

## Section 12: Severe Weather Occasions

### Windstorms

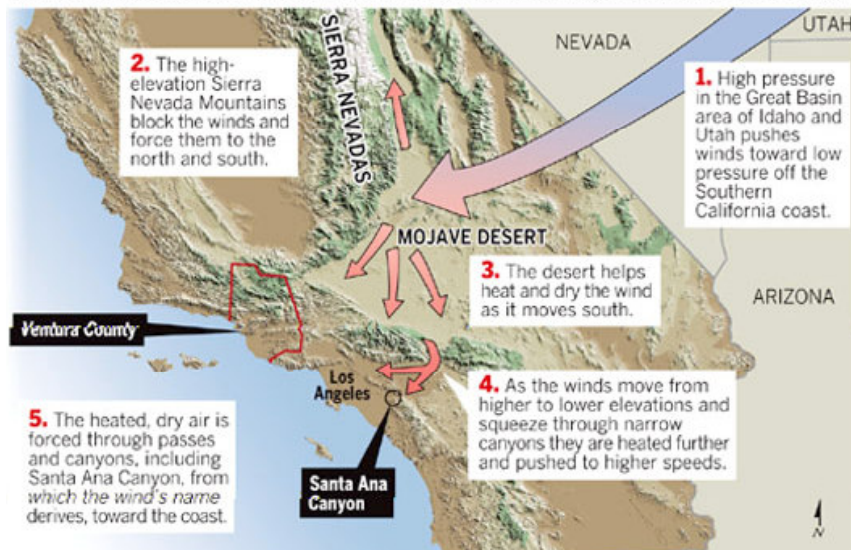
Historically high wind conditions have caused injury, death, property damage, and fanned wild fires until it becomes a firestorm. Windstorms with significant intensity have been responsible for the sinking of watercraft and the downing of aircraft resulting in the loss of life. The most common wind condition in the Los Angeles region is the Santa Ana Wind. This condition has generated winds that have exceeded 100 mph. As recently as 1996, a wind velocity of 111 mph was recorded in the Freemont Canyon and 92 mph in the City of Rialto, both of which were generated from the same Santa Ana Wind, resulting in the loss of life due to flying debris. The high wind velocities caused by this condition has brought the temporary closure of state highways, in particular Interstate 15 and 215 Freeway, due to the hazards of vehicles traveling on them. The City is not located near passes where the highest velocities are generated. However, the City can still experience high winds from a Santa Ana wind condition.

### Santa Ana Wind Condition

Santa Ana winds are generally defined as warm, dry winds that blow from the East or northeast (offshore). These winds occur below passes and canyons of the coastal ranges of Southern California and in the Los Angeles basin. Santa Ana winds often blow with exceptional speed in the Santa Ana Canyon, the canyon from which it derived its name. Forecasters at the National Weather Service in Oxnard and San Diego usually place speed minimums on these winds and reserve the use of "Santa Ana" for winds greater than 25 knots.

#### The Santa Ana winds

Santa Anas are dry, sometimes hot winds in Southern California that blow westward through canyons toward coastal regions. They typically occur from October through March, tending to peak in December, but often spread wildfires in the fall across areas that have gone for months without rain.



Source: UCLA and UC San Diego research studies

<http://www.greenberg-art.com/Infographics/qq1sgSantaAnaWinds.jpg>

The complex topography of Southern California, combined with various atmospheric conditions, creates numerous scenarios that can cause widespread or isolated Santa Ana events. Commonly, Santa Ana winds develop when a region of high pressure builds over the Great Basin (the high plateau east of the Sierra mountains and west of the Rocky mountains including most of Nevada and Utah). Clockwise circulation around the center of a high-pressure area forces air down the slope from the high plateau. The air warms as it descends toward the California coast at the rate of 5 degrees Fahrenheit per 1,000 feet of elevation change, due to the heating of the air caused by compression. This heating of the air as it is compressed, provides the primary source of warming. The air is dry since it originated in the desert, and its moisture will continue to dissipate as it is heated.

Santa Ana winds commonly occur between October and February, with December having the highest frequency of events; summer events are rare. Wind speeds are typically north to east at 35 knots through and below passes and canyons with gusts to 50 knots. Stronger Santa Ana winds can have gusts greater than 60 knots over widespread areas and gusts greater than 100 knots in favored areas. Frequently, the strongest winds in the basin occur during the night and morning hours, due to the absence of a sea breeze. The sea breeze that blows onshore daily can moderate the Santa Ana winds during the late morning and afternoon hours.

Santa Ana winds are an important forecast challenge because of the high fire danger associated with them. Also, unusually high surf conditions on the northeast side of the Channel Islands, normally accompany a Santa Ana event. Other hazards include: wind damage to property, turbulence, low-level wind shear for aircraft, and high seas and wind conditions can also be a danger for boaters.

### ***Severe Weather***

A variety of weather related events have occurred in Southern California in recent and past years that would seem unusual for the region, due to the fact that these events do not occur with great frequency. Some of these weather events have occurred in other parts of the country on a larger scale with severe intensity that has resulted in wide scale destruction, injury, and loss of life.

### ***Thunderstorms and Hail***

Thunderstorms occur annually in Southern California, but their impact is usually limited to power outages in urban areas; however, ground strikes have been responsible for fires in rural and wooded areas. It is rare that a person is struck by lightning, but loss of life has resulted.

Hail is rare, but when it occurs it is usually in conjunction with windy conditions. The intensity of a driving wind and hailstorms, some as big as the size of a golf ball, have caused significant damage in the past.

## ***High and Low Temperatures***

Generally California, especially Southern California, is considered to have a Mediterranean type of climate. The area has experienced both very high and significantly low temperatures. High temperatures have exceeded 110 degrees, which resulted in the loss of crops, livestock, workers sent home, and the temporary closure of schools. Extremely high temperatures in August of 1997, contributed to five deaths. During, what is referred to as California's fire season, high temperatures have been known to hamper firefighting efforts. Southern California has experienced low temperatures, but this situation is usually short in duration. The most significant impact is the loss of seasonal crops fortunately Temple City does not have any agriculture zones.

## ***Tornados, Funnel Clouds, and Waterspouts***

These weather events are considered rare for southern California and historically have not impacted the City; however, these events are not predictable as to time of the event or location. Funnel clouds and waterspouts are related to coastal areas and have been responsible for damage and injuries.

Several tornados have been recorded in the Southern California area. When a tornado touched down in Santa Monica in 1952 it caused damage to property, caused power outages, injuries, and responsible for the loss of life. Meteorologists can identify weather conditions that would be conducive to forming a tornado, but this does mean that the tornado will form. Conversely, the exact location, size and intensity are not predictable.

## ***What are Tornados?***

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

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

**Figure VII-1 below depicts the Fujita Tornado Damage Scale:**

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

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

### ***Microbursts***

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

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

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

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

“Downbursts of all sizes descend from the upper regions of severe thunderstorms when the air accelerates downward through either exceptionally strong evaporative cooling or by very heavy rain which drags dry air down with it. When the rapidly descending air strikes the ground, it spreads outward in all directions, like a fast-running faucet stream hitting the sink bottom.

When the microburst wind hits an object on the ground such as a house, garage or tree, it can flatten the buildings and strip limbs and branches from the tree. After striking the ground, the powerful outward running gust can wreak further havoc along its path. Damage associated with a microburst is often mistaken for the work of a tornado, particularly directly under the microburst. However, damage patterns away from the impact area are characteristic of straight-line winds rather than the twisted pattern of tornado damage.”

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

### Local History of Windstorm Events

While the effects of Santa Ana Winds are often overlooked, it should be noted that in 2003, two deaths in Southern California were directly related to the fierce conditions. A falling tree struck one woman in San Diego.<sup>jj</sup> The second death occurred when a passenger in a vehicle was hit by a flying pickup truck cover that was launched by the Santa Ana Winds.

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

## **Windstorm Hazard Assessment**

### Hazard Identification

A windstorm event in the region can range from short term microburst activity lasting only minutes to a long duration Santa Ana wind condition that can last for several days, as in the case of the January 2003 Santa Ana wind event. Windstorms can cause extensive damage, including heavy tree stands, road and highway infrastructure, and critical utility facilities.

The map shows clearly the direction of the Santa Ana winds, as they travel from the stable high-pressure weather system called the Great Basin, through the canyons and towards the low-pressure system off the Pacific Ocean. Clearly the City is in the direct path of the ocean-bound Santa Ana winds.

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

### **Community Windstorm Issues**

What is Susceptible to Windstorms?

Life and Property

Based on the history of the region, windstorm events can be expected, perhaps annually, across widespread areas of the region, which can be adversely impacted during a windstorm event. This can result in the involvement of City emergency response personnel during a wide-ranging windstorm or microburst tornadic activity. Both residential and commercial structures, with weak reinforcement are susceptible to damage. Wind



Source: NASA's Observatorium  
[http://observe.arc.nasa.gov/nasa/ootw/1996/ootw\\_961029/ob961029.html](http://observe.arc.nasa.gov/nasa/ootw/1996/ootw_961029/ob961029.html)

pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift suction forces that pull building components and surfaces outward. With extreme wind forces, the roof or entire building can fail causing considerable damage.

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

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

<b>BEAUFORT SCALE</b>		
Beaufort Force	Speed (mph)	Wind Description - State of Sea - Effects on Land
0	Less 1	Calm - Mirror-like - Smoke rises vertically
1	1-3	Light - Air Ripples look like scales; No crests of foam - Smoke drift shows direction of wind, but wind vanes do not
2	4-7	Light Breeze - Small but pronounced wavelets; Crests do not break - Wind vanes move; Leaves rustle; You can feel wind on the face
3	8-12	Gentle Breeze - Large Wavelets; Crests break; Glassy foam; A few whitecaps - Leaves and small twigs move constantly; Small, light flags are extended
4	13-18	Moderate Breeze - Longer waves; Whitecaps - Wind lifts dust and loose paper; Small branches move
5	19-24	Fresh Breeze - Moderate, long waves; Many whitecaps; Some spray - Small trees with leaves begin to move
6	25-31	Strong Breeze - Some large waves; Crests of white foam; Spray - Large branches move; Telegraph wires whistle; Hard to hold umbrellas
7	32-38	Near Gale - White foam from breaking waves blows in streaks with the wind - Whole trees move; Resistance felt walking into wind
8	39-46	Gale - Waves high and moderately long; Crests break into spin drift, blowing foam in well marked streaks - Twigs and small branches break off trees; Difficult to walk
9	47-54	Strong Gale - High waves with wave crests that tumble; Dense streaks of foam in wind; Poor visibility from spray - Slight structural damage
10	55-63	Storm - Very high waves with long, curling crests; Sea surface appears white from blowing foam; Heavy tumbling of sea; Poor visibility - Trees broken or uprooted;

		Considerable structural damage
11	64-73	Violent Storm - Waves high enough to hide small and medium sized ships; Sea covered with patches of white foam; Edges of wave crests blown into froth; Poor visibility - Seldom experienced inland; Considerable structural damage
12	>74	Hurricane - Sea white with spray. Foam and spray render visibility almost non-existent - Widespread damage. Very rarely experienced on land.
Source: <a href="http://www.compuweather.com/decoder-charts.html">http://www.compuweather.com/decoder-charts.html</a>		

### ***Utilities***

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

### ***Infrastructure***

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

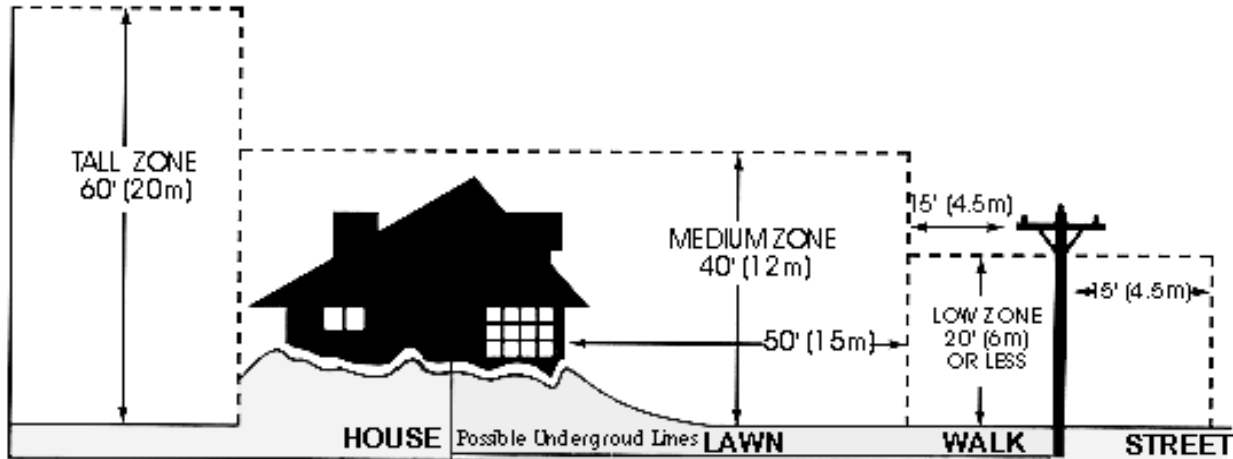
Windstorms can result in collapsed or damaged buildings or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Roads blocked by fallen trees during a windstorm may have severe consequences to people who need access to emergency services. Emergency response operations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

### ***Increased Fire Threat***

Perhaps the greatest danger from windstorm activity in Southern California comes from the combination of the Santa Ana winds and the major fires that occur every few years in the urban/wildland interface. A fire that is affected by Santa Ana winds becomes more intense than clam wind conditions, as the flames spread faster making the fire harder to control. The higher fire hazard raised by a Santa Ana wind condition requires that even more care and attention be paid to proper brush clearances on properties adjacent to wildland/urban interface areas.

## Transportation

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

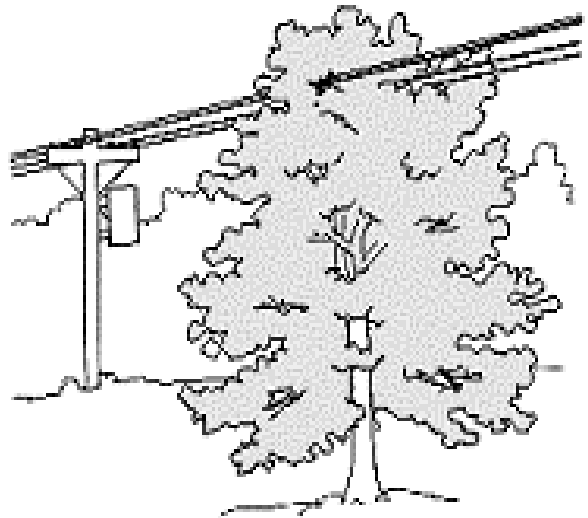


Source: [http://www.treesaregood.com/treecare/avoiding\\_conflicts.asp](http://www.treesaregood.com/treecare/avoiding_conflicts.asp)

## Existing Windstorm Mitigation Activities

As stated, one of the most common problems associated with windstorms is power outage. High winds commonly occur during winter storms, and can cause trees to bend, sag, or fall (tree limbs or entire trees), coming into contact with nearby distribution power lines.

Fallen trees can cause short-circuiting and conductor overloading. Wind-induced damage to the power system causes power outages to customers, incurs cost to make repairs, and in some cases lead to ignitions that start wild land fires.



Source: [http://www.treesaregood.com/treecare/avoiding\\_conflicts.asp](http://www.treesaregood.com/treecare/avoiding_conflicts.asp)

One of the strongest and most widespread existing mitigation strategies pertains to tree clearance. Currently, California State Law requires utility companies to maintain specific clearances (depending on the type of voltage running through the line) between electric power lines and all vegetation.

Enforcement of the following California Public Resource Code Sections provides guidance on tree pruning regulations:<sup>kk</sup>

4293: Power Line Clearance Required  
4292: Power Line Hazard Reduction  
4291: Reduction of Fire Hazards around Buildings  
4171: Public Nuisances

The following pertain to tree pruning regulations and are taken from the California Code of Regulations:

Title 14: Minimum Clearance Provisions  
Sections 1250-1258  
General Industry Safety Orders

Title 8: Group 3: Articles 12, 13, 36, 37, 38  
California Penal Code Section 385

Finally, the following California Public Utilities Commission section has additional guidance:

California Public Utilities Commission  
General Order 95: Rule 35

Homeowner Liability:

Failure to allow a utility company to comply with the law can result in liability to the homeowner for damages or injuries resulting from a vegetation hazard. Many insurance companies do not cover these types of damages if the policy owner has refused to allow the hazard to be eliminated.

The power companies, in compliance with the above regulations, collect data about tree failures and their impact on power lines. This mitigation strategy assists power companies in preventing future tree failure. From the collection of this data, power companies can advise residents as to the most appropriate vegetative planting and pruning procedures. The following chart depicts some of the tree failure data collected by Southern California Edison in this comprehensive mitigation strategy:

## Windstorm Mitigation Action Items

The windstorm mitigation action items provide direction on specific activities that organizations and residents in the City can undertake to reduce risk and prevent loss from windstorm events.

### **MITIGATION OBJECTIVE**

- (1) Reduce the hazard of falling trees and tree limbs during high wind conditions.

#### ***Actions for Implementation***

- a) Perform regular assessments of all major trees and their health status throughout the City.
- b) Remove trees that are diseased or may have the potential to fall and are deemed hazardous to life and property.

**Timeline:** Ongoing

**Constraints:** Not a budgeted item, lack of funds to fully implement in the short term.