

## 3.4 AIR QUALITY

This section presents a description of the existing air quality setting in the vicinity of the Wilfred, Stony Point, and Lakeville sites. A substantial portion of the following information is from the Bay Area Air Quality Management District (BAAQMD) website (<http://www.baaqmd.gov>).

### 3.4.1 AIR BASIN CHARACTERISTICS

To better manage common air quality problems, California is divided into 15 air basins. An air basin generally has similar meteorological and geographical conditions throughout. To the extent possible, the air basin boundaries follow along political boundary lines but in the case of Sonoma County, the northern portion of the County is in the North Coast Air Basin, where the southern part of the County is in the San Francisco Bay Area Air Basin. The Wilfred, Stony Point, and Lakeville sites are in the part of Sonoma County that is included in the nine-county San Francisco Bay Area Air Basin. The valley that stretches from Santa Rosa to the San Pablo Bay is known as the Cotati Valley at the north end, and the Petaluma Valley at the south end. The Lakeville site is southeast of Petaluma, at the southeast corner of the Petaluma Valley. The following is a description of climate as it affects air quality in the Bay Area, and the Cotati and Petaluma Valleys.

#### *CLIMATE IN THE BAY AREA*

##### *Large Scale Influences*

A semi-permanent high-pressure area centered over the northeastern Pacific Ocean dominates the summer climate of the West Coast. Because this high-pressure cell is quite persistent, storms rarely affect the California coast during the summer. Thus, the conditions that persist along the coast of California during summer are a northwest airflow and negligible precipitation. A thermal low-pressure area from the Sonoran-Mojave Desert also causes air to flow onshore over the San Francisco Bay Area much of the summer.

The steady northwesterly flow around the eastern edge of the Pacific high-pressure cell exerts a stress on the ocean surface along the west coast. This induces upwelling of cold water from below. Upwelling produces a band of cold water that is approximately 80 miles wide off San Francisco. During July, the surface waters off San Francisco are 3 degrees Fahrenheit (°F) cooler than those off Vancouver, more than 700 miles farther north. Air approaching the California coast, already cool and moisture-laden from its long trajectory over the Pacific, is further cooled as it flows across this cold bank of water near the coast, thus accentuating the temperature contrast across the coastline. This cooling is often sufficient to produce condensation – a high incidence of fog and stratus clouds along the Northern California coast in summer.

In winter, the Pacific high-pressure area weakens and shifts southward, upwelling ceases, and winter storms become frequent. Almost all of the Bay Area's annual precipitation takes place in the November through April period. During the winter rainy periods, inversions are weak or nonexistent, winds are often moderate and air pollution potential is very low. During some periods in winter, when the Pacific high becomes dominant, inversions become strong and often are surface-based; winds are light and pollution potential is high. These periods are characterized by winds that flow out of the Central Valley into the Bay Area and often include tule fog<sup>1</sup>.

### ***Topography***

The San Francisco Bay Area is characterized by complex terrain consisting of coastal mountain ranges, inland valleys and bays. Elevations of 1,500 feet are common in the higher terrain of this area. Normal wind flow over the area is distorted in the lowest levels. This is particularly true when the air mass is stable and the wind velocity is not strong. With stronger winds and unstable air masses moving over the area this distortion is reduced. The distortion is greatest when low-level inversions are present with the surface air beneath the inversion, flowing independently of the air above the inversion. This latter condition is very common in the summer, the surface air mass being the sea breeze.

### ***Winds***

In summer, the northwest winds to the west of the Pacific coastline are drawn into the interior through the Golden Gate and over the lower portions of the San Francisco Peninsula. Immediately to the south of Mount Tamalpais, the northwesterly winds accelerate considerably and originate from the west as they stream through the Golden Gate Bridge. This channeling of the flow through the Golden Gate produces a jet that sweeps eastward but widens downstream producing southwest winds at Berkeley and northwest winds at San Jose; a branch curves eastward through the Carquinez Straits and into the Central Valley. Wind speeds may be locally strong in regions where air is channeled through a narrow opening such as the Carquinez Strait, the Golden Gate Bridge, or San Bruno Gap.

The sea breeze between the coast and the Central Valley commences near the surface along the coast in late morning or early afternoon; it may be first observed only through the Golden Gate Bridge. Later in the day, the layer deepens and intensifies while spreading inland. As the breeze intensifies and deepens, it flows over the lower hills farther south along the Peninsula. This process frequently can be observed as a bank of stratus "rolling over" the coastal hills on the west side of the Bay. The depth of the sea breeze depends in large part upon the height and strength of the inversion. The generally low elevation of this stable layer of air prevents marine air from

---

<sup>1</sup> Tule fog is a dense night and morning valley fog that is commonly known as "tule fog" because of its prevalence in marshy areas populated by tule reeds or cattails. Technically it's a radiation fog, which forms as the ground cools off at night and radiates heat into space. (Null, 2001)

flowing over the coastal hills. It is unusual for the summer sea breeze to flow over terrain exceeding 2000 feet in elevation.

In winter, the Bay Area experiences periods of storminess and moderate-to-strong winds and periods of stagnation with very light winds. Winter stagnation episodes are characterized by outflow from the Central Valley, nighttime drainage flows in coastal valleys, weak onshore flows in the afternoon and otherwise light and variable winds.

**Temperature**

In summer, the distribution of temperature near the surface over the Bay Area is determined in large part by the effect of differential heating between land and water surfaces. This process produces a large-scale gradient between the coast and the Central Valley as well as small-scale local gradients along the shorelines of the ocean and bays. The temperature contrast between coastal ocean water and land surfaces 15 to 20 miles inland reaches 35°F or more on many summer afternoons. At night this contrast usually decreases to less than 10°F.

The winter mean temperature maxima and minima reverse the summer relationship in that daytime variations are small while mean minimum (nighttime) temperatures show large differences and strong gradients. The moderating effect of the ocean influences warmer minimums along the coast and penetrating the Bay. Coldest temperatures are in the sheltered valleys, implying strong radiation inversions and very limited vertical diffusion. An anomaly of warmer temperatures in the Santa Clara Valley over San Jose is clearly an urban “heat island” effect, most pronounced on winter nights. Such heat islands are proportional to structure density, and appear also over San Francisco and Oakland.

**Inversions**

A primary factor in air quality is the mixing depth (i.e., the vertical dimension available for dilution of contaminant sources near the ground). Over the Bay Area, the frequent occurrence of temperature inversions limits mixing depth and consequently limits the availability of air for dilution. A temperature inversion may be described as a layer of warmer air over cooler air as is depicted in **Figure 3.4-1**.

On most days, higher altitudes mean lower air temperatures. This is because most of the sun’s energy is converted to sensible heat at the ground, which in turn warms the air at the surface. The warm air rises in the atmosphere, where it expands and cools. Sometimes, however, the temperature of air actually increases with height. This condition is known as *temperature inversion*, because the temperature profile of the



**Figure 3.4-1 – Temperature inversions**  
(Source: AIRNow 2006)

atmosphere is “inverted” from its usual state. There are two major types of temperature inversion: “surface inversions,” that occur near the Earth’s surface, and “aloft inversions,” that occur higher above the ground than surface inversions. Surface inversions are the most important in the study of air quality.

For the most part, surface inversion patterns correlate with seasonality. The strong inversions typical of summer are formed by subsidence, the heating of downward-moving air in the high-pressure anticyclone over the western Pacific. The surface inversions typical of winter are formed by radiation as air is cooled in contact with the earth’s cold surface at night. While these seasonal correlations are most prevalent, both inversion mechanisms may operate at any time of the year. At times, surface inversions formed by radiational cooling may reinforce the subsidence inversion aloft, particularly in fall and winter. The thick, strong inversion resulting in this case is especially effective in trapping pollutants.

The vertical temperature structure over the Bay Area is taken by the National Weather Service (NWS) twice daily, at 4 AM and 4 PM, at Oakland International Airport. NWS reports that the inversion types found vary widely in seasonal patterns and over a 24-hour period. Localized inversion variations resulting from the numerous terrain types within the Bay Area have also been observed.

In the morning the seasonal variations are most dramatic. From June through September there are only two days per year, on average, with no inversion below 5,000 feet. March and April have fewer morning inversions. The occurrence of surface inversions is highest from October through January, when the characteristic radiation inversion predominates. A wide cluster of cases between 500 to 2,500 feet dominates from May through September, when the summer subsidence inversion over the marine layer dominates. There is substantial day-to-day variability in the depth of the marine layer.

In the afternoon data, two differences from the morning data are most striking and significant. First is the frequent disappearance of the surface radiation inversion that dominates the winter nights. In these months, a surface inversion observed in the morning persists through the afternoon less than 20percent of the time. However, a corresponding afternoon increase may be noted in the cases from 500 to 2,500 feet. Thus the inversion is frequently raised and perhaps weakened, but not destroyed. Second is the afternoon lowering of the marine inversion that dominates the summer months. In July and August, the afternoon inversions are frequently in the 500 to 1,000 foot interval, compared with the 1,000 to 1,500 foot interval in the morning.

### ***Precipitation***

Moderately wet winters and dry summers characterize the San Francisco Bay Area climate. Winter rains (December through March) account for about 75 percent of the average annual

rainfall; about 90 percent of the annual total rainfall is received in the November-April period; and between 15 June and 22 September, normal rainfall is typically less than 1/10 inch.

Annual precipitation amounts show great differences in short distances. Annual totals exceed 40 inches in the mountains and are less than 15 inches in the sheltered or 'shadowed' valleys. The frequency of winter rain is more uniform, however, with 10 days per month (December through March) being typical.

During rainy periods, ventilation and vertical mixing are usually high, and consequently pollution levels are low. However, there are frequent winter dry periods lasting over a week. It is during some of these periods that CO and particulate pollution episodes develop.

#### *CLIMATE IN THE COTATI AND PETALUMA VALLEYS*

The valley that stretches from Santa Rosa to the San Pablo Bay is known as the Cotati Valley at the north end, and the Petaluma Valley at the south end. Some maps show the whole area as the Petaluma Valley. The Wilfred and Stony Point sites are located in the Cotati Valley and the Lakeville site is in the Petaluma Valley. To the east, the valley is bordered by the Sonoma Mountains, with the San Pablo Bay at the southeast end of the valley. To the immediate west are a series of low hills and further west are the Estero Lowlands, which open to the Pacific Ocean. The region from the Estero Lowlands to the San Pablo Bay is known as the Petaluma Gap. This low-terrain area is a major transport corridor allowing marine air to pass into the Bay Area.

Wind patterns in the Petaluma and Cotati Valleys are strongly influenced by the Petaluma Gap. The predominant wind pattern in this region is for marine air to move eastward through the Petaluma Gap, then to split into northward and southward paths as it moves into the Cotati and Petaluma valleys. The southward path crosses the San Pablo Bay and moves eastward through the Carquinez Straits. Consequently, although Santa Rosa and Petaluma are only 16 miles apart, their predominant wind patterns are quite different. Santa Rosa's prevailing winds are out of the south and southeast, while Petaluma's prevailing winds are out of the northwest. When the ocean breeze is weak, a bay breeze pattern can also occur, resulting in east winds near the bay. Strong winds from the east occur as part of a larger scale pattern and often carry pollutants picked up along the trajectory through the Central Valley and the Carquinez Straits. During these periods, upvalley flows can carry the polluted air as far north as Santa Rosa.

Winds are usually stronger in the Petaluma Valley than the Cotati Valley because it is part of the Petaluma Gap and readily escapes through the Carquinez Strait. The low-terrain in the Petaluma Gap does not offer much resistance to the marine air as it flows to the San Pablo Bay. Consequently, even though Petaluma is 28 miles from the ocean, its climate is similar to areas closer to the coast. Average annual wind speeds at the Petaluma Airport are 7 miles per hour (mph). This is almost identical to the average annual wind speed measured in Valley Ford, 5

miles from the coast. Winds are light in the morning in the Petaluma Valley, and become windy in the afternoon as the sea breeze arrives. The Cotati Valley, being slightly north of the Petaluma Gap experiences lower wind speeds. In Santa Rosa, the annual average wind speed is 5.4 mph.

During summer afternoons, the land over which the wind has blown before reaching the Petaluma Gap is sufficiently long so that the marine air is warmed and the fog evaporated before it reaches the Petaluma and Cotati valleys. As the surface heating weakens in the late afternoon, the marine layer becomes less heated with distance, and eventually fog is able to form in these valleys. The fog may then persist until late in the morning the next day.

Air temperatures are very similar in the two valleys. Average maximum temperatures in Santa Rosa are 1 degree higher than in Petaluma. Summer maximum temperatures for this region are in the low 80's, while winter maximum temperatures are in the high 50's to low 60's. The reverse is true for average minimum temperatures, with Petaluma being 1 degree warmer than Santa Rosa. Summer minimum temperatures are 50-51 degrees, and wintertime minimum temperatures are 36-40 degrees.

Rainfall averages are 24 inches per year in Petaluma, and 30 inches in Santa Rosa. Santa Rosa's rainfall is higher because the air is lifted and cooled in advance of the Sonoma Mountains, thereby causing condensation of the moisture. Consistent with the Bay Area Mediterranean climate, Santa Rosa receives 81 percent of its annual rainfall from November through March; and at Petaluma, 83 percent during that same period.

Generally, air pollution potential is low in the Petaluma Valley because of its link to the Petaluma Gap, and because of its low population density. However, there are two scenarios that could produce elevated pollutant levels. Stagnant conditions could occur in the morning hours with a weak ocean flow meeting a weak bay breeze flow. Another scenario can occur during the afternoon when a synoptically induced east wind pattern advects pollution from the Central Valley to Petaluma.

The Cotati Valley lacks a gap to the sea, accommodates a larger population, and has a natural barrier at its northern and eastern ends; therefore it has a higher pollution potential than does the Petaluma Valley. During stagnant conditions, polluted air carried up the Cotati Valley by diurnal upvalley flow, and added to by local emissions, could be trapped against the mountains to the north and east.

### **3.4.2 POLLUTANTS OF CONCERN**

Pollutants are generally classified as either criteria pollutants or non-criteria pollutants. Federal ambient air quality standards have been established for criteria pollutants whereas no ambient standards have been established for non-criteria pollutants. For some criteria pollutants, separate standards have been set for different periods. Most standards have been set to protect public

health. For some pollutants, standards have been based on other values (such as protection of crops, protection of materials, or avoidance of nuisance conditions). A summary of federal ambient air quality standards, or National Ambient Air Quality Standards (NAAQS), for criteria pollutants and the attainment status of the San Francisco Bay Area Air Basin are shown in **Table 3.4-1**. United States Environmental Protection Agency (USEPA) uses two categories to designate areas with respect to ozone (O<sub>3</sub>), carbon monoxide (CO), and nitrogen dioxide (NO<sub>2</sub>). These designation categories are nonattainment (N), when the area does not meet primary standards and unclassifiable/attainment (U/A), when the areas either cannot be classified or is better than national standards. USEPA uses four categories to designate areas with respect to sulfur dioxide. These designation categories are nonattainment-primary (N-P), when an area does not meet the primary standards; nonattainment-secondary (N-S), when an area does not meet the secondary standards; unclassifiable (U), when an area cannot be classified; and attainment (A), when the area is better than the national standards. Finally, USEPA uses two categories to designate areas with respect to suspended particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>). These designation categories are nonattainment (N), when the area does not meet standards and unclassifiable (U), when an area cannot be classified.

**TABLE 3.4-1**  
NATIONAL AMBIENT AIR QUALITY STANDARDS FOR CRITERIA POLLUTANTS AND ATTAINMENT STATUS FOR THE BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Pollutant	Averaging Time	National Standards	
		Concentration	Attainment Status
Ozone	8 Hour	0.08 ppm	N - Marginal
Carbon Monoxide	8 Hour	9 ppm	U/A - Maintenance
	1 Hour	35 ppm	U/A
Nitrogen Dioxide	Annual Average	0.053 ppm	U/A
Sulfur Dioxide	AAM	0.03 ppm	A
	24 Hour	0.14 ppm	A
Respirable Particulate Matter (PM <sub>10</sub> )	AAM	50 µg/m <sup>3</sup>	U
	24 Hour	150 µg/m <sup>3</sup>	U
Fine Particulate Matter (PM <sub>2.5</sub> )	AAM	15 µg/m <sup>3</sup>	U/A
	24 Hour	35 µg/m <sup>3</sup>	U/A
Lead	Calendar Quarter	1.5 µg/m <sup>3</sup>	A

NOTES: ppm = parts per million µg/m<sup>3</sup> = micrograms per cubic meter A = Attainment N = Nonattainment U = Unclassified U/A = Unclassifiable/Attainment AAM = Annual Arithmetic Mean EPA lowered the 24-hour PM<sub>2.5</sub> standard in December 2006.

SOURCE: BAAQMD, 2004

For reasons described below, the criteria pollutants of greatest concern for the proposed project are CO, O<sub>3</sub>, inhalable particulate matter less than 10 microns in diameter, and fine particulate matter.

***CARBON MONOXIDE (CO)***

Carbon monoxide (CO) is a colorless, odorless gas that is formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust, which contributes about 56 percent of all CO emissions nationwide. Other non-road engines and vehicles (such as construction equipment and boats) contribute about 22 percent of all CO emissions nationwide. Higher levels of CO generally occur in areas with heavy traffic congestion. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Other sources of CO emissions include industrial processes (such as metals processing and chemical manufacturing), residential wood burning, and natural sources such as forest fires. Woodstoves, gas stoves, cigarette smoke, and unvented gas and kerosene space heaters are sources of CO indoors. The highest levels of CO in the outside air typically occur during the colder months of the year when inversion conditions are more frequent. The air pollution becomes trapped near the ground beneath a layer of warm air.

CO is a public health concern because it combines readily with hemoglobin and thus reduces the amount of oxygen transported in the bloodstream. The health threat from lower levels of CO is most serious for those who suffer from heart disease, like angina, clogged arteries, or congestive heart failure. For a person with heart disease, a single exposure to CO at low levels may cause chest pain and reduce that person's ability to exercise; repeated exposures may contribute to other cardiovascular effects. High levels of CO can affect even healthy people. People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks. At extremely high levels, CO is poisonous and can cause death.

Motor vehicles are the dominant source of CO emissions in most areas. CO is described as having only a local influence because it dissipates quickly. High CO levels develop primarily during winter when periods of light winds combine with the formation of ground level temperature inversions (typically from the evening through early morning). These conditions result in reduced dispersion of vehicle emissions. Because CO is a product of incomplete combustion, motor vehicles exhibit increased CO emission rates at low air temperatures. High CO concentrations occur in areas of limited geographic size, sometimes referred to as hot spots. Since CO concentrations are strongly associated with motor vehicle emissions, high CO concentrations generally occur in the immediate vicinity of roadways with high traffic volumes and traffic congestion, active parking lots, and in automobile tunnels. Areas adjacent to heavily traveled and congested intersections are particularly susceptible to high CO concentrations.

Federal CO standards have been set for both 1-hour and 8-hour averaging times. The federal 1-hour standard is 35 ppm and 9 ppm for the 8-hour averaging period. CO is a public health concern because it combines readily with hemoglobin and, thus, reduces the amount of oxygen

transported in the bloodstream. As shown in **Table 3.4-1**, the SFBAAB is designated<sup>2</sup> attainment for CO, however portions of the air basin (delineated as “urbanized areas”) were in non-attainment until 1998. In 1998 the SFBAAB was given a designation of maintenance. The SFBAAB will always have this designation and will have to prepare a maintenance plan every 10 years. Since an area-designated maintenance does not have to prepare a State Implementation Plan, the maintenance plan takes its place as the equivalent document. The Wilfred and Stony Point sites are within the urbanized area maintenance area. The Lakeville site is outside of the urbanized area maintenance area.

### ***OZONE (O<sub>3</sub>)***

Ozone is not emitted directly into the air, but is formed by a photochemical reaction in the atmosphere. Ozone precursors, which include reactive organic gases (ROGs) and oxides of nitrogen (NO<sub>x</sub>), react in the atmosphere in the presence of sunlight to form ozone. Because photochemical reaction rates depend on the intensity of ultraviolet light and air temperature, ozone is primarily a summer air pollution problem and often the effects of the emitted ROG and NO<sub>x</sub> is felt a distance downwind of the emission sources. Ozone is subsequently considered a regional pollutant. Ground-level ozone is a respiratory irritant and an oxidant that increases susceptibility to respiratory infections and can cause substantial damage to vegetation and other materials.

Ozone can irritate lung airways and cause inflammation much like a sunburn. Other symptoms include wheezing, coughing, pain when taking a deep breath, and breathing difficulties during exercise or outdoor activities. People with respiratory problems are most vulnerable, but even healthy people that are active outdoors can be affected when ozone levels are high. Chronic ozone exposure can induce morphological (tissue) changes throughout the respiratory tract, particularly at the junction of the conducting airways and the gas exchange zone in the deep lung. Anyone who spends time outdoors in the summer is at risk, particularly children and other people who are active outdoors. Even at very low levels, ground-level ozone triggers a variety of health problems including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

Ozone also damages vegetation and ecosystems. It leads to reduced agricultural crop and commercial forest yields, reduced growth and survivability of tree seedlings, and increased susceptibility to diseases, pests, and other stresses such as harsh weather. In the United States alone, ozone is responsible for an estimated \$500 million in reduced crop production each year. Ozone also damages the foliage of trees and other plants, affecting the landscape of cities,

---

<sup>2</sup> In April 1998, the Bay Area was redesignated to attainment for the national 8-hour carbon monoxide standard.

national parks and forests, and recreation areas. In addition, ozone causes damage to buildings, rubber, and some plastics.

Ozone is a regional pollutant, as the reactions forming it take place over time, and downwind from the sources of the emissions. As a photochemical pollutant, ozone is formed only during daylight hours under appropriate conditions, but is destroyed throughout the day and night. Thus, ozone concentrations vary depending upon both the time of day and the location. Even in pristine areas there is some ambient ozone that forms from natural emissions that are not controllable. This is termed “background” ozone. The average “background” ozone concentrations near sea-level are in the range of 0.015 to 0.035 ppm, with a maximum of about 0.04 ppm (CARB, 2005).

A federal standard for ozone had been set for a 1-hour averaging time of 0.12 ppm, not to be exceeded more than three times in any 3-year period but was officially revoked in June 2005. Presently, the federal ozone standard has been set at a concentration of 0.08 ppm measured over 8 hours. However, on March 12, 2008 the USEPA announced that the 8 hour standard will be reduced to 0.075 ppm, effective May 27, 2008. The USEPA will not redesignate the SFBAAB due to the new ozone standard until March 2010. When and if redesignation occurs the BAAQMD will issue a new SIP, which would not occur until at least 2012. As shown in **Table 3.4-1**, the San Francisco Bay Area Air Basin is classified as a nonattainment area for the federal 8-hour ozone standard. Whereas the Air Basin had been designated nonattainment for the federal 1-hour standard, that classification is no longer pertinent. The federal 8-hour nonattainment designation has been classified as “marginal”, which requires a maximum attainment date of June 2007.

#### ***NITROGEN DIOXIDE (NO<sub>2</sub>)***

Nitrogen dioxide (NO<sub>2</sub>) is a brownish, highly reactive gas that is present in all urban environments. The major artificial sources of NO<sub>2</sub> are combustion devices, such as boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines. Combustion devices emit primarily nitric oxide (NO), which reacts through oxidation in the atmosphere to form NO<sub>2</sub>. The combined emissions of NO and NO<sub>2</sub> are referred to as NO<sub>x</sub>, which are reported as equivalent NO<sub>2</sub>. Because NO<sub>2</sub> is formed and depleted by reactions associated with photochemical smog (ozone), the NO<sub>2</sub> concentration in a particular geographical area may not be representative of the local NO<sub>x</sub> emission sources.

Inhalation is the most common route of exposure to NO<sub>2</sub>. Because NO<sub>2</sub> has relatively low solubility in water, the principal site of toxicity is in the lower respiratory tract. The severity of the adverse health effects depends primarily on the concentration inhaled rather than the duration of exposure. An individual may experience a variety of acute symptoms during or shortly after exposure, including coughing, difficulty with breathing, vomiting, headache, and eye irritation. After a period of approximately 4–12 hours, an exposed individual may experience chemical

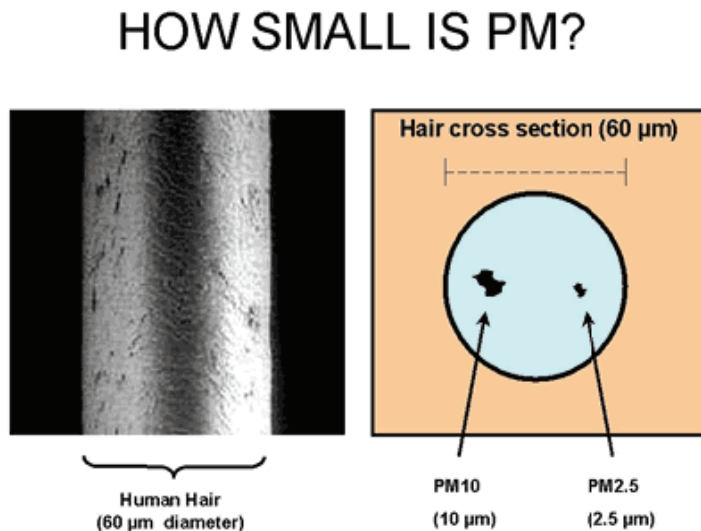
pneumonitis or pulmonary edema with breathing abnormalities, cough, cyanosis, chest pain, and rapid heartbeat. Severe, symptomatic NO<sub>2</sub> intoxication after acute exposure has been linked on occasion with prolonged respiratory impairment with such symptoms as chronic bronchitis and decreased lung functions.

The federal standard for an annual average is 0.053 ppm. As shown in **Table 3.4-1**, the San Francisco Bay Area Air Basin is classified as unclassifiable/attainment for the federal standard. However, since NO<sub>2</sub> is a component in the formation of ozone, it is considered a pollutant of concern for the proposed project.

**PARTICULATE MATTER (PM<sub>10</sub> AND PM<sub>2.5</sub>)**

Particle pollution is a mixture of microscopic solids and liquid droplets suspended in air. This pollution, also known as particulate matter, is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, soil or dust particles, and allergens (such as fragments of pollen or mold spores). The size of particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers (µm) in diameter pose the greatest problems, because they can get deep into lungs and the bloodstream. Exposure to such particles can affect both lungs and heart. Larger particles are of less concern, although they can irritate eyes, nose, and throat. **Figure 3.4-2** shows the relative sizes of particulate matter.

Particle exposure can lead to a variety of health effects. For example, numerous studies link particle levels to increased hospital admissions and emergency room visits—and even to death from heart or lung diseases. Both long- and short-term particle exposures have been linked to health problems. Long-term exposures, such as those experienced by people living for many years in areas with high particle levels, have been associated with problems such as reduced lung function and the development of chronic bronchitis and even premature death. Short-term exposures to particles (hours or days)



**Figure 3.4-2 – Relative sizes of particulate matter pollution**  
Source: CARB, 2005

can aggravate lung disease, causing asthma attacks and acute bronchitis, and may also increase susceptibility to respiratory infections. In people with heart disease, short-term exposures have been linked to heart attacks and arrhythmias. Healthy children and adults have not been reported to suffer serious effects from short-term exposures, although they may experience temporary minor irritation when particle levels are elevated.

The current federal PM<sub>10</sub> standards are 150 µg/m<sup>3</sup> as a 24-hour average, and 50 µg/m<sup>3</sup> as an annual arithmetic mean. In July 1997, while it was determined that the PM NAAQS should continue to focus on particles less than or equal to 10 µm in diameter, it was also determined that the fine and coarse fractions of PM<sub>10</sub> should be considered separately. USEPA promulgated a new standard for PM<sub>2.5</sub>, or fine particulate matter. The new NAAQS was 65 µg/m<sup>3</sup>, for a 24-hour sample, and 15 µg/m<sup>3</sup>, for an annual arithmetic mean.

In 2005, BAAQMD released a Staff Report (BAAQMD 2005) that analyzes the sources of PM in the Bay Area. Based on 2000-2003 ambient air monitoring data, BAAQMD and the California Air Resources Board (CARB) estimated that the PM<sub>2.5</sub> fraction of total PM accounted for approximately 60 percent of PM<sub>10</sub> during the winter and approximately 45 percent during the rest of the year. On days when the PM standards are exceeded, PM<sub>2.5</sub> can account for as much as 99.2 percent of PM<sub>10</sub>. On an annual basis, CARB estimated that PM<sub>2.5</sub> comprised approximately 50 percent of the PM<sub>10</sub> levels.

Based on the inventory data, BAAQMD has determined that combustion activities such as residential wood burning, construction/demolition activities, road dust, and emissions from on and off-road engines were identified as significant sources of PM<sub>10</sub> emissions in the Bay Area. However, while the inventory was helpful in determining potential PM<sub>10</sub> sources in the region, it did not provide the full picture of the makeup of the region's PM. The nature of particulates is that larger, coarser particles tend to settle out of the air closer to their emission source while smaller particles, such as the size of PM<sub>2.5</sub>, tend to remain suspended in the air longer and travel further.

BAAQMD's analysis showed that, for annual average PM<sub>2.5</sub>, the largest source categories are on and off-road motor vehicle exhaust and carbon from cooking and wood-burning activities. These categories include both directly emitted PM and secondary PM, such as ammonium nitrate formed by atmospheric reactions of ammonia with nitrogen oxides from motor vehicles and other combustion sources. Geological dust was found to only be a minor component of ambient PM.

Subsequently, it was determined that during the winter, residential wood smoke and cooking were major contributors to ambient PM. Combustion PM<sub>2.5</sub>, which includes vehicle exhaust, was the second major component of PM<sub>2.5</sub> and a significant component of PM<sub>10</sub>. Ammonium nitrate was also a principal component of ambient PM. Road dust and other dust producing activities also contributed to ambient PM<sub>10</sub>, but not significantly to PM<sub>2.5</sub>, and had a more local impact.

As shown in **Table 3.4-1**, the San Francisco Bay Area Air Basin is designated unclassified for the federal PM<sub>10</sub> and unclassifiable/attainment for the PM<sub>2.5</sub> standards.

#### ***OTHER CRITERIA POLLUTANTS***

The standards for sulfur dioxide (SO<sub>2</sub>) and lead are either being met or are unclassified in the San Francisco Bay Area Air Basin portion of Sonoma County, and the latest pollutant trends suggest that these standards will not be exceeded in the foreseeable future.

#### ***TOXIC AIR CONTAMINANTS***

In addition to the above-listed criteria pollutants, Toxic Air Contaminants (TACs) are another group of pollutants of concern. Sources of TACs include industrial processes such as petroleum refining and chrome plating operations, commercial operations such as gasoline stations and dry cleaners, and motor vehicle exhaust. Cars and trucks release at least forty different toxic air contaminants. The most important, in terms of health risk, are diesel particulates, benzene, formaldehyde, 1,3-butadiene, and acetaldehyde. Public exposure to TACs can result from emissions from normal operations, as well as accidental releases. Health effects of TACs include cancer, birth defects, neurological damage, and death.

Toxic air contaminants are less pervasive in the urban atmosphere than the criteria air pollutants, but are linked to short-term (acute) or long-term (chronic or carcinogenic) adverse human health effects. There are hundreds of different types of toxic air contaminants, with varying degrees of toxicity. Sources of toxic air contaminants include industrial processes, commercial operations (e.g., gasoline stations and dry cleaners), and motor vehicle exhaust.

According to the 2005 California Almanac of Emissions and Air Quality, the majority of the estimated health risk from TACs can be attributed to relatively few compounds, the most important being diesel particulate matter (DPM). The identification of DPM as a toxic air contaminant in 1998 led CARB to adopt the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-fueled Engines and Vehicles (Plan)* in September 2000. The Plan's goals are a 75 percent reduction in DPM by 2010 and an 85 percent reduction by 2020 from the 2000 baseline. Diesel engines emit a complex mixture of air pollutants, composed of gaseous and solid material. The visible emissions in diesel exhaust are particulate matter that includes carbon particles or "soot." Diesel exhaust also contains a variety of harmful gases and over 40 other cancer causing substances. California's identification of DPM as a toxic air contaminant was based on its potential to cause cancer, premature deaths, and other health problems. Exposure to DPM is a health hazard, particularly to children whose lungs are still developing and the elderly who may have other serious health problems. Overall, diesel engine emissions are responsible for the majority of California's potential airborne cancer risk from combustion sources (CARB, 2000).

In January 2006, CARB officially identified environmental tobacco smoke (ETS) as a TAC. ETS is a complex mixture of thousands of gases and fine particulate matter emitted by the burning of tobacco products and from smoke exhaled by the smoker. The composition will vary depending on heat of combustion, tobacco content and additives present, and type of filter material used. Researchers distinguish cigarette smoke as being comprised of two main components: mainstream and sidestream smoke. ETS is a combination of exhaled mainstream smoke, sidestream smoke, and compounds that diffuse through the cigarette paper. According to the Surgeon General's 2006 Report on Exposure to Tobacco Smoke, there is no "risk-free" level of exposure to ETS (HHS, 2006).

### ***ASBESTOS***

Asbestos is the name given to a number of naturally occurring fibrous silicate minerals that have been mined for their useful properties such as thermal insulation, chemical and thermal stability, and high tensile strength. The three most common types of asbestos are: a) chrysotile, b) amosite, and c) crocidolite. Chrysotile, also known as white asbestos is the most common type of asbestos found in buildings. Chrysotile makes up approximately 90 percent-95 percent of all asbestos contained in buildings in the United States.

In addition asbestos is also found in its natural state, referred to as naturally occurring asbestos (NOA). Exposure and disturbance of rock and soil that naturally contains asbestos can result in the release of fibers to the air and consequent exposure to the public. Asbestos most commonly occurs in ultramafic rock that has undergone partial or complete alteration to serpentine rock (serpentinite) and often contains chrysotile asbestos. In addition, another form of asbestos, tremolite, can be found associated with ultramafic rock, particularly near faults. Sources of asbestos emissions include: unpaved roads or driveways surfaced with ultramafic rock, construction activities in ultramafic rock deposits, or rock quarrying activities where ultramafic rock is present.

To address some of the health concerns associated with exposure to asbestos from these activities, CARB has adopted two Airborne Toxic Control Measures (ATCMs). CARB has an ATCM for construction, grading, quarrying, and surface mining operations requiring the implementation of mitigation measures to minimize emissions of asbestos-laden dust. This ATCM applies to road construction and maintenance, construction and grading operations, and quarries and surface mines when the activity occurs in an area where NOA is likely to be found. Areas are subject to the regulation if they are identified on maps published by the Department of Conservation as ultramafic rock units or if the APCO or owner/operator has knowledge of the presence of ultramafic rock, serpentine, or NOA on the site. The ATCM also applies if ultramafic rock, serpentine, or asbestos is discovered during any operation or activity.

In addition, CARB has an ATCM for surfacing applications. This ATCM applies to any person who produces, sells, supplies, offers for sale or supply, uses, applies, or transports any 1) aggregate material extracted from property where any portion of the property is located in a geographic ultramafic rock unit or 2) aggregate material extracted from property that is not located in a geographic ultramafic rock unit if the material has been evaluated at the request of the Air Pollution Control Officer (APCO) and determined to be ultramafic rock or serpentine; tested at the request of the APCO and determined to have an asbestos content of 0.25 percent or greater; or determined by the owner / operator of a facility to be ultramafic rock, or serpentine, or material that has an asbestos content of 0.25 percent or greater. The ATCM prohibits person from using, applying, selling, supplying, or offering for sale or supply any restricted material for surfacing unless it has been tested and determined to have an asbestos content that is less than 0.25 percent.

### 3.4.3 EXISTING AIR QUALITY

#### *EMISSION SOURCES*

California is a diverse state with many sources of air pollution. To estimate the sources and quantities of pollution, CARB, in cooperation with local air districts and industry, maintains an inventory<sup>3</sup> of California emission sources. Sources are subdivided into four major emission categories: stationary sources, area-wide sources, mobile sources, and natural sources. Stationary source emissions are based on estimates made by facility operators and local air districts. Emissions from specific facilities can be identified by name and location. CARB and local air district staff estimate area-wide emissions. Emissions from area-wide sources may be either from small individual sources, such as residential fireplaces, or from widely distributed sources that cannot be tied to a single location, such as consumer products and dust from unpaved roads. CARB staff estimates mobile source emissions with assistance from districts and other government agencies. Mobile sources include on-road cars, trucks, and buses and other sources such as boats, off-road recreational vehicles, aircraft, and trains. CARB staff and the air districts also estimate natural sources. These sources include geogenic (petroleum seeps<sup>4</sup>) and biogenic (vegetation) sources and wildfires.

**Table 3.4-2** summarizes estimated 2005 emissions of key criteria air pollutants from major categories of air pollutant sources. For each pollutant, estimated emissions are presented for the

<sup>3</sup> Inventory data can be retrieved from the CARB's Emission Inventory website <http://www.arb.ca.gov/ei/ei.htm>

<sup>4</sup> Petroleum gas and oil seeps occur naturally in California and have been active for millennia. Oil and gas seeps form where oil or natural gas emerge from subsurface sources to the ground or water surface.

portion of Sonoma County that is in the San Francisco Bay Area Air Basin (SFBAAB). No further spatial refinement is available (CARB, 2005).

The SFBAAB portion of Sonoma County is similar to many other portions of California and the United States in general in that a large portion of the CO emissions comes from on-road mobile sources (72 percent), with the majority coming from passenger cars and trucks. NO<sub>x</sub> is also dominated by on-road mobile sources (73 percent) still coming mostly from passenger cars and trucks, but heavy-duty diesel trucks supply a stronger portion (27 percent) of that on-road total. In the SFBAAB portion of Sonoma County two thirds of the total ROG are divided evenly between on-road vehicles and natural sources, which, in this case, is primarily biogenic sources emanating from the plant life in the area. Particulate matter is primarily coming from a category called “miscellaneous processes”, which includes a variety of subcategories. In the case of the SFBAAB portion of Sonoma County’s emissions, these subcategories are primarily paved road dust, construction and demolition, and residential fuel combustion.

**TABLE 3.4-2**  
SFBAAB PORTION OF SONOMA COUNTY  
2005 EMISSIONS INVENTORY  
(TONS PER DAY)

<b>Emission Category</b>	<b>ROG</b>	<b>CO</b>	<b>NO<sub>x</sub></b>	<b>PM<sub>10</sub></b>	<b>PM<sub>2.5</sub></b>
Fuel Combustion	0	1.0	0.8	0.1	0.1
Waste Disposal	0.3	0	0	0	0
Cleaning & Surface Coatings	1.8	0	0	0	0
Petroleum Production & Marketing	0.9	0	0	0	0
Industrial Processes	0.6	0	0	0.6	0.3
Solvent Evaporation	4.5	0	0	0	0
Miscellaneous Processes	2.1	17.5	1.2	9.9	3.8
On-Road Motor Vehicles	10.1	97.1	17.0	0.5	0.4
Other Mobile Sources	2.6	18.6	4.3	0.4	0.3
Natural Sources	10.1	0.5	0	0.1	0
<b>Total</b>	<b>33.0</b>	<b>134.7</b>	<b>23.3</b>	<b>11.5</b>	<b>4.9</b>

NOTES: All values in tons per day. 2005 is estimated from a base year inventory for 2004 based on growth and control factors available from CARB. The sum of values may not equal total shown due to rounding.

SOURCE: CARB 2005.

**INDUSTRIAL EMISSIONS SOURCES NEAR THE WILFRED SITE**

An analysis of the area surrounding the Wilfred site using CARB’s Facility Search Engine, which allows the user to find emissions data for more than 10,000 facilities in California, shows that there are 8 facilities within a 10-mile radius of the Wilfred site that emit more than 10 tons per

year of any of the pollutants of concern (ROG, CO, NO<sub>x</sub>, PM<sub>10</sub>, or PM<sub>2.5</sub>). These facilities, their estimated emissions, and their relative distances from the Wilfred site are presented in **Table 3.4-3**.

**INDUSTRIAL EMISSIONS SOURCES NEAR THE STONY POINT SITE**

The Wilfred site and the Stony Point site are differentiated from each other by boundary configurations and total acreages. They do, however, share the same general location, and as such, their boundaries have considerable overlap as discussed in **Section 2.0**. Therefore, they are substantially similar in localized air quality issues, and identical in regional considerations. Thus, **Table 3.4-3** would also give an accurate representation of industrial emission sources near the Stony Point site.

**TABLE 3.4-3**  
EMISSION SOURCES GREATER THAN 10 TONS PER YEAR  
WITHIN 10-MILE RADIUS OF WILFRED SITE

Facility Name / Address	Emissions in tons per year					Distance from Wilfred Site
	ROG	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	
Interior Finishing 137 Utility Court, Rohnert Park	13.1	0	0	0	0	1 mi E
Deas Custom Wood Finishing 2985 Dutton, Santa Rosa	12.9	0	0	0	0	3 mi N
Stony Point Rock Quarry, Inc 7171 Stony Point Road, Cotati	2.8	8.6	39.6	8.1	4.3	3 mi SSW
City Of Santa Rosa Wastewater 4300 Llano Road, Santa Rosa	11.1	43.2	12.5	0.4	0.4	3 mi WNW
Sonoma County Dept of PW 500 Mecham Road, Petaluma	85.7	180.6	85.9	17.3	17.2	4 mi SSW
Superior Supplies Inc 40 Ridgeway Avenue, Santa Rosa	0	0	0	30.9	20.8	6 mi N
Willowbrook Feeds 40 Ely Road N, Petaluma	0	0.2	0.8	25.5	7.7	6 mi SSE
Harding Lawson Associates 500 Hopper Street, Petaluma	15.2	0	0	0	0	10 mi SSE

Source: CARB, 2005. (<http://www.arb.ca.gov/app/emsinv/facinfo/facinfo.php>)

**INDUSTRIAL EMISSIONS SOURCES NEAR THE LAKEVILLE SITE**

An analysis of the area directly surrounding the Lakeville site using CARB’s Facility Search Engine shows that there are 4 facilities within 10 miles of the Lakeville site that emit more than 10 tons per year of any of the pollutants of concern (ROG, CO, NO<sub>x</sub>, PM<sub>10</sub>, or PM<sub>2.5</sub>). These facilities, their estimated emissions, and their relative distances from the Lakeville site are presented in **Table 3.4-4**.

**MONITORING DATA**

Meteorology acts on the emissions released into the atmosphere to produce pollutant concentrations. These airborne pollutant concentrations are measured throughout California at air quality monitoring sites. CARB operates a statewide network of monitors. Data from this network are supplemented with data collected by local air districts, other public agencies, and private contractors. There are more than 250 criteria pollutant monitoring sites in California. Each year, more than ten million air quality measurements from all of these sites are collected and stored in a comprehensive air quality database maintained by CARB<sup>5</sup>.

**TABLE 3.4-4**  
EMISSION SOURCES GREATER THAN 10 TONS PER YEAR  
WITHIN 10-MILE RADIUS OF LAKEVILLE SITE

Facility Name / Address	Emissions in tons per year					Distance from Lakeville Site
	ROG	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	
Harding Lawson Associates 500 Hopper Street, Petaluma	15.2	0	0	0	0	10 mi NW
Carpenter Parmatech 2221 Pineview Way, Petaluma	15.6	0	0	0	0	8 mi NW
Sonoma Rock Co 26650 Arnold Drive, Sonoma	0.4	1.2	5.5	10.6	3.4	7 mi N
Redwood Landfill 8950 Redwood Hwy, Novato	73.1	0.9	1.6	13.5	12.9	4 mi WSW

Source: CARB, 2005. (<http://www.arb.ca.gov/app/emsinv/facinfo/facinfo.php>)

Air quality data for the period from 2002 through 2004 from the monitoring station nearest the project site are summarized in **Table 3.4-5**. The station closest to the Wilfred and Stony Point sites is the Santa Rosa station on 5<sup>th</sup> Street, which is located approximately 6 miles north of the Wilfred and Stony Point sites. The station closest to the Lakeview site is the San Rafael station on 4<sup>th</sup> Street, approximately 12 miles south of the Lakeview site.

Monitored CO levels at both stations have been well below the 9 ppm eight-hour average. As shown on **Table 3.4-5**, the highest monitored concentration during the three-year period at either station was 2.10 ppm. The 1-hour or 8-hour ozone standard, the 24-hour PM<sub>10</sub> standard, the 24-hour PM<sub>2.5</sub> standard, or any of the particulate matter annual standards were not exceeded at either station during the three-year period.

**ODORS**

Existing odor sources in the area of the Wilfred and Stony Point sites are primarily limited to those associated with various agricultural activities, including fertilization and scattered cattle

<sup>5</sup> Air monitoring data can be retrieved from the CARB's Air Quality Data website <http://www.arb.ca.gov/aqd/aqdpage.htm>

grazing activities. The BAAQMD has stated that there has been no major source of odor complaints in the vicinity within the last three years (personal communication with David Farr, Inspector with the BAAQMD, 1/31/06). During site visits, AES observed no detectable odors from the Wilfred and Stony Point site areas.

**TABLE 3.4-5**  
AIR MONITORING DATA FOR LATEST MONITORING YEARS IN PROJECT AREAS

Pollutant (Location)	NAAQS	2002	2003	2004
<b>Ozone (Santa Rosa)</b>				
Highest 1-Hour Average (ppm)		0.077	0.096	0.076
Highest 8-Hour Average (ppm)	0.08	0.060	0.079	0.060
Days > 1-Hour Standard		0	0	0
Days > 8-Hour Standard		0	0	0
<b>Ozone (San Rafael)</b>				
Highest 1-Hour Average (ppm)		0.077	0.087	0.091
Highest 8-Hour Average (ppm)	0.08	0.056	0.067	0.063
Days > 1-Hour Standard		0	0	0
Days > 8-Hour Standard		0	0	0
<b>Carbon Monoxide (Santa Rosa)</b>				
Highest 8-Hour Average (ppm)	9	2.10	1.77	1.57
Days > Standard		0	0	0
<b>Carbon Monoxide (San Rafael)</b>				
Highest 8-Hour Average (ppm)	9	1.88	2.03	1.96
Days > Standard		0	0	0
<b>PM<sub>10</sub> (Santa Rosa)</b>				
Highest 24-Hour Average	150	60.2	34.2	47.4
Days > Standard		0	0	0
Annual Average	50	19.7	16.4	17.3
<b>PM<sub>10</sub> (San Rafael)</b>				
Highest 24-Hour Average	150	69.6	39.1	51.0
Days > Standard		0	0	0
Annual Average	50	21.4	17.0	17.4
<b>PM<sub>2.5</sub> (Santa Rosa)</b>				
Highest 24-Hour Average	65	50.7	38.8	26.6
Days > Standard		0	0	0
Annual Average	15	10.5	8.8	8.3

NOTES: The number of days that at least one measurement was greater than the level of the state or national standard is not necessarily the number of violations of the standard for the year since the hourly and eight-hour standards can be violated more than once per day.

ppm = parts per million       $\mu\text{g}/\text{m}^3$  = micrograms per cubic meter

SOURCE: CARB, 2005a.

Existing odor sources in the area of the Lakeville site are rangeland and agricultural activities. During site visits, AES observed no detectable odors from the Lakeville site area.

#### ***TOXIC AIR CONTAMINANTS***

A major source of toxics is defined as a source that emits 10 tons per year of any listed toxic air pollutant or 25 tons per year of any mixture of air toxics. An area source is defined as a source that emits less than these levels of air toxics and which is a concern because there are a large number of these small emitters within a single area. A search of the USEPA Toxic Release Inventory shows no major sources of toxic emissions near the Wilfred, Stony Point, or Lakeville sites.

#### ***INDOOR AIR QUALITY***

Since 1992 there has been an Indoor Air Quality (IAQ) Program at CARB that is primarily designed “to conduct and promote the coordination of research, investigations, experiments, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, and control of indoor pollution in California.”

Practical applications and solutions for IAQ issues have been combined with other environmental concerns in an emerging concept of green or sustainable building designs. The State agency that has taken the lead in green buildings is the Integrated Waste Management Board (IWMB). In fact, the IWMB has developed a central informational web source at <http://www.ciwmb.ca.gov/GreenBuilding/> where they discuss green building basics, supply a sustainable building tool kit, provide training programs for state and local government, and supply a sustainable building implementation plan.

On a national level in 1999, the USEPA completed an extensive modeling study to assess the compatibilities and trade-offs between energy, indoor air quality, and thermal comfort objectives for HVAC systems, and help formulate strategies to simultaneously achieve superior performance of each objective. To gain a better understanding of IAQ, USEPA’s Office of Radiation and Indoor Air also conducted a major study of IAQ in public and commercial office buildings. Most recently, USEPA has expanded their existing Building Air Quality guidance with a practical tool designed to be comprehensive state-of-the-art guidance for managing IAQ in commercial buildings. This tool is called the IAQ Building Education and Assessment Tool (I-BEAM) and is designed to be used by building professionals and others interested in indoor air quality in commercial buildings.

In addition, the U.S.Green Building Council (USGBC) has developed the Leadership in Energy and Environmental Design (LEED) Green Building Rating System as a national consensus-based, market-driven building rating system designed to accelerate the development and implementation of green building practices. Based on well-founded scientific standards, LEED emphasizes state

of the art strategies for sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.

LEED standards are currently available for new commercial construction. The module for new commercial construction gives credits for categories entitled Sustainable Sites; Water Efficiency; Energy & Atmosphere; Materials & Resources; Innovation & Design Process; and Indoor Environmental Quality.

IAQ problems result from interactions between contaminant source, building site, building structure, activities within the building, mechanical equipment, climate, and occupants. Efforts to control indoor air contaminants change the relationships between these factors. There are many ways that people can intervene in these relationships to prevent or control indoor air contaminant problems. Control strategies can be categorized as source control, ventilation, air cleaning, or exposure control and successful mitigation often involves a combination of these strategies. A combination of I-BEAM and LEED factors and strategies were utilized to evaluate the IAQ concerns for this project and, where appropriate, to incorporate green building best practices for each alternative.

#### ***SENSITIVE RECEPTORS***

Current land uses of the Wilfred and Stony Point sites are unirrigated pasture, grazing, and rye grass cultivation. Surrounding land uses consist mainly of pasture and rural residential units. Adjacent properties include large retail businesses to the east and south.

Several school facilities are within a 2-mile radius of the Wilfred site. Hahn Elementary School is approximately 1.6 miles east; Reed Elementary School is approximately 1.8 miles south-southeast; and Evergreen Elementary School is approximately 1.8 miles east-southeast.

For Alternative C, where construction activity would occur on the northeast corner of the Stony Point site, only Hahn Elementary is within 2 miles. For Alternatives B, D, and E, where construction activity would occur on the northwest corner of the Stony Point site, there are no schools within 2 miles.

#### ***CLIMATE CHANGE***

##### ***Introduction***

The *Fourth Assessment Report*, issued by the International Panel on Climate Change (IPCC) in 2001, anticipates that the average global temperature between the years 2000 and 2100 could rise from 0.6 (33.0) to 4.0 °C (39.2 °F) (IPCC, 2007). The extent to which human activities affect global climate change is a subject of considerable scientific debate. While many in the scientific community contend that global climate variation is a normal cyclical process that is not

necessarily related to human activities, the IPCC report identifies anthropogenic greenhouse gases (GHGs) as a contributing factor to changes in the Earth's climate (Michaels, 2004; IPCC, 2007). Preferring to error on the side of caution, the analysis in this Environmental Impact Statement (EIS) assumes anthropogenic GHGs are in fact contributing to global climate changes.

The U.S. Supreme Court has held that CO<sub>2</sub> (a GHG) falls under the Clean Air Act's (CAA's) definition of an "air pollutant", such that the USEPA has statutory authority to regulate the emissions of this gas (CO<sub>2</sub>). *Massachusetts v. Environmental Protection Agency*, U.S., 1275 S.Ct. 1438, 1462 (2007), concluded that GHG emission from human activities would result in an additional warming of the Earth's surface. The U.S. Court of Appeals, stated succinctly, the potential for greenhouse gas emissions must be analyzed in NEPA documents, *Center for Biological Diversity v. National Highway Safety Administration*, 508 F.3d 508 (9<sup>th</sup> Cir. 2007).

### ***The Greenhouse Effect and Climate Change***

The Earth's temperature is regulated by a system known as the "greenhouse effect." GHGs are primarily water vapor (H<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) that trap the heat of the sun, preventing radiation from dissipating into space. Water vapor is the most abundant GHG and CO<sub>2</sub> is a distant second. Without the effect of these GHGs, which are both naturally occurring and anthropogenic, the average temperature on the Earth would be approximately -18 °C (-64.4 °F), instead of the current average of 15 °C (59 °F).

IPCC modeling estimates that anthropogenic CO<sub>2</sub> in the lower atmosphere has increased by approximately 31 percent since 1750. At the same time, average temperature in the lower atmosphere has increased approximately 0.6 (33.0) to 0.8 °C (33.4 °F). Due to the challenges inherent in modeling the complexities of the Earth's climate, the proportional importance of anthropogenic activities as opposed to natural feedback systems is exceptionally difficult to establish. Nonetheless, the IPCC concludes that "Most of the observed increase in globally-averaged temperatures since the mid-20<sup>th</sup> century is very likely due to the observed increase in anthropogenic GHG concentrations." As noted above, this EIS assumes that an increase in anthropogenic GHG concentration is in fact contributing to global warming.

IPCC theorizes that a continuation of this warming trend could have profound implications, including flooding, erratic weather patterns, increased sea levels, and reduced arctic ice. The IPCC projects a number of future GHG emissions scenarios leading to a varying severity of impacts on the environment and the global economy. According to the 2007 IPCC report if anthropogenic GHG continue to increase in the atmosphere there will be a point at which the above impacts would become irreversible, this point is commonly referred to as the "tipping point." Although the 2007 IPCC Report states the tipping point may be as far off as 20 years, some experts contend the tipping point has already been reached.

**Table 3.4-6** illustrates the state contribution to the global increase in GHG emissions. The 2020 estimates assume “business as usual.” As shown, without modifications in human activities or the introduction of new technologies, GHG emissions are anticipated to increase.

**TABLE 3.4-6  
GLOBAL GREENHOUSE GAS EMISSIONS**

Regions	Estimated GHG Emissions
	Million metric tons per year of CO <sub>2</sub> e <sup>1</sup>
	<b>1990</b>
Global Emissions	626,395
California Emissions	427
	<b>2020</b>
Global Emissions	882,246
California Emissions	600

NOTE: <sup>1</sup>Carbon Dioxide Equivalent (see methodology in **Section 4.12**)  
SOURCE: CARB, 2007; IPCC. 2007

### 3.4.4 REGULATORY CONTEXT

#### *FEDERAL CLEAN AIR ACT*

The Federal Clean Air Act (CAA) was enacted for the purposes of protecting and enhancing the quality of the nation’s air resources to benefit public health, welfare, and productivity.

In 1971, the USEPA developed primary and secondary National Ambient Air Quality Standards (NAAQS). Six pollutants of primary concern were designated: CO, ozone, suspended particulate matter, sulfur dioxide, NO<sub>x</sub>, and lead. The primary NAAQS must “protect the public health with an adequate margin of safety” and the secondary standards must “protect the public welfare from known or anticipated adverse effects (aesthetics, crops, architecture, etc.)”. The primary standards were established, with a margin of safety, considering long-term exposures for the most sensitive groups in the general population. The USEPA allows states the option to develop different (stricter) standards. California elected this option and adopted standards that are more stringent. **Table 3.4-1** shows the federal standards.

If an air basin is not in federal attainment (e.g. does not meet federal standards) for a particular pollutant, the basin is classified as a marginal, moderate, serious, severe, or extreme nonattainment area. Nonattainment areas must take steps towards attainment by a specific timeline. These steps include establishing a transportation control program and clean-fuel vehicle program, decreasing the emissions threshold for new stationary sources and for major sources, and increasing the stationary source emission offset ratio to at least 1.3:1 (federal Clean Air Act, 1990).

The CAA establishes specific attainment dates for areas that are designated as nonattainment. Dates are determined by the degree of severity of the pollutant problem. For example, for the 1-hour ozone standard, if the design value or the fourth highest value in three years of monitoring, of an area is from 0.180 ppm up to 0.190 ppm, the area is considered severe nonattainment and would be required to attain within 15 years after the enactment of the 1990 CAA, which would translate to the year 2005.

The State Implementation Plan (SIP) is a number of documents that set forth the state's strategies for achieving federal air quality standards. The Code of Federal Regulations (CFR Title 40, Chapter I, Part 52, Subpart F, §52.220) lists all of the items that are included in the California SIP. The SIP is not a single document, but a compilation of new and previously submitted plans, programs (such as monitoring, modeling, permitting, etc.), district rules, state regulations, and federal controls. Many of California's SIPs detail control strategies, including emission standards for cars and heavy trucks, fuel regulations and limits on emissions from consumer products. Local air districts and other agencies, such as the Bureau of Automotive Repair, prepare SIP elements and submit them to CARB for review and approval. State law makes CARB the lead agency for all purposes related to the SIP.

#### ***Federal Hazardous Air Pollutant Program***

Title III of the CAA requires the USEPA to promulgate National Emissions Standards for Hazardous Air Pollutants (NESHAP). The NESHAP may differ between major sources and area sources of hazardous air pollutants (HAPs). Major sources are defined as stationary sources with potential to emit more than 10 tons per year (tpy) of any HAP or more than 25 tpy of any combination of HAPs; all other sources are considered area sources. The emissions standards were to be promulgated in two phases. In the first phase (1992–2000), USEPA developed technology-based emission standards designed to produce the maximum emission reduction achievable. For area sources, the standards were different, based on generally available control technology. In the second phase (2001–2008), USEPA is required to promulgate health risk–based emissions standards where deemed necessary to address risks remaining after implementation of the technology-based NESHAP standards.

The CAA requires the USEPA to promulgate vehicle or fuel standards to include reasonable controls for toxic emissions, addressing at a minimum benzene and formaldehyde. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene. In addition, Section 219 required the use of reformulated gasoline in selected U.S. cities (those with the most severe ozone nonattainment conditions) to further reduce mobile-source emissions.

### ***Federal Clean Air Act and Indian Tribes***

The federal CAA authorizes USEPA to issue regulations specifying the provisions of the Act for which Indian tribes may be treated in the same manner as States. For those provisions specified, a tribe may develop and implement one or more of its own air quality programs under the Act. The USEPA issued its final rule on this issue in 1998. The rule provides that tribes will be treated in the same manner as states for virtually all federal CAA programs. The rule grants tribes with USEPA-approved CAA programs authority over all air resources within the exterior boundaries of a reservation (including non-Indian owned fee lands). No such program exists for the Federated Indians of Graton Rancheria, and thus the USEPA retains permitting authority for sources of air pollution located on the project site.

### ***Federal General Conformity***

The General Conformity Rule of the federal CAA (42 USC 7401), implements Section 176(c) of the Act, and establishes minimum thresholds for volatile organic compounds (VOCs) and ozone precursors (NO<sub>x</sub>), CO, and other regulated constituents for non-attainment and maintenance areas.

Title 40 Part 93 of the CFR was promulgated in order to determine conformity of federal actions to state or federal implementation plans. Whereas Subpart A of Part 93 relates to transportation plans, Subpart B is directed to general federal actions. A federal agency must make a determination that a federal action conforms to the applicable implementation plan before the action is taken. A Conformity Determination is required for each pollutant where a total of direct and indirect emissions in a nonattainment or maintenance area caused by the federal action are greater than *de minimis* thresholds as listed in CFR Section 93.153(b).

These thresholds provide simple and direct guidance for federal agencies to assure that they comply with approved SIPs. The General Conformity Rule includes a procedure for determining whether the rule is applicable to the actions of a federal agency.

There are two phases to general conformity:

- 1) The Conformity Review process entails a review of each analyzed alternative to assess whether a full conformity determination is necessary, and
- 2) The Conformity Determination process, which demonstrates how an action would conform with the applicable implementation plan (usually the SIP).

The first step compares emissions estimates for the project to the appropriate general conformity *de minimis* threshold based on a nonattainment type. If the emission estimates from step one are below the thresholds, then a General Conformity Determination is not necessary and step two is not required.

The regulations apply to a proposed federal action that would cause emissions of criteria air pollutants (CAPs) above certain levels to occur in locations designated as nonattainment or maintenance areas for the emitted pollutants. If a federal action occurs in a location designated as attainment or unclassified then the General Conformity regulation does not apply to the project. See **Section 3.4.2** for a discussion of the San Francisco Bay Area Air Basin's attainment status. Because the San Francisco Bay Area Air Basin is listed as marginal nonattainment for O<sub>3</sub>, the *de minimis* threshold for ozone precursors (VOC and NO<sub>x</sub>) is 100-tons per year.

### ***Federal Class I Areas***

Title 1, Part C of the FCAA was established, in part, to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value. The FCAA promised to prevent significant deterioration of air quality under the Prevention of Significant Deterioration (PSD) program. The FCAA designates all international parks, national wilderness areas, and memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres as "Class I areas." There are 156 mandatory Class I areas nationwide.

Any major source of emissions within 100 kilometers (62.1 miles) from a federal Class I area is required to conduct a pre-construction review of air quality impacts on the area(s). The PSD Program protects Class I areas by allowing only a small increment of air quality deterioration in these areas by providing for assessment of potential impacts on air quality related values of Class I areas. A "major source" for the PSD program is defined as a facility that will emit (from direct stationary sources) 250 tons per year of regulated pollutant. "Mobile sources (i.e. vehicle emissions) are by definition not stationary sources and are therefore not considered under the PSD program". For certain specific industries, the requirements apply to facilities that emit (through direct stationary sources) 100 tons per year or more of a regulated pollutant.

### ***BAY AREA AIR QUALITY MANAGEMENT DISTRICT***

At a local level, the Bay Area Air Quality Management District (BAAQMD) has jurisdiction over all or portions of the nine counties in the Bay Area including the San Francisco Bay Area Air Basin portion of Sonoma County. The BAAQMD periodically prepares and updates plans to achieve the goal of clean air. Typically, a plan will analyze emissions inventories and combine that information with air monitoring data and computer modeling simulations to test future strategies to reduce emissions in order to achieve state and federal air quality standards. Air quality plans usually include measures to reduce air pollutant emissions from industrial facilities, commercial processes, motor vehicles, and other sources. Bay Area plans are prepared with the cooperation of the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG).

BAAQMD has an Air Toxics Program that consists of several elements that are designed to identify and reduce public exposure to toxic air contaminants (TACs). The three primary control programs are 1) preconstruction review of new and modified sources, 2) the Air Toxics “Hot Spots” program, and 3) air pollution control measures designed to reduce emissions from categories of sources of TACs, including BAAQMD rules, statewide Airborne Toxic Control Measures (ATCMs), and National Emission Standards for Hazardous Air Pollutants (NESHAPs).

In addition to the enhanced wood burning activities instituted in response to Senate Bill (SB) 656, the BAAQMD will also be implementing a number of additional activities to reduce emissions, gain a better understanding of the nature and severity of wood smoke in the Bay Area, and to help inform potential emission reduction strategies. These programs include:

- Focused wood smoke air monitoring study in specific neighborhoods;
- Financial incentives for residents to remove non-USEPA certified wood burning devices and install USEPA certified devices and to replace wood burning fireplaces with natural gas fireplaces; and
- Enhanced enforcement response when air pollution complaints about wood smoke occur;
- A 2005 Wintertime Survey to gather information about wood burning activities, including the quantities of wood being burned, the types of appliances being used, and the frequency of burning.

### *CLIMATE CHANGE*

#### *Federal*

In 1997 the Council on Environmental Quality (CEQ) circulated an internal draft memorandum (CEQ, 1997a) on how global climate change should be treated for the purposes of the National Environmental Policy Act (NEPA). The CEQ draft memorandum advised federal lead agencies to consider how proposed actions subject to NEPA would affect sources and sinks of GHGs. During the same year, CEQ released guidance on the assessment of cumulative effects in NEPA documents (CEQ, 1997b). Consistent with the CEQ draft memorandum, climate change impacts were offered as one example of a cumulative effect. In November, 2007 the United States Court of Appeals for the 9<sup>th</sup> Circuit (which has jurisdiction over California) held that climate change must be addressed in analyses and documentation prepared under NEPA. Center for Biological Diversity v. National Highway Transportation, 508 F 3d 508 (9<sup>th</sup> Cir. 2007).

#### *State*

California has been a leader among the states in outlining and aggressively implementing a comprehensive climate change strategy that is designed to result in a substantial reduction in total statewide GHG emissions in the future. California’s climate change strategy is multifaceted and

involves a number of state agencies implementing a variety of state laws and policies. We have attempted to briefly summarize these laws and policies below.

**Assembly Bill 1493 (AB 1493)**

Signed by the Governor in 2002, AB 1493 requires that the California Air Resources Board (CARB) adopt regulations requiring a reduction in GHG emissions emitted by cars in the state. AB 1493 is intended to apply to 2009 and later vehicles, however recently the USEPA has denied a Clean Air Act waiver, which the state needs in order to implement AB 1493. Although the state is apparently planning to appeal this decision, at this time it is unclear whether AB 1493 will be implemented (Bee, 2007).

**Executive Order S-3-05 (EO S-3-05)**

EO S-3-05 was signed by the Governor on June 1, 2005. EO S-3-05 established the following statewide emission reduction targets:

- Reduce GHG emissions to 2000 levels by 2010,
- Reduce GHG emissions to 1990 levels by 2020, and
- Reduce GHG emissions to 80 percent below 1990 levels by 2050.

EO S-3-05 created a “Climate Action Team” or “CAT” headed by the California Environmental Protection Agency and including several other state agencies. The CAT is tasked by EO S-3-05 with outlining the effects of climate change on California and recommending an adaptation plan. The CAT is also tasked with creating a strategy to meet the emission reduction target required by the EO. In April 2006 the CAT published an initial report that accomplished these two tasks, **Appendix KK** provides the CAT strategies.

**Assembly Bill 32 (AB 32)**

Signed by the Governor on September 27, 2006, AB 32 codifies a key requirement of EO S-3-05, specifically the requirement to reduce statewide GHG emissions to 1990 levels by 2020. AB 32 tasks CARB with monitoring state sources of GHGs and designing emission reduction measures to comply with the law’s emission reduction requirements. However, AB 32 also continues the CAT’s efforts to meet the requirements of EO S-3-05 and states that the CAT should coordinate overall state climate policy.

In order to accelerate the implementation of emission reduction strategies, AB 32 requires that CARB identify a list of discrete early action measures that can be implemented relatively quickly. In October 2007, CARB published a list of early action measures that it estimated could be implemented and would serve to meet about a quarter of the required 2020 emissions reductions (CARB, 2007a). In order to assist CARB in identifying early action measures, the CAT published a report in April 2007 that updated their 2006 report and identified strategies for

reducing GHG emissions (CAT, 2007). In its October 2007 report, CARB cited the CAT strategies and other existing strategies that may be utilized in achieving the remainder of the emissions reductions. AB 32 requires that CARB prepare a comprehensive “scoping plan” that identifies all strategies necessary to fully achieve the required 2020 emissions reductions. According to AB 32 this scoping plan must be in place no later than January 1, 2009. CARB has initiated preparation of the scoping plan and plans on adopting a final plan in late 2008 (CARB, 2007b).

**Executive Order S-01-07 (EO S-01-07)**

EO S-01-07 was signed by the Governor on January 18, 2007. It mandates a statewide goal to reduce the carbon intensity of transportation fuels by at least 10 percent by 2020. This target reduction was identified by CARB as one of the AB 32 early action measures identified in their October 2007 report.

**Western Regional Climate Initiative**

The Western Regional Climate Initiative creates a coalition of western states (California, Washington, Oregon, Arizona, New Mexico) and British Columbia, Canada that have agreed to collaborate on identifying, evaluating, and implementing regional mechanisms for reducing GHG emissions. In light of this goal, the Initiative creates a regional emissions registry and plans the creation of a regional market-based multi-sector emissions reduction mechanism by August 2008.

**Senate Bill 97 (SB 97)**

Signed by the governor on August 24, 2007, SB 97 requires that no later than July 1, 2009, the state Office of Planning and Research (OPR) prepare CEQA guidelines for evaluating the effects of GHG emissions and for mitigating such effects. The Resources Agency is required to certify and adopt these guidelines by January 1, 2010. It is anticipated that this guidance would establish standardized significance criteria for the purposes of assessing project impacts pursuant to CEQA. In the absence of specific guidelines, OPR has referred CEQA document authors to existing general guidelines, examples of impact analyses in existing CEQA documents (which OPR acknowledges ranges greatly from little analysis due to the speculative nature of climate change impact analysis to the calculation of GHG emissions and the inclusion of mitigation), and to a variety of white papers on the subject of GHG impact analysis, including one prepared by the Association of Environmental Professionals (OPR, 2007).

***INDOOR AIR QUALITY***

Indoor air quality (IAQ) refers to the quality of the air inside buildings as represented by concentrations of pollutants and thermal (temperature and relative humidity) conditions that affect the health, comfort, and performance of occupants.

Although the total quantity of air pollutants emitted indoors is less than that emitted by outdoor sources, once emitted, indoor air pollutants are diluted much more slowly, due to the partial trapping effect of the building shell. Additionally, indoor emissions occur in closer proximity to people. Californians spend most of their time indoors; adults spend an average of 87 percent of their time indoors, and children under 12 years of age spend about 86 percent of their time indoors. While most of the time spent indoors is spent in the home, working adults spend about 25 percent of their time at other indoor locations such as office buildings, stores, and restaurants, primarily for work, and children spend about 21 percent of their time in school on a school day. Because of these time budgets, the trapping effect of buildings, and people's proximity to indoor emissions, there is a much higher likelihood that people will be exposed to indoor pollutants than outdoor pollutants. Investigators have calculated that pollutants emitted indoors are 1,000 times more likely to be inhaled than those emitted outdoors (CARB, 2005b).

Indoor air pollution can cause a variety of impacts on human health, from irritant effects to respiratory disease, cancer, and premature death dependent upon specific chemical types and concentrations. Indoor air pollutants can be elevated to levels that may result in adverse health effects. The major indoor pollutants that can have a substantial impact on Californians' health are listed in **Table 3.4-7**, along with their sources and associated health impacts.

#### ***“Green” Buildings and Indoor Air Quality***

Buildings exist to protect people from the elements and to otherwise support human activity. Buildings should not make people sick, cause them discomfort, or otherwise inhibit their ability to perform. How effectively a building functions to support its occupants and how efficiently the building operates to keep costs manageable is a measure of the building's performance.

The growing proliferation of chemical pollutants in consumer and commercial products, the tendency toward tighter building envelopes and reduced ventilation to save energy, and pressures to defer maintenance and other building services to reduce costs have fostered indoor air quality problems in many buildings.

#### **Building Factors Affecting Indoor Air Quality**

The thermal environment (temperature, relative humidity, and airflow) is an important dimension of indoor air quality for several reasons. First, many complaints of poor indoor air may be resolved by simply altering the temperature or relative humidity. Second, people that are thermally uncomfortable will have a lower tolerance to other building discomforts. Third, the rate at which chemicals are released from building materials is usually higher at higher building temperatures. Thus, if occupants are too warm, it is also likely that they are being exposed to higher pollutant levels.

Indoor thermal conditions are controlled by the heating, ventilating, and air conditioning (HVAC) system. How well the thermal environment is controlled depends on the design and operating parameters of the system, and on the heat gains and losses in the space being controlled. These gains and losses are principally determined by indoor sources of heat, the heat gains from sunlight, the heat exchange through the thermal envelope, and the outdoor conditions and outdoor air ventilation rate.

Additionally, much of the building fabric, its furnishings and equipment, its occupants, and their activities also produce pollution. In a well functioning building, some of these pollutants will be

**TABLE 3.4-7**  
SOURCES AND POTENTIAL HEALTH EFFECTS OF MAJOR INDOOR AIR POLLUTANTS

<b>Pollutant</b>	<b>Major Indoor Sources</b>	<b>Potential Health Effects Associated with One or More of The Pollutants Listed*</b>
Asbestos	Building materials in older homes disturbed during renovation. Naturally occurring in some soils.	Lung cancer, asbestosis, mesothelioma.
Biological Agents (bacteria, fungi, viruses, house dust mites, animal dander, cockroaches, microbial VOCs)	House and floor dust; bedding; poorly maintained air conditioners, humidifiers, dehumidifiers; moist structures; insect infestation; building occupants; pets.	Allergic reactions; asthma; eye, nose, and throat irritation; humidifier fever, influenza, other infectious diseases.
Carbon Monoxide	Unvented/malfunctioning gas and propane appliances, woodstoves, fireplaces, tobacco smoke, vehicles in garages.	Headache; nausea; angina; impaired vision and mental functioning; fatal at high concentrations.
Endocrine Disruptors (PBDEs, some phthalates, some pesticides)	Flame retardants, plastics, and pesticides.	Mimic or block natural effects of hormones (estrogen and others); developmental abnormalities.
Environmental Tobacco Smoke (ETS)	Cigarettes, cigars, and pipes.	Respiratory irritation, bronchitis and pneumonia in children; asthma in preschool children; lung cancer; heart disease; aggravated asthma; decreased lung function.
Formaldehyde, Other Aldehydes	Composite wood products such as plywood and particleboard, furnishings, wallpaper, durable press fabrics, paints, combustion appliances, and tobacco smoke.	Cancer; eye, nose, and throat irritation; headache; allergic reactions; aggravated asthma, decreased lung function.
Lead	Lead paint chips, contaminated soil.	Learning impairment.
Nitrogen Dioxide	Unvented or malfunctioning gas appliances, other combustion appliances.	Aggravated asthma; decreased lung function; eye, nose, and throat irritation; increased respiratory disease in children.
Organic Chemicals (benzene, chloroform, paradichlorobenzene, methylene chloride, perchloroethylene, others)	Solvents, glues, cleaning agents, pesticides, building materials, paints, treated water; moth repellents, dry-cleaned clothing, air fresheners.	Cancer; eye, nose, throat irritation; aggravated asthma; decreased lung function; at high levels: loss of coordination, damage to liver, kidney, brain.
Ozone	Infiltration of outdoor air, some air "purifiers", office machines.	Lung inflammation, aggravated asthma, cough, wheeze, chest pain.

Pollutant	Major Indoor Sources	Potential Health Effects Associated with One or More of The Pollutants Listed*
Particulate Matter	Cigarettes, wood stoves, fireplaces, cooking, candles, aerosol sprays, house dust.	Increased mortality and hospital admissions; lung cancer; irritation; susceptibility to sinus and respiratory infections; bronchitis; aggravated asthma; decreased lung function.
Pesticides	Insecticides, herbicides, sanitizers, or disinfectants used indoors or tracked in or blown in from outdoors.	Neurological impairment; nausea, headache, dizziness; skin and eye irritation; hormone disruption.
Polycyclic Aromatic Hydrocarbons (PAH)	Cigarette smoke, cooking, wood burning.	Cancer, gene mutation.
Radon	Uranium-bearing soil under buildings, groundwater, construction materials.	Lung cancer (especially in smokers).

NOTE: \*When multiple pollutants are listed in a group, each pollutant may not cause all of the health effects listed in the third column.

SOURCE: CARB, 2005b.

directly exhausted to the outdoors and some will be removed as outdoor air enters the building and replaces the air inside. The air outside may also contain contaminants that will be brought inside in this process. This air exchange is brought about by the mechanical introduction of outdoor air (outdoor air ventilation rate), the mechanical exhaust of indoor air, and the air exchanged through the building envelope (infiltration and exfiltration).

Pollutants inside can travel through the building as air flows from areas of higher atmospheric pressure to areas of lower atmospheric pressure. Some of these pathways are planned and deliberate so as to draw pollutants away from occupants, but problems arise when unintended flows draw contaminants into occupied areas. In addition, some contaminants may be removed from the air through natural processes, as with the adsorption of chemicals by surfaces or the settling of particles onto surfaces. Removal processes may also be deliberately incorporated into the building systems. Air filtration devices, for example, are commonly incorporated into building ventilation systems.

Thus, the factors most important to understanding indoor pollution are a) indoor sources of pollution, b) outdoor sources of pollution, c) ventilation parameters, d) airflow patterns and pressure relationships, and e) air filtration systems.

### Green Buildings

As the environmental impact of buildings becomes more apparent, a new field called “green building” is gaining momentum. Green or sustainable building is the practice of creating healthier and more resource-efficient models of construction, renovation, operation, maintenance, and demolition. Research and experience increasingly demonstrate that when buildings are designed and operated with their lifecycle impacts in mind, they can provide great environmental, economic, and social benefits.

The building industry is increasingly focused on making its buildings greener, which includes using healthier, less polluting, and more resource-efficient practices. Indoor environmental quality (IEQ) refers to the quality of the air and environment inside buildings, based on pollutant concentrations and conditions that can affect the health, comfort, and performance of occupants – including temperature, relative humidity, light, sound, and other factors. Good IEQ is an essential component of any building, especially a green building.

Creating a better indoor environment can help building owners, managers, occupants, architects, and builders to minimize or eliminate the negative health effects, liability, bad publicity, and costly renovations and repairs often associated with IEQ problems. Improving IEQ involves designing, constructing, commissioning, operating, and maintaining buildings in ways that reduce pollution sources and remove indoor pollutants while ensuring that fresh air is continually supplied and properly circulated.

#### Changes in Tribal Development Projects

As contemporary tribes work to achieve healthy and prosperous communities, they are presented with the challenge of reconciling their current needs with more traditional practices, particularly those that show respect for nature.

The Center for Indian Community Development, the Center for Environmental and Economic Development, and Boisson and Associates developed a green building Guide for California Indian tribes (*Building and Buying Green in Indian Country; a Practical Guide for California Tribes*, May 2004) that was developed to provide basic information about sustainable building practices, considerations, and planning for building projects in Indian Country. It was intended to:

1. Give Tribal project decision makers and planners an overview of sustainable and “green” building practices and options, and
2. Serve as a tool to support those decision makers and planners in evaluating and choosing sustainable options as they develop projects with architects, contractors, suppliers, or other building professionals.

The Guide states, “sustainable building designs, options, and strategies are ultimately about resource efficiency, and can be incorporated in every building project within tribal jurisdiction.” A building such as a casino might be limited in its use of day lighting and may not be able to use windows as a natural ventilation system but sustainable furnishings, flooring, and paint products can still be used.

Sustainable design involves a systematic effort to create a useful space that takes maximum advantage of the local climatic and geographic benefits while also efficiently compensating for its

less beneficial aspects. Sustainable building integrates concerns over the environment, health, and comfort into the design, construction, and operation of buildings.

Sustainable building designs, plans, and strategies are based on lessening environmental and energy impacts while producing quality, attractive, useful, comfortable projects. These are goals that may be highly compatible with tribal values. California tribes have an opportunity to demonstrate how sustainable building policies can be successful in simultaneously achieving environmental and community development goals. Tribes can promote this philosophy by adopting tribal sustainable building planning, design and construction frameworks, and codes or policies.

The Guide explains that the sovereign status of California Indian nations presents exciting decision-making opportunities for tribal members, councils, planners, and staff when it comes to developing or adopting building codes and construction guidelines. Within Indian Country, tribes constitute the governing body or regulatory authority, and like the federal or state government, may legislate to encourage sustainable development. Tribes are often the owner of much of the land area within a reservation. As both the governing authority and property owner, tribes may be in a position to implement a comprehensive, long-range vision for a sustainable community. Outside of Indian Country, to the extent sustainable building principles are incorporated into tribal goals, tribes may find sustainable building principles and programs useful tools in achieving building development objectives.