additional information.

Liquefaction Susceptibility

High — Areas underlain by youthful, unconsolidated sediments, and where historically shallow groundwater, within 30 feet of the ground surface, has been reported. These conditions indicate a high potential for permanent ground displacements such that mitigation for liquefaction may be required.

Moderate — Areas underlain by youthful, unconsolidated sediments, and where historically shallow groundwater, 30 to 50 feet below the ground surface, has been reported. These conditions indicate a moderate potential for permanent ground displacements such that mitigation for liquefaction may be required.

Historical groundwater elevation in feet relative to sea level (DWR, 1964). This shallow groundwater is generally perched above fine-grained sediments, and is for the most part not potable. Review of several geotechnical, geological and groundwater monitoring reports indicate that between 1990 and 2011, groundwater levels have dropped approximately 10 feet from the levels shown here.

Coachella City Boundary

Coachella Planning Area Boundary

Note that shallow groundwater, within 30 feet of the ground surface, and unconsolidated sediments susceptible to liquefaction occur locally adjacent to the San Andreas fault, with shallower groundwater levels typically present on the east side of the fault zone. These zones are not shown on this map. Nevertheless, studies to evaluate the potential for liquefaction should be conducted on a site-specific basis in areas proposed for development adjacent to the fault zone.

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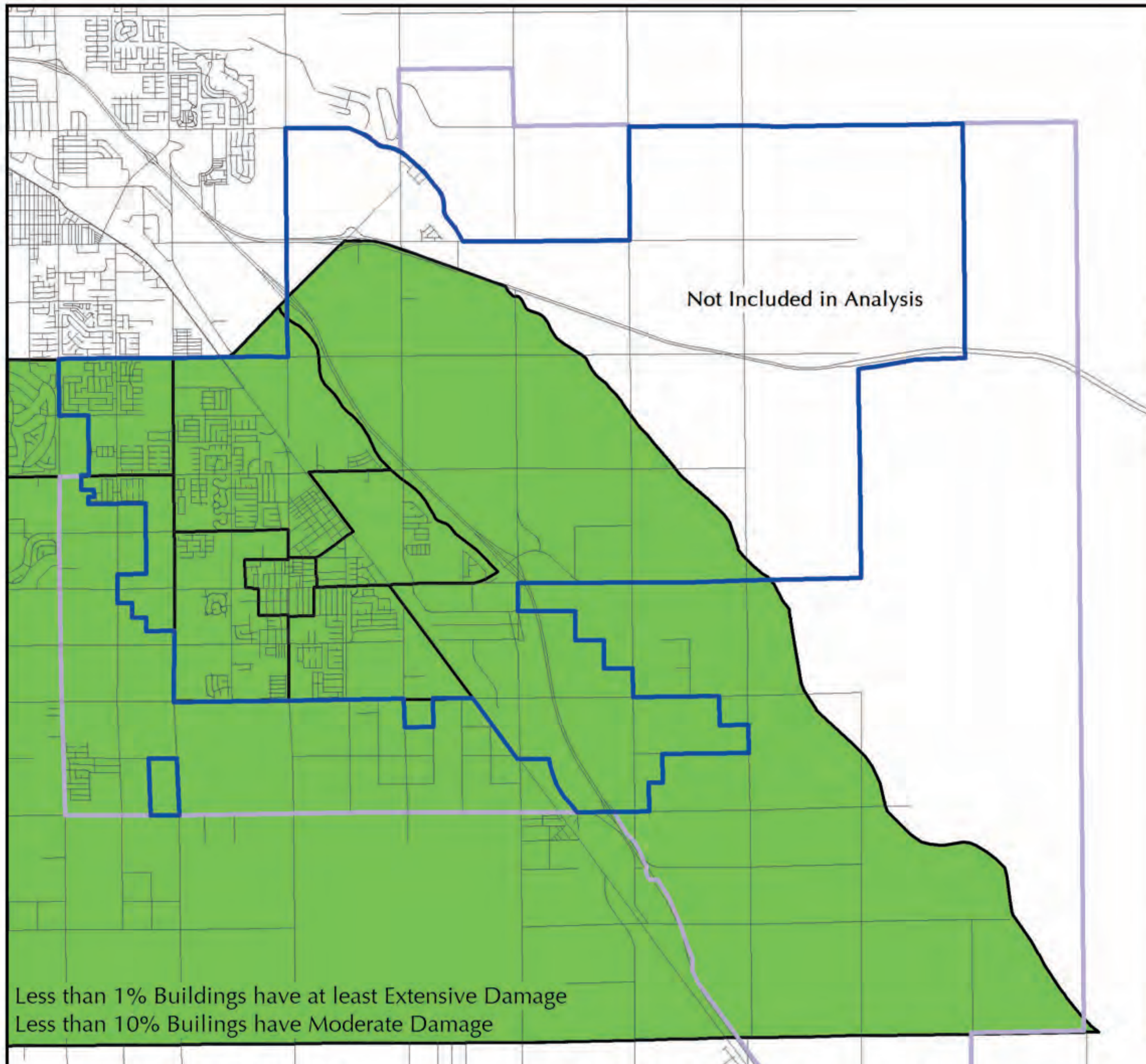
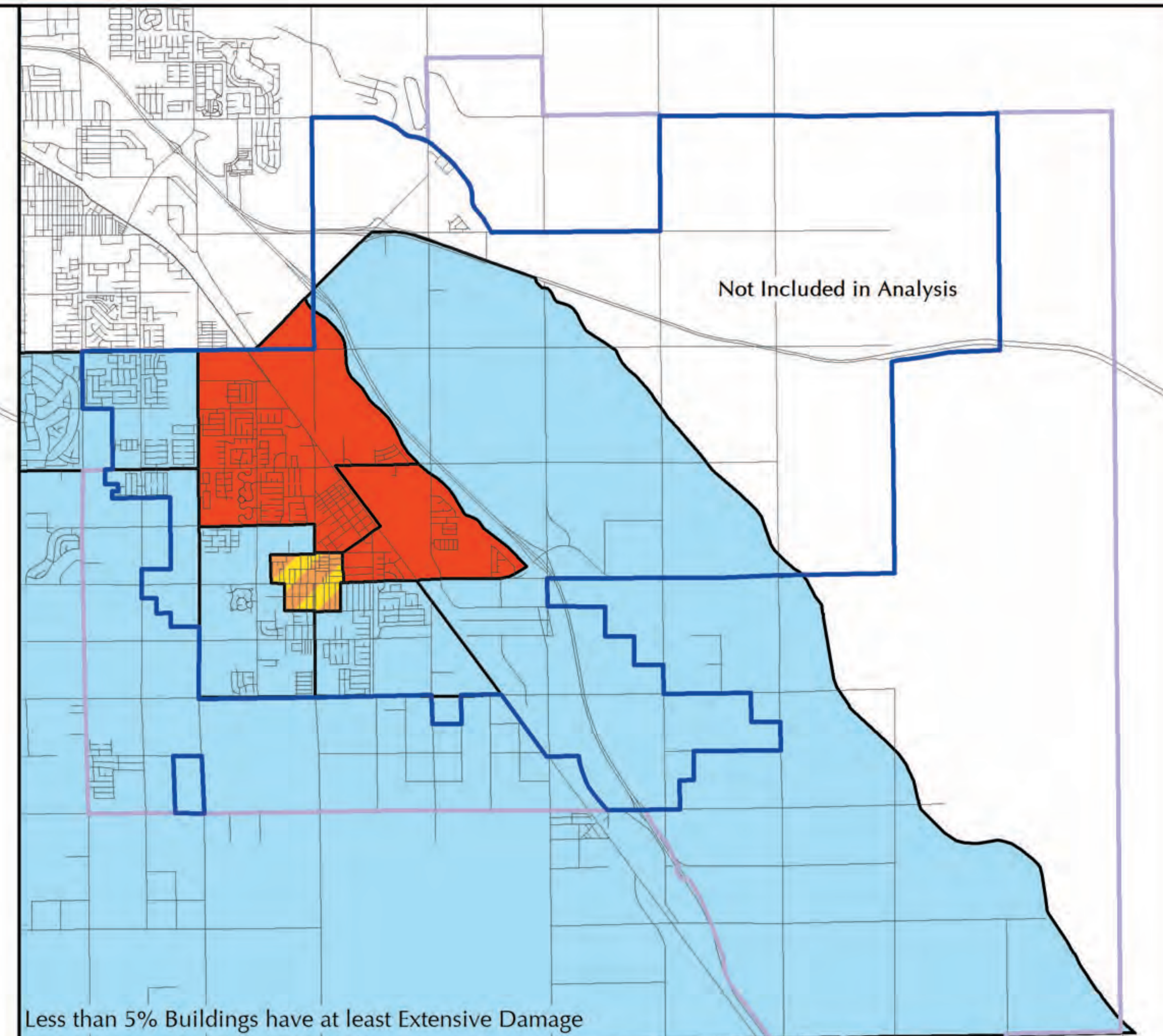
Plate 1-3



Magnitude 7.1 Earthquake on Coachella Section of San Andreas Fault



Magnitude 7.8 Earthquake on the Southern Sections of the San Andreas Fault (ShakeOut Scenario)

Source: Federal Emergency Management Agency, HAZUS 2.1 v 12.2.0

N W E S

7000 0 7000 14000

Feet

Scale: 1:84,000

EXPLANATION

Building Damage

- 50-70% Buildings have at least Moderate Damage
- 30-50% Buildings have at least Moderate Damage
- 50-70% Buildings have Slight to No Damage
- 70-90% Buildings have Slight to No Damage
- Greater than 90% Buildings have Slight to No Damage
- Coachella City Boundary
- Coachella Planning Area Boundary

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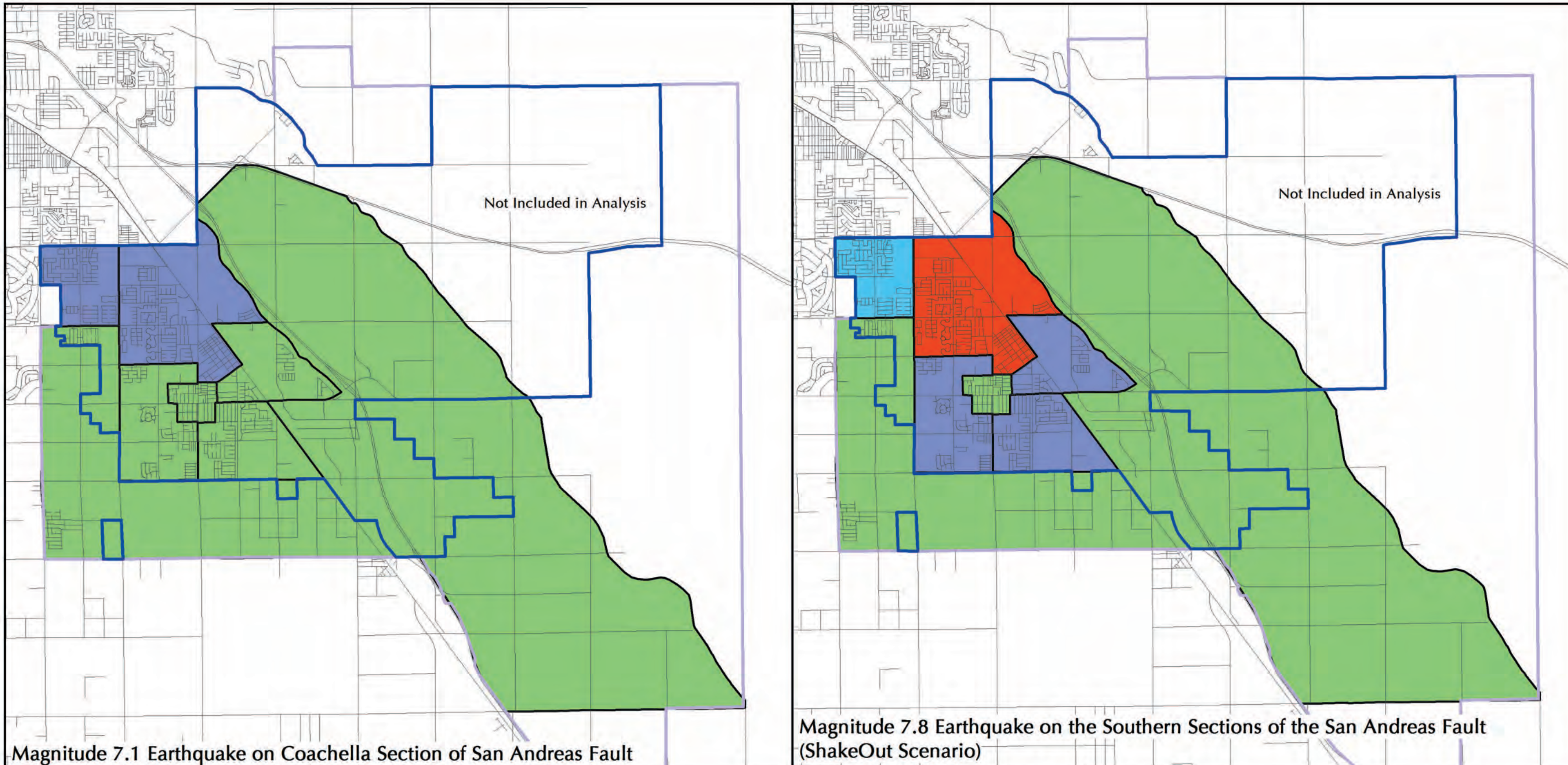
Residential Building Damage

(Based on Two Earthquake Scenarios)

Coachella, California

Plate 1-4



Magnitude 7.1 Earthquake on Coachella Section of San Andreas Fault

Magnitude 7.8 Earthquake on the Southern Sections of the San Andreas Fault (ShakeOut Scenario)

Source: Federal Emergency Management Agency, HAZUS 2.1 v.12.2.0

Based on 2000 real estate values, not adjusted for inflation

N W E S

7000 0 7000 14000

Feet

Scale: 1:84,000

EXPLANATION

Economic Loss by Census Tract
(in Millions of Dollars)

- 60 - 70
- 50 - 60
- 40 - 50
- 30 - 40
- 20 - 30
- 10 - 20
- 0 - 10
- Coachella City Boundary
- Coachella Planning Area Boundary

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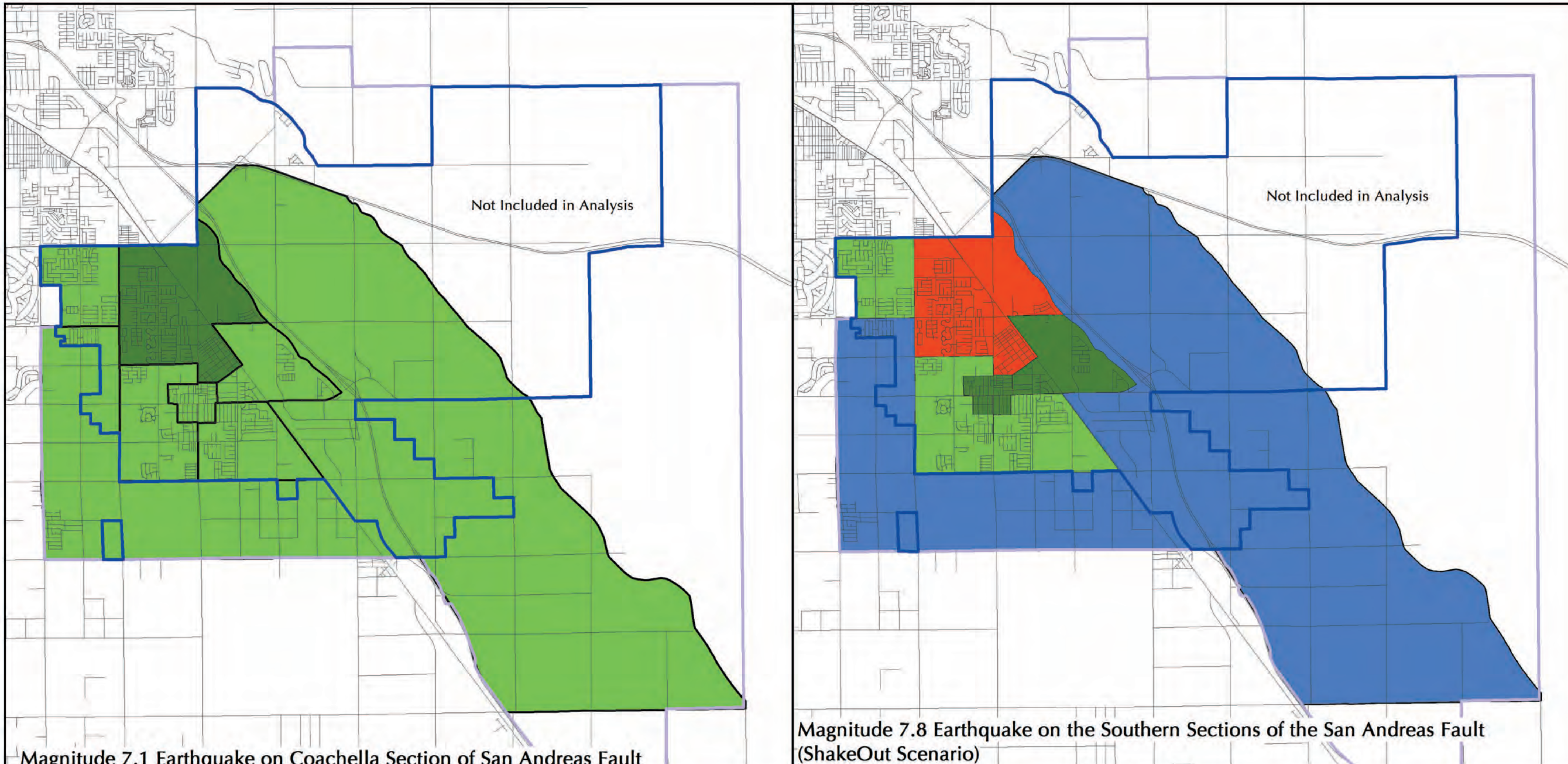
Date: 2014

Economic Losses due to Residential Building Damage

(Based on Two Earthquake Scenarios)

Coachella, California

Plate 1-5



Source: Federal Emergency Management Agency, HAZUS 2.1 v 12.2.0

N W E S

7000 0 7000 14000

Feet

Scale: 1:84,000

EXPLANATION

Economic Loss by Census Tract
(in Millions of Dollars)

80 - 90
70 - 80
60 - 70
50 - 60
40 - 50
30 - 40
20 - 30
10 - 20
0 - 10

Coachella City Boundary
Coachella Planning Area Boundary

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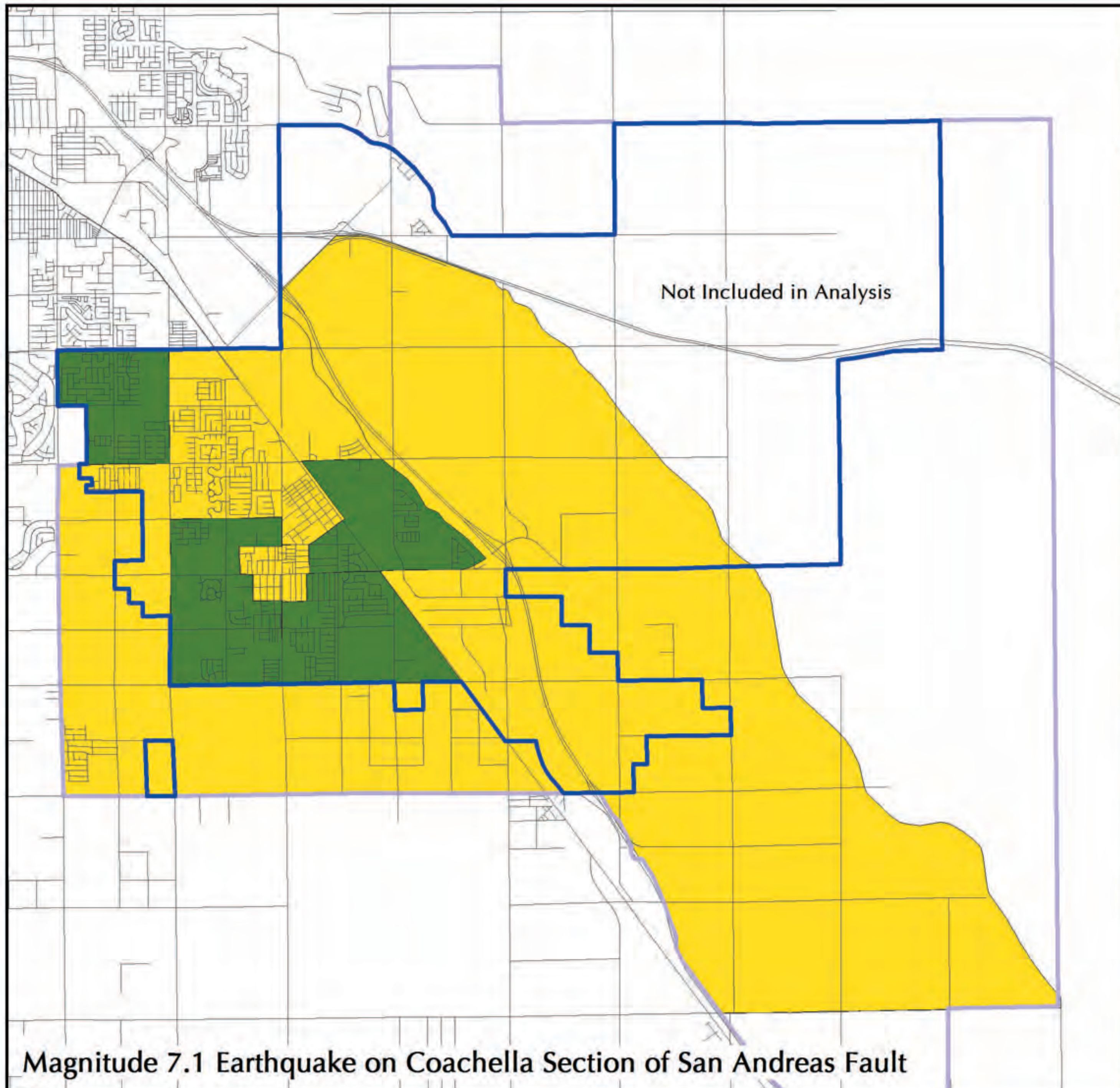
Date: 2014

Commercial and Industrial Loss

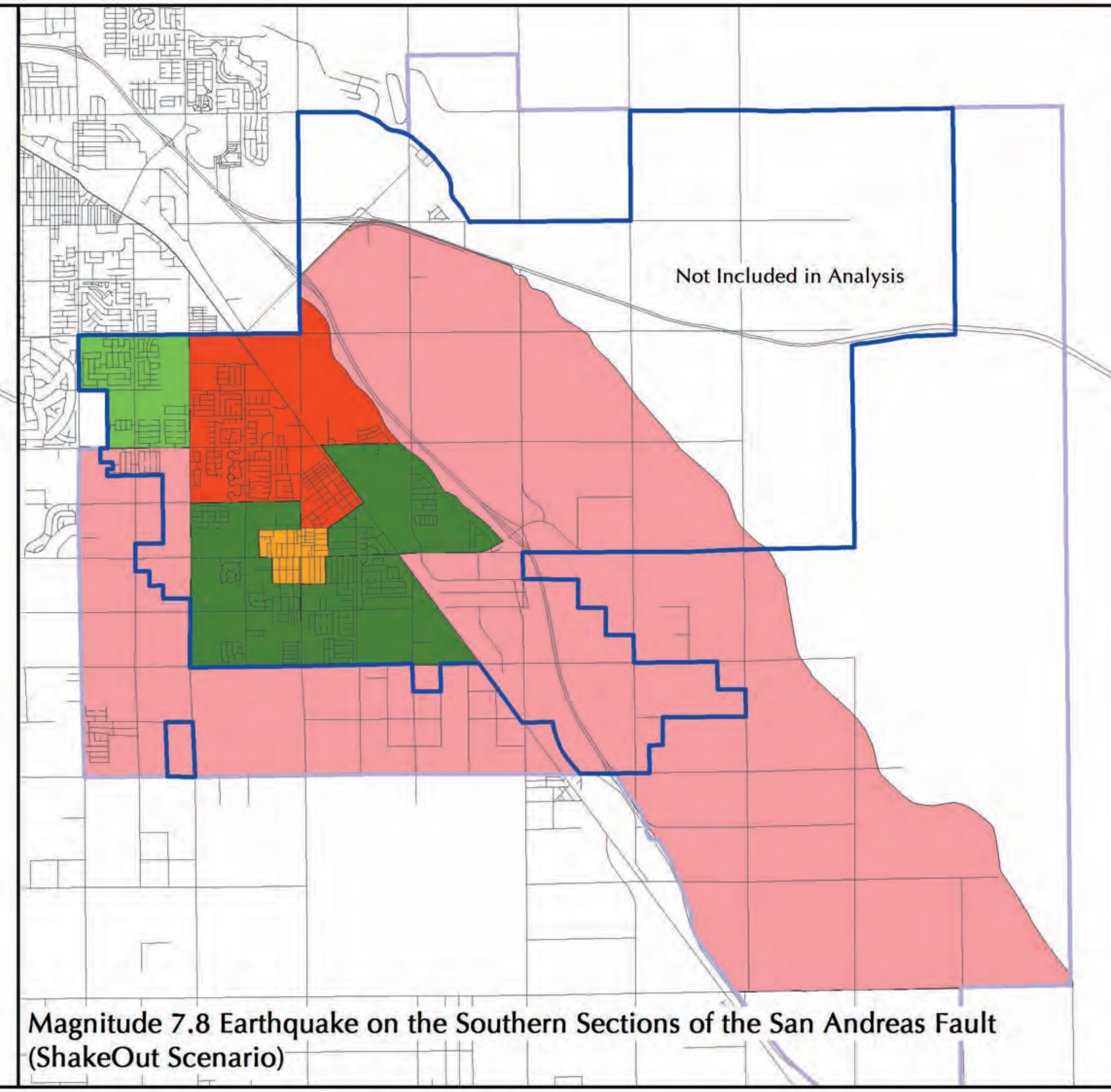
(Based on Two Earthquake Scenarios)

Coachella, California

Plate 1-6



Magnitude 7.1 Earthquake on Coachella Section of San Andreas Fault



Magnitude 7.8 Earthquake on the Southern Sections of the San Andreas Fault (ShakeOut Scenario)

Sources: Federal Emergency Management Agency, HAZUS 2.1

N
W E
S

7000 0 7000 14000

Feet

Scale: 1:84,000

EXPLANATION

Economic Loss by Census Tract
(in Millions of Dollars)

- 15 - 20
- 10 - 15
- 5-10
- 1 - 5
- 0.5 - 1
- 0 - 0.5

- Coachella City Boundary
- Coachella Planning Area Boundary

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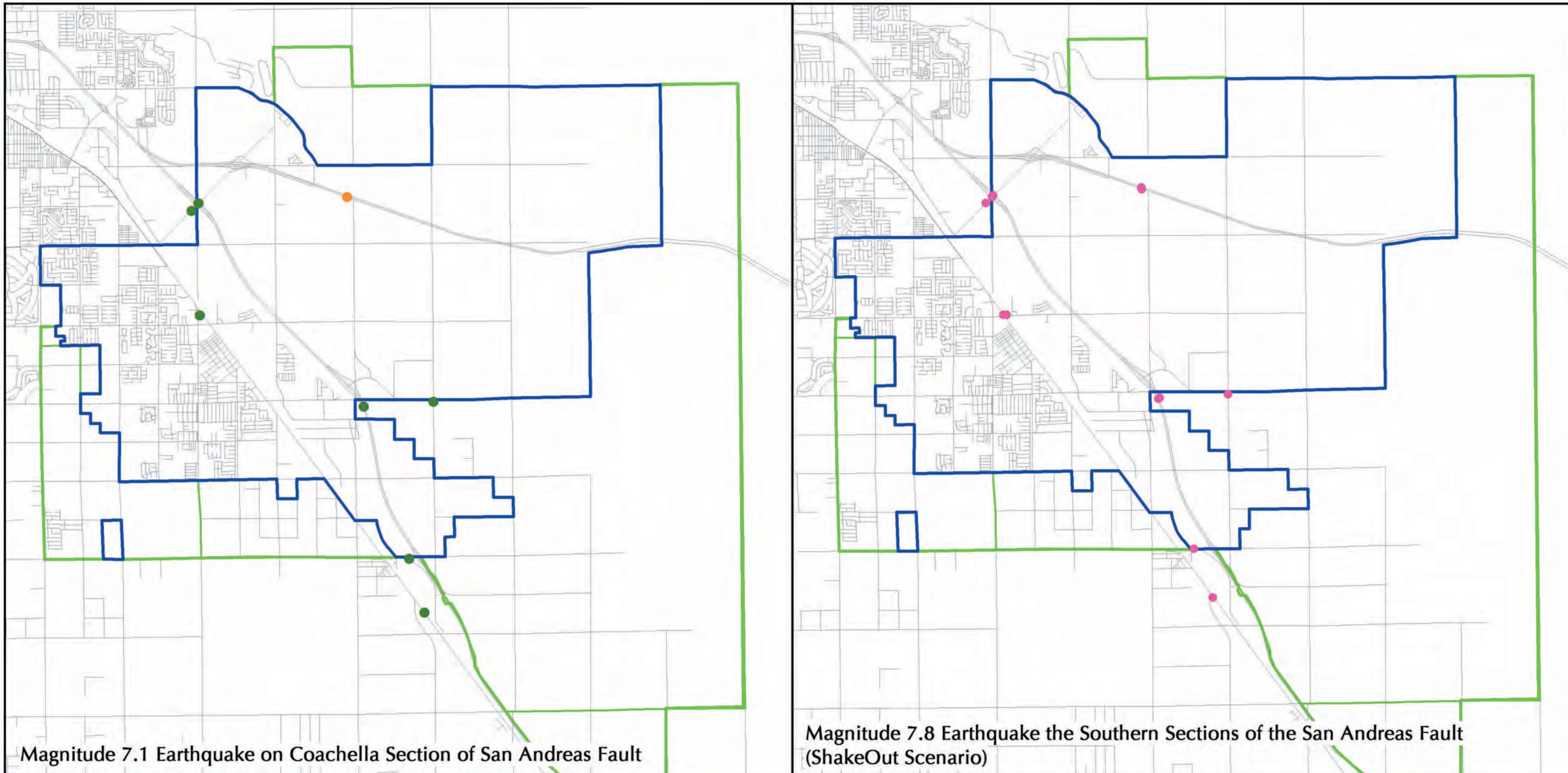
Date: 2014

Economic Loss due to School Damage

(Based on Two Earthquake Scenarios)

Coachella, California

Plate 1-7



Source: Federal Emergency Management Agency, HAZUS 2.1 v12.2.0

N W E S

7000 0 7000 14000

Feet

Scale: 1:84,000

EXPLANATION

Bridge Damage

- >50% probability damage exceeds extensive
- >50% probability damage exceeds moderate
- >50% probability damage is slight to none

Coachella City Boundary

Coachella Planning Area Boundary

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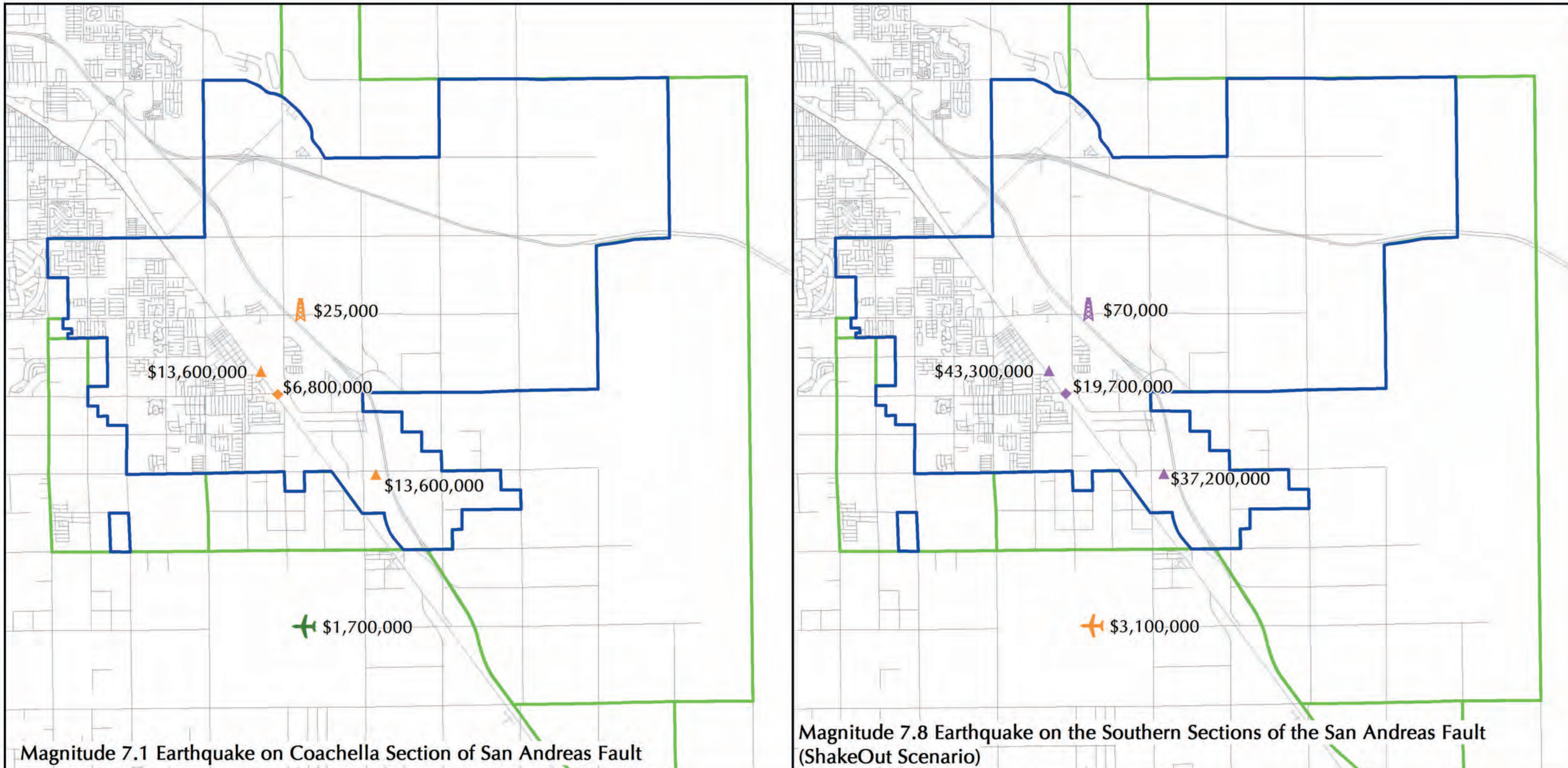
Highway Bridge Damage

(Based on Two Earthquake Scenarios)

Coachella, California

Plate 1-8



Source: Federal Emergency Management Agency, HAZUS 2.1 v12.2.0

N W E S

7000 0 7000 14000

Feet

Scale: 1:84,000

EXPLANATION

Damage (Labeled with Economic Loss in Dollars)

- Airport
- Radio Tower
- Potable Water System Facility
- Waste Water Facility
- >50% probability damage exceeds extensive
- >50% probability damage exceeds moderate
- >50% probability damage is slight to none

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Date: 2014

Utility and Communication Facilities Damage and Economic Loss

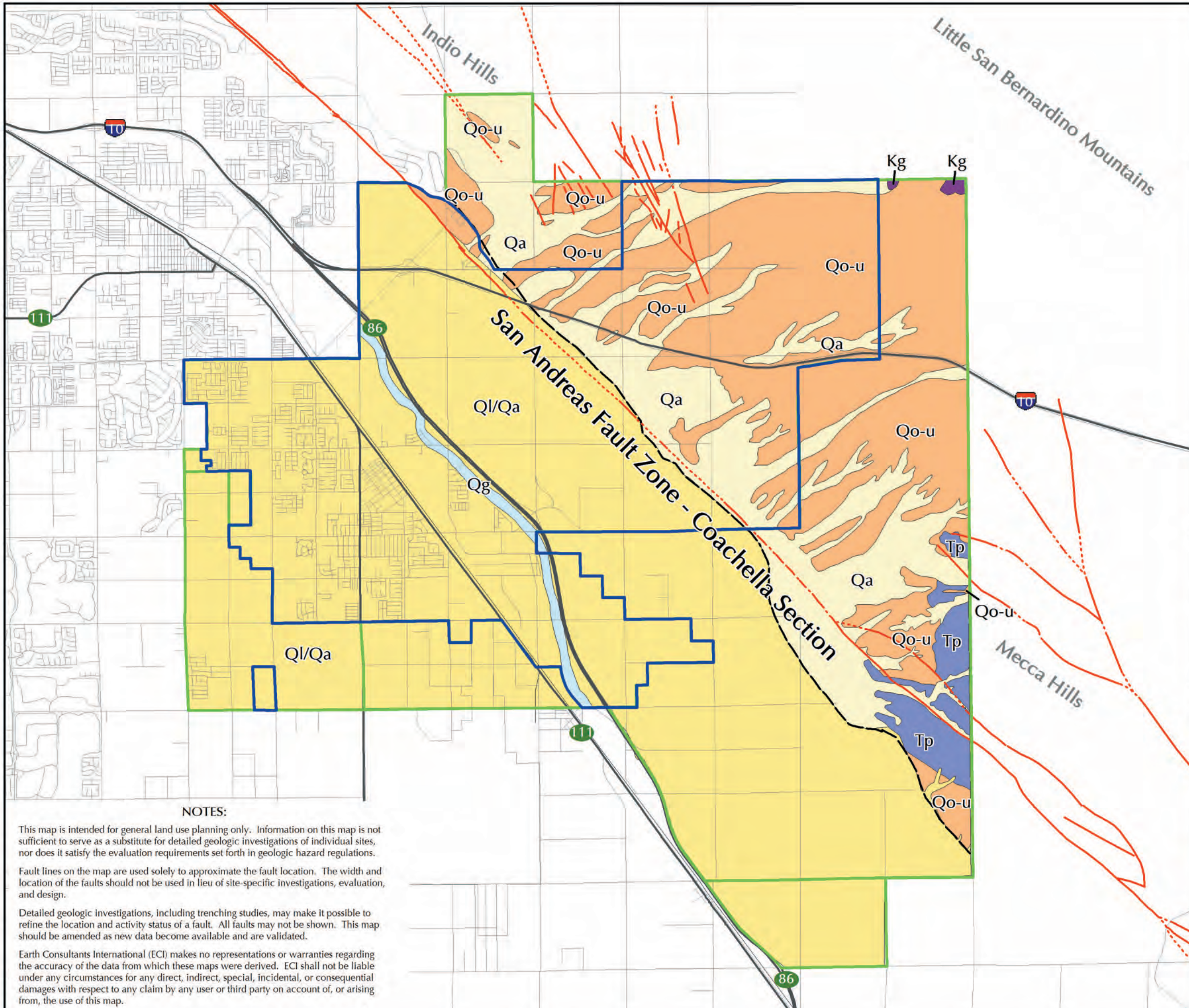
(Based on Two Earthquake Scenarios)

Coachella, California

Plate 1-9

Geologic Map

Coachella, California



NOTES:

This map is intended for general land use planning only. Information on this map is not sufficient to serve as a substitute for detailed geologic investigations of individual sites, nor does it satisfy the evaluation requirements set forth in geologic hazard regulations.

Fault lines on the map are used solely to approximate the fault location. The width and location of the faults should not be used in lieu of site-specific investigations, evaluation, and design.

Detailed geologic investigations, including trenching studies, may make it possible to refine the location and activity status of a fault. All faults may not be shown. This map should be amended as new data become available and are validated.

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Symbols

- Fault; solid where location known, dashed where approximate, dotted where concealed. (For more information refer to Plates 1-1 and 1-2)
- Approximate location of eastern shoreline of ancient Lake Cahuilla
- Geologic Contact
- Coachella City Boundary
- Coachella Planning Area Boundary

For Geologic Unit Descriptions See Plate 2-1b

N W E S

Scale: 1:72,000

6000 0 6000
Feet

2000 0 2000
Meters

Base Map: From City of Coachella.
Sources: Modified from Dibblee (2008) and Rogers (1965, reprinted 1992); faults from Quaternary fault and fold database for the United States, accessed April 2010, from USGS web site: http//earthquakes.usgs.gov/regional/qfaults; location of main San Andreas fault from Petra (2006-2007).

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Plate 2-1a

Geologic Unit Descriptions

Surficial Sediments

Qg	River Channel Deposits: Sand, gravel, and boulders within the modern Whitewater River channel (Holocene)
Ql/Qa	Lake and Distal Fan Deposits: Fine-grained sand, silt, and clay of the valley floor (Holocene)
Qa	Alluvial Fan and Stream Deposits: Sand, silt, and gravel filling active drainages within the Indio and Mecca Hills, and forming gently sloping fans at the valley margin (Holocene)

Upper Ocotillo Conglomerate

Qo-u	Upper Ocotillo Conglomerate: Sand, gravel, and boulders, gray, widely exposed in the Indio and Mecca Hills (late Pleistocene to early Holocene)

Palm Spring Formation

Tp	Palm Spring Formation: Arkosic sandstone, light pinkish-gray, with interbedded siltstone and red clays, exposed in southeastern part of the Planning Area, in the Mecca Hills (Pliocene)

Crystalline Rocks

Kg	Plutonic rocks of variable composition, including quartz monzonite and quartz diorite, exposed in the Little San Bernardino Mountains (Cretaceous)

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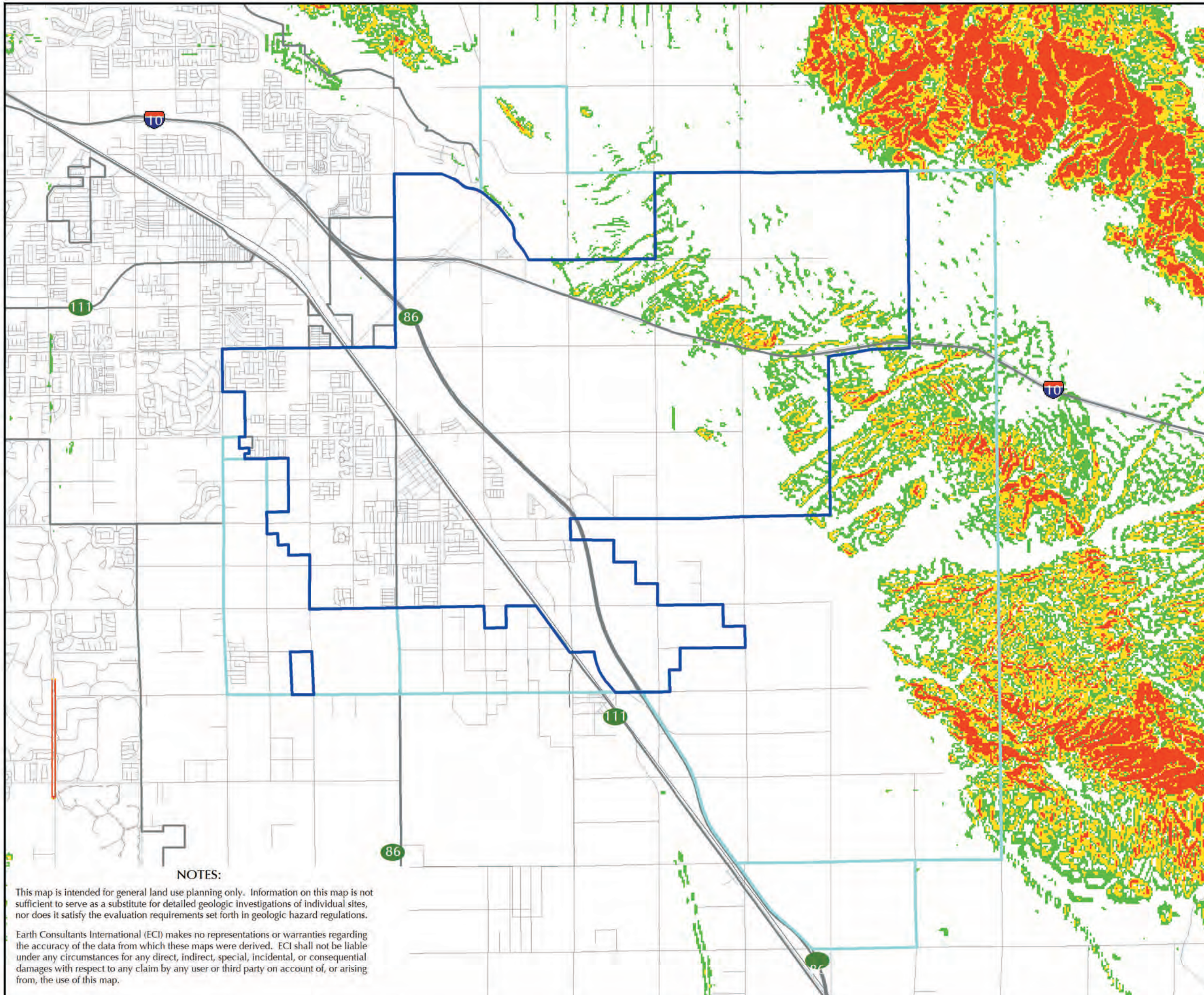
Explanation for Geologic Map

Plate 2-1b

Slope Distribution Map

Coachella, California



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Explanation

Slope (in Percent Grade)

- 0 to 10
- 10 to 20
- 20 to 36
- 37 and greater

- Coachella City Boundary
- Coachella Planning Area Boundary

N E S W

Scale: 1:72,000

6000 0 6000
Feet

2000 0 2000
Meters

Base Map: From the City of Coachella.
Source: Derived from USGS 30m Digital Elevation Model.

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Plate 2-2