

4.3	Air Quality	4.3-1
4.3.1	Environmental Setting	4.3-1
4.3.2	Impacts and Mitigation Measures.....	4.3-14
4.3.3	References.....	4.3-42

T A B L E S

Table 4.3-1	Historical Monthly Average Precipitation in the Santa Cruz Vicinity
Table 4.3-2	State and Federal Ambient Air Quality Standards
Table 4.3-3	Attainment Status for the North Central Coast Air Basin
Table 4.3-4	Maximum Measured Pollutant Concentrations at Nearby Monitoring Stations
Table 4.3-5	Average Ambient Concentrations of Toxic Air Contaminants in the San Francisco Bay Area Air Basin in 2003
Table 4.3-6	Estimated Natural Gas Consumption for Space Heating
Table 4.3-7	Sources of Emission Factors for Cogeneration System
Table 4.3-8	Chemicals Analyzed in the Health Risk Assessment by Source
Table 4.3-9	Equipment Usage Analyzed for PM ₁₀ Emissions During Construction
Table 4.3-10	Total Estimated PM ₁₀ Emissions During Construction
Table 4.3-11	Emissions from Space and Water Heating of Nonresidential Buildings
Table 4.3-12	Emissions from Residential Space and Water Heating and Consumer Products
Table 4.3-13	Emergency Generator Testing Emissions
Table 4.3-14	Summary of the Cogeneration System Emissions
Table 4.3-15	Estimated 2020 Vehicle Emissions
Table 4.3-16	Summary of 2020 Emissions from All New Sources
Table 4.3-17	Predicted 1-Hour Average CO Concentrations
Table 4.3-18	Predicted 8-Hour Average CO Concentrations
Table 4.3-19	Results of UC Santa Cruz 2020 Health Risk Assessment of Emissions from Routine Operations
Table 4.3-20	Source Contribution of Cancer Risks at MEI from Routine Operations (Lifetime Cancer Risk; Chances in One Million)
Table 4.3-21	UC Santa Cruz 2020 Cancer Risks at Sensitive Receptor Locations due to Emissions from Routine Operations
Table 4.3-22	Generator Maintenance Testing Scenarios

Table 4.3-23 Results of UC Santa Cruz 2020 Health Risk Assessment of Emissions from Construction Projects

Air Quality

The section characterizes existing air quality in the project area and evaluates the potential effects of campus growth under the 2005 LRDP on regional and local air quality.

Public comments in response to the Notice of Preparation of this EIR requested that the following issues be addressed in the EIR, all of which are addressed in this section:

- Quantification of air quality impacts from area, mobile, and construction sources
- Mitigation strategies to alleviate increases in emissions
- The effect of campus growth under the 2005 LRDP on concentrations of criteria pollutants in the air

4.3.1 Environmental Setting

4.3.1.1 Study Area

The proposed project is located in the city and county of Santa Cruz, which is within the North Central Coast Air Basin (NCCAB or Basin). The Basin includes Santa Cruz, Monterey, and San Benito counties.

Air pollutants are emitted by a variety of sources, including mobile sources such as automobiles, stationary sources such as manufacturing facilities, power plants and laboratories, and area sources such as homes and commercial buildings. While some of the air pollutants that are emitted need to be examined at the local level, others are predominately an issue at the regional level. For instance, ozone (O₃) is formed in the atmosphere in the presence of sunlight by a series of chemical reactions involving oxides of nitrogen (NO_x) and reactive organic gases (ROG). Because these reactions are broad-scale in effects, ozone is typically analyzed at the regional level (i.e., in the Basin) rather than the local level. On the other hand, other air pollutants such as sulfur dioxide (SO₂), respirable particulate matter (PM₁₀), fine particulate matter (PM_{2.5}), carbon monoxide (CO), lead (Pb), and toxic air contaminants (TAC) are a potential concern in the immediate vicinity of the pollutant source because the pollutants are emitted directly or are formed close to the source. Therefore, the study area for emissions of SO₂, PM₁₀, PM_{2.5}, CO, Pb, and TAC is the local area nearest the source, such as in the vicinity of congested intersections, whereas the study area for regional pollutants such as NO_x and ROG is the entire Basin.

4.3.1.2 Climate and Topography

Air quality in the NCCAB is affected by topographical and meteorological features that influence the migration of pollutants. The NCCAB is located along the central coast of California, with the northwest portion of the basin dominated by the Santa Cruz Mountains and the northeast bounded by the Diablo Range. San Benito Valley, a southern extension of the Santa Cruz Valley, runs northwest-southeast and lies in the eastern portion of the basin. In the summer, a high-pressure system over the eastern Pacific

generally results in persistent west and northwest winds along the coast. The northwest-southeast orientation of the mountains also restricts and channels onshore air currents in summer.

Inversion layers frequently occur during this season, with a layer of hot air forming over a cool coastal air layer. This inversion inhibits vertical mixing of the air, resulting in high ambient concentrations of air pollutants near ground level.

In the winter, the high-pressure system over the Pacific generally moves southward and has less influence on wind conditions in the NCCAB. Winds are reduced overall and occasional offshore winds may occur. Northwest winds are still dominant but easterly winds are more frequent. Winter winds from the north and east tend to transport pollutants from the San Francisco Bay area or the Central Valley into the Santa Cruz region. Less frequent inversion layers along with storms and the influence of the coastal mountains on atmospheric circulation generally result in good air quality in the Santa Cruz region during this season.

The difference between winter and summer trends for wind speeds and direction can be observed in the monthly average wind speeds monitored at the Watsonville Municipal Airport.¹ Although this station is approximately 12 miles distant from the UC Santa Cruz campus, it is the closest site with readily available data. At this site, average wind speeds vary from 3.0 to 5.4 miles per hour (mph). Average wind speeds have historically been higher between April and July than between October and January. Winds at this site between April and July come predominately out of the west and winds between October and January come primarily from the north.

In addition to winds, precipitation also impacts air quality. For example, rains can help wash out particulate matter from the atmosphere. Table 4.3-1 shows that the average monthly rainfall in Santa Cruz has historically been the heaviest in January and lightest in July. Annual average rainfall ranges between about 30 to 45 inches in the Santa Cruz area, with the higher rainfall levels at upper elevations inland.

**Table 4.3-1
Historical Monthly Average Precipitation in the Santa Cruz Vicinity**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inches of Rain	6.57	5.48	4.28	2.12	0.65	0.19	0.08	0.09	0.34	1.29	3.93	5.42

Source: Western Regional Climate Center, Santa Cruz, California Station. 1948-2004 (www.wrcc.dri.edu, accessed February 28, 2005)

4.3.1.3 Air Quality Standards and Existing Air Quality

Air pollutants are typically categorized as either criteria pollutants or TAC. The criteria pollutants are those regulated at the federal level by the U.S. Environmental Protection Agency (U.S. EPA) and at the state level by the California Air Resources Board (CARB). These include O₃, PM₁₀, PM_{2.5}, CO, NO₂, SO₂, and Pb. Toxic air contaminants are airborne pollutants for which there are no air quality standards but that are known to have adverse human health effects.

The federal and state governments have each established their own ambient air quality standards. The U.S. EPA has established primary and secondary National Ambient Air Quality Standards (NAAQS) that

¹ Although the Delaveaga Golf Course weather station is located closer to the campus than the National Weather Service weather station at the Watsonville Airport, a wind data summary is not available for the DeLaveaga weather station.

specify allowable ambient concentrations for criteria pollutants under the provisions of the Clean Air Act (CAA). Primary NAAQS are established at levels necessary, with an adequate margin of safety, to protect the public health, including the health of sensitive populations such as asthmatics, children and the elderly. Healthy adults can generally tolerate periodic exposure to air pollution levels somewhat above these standards before adverse health effects are observed. Secondary NAAQS specify the levels of air quality determined appropriate to protect the public welfare from any known or anticipated indirect adverse effects associated with air pollutants, such as damage to farm crops and vegetation and damage to buildings. Allowable ambient concentrations are set for O₃, PM₁₀, PM_{2.5}, CO, NO₂, SO₂, and Pb. Table 4.3-2 summarizes the NAAQS for these pollutants. The newer 8-hour average O₃ and PM_{2.5} standards listed in the table were promulgated in 1997 but were challenged in the courts. In 2002, the courts upheld these two standards; the U.S. EPA and the states are now working together to implement them. These efforts include determining the attainment status for regions and developing air quality plans to achieve compliance with the standards, if needed. On April 15, 2004, EPA made final designations for the 8-hour O₃ standards (i.e., classified areas as attainment or nonattainment). Final designations for the new federal PM_{2.5} standards were completed in December 2004.

In California, CARB, which is part of the California Environmental Protection Agency, has promulgated ambient air quality standards for O₃, PM₁₀, PM_{2.5}, CO, NO₂, SO₂, and Pb that are more stringent than U.S. EPA's standards, as shown in Table 4.3-2. In 2002, CARB revised the state's annual PM₁₀ standard and established an annual PM_{2.5} standard. These standards were formally approved by the Office of Administrative Law on June 7, 2004. CARB has also developed standards for visibility reducing particles, sulfates, hydrogen sulfide, and vinyl chloride.

Counties and metropolitan areas are classified as being in attainment, nonattainment, or unclassified with respect to these federal and state ambient pollutant standards. The state also has a designation of nonattainment-transitional for areas that are in nonattainment with state standards but are close to attaining these standards. If an area is designated unclassified, the area does not have adequate air quality data available to ascertain a nonattainment or attainment designation.² Maintenance areas are those that were previously in nonattainment but have been redesignated as attainment. An area's classification is determined by comparing actual monitored air pollutant concentrations with federal and state standards. More than 200 air monitoring stations located in California are part of the State and Local Air Monitoring Network. These stations are operated by CARB, local Air Pollution Control Districts (APCDs) or Air Quality Management Districts (AQMDs), private contractors, and the National Park Service. Based on pollutant concentrations measured at monitoring stations within the NCCAB, the NCCAB is in attainment or unclassifiable for all standards except for the state O₃ and PM₁₀ standards (see Table 4.3-3). The area was redesignated from nonattainment to attainment of the federal O₃ standards and therefore is identified as a maintenance area in Table 4.3-3.

² According to the MBUAPCD, EPA generally designates an area as either nonattainment or unclassified/attainment and does not officially distinguish between unclassified and attainment. From a planning perspective, "unclassified" and "attainment" have the same implications, i.e., an Air Quality Plan for the pollutant thus classified is not needed.

**Table 4.3-2
State and Federal Ambient Air Quality Standards**

Pollutant	Averaging Time	California Standards ^a	National Standards ^b	
		Concentrations ^c	Primary ^{c,d}	Secondary ^{c,e}
Ozone (O ₃)	8-hour	0.070 ppm	0.08 ppm	Same as Primary
	1-hour	0.09 ppm	0.12 ppm	Same as Primary
Respirable Particulate Matter (PM ₁₀)	Annual Mean	20 µg/m ³	50 µg/m ³	Same as Primary
	24-hour	50 µg/m ³	150 µg/m ³	Same as Primary
Fine Particulate Matter (PM _{2.5})	Annual Mean	12 µg/m ³	15 µg/m ³	Same as Primary
	24-hour	--	65 µg/m ³	Same as Primary
Carbon Monoxide (CO)	8-hour	9.0 ppm	9 ppm	None
	1-hour	20.0 ppm	35 ppm	None
Nitrogen Dioxide (NO ₂)	Annual Mean	--	0.053 ppm	Same as Primary
	1-hour	0.25 ppm	--	--
Sulfur Dioxide (SO ₂)	Annual Mean	--	0.03 ppm	--
	24-hour	0.04 ppm	0.14 ppm	--
	3-hour	--	--	0.5 ppm
	1-hour	0.25 ppm	--	--
Lead (Pb)	30 Day Average	1.5 µg/m ³	--	--
	Calendar Quarter	--	1.5 µg/m ³	Same as Primary
Visibility Reducing Particles	8-hour	Extinction Coefficient of 0.23 per kilometer-visibility of ten miles or more due to particles when relative humidity is less than 70 percent	None	None
Sulfates	24-hour	25 µg/m ³	None	None
Hydrogen Sulfide	1-hour	0.03 ppm (42 µg/m ³)	None	None
Vinyl Chloride	24-hour	0.01 ppm (26 µg/m ³)	None	None

Source: California Air Resources Board air quality standards. <http://www.arb.ca.gov/aqs/aaqs2.pdf>

Notes:

ppm = parts per million, µg/m³ = micrograms per cubic meter

- California standards for O₃, CO, SO₂ (1 and 24 hour), NO₂, PM₁₀, and PM_{2.5} are not to be exceeded. All others are not to be equaled or exceeded.
- Other than O₃, PM_{2.5} and PM₁₀, and those standards based on annual averages, national standards (NAAQS) are not to be exceeded more than once a year. The 1-hour O₃ standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one. The 8-hour O₃ standard is attained when the 3-year average of the annual fourth highest daily maximum concentration is less than the standard. The 24-hour PM₁₀ standard is attained when the expected number of days per calendar year with a 24-hour average concentration above the standard is equal to or less than one. The 24-hour PM_{2.5} standard is attained when the 98th percentile of 24-hour PM_{2.5} concentrations in a year, averaged over 3 years, at the population-oriented monitoring site with the highest measured values in the area, is equal to or less than the standard. The annual average PM_{2.5} standard is attained when the 3-year average of the annual arithmetic mean PM_{2.5} concentrations, from single or multiple community-oriented monitors, is less than or equal to the standard.
- All measurements of air quality are to be corrected to a reference temperature of 25° C and a reference pressure of 760 mm of mercury (Hg) (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
- National Primary Standards: The levels of air quality deemed necessary by the federal government, with an adequate margin of safety, to protect the public health.
- National Secondary Standards: The levels of air quality deemed necessary by the federal government to protect the public welfare from any known or anticipated adverse effects of a pollutant.

**Table 4.3-3
Attainment Status for the North Central Coast Air Basin**

Pollutant	Averaging Time	State Status	Federal Status
Ozone (O ₃)	8-hour	Not Applicable	Unclassified/Attainment
	1-hour	Nonattainment-Transitional	Maintenance
Respirable Particulate Matter (PM ₁₀)	Annual Mean	Nonattainment	Unclassified/Attainment
	Annual Geometric Mean		
	24-hour		
Fine Particulate Matter (PM _{2.5})	Annual Mean	Unclassified	Unclassified/Attainment
Carbon Monoxide (CO)	8-hour	Unclassified (Santa Clara County)/Attainment (Monterey County)	Unclassified/Attainment
	1-hour		
Nitrogen Dioxide (NO ₂)	Annual Mean	Attainment	Unclassified/Attainment
	1-hour		
Sulfur Dioxide (SO ₂)	Annual Mean	Attainment	Unclassified
	24-hour		
	3-hour		
	1-hour		

Sources:

Status attainment status based on CARB website accessed June 10, 2005 (Area designation maps: <http://www.arb.ca.gov/desig/adm/adm.htm>)

Federal attainment status based on U.S. EPA Region 9 air quality maps (http://www.epa.gov/region09/air/maps/maps_top.html) and U.S. EPA Green Book website (<http://www.epa.gov/air/oaqps/greenbk/index.html>) accessed June 10, 2005 and MBUAPCD (2005).

Note:

Status shown as of April 2005. State attainment status for state PM_{2.5} is expected to be changed from unclassified to attainment.

The two ambient pollutant monitoring stations closest to the proposed project site are located at 2544 Soquel Avenue in Santa Cruz and at the intersection of Marine View and Center Avenue in Davenport. Table 4.3-4 summarizes measured criteria pollutant concentrations over the past five years at these stations. The following discusses the characteristics, health effects, and local measured concentrations of O₃, PM₁₀, PM_{2.5}, CO, NO₂, and SO₂. Sulfates, Pb, and hydrogen sulfide are the pollutants of least concern in this project area because recorded levels are well below standards and no major sources of these pollutants exist in the project area.

Ozone

O₃ is a colorless gas that has a pungent odor and causes eye and lung irritation, visibility reduction, chemical deterioration of various materials, and crop damage. As mentioned previously, a primary constituent of smog, O₃ is a secondary pollutant formed in the atmosphere in the presence of sunlight by a series of chemical reactions involving NO_x and ROG. Because these reactions occur on a regional scale, ozone is considered a regional air pollutant. Motor vehicles are primary sources of NO_x and ROG.

As shown in Table 4.3-4, O₃ concentrations have not exceeded federal and state ambient air quality standards at the nearby monitoring station in the past five years, although the NCCAB as a whole is considered to be a nonattainment-transitional area for the state O₃ standard.

**Table 4.3-4
Maximum Measured Pollutant Concentrations at Nearby Monitoring Stations**

Pollutant	Averaging Time	Units	Standards		Maximum Measured Concentration				
			State	Federal	2000	2001	2002	2003	2004
O ₃	1 hour	ppm	0.09	0.12	0.079	0.076	0.081	0.087	0.085
	8 hours	ppm	None	0.08	0.061	0.060	.060	0.065	0.077
PM ₁₀	24 hours	µg/m ³	50	150	30	35	41	37	34
	Annual Average ^a	µg/m ³	20	50	16.0	18.6	17.7	16.9	NA ^b
PM _{2.5}	24 hours	µg/m ³	None	65	23.3	23.1	22.8	15.0	22.6
	Annual Average ^a	µg/m ³	12	15	7.9	9.1	8.6	7.4	NA ^b
CO	1 hour	ppm	20	35	1.3	1.9	1.3	1.6	2.1
	8 hours	ppm	9.0	9	0.78	1.01	0.81	0.74	1.03
NO ₂	1 hour	ppm	0.25	None	0.035	0.042	0.035	0.034	0.032
	Annual Average	ppm	None	0.053	0.005	0.005	0.005	NA ^b	NA ^b
SO ₂	24 hours	ppm	0.04	0.14	0.004	0.008	0.010	0.005	0.005

Source: CARB Air Quality Data Statistics ADAM website, www.arb.ca.gov/adam, accessed on February 15 and 16, 2005. O₃, PM₁₀, and PM_{2.5} monitoring station located at 2544 Soquel Ave., Santa Cruz, CA. CO, NO₂, and SO₂ monitoring station located at Marine View and Center Avenue, Davenport, CA.

Notes:

(a) Annual average data available differ between state and national annual averages due to differences in method of obtaining such averages. Numbers shown above are based on national average

(b) NA= not available

Particulate Matter

Particulate matter is generally composed of particles in the air such as dust, soot, aerosols, fumes, and mists. Of particular concern are inhalable particulates, which have aerodynamic diameters of 10 micrometers or less (PM₁₀). PM₁₀ are generated by sources such as windblown dust from agricultural fields, and dust from vehicular traffic on unpaved roads. PM₁₀ affects breathing and the respiratory system, and, in particular, can damage lung tissue and contribute to cancer and premature death. Other effects include visibility reduction, and corrosion and soiling of structures, which has economic effects.

A subgroup of PM₁₀ is fine particulates, PM_{2.5}. These are particles with aerodynamic diameters less than 2.5 micrometers. PM_{2.5} have very different characteristics, sources, and potential health effects than PM₁₀ as a whole. PM_{2.5} are generally emitted from sources such as industrial combustion, vehicle exhaust, and residential wood-burning stoves and fireplaces. PM_{2.5} are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds emitted by combustion activities are transformed by chemical reactions in the air. Separate standards for PM_{2.5} were established in 1997 because these smaller particles can penetrate deep into the respiratory tract and cause unique adverse health effects.

Measured concentrations at the monitoring stations near UC Santa Cruz have not exceeded federal or state PM₁₀ or PM_{2.5} standards in the past five years. However, the Basin has been designated as nonattainment for the state PM₁₀ standard on account of exceedances at other monitoring stations. The Basin is designated as unclassified/attainment and unclassified for federal and state PM_{2.5} standards, respectively.

Carbon Monoxide

CO is an odorless, colorless gas that can impair the transport of oxygen in the bloodstream, aggravate cardiovascular disease, and cause fatigue, headache, confusion, and dizziness. CO forms through incomplete combustion of fuels in vehicles, wood stoves, industrial operations and fireplaces. In Santa Cruz County, vehicular exhaust is a major source of CO. CO tends to dissipate rapidly into the atmosphere and consequently is a concern primarily at the local level, particularly at major road intersections during peak hour traffic conditions.

Table 4.3-4 shows that the nearby monitoring station has measured CO concentrations well below the federal and state standards. The NCCAB is designated as unclassified/attainment for the federal and state CO standards.

Nitrogen Dioxide

NO₂ is a brownish, highly reactive gas that can irritate the lungs, cause pneumonia, and lower resistance to respiratory infections. Chronic exposure to oxides of nitrogen, or NO_x, which include NO₂, may lead to irritation of eyes and mucus membranes along with pulmonary dysfunction. Airborne NO_x can also impair visibility. NO_x is a key precursor to O₃ and acid rain. NO_x forms when fuel is burned at high temperatures, and principally comes from transportation sources and stationary fuel combustion sources such as electric utilities and industrial boilers.

Table 4.3-4 shows that measured concentrations of NO₂ have consistently remained well below the federal and state standards at the nearby monitoring station. With similar trends throughout the region (and state), the NCCAB is well within federal and state NO₂ standards.

Sulfur Dioxide

SO₂ is a colorless acidic gas with a strong odor. High concentrations of SO₂ affect breathing and may aggravate existing respiratory and cardiovascular disease. SO₂ is also a primary contributor to acid deposition, which causes acidification of lakes and streams and can damage trees, crops, building materials, and statues. In addition, sulfur compounds in the air can contribute to visibility impairment. The major source category for SO₂ is equipment combusting sulfur-containing fossil fuels.

The nearby monitoring station that measures SO₂ has not shown an exceedance of the federal or state SO₂ standard for the last five years. The NCCAB as a whole is designated as attainment for the state SO₂ standard and unclassified for the federal SO₂ standard.

Other State-Regulated Pollutants

In addition to the criteria pollutants discussed above that are regulated by both the state and federal governments, four pollutants are regulated by the state only: sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particles. Airborne sulfates are created by the photochemical reaction of by-products from the burning of fuels containing sulfur. Sulfates are also produced in mining soils that contain sulfates. The hydrogen sulfide standard was primarily created to reduce odors. Hydrogen sulfide, which typically creates smells similar to rotten eggs, is produced in petroleum processing, geothermal plants, and the decomposition of vegetable and animal material without oxygen. Vinyl chloride is

typically produced by plastic industrial processes. These other pollutants are not a major concern in the NCCAB.

The state has instituted a visibility standard to monitor visibility impairment due to regional haze caused by particulate matter present in air. Visibility is affected by the absorption of light by dark particles in the air and (such as soot), and by light-scattering particles, particularly those that are greater than or equal to the size of the visible spectrum wavelength. The standard is defined in terms of the extinction coefficient, which is a measure of how much light is being scattered or absorbed. The standard is exceeded if sufficient particulates are present in the air to result in an extinction coefficient higher than 0.23 per kilometer (equal to having a visibility of less than 10 miles when relative humidity is less than 70 percent). Sources of visibility-reducing particles include motor vehicles, industrial processes, power plants, and naturally occurring particles (such as dust). The area is designated as unclassified for this standard.

Toxic Air Contaminants

Toxic air contaminants (TACs) are a category of airborne pollutants that have been shown to have an impact on human health but are not classified as criteria pollutants. Examples include certain aromatic and chlorinated hydrocarbons, certain metals, and asbestos. Adverse health effects of toxic air contaminants can be carcinogenic (cancer-causing), short-term (acute) noncarcinogenic, and long-term (chronic) noncarcinogenic. TACs are generated by a number of sources, including stationary sources such as dry cleaners, gas stations, combustion sources, and laboratories; mobile sources, such as automobiles and trucks, particularly diesel-fueled vehicles; and area sources, such as farms, landfills, construction sites, and residential areas. Sources of TACs around and within the UC Santa Cruz campus include diesel buses and trucks, laboratory emissions; campus Central Heating Plant boilers; boilers in individual buildings; the campus cogeneration facility; emergency generators; and painting operations.

CARB has prepared a stationary source air toxics emissions inventory. The inventory identifies air toxics emissions from sources in each California air district and, where feasible, quantifies these emissions based on information reported through the AB 2588 Program. Air toxics monitoring stations are located throughout California. These stations, maintained either by the CARB or the local Air Pollution Control District, monitor and record existing levels of various organic gases and metals in air. However, there are no stations that monitor toxic air contaminants in the NCCAB. The San Francisco Air Basin toxic monitoring data is the closest match for the Santa Cruz area since it is geographically the closest and near the coast. *The 2005 California Almanac of Emissions and Air Quality* (CARB 2005a) presents annual average concentrations, emissions, and health risks for California air basins. Table 4.3-6 presents CARB's estimates of background TAC concentrations and 70-year cancer risks in the San Francisco Bay Area Air Basin for the year 2003 for the 10 TACs that pose the greatest health risk, based on monitored values from throughout the basin. CARB estimates a risk of 150 in one million from ambient air toxics without considering diesel particulate. In the case of diesel particulate matter, there is no routine method for monitoring ambient concentrations, thus CARB made preliminary estimates for the San Francisco Bay Area using its PM₁₀ emissions database and PM₁₀ ambient monitoring data, the results of several studies with chemical speciation of ambient data, and receptor modeling techniques. The last year this estimation for diesel particulate-associated cancer risk was for 2000, as noted in Table 4.3-5.

**Table 4.3-5
Average Ambient Concentrations of Toxic Air Contaminants in the
San Francisco Bay Area Air Basin in 2003**

Compound	Concentration	Unit Risk	Cancer Risk (Chances In One Million)
	(ppb)	($\mu\text{g}/\text{m}^3$) ⁻¹	
Gaseous TACs			
Acetaldehyde	0.74	2.70E-06	4
Benzene	0.44	2.90E-05	41
1,3-Butadiene	0.10	1.70E-04	37
Carbon Tetrachloride	0.10	4.20E-05	25
<i>Para</i> -Dichlorobenzene	0.15	1.10E-05	10
Formaldehyde	2.22	6.00E-06	16
Methylene Chloride	0.22	1.00E-06	1
Perchloroethylene	0.04	5.90E-06	2
Compound	Concentration	Unit Risk	Cancer Risk (Chances in one million)
	(ng/m^3)	($\mu\text{g}/\text{m}^3$) ⁻¹	
Particulate TACs			
Chromium (Hexavalent)	0.10	1.50E-01	14
Diesel Exhaust Particulate Matter ¹	1600	3.00E-04	480
Total Risk for All TACs			630

Source: CARB 2005a

¹Data is from the year 2000 since more recent data is unavailable.

Since 1990, annual average concentrations of TACs in the San Francisco Bay Area Air Basin have declined due to the implementation of air toxics control programs. The estimated cancer risk associated with diesel particulate matter for the San Francisco Bay Area Air Basin was 750 in one million in 1990 and 480 in one million in 2000 (CARB 2005). The estimated combined cancer risk for the 10 TACs for the San Francisco Bay Area Air Basin was 1,153 in one million in 1990, 659 in one million in 2000, and 630 in one million in 2005 (CARB 2005).

The calculated average cancer risk values from monitored TACs can be compared against the lifetime probability, regardless of gender, of being diagnosed with cancer in the United States from all causes, which is about 40 percent, or 400,000 in a million (National Cancer Institute [NCI] 2000). Medical advances have improved cancer cure rates such that the lifetime probability of dying from cancer in the United States today is about 220,000 in a million (NCI 2000), or about 55 percent of the lifetime probability of a cancer diagnosis. It is generally believed that a large portion of these cancer cases come from smoking habits, genetic susceptibilities, diet, natural radiation including radon, and other lifestyle factors. According to one source, smoking may account for about 30.5 percent of the cancer deaths in the United States (Shopland et al. 1991). Environmental and occupational exposures are generally thought to be responsible for a small portion of this background risk. But, because these exposures are often involuntary and in principle can be reduced by regulatory initiatives, environmental and occupational carcinogens are a principal focus of regulatory policy.

4.3.1.4 Sensitive Receptors

Some groups of people are considered more sensitive to adverse effects from air pollution than the general population. These groups are termed sensitive receptors. Sensitive receptors include children, the elderly, and people with existing health problems, who are more often susceptible to respiratory infections and other air-quality-related health problems. Schools, childcare centers, hospitals, and nursing homes are all considered sensitive receptors. There are two childcare centers on campus: one is located on the western edge of the central campus within the Family Student Housing area, and the other is located near the campus main entrance. The two nearest off-campus schools are West Lake Elementary School and the Santa Cruz Waldorf School. West Lake Elementary School is located just south of the campus on High Street at a distance of about 2,000 feet from the campus entrance and 6,000 feet from the nearest portion of the campus core. The Santa Cruz Waldorf School is located just west of the campus on Empire Grade Road approximately 10,000 feet from the main entrance and about 2,500 feet from the nearest portion of the campus core. There are no hospitals or nursing homes in the project vicinity.

4.3.1.5 Regulatory Setting

NCCAB is comprised of Monterey, Santa Cruz, and San Benito Counties. The project area is subject to air quality planning programs by both the federal CAA and the California Clean Air Act (CCAA). Both the federal and state statutes provide for ambient air quality standards to protect public health, timetables for progressing toward achieving and maintaining ambient standards, and the development of plans to guide the air quality improvement efforts of state and local agencies. Within the project vicinity, air quality is monitored, evaluated, and controlled by the U.S. EPA, the CARB, and Monterey Bay Unified Air Pollution Control District (MBUAPCD).

Applicable federal, state, and local regulations are discussed below in more detail.

Federal

Criteria Pollutants. As discussed previously, the federal government, through the U.S. EPA, has established primary and secondary NAAQS for criteria pollutants under the provisions of the CAA (see Table 4.3-2). The U.S. EPA has classified the NCCAB status as maintenance for O₃ and unclassified or attainment for PM₁₀, PM_{2.5}, CO, NO₂, and SO₂ with respect to federal air quality standards.

For areas designated as nonattainment, the 1990 Clean Air Act Amendments (CAAA) require that each state have an air pollution control plan called the State Implementation Plan (SIP). The SIP includes strategies and control measures to attain the NAAQS by deadlines established by the CAA. The U.S. EPA reviews the SIPs to determine whether the plans would conform to the CAAA and achieve the air quality goals. The U.S. EPA may prepare a Federal Implementation Plan for a nonattainment area if the EPA determines a SIP to be inadequate.

The 1990 CAAA also require emission controls on factories, businesses, and automobiles to reduce criteria pollutant emissions. The CAAA regulate automobiles by lowering the permissible limits on ROG and NO_x emissions, requiring the phasing-in of alternative-fuel cars, requiring on-board canisters to capture vapors during refueling, and extending emission-control warranties.

Toxic Air Contaminants. At the federal level, air toxics are identified as hazardous air pollutants (HAPs). HAPs have been regulated at the federal level since the CAA of 1977. Following the passage of this law, regulations for seven HAPs were promulgated as National Emission Standards for Hazardous Air Pollutants (NESHAP) over a 13-year period. The 1990 CAA amendments revamped the NESHAP program to offer a technology-based approach for reducing the emissions of a greater number of HAPs. Under the 1990 CAAA, 189 substances were identified as HAPs and slated for regulation. The program requires certain facilities to control toxic air emissions by the installation of Maximum Achievable Control Technology (MACT), which is implemented and enforced in the MBUAPCD through Rule 218, *Title V: Federal Operating Permits*, which administers the federal operating permits program established by the 1990 CAAA.

State

Criteria Pollutants. CARB regulates mobile emissions sources, oversees the activities of county and regional APCDs and AQMDs, and implements the CCAA of 1988. CARB regulates local air quality indirectly by establishing state ambient air quality standards and vehicle emission standards, by conducting research activities, and through its planning and coordinating activities.

As mentioned previously, California has adopted ambient standards that are more stringent than the federal standards for the criteria air pollutants (see Table 4.3-2). Table 4.3-3 shows that the Basin has been designated as nonattainment for the state PM₁₀ standard, nonattainment-transitional for the state O₃ standard, and is unclassified or attainment for the state PM_{2.5}, CO, NO₂, and SO₂ standards.

The CCAA requires that air districts design a plan to achieve an annual reduction in district wide emissions of 5 percent or more for each nonattainment criteria pollutant or its precursor(s). These plans include the following: emission control standards that require local districts to stringently control emissions through stationary and mobile source control programs; application of additional control measures if a regional AQMD or unified APCD contributes to downwind nonattainment areas; cost-effectiveness estimates for all proposed emission control measures; and development and implementation of transportation controls for cities and counties to enforce.

Toxic Air Contaminants. California's TAC control program began in 1983 with the passage of the Toxic Air Contaminant Identification and Control Act, better known as Assembly Bill 1807 (AB 1807) or the Tanner Bill. The Tanner Bill established a regulatory process for the scientific and public review of individual toxic compounds. When a compound becomes listed as a TAC under the Tanner process, the CARB normally establishes minimum statewide emission control measures to be adopted by local air pollution control districts. By 1992, 18 of the 189 federal HAPs had been listed by the CARB as state TACs. Later legislative amendments (AB 2728, Tanner 1992) required the CARB to incorporate all 189 federal HAPs into the state list of TACs. In April 1993, the CARB added 171 substances to the state program to make the state TAC list equivalent to the federal HAP list.

The second major component of California's air toxics program, supplementing the Tanner process, was provided by the passage of AB 2588, the Air Toxics "Hot Spots" Information and Assessment Act of 1987. AB 2588 currently regulates over 600 air compounds, including all of the Tanner-designated TACs. Under AB 2588, specified facilities must quantify emissions of regulated air toxics and report them to the

local APCD. If the APCD determines that a potentially significant public health risk is posed by a given facility, the facility is required to perform a health risk assessment (HRA) and notify the public in the affected area if the calculated risks exceed specified criteria. The MBUAPCD's implementation of AB 2588 is discussed below.

On August 27, 1998, the CARB formally identified particulate matter emitted by diesel-fueled engines as a TAC. Diesel engines emit TACs in both gaseous and particulate forms. The particles emitted by diesel engines are coated with chemicals, many of which have been identified by the EPA as HAPs and by the CARB as TACs. Since, by weight, the vast majority of diesel exhaust particles are very small (94 percent of their combined mass consists of particles less than 2.5 microns in diameter), both the particles and their coating of TACs are inhaled into the lung. While the gaseous portion of diesel exhaust also contains TACs, the CARB's August 1998 action was specific to diesel particulate emissions, which, according to supporting CARB studies, represent 50 to 90 percent of the mutagenicity of diesel exhaust (CARB 1998).

The CARB action was taken at the end of a lengthy process that considered dozens of health studies, extensive analysis of health effects and exposure data, and public input collected over the previous 9 years. CARB's Scientific Advisory Committee has recommended a unit risk factor of 300 in one million for diesel particulate. The CARB action will lead to additional control of diesel engine emissions in coming years by the CARB. The EPA has also begun an evaluation of both the cancer and noncancer health effects of diesel exhaust.

The CARB's 1998 ruling prompted the CARB to begin searching for means to reduce diesel particulate matter emissions. In September 2000, the CARB approved the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles* (Diesel Risk Reduction Plan). The Diesel Risk Reduction Plan outlines a comprehensive and ambitious program that includes the development of numerous new control measures over the next several years aimed at substantially reducing emissions from new and existing on-road vehicles (e.g., heavy-duty trucks and buses), off-road equipment (e.g., graders, tractors, forklifts, sweepers, and boats), portable equipment (e.g., pumps), and stationary engines (e.g., stand-by power generators).

Many laboratory fume hoods are operated on the UC Santa Cruz campus. Title 8 of the California Code of Regulations contains California Occupational Safety and Health Administration requirements for these emission sources. The regulations are concerned with worker health and safety, requiring a minimum flow of speed, face velocity, and certain design features to protect laboratory personnel in their work. In addition, the code establishes specific requirements for the use and storage of carcinogens, including a requirement to scrub or filter air emissions from areas where carcinogens are used. Other than the requirement that the top of the fume hood stack must be located at least 7 feet above the roof, the regulations do not address emissions once the exhausted air mixes with outdoor air.

Regional

Criteria Pollutants. The MBUAPCD is one of 35 districts established to protect air quality in the state. The MBUAPCD has jurisdiction over air quality in Monterey, Santa Cruz, and San Benito Counties, including the proposed project area. The MBUAPCD regulates most air pollutant sources (stationary sources) in the Basin, with the exception of motor vehicles, aircraft, and agricultural

equipment, which are regulated by the CARB or the U.S. EPA. State and local government projects, as well as projects proposed by the private sector, are subject to requirements of the local air district and the state CCAA. In addition, the MBUAPCD and the CARB maintain ambient air quality monitoring stations at numerous locations throughout the NCCAB.

Before the passage of the CCAA, the MBUAPCD's primary role was stationary source control of industrial processes and equipment. After passage of the CCAA and the CAAA, air districts were directed to implement transportation control measures and were encouraged to employ indirect source control programs to reduce mobile source emissions.

The CCAA of 1988 required that a 1991 air quality plan be developed for areas that do not meet the state ozone standards. MBUAPCD developed the 1991 Air Quality Management Plan, which has been updated every three years, with the last update completed in 2004. The latest Air Quality Management Plan revisions were based on air monitoring data showing less than three exceedances of the state ozone standard at any one monitoring station. Based on the monitoring data, the Basin has been designated as nonattainment-transitional for the state ozone standard. The borderline designation is a result of variable meteorological conditions, transport of air pollutants from the San Francisco Bay Area, and locally generated emissions. The latest Air Quality Management Plan has revised emission inventories and added five new stationary source control measures.

The MBUAPCD's "CEQA Air Quality Guidelines" (MBUAPCD 2004a) contains guidance for analysis of the impacts on air quality of land development projects. The guidelines include thresholds above which a project's air emissions contributions are considered significant (see Section 4.3.2.1, *Standards of Significance*, for a summary of significance thresholds).

Toxic Air Contaminants. In compliance with federal law, MBUAPCD Rule 218 implements federal NESHAP and MACT requirements through the federal operating permit program. The MBUAPCD has also developed various rules for specific source categories pursuant to the Tanner process under MBUAPCD Regulation IV, *Prohibitions*. Dust from construction and demolition activities is addressed by MBUAPCD Rule 402, *Nuisances*, which states that sources cannot emit air contaminants that cause nuisances to "any considerable number of persons or to the public."

The MBUAPCD's permitting program also includes a "Best Control Technology" (BCT) review under MBUAPCD Rule 1000, *Permit Guidelines and Requirements for Sources Emitting Toxic Air Contaminants.*" This rule covers proposed new or reconstructed major sources of federal HAPs, TACs, and Carcinogenic Toxic Air Contaminants (CTACs). It implements Section 112(g) of the federal 1990 CAAA, which addresses new or reconstructed major sources of federal HAPs included in the specific source categories for which EPA promulgates MACT standards (as described above). If a source falls under this rule, a case-by-case TAC/CTAC control determination must be made, unless the source is specifically exempt (research and development activities as defined in 40 CFR 63.41). A major HAP source is one that emits 10 tons per year or more of a single federal HAP, or 25 tons per year or more of any combination of federal HAPs.

In compliance with state law, the MBUAPCD also administers the AB 2588 Air Toxics "Hot Spots" Program. Facilities must report their TAC emissions and if the MBUAPCD determines the facility poses

a potential public health risk, the facility must perform a HRA. An HRA includes an analysis of TAC emissions and characterizes human health risks as a result of the estimated TAC exposures. If the estimated health risks exceed threshold levels, the public in the affected area must be notified and steps taken to reduce emissions. For carcinogens, the MBUAPCD uses a 70-year cancer risk level of 10 in one million as the AB 2588 public notification level. For noncarcinogens, public health risk is assessed by the “hazard index” for both long-term (chronic) and short-term (acute) exposures. A hazard index is the sum of the ratios of each chemical’s actual exposures to acceptable exposures. Hazard index values less than 1.0 indicate an acceptable non-cancer health risk. The MBUAPCD uses a hazard index threshold of 1.0 as the AB 2588 public notification level for non-cancer toxicants. On account of campus facilities such as the cogeneration plant and Central Heating Plant boilers, UC Santa Cruz is subject to AB 2588 requirements.

4.3.2 Impacts and Mitigation Measures

4.3.2.1 Standards of Significance

The following standards of significance are based on Appendix G of the CEQA Guidelines and significance thresholds recommended by the MBUAPCD in its CEQA Air Quality Guidelines (MBUAPCD 2004a).

Criteria Pollutants

For the purposes of this EIR, an impact is considered significant if the implementation of the LRDP would:

- Conflict with or obstruct implementation of the applicable air quality plan
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)
- Expose sensitive receptors to substantial pollutant concentrations
- Create objectionable odors affecting a substantial number of people

All of these issues are evaluated below except an impact related to objectionable odors. None of the new facilities that would be built on campus under the 2005 LRDP would involve a source of objectionable odors.

To determine the significance of an air quality impact, the following thresholds recommended by the MBUAPCD are used in this EIR:

- During construction, PM₁₀ emissions of 82 pounds per day (lb/day) or more
- During operations, increase in emissions of:

- 137 lb/day or more of volatile organic compounds (VOC) or NO_x (from direct and indirect sources)
- 82 lb/day or more of PM₁₀ (from direct sources)
- 550 lb/day or more of CO (from direct sources, not from vehicle emissions)
- 150 lb/day or more of sulfur oxides (SO_x) (from direct sources)

Direct emissions are emitted on site. Indirect emissions come from mobile sources that may be emitted on and off site.

Toxic Air Contaminants

An impact would be considered significant if the implementation of the 2005 LRDP or a specific project under the 2005 LRDP would:

- Contribute to the probability of contracting cancer for the Maximally Exposed Individual (MEI) exceeding the AB 2588 threshold of 10 in 1 million
- Result in a noncarcinogenic (chronic and acute) health hazard index greater than the AB 2588 threshold of 1.0

4.3.2.2 Analytical Method

Criteria Pollutant Emissions from Construction Activities

Construction associated with the 2005 LRDP is expected to start in 2006. Construction activities generate short-term fugitive dust emissions, equipment exhaust emissions, and worker vehicle exhaust emissions. The term “fugitive dust emissions” refers to particulate matter (“dust”) emitted from an open area (i.e., not through a stack or an exhaust vent) due to ground disturbance activities. A portion of the fugitive dust includes PM₁₀ (approximately 64 percent [by weight] according to the MBUAPCD CEQA Guidelines).

For the 2005 LRDP, construction activities are expected to consist mostly of minimal grading activities. However, in order to ensure that the overall PM₁₀ emissions are not underestimated, PM₁₀ emissions for both minimal and major excavation were calculated. The MBUACPD recommends using the assumption that minimal grading will emit 10 pounds per day of PM₁₀ per acre of land disturbed, and major earthmoving activities will emit 38 pounds per day of PM₁₀ per acre of land disturbed. To estimate maximum daily PM₁₀ fugitive emissions, the maximum acreage expected to be disturbed in a day is multiplied by these pound/day/acre emission factors.

Because detailed information regarding the maximum areas of disturbance from future construction activity under the 2005 LRDP is not available at this time, an estimate was made of the maximum acreage that would be disturbed in a day based on recent projects constructed on campus, on the assumption that recent campus construction is representative of future construction activities. Since 1999, the Campus has constructed the College Infill Apartments that involved a total area of 3.5 acres, the Physical Sciences Building that involved a total area of 2.3 acres, and the Humanities Building which involved a total area of 0.95 acre. Construction is currently underway on the Emergency Response Center which involves an

area of 0.82 acre and the McHenry Library expansion project which will disturb about 1.1 acre. Currently, planned projects include the Digital Arts Facility, which will disturb about 1.6 acres and the Ranch View Terrace employee housing project, which will disturb 13 acres. At the time that Colleges Nine and Ten were built, they encompassed an area of 6.9 acres built in three phases. In light of these past projects, for purposes of estimating ongoing emissions from construction activities under the 2005 LRDP, it was assumed that a total of three projects would be under construction at any given point in time and the three projects together would involve up to a total of 6.75 acres and 270,000 square feet of building space.³ The three previous projects used as representative for this analysis include the construction of residential units for Colleges Nine and Ten and the construction of two buildings, Physical Sciences Building and Humanities and Social Sciences Facility. Using the same assumption incorporated into the URBEMIS2002 land use emission model, 25 percent of the total area of these representative projects was treated as disturbed on the worst-case day. The URBEMIS2002 model is one of the tools recommended by the MBUAPCD for calculating construction-related dust emissions.

URBEMIS2002 was also used to estimate equipment usage and worker vehicle emissions. The model estimates construction equipment usage and worker trips based on the project acreage and building square footage. The equipment usage generated by the model was reviewed, and additional equipment was added when deemed necessary for conservatism. Emissions from the estimated equipment usage was calculated using the latest off-road mobile source emission factors from the South Coast Air Quality Management District (SCAQMD). The SCAQMD off-road emission factors were calculated using the CARB off-road model and are based on statewide horsepower and load factors. Emissions from construction worker vehicles were calculated using the URBEMIS2002 emission factors. PM₁₀ emissions from fugitive dust, equipment exhaust, and worker vehicle exhaust were totaled and compared with the threshold of 82 pounds per day to evaluate the level of significance of construction activities. The results of this analysis are described under Section 4.3.2.3, *2005 LRDP Impacts and Mitigation Measures*, below.

According to MBUAPCD CEQA guidelines, temporary exhaust emissions of VOC and NO_x from typical construction equipment are accounted for in the air quality plans, and quantification of these emissions are not needed. Construction activities under the 2005 LRDP would be conducted with typical construction equipment, and thus exhaust emissions are not quantified here.

Criteria Pollutant Emissions from Campus Operations

Increased emissions would result from stationary, area, and mobile sources that would be added to the campus under the 2005 LRDP. The following sources were examined with respect to potential changes in daily criteria pollutant emissions that would result from development under the 2005 LRDP.

- Nonresidential space and water heating supplied by Central Heating Plant boilers and local boilers and furnaces fueled by natural gas
- Residential space and water heating from local boilers and furnaces fueled by natural gas
- Residential consumer products (e.g., VOC emissions from household cleaners)

³ 270,000 square feet was calculated based on 4 million square feet of additional building space that would be built under the 2005 LRDP divided by 15, the number of years in which the space is projected to be added to the campus.

- Emergency generators fueled by natural gas
- Expansion of the campus cogeneration system
- Motor vehicles

Nonresidential Space and Water Heating Emissions. Maximum hourly natural gas usage for space and water heating in new nonresidential buildings, estimated by the Campus, was used to calculate emissions from these sources. In order to be conservative, the maximum hourly natural gas rate was assumed to be constant for 24 hours on the worst-case day. Emission factors for uncontrolled small boilers (less than 100 million British thermal units per hour [MMBtu/hr]) fueled by natural gas, contained in EPA's guidance AP-42, Section 1.4 (U.S. EPA 1998), were used together with the estimated space heating natural gas usage to calculate emissions. The same emission factors were used to represent emissions from the Central Heating Plant boilers and from local boilers and furnaces. These factors are expected to overestimate emissions since some of the boilers would be classified as residential furnaces (less than 0.3 MMBtu/hr), which typically have lower emission factors than those used in the model. Natural gas consumption due to water heating for most of the nonresidential buildings is expected to be very small compared to their natural gas consumption from space heating, and thus is treated as negligible. On the other hand, natural gas consumption for water heating for the recreational swimming pool may be substantial. Actual natural gas consumption data for this water heating was not readily available; the natural gas consumption for campus swimming pool water heating was assumed to be equal to the consumption for the buildings' space heating, an overestimate for conservative purposes. The square footage, expected loads, and projected natural gas consumption are summarized in Table 4.3-6.

**Table 4.3-6
Estimated Natural Gas Consumption for Space Heating**

Future Buildings	Bldg Space (ft²)	Load Factor (Btu/hr/ft²)	Max Space Heating Load (MMBtu/hr)	Natural Gas Consumption (MMscf/day)
Total Arts Area	353,840	25	8.85	0.208
Total Humanities	111,594	25	2.79	0.066
Total Physical/Biological Sciences	993,902	100	99.39	2.339
Total Engineering	352,600	25	8.82	0.207
Total Social Sciences	323,950	25	8.10	0.191
Library Expansion	40,083	25	1.00	0.024
Media Services	15,800	25	0.40	0.009
General Services	14,450	25	0.36	0.009
Total Administration	53,130	25	1.37	0.032
Student Services	43,300	25	1.08	0.025
Student Health	19,100	25	0.48	0.011
Student Union	127,500	25	3.19	0.075
Bookstore Expansion	16,600	25	0.42	0.010
OPERS Event Center	148,000	25	3.70	0.087
OPERS Other Facilities	48,800	25	1.22	0.029

**Table 4.3-6
Estimated Natural Gas Consumption for Space Heating**

Future Buildings	Bldg Space (ft²)	Load Factor (Btu/hr/ft²)	Max Space Heating Load (MMBtu/hr)	Natural Gas Consumption (MMscf/day)
Nature Center	95,000	25	2.38	0.056
Total				3.400

Note: Assume maximum load for 24 hours.

Residential Space and Water Heating and Other Sources. Using URBEMIS2002, emissions from space and water heating of residential units were calculated based on the number of townhouses and apartment/dormitories. The LRDP plans for 125 townhouses, and 3,390 student beds contained in dormitories and apartments. Because URBEMIS2002 does not provide a category for dormitories, the dormitories were assumed to be equivalent to apartment buildings. The analysis assumes that 3.5 student beds are equal to one apartment for purposes of emissions estimates. The residential boilers and furnaces would be fueled by natural gas.

URBEMIS2002 also estimated VOC emissions from consumer products used by residents of residential units. The new residential buildings to be constructed under the 2005 LRDP would not be equipped with wood-burning fireplaces. The 125 employee townhouses may have gas-fired fireplaces but, since the emissions from gas-fired fireplaces would be very small compared to the total increase in emissions from implementation of the 2005 LRDP overall, they were not estimated. The emission increase from landscaping equipment was also assumed to be negligible compared to the total emission increase.

Emergency Generators. Under the 2005 LRDP, each of the new residential and nonresidential buildings would also be equipped with emergency and standby generators. These generators are expected to have an average rating of either 60 kW or 250 kW and would be tested regularly. For the 2020 analysis, 38 small (60 kW) new generators and 14 large (250 kW) new generators were assumed to be available for use on the campus. In order to be conservative, reasonable worst-case daily emissions from testing were calculated, assuming testing will last for one hour and that up to five (three small and two large) generators would be tested on the same day.⁴ Currently, the Campus typically tests four generators in one day, and occasionally tests up to five generators in one day. The testing is conducted every six weeks and quarterly. During the six-week tests, the generators are tested for 15 minutes, one at a time. During the quarterly testing, the generators are tested one at a time for 1.5 hours. The average load during a one-hour test was assumed to be less than 90 percent, while the average efficiency of the generator set was assumed to be about 30 percent. Emission factors contained in EPA's guidance, AP-42, Section 3.2, "Natural Gas-Fired Reciprocating Engines" (U.S. EPA 2000) for 4-stroke lean-burn engines were used to calculate emissions.

⁴ The Airborne Toxic Control Measure (ATCM) for Stationary IC engines limits the annual hours of operations used for maintenance/reliability purposes. The ATCM does not specifically limit daily hours of operations unless the daily hours of operations would exceed the annual limit.

Cogeneration System. The Campus currently has a cogeneration system⁵ rated at 2.6 MW, which includes a dual-fuel reciprocating engine. Expansion of this Campus's cogeneration system is needed to accommodate the increased electrical and heating demand expected in the future.

A Draft Self-Generation/Cogeneration Feasibility Study (UC Santa Cruz 2005) has been prepared by the Campus, which examines possible options for the expansion of the cogeneration system. Of the options discussed in the study, replacement of the existing cogeneration system with two 5 MW gas turbines was considered by the Campus to be the most feasible.

As a result, this analysis examines the change in emissions that would result if the existing cogeneration system were replaced with two 5 MW gas turbines. However, if the existing cogeneration system is maintained, an emission control system may be installed on the engines. For purposes of emissions comparisons with potential future gas turbines, the analysis assumes emissions from the existing system equipped with emission controls that reduce emissions of VOC, NO_x, and PM₁₀ by 75 percent. This would tend to overstate the increase in emissions (or minimize the benefit) from replacing the existing cogeneration system with two new 5 MW gas turbines.

Emission factors were identified in the Draft Feasibility Study for VOC, NO_x, and CO emissions for the two 5 MW gas turbines, and were used to estimate emissions. PM₁₀ and SO_x, emissions were estimated based on AP-42 emission factors. Because the VOC emission data provided in the Draft Feasibility Study are for total hydrocarbons, the values were reduced for this EIR based on the ratio of VOC to total hydrocarbons provided in the applicable AP-42 document. Maximum hourly emissions were assumed to be constant throughout the course of a day. The sources of the emission factors are summarized in Table 4.3-7. Emissions are based on a natural gas consumption rate of 89 MMBtu per hour as identified in the feasibility study.

**Table 4.3-7
Sources of Emission Factors for Cogeneration System**

Option	VOC	NO _x	PM ₁₀	CO	SO _x
Replace existing system with two 5 MW Natural Gas Turbines	Cogen Study	Cogen Study	AP-42	Cogen Study	AP-42

Note:

(a) EPA guidance

Mobile Vehicles. An increase in mobile (or indirect) source emissions would result from exhaust from vehicles driven by an increased number of employees, students, and family members under the 2005 LRDP. Mobile source emissions can affect the air quality of the air basin as a whole and can locally affect the air quality near intersections that are congested.

Regional Emissions from Mobile Sources. U.S. EPA's EMFAC2002 emission model was used to estimate emissions from campus population-associated vehicle trips. Emissions from vehicles are a

⁵ The Campus has two cogeneration systems. The larger system is located near the Central Heating Plant and as described above would be expanded to serve the growth under the 2005 LRDP. The smaller system is located in the East Field area and is operated to heat the campus swimming pool. No expansion of the smaller system is anticipated at this time.

function of miles driven, number of starts, and number of vehicles. Emissions are typically highest when a driver starts a vehicle; therefore, EMFAC calculates the additional emissions associated with a “start.” In addition, evaporation of ROG through fuel equipment occurs when the vehicle is not operating, and thus can be considered a function of the number of vehicles. Therefore, for this EIR, three emission factors (per mile, per trip, and per vehicle) were generated from EMFAC2002 to more precisely calculate the emissions from vehicles. The fleet average vehicle mix contained in EMFAC2002 for Santa Cruz County was assumed for this analysis. The traffic analysis predicted 10,590 new daily trips in 2020. Vehicle emissions for 2020 were estimated assuming each trip to be 10 miles. This is a conservative estimate based on a review of the project origins and destination of all the trips. This is also consistent with the value assumed in URBEMIS2002 for the region. To generate a conservatively high number of vehicles based on the number of trips, it was assumed that each vehicle produces two daily trips. According to the MBUAPCD CEQA Guidelines, the only applicable thresholds for mobile (indirect) emissions are for VOC and NO_x and therefore only these emissions were calculated for vehicles.

The emissions from stationary, area, and mobile sources were added and compared to the emission thresholds identified in Section 4.3.2.1, *Standards of Significance*, above.

Local Carbon Monoxide Concentrations. The potential for 2005 LRDP-related traffic to cause CO exceedances at study area intersections was examined based on the traffic study. MBUAPCD CEQA Guidelines contain the following guidance for when traffic emissions at an intersection may exceed CO standards and may require detailed modeling:

- Intersections or road segments that operate at LOS D or better that would operate at LOS E or F with the project's traffic,
- Intersections or road segments that operate at LOS E or F where the volume-to-capacity (V/C) ratio would increase 0.05 or more with the project's traffic, or
- Intersections that operate at LOS E or F where delay would increase by 10 seconds or more with the project's traffic.

Several intersections met these criteria and so the six intersections that were considered to be the “worst” intersections were modeled to determine if CO standards may be exceeded.⁶ The intersections selected for detailed modeling were the three intersections with the highest delays and the three intersections with the highest traffic volumes. These six intersections were modeled using the California Department of Transportation CALINE4 dispersion model (Caltrans 1989). The analysis followed the approach outlined in the Transportation Project-Level Carbon Monoxide Protocol (UC Davis 1997) and the draft Caltrans document “Use of EMFAC2002 to Replace CT-EMFAC: A Users Guide (Caltrans 2005).

The CALINE4 model predicts maximum 1-hour concentrations at the modeled intersections. However, the CO standards consist of both a 1-hour and 8-hour average standard. The predicted 1-hour average concentrations were multiplied by a persistence factor of 0.6 to estimate the 8-hour average. This factor is consistent with the CO Protocol recommendation for rural and suburban areas.

⁶ Because of slower speeds and idling of vehicles, intersections are typically worse than roadway segments with respect to CO concentrations. Therefore, concentrations along roadway segments were not modeled.

In addition, the analysis assumed a worst-case wind speed of 0.5 m/s and stability class of G. Receptors were located adjacent to the roadways to examine maximum potential impacts from vehicles. The maximum monitored CO concentrations between 2000 and 2004 were used as the background concentrations in the CO analysis.

Toxic Air Contaminant Emissions

Since there are no ambient standards for toxic air contaminants, evaluation of impacts is based upon a health risk assessment. The *Air Toxics Health Risk Assessment for the University of California Santa Cruz 2005 Long Range Development Plan* (URS 2005) prepared as part of the analysis of impacts in this EIR assessed total campus health risks associated with full development under the 2005 LRDP. That is, the projected cancer risks and non-cancer hazard indices in the 2005 HRA were evaluated for existing routine campus operations plus all projected routine operations associated with potential development under the 2005 LRDP through the academic year 2020-21. In addition to campus stationary sources, the 2005 HRA included the impact of diesel-powered mobile sources on campus roads (METRO buses, campus shuttles, and delivery trucks). At the request of MBUAPCD, a separate analysis has also been conducted to evaluate the potential impacts associated with emissions of TACs from projected construction operations, even though these operations are nonroutine and do not represent a constant source of TAC emissions and there is no established method for analyzing the potential impacts associated with these emissions.

Many chemicals are used or produced by routine campus operations, but only a portion of these chemicals contribute substantially to human health risks. Twenty two chemicals were selected for modeling in the 2005 HRA based on previous assessments of their use, production, volatility, and toxicity as previously reported by UC Santa Cruz in AB2588-related submittals. These chemicals are listed in Table 4.3-8. A full description of the HRA analytical methodology can be found in the *Air Toxics Health Risk Assessment for the University of California Santa Cruz 2005 Long Range Development Plan* (URS 2005).

**Table 4.3-8
Chemicals analyzed in the Health Risk Assessment by Source**

Pollutant ^a	Gas Turbine - NG ^b	Cogen ICE - NG ^b	Large Boilers - NG ^b	Small Boilers - NG ^b	Generator (ICE) - NG^b	Generator (ICE) - Diesel	Paint Booth	Fume Hoods
1,3-Butadiene	x	x			x			
Acetaldehyde	x	x	x	x	x			
Acrolein	x	x	x	x	x	x		
Benzene	x	x	x	x	x			
Ethylbenzene	x	x	x	x	x			
Formaldehyde	x	x	x	x	x			

**Table 4.3-8
Chemicals analyzed in the Health Risk Assessment by Source**

Pollutant^a	Gas Turbine - NG^b	Cogen ICE - NG^b	Large Boilers - NG^b	Small Boilers - NG^b	Generator (ICE) - NG^b	Generator (ICE) - Diesel	Paint Booth	Fume Hoods
Naphthalene	x		x	x	x			
PAH	x		x	x				
Toluene	x	x	x	x	x		x	
Xylenes	x	x	x	x	x		x	
Hexane			x	x				
Propylene		x	x	x	x			
Diesel Exhaust Particulate						x		
Ethanol							x	
Ethyl Acetate							x	
Ethylene Glycol Butyl Ether							x	
Isopropyl Alcohol							x	x
Methylene Chloride							x	
Carbon Tetrachloride								x
Chloroform								x
Chlorine								x
Mercury Compounds								x

Notes:

(a) List of pollutants is derived from data submitted by UC Santa Cruz to MBUAPCD in support of the 2002 Air Toxics Emissions Report for AB2588 and in a Health Risk Assessment that is being developed as an AB 2588 submittal.

(b) NG - Natural Gas

ICE – Internal Combustion Engine

4.3.2.3 2005 LRDP Impacts and Mitigation Measures

LRDP Impact AIR-1: Construction activities under the 2005 LRDP would result in emissions of PM₁₀ on a short-term basis.

Significance: Less than significant

LRDP Mitigation AIR-1: The Campus shall apply standard MBUAPCD recommended mitigation measures during construction of new facilities under the 2005 LRDP, as appropriate.

- Water all active construction areas at least twice daily, or as needed.
- Prohibit all grading activities during periods of high wind (over 15

mph).

- Apply chemical soil stabilizers on inactive construction areas (disturbed lands within construction projects that are unused for at least four consecutive days).
- Apply non-toxic binders (e.g., latex acrylic copolymer), as appropriate, to exposed areas after cut and fill operations and hydroseed area.
- Require haul trucks to maintain at least 2 feet of freeboard.
- Cover all trucks hauling dirt, sand, or loose materials.
- Plant vegetative ground cover in disturbed areas as soon as possible.
- Cover inactive storage piles.
- Install wheel washers at the entrances to construction sites for all exiting trucks.
- Pave all roads on construction sites.
- Damp-sweep streets if visible soil material is carried out from the construction site.
- Post a publicly visible sign that specifies the telephone number and person to contact regarding dust complaints. This person shall respond to complaints and take corrective action within 48 hours. The phone number of the Monterey Bay Unified Air Pollution Control District shall be visible to ensure compliance with Rule 402.
- To the extent feasible, limit the area under construction at any one time.

Residual Significance: Not Applicable

According to MBUAPCD CEQA Guidelines, projects with potential daily ground disturbance of less than 8.1 acres with minimal grading, and 2.2 acres with major earthmoving, would result in fugitive dust emissions during construction that would not be significant. Based on recent construction activities on campus and expected future activities under the proposed 2005 LRDP, construction activities involving a total of 6.75 acres of land area and 270,000 square feet of building space were modeled as representative of the maximum scale of construction likely to occur simultaneously under the 2005 LRDP. Based on this projection, the equipment usage listed in Table 4.3-9 was analyzed for grading and building construction-phase emissions.

**Table 4.3-9
Equipment Usage Analyzed for PM₁₀ Emissions During Construction**

Activity	Pieces of Equipment	Hours/ Day
Site Grading		
Rubber Tired Dozers	3	8
Tractor/Loaders/Backhoes	3	8
Drill Rig	1	8
Building Construction		
Concrete/Industrial Saws	6	8
Other Equipment (e.g., supply trucks, but conservatively assume off-road for criteria pollutant analysis)	12	8
Rough Terrain Forklifts	6	8

Note:

Values presented in the table are calculated using URBEMIS2002 defaults for year 2007 except that one drill rig was added to the site grading phase.

Based on concurrent construction of the three projects described above, total short-term emissions from grading, equipment usage, and worker vehicle trips are summarized in Table 4.3-10.

**Table 4.3-10
Total Estimated PM₁₀ Emissions During Construction**

Activity	PM ₁₀ (lb/day)	
	Minimal Grading	Major Grading
Grading Phase		
Fugitive Dust	17	64.6
Construction Equipment Exhaust	5	5
Worker Trips	0.02	0.02
Total for Grading	22	70
Significance Threshold	82	82
Building Construction Phase		
Construction Equipment Exhaust	13	13
Worker Trips	0.09	0.09
Total for Building Construction	13	13
Significance Threshold	82	82

The analysis above assumes that the cut and fill on the construction sites would be balanced, and thus soils would not have to be hauled in or out of the area; however, off-haul for asphalt paving is included in the analysis. Table 4.3-10 shows total construction-related PM₁₀ emissions for each phase of construction compared to the MBUAPCD-recommended PM₁₀ emission threshold. If simultaneous construction activities occur on about 6.75 acres, emissions from construction activities associated with new development under the proposed 2005 LRDP would be less than significant. Nevertheless, LRDP

Mitigation AIR-1 is recommended to minimize short-term construction emissions. These measures would reduce fugitive dust emissions by more than 50 percent.

The analysis above is based on the campus's best estimate of future construction activities that would take place concurrently. However, a future project involving more than 6.75 acres cannot be ruled out. Therefore, in conjunction with the environmental review of all future land disturbing construction projects, the Campus will estimate construction emissions and will apply LRDP Mitigation AIR-1 to minimize emissions. The Campus will use the MBUAPCD guidance to evaluate the construction emissions from future projects.

LRDP Impact AIR-2: Campus growth under the 2005 LRDP would result in daily operational emissions above the MBUAPCD thresholds, and therefore the proposed project may contribute substantially to a violation of air quality standards or hinder attainment of the regional air quality plan.

Significance: Significant

LRDP Mitigation AIR-2A: The Campus shall consider design and construction features that reduce natural gas dependence in the design of each new project, and incorporate those measures that are feasible and that would be effective for the site, such as:

- Orientation of buildings to optimize solar heating and natural cooling
- Use of solar or low-emission water heaters in new buildings
- Install best available wall and attic insulation in new buildings

LRDP Mitigation AIR-2B: The Campus shall implement LRDP Mitigation TRA-1B to reduce motor vehicle trips.

LRDP Mitigation AIR-2C: The Campus shall install VOC and NO_x controls on the new gas turbines to reduce emissions by 90 percent (e.g., Oxidation catalyst and SCR).

Residual Significance: Significant and unavoidable

Increased emissions would result from stationary, area, and mobile sources that would be added to the campus under the 2005 LRDP. Estimated emissions from each of the future sources are reported below. The emissions from the individual sources are then summed together to present the total increase in emissions of criteria pollutants as a result of the 2005 LRDP and the increase is compared to the significance thresholds established by the MBUAPCD for evaluation of significant impacts.

Nonresidential Space and Water Heating

As discussed in Section 4.3.2.2, *Analytical Method*, above, natural gas consumption for nonresidential building space heating was estimated based on projected square footage of new buildings and expected

loads. Based on these estimated consumption rates, daily emissions of criteria pollutant from space and water heating of nonresidential buildings associated with the 2005 LRDP were estimated, as presented in Table 4.3-11. These values conservatively assume the peak hourly load occurs 24 hours a day, although peak load would normally be expected to occur for only a portion of the day.

**Table 4.3-11
Emissions from Space and Water Heating of Nonresidential Buildings**

Source	VOC	NO _x	PM ₁₀	CO	SO _x	Units
Non-residential Buildings	19.2	349	26.5	293	2.1	lb/day

Residential Space and Water Heating and Consumer Products

Criteria pollutant emissions resulting from burning of natural gas for space and water heating of residential units and use of consumer products were estimated using URBEMIS2002. With 125 additional townhouses and 969 additional apartment-style units under the 2005 LRDP, emissions were estimated as shown in Table 4.3-12.

**Table 4.3-12
Emissions from Residential Space and Water Heating and Consumer Products**

Source	VOC	NO _x	PM ₁₀	CO	SO _x	Units
Space/Water Heating	1	14	0	6	0.0	lb/day
Consumer Products	54	0	0	0	0.0	lb/day
Total	55	14	0	6	0.0	lb/day

Emergency Generators

The routine testing of emergency generators that run on natural gas would generate criteria pollutant emissions. Emissions were calculated by conservatively assuming that up to three small (60 MW) and two large (250 MW) generators would be tested for 1 hour on the same day. The resulting emissions are presented in Table 4.3-13.

**Table 4.3-13
Emergency Generator Testing Emissions**

Source	VOC	NO _x	PM ₁₀	CO	SO _x	Units
Emergency Generators	1	7	0.1	4	0.004	lb/day

Expansion of Cogeneration System

Based on the method described in Section 4.3.2.2, *Analytical Method*, the change in emissions that would result from replacing the existing cogeneration system with two 5 MW gas turbines was estimated. Table 4.3-14 presents the emissions from the cogeneration system with additional emissions control, the new emissions when this system is replaced with the two 5 MW gas turbines, and the difference in emissions.

**Table 4.3-14
Summary of the Cogeneration System Emissions**

Option	VOC	NO _x	PM ₁₀	CO	SO _x	Units
Existing Cogeneration Facility	29	21	8	300	1	lb/day
Proposed Facility (Two 5 MW NG Gas Turbines)	6	38	14	48	2	lb/day
Difference	-23	17	6	-252	1	lb/day

Note:

Negative numbers represent a decrease in emissions relative to the existing case (i.e., the proposed new gas turbines have a beneficial effect in reducing emissions).

As shown in this table, the new gas turbines (resulting in greater capacity) would increase NO_x, PM₁₀, and SO_x emissions, but would decrease VOC and CO emissions compared to the existing cogeneration system.

Motor Vehicles

Vehicle emissions were estimated using EMFAC2002 as described in Section 4.3.2.2, *Analytical Method*. Campus growth under the 2005 LRDP would generate 10,590 new vehicle trips per day in 2020. The emissions from these daily vehicle trips are shown in Table 4.3-15.

**Table 4.3-15
Estimated 2020 Vehicle Emissions**

	ROG	NO _x	Units
Per Mile Emission Factor	0.000607	0.000823	lb/mi
Per Trip Emission Factor	0.001112	0.001112	lb/trip
Per Vehicle Emission Factor	0.002303	0	lb/vehicle
Total Trips	10,590		trips
Miles/trip	10		mi/trip
Total Miles	105,900		mi
Ratio of Trip/Vehicles	2		trips/vehicle
Total Vehicles	5,295		vehicles
Emissions Effected by Miles Driven	64.2	87.1	lb/day
Emissions Effected by Number of Trips	11.8	11.8	lb/day
Emissions Effected by Number of Vehicles	12.2	0	lb/day
Total Emissions	88	99	lb/day

Total Emissions

Table 4.3-16 summarizes the emissions in 2020 from all campus sources.

**Table 4.3-16
Summary of 2020 Emissions from All New Sources**

Sources	VOC	NO _x	PM ₁₀	CO	SO _x	Units
Nonresidential NG Space and Water Heating	19.2	349	26.5	293	2.1	lb/day
Residential NG Space and Water Heating	1	14	0	6	0	lb/day
Consumer Products	55	0	0	0	0	lb/day

Emergency Generators	1	7	0.1	4	0.004	lb/day
Motor Vehicles	88	99	--	--	--	lb/day
Cogeneration System (Change in Emissions)	-23	17	6	-252	1	lb/day
Total	141	486	33	51	3	lb/day
Significant Threshold	137	137	82	550	150	lb/day

Notes:

Shaded cells indicate emissions that exceed significance thresholds.

As Table 4.3-16 shows, VOC and NO_x emissions from campus growth under the 2005 LRDP are predicted to exceed the MBUAPCD emission threshold of 137 lbs per day. Emissions of all other pollutants are predicted to be below the significance thresholds. The major contributors to VOC and NO_x emissions are motor vehicles and space heating of the nonresidential units, respectively. As noted earlier, some of these emission estimates are conservative and therefore likely overstate the impacts. Space heating emissions are responsible for about 65 percent of the total emissions of VOC, and the space heating emissions estimates conservatively assume the peak hourly load occurs 24 hours a day when it is likely to occur for only a portion of the day. To address this impact, the Campus would implement LRDP Mitigations AIR-2A through 2C. LRDP Mitigations AIR-2A and AIR-2B would reduce VOC and NO_x emissions from buildings and vehicle emissions, and LRDP Mitigation AIR-2C would reduce VOC and NO_x emissions from the proposed gas turbines. In addition, when the guidelines for sustainable transportation initiatives are developed by the University of California, the Campus will implement programs with goals to reduce greenhouse gas emissions, especially through conversion of campus fleets to low or zero emission vehicles and through the use of alternate fuels. The three mitigation measures listed above are expected to reduce VOC to less-than-significant levels. The three measures would also reduce NO_x emissions, but not likely to less-than-significant levels.

LRDP Impact AIR-3: Traffic generated by development under the 2005 LRDP, in conjunction with traffic associated with other regional growth, would result in an increase in local CO concentrations at study area intersections.

Significance: Less than significant

LRDP Mitigation: Mitigation not required

Residual Significance: Not applicable

Several intersections were found to exceed the screening threshold identified in Section 4.3.2.2, *Analytical Method*. Therefore, the three intersections with the highest delay and three intersections with the highest traffic volume were evaluated for CO concentrations using CALINE4. The six intersections selected for modeling included:

- Empire Grade Road/Western Drive
- Mission Street/Bay Street
- Mission Street/King Street
- Mission Street/Highway 1

- Highway 1/River Street
- Highland Avenue/High Street

The Mission Street/King Street and Mission Street/Highway 1 intersections are within approximately 500 feet of each other and, therefore, may contribute to each other's local CO concentration. However, due to the limitation of the CALINE4 model, these two intersections had to be modeled separately. To account for the proximity of the two intersections, the Mission Street/King Street receptors were added to the Mission Street/Highway 1 model and vice versa. The maximum predicted concentrations at the receptors from each intersection alone were added together to obtain a concentration that included the contribution from each of the two intersections. This was a conservative approach inasmuch as the maximum predicted concentrations at the two intersections occurred under different wind conditions.

Tables 4.3-17 and 4.3-18 below summarize the predicted concentrations for the 2020 traffic conditions. Background concentrations refer to ambient CO concentrations based on monitoring in the county. For 2020, CO concentrations due to traffic associated with both a "2020 without-project" and a "2020 with-project scenario" (traffic increase under the 2005 LRDP, including 2300 Delaware Avenue) were estimated. These concentrations were then added to the background concentrations, and the results are reported in Table 4.3-15.

Table 4.3-17
Predicted 1-Hour Average CO Concentrations (in ppm)

Intersection Standard	Background^a	2020 –Without-Project Scenario Plus Background	2020-With-Project Scenario Plus Background
Empire Grade Road/ Western Drive	2.1	2.9	3.0
Mission Street/ Bay Street	2.1	6.8	7.8
Mission Street/ King Street	2.1	7.7	8.0
Mission Street/ Highway 1	2.1	7.8	8.1
Highway 1/ River Street	2.1	6.6	6.8
Highland Ave/ High Street	2.1	3.4	3.5
State Standard		20	20
Federal Standard		35	35

Notes:

(a) Background concentrations represent the highest concentrations recorded in recent years. The concentration data in this table are from 2004.

Table 4.3-18
Predicted 8-Hour Average CO Concentrations (in ppm)

Intersection	Background^a	2020 –Without-Project Scenario Plus Background	2020 With-Project Scenario Plus Background
Empire Grade Road/ Western Drive	1.0	1.5	1.5
Mission Street/ Bay Street	1.0	3.8	4.4
Mission Street/ King Street	1.0	4.4	4.5
Mission Street/ Highway 1	1.0	4.4	4.6

Highway 1/ River Street	1.0	3.7	3.8
Highland Ave/ High Street	1.0	1.8	1.8
State Standard		9.0	9.0
Federal Standard		9	9

Notes:

(a) Background concentrations represent the highest concentrations recorded in recent years. The concentration data in this table are from 2001.

A persistence factor of 0.6 was applied to the 8-hour predicted CO concentrations to arrive at the 1-hour predicted CO concentrations (without background).

The resulting analyses showed that predicted CO concentrations would be less than significant at all six intersections analyzed. The maximum predicted 1-hour and 8-hour average CO concentrations were 8.1 ppm and 4.6 ppm at the Mission Street/Highway 1 intersection for the 2020 With LRDP Project scenario. Again, the concentrations at this intersection are likely overpredicted because of the conservative approach used to account for the influence of the adjacent intersection. Since the intersections analyzed had either the highest delay or the highest traffic volumes, the other intersections not analyzed are expected to experience even smaller, less-than-significant impacts related to CO concentrations.

LRDP Impact AIR-4: Growth associated with the 2005 LRDP would conflict with the Air Quality Management Plan.

Significance: Significant

LRDP Mitigation AIR-4A: The Campus will work with AMBAG to ensure that campus growth associated with the 2005 LRDP is accounted for in the regional population forecasts.

LRDP Mitigation AIR-4B: The Campus will work with MBUAPCD to ensure that the campus growth-related emissions are accounted for in the regional emissions inventory and mitigated in future regional air quality planning efforts.

Residual Significance: Significant and unavoidable

The MBUAPCD considers any project that is not consistent with the Air Quality Management Plan (AQMP) to be cumulatively significant. AQMP are developed for regions that do not meet ambient air quality standards. The region currently is not in attainment of the state ozone and PM₁₀ standards. To satisfy the California Clean Air Act, an AQMP was developed to show how the region would comply with the state ozone standard. The plan was last updated in 2004 (MBUAPCD 2004b). The AQMP projects ozone precursor emissions (VOC and NO_x) from stationary, area, and mobile sources in the region, and develops mitigation measures to reduce such emissions so that the region can eventually achieve attainment of the ozone standard.

The plan is based on population forecasts prepared by the Association of Monterey Bay Area Governments (AMBAG). In a consistency determination performed at the request of the Campus, AMBAG determined that the growth of the campus projected under the 2005 LRDP was not accounted for in AMBAG forecasts (AMBAG 2005), and therefore, the 2005 LRDP would not be consistent with the AQMP. This is considered a cumulatively significant impact. LRDP Mitigation AIR-4A and AIR-4B would require the Campus to work closely with AMBAG to ensure that campus growth under the 2005

LRDP is accounted for in the regional population forecasts, and with MBUAPCD to ensure that emissions from campus growth under the 2005 LRDP are accounted for in future air quality plans. Nevertheless, even with the implementation of these mitigation measures, the increase in emissions from campus growth under the 2005 LRDP may hinder the region's attainment of air quality standards. Thus the 2005 LRDP may result in a significant and unavoidable impact on regional air quality.

LRDP Impact AIR-5: Campus operations under the 2005 LRDP would not result in a substantial human health risk to campus occupants and other populations in the vicinity of the campus from long-term exposures to TACs, but would result in a substantial health risk to campus occupants at certain on-campus locations from short-term exposures to TACs.

Significance: Significant

LRDP Mitigation AIR-5: The Campus shall develop and implement an emergency generator maintenance testing schedule consistent with Table 4.3-22.

Residual Significance: Less than significant

UC Santa Cruz conducted an HRA to identify potential human health risks associated with routine operations anticipated to occur under the 2005 LRDP (URS 2005). An HRA characterizes human health risks as a result of exposure to toxic substances. In order to assess potential health risks associated with the full development under the 2005 LRDP, total health risks for the academic year 2020-21 were evaluated for existing campus routine operations combined with routine operations associated with future development. The HRA included TAC emissions associated with existing and future (1) laboratory operations; (2) natural gas and diesel fired stationary combustion sources (such as boilers at the Central Heating Plant, boilers in individual buildings, internal combustion engines at the Cogeneration Plant, and routine firing of back-up emergency generators for maintenance and testing purposes); (3) diesel-fueled mobile sources (delivery trucks, METRO buses and campus shuttles) on campus roadways; and (4) painting operations.

To estimate human health risk from exposure to TAC concentrations at locations throughout the campus and in adjacent areas, a grid of receptor points at every 50 meters (164 feet) along the campus boundaries and a sparser 100-meter grid of receptors outside of the campus boundary were utilized. Within the campus boundaries, receptors were placed at buildings where students or employees would be present. In the discussion below, the term "receptor" is used to note the grid locations where the impacts would be experienced. There may or may not be a person/residence at each of these receptor locations. Each receptor is assigned a number (Receptor #464, 108, etc.). The other term used in the discussion below is "sensitive receptor," which in fact represents the location of a real existing/planned receptor such as a school, residential area, or childcare center or an on-campus college. Other key phrases used below include "residential exposure," which is the length of time that a person living in a residence near a TAC source could be exposed to TAC emissions (a period of 70 years is used in the analysis below), and "occupational exposure," which is the reduced length of time a person working or studying in an area near a TAC source would be exposed to TAC emissions (a period of nine years is used in the analysis below).

Components of the Health Risk Assessment

An HRA consists of four basic steps to assess potential public health risk. First, the TACs to be evaluated are identified and emissions quantified. This was accomplished by a review of activities and materials that are part of the existing campus operations and proposed new development. Emissions were quantified from data previously submitted by UC Santa Cruz to MBUAPCD in response to AB 2588 requirements, and from data developed as part of the planning process for future construction. Second, ground-level concentrations resulting from the transport and dilution of these emissions through the atmosphere were assessed by air dispersion modeling. The U.S. EPA-approved Industrial Source Complex Short Term 3 (ISCST3) dispersion model as implemented in the California Air Resources Board's (CARB) Hotspots Analysis and Reporting Program (HARP) was used for this assessment. Third, potential public exposures to these compounds resulting from atmospheric transport were calculated. For this step, methods from current OEHHA guidance (OEHHA 2000) for exposure assessments from inhalation and non-inhalation exposure pathways as implemented in HARP were employed. Exposure pathways evaluated included direct inhalation, soil ingestion, dermal absorption, mother's milk, and consumption of locally grown produce. Finally, potential cancer and non-cancer health risks resulting from the calculated exposures were estimated using dose-response relationships developed from toxicological data as implemented in HARP. The details of the steps summarized above can be found in the *Air Toxics Health Risk Assessment for the University of California Santa Cruz 2005 Long Range Development Plan* (URS 2005).

Results of the Health Risk Assessment

Cancer Risk. Table 4.3-19 summarizes the results of the HRA at off-campus and on-campus maximally exposed individual (MEI) locations. An off-campus MEI location indicates a location where a hypothetical person is assumed to reside for 70 years and to be exposed continuously during this period to TAC emissions from campus operations (also called residential exposure). An on-campus MEI location is a location on campus where a hypothetical person is assumed to reside, work or study for a period of 9 years and to be exposed continuously during this period to TAC emissions from campus operations (also called occupational exposure). As a result of the shorter duration of exposure at the on-campus MEI, the calculated risk is lower than the risk at the off-campus MEI. As noted earlier, for carcinogens, the MBUAPCD uses a cancer risk level of 10 in one million for an exposure period of 70 years.

The highest calculated lifetime cancer risk from total combined academic year 2020-21 operations (current emission sources with appropriate growth factors and projected emission sources associated with planned growth identified in the 2005 LRDP) is calculated to be 5.41 in one million at Receptor #264 located on the western boundary of the campus, west of Kresge College. This risk is representative of the theoretical maximum off-site residential exposure, although at this location on the campus's western boundary, there are in fact no residences, schools, or other sensitive receptors present at this time, nor would they be established in the future, as the area is part of Wilder State Park. As shown in Table 4.3-20, 84 percent of the cancer risk at this location is associated with stationary sources on campus, while 16 percent of the cancer risk is associated with mobile sources. The largest contributors to the stationary source cancer risk are the polycyclic aromatic hydrocarbon (PAH) emissions from the two proposed gas turbines that would comprise the new cogeneration facility. These two gas turbines would replace the internal combustion (IC) engine at the campus cogeneration plant that currently provides cogeneration

capacity. These risks were calculated assuming that the MEI would remain at this location continuously for a 70-year period. As noted above, there are no residences at Receptor #264 where the highest off-campus cancer risk is predicted. The cancer risk at all other off-campus locations, including all off-campus residences would be lower than 5.41 in a million.

Table 4.3-19
Results of UC Santa Cruz 2020 Health Risk Assessment of
Emissions from Routine Operations

Health Risk	Off-Campus MEI ^a	On-Campus MEI ^b	Significance Level
Cancer Risk	5.41 in one million	2.48 in one million	10 in one million
Chronic Hazard Index	0.04	0.08	1.0
Acute Hazard Index	0.66	1.34 ^c	1.0

Notes:

(a) The maximum off-campus cancer risk was calculated at Receptor #264 located on the western boundary of the campus west of Kresge College. The maximum off-campus chronic hazard index was calculated at Receptor # 250 approximately on the western boundary of campus west of Porter College. The maximum off-site acute hazard index was calculated near Receptor #108 located on the UC Santa Cruz eastern boundary between Crown and Cowell Colleges.

(b) The maximum on-campus cancer risk was calculated at Receptor # 437, a hypothetical student or employee at a receptor located near College Nine assuming a 9-year exposure period. The maximum on-campus chronic hazard index was calculated at Receptor # 436, a hypothetical student located near Science & Engineering Library South, and the maximum on-campus acute hazard index was calculated at Receptor #434, a receptor located near Baskin Engineering.

(c) Shaded cell indicates significant impact.

For the on-campus MEI (Receptor # 437), a hypothetical student or employee at a receptor located near College Nine), the highest cancer risk is calculated to be 2.48 in one million, with the two proposed gas turbines contributing about 76 percent, the Central Heating Plant back-up generator contributing about 16 percent, mobile sources contributing about 6 percent, and all other emissions combined contributing 2.0 percent, as shown in Table 4.3-20. The on-site MEI was assumed to be continuously exposed over a 9-year period, a conservative exposure scenario that is in accordance with the OEHHA guidelines for assessing potential health risks.

Table 4.3-20
Source Contribution of Cancer Risks at MEI from Routine Operations
(Lifetime Cancer Risk; Chances in One Million)

Source Categories	Off-Campus MEI ^a		On-Campus MEI ^b	
	Risk	Percent	Risk	Percent
New Turbines	3.70	68.39%	1.89	76.11%
Mobile Sources	0.85	15.75%	0.14	5.74%
Central Plant Back-Up Generator	0.74	13.62%	0.40	16.22%
Fume Hoods	0.06	1.17%	0.02	0.84%
Boilers, Small	0.03	0.59%	0.01	0.50%
Central Plant Boilers	0.02	0.35%	0.01	0.43%
OPERS Cogeneration Plant	0.01	0.13%	0.00	0.08%
Paint Booths	0.00	0.01%	0.00	0.00%
Generators, Small	0.00	0.00%	0.00	0.00%
Total Health Risk	5.41	100%	2.48	100%

Notes:

(a) The maximum off-campus cancer risk was calculated at Receptor # 264 located on the western campus boundary west of Kresge College, where a 70-year exposure period was assumed.

(b) The maximum on-campus cancer risk was calculated at Receptor # 437 for a hypothetical student at a receptor located near College Nine, where a 9-year exposure period was assumed.

In addition to the maximum cancer risk at an on-campus and an off-campus location, the HRA modeling also included specific on- and off-campus locations for which health risks to students and children were estimated.

For daycare/school locations, the exposure duration used in the modeling was 24 hours/day, 365 days/year for nine years. Furthermore, cancer risk predictions were adjusted to account for a child's smaller body weight and faster breathing rates. The 2005 HRA that supports this EIR discusses this in more detail (URS 2005). As shown in Table 4.3-21, the estimated cancer risk at all modeled locations would be less than 2.5 in a million, and for off-campus schools and daycare centers in the surrounding area, the calculated risks are lower than for the on-campus daycare and school locations, and well below the significance thresholds.

Table 4.3-21
UC Santa Cruz 2020 Cancer Risks at Sensitive Receptor Locations due to
Emissions from Routine Operations

Location	Description	Exposure Assumption	Cancer Risk ^a
Arts	On Campus	Student	0.38
Kresge College	On Campus	Student	0.43
Baskin Engineering	On Campus	Student	1.92
Sinsheimer Labs East	On Campus	Student	1.09
Science & Engineering Library South	On Campus	Student	1.65
College Nine	On Campus	Student	2.48
Crown College	On Campus	Student	0.80
Graduate Student Commons	On Campus	Student	0.49
Student Union Redwood Bldg East	On Campus	Student	0.55
Cowell College	On Campus	Student	0.68
Cowell College South	On Campus	Student	0.46
FSH Day Care Center	On Campus	Child	0.54
Granary Child Care Center	On Campus	Child	0.12
Holy Cross Preschool	Off Campus	Off-Site Worker ^b	0.76
Messiah Lutheran Preschool	Off Campus	Off-Site Worker ^b	0.16
Westlake Elementary Preschool	Off Campus	Off-Site Worker ^b	0.30
Santa Cruz Waldorf School	Off Campus	Off-Site Worker ^b	1.48
Harvey West Children's Center	Off Campus	Off-Site Worker ^b	0.09
Johnny Crow's Garden	Off Campus	Off-Site Worker ^b	0.11
Neighborhood Child Care	Off Campus	Off-Site Worker ^b	0.15

Notes:

(a) Reported in units of number in one million. Significance threshold is equal to or greater than 10 in one million.

(b) At these locations, the calculated risk for workers is higher than for the children; therefore the higher (worker) cancer risk at these locations is reported in this table.

Non-Cancer Risk

Non-cancer health risk is assessed by the “hazard index,” which is the sum of the ratios of each chemical’s actual exposures to acceptable exposures. Hazard indices are calculated for both long-term (chronic) and short-term (acute) health effects. Chronic non-cancer health effects are estimated based on constant exposure to TACs for a 70-year period. Acute health effects are estimated based on exposure to TACs over a period of 1-hour. Hazard indices less than 1.0 indicate an acceptable non-cancer health risk.

The highest calculated chronic hazard index from long-term exposures for the off-campus MEI is calculated to be 0.04 at Receptor #250 located approximately 500 m (about 1,640 feet) southeast of Receptor #264 on the western campus boundary. The highest calculated acute hazard index from short-term exposures is calculated to be 0.66 at Receptor #108, located on the eastern boundary of the campus between Crown and Cowell Colleges (Table 4.3-19).

The highest calculated chronic hazard index from long-term exposures for the on-campus MEI is about 0.08 for a hypothetical student at a location near Science & Engineering Library South). The highest calculated acute hazard index from short-term exposures is calculated to be 1.34 for a hypothetical student at a receptor located near Baskin Engineering. In addition to this location, the acute hazard index would exceed 1 at two other locations in the central portion of the campus core.

With respect to potential non-residential child exposures, the estimated chronic and acute hazard index values for all schools and daycare centers on campus and in the surrounding area are lower than the on-campus MEI locations summarized above, with hazard indices well below 1.

Conclusion

In summary, the total estimated cancer risk from UC Santa Cruz routine campus operations for academic year 2020-21 is predicted to be below the threshold of 10 in one million for both the off-campus and on-campus MEI. This includes emissions from all current campus operations and future sources under the 2005 LRDP. Similarly, the total estimated long-term (chronic) non-cancer hazard indices for academic year 2020-21 are projected to be below the significance threshold for both on-campus and off-campus MEI locations. Finally, the total estimated short-term (acute) non-cancer hazard index for academic year 2020-21 for the off-campus MEI location is projected to be below the significance threshold while that for the on-campus MEI location is projected to exceed the significance threshold. The short-term (acute) hazard index exceeds the significance threshold at three locations on the campus, driven primarily by acrolein emissions from the back-up/emergency generators at the Central Heating Plant and in the Science Hill area.

In the analysis above, it was conservatively assumed that as part of the routine maintenance program, all back-up/emergency generators would be tested at the same time during a 1-hour period. If this were indeed the case, the TAC emissions from campus growth under the 2005 LRDP would result in a significant impact related to the human health effects from acute exposure to a variety of TACs, most notably to acrolein, a TAC that is associated not only with diesel but also with other fossil fuels. The emission sources that together would cause almost 40 percent of this risk are the diesel-fueled emergency generator at the Central Heating Plant and 14 new emergency generators in new buildings in the northern portion of the campus core.

Because this impact is the result of exposure to concentrated emissions in one hour, this impact can be avoided by limiting the number of emergency generators in the central campus that are operated simultaneously in one hour. To reduce the emissions from generators, the Campus would implement LRDP Mitigation AIR-5, according to which the Campus will develop and implement an emergency generator maintenance testing schedule. According to the Campus, under the quarterly testing program, up to three backup generators may be tested in one hour, running for up to one and one-half hours each run. To ensure that the predicted hazard index for acute exposures (HIA) value of 1.0 is not exceeded, a testing schedule would be enforced consistent with Table 4.3-22 below. As the table shows, if the Central Plant Generator is run for a given hour and no other backup generator is tested during the same hour, the HIA value is predicted to be 0.97. Should the Central Plant Generator be tested in a given hour and one other large (100 kW) backup generator be tested in that same hour, the total predicted HIA for that hour would then be a maximum of 0.996, rounding to 1.0. If two smaller (25 kW each) backup generators are tested in the same hour as the Central Plant Generator, the HIA value is predicted to be 0.982, rounded to 0.98. If the Central Plant Generator is not operated in a given hour, the operation of three larger (100 kW each) generators would result in a predicted HIA of 0.78. Therefore, if maintenance testing of the new generators were performed under any of the scenarios presented in Table 4.3-22 below, HIA value of 1 would not be exceeded.

Table 4.3-22
Generator Maintenance Testing Scenarios

Equipment	Scenario			
Equipment Operating In a Given Hour	1	2	3	4
Central Plant Generator:	Y	Y	Y	N
No. of Large (100 kW) Generators	1	0	0	3
No. of Small (25 kW) Generators	0	2	0	0
Predicted HIA	1	0.98	0.97	0.78

Note:

In addition to the Central Plant Generator, the maximum impact is from the planned generators in the Physical/Biological Sciences area. Therefore, maximum impacts are calculated using these generators. Impacts would be less when testing generators in other areas of the main campus.

Under existing conditions on campus, testing is also performed every 6 weeks for the backup generators. Each generator runs for 15 minutes, one generator at a time. Calculations of predicted HIA were also performed for this scenario. If the Central Plant Generator and up to three large (100 kW each) generators were run in one hour back-to-back, the predicted maximum HIA value is 0.79. With the hourly impact divided by 4 (4-15 minute sections per hour), the emissions and resulting impact of each generator is cut by 75 percent, and therefore, under the current maintenance testing program, an impact is not expected from 6-week testing methods.

In summary, maintenance testing of the emergency generators consistent with the scenarios in Table 4.3-22 would reduce the impact from short-term exposures of TACs from routine campus operations to a less-than-significant level.

LRDP Impact AIR-6: Construction activities under the 2005 LRDP could potentially result in a substantial health risk to campus occupants at certain on-campus locations from short-term exposures to TACs.

Significance: Speculative

LRDP Mitigation AIR-6: The Campus will minimize construction emissions by implementing measures such as those listed below:

- Require the use of cleaner fuels in construction equipment
- Require that construction contractors use electrical equipment where possible
- Require construction contractors to minimize the simultaneous operation of multiple pieces of equipment at a construction site
- Discourage idling of construction equipment and vehicles
- Schedule operations of construction equipment to minimize exposure as much as possible

Residual Significance: NA

The MBUAPCD requested that UC Santa Cruz conduct a HRA to identify potential health risks associated with emissions of TACs from potential construction projects in the future. UC Santa Cruz has conducted the requested analysis even though there is no established methodology to model human health risk from future construction activities that would occur under a development program such as the 2005 LRDP. Unlike stationary sources that emit TACs from fixed locations, construction activity under the 2005 LRDP would not remain at any location for the entire length of time that is modeled for exposure. Therefore, there is no reasonable way to model the effects of construction activities without making certain simplifying assumptions, which then provide results that are not reliable. Furthermore, there is a high degree of uncertainty regarding the emissions of acrolein from combustion engines, including mobile combustion engines such as those used during construction. Acrolein is a TAC that is present in diesel exhaust as well as natural gas. There are no emission factors available for acrolein emissions from construction equipment. The emission factor for acrolein emissions from construction emission sources was derived as a fraction of the total organic compounds from the exhaust. This approach was suggested by the EPA (EPA 2005b) and it is also consistent with the approach recommended by MBUAPCD. This estimate was derived by applying an acrolein factor used in the EPA mobile equipment model MOBILE 6.2 to the total organic gas emissions rather than directly measuring acrolein in the exhaust. This method invariably produced uncertainty in estimations since emission factors for general categories of equipment are always conservative and each piece of equipment has its own emission characterization. The California Air Toxics Emission Factor (CATEF) database on the CARB website casts doubt on the accuracy of the acrolein emission factor derivation method. CARB staff has also stated that the actual analytical method used to estimate acrolein emissions is highly unreliable, that a reliable test method does not currently exist, and that the test method used may over- or underestimate the actual emission factor

(CARB 2005b, c). Until such a time as a dependable method is available, acrolein emission factors used in a health risk assessment are subject to significant uncertainty.

Despite these issues, UC Santa Cruz has developed estimates of potential human health effects from future construction activities on the campus. The analysis is described in greater detail in the *Air Toxics Health Risk Assessment for the University of California Santa Cruz 2005 Long Range Development Plan* (URS 2005). As discussed earlier in Section 4.3.2.2, *Analytical Method*, based on a review of future projects as well as a review of recent construction projects on the campus, three hypothetical construction projects covering an area of 0.95 acres, 2.3 acres, and 3.5 acres, for a total of 6.75 acres of land area, and together involving a building area of about 270,000 square feet, were modeled. The construction emissions of TACs from these hypothetical construction projects were modeled assuming that one building project would be located on the central campus near the intersection of McLaughlin Drive and Hagar Drive, the second one would be in the Arts area, and the third one would be north of the central campus near the north remote parking lot, and that there would be continuous construction at these sites during each of the 15 years that comprise the timeline of the 2005 LRDP. In reality, construction would not occur at these three locations continuously for 15 years, but would instead be located only for 2 or 3 years, at the most, at any construction site. However, it is assumed that comparable projects would be underway at other locations on the campus.

Table 4.3-23 shows the results from modeling based on the assumptions above. These results show that the maximum lifetime cancer risks from construction emissions during the 15-year LRDP period at the on-campus MEI (Receptor #434) would be 5.95 in one million and at the off-campus MEI (Receptor #73) it would be 2.89 in one million. The on-campus cancer MEI is located at a receptor located at Baskin Engineering, and the off-campus MEI is located on the campus boundary directly north of College Nine.

The highest estimated chronic non-cancer hazard index on campus is 0.05 at Receptor #434, a receptor located near Baskin Engineering. The highest chronic non-cancer hazard index off campus at Receptor #77 is 0.01, about 200 meters (656 feet) east of the vertex of the northeast boundary, directly north of College Nine.

The highest estimated acute non-cancer hazard indices on-campus and off-campus are 4.64 and 1.53, respectively, and are at Receptor #434, at Baskin Engineering, and at Receptor #253, located on the campus boundary directly west of the northern section of Porter College. There are no established residential or other uses near the campus boundary in the vicinity of Receptor #253.

Table 4.3-23
Results of UC Santa Cruz 2020 Health Risk Assessment of
Emissions from Construction Projects

Health Risk	Off-Campus MEI ^a	On-Campus MEI ^b	Significance Level
Cancer Risk	2.89 in one million	5.95 in one million	10 in one million
Chronic Hazard Index	0.01	0.05	1.0
Acute Hazard Index	1.53	4.64	1.0

Notes:

(a) The maximum off-campus cancer risk was calculated at Receptor # 73 located on the campus boundary directly north of College Nine, where a 70-year exposure period was assumed. The maximum off-campus chronic hazard index was calculated at Receptor #77 located 200 meters (656 feet) east of Receptor #73. The maximum off-campus acute hazard index was calculated near Receptor #253 located on the UC Santa Cruz boundary directly west of the northern section of Porter College.

(b) The maximum on-campus cancer risk, chronic hazard index and acute hazard index were calculated at Receptor #434 located near Baskin Engineering.

In summary, based on the hypothetical construction scenario, the total estimated cancer risk from projected construction projects at UC Santa Cruz over the 15-year LRDP period is predicted to be below 10 in one million for both the off-campus and on-campus MEI. Similarly, the total estimated chronic non-cancer hazard indices are projected to be below the value of 1 at the MEI locations. However, the total estimated acute non-cancer hazard indices for the on-campus and off-campus MEI location would exceed the value of 1. The acute hazard index also exceeds the value of 1.0 at 11 sensitive receptor locations on the campus, but there would be no off-campus exceedances.

The acute hazard index is driven by acrolein emissions from off-road equipment doing building construction. As noted earlier, there is a high level of uncertainty with respect to the emissions of acrolein from construction equipment. Therefore the reliability of this analysis is uncertain. This analysis was included in this EIR at the request of the MBUAPCD, but because of the uncertainty with respect to the results of this analysis, no conclusion as to the significance of the impact can be reached. The Campus will nonetheless implement LRDP Mitigation AIR-6 in conjunction with construction projects on the campus to minimize TAC emissions to the maximum extent feasible.

4.3.2.4 Cumulative Impacts and Mitigation Measures

According to MBUAPCD CEQA Guidelines, “A consistency analysis and determination serve as the project’s analysis of cumulative impacts on regional air quality. Project emissions which are not consistent with the AQMP are not accommodated in the AQMP and will have a significant cumulative impact unless offset.” The analysis of consistency is performed by AMBAG for population-related projects and by the Air District for all others. As discussed above under LRDP Impact AIR-4, given that campus growth under the LRDP is not accounted for in the regional population forecasts, the project is not consistent with the AQMP, and would therefore result in a cumulatively considerable contribution of ozone precursors to the regional air basin. The Campus would implement LRDP Mitigations AIR-2A through AIR-2C and LRDP Mitigation AIR-4A and AIR-4B to minimize operational emissions and address the emissions that would result from campus growth under the 2005 LRDP, but the cumulative impact would remain significant and unavoidable.

With respect to emissions of localized pollutant PM₁₀, emissions of PM₁₀ from construction activities on campus would not cumulate with those from other off-campus construction sites; and therefore, there is no potential for a cumulative impact.

With respect to emissions of localized pollutant CO, LRDP Impact AIR-3 evaluates CO concentrations at study area intersections that would result under two scenarios: a 2020 Without LRDP Project scenario which estimates increase in CO concentrations as a result of the increase in background traffic volumes between now and 2020, and a 2020 With LRDP Project scenario, which includes 2005 LRDP-related traffic volumes added to 2020 background volumes. Note that the 2020 background traffic volumes were derived from the AMBAG regional traffic model and reflect the increased traffic that would result from population and employment growth projected in the study area through 2020 by AMBAG. The analysis presented under LRDP Impact AIR-3, therefore, presents the cumulative CO impact, which is less than significant.

LRDP Impact AIR-7: Regional growth could result in an increase in toxic air contaminants but the implementation of technological improvements would reduce air toxics and associated human health risks.

Significance: Less than significant

LRDP Mitigation AIR-7: UC Santa Cruz will continue its efforts in the area of TAC emission reduction.

Residual Significance: Not applicable

As discussed under LRDP Impact AIR-5, the total estimated cancer risk from UC Santa Cruz campus operations for academic year 2020-21 is predicted to be below 10 in one million for both the off-campus and on-campus MEI assuming a 70-year exposure period. This includes all current campus operations and future 2005 LRDP projects. Similarly, the total estimated non-cancer chronic hazard indices for academic year 2020-21 are predicted to be below 1.0 at the MEI locations and, with mitigation, the non-cancer acute hazard indices would also be below 1.0 at the MEI locations. The proposed and future 2005 LRDP projects, a subset of these total health risk estimates, would contribute a portion of these totals. But cumulatively with all other campus operations, the estimated health risks are still below levels that would require public notification and emissions reduction actions by the MBUAPCD under the AB 2588 Air Toxics “Hot Spots” Law. For cancer risk, the MBUAPCD’s AB 2588 public notification level of 10 in one million matches the “no significant risk level” established under California’s Proposition 65, a level below which public notification of potential health risks is not required.

As discussed in Section 4.3.1.5, there are no ambient TAC monitors operated in Santa Cruz County. As an approximation of current TAC levels in the area, an average lifetime cancer risk from TACs for the year 2003 in the San Francisco Bay Area Air Basin of 630 in one million can be used, with about 480 in one million of this background risk coming from diesel particulate matter (CARB 2005a). Thus, diesel particulate matter emissions represent about 76 percent of the current background TAC cancer risk in the San Francisco Bay Area Air Basin. Since 1990, air toxics control programs have reduced the overall level of TACs in the San Francisco Bay Area Air Basin. In 1990, the cancer risk from 10 TACs was estimated

at 1,153 in one million, with 750 in one million coming from diesel particulate matter. In 2000, the TAC cancer risk was 659 in one million, with 480 in one million coming from diesel particulate matter (CARB 2005a).

With the exception of additional emissions controls at the campus cogeneration plant, current UC Santa Cruz operations were assessed assuming no retrofit controls, and emissions from future equipment were based on current new equipment performance standards. Through CARB's implementation of its adopted *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles* ("Risk Reduction Plan") (CARB 2000), as well as future potential U.S. EPA emission standards, diesel emission sources at UC Santa Cruz will likely undergo further emission reductions not accounted for in the HRA. The CARB Risk Reduction Plan has retrofit standards for existing engines and more stringent emission standards for new engines. New emergency generators must already be CARB-certified cleaner burning engines. CARB estimates that full implementation of the Risk Reduction Plan for all covered emissions units will reduce diesel emissions in the year 2010 by 75 percent over year 2000 levels. In addition, the U.S. EPA issued final rulemaking notices establishing more stringent federal emission standards for light-duty vehicles, heavy-duty vehicles, and nonroad engines. These rulemakings will phase in requirements to use cleaner burning EPA-certified diesel engines between 2004 and 2008.

As described above, despite the growth of UC Santa Cruz operations between 1990 and 2000, the average TAC background cancer risk has declined due to control measures that have included UC Santa Cruz operations. In addition, UC Santa Cruz has reduced diesel emissions where feasible by switching to natural gas, especially to operate the emergency and back-up generators. UC Santa Cruz will continue to implement diesel emission reduction efforts and will also be subject to required control measures in the future. UC Santa Cruz emission reductions in future years should continue to reflect the anticipated overall regional reductions in TAC levels.

In conclusion, TAC emissions from the 2005 LRDP in combination with existing campus operations are anticipated to decline due to implementation of new technologies to reduce air toxics, particularly from diesel engines. Furthermore, future operation of current campus activities, new campus projects and other air toxics sources in the region will be subject to future TAC emission control programs, and as such, regional TAC levels including future UC Santa Cruz operations are expected to continue to decline. Additionally, air toxics impacts generally are localized around emission sources, so impacts do not generally cumulate at a substantial distance. There are no reasonably foreseeable developments in the vicinity of the campus that would be significant sources of air toxics. In light of the priority being given to air toxics regulation by CARB and EPA, the significant programs presently under development, and the availability of technologies to achieve substantial additional TAC reductions, CARB's projections of continuing regional TAC reductions are well supported, resulting in a less-than-significant cumulative impact.

4.3.3 References

- AMBAG (Association of Monterey Bay Area Governments). 2005. Letter from Todd Muck, AMBAG Senior Transportation Planner, to S. Barati, URS Corporation, regarding a determination of consistency for the UC Santa Cruz 2005 Long Range Development Plan, dated July 14.
- Caltrans. 1989. CALINE4-A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, Version 4.
- Caltrans (California Department of Transportation). 2005. *Draft-Use of EMFAC2002 to Replace CT-EMFAC: A Users Guide*, accessed <http://www.dot.ca.gov/hq/env/air/emfac.htm> in August 2005.
- CARB (California Air Resources Board). 1998. *Initial Statement of Reasons for Rulemaking, Staff Report: Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant*. Prepared by the California Air Resources Board and Office of Environmental Health Hazard Assessment Staff. Cal/EPA. June.
- CARB (California Air Resources Board). 2000. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. Stationary Source Division and Mobile Source Division. October.
- California Air Resources Board (CARB). 2005a. The California Almanac of Emissions and Air Quality – 2005 Edition. Chapter 5 – Toxic Air Emissions, Air Quality, and Health Risks. <http://www.arb.ca.gov/aqd/almanac/almanac05/chap505.htm>
- California Air Resources Board (CARB). 2005b. Telephone conversation between Chris Halm of CARB and James Heumann of URS Corporation. September 9.
- California Air Resources Board (CARB). 2005c. Telephone conversation between Renaldo Crooks of CARB and James Heumann of URS Corporation. September 9.
- MBUAPCD (Monterey Bay Unified Air Pollution Control District). 2004a. CEQA Air Quality Guidelines. June.
- MBUACPD (Monterey Bay Unified Air Pollution Control District). 2004b. 2004 Air Quality Management Plan For the Monterey Bay Region, September.
- MBUAPCD (Monterey Bay Unified Air Pollution Control District). 2005. Telephone conversation between Bob Nunez of MBUAPCD and R. Shih of URS Corporation. September 2.
- UC Davis. 1997. *Transportation Project-Level Carbon Monoxide Protocol (CO Protocol)*. December.
- UC Santa Cruz. 2005. Draft Self-Generation/Cogeneration Feasibility Study. April 21. U.S. EPA (U.S. Environmental Protection Agency). 1998. AP-42 Compilation of Air Pollutant Emission Factors, Chapter 1 External Combustion Sources, Section 1.4, Natural Gas Combustion. July.

- U.S. EPA (U.S. Environmental Protection Agency). 2000. AP-42 Compilation of Air Pollutant Emission Factors, Chapter 3 Stationary Internal Combustion Engines, Section 3.2, Natural Gas-fired Reciprocating Engines. August.
- U.S. EPA (U.S. Environmental Protection Agency). 2005. Email correspondence between Richard Cook of EPA and James Heumann of URS Corporation. August 17.
- URS. 2005. Air Toxic Health Risk Assessment for the University of California, UC Santa Cruz 2005 Long Range Development Plan. October.