4.7 AIR QUALITY

Air quality in the immediate LTMS activity areas and in the surrounding regional environment would be affected by emissions from equipment associated with the proposed dredging, transportation, and disposal activities. The LTMS dredging areas and disposal sites are located mainly in the San Francisco Bay Area Air Basin (SFBAAB). However, operations occurring in the Delta region would also potentially affect the Sacramento and Solano County portions of the Sacramento Valley Air Basin (SVAB) and/or the San Joaquin County portion of the San Joaquin Valley Air Basin (SJVAB). The SFBAAB is composed of the counties of Santa Clara, San Mateo, San Francisco, Marin, Napa, Contra Costa, and Alameda, along with the southeast section of Sonoma and the southwest section of Solano counties. The boundaries of the SFBAAB, SVAB, and SJVAB are shown in Figure 4.7-1.

General descriptions of the air quality resource and potentially affected region of influence are provided in this section. Subsequent sections discuss the existing climate and meteorology of the region; regulatory environment; baseline air quality concentrations; and baseline emissions within the SFBAAB, and the potentially affected portions of the SVAB and SJVAB.

Description of Resource

Air quality at a given location can be described by the concentrations of various pollutants in the atmosphere. Units of concentration are generally expressed in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The significance of a pollutant concentration is determined by comparing the concentration to an appropriate federal and/or state ambient air quality standard. The standards represent the allowable atmospheric concentrations at which the public health and welfare are protected and include a reasonable margin of safety to protect the more sensitive individuals in the population. Federal standards, established by the EPA, are termed the National Ambient Air Quality Standards (NAAQS). The NAAQS are defined as the maximum acceptable concentrations that may not be exceeded more than once per year, except the annual standards, which may never be exceeded. The state standards, established by the California Air Resources Board (ARB), are termed the California Ambient Air Quality Standards (CAAQS). The CAAQS are defined as the maximum acceptable pollutant concentrations that are not to be equaled or exceeded. The NAAQS and CAAQS are presented in Table 4.7-1. The pollutants of main concern that are considered in this analysis include ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), and particulate matter smaller than 10 microns in diameter (PM10).

Region of Influence

Identifying the specific region of influence (ROI) for air quality requires knowledge of the types of pollutants being emitted, the emission rates and release parameters of the pollutant source (e.g., release temperature, area of release, release height), the source proximity to other pollutant sources, and local and regional meteorological conditions. The ROI for emissions of inert pollutants (all pollutants other than O3 and its precursors) is generally limited to a few miles downwind from a source. Thus, for the emission of inert pollutants from LTMS-related dredging and transport activities, the ROI is limited to the immediate waters and coastal areas of San Francisco Bay, the Central Bay, San Pablo Bay, Suisun Bay, the Delta, and the Pacific Ocean. Emissions of inert pollutants from equipment associated with disposal activities may affect areas farther inland in the vicinity of upland disposal sites and along the sediment haul routes to those sites.

The ROI for O3 can extend much farther downwind than for inert pollutants. Ozone is a secondary pollutant formed in the atmosphere by photochemical reactions of previously emitted pollutants, or precursors. Ozone precursors are mainly the reactive organic gas (ROG) portion of volatile organic compounds (VOC) and oxides of nitrogen (NOx). In the presence of solar radiation, the maximum effect of ROG and NOx emissions on O3 levels usually occurs several hours after they are emitted and many miles from the source. Ozone and O3 precursors transported from other regions can also combine with local emissions to increase local O3 concentrations. Therefore, the ROI for O3 may include much of the SFBAAB and portions of the SVAB and/or SJVAB.

4.7.1 Climate and Meteorology

The climate of the LTMS project area can be classified as Mediterranean, characterized by cool, dry summers and mild, wet winters. The major influence on the regional climate is the Eastern Pacific High, a strong persistent anticyclone. Seasonal variations in the position and strength of this system are a key factor in producing weather changes in the area.

Figure 4.7-1 LTMS Area of Air Quality Impact

Table 4.7-1. National and California Ambient Air Quality Standards

Pollutant	*Averaging Time*	*California Standards (a)*	NATIONAL STANDARDS (b)	
			Primary (c)	*Secondary (d)*
Ozone (O3)	1-Hour	0.09 ppm (180 µg/m^3)	0.12 ppm (235 µg/m^3)	Same as Primary Standard
Carbon Monoxide (CO)	8-Hour	9 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	—
	1-Hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	—
Nitrogen Dioxide (NO2)	Annual	—	0.053 ppm (100 µg/m^3)	Same as Primary Standard
	1-Hour	0.25 ppm (470 µg/m^3)	—	—
Sulfur Dioxide (SO2)	Annual	-	0.03 ppm (80 µg/m^3)	—
	24-Hour	0.04 ppm (105 µg/m^3)	0.14 ppm (365 µg/m^3)	—
	3-Hour	—	—	0.5 ppm (1,300 µg/m^3)
	1-Hour	0.25 ppm (655 µg/m^3)	—	—
Suspended Particulate Matter (PM10)	Annual	30 µg/m^3	50 µg/m^3	Same as Primary Standard
	24-Hour	50 µg/m^3	150 µg/m^3	Same as Primary Standard
Sulfates	24-Hour	25 µg/m^3	—	—
Lead	30-Day	25 µg/m^3	—	—
	Quarterly	—	1.5 µg/m^3	Same as Primary Standard
Hydrogen Sulfide	1-Hour	0.03 ppm (42 µg/m^3)	—	—
Vinyl Chloride	24-Hour	0.010 ppm (26 µg/m^3)	—	—
Visibility Reducing Particles (e)	8-Hour (10 A.M.. to 6 P.M..)	In sufficient amount to produce an extinction coefficient of 0.23 per km due to particles when the relative humidity is less than 70%.	—	—

Notes: a. California standards for O_3, CO, SO_2 (1-hour and 24-hour), NO_2, PM_{10}, and visibility reducing particles are not to be exceeded. The standards for sulfates, lead, hydrogen sulfide, and vinyl chloride are not to be equaled or exceeded.

b. National standards other than O_3 and those based on annual averages, are not to be exceeded more than once a year. The O_3 standard is attained when the expected number of days per calendar year with a maximum hourly average concentrations above the standard is equal to or less than one.

c. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

d. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects from a pollutant.

e. This standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range when relative humidity is less than 70%.

The Eastern Pacific High attains its greatest strength and most northerly position during the summer, when it is centered west of northern California. In this location, the High effectively shelters California from the effects of polar storm systems from the North Pacific. Due to the large-scale atmospheric subsidence associated with the High, an elevated temperature inversion often occurs along the West Coast. The base of this inversion is usually located from 1,000 to 3,000 feet above mean sea level, depending on the intensity of subsidence and the prevailing weather condition. Vertical mixing is often limited to the base of the inversion, trapping air pollutants in the lower atmosphere. Marine air trapped below the base of the inversion is often condensed into fog and stratus clouds by the cool Pacific Ocean. This condition is typical of the warmer months of the year from roughly May through October. Stratus usually forms offshore and moves into coastal areas during the evening hours. As the land heats up the following morning, the clouds will burn off to the immediate coastline, then move back onshore the following evening.

As winter approaches, the High begins to weaken and shift to the south, allowing polar storms to pass through the region. These storms produce periods of cloudiness, strong shifting winds, and precipitation. The number of days with precipitation can vary greatly from year to year, resulting in a wide range of annual precipitation totals. Storm conditions are usually followed by periods of clear skies, cool temperatures, and gusty northwest winds as the storm systems move eastward. Annual precipitation totals for the Oakland International Airport ranged from 9 to 30 inches during a 40-year period of record (1941 through 1980), with an annual average of 17.77 inches (National Oceanic and Atmospheric Administration [NOAA] 1980). Meteorological data from this station are considered generally representative of regional conditions throughout the LTMS area. Precipitation would be somewhat lower along the coast and within the San Francisco Bay waters and would increase northward and inland toward higher, more mountainous terrain. About 90 percent of rainfall in the region occurs from November through April.

The average high and low temperatures at the Oakland International Airport in July are 71.1°F and 55.5°F, respectively. January average high and low temperatures are 55.6°F and 40.7°F. Extreme high and low temperatures recorded from 1941 through 1980 were 107.0°F and 23.0°F, respectively (NOAA 1980). Temperatures within and near the Bay do not fluctuate greatly, due to the moderating effect of the Pacific Ocean. Temperatures would generally increase and extremes would be greater farther inland, away from the ocean.

The proximity of the Eastern Pacific High and a thermal low pressure system in the Central Valley region to the east produces air flow generally from the west to northwest along the central and northern California coast for most of the year. The persistence of these breezes is a major factor in minimizing air quality impacts from almost 6 million people that live in the region. As this flow is channeled through the Golden Gate Bridge, it branches off to the northeast and southeast, once inside the Bay. As a result, winds often blow from the northwest in the South Bay, from the southwest in the Central Bay, then from the west as winds flow through the Suisun Bay and Delta regions towards the San Joaquin Valley. Nocturnal and wintertime land breezes tend to blow in the opposite direction of this pattern. These land breezes may extend many miles offshore during the colder months of the year until daytime heating reverses the flow back onshore.

During the fall and winter months, the Eastern Pacific High can combine with high pressure over the Great Basin to produce extended periods of light winds and low-level temperature inversions. This condition frequently produces poor atmospheric dispersion that results in degraded regional air quality. Ozone standards traditionally are exceeded when this condition occurs during the warmer months of the year.

4.7.2 Applicable Air Quality Regulations

4.7.2.1 Federal Regulations

Clean Air Act of 1969 (42 U.S.C. Section 7401 et seq.)

Air quality regulations were first promulgated with the Clean Air Act (CAA) of 1969. The CAA is intended to protect the Nation's air quality by regulating emissions of air pollutants. The CAA is applicable to permits and planning procedures related to dredged material disposal onshore and within the territorial sea. The territorial sea is defined as waters 3 miles seaward of the nearest shoreline. For bays or estuaries, the 3-mile territorial sea begins at a baseline drawn across the opening of the water body. Section 118 of the CAA (42 U.S.C. 7418) requires that all federal agencies engaged in activities that may result in the discharge of air pollutants comply with state and local air pollution control requirements. In addition, Section 176 of the CAA (42 U.S.C. 7506) prohibits federal agencies from engaging in any activity that does not conform to an approved State Implementation Plan (SIP).

This act established the NAAQS and delegated enforcement of air pollution control to the states. In California, the ARB has been designated as the agency

responsible for regulating air pollution sources at the state level. The ARB, in turn, has delegated the responsibility of regulating stationary emission sources to local air pollution control or management districts which, for LTMS activity, are the Bay Area Air Quality Management District (BAAQMD), the Sacramento Metropolitan Air Quality Management District (SMAQMD), and the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD).

The NAAQS (shown in Table 4.7-1) include both primary and secondary standards for various pollutants. Primary standards are mandated by the CAA to protect the public health, while secondary standards are intended to protect the public welfare from any known or anticipated adverse effects of a pollutant, such as materials soiling, vegetation damage, and visibility impairment.

The CAA states that all applicable federal and state ambient air quality standards must be maintained during the operation of any emission source. The CAA also identifies how the state will meet the standards within the time frame mandated by the Clean Air Act Amendments of 1990.

The Clean Air Act Amendments of 1990 (42 U.S.C. 7401 et seq., as amended by P.L. 101-549)

The Clean Air Act Amendments of 1990 (1990 CAA) established new nonattainment classifications, new emission control requirements, and new compliance dates for areas presently in nonattainment of the NAAQS, based on upon the design day value. The design day value is the fourth highest pollutant concentration recorded in a 3-year period. The requirements and compliance dates for reaching attainment are based on the nonattainment classification. The classifications and compliance dates are shown in Table 4.7-2.

One of the requirements established by the 1990 CAA was an emission reduction amount that would be used to judge how progress toward attainment of the O3 standards would be measured. The 1990 CAA requires

Table 4.7-2. Federal Attainment Schedule

Pollutant/Classification	***Design Day Value Concentration (a) (ppm)***	***Compliance Date***
Ozone (b)		
Marginal	0.121-0.138	November 15, 1993
Moderate	0.138-0.160	November 15, 1996
Serious	0.160-0.180	November 15, 1999
Severe	0.180-0.280	November 15, 2005
Severe	0.190-0.280	November 15, 2007 (c)
Extreme	≥0.280	November 15, 2010
Carbon Monoxide (d)		
Moderate	9.1-16.4	December 31, 1995
Serious	≥16.5	December 31, 2000
PM_{10} (e)		
Moderate	--	February 8, 1997
Serious	--	December 31, 2001

Notes: a. The design day value is the fourth highest pollutant concentration recorded in a 3-year period.
b. 42 USC 7511.
c. 42 USC 7511(a)(2)
d. 42 USC 7512.
e. 42 USC 7513.

Source: Clean Air Act Amendments, November 1990.

delegates to each state the authority to establish their own air quality rules and regulations. State adopted rules and regulations must be at least as stringent as the mandated federal requirements. In states where the NAAQS are exceeded, the CAA requires preparation of a SIP that areas in nonattainment of the NAAQS for ozone to reduce basinwide VOC emissions by 15 percent for the first 6 years and by an average of 3 percent per year thereafter until attainment is reached. Control measures must be identified in the SIP that will facilitate the

reduction in emissions and show progress toward attainment of the O3 standard. With regard to CO and PM10 nonattainment areas, plans must be submitted that identify ways to reduce emissions and show progress toward attainment. Additionally, the 1990 CAA promulgates new toxic air pollutant standards and identifies affected sources and control measures required to meet these standards.

The 1990 CAA also provides that a federal agency cannot support an activity unless the federal agency determines that the activity will conform to the most recent EPA-approved SIP within the region of the proposed action. This means that federally supported or funded activities will not (1) cause or contribute to any new violation of any air quality standard; (2) increase the frequency or severity of any existing violation of any standard; or (3) delay the timely attainment of any standard or any required interim emission reductions or other milestones in any area. In accordance with Section 176(c) of the 1990 CAA, the EPA promulgated the final conformity rule for general federal actions in the November 30, 1993 *Federal Register*. Section 5.2 of this EIS/R presents a discussion of conformity issues that relate to the proposed actions.

4.7.2.2 State Regulations

The CAA delegates to each state the authority to establish air quality rules that must be at least as restrictive as the federal requirements. The ARB has established the CAAQS, which are more restrictive than the NAAQS and include pollutants for which there are no federal standards.

California Clean Air Act of 1992 (CCAA) develops and implements a program to attain the CAAQS for O3, CO, NO2, SO2, PM10, lead, sulfates, hydrogen sulfide, and visibility reducing particulate matter. Similar to the federal nonattainment rating system, the state ozone nonattainment rating system is based on a design day concentration. Attainment is reached when the design day concentration falls below 0.09 ppm. The state nonattainment rating system is shown in Table 4.7-3. Progress toward attainment is demonstrated by implementation of new emission control measures. Since the CAAQS are more restrictive than the NAAQS, emission reductions beyond what would be required to show attainment for the NAAQS will be needed. Consequently, the main focus of attainment planning in California has shifted from the federal to state requirements.

Table 4.7-3. State Nonattainment Classifications

Pollutant/Classification	*Design Day Value Concentration (a)*
Ozone	
Moderate	0.09-0.12 ppm, inclusive
Serious	0.13-0.15 ppm, inclusive
Severe	0.16-0.20 ppm, inclusive
Extreme	>0.20 ppm
Carbon Monoxide	
Moderate	9.0-12.7 ppm, inclusive
Serious	> 12.7 ppm

Note: a. Ozone data based on 1989-1991 calendar years, without regard to transport conditions. CO data based on 1989-1990 and 1990-1991 winter seasons.

Source: California Health and Safety Code Sec. 40921.5.

4.7.2.3 Local Regulations

Rules adopted by local air pollution control districts and accepted by the ARB are included in the SIP. When approved by the EPA, these rules become federally enforceable. The BAAQMD, the SMAQMD, and the SJVUAPCD have each developed rules and regulations specific to their jurisdiction. Rules from the BAAQMD that may apply to the LTMS are presented below. These examples from the BAAQMD are considered typical of the types of rules that would also be found in the SMAQMD and SJVUAPCD.

BAAQMD Rules and Regulations

The BAAQMD, having received the necessary approvals, has developed the *BAAQMD Rules and Regulations* to regulate stationary sources of air pollution in the San Francisco Bay Area Air Basin (SFBAAB). Selected rules and regulations described from this document pertinent to the LTMS and related activities are summarized below:

- RULE 1-301 - PUBLIC NUISANCE. This rule states that no person shall discharge from any source air contaminants that cause injury, detriment, nuisance, or annoyance to any considerable number of persons or public, or that endangers the comfort, repose, health or safety of any such persons or public, or that

causes, or has a tendency to cause, injury or damage to business or property.

- REGULATION 2 defines the review process of sources that require air permits. This regulation sets forth preconstruction requirements for stationary sources that may include Best Available Control Technology (BACT) and emission offsets. Additionally, Rule 2-1-310.3 states that the air pollution control officer shall not authorize the installation or operation of any new source that is subject to the requirements of CEQA, until all CEQA requirements are satisfied.

- REGULATION 6 identifies standards that limit particulate matter emissions and the visibility and opacity of effluent from all sources.

- REGULATION 7 identifies limitations on odorous substances and specific emission limitations on certain odorous compounds.

- RULE 9-1-304 states that a person shall not burn any liquid fuel having a sulfur content in excess of 0.5 percent by weight. However, this rule exempts fuel used to propel any motor vehicle, boat, or ship. As a result, the sulfur limitation would only apply to project construction machinery and dredges.

For the purpose of evaluating air quality impacts from proposed projects, the following emission thresholds are used by the BAAQMD to determine the significance of pollutant emissions: 80 pounds per day or 15 tons per year of ROG, NOx, or PM10 (BAAQMD 1995). The SMAQMD has set significance levels for ROG or NOx (ozone precursors), and PM10 at 85 and 275 pounds per day, respectively, (personal communication, G. Tholen 1995). The SJVUAPCD considers emissions of ROG or NOx greater than 10 tons per year to be significant (personal communication, D. Mitchell 1995). For pollutants without a specific emission significance threshold, both the SMAQMD and the SJVUAPCD consider the CAAQS and NAAQS as the determining factor for indicating when an impact is significant.

Attainment/Maintenance Plans

Ever since the NAAQS for O3 was promulgated by the EPA in 1971, violations of this standard have occurred annually in the SFBAAB. Pursuant to the regulations of the CAA, the ARB was required to periodically submit plans to the EPA that would demonstrate attainment or progress towards attainment of the O3 standard, beginning in 1979. These *attainment plans*, authored largely by the BAAQMD, outlined measures that would reduce emissions mainly from stationary sources and eventually bring the region into attainment. Due to the success of these plans and the decrease in emissions from on-road vehicles over the last two decades, no O3 violations occurred in the SFBAAB from 1990 through 1992. In 1993, the BAAQMD requested the EPA to redesignate the region as attainment for O3 in the submittal of the *Redesignation Request and Maintenance Plan for the National O3 Standard* (BAAQMD, ABAG, and MTC 1993) (O3 Maintenance Plan). Upon final approval of the O3 Maintenance Plan by the EPA, this redesignation became effective on June 21, 1995. However, due to violations of the O3 standard in 1995 and 1996, the EPA is in the process of redesignating the SFBAAB from attainment/maintenance to nonattainment of the O3 standard. This redesignation became effective on August 10, 1998; it will require the BAAQMD to prepare a new plan that demonstrates attainment of the O3 standard within a mandated time frame.

In addition to the O3 redesignation, the BAAQMD requested the EPA to redesignate the SFBAAB as in attainment of CO, since the region did not record any violations of the eight-hour CO NAAQS for the 2-year period of 1992-1993 (the one-hour standard for CO has not been exceeded in the region since 1985). Credit for this air quality improvement can be traced to improvements to the vehicle inspection and maintenance (I&M) program and additional contingency measures adopted in 1990 and the introduction of a wintertime oxygenated fuels program, as required by the 1990 CAA. The request for redesignation is presented in the *Redesignation Request and Maintenance Plan for the National CO Standard* (BAAQMD, ABAG, and MTC 1994). This CO Maintenance Plan contains a contingency measure that would improve the effectiveness of the existing I&M program in the event of a CO standard violation. On June 1, 1998, the SFBAAB was redesignated to attainment of the national CO standard by the EPA.

In conformance with the CCAA, the BAAQMD developed the *Bay Area 1994 Clean Air Plan* (CAP) to bring the SFBAAB into attainment with the O3 CAAQS (BAAQMD 1994). The CAP is an updated version of the 1991 plan and includes eight additional control measures beyond what were proposed in the 1991 plan. The control measures proposed in the CAP represent all feasible measures to control O3 precursor emissions in the SFBAAB. Nevertheless, the CAP cannot demonstrate attainment of the state O3 standard by 1997. As a result, the BAAQMD will be required to update the CAP in 1997 to report on progress toward attainment of the state O3 standard. Application of all feasible control measures outlined in the CAP would theoretically reduce basinwide emissions of ROG and NOx by 13.6 and 7.3

percent, respectively, during the 1994 through 1997 planning period.

Emission control measures proposed in the CAP include indirect and area source control programs, application of Best Available Retrofit Control Technology (BARCT) to existing stationary sources, a modification of the permitting program to achieve no net increase in emissions from permitted sources with a potential to emit more than 15 tons per year of O3 precursor pollutants, consideration of transportation control measures that will reduce vehicle miles travelled, and significant use of low-emission motor vehicles by vehicle fleet operators.

A determination of project consistency with each plan is required to evaluate if a proposed action would interfere with the attainment or maintenance strategy outlined in these documents. A proposed action generally would be consistent with the intent of a plan if project emissions are included in the future emission inventories of the plan.

4.7.3 Baseline Air Quality

The EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. A nonattainment designation means that a primary NAAQS has been exceeded more than three discontinuous times in 3 years in a given area. Pollutants in an area are often designated as unclassified when there is a lack of data for the EPA to form a basis of attainment status. The SFBAAB is in attainment for NO2, O3, SO2 and CO, and unclassified for PM10 (ARB 1994a). Portions of the SVAB (including Butte, Placer, Sacramento, Solano, Sutter, Yolo, and Yuba counties) are in "severe" nonattainment for O3. All of the SJVAB is designated as in "serious" O3 nonattainment. CO nonattainment areas of potential concern include the urbanized areas of Sacramento and Yolo counties in the SVAB and the Stockton urbanized area in the SJVAB (all are classified as "moderate" CO nonattainment areas). Sacramento County is in "moderate" nonattainment of the federal PM10 standards and all of the SJVAB is "serious" PM10 nonattainment. NOx and SO2 are in attainment throughout the SVAB and SJVAB.

The ARB designates areas of the state as either in attainment or nonattainment of the CAAQS. An area is in nonattainment if the CAAQS has been exceeded more than once in 3 years. At the present time, the SFBAAB is in nonattainment of the CAAQS for O3 ("serious") and PM10; the SVAB is nonattainment for O3 ("serious"), CO ("serious" - Sacramento urbanized area only), and PM10; and the SJVAB is nonattainment for O3 ("severe") and PM10 (ARB 1994a). (Refer to Tables 4.7-2 and 4.7-3 for an explanation of the federal and state nonattainment classification schemes.)

Maximum pollutant concentrations measured at various monitoring stations in the SFBAAB from 1991 through 1993 are provided in Table 4.7-4. Stations were chosen for inclusion in Table 4.7-4 to provide a survey of the background air quality found in the various potential project regions (ARB 1992, 1993a, 1994b). For example, the Redwood City and San Leandro monitoring stations are located in the South Bay portion of the LTMS activity area; the San Francisco station is in the Ocean area; the Oakland and Richmond stations are in the Central Bay area; San Rafael and Vallejo are in the San Pablo Bay area; Benicia, Fairfield, and Pittsburg are in the Suisun Bay area; and Bethel Island and Stockton are in the Delta area. (See Figure 4.1-1 for a description of the regions potentially affected by LTMS activity.)

Concentrations of photochemical smog, or O3, are highest during the warmer months and coincide with the season of maximum insolation. Inert pollutant concentrations (pollutants other than O3) tend to be the greatest during the winter months when extended periods of light wind conditions and surface-based temperature inversions occur. The following is a discussion of the various pollutants monitored within the SFBAAB, SVAB, and SJVAB.

Ozone

Ozone is a colorless gas that is formed in the atmosphere by the photochemical reactions of ROG and NOx. Ozone is a respiratory irritant and can cause damage to lung tissue. Sensitive plant species and synthetic materials can also be damaged by O3 at concentrations as low as 0.02 ppm. The data in Table 4.7-4 show that the 1-hour NAAQS was exceeded only in the Suisun Bay region at the Fairfield and Pittsburg monitoring stations in 1993. The CAAQS of 0.09 ppm was exceeded several times during the 1991 through 1993 period at various stations in each of the regions except Ocean (as represented by the San Francisco station).

Table 4.7-4 Maximum Pollutant Concentrations Monitored in the Regions Affected by LTMS Activity (1991-1993)

Table 4.7-4. Maximum Pollutant Concentrations Monitored in the Regions Affected by LTMS Activity (1991-1993)

Pollutant/Region/Monitoring Station	MAXIMUM CONCENTRATION BY YEAR			NUMBER OF DAYS FEDERAL STANDARDS EXCEEDED**			NUMBER OF DAYS STATE STANDARDS EXCEEDED**		
	1991	*1992*	*1993*	*1991*	*1992*	*1993*	*1991*	*1992*	*1993*
OZONE (1-hour [ppm])									
South Bay									
Redwood City	0.08	0.09	0.10	0	0	0	0	0	1
San Leandro	0.12	0.11	0.12	0	0	0	2	2	3
Ocean									
San Francisco	0.05	0.08	0.08	0	0	0	0	0	0
Central Bay									
Oakland	0.06	0.08	0.11	0	0	0	0	0	1
Richmond	0.05	0.08	0.12	0	0	0	0	0	2
San Pablo Bay									
San Rafael	0.08	0.07	0.08	0	0	0	0	0	0
Vallejo	0.11	0.10	0.11	0	0	0	2	1	3
Suisun Bay									
Fairfield	0.10	0.10	0.13	0	0	1	3	3	3
Pittsburg	0.08	0.11	0.13	0	0	1	0	3	4
Delta									
Bethel Island	0.11	0.11	0.11	0	0	0	3	7	3
Stockton	0.11	0.11	0.11	0	0	0	10	7	7
NITROGEN DIOXIDE (Annual [ppm])									
South Bay	0.025	0.021	0.022	0	0	0	NA	NA	NA
Redwood City									
Ocean	0.024	0.022	0.024	0	0	0	NA	NA	NA
San Francisco									
Central Bay	0.019	0.019	0.020	0	0	0	NA	NA	NA
Richmond									
San Pablo Bay	0.022	0.021	0.021	0	0	0	NA	NA	NA
San Rafael	0.019	0.017	0.016	0	0	0	NA	NA	NA
Vallejo									
Suisun Bay	0.019	0.018	0.017	0	0	0	NA	NA	NA
Pittsburg									
Delta	0.018	0.016	0.015	0	0	0	NA	NA	NA
Bethel Island	0.025	0.023	0.024	0	0	0	NA	NA	NA
Stockton									

Table 4.7-4. Maximum Pollutant Concentrations Monitored in the Regions Affected by LTMS Activity (1991-1993)

Pollutant/Region/Monitoring Station	MAXIMUM CONCENTRATION BY YEAR			NUMBER OF DAYS FEDERAL STANDARDS EXCEEDED**			NUMBER OF DAYS STATE STANDARDS EXCEEDED**		
	1991	*1992*	*1993*	*1991*	*1992*	*1993*	*1991*	*1992*	*1993*
NITROGEN DIOXIDE (1-hour [ppm])									
South Bay	0.12	0.10	0.09	NA	NA	NA	0	0	0
Redwood City									
Ocean	0.10	0.09	0.08	NA	NA	NA	0	0	0
San Francisco									
Central Bay	0.08	0.08	0.08	NA	NA	NA	0	0	0
Richmond									
San Pablo Bay	0.07	0.08	0.08	NA	NA	NA	0	0	0
San Rafael	0.09	0.07	0.07	NA	NA	NA	0	0	0
Vallejo									
Suisun Bay	0.07	0.08	0.08	NA	NA	NA	0	0	0
Pittsburg									
Delta	0.08	0.07	0.07	NA	NA	NA	0	0	0
Bethel Island	0.11	0.19	0.16	NA	NA	NA	0	0	0
Stockton									
CARBON MONOXIDE (8-hour [ppm])									
South Bay	6.5	4.8	5.8	0	0	0	0	0	0
Redwood City									
Ocean	6.5	7.4	6.9	0	0	0	0	0	0
San Francisco									
Central Bay	6.8	4.6	4.9	0	0	0	0	0	0
Oakland	4.5	4.1	3.8	0	0	0	0	0	0
Richmond									
San Pablo Bay	5.7	5.0	4.0	0	0	0	0	0	0
San Rafael	9.6	6.6	7.9	0	0	0	0	0	0
Vallejo									
Suisun Bay	3.6*	--	--	0	--	--	0	--	--
Fairfield	4.1	3.9	2.8	0	0	0	0	0	0
Pittsburg									
Delta	2.3	3.9	2.0	0	0	0	0	0	0
Bethel Island	11.4	8.3	6.3	1	0	0	0	0	0
Stockton									

Table 4.7-4. Maximum Pollutant Concentrations Monitored in the Regions Affected by LTMS Activity (1991-1993)

Pollutant/Region/Monitoring Station	MAXIMUM CONCENTRATION BY YEAR			NUMBER OF DAYS FEDERAL STANDARDS EXCEEDED**			NUMBER OF DAYS STATE STANDARDS EXCEEDED**		
	1991	*1992*	*1993*	*1991*	*1992*	*1993*	*1991*	*1992*	*1993*
CARBON MONOXIDE (1-hour [ppm])									
South Bay	11.0	12.0	10.0	0	0	0	0	0	0
Redwood City									
Ocean	9.0	10.0	10.0	0	0	0	0	0	0
San Francisco									
Central Bay	9.0	7.0	7.0	0	0	0	0	0	0
Oakland	7.0	5.0	9.0	0	0	0	0	0	0
Richmond									
San Pablo Bay	10.0	8.0	9.0	0	0	0	0	0	0
San Rafael	13.0	11.0	12.0	0	0	0	0	0	0
Vallejo									
Suisun Bay	6.0*	--	--	0	--	--	0	--	--
Fairfield	7.0	5.0	6.0	0	0	0	0	0	0
Pittsburg									
Delta	3.0	5.0	3.0	0	0	0	0	0	0
Bethel Island	14.0	11.0	10.0	0	0	0	0	0	0
Stockton									
SULFUR DIOXIDE (Annual [ppm])									
South Bay	ND	ND	ND	--	--	--	--	--	--
(no data)									
Ocean	0.002*	0.002	0.001	0	0	0	NA	NA	NA
San Francisco									
Central Bay	0.001	0.001	0.001	0	0	0	NA	NA	NA
Richmond									
San Pablo Bay	0.001	0.001	0.001	0	0	0	NA	NA	NA
Vallejo									
Suisun Bay	0.001	0.000	0.001	0	0	0	NA	NA	NA
Benicia	0.002	0.002	0.001	0	0	0	NA	NA	NA
Pittsburg									
Delta	0.001	0.001	0.000	0	0	0	NA	NA	NA
Bethel Island									

Table 4.7-4. Maximum Pollutant Concentrations Monitored in the Regions Affected by LTMS Activity (1991-1993)

Pollutant/Region/Monitoring Station	Maximum Concentration by Year			Number of Days Federal Standards Exceeded**			Number of Days State Standards Exceeded**		
	1991	*1992*	*1993*	*1991*	*1992*	*1993*	*1991*	*1992*	*1993*
SULFUR DIOXIDE (24-hour [ppm])									
South Bay	ND	ND	ND	--	--	--	--	--	--
(no data)									
Ocean	0.016*	0.013	0.011	0	0	0	0	0	0
San Francisco									
Central Bay	0.011	0.011	0.012	0	0	0	0	0	0
Richmond									
San Pablo Bay	0.008	0.017	0.010	0	0	0	0	0	0
Vallejo									
Suisun Bay	0.013	0.008	0.009	0	0	0	0	0	0
Benicia	0.015	0.023	0.009	0	0	0	0	0	0
Pittsburg									
Delta	0.008	0.011	0.009	0	0	0	0	0	0
Bethel Island									
SULFUR DIOXIDE (1-hour [ppm])									
South Bay	ND	ND	ND	--	--	--	--	--	--
(no data)									
Ocean	0.04*	0.04	0.04	0	0	0	0	0	0
San Francisco									
Central Bay	0.03	0.03	0.11	0	0	0	0	0	0
Richmond									
San Pablo Bay	0.02	0.03	0.02	0	0	0	0	0	0
Vallejo									
Suisun Bay	0.04	0.03	0.04	0	0	0	0	0	0
Benicia	0.04	0.10	0.05	0	0	0	0	0	0
Pittsburg									
Delta	0.02	0.03	0.02	0	0	0	0	0	0
Bethel Island									

Table 4.7-4. Maximum Pollutant Concentrations Monitored in the Regions Affected by LTMS Activity (1991-1993)

Pollutant/Region/Monitoring Station	MAXIMUM CONCENTRATION BY YEAR			NUMBER OF DAYS FEDERAL STANDARDS EXCEEDED**			NUMBER OF DAYS STATE STANDARDS EXCEEDED**		
	1991	*1992*	*1993*	*1991*	*1992*	*1993*	*1991*	*1992*	*1993*
PM_{10} (Annual [geometric] [$\mu g/m^3$])									
South Bay	26.6	24.9	22.9	NA	NA	NA	0	0	0
Redwood City	27.6	22.7	18.1	NA	NA	NA	0	0	0
San Leandro									
Ocean	29.7	27.6*	25.1	NA	NA	NA	0	0	0
San Francisco									
Central Bay	24.4	23.4*	21.3	NA	NA	NA	0	0	0
Richmond									
San Pablo Bay	26.4	22.0	21.3	NA	NA	NA	0	0	0
San Rafael									
Suisun Bay	ND	ND	ND	--	--	--	--	--	--
(no data)									
Delta	27.1	22.6	19.4	NA	NA	NA	0	0	0
Bethel Island	43.0*	39.9*	32.0*	NA	NA	NA	1	1	1
Stockton									
PM_{10} (Annual [arithmetic] [$\mu g/m^3$])									
South Bay	32.1	28.7	26.4	0	0	0	NA	NA	NA
Redwood City	32.4	24.9	20.8	0	0	0	NA	NA	NA
San Leandro									
Ocean	34.9	31.6*	28.8	0	0	0	NA	NA	NA
San Francisco									
Central Bay	29.1	26.1	25.2	0	0	0	NA	NA	NA
Richmond									
San Pablo Bay	30.4	24.5	23.3	0	0	0	NA	NA	NA
San Rafael									
Suisun Bay	ND	ND	ND	--	--	--	--	--	--
(no data)									
Delta	33.4	26.1	23.6	0	0	0	NA	NA	NA
Bethel Island	52.5*	44.8*	38.5*	1	0	0	NA	NA	NA

Table 4.7-4. Maximum Pollutant Concentrations Monitored in the Regions Affected by LTMS Activity (1991-1993)

Pollutant/Region/Monitoring Station	Maximum Concentration by Year			Number of Days Federal Standards Exceeded**			Number of Days State Standards Exceeded**		
	1991	*1992*	*1993*	*1991*	*1992*	*1993*	*1991*	*1992*	*1993*
Stockton									
PM_{10} (24-hour [$\mu g/m^3$])									
South Bay	90	80	76	0	0	0	12/60	7/61	5/61
Redwood City	99	56	84	0	0	0	10/60	2/61	4/65
San Leandro									
Ocean	109	81	69	0	0	0	15/60	9/61	5/61
San Francisco									
Central Bay	97	55	76	0	0	0	9/59	3/61	3/61
Richmond									
San Pablo Bay	115	63	69	0	0	0	10/60	5/61	1/61
San Rafael									
Suisun Bay	ND	ND	ND	--	--	--	--	--	--
(no data)									
Delta	123	73	71	0	0	0	10/60	4/61	6/61
Bethel Island	140	145	104	0	0	0	21/53	18/53	13/58
Stockton									

Notes: NA = Not applicable.
ND = No data.
* = Data presented are valid, but incomplete in that an insufficient number of valid data points were collected to meet EPA and/or ARB criteria for representativeness.
** = Annual averaging periods are reported as either being exceeded or not being exceeded. PM_{10} 24-hour standard exceedances are reported as number of exceedances per total number of samples taken. PM_{10} sampling is not performed on a daily basis.

Source: ARB 1992, 1993, 1994.

Nitrogen Dioxide

Nitrogen dioxide is a reddish-brown gas with an irritating odor. As a product of nitrogen oxides (NOx), NO2 is one of the primary pollutants in the formation of photochemical smog. Nearly all NO2 is emitted from anthropogenic sources such as automobiles and power plants that burn fossil fuels. Health effects associated with NO2 range from irritation to the eyes, nose, and throat to increased susceptibility to infection. The maximum NO2 concentrations monitored in the LTMS area are shown in Table 4.7-4. These data show that the 1-hour and annual concentrations were less than 50 percent of their applicable standards at all stations during the monitoring period, with the exception of 1-hour values measured at Stockton (the Delta region) in 1992 and 1993.

Carbon Monoxide

Carbon monoxide is a clear, odorless gas produced by the incomplete combustion of fossil fuels and organic substances. The natural degradation of plant matter can also contribute to the production of CO, but motor vehicles are by far the largest man-made source. The highest ambient CO concentrations usually occur near congested transportation arteries and intersections. Carbon monoxide is not a respiratory irritant, but rather passes through lungs and interferes with the transfer of oxygen in blood. Symptoms of exposure include dizziness, headache, and, in extreme cases, loss of consciousness. Table 4.7-4 shows that the maximum CO levels monitored at all stations within the LTMS area were less than their applicable standards during the monitoring period.

Sulfur Dioxide

Sulfur dioxide is a colorless, nonflammable gas with a pungent odor. SO2 is a respiratory irritant that is mainly produced from the combustion of sulfur-containing fossil fuels, as a byproduct in the refining of fossil fuels from crude oil, and from the production of sulfuric acid. Marine vessels contribute substantially to SO2 emissions in the SFBAAB (approximately 14.5 percent of the total from all sources) due to the use of high-sulfur fuels. About one-third of these emissions occur when vessels operate in harbors and bays and two-thirds occur while vessels cruise along the coast (ARB 1984). The data in Table 4.7-4 show that SO2 concentrations monitored at stations within the LTMS area were only a small fraction of their applicable standards.

PM10

PM10 is produced by a wide range of activities including natural wind erosion, combustion of fossil fuels, mining, and transporting and handling of minerals. PM10 is of concern because the small particles can pass through the bronchial passages in the lung and into the alveoli where they can be retained indefinitely. If PM10 contains water soluble compounds, the soluble portion can be absorbed and transported through the blood system to other organs where they can cause damage. Table 4.7-4 shows that the maximum PM10 levels monitored in the LTMS area periodically exceeded the 24-hour CAAQS. However, the 24-hour NAAQS and the state and federal annual PM10 standards were not exceeded at any location other than Stockton (the Delta region) during the monitoring period.

4.7.4 San Francisco Bay Area Air Basin Emissions

The total air emissions that occurred within the SFBAAB during 1990 are shown in Table 4.7-5. The SFBAAB emissions inventory is periodically updated for planning purposes to forecast future emissions inventories, to analyze individual control measures, and for input data to regional air quality modeling. The 1990 inventory represents the most current emissions data available for the SFBAAB (BAAQMD 1993). Table 4.7-5 shows that one of the largest contributors to air pollutants in the SFBAAB are mobile sources. On-road motor vehicles account for approximately 46 percent of the ROG, 70 percent of the CO, 45 percent of the NOx, and 18 percent of the SO2 emitted in the SFBAAB. Total emissions from each of the counties within the SFBAAB that would be affected by the LTMS program, and the two counties that would be the primary areas affected in the SVAB and SJVAB (Sacramento County and San Joaquin County), are also shown in Table 4.7-5.

Table 4.7-5. 1990 Emission Inventory for the San Francisco Bay Area Air Basin (tons/day)

Emission Source	*TOG*	*ROG*	*CO*	*NOx*	*SOx*	*PM10*
Petroleum Process, Storage, and	37.4	32.1	6.6	42.9	47.3	2.9
Chemical Manufacturing Processes	397.4	23.3	27.6	3.0	8.7	146.6
Organic Compounds Evaporation	145.5	139.1	—	—	—	—
Combustion	16.5	7.3	76.4	99.7	9.5	10.6
Off-Highway Mobile Sources	68.5	63.1	647.6	143.9	28.3	8.1
Aircraft	18.4	18.1	70.8	15.4	0.5	2.7
Motor Vehicles	323.3	299.5	1,966.5	250.6	21.1	23.5
Miscellaneous Emission Sources	99.8	69.3	—	—	—-	341.6
TOTAL — BAY AREA AIR QUALITY MANAGEMENT DISTRICT	1,110	652	2,800	557	116	536
TOTAL — ALAMEDA COUNTY	238	141	612	114	15.1	103
TOTAL — CONTRA COSTA COUNTY	192	116	447	140	55.7	85.5
TOTAL — MARIN COUNTY	44.8	26.6	137	18.5	1.4	27.5
TOTAL — NAPA COUNTY	23.9	14.7	67.9	10.2	0.8	14.2
TOTAL — SAN FRANCISCO COUNTY	69.4	59.2	235	42.9	10	38.8
TOTAL — SAN MATEO COUNTY	136	68.8	313	53.9	3.9	61
TOTAL — SANTA CLARA COUNTY	287	154	704	120	10	137
TOTAL — SOLANO COUNTY	58.7	39.4	130	31.2	16.7	29
TOTAL — SONOMA COUNTY	58.7	32.6	159	26.7	2.2	40.2
TOTAL — SACRAMENTO COUNTY	210	100	480	88	7.8	130
TOTAL — SAN JOAQUIN COUNTY	85	75	290	64	12	93

Sources: BAAQMD 1993 — For all values except Sacramento and San Joaquin counties. Values are 1990 summer average emissions reported as rounded in the 1990 Emission Inventory Summary Report document.
ARB 1991 — For Sacramento and San Joaquin counties values. Values are 1989 annual average emissions reported as rounded in the 1989 Emission Inventory document.