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SAN FRANCISCO BAY AREA

OZONE ATTAINMENT PLAN

FOR THE 1-HOUR NATIONAL OZONE STANDARD

ADOPTED

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BAY AREA AIR QUALITY MANAGEMENT DISTRICT

METROPOLITAN TRANSPORTATION COMMISSION

SUMMARY

The United States Environmental Protection Agency (EPA) redesignated the Bay Area in attainment of the 1-hour National Ozone Standard on May 22, 1995. The agency did this because the Bay Area attained the ozone standard for five years (1990 – 1994). EPA also approved an *Ozone Maintenance Plan* submitted by the "co-lead" agencies for federal air quality planning in the Bay Area.[1]

In the summers of 1995 and 1996, the Bay Area experienced hot, stagnant weather. This led to exceedances of the 1-hour standard. The "contingency measures" in the *Maintenance Plan* were not adequate to bring the region back into compliance with the standard. EPA was not satisfied that the region's adopted and projected actions would be sufficient to reestablish compliance with the standard.

EPA published a notice that revoked the region's clean air status on July 10, 1998. The notice calls for the region to submit three plan elements:

- 1995 Emission Inventory for Volatile Organic Compounds (VOCs) and Nitrogen Oxides (NOx) (these two pollutants combine to form ozone)
- Assessment of the Emission Reductions Needed to Attain the National Ozone Standard by 2000 (the "Attainment Assessment")
- Control Strategy

This Bay Area Ozone Attainment Plan (Plan) contains these three elements.

The 1995 Emission Inventory identifies emissions of major source categories for an average ozone season (summer) day. It is based on the latest available motor vehicle emissions factors from the California Air Resources Board (ARB), actual emissions data from industrial sources and staff's best estimates for area sources. Our estimate of 1995 emissions of VOCs is 562 tons per day (tpd), and for NOx, 626 tpd.

The Attainment Assessment uses existing analyses based on the Urban Airshed Model, a model approved by EPA, to estimate the amount by which emissions must be reduced between 1995 and 2000, in order to attain the national 1-hour ozone standard of 12 parts per hundred million. The schedule set forth by EPA did not allow time for gathering new data or performing new photochemical modeling.

The Attainment Assessment estimates that a 128 tpd reduction in VOCs combined with a 92 tpd reduction in NOx, between 1995 and 2000, would result in an attainment inventory. Significant reductions of both pollutants will occur between 1995 and 2000. Expected reductions, based on already adopted control measures that have been submitted into the SIP, and growth or decline in source category emissions, will result in a 117 tpd reduction in VOCs, and a 92 tpd reduction in NOx by 2000. This leaves a shortfall for VOCs of 11 tpd, and no shortfall for NOx.

The Control Strategy includes the following 11 control measures:

- Metal Container, Closure, and Coil Coating Limitations
- Fugitive Emissions, Refinery and Chemical Plants
- Episodic Releases from Pressure Relief Devices, Refinery and Chemical Plants
- Low VOC Solvent, Cold Solvent Cleaners
- Graphic Arts Operations
- Polystyrene, Polypropylene and Polyethylene Foam Product Manufacturing
- Low Emitting Retrofits for Slotted Guide Poles, Organic Liquid Storage
- Emission Reductions from Gasoline Dispensing Facilities
- Prohibition of Contaminated Soil as Alternate Daily Cover at Landfills
- Prohibition of Contaminated Soil Aeration
- Electric Golf Carts (2000)

In addition, two voluntary measures have been included in the Plan — the Spare the Air Program (1999 and 2000 ozone seasons only) and Low Emission Alternatively Fueled Vehicles and Infrastructure.

Given the number of exceedances the Bay Area experienced in 1998, the region will not be able to establish a three-year attainment record based on 1998, 1999 and 2000 data. The co-lead agencies can apply for an extension of the attainment deadline to 2001, or if necessary to 2002. Although exceedances of the standard were recorded in 1998, the Ozone Attainment Plan will help reestablish the Bay Area's attainment record by providing 60 tons per day of VOC and NOx reductions between 1998 and 2000.

In addition, contingency measures are included in the Plan in the event that existing and proposed control measures are not sufficient to attain the standard by the deadline. Control measures that are already in the SIP will reduce emissions by 47 tons per day of VOC and 53 tons per day of NOx between 2000 and 2003. In addition, the following 4 ARB measures are included as contingency measures:

- Consumer Products
- Marine Pleasure Craft 2-Stroke Outboard Emissions Standards
- Electric Golf Carts (post-2000)
- Off Road Spark Ignition Engines

The co-lead agencies submit that this Plan meets the requirements set forth in the July 10, 1998 *Federal Register* notice (63 FR 37258), and will significantly reduce ozone precursor emissions to enable the region to attain the national 1-hour ozone standard on the proposed schedule.

[1] The co-lead agencies are the Bay Area Air Quality Management District (BAAQMD), the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG).

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SECTION 1: INTRODUCTION

This is an Attainment Plan for the 1-hour *National* Ozone Standard.[2] It is designed to identify control measures the region should implement in order to improve air quality in the San Francisco Bay Area air basin. The goal of the Ozone Attainment Plan is to identify a means for the region to re-attain the national ozone standard. It is intended to comply with requirements of the United States Environmental Protection Agency (EPA). EPA outlined their requirements in the July 10, 1998 *Federal Register* (63 FR 37258). After this Plan is adopted, it will be submitted to the California Air Resources Board (ARB) and EPA for incorporation into California's State Implementation Plan (SIP).

This SIP submittal, as part of the air quality planning process set forth in the federal Clean Air Act, is a revision to the Bay Area's Environmental Management Plan. Previous revisions to the air quality component of the Environmental Management Plan are the *1982 Bay Area Air Quality Plan* and the *1994 Bay Area Redesignation Request and Maintenance Plan*.

Ozone in the lower atmosphere is an air pollutant that is harmful to humans because it causes respiratory problems. Ozone also reduces crop yields, and accelerates deterioration of paints, finishes, rubber products, plastics and fabrics. The EPA has set primary national ambient air quality standards (NAAQS) for ozone and other air pollutants[3] to define the levels considered safe for human health.

EPA redesignated the Bay Area in attainment of the 1-hour National Ozone Standard on May 22, 1995. The agency did this because the Bay Area attained the ozone standard for five years (1990 – 1994). EPA also approved an *Ozone Maintenance Plan* submitted by the "co-lead" agencies for federal air quality planning in the Bay Area.

The Bay Area has a network of air monitoring stations measuring ozone and other pollutants. In the summers of 1995 and 1996, the Bay Area experienced hot, stagnant weather. This led to exceedances of the 1-hour standard. EPA received two petitions requesting redesignation of the Bay Area to nonattainment status (see 63 FR 37261). EPA determined that the "contingency measures" in the *Maintenance Plan* were not adequate to bring the region back into compliance with the standard and that the region's adopted and projected actions would not be sufficient to reestablish compliance with the standard.

EPA published a notice that revoked the region's clean air status (proposed action 62 FR 66578; final action 63 FR 37258). The final notice (July 10, 1998) calls for the region to submit three plan elements:

- **1995 Emissions Inventory** for Volatile Organic Compounds (VOC) and Nitrogen Oxides (NOx). (These two compounds combine in the presence of sunlight to form ground-level ozone.)
- **Attainment Assessment**. An analysis of the VOC and NOx reductions that are necessary for the region to re-attain the 1-hour National Ozone Standard.
- **Control Strategy**, which is comprised of the "control measures" that provide sufficient emission reductions to attain the ozone standard. This plan also includes contingency measures to be implemented if the region fails to attain the standard.

The deadline EPA has set for attaining the 1-hour national ozone standard is November 15, 2000. In 1997, the Bay Area experienced the lowest ozone readings in the 43-year history of the agency. But in 1998 the region experienced exceedances of the standard which do not allow the region to attain by 2000 because three clean years are required to meet the standard. However, the Clean Air Act provides for two 1-year extensions of the attainment deadline. If the Bay Area can achieve clean conditions in 1999, 2000 and 2001, or in 2000, 2001 and 2002, it will be able to attain the standard.

This document is a plan for the 1-hour national ozone standard. In addition to the 1-hour standard (0.12 parts per million), in 1997 EPA adopted a new standard of 0.08 ppm for an 8-hour averaging time. Control measures in this plan will help the region attain the 8-hour standard as well if the standard is upheld on appeal or following the remand to EPA.[4]

The BAAQMD was established in 1955 by the California Legislature to control air pollution in the counties around San Francisco Bay.[5] The BAAQMD has measured ozone levels for many years and now has 22 ozone monitoring sites.

[2] The 1-hour national ozone standard is a health-based ambient air quality standard, set by EPA in 1979, at a level of 0.12 parts per million (ppm) for a 1-hour average. California has a separate standard for ozone set at 0.09 parts per million, for a 1-hour average. There is a separate State air quality planning process outlined in the *1988 California Clean Air Act*, as amended. The Bay Area's most recent plan to comply with California requirements is the *1997 Clean Air Plan*.

[3] Carbon monoxide, particulate matter, sulfur dioxide, nitrongen dioxide and lead are other pollutants for which NAAQS have been established.

[4] A U.S. Court of Appeals decision in *American Trucking Association, Inc., et al v. U.S. EPA*, –F.3d–, 1999 WL 300618 (D.C. Cir., May 14, 1999), has remanded the new 8-hour ozone standard to EPA based on constitutional grounds so that EPA might articulate "intelligible principles" for this new standard. The standard may be reinstituted through appeal or new promulgation.

[5] Counties in the San Francisco Bay Area air basin include all of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo and Santa Clara counties, and the western part of Solano and the southern part of Sonoma conties.

SECTION 2: CONTEXT FOR BAY AREA OZONE PLANNING

Everyone wants clean air. Yet, despite decades of substantial progress and improvements the goal remains elusive. With this assessment, the San Francisco Bay Area continues in its efforts to reach the national 1-hour standard for ozone. The Bay Area is not alone. Most of California and many parts of the country are also still in violation of this standard.

The 1-hour standard for ozone (originally "photochemical oxidants") was first established under the federal Clean Air Act of 1970. The first State Implementation Plans (SIP) were due in 1972 and were mandated to show how every region would meet the ambient air quality standards by 1975, or no later than 1976. This was the law. When California's SIP failed to meet the law, EPA stepped in and proposed gasoline rationing in the early 1970s "to meet the requirements of the law." Lessons learned from the failed SIP planning process during the early '70s included:

- Realistic plans must be based on an improved scientific understanding of the ozone phenomenon, a very complex air pollutant;
- SIPs need realistic time schedules to develop cost-effective measures to reduce precursor emissions **and** reduce ozone levels;
- Effective plans must have widespread support of all the region's stakeholders, ranging from the environmental and public interests to the regulated and business community;
- Ozone attainment cannot be mandated by law, any more than damages from earthquakes, flooding, and tornadoes or traffic congestion can be stopped by regulation.

Recognizing the widespread inability of the country to meet the ambitious deadlines set by the Clean Air Act of 1970, that Act was amended. Revisions to the Clean Air Act passed in 1977, and deadlines were extended for up to **ten** more years. The new deadlines for meeting the 1-hour ozone standard allowed SIPs until 1987 to "demonstrate attainment."

The Bay Area SIPs prepared in the late '70s and early '80s laid the foundation for the dramatic improvements in ozone air quality the region has witnessed. Today, the ozone air quality – although not in attainment – is dramatically better than it was in the '70s. Peak ozone values are much lower, days over the standard are fewer, and person hours of ozone exposure to the public are significantly less. The improvements to date are the result of a concerted collective effort – federal, state, regional and local governments, along with other public and private support.

Even with the additional ten years of planning and control programs allowed by the 1977 Clean Air Act Amendments, virtually all major metropolitan areas of the country failed to meet the 1-hour ozone standard by 1987. A new set of amendments to the Clean Air Act began to take form. And again, in recognition of the difficulties and complexities of ozone attainment, more time was allowed in the 1990 Clean Air Act Amendments. This time, however, it was clearly recognized that different regions had varying levels of ozone air pollution severity. To compensate for these differences, regions with the most severe problem were given the most time to come into attainment, e.g., the Los Angeles region with an "extreme" problem. Under the provisions of the new law, the Bay Area was classified a "moderate" ozone non-attainment region and given until 1996 to come into attainment – yet another **nine** years.

Early Attainment

From the early '70s onward, all emission inventory projections have consistently shown that emission trends were down for both volatile organic compounds (VOCs) and nitrogen oxides (NOx), the precursors needed for ozone formation. In general, from the mid-'70s through early '90s, ozone air quality trends also improved. Year to year changes, however, were also significantly affected by meteorology. One year might show only a few exceedances of the standard, while the following year would produce many, even though the emissions inventory projected for the year with more exceedances was less than the year experiencing fewer exceedances. This phenomenon reinforced our understanding that observed air quality does not directly track emissions. Equal levels of emissions can produce vastly different ozone levels depending on primarily weather conditions, but also on the timing, location, and magnitude of precursor emissions.

The Bay Area 1991 Clean Air Plan included a projection that the region would attain the national ozone standard before 1997. In the early '90s the Bay Area observed five years of ozone levels (from 1990 through 1994) sufficient to qualify for "attainment" status. These levels were not a fluke; they occurred as a direct result of the successful implementation of many control programs on millions of mobile, stationary and area sources of pollution. Reduced emission levels accompanied by normal or favorable meteorology allowed the region to show that ozone levels protective of public health are clearly possible under certain circumstances.

Regional Disappointment

The "success" of the early '90s was short-lived. Right after the redesignation of the Bay Area to attainment for ozone, the region had two summers--1995 and 1996--with adverse meteorology and with numerous exceedances of the ozone standard. The Clean Air Act requires SIPs demonstrate attaining and **maintaining** the ozone standard. Clearly, the frequent exceedances showed the region was not maintaining the ozone levels required by law and something was amiss. In 1997, with more favorable meteorology, the Bay Area experienced another clean year with no exceedances of the ozone standard. This past year was again quite hot, following a winter of El Nino

storms. Once again, the Bay Area experienced eight exceedances of the ozone standard, including three on weekends.

There is every reason to believe that throughout the '90s, the overall emission levels of ozone precursors (VOCs and NOx) have steadily decreased, and that the control programs required by the SIP have been largely effective. More control measures at the federal, state, and local level are already on the books, and we expect that emissions will continue to decrease for the foreseeable future. Concomitantly, trends in ozone air quality will also continue to improve. Overall, ozone air quality in the coming decade will be better than the decade of the '90s. How much better is unclear. Improvements in ozone air quality are **not** linearly related to reductions in precursor emissions. In fact, both empirical (observed) and modeling analysis show that NOx reductions can lead to higher local ozone levels. This could explain, for example, the weekend effect, where, on weekends, lower levels of NOx and a change in the VOC to NOx ratio lead to higher observed ozone levels. Further research and analysis are needed to evaluate these effects.

Monitoring data from the past thirteen years show the natural variability to be expected in ozone levels, even with steadily declining emissions. Data from earlier decades show similar year-to-year variability. Fluctuations would also be expected to occur in the future.

TABLE 1
BAY AREA OZONE EXCESS DAYS (1986-1998)*

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Exceedances	5	14	5	4	2	2	2	3	2	11	8	0	8

* During entire period noted, average emissions of VOC and NOx were estimated to be steadily decreasing

EPA's Request for a Bay Area SIP Revision

In July, 1998, after much debate and consideration, EPA published in the *Federal Register* a notice calling for the Bay Area to submit a SIP revision which would among other things include: 1) a 1995 emission inventory; 2) an attainment assessment; and 3) control measures demonstrating how the region would return to attainment by the year 2000. This straight forward request may appear to be consistent with air quality planning processes of earlier years. In fact, it is different, if not unique. It is especially unusual in terms of the compressed schedule imposed on the region for both preparing the SIP and attaining the standard.

The Bay Area is perhaps the first region to "attain" and fall out of attainment, requiring EPA to request a SIP revision to correct our revised "non-attainment" status. The Bay Area may be the first, but we are not likely to be the only region to fall in and out of attainment due to cycles of weather patterns.

This SIP revision provides what EPA has requested. It meets the letter of the law. It only partially meets the spirit of the law, because much of what EPA requests is provided without confidence or guarantee that this revision will provide what everyone wishes – legally enforceable control measures that will ensure the attainment and maintenance of the 1-hour ozone standard by 2000. There are too many uncertainties to provide that assurance. The key uncertainties are touched upon briefly below.

1995 Emission Inventory

Historically, baseyear and baseline emission inventories have been the foundation of air quality plans. The Bay Area's inventory estimation and projection methods represent a developing state-of-the-art and produce much better emission inventories than in the past, but the methods continue to be filled with uncertainties and known errors. More importantly, the inventories provided generally represent typical seasonal estimates, e.g. average summer weekday. Ozone exceedances occur on specific "worst case" days; emission inventories do not correspond to worst case meteorology. Detailed, accurate and verified weekend emission inventories have not been developed or used for modeling. On weekends, emissions are probably lower and yet ozone exceedances still occurr. Another large uncertainty deals with estimates of biogenic or natural emissions, which are known to be highly variable, depending on light, temperature, humidity, soil moisture, plant stress, etc. It is quite possible that on days of ozone exceedances in the Bay Area, natural emissions are as great, if not greater, than those that are humanly produced.

Attainment Assessment

The EPA notice uses the term "attainment assessment" which is not defined in law or guidance. Presumably, an attainment assessment is similar to an "attainment demonstration," since it is being used for the same purpose – identifying the additional controls needed to show attainment. This assessment is fraught with even more uncertainties than the emission inventories. Reasonable professionals will differ in their judgment of what constitutes a defensible attainment assessment. The differences between conservative and optimistic attainment assessments are likely to be substantial and yet both can still be viewed as "reasonable" by professional scientific and engineering experts.

The implications of the above reasonable assessments are dramatic when control programs are considered. Using a reasonable, but optimistic attainment assessment, one can argue that no additional controls are needed and that current planned reductions will be enough to meet the ozone standard by 2000.

Using a very conservative and equally reasonable attainment assessment, one can also argue that many more controls requiring substantially more emission reductions are needed. This kind of assessment could place the control requirements so high that no economically feasible control program could be drafted to meet them.

Attainment Demonstration by Year 2000

Lessons learned from the early SIP submittals have previously been noted. In 1977, Krier and Ursin noted the following in their monograph, ***Pollution and Policy***:

> *"The Clean Air Act Amendments of 1970 took far too rigid and polar an approach to "cooperative" federalism, with the result that there has been very little cooperation...the federal government has dictated standards and left implementation in the first instance to the states and in the last to the federal government, with too little room for interaction in between...In mid-1974 the Administrator of EPA (no doubt speaking from experience) observed that "success in carrying out the Clean Air Act as well as other legislation depends on the willingness of the EPA to work with state and local government." In the administrator's view, state and local governments must be "full partners...in the formulation of...regulations, guidelines, and plans...EPA cannot fulfill its mandate "by means of edicts issued with a high and heavy hand from the Olympian heights of our ineffable wisdom."*

The table below notes the history of almost three decades of experience in SIP planning and mandating unrealistic deadlines. It is unclear what the outcome of the latest EPA deadline push will be. Given the region's (and country's) inability to meet deadlines even with several ten year extensions, it will be extremely challenging for the Bay Area to meet a new one year deadline.

Public Policy Perspectives

In reviewing the entire range of issues dealing with ozone control in 1991, the prestigious National Research Council, in *Rethinking the Ozone Problem in Urban and Regional Air Pollution*, made the following comments about the SIP process:

> *"The State Implementation Plan (SIP) process, outlined in the Clean Air Act for developing and implementing ozone reduction strategies, is fundamentally sound in principle but is seriously flawed in practice because of the lack of adequate verification programs...Until verification programs are incorporated into the SIP process, the use of unverified emission inventories in air quality models will continue to involve considerable uncertainties in predicting changes in ozone concentrations resulting from emission controls."*

To date and for a variety of reasons, **no** region in the country has developed such a verification program as part of the SIP process. Herein lies the difficult public policy dilemma the region faces. EPA-Region IX publishes a mandate which is well intended and with which nobody disputes the goal or intent. History and science, however, would suggest the mandate will be extremely difficult, if not impossible, to meet with any credibility. Unquestionably, EPA (with much support from the environmental community) has the law behind it. However, the law has mandated for decades that the country have clean air and far more regions have failed in this pursuit than have been successful in achieving it. By and large, the failures have not been due to lack of effort, sincerity, or commitments to the goal. The Bay Area is committed to clean air; billions have been invested and remarkable progress has been made. Ozone attainment will remain, however, a complex and difficult public policy pursuit.

This SIP revision is provided to meet the requirements of the law. The co-lead agencies have not been able to identify a sound technically defensible procedure to estimate, with any degree of confidence, a specific emission reduction target that would ensure attainment of the ozone standard by a specific year. The time constraints imposed by EPA for this submittal do not allow such an assessment or attainment demonstration to be conducted. The attainment assessment provided in this submittal is "reasonable," but clearly optimistic.

TABLE 2
HISTORY OF CLEAN AIR ACT SIP MANDATES

Mandate	Authority	SIP Due	Attainment Required	Met?
CAA 1970	Congress	1972	1976	No
CAA 1977	Congress	1982	1987	No
CAA 1990	Congress	1993	1996	Yes, then No
Federal Register 1998	EPA Region IX	1999	2000	?

SECTION 3:
BAY AREA OZONE EXPERIENCE - 1990 THROUGH 1998

Air in the Bay Area meets the national 1-hour ozone standard more than 99.9% of the time. On occasion, during hot summer afternoons, ozone concentrations may approach or even exceed the standard. This is most likely to occur in the inland valleys, and especially in the Livermore Valley. During the 1990s, the Bay Area has experienced cleaner air than all but a few air basins with a population of greater than 3,000,000 (See Table 3). In fact, over the first eight ozone seasons of the 1990's (1990-1997), only two populous air basins (Miami and Seattle) had cleaner air. Each of these has fewer people than the Bay Area.

Emissions of ozone precursors have trended downward throughout the decade, both in the Bay Area and nationally. This is largely as a result of cleaner vehicles and cleaner fuels. Also, the Bay Area has made tremendous progress in reducing stationary source emissions.

TABLE 3
1990-1997 AVERAGE ANNUAL OZONE – CMSAs* OVER 3,000,000 POPULATION

Consolidated Metropolitan Statistical Area (CMSA)	1996 Population (Rank)	1990-1997 Average Annual Ozone (2nd High)**	EPA Ozone Classification***
Los Angeles	15,495,000 (2)	18.50	Extreme
Houston	4,253,000 (10)	17.38	Severe-17
New York	19,938,000 (1)	15.50	Severe-17
Philadelphia	5,973,000 (6)	13.38	Severe-15
Dallas-Ft. Worth	4,575,000 (9)	13.25	Serious
Atlanta	3,541,000 (11)	13.13	Serious
Washington-Baltimore	7,165,000 (4)	12.88	Serious
Boston	5,563,000 (7)	12.63	Serious
Chicago	8,600,000 (3)	11.88	Severe-17
Detroit	5,284,000 (8)	10.88	Maintenance
San Francisco-Oakland-San Jose	**6,605,000 (5)**	**10.88[6]**	**Nonattainment-Unclassified**
Seattle	3,321,000 (13)	10.13	Maintenance
Miami-Ft. Lauderdale	3,514,000 (12)	9.50	Maintenance

* Consolidated Metropolitan Statistical Area is an aggregation of two or more Metropolitan Statistical Areas, as defined by the U.S. Bureau of the Census.
** Average of Each Year's Second Highest 1-hour Reading
*** As of February 17, 1999. Source: EPA Green Book.

EPA has set criteria for designation to attainment of the national 1-hour ozone standard. EPA requires that air basins record no more than three exceedances at a single station, over a three-year period. Stations that record four or more exceedances in three years cause the region to violate the standard. Typically, Livermore has the highest ozone levels in the Bay Area. Table 4 illustrates the number of exceedances recorded at each air monitoring station in the region that recorded an exceedance in any year from 1990 to 1998. Livermore, the station with the greatest number of exceedances, has averaged less than three exceedances per year over the nine year period. This record has been achieved despite the unusually hot weather experienced in 1995, 1996 and 1998. Six stations recorded no exceedances in any year.

[6] The data analyzed are for 19 of the Bay Area's 23 current and former ozone air monitoring stations, as reported in EPA's annual air quality trends report (National Air Quality and Emissions Trends Report, 1997). EPA does not include sites that have less than 8 (out of the last 10) years monitoring data. The Bay Area stations that were not included are Bethel Island, San Jose East, San Leandro, San Martin, and San Pablo. Some of the region's highest readings have recently been recorded at San Martin.

TABLE 4
EXCEEDANCES OF THE 1-HOUR NATIONAL OZONE STANDARD

Station	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total	Annual Average
Livermore	1	1	0	1	2	7	8	0	6	26	2.89
Concord	0	0	0	2	0	3	1	0	2	8	0.89
Los Gatos	0	0	1	1	0	4	1	0	1	8	0.89
San Martin					1	1	0	0	3		
Gilroy	0	1	0	0	0	1	0	0	2	4	0.44
Fremont	1	0	0	1	0	2	0	0	0	4	0.44
San Jose East (Burbank)	1	0	0	1	0						
San Jose, Alum Rock	0	0	1	0	0	3	0	0	0	4	0.44
Hayward	0	0	1	0	0	2	0	0	0	3	0.33
San Leandro	0	0	0	0	0	3	0	0	0	3	0.33
San Jose, 4th Street	0	0	0	0	0	1	0	0	1	2	0.22
Bethel Island	0	0	0	0	0	1	1	0	0	2	0.22
Fairfield	0	0	0	1	0	1	0	0	0	2	0.22
Napa	0	0	0	0	0	1	0	0	1	2	0.22
Pittsburg	0	0	0	1	0	0	0	0	0	1	0.11
Redwood City	0	0	0	0	0	1	0	0	0	1	0.11
Vallejo	0	0	0	0	0	1	0	0	0	1	0.11
San Rafael	0	0	0	0	0	0	0	0	0	0	0.00
Santa Rosa	0	0	0	0	0	0	0	0	0	0	0.00
Oakland	0	0	0	0	0	0	0	0	0	0	0.00
San Francisco	0	0	0	0	0	0	0	0	0	0	0.00
San Pablo	0	0	0	0	0	0	0	0	0	0	0.00
Mountain View	0	0	0	0	0	0	0	0	0	0	0.00

SECTION 4: EMISSION INVENTORY

Introduction

EPA's *Federal Register* notice redesignating the Bay Area requires this SIP revision to include an "existing" 1995 emission inventory for VOC and NOx (63 FR 37275). EPA's notice, in addressing commenters' concerns regarding inventory requirements, specificially did not require a weekend inventory (63 FR 37270). The notice also did not include a requirement for an attainment year (2000) inventory. EPA sought to minimize requirements and expedite submittal of the SIP revision.

An emission inventory is an itemized list of emission estimates for sources of air pollution in a given area, for a specified time period. These inventories are sometimes called "source inventories" because they list various sources, or categories of sources, of pollutant emissions.

The BAAQMD began preparing emission inventories in 1957. This 1995 emission inventory is a "Planning Inventory" for ozone. For ozone, a typical summer day inventory is needed, because ozone levels are highest during summer.

The inventory is divided into stationary sources (point, area and biogenic) and mobile sources. Stationary source emissions are calculated by the BAAQMD using various procedures. Generally, the reported emissions estimates come from engineering calculations using emission factors from local or outside test data. Emission computation methodology by source categories is set forth in the BAAQMD publication "Source Category Methodologies." The BAAQMD participates in the California Emission Inventory Technical Advisory Committee (EITAC). The BAAQMD maintains the best available inventory methodologies.

Many area source categories are further classified into sub-categories for better emission computation, speciation and regulation development. For example, emissions from aircraft categories are subdivided into various aircraft types. Architectural coating categories are subdivided into various types of coatings and varnishes to account for varying solvent content. More than 900 different sub-categories are used in this inventory. Emissions for categories affected by regulations are adjusted to reflect the controls required. They are also adjusted to reflect our estimate of rule effectiveness. The emissions are presented in tons per day (tpd) for volatile organic compounds (VOC) and oxides of nitrogen (NOx).

Table 5 shows some of the factors (by county, for 1995) that influence emissions of air pollutants: population, natural gas use, gasoline sales and vehicle use.

In its redesignation notice, EPA required submittal of a 1995 inventory for VOC and NOx. The 1995 emission inventory was chosen as the base year for the Plan because the region recorded 11 exceedances of the 1-hour national ozone standard that year – the most recorded in the Bay Area since 1987 (63 FR 37270 and 37276).

TABLE 5
1995 INVENTORY-RELATED STATISTICS, BY COUNTY

County	Population (1000's)	Area (Square Miles)			Daily Natural Gas Usage (Million cu.ft.)	Daily Gasoline Sales (1000's gal.)	Daily Vehicle** Miles Traveled (Millions)
		Land	Water	Total			
Alameda	1,365,000	734	84	818	140	1,690	24
Contra Costa	883,000	733	73	806	426	1,105	16
Marin	243,000	520	87	607	23	335	5
Napa	122,000	788	6	794	11	160	2
San Francisco	752,000	45	57	102	137	1,015	8
San Mateo	688,000	447	106	553	67	1,003	14
Santa Clara	1,608,000	1,300	12	1,312	184	1,922	28
Solano*	280,000	370	64	434	42	323	6
Sonoma*	375,000	664	4	668	32	433	6
TOTAL	**6,317,000**	**5,600**	**493**	**6,094**	**1,062**	**7,986**	**109**

* Portion within Bay Area Air Quality Management District.

** Source for Light-Duty Vehicle VMT: 1997 Transportation Improvement Program Air Quality Conformity Analysis, Metropolitan Transportation Commission, September 13, 1996.

Stationary Source Emissions

Point Sources

Sources identified on an individual facility or source basis are called point sources. Refineries and industrial plants are examples of point sources. The emission characteristics of individual facilities vary widely and each facility is examined individually. The BAAQMD collects and maintains a computer data bank with detailed information on point sources. Almost all facilities emitting greater than 2.5 tons per year of any air pollutant are included. The 1995 inventory accounts for about 3,900 facilities, with 20,000 different sources. There are about 35,000 different emissions factors, because some sources have more than one factor (e.g., boilers burning different fuels, tanks storing different materials, and painting/printing operations using different coatings).

Data on the activity, seasonal variations, and hours of operation are collected at the process level from each facility. Parameters that affect the quantity of emissions are updated regularly. Emissions are calculated using the detailed data for each of the 7,000 facility processes listed as storage of organic liquid, and 10,000 facility processes listed as organic solvent users. The emissions from combustion and other general processes are computed using generalized or specific emission factors. These factors are periodically reviewed and updated.

Area Sources

Those stationary sources that are not identified individually are called area sources. This term is sometimes extended to cover numerous small point sources such as dry cleaners or gas stations which are known individually. It also includes the diverse universe of unpermitted small sources. These small sources individually do not emit significant amounts of pollutants. However, together they make a large contribution to the emission inventory. Examples of area sources are residential heating equipment and the diverse use of paints, solvents, and consumer products. Emissions from these sources are grouped into categories and calculated based on surrogate variables. Information on these surrogates is usually available for the state or by county. Selected surrogates are used to apportion the category emissions into diurnal and spatial patterns. Emissions for some source categories are estimated by the California Air Resources Board (ARB) based on statewide data.

Biogenic Sources

In addition to man-made air pollution, there are significant quantities of pollutants from natural sources (e.g., plants, animals, marshes, and the earth itself). Vegetation, for example, emits large amounts of isoprene, terpenes, and other organic compounds. These compounds are precursors of ozone. Emission rates depend upon species, season, biomass density, time of day, local temperature, moisture and other factors. Total reactive organic emissions from Bay Area vegetation are estimated to be about 300 tons per day and are not included in the Planning Inventory but *are* included in photochemical modeling inventories. Biogenic emission estimates are developed using EPA's personal computer version of the Biogenic Emissions Inventory System (PC-BEIS).

Mobile Source Emissions

Mobile sources consist of on- and off-road sources such as passenger cars, motorcycles, trucks, buses, heavy-duty construction equipment, recreational vehciles, marine vessels, lawn and garden equipment, and small utility engines. There were approximately 4.2 million light duty vehicles in the Bay Area in 1995.

On-Road Motor Vehicles

These consist of passenger cars, trucks, buses and motorcycles. Emissions from on-road motor vehicles are a major portion of the emission inventory and are estimated using computer models developed by ARB. The models are referred to as Motor Vehicle Emission Inventory (MVEI). The latest version used for this inventory is MVEI7G Version 1.0c, released by ARB on May 27, 1997. MVEI7G consists of two major parts: EMFAC and BURDEN. EMFAC calculates emission rates for a variety of vehicle types (passenger cars, trucks, etc.), fuel usage, control technology and mode of operation (e.g., hot start, cold start). It also accounts for vehicle age, and operating conditions such as speed and temperature. Emission factors are produced for summer and winter operations to reflect the type of fuel in use, such as winter-time oxygenated fuel and summer-time fuel which has lower volatility (lower Reid Vapor Pressure) than winter. Emission reductions resulting from California's Inspection and Maintenance ("Smog Check") program are incorporated. EMFAC7G was used for this inventory.

BURDEN uses emission factors from EMFAC and a large data base of activity for each county to calculate total daily emissions. The activity is in the form of number of in-use vehicles, number of vehicle engine starts and vehicle miles traveled (VMT) for each vehicle type. The vehicle trips, VMT data, and vehicle speeds for these calculations are developed using the Metropolitan Transportation Commission (MTC) regional travel model. Vehicle population is derived from Department of Motor Vehicle (DMV) data and number of engine starts are based on the population data and ARB guidelines.

Other Mobile Sources

These sources include boats, ships, trains, and aircraft, as well as garden, farm and construction equipment. Various methodologies are used for compilation of emissions for these mobile sources. Emission factors and methodologies for these sources are provided by ARB and EPA. Aircraft type and activity data specific to each airport were used in estimating aircraft emissions.

Planning Inventory

A planning inventory is a seasonal inventory representing emissions when a pollutant's concentrations are at their highest levels. For example, the emission inventory for the ozone season represents emissions occurring during the summer when ozone levels are highest. The emission inventory for the particulates season represents emissions occurring during the winter when particulate levels are highest. The seasonal inventories (summer and winter) are prepared based on the ARB's published guidelines described below.

The point source emissions are based on "average annual operating day" during the year. Therefore, the summer and winter point source emissions are the same. Area source emissions are based on "average seasonal operating day". The summer season is considered May through October and the winter season is considered November through April. Data on normal operating schedules (hours per day, days per week and weeks per year) are collected as part of routine point source inventory procedures. For area sources, representative profiles showing monthly, weekly, and daily variation in emissions are prepared for each source category. These profiles are then used to obtain average seasonal operating day emissions.

For on-road motor vehicles, the MVEI7G was used to develop planning inventories. The emission estimates for these inventories are based on ambient temperature profiles representing the ten days having the highest pollution levels. Summer temperature profiles are used to generate the ozone-precursor (VOC and NO_x) emission inventory, and winter temperature profiles are used for PM_{10} emissions.

BURDEN divides the day into six different time periods consistent with motor vehicle activity patterns, including the morning and evening commute periods. These six periods are: midnight - 6am, 6am - 9am, 9am - noon, noon - 3pm, 3pm - 6pm, and 6pm - midnight. For each period, specific temperatures, activity data and vehicle speeds are used to estimate emissions. The emissions from the six periods are then summed to get daily emissions.

The above calculations are made for each county. For Solano and Sonoma, only the portions under BAAQMD jurisdiction are represented. As mentioned earlier, a distribution of vehicle miles traveled, vehicle trips and average vehicle speed for each county was derived from data supplied by MTC. The number of vehicles by vehicle class (e.g., light-duty truck, motorcycle, etc.) was based on vehicle registration information supplied by ARB.

EPA has exempted certain low reactivity organic compounds from federal control. Some of these compounds are shown in Table 6. Although they are not part of the VOC emission inventory, they are included in air quality modeling runs.

TABLE 6

LOW REACTIVITY COMPOUNDS

1. Methane
2. Ethane
3. Acetone
4. Methylene chloride
5. Perchloroethylene
6. Methyl Chloroform (1,1,1 Trichloroethane)
7. Trichlorotrifluoroethane (CFC-113)
8. Trichlorofluoromethane (CFC-111)
9. Dichlorodifluoromethane (CFC-12)
10. Chlorodifluoromethane (CFC-22)
11. Trifluoromethane (CFC-23)
12. Dichlorotetrafluoroethane (CFC-114)
13. Chloropentafluoroethane (CFC-115)

The BAAQMD does not have jurisdiction over all emitting sources shown in the inventory. Figures 1 and 2 show 1995 VOC and NO_x emissions breakdown by government regulatory jurisdictions. The largest inventory sector, shown as "State/MTC" jurisdiction, covers on-road mobile sources. These emission rates are directly affected by ARB's clean fuel and clean vehicle programs. They are also affected by the Bureau of Automobile Repair's Smog Check Program. They are affected to a lesser degree by MTC decisions on developing and maintaining the various components of the Bay Area's transportation system, which includes roads, bridges, public transit, and bicycle facilities.

1995 emissions of VOC and NOx by source categories are presented in Table 7. Total VOC and NO_x emissions in the Bay Area Air Basin were 562 and 626 tons/day, respectively.

FIGURE 1
1995 VOC Emissions by Jurisdiction
562 tons/day

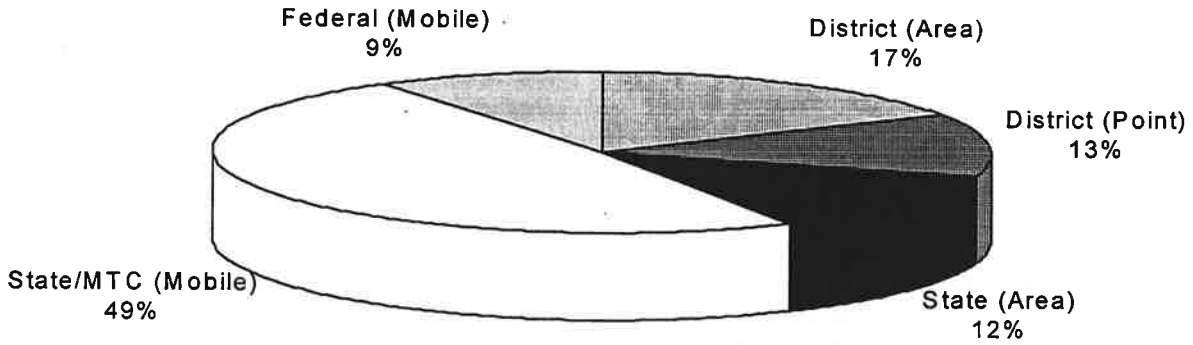


FIGURE 2
1995 NOx Emissions by Jurisdiction
626 tons/day

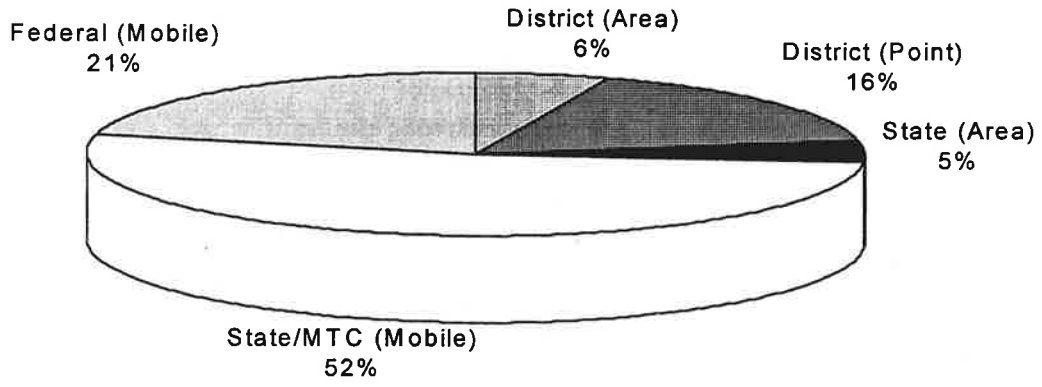


TABLE 7

1995 EMISSIONS OF VOLATILE ORGANIC COMPOUNDS AND NITROGEN OXIDES – PLANNING INVENTORY

		VOC	NOx
INDUSTRIAL COMMERCIAL PROCESSES			
PETROLEUM REFINING FACILITIES			
Basic Refining Processes		0.10	6.42
Wastewater (Oil-Water) Separators		3.32	—
Wastewater Treatment Facilities		0.13	—
Cooling Towers		2.27	—
Flares and Blowdown Systems		0.11	1.73
Other Refining Processes		0.51	—
Fugitives		9.90	—
	Subtotal	**16.3**	**8.2**
CHEMICAL MANUFACTURING FACILITIES			
Sulfur Manufacturing		0.03	0.06
Coatings & Inks Manufacturing		0.68	—
Resins Manufacturing		0.02	—
Other Chemicals Manufacturing		0.73	2.18
Fugitives (all manufacturing)- Valves & Flanges		1.64	—
	Subtotal	**3.1**	**2.2**
OTHER INDUSTRIAL COMMERCIAL PROCESSES			
Bakeries		1.33	—
Cooking		0.97	—
Wineries		0.64	—
Other Food & Agricultural Processes		0.54	—
Metallurgical		0.04	—
Asphalt Concrete Plants		0.05	0.04
Glass & Related Products Manufacturing		0.02	0.82
Stone, Sand & Gravel		0.06	—
Oil Production Fields		0.06	—
Gas Production Fields		0.15	—
Waste Management		4.47	0.24
Semiconductor Manufacturing		0.86	—
Flexible & Rigid Discs Manufacturing		0.02	—
Fiberglass Products Manufacturing		0.49	—
Rubber Products Manufacturing		0.20	—
Plastic Products Manufacturing		0.68	0.03
Contaminated Soil Aeration		4.07	—
Soil Vapor Extraction & Air Stripping		0.29	—
Other Industrial Commercial		0.90	0.23
	Subtotal	**15.8**	**1.4**
PETROLEUM PRODUCTS/SOLVENT EVAPORATION			
PETROLEUM REFINERY			
Storage Tanks		6.71	—
Loading Operations		2.94	—
	Subtotal	**9.7**	**—**
FUELS DISTRIBUTION			
Natural Gas Distribution		0.45	—
Bulk Plants (Gasoline Only)		0.82	—
Bulk Plants and Terminals (Non-Gasoline)		0.06	—
Loading Trucks		0.41	—
Trucking		0.17	—
Gasoline Filling Stations		23.40	—
Aircraft Fueling		2.71	—
Recreational Boat Fueling		0.87	—
Ferry & Fishing Boats Fueling		0.19	—
Other Fueling		0.19	—
	Subtotal	**29.3**	**—**
OTHER ORGANIC COMPOUNDS EVAPORATION			
Industrial Degreasing		3.27	—
Commercial Degreasing		2.22	—
Dry Cleaners		0.14	—
Printing		8.25	—
Adhesives & Sealants		11.10	—
Structures Coating		25.40	—
Industrial/Commercial Coating		31.30	—
Storage Tanks		1.39	—
Lightering		0.08	—
Ballasting		1.67	—

Marine Vessel Cleaning & Gas Freeing		0.68	—
Sterilizers		—	—
Marine Loading (Non-Refinery)		0.19	—
Asphalt Paving		0.25	—
Other Organics Evaporation		0.90	—
	Subtotal	**86.8**	**—**
COMBUSTION-STATIONARY SOURCES			
FUELS COMBUSTION			
Domestic		2.03	11.80
Cogeneration		0.78	11.50
Power Plants		0.06	12.90
Oil Refineries External Combustion		0.37	31.20
Glass Melting Furnaces - Natural Gas		—	4.61
Reciprocating Engines		0.30	8.78
Turbines		0.13	2.16
Other External Combustion		0.91	41.20
	Subtotal	**4.6**	**124.2**
BURNING OF WASTE MATERIAL			
Incineration		0.70	1.22
Planned Fires		0.09	0.01
	Subtotal	**0.8**	**1.2**
COMBUSTION-MOBILE SOURCES			
OFF-HIGHWAY MOBILE SOURCES			
Lawn, Garden and Other Utility Equipment		13.30	0.61
Transportation Refrigeration Units		0.22	1.79
Farm Equipment		1.26	7.14
Heavy Duty Industrial/Construction Equipment		2.27	26.20
Light Duty Industrial/Construction Equipment		22.10	77.70
Locomotive Operations		0.50	11.00
Off Road Motorcycles		2.16	0.16
All Terrain Vehicles		0.74	0.02
Four-wheel Drive Vehicles		0.11	0.08
Ships Maneuvering		0.11	3.12
Ships Berthing		0.28	1.65
Ships In-Transit		0.15	5.42
Commercial Boats		0.65	4.02
Recreational Boats		16.90	1.41
	Subtotal	**60.7**	**140.3**
AIRCRAFT			
Commercial Aircraft		3.58	17.00
General Aviation		0.88	0.20
Military Aircraft		5.91	4.35
Agricultural Aircraft		—	—
Airport Ground Support Equipment		0.16	0.47
	Subtotal	**10.5**	**22.0**
ON-ROAD MOTOR VEHICLES			
Light Duty Passenger		176.30	149.00
Light Duty Trucks		74.40	86.60
Medium Duty Trucks		9.70	12.80
Light Heavy Duty Trucks		3.48	17.70
Medium Heavy Duty Trucks		2.92	15.20
Heavy Heavy Duty Trucks		4.35	38.80
Heavy Duty Buses		0.53	5.28
Motorcycles	~50%	2.01	0.93
	Subtotal	**273.7**	**326.3**
MISCELLANEOUS OTHER SOURCES			
Construction Operations		—	—
Farming Operations		—	—
Entrained Road Dust		—	—
Accidental Fires		0.42	0.14
Animal Waste		3.75	—
Wind Blown Dust		—	—
Agricultural Pesticides		2.86	—
Non-Agricultural Pesticides		1.51	—
Consumer Products (no pesticides)		42.20	—
Other Miscellaneous Sources		0.18	0.07
	Subtotal	**50.9**	**0.2**
	Total	**562**	**626**

all mobile sources ~60% ROG ~75% NOx

52%

Inventory Review and Approval

Substantial evidence and expert opinion indicate that real-world motor vehicle emissions may be higher than shown in source inventory estimates. [Research on this topic was reviewed in an October 15, 1998 letter from Dr. Robert Harley, UC Berkeley, to the BAAQMD. Seminal work in this area was performed Dr. Harley, and two BAAQMD staff, Amir Fanai and Phil Martien (see *A Fuel Based Motor Vehicle Emission Inventory for the San Francisco Bay Area*, presented at the Air and Waste Management Association's 90th Annual Meeting in Toronto, June 8-13, 1997).] To address this and other uncertainty issues associated with the inventory, ARB staff reviewed their inventory process. They held a hearing on December 11, 1997, and approved the 1995 statewide inventory. The mobile source portion was based on MVEI7G, which has been used in the 1995 inventory developed for this Plan. The next formal update of the MVEI has been scheduled for 1999.

Transportation Emissions Budgets

Section 176(c) of the 1990 Clean Air Act Amendments outlines the "conformity" provisions of the Act. Federal actions are required to conform to the SIP's purpose of eliminating or reducing the severity and number of exceedances of the NAAQS and achieving expeditious attainment of these standards. Federal actions are differentiated into transportation actions by FHWA or FTA, and all other federal actions.

The current conformity procedures in the SIP, which outline the process MTC uses to make conformity determinations on the Regional Transportation Plan (RTP), the Transportation Improvement Program (TIP), and specific projects, as well as ensuring the expeditious implementation of SIP transportation control measures, was approved by EPA on October 21, 1997. In order to make a favorable conformity finding on the RTP and the TIP, MTC must demonstrate (through modeling) that the motor vehicle emissions are lower than the approved emissions budgets.

Motor vehicle emissions budgets have been established for VOCs, NOx and carbon monoxide. The current VOC and NOx emissions budgets (299 tpd and 251 tpd, respectively) were included in the region's *Ozone Maintenance Plan* (1994), and continue to apply. However, for purposes of determining conformity, this Plan revision, upon EPA's publication in the *Federal Register* that the budgets are adequate, will establish new VOC and NOx emission budgets of 175.2 tpd and 247.1 tpd, respectively. The 1990 VOC and NOx budgets will no longer be applicable.

The new emission budgets are derived from Tables 7 and 11, as follows:

VOC

1995 On Road Motor Vehicle Emissions	273.7
1995-2000 change due to ARB rule for light/med. duty cars and trucks*	(94.3)
1995-2000 change due to ARB rule for heavy duty trucks*	(4.2)
2000 On Road Motor Vehicle Emissions	175.2

NOx

1995 On Road Motor Vehicle Emissions	326.3
1995-2000 change due to ARB rule for light/med. duty cars and trucks*	(66.5)
1995-2000 change due to ARB rule for heavy duty trucks*	(12.7)
2000 On Road Motor Vehicle Emissions	247.1

* includes growth in source category

SECTION 5: ATTAINMENT ASSESSMENT

Introduction

EPA's *Federal Register* notice redesignating the Bay Area requires this SIP revision to include an "attainment assessment" which employs available air quality data and technical analyses to estimate the level of emission reductions needed to attain the 1-hour ozone National Ambient Air Quality Standard (NAAQS). EPA requires that the attainment assessment take into account the meteorological conditions and ambient air pollution concentrations associated with the exceedances of the NAAQS in the Bay Area in 1995 and 1996 (62 FR 66580-66581; see also 63 FR 37270-37271). BAAQMD staff have reviewed available and accessible air quality data, modeling and analyses to respond to this requirement.

The assessment consists of three elements: (1) an analysis of the magnitude of the problem, i.e. the amount by which the national 1-hour ozone standard is exceeded in the Bay Area; (2) an examination of recent trends in ambient levels of ozone and its precursors, emission trends, spatial and temporal variations, and source-receptor relationships; and (3) the identification and application of analytical methods that can be used to predict future changes in ambient ozone resulting from changes in precursor emissions.

The first part of the assessment addresses the magnitude of the ozone problem in the Bay Area. This is done by calculating the air basin's "design value".

The second part of the assessment uses a variety of approaches to further characterize the nature of the ozone problem in the Bay Area: First, trends in ambient ozone, its precursors, and precursor emissions are assessed and compared. Second, trajectory analyses are used to assess source-receptor relationships. Third, the results from applying the Smog Production Algorithm are reviewed for evidence of a 'limiting' precursor in the Bay Area (i.e., evidence that emissions of only one of the two precursors of ozone, nitrogen oxide (NOx) or volatile organic compounds (VOC), works to reduce ozone in the local area). Finally, weekend-weekday differences are also examined for evidence of a limiting precursor.

The third part of the assessment presents the BAAQMD's estimate of the amount and type of emission reductions that may be needed by the year 2000 for attainment of the 1-hour ozone standard. It is based on past Bay Area photochemical modeling results.

The Design Value

The first step in the ozone air quality attainment assessment is to estimate the amount by which Bay Area peak ozone concentrations exceed the standard. An index called the 'design value' is the measure used in air quality planning. A region's attainment/nonattainment status is determined by the site with the highest design value. For the Bay Area, Livermore has been that site in recent years. Thus, the BAAQMD has attempted to estimate the amount by which Livermore's highest ozone concentrations must be reduced in order to attain the standard.

Based on the form of the national ozone standard, attainment is determined from air monitoring data from a three-year period. If a site has no more than one exceedance per year on average, it has attained the NAAQS for ozone. A site's design value is defined as the ozone concentration that would be expected to be exceeded once per year on average over a three-year period. It is most commonly approximated as the fourth highest ozone concentration recorded in the past three years. Note that a site exceeds the NAAQS if its 4th highest value is at least 125 parts per billion (ppb), which is the effective level of the standard. The design value also indicates the amount by which the standard is exceeded. For example, if a site's design value is 130 ppb, then peak ozone levels would have to be reduced by 6 ppb, or about 5%, to meet the standard.

The July 10, 1998 *Federal Register* Notice (63 FR 37270-37271) requires the BAAQMD to develop an attainment assessment that takes into account the meteorological conditions and ambient concentrations associated with exceedances of the national 1-hour ozone standard in 1995 and 1996. Because the meteorology and ambient ozone concentrations were particularly severe in 1995, it was used as the base year for this assessment. The fourth highest daily peak-hour ozone concentration in Livermore in 1993-5 was 138 ppb. Thus, in 1995 the Bay Area's design value was 13 ppb (or about 10 percent) above the level of the national 1-hour standard.

Characterizing the Region's Ozone Problem

From 1990 through 1994 the Bay Area experienced a five year period with ozone concentrations that met the national 1-hour ozone standard. Based on projections that emissions would continue to decrease, the BAAQMD, MTC and ABAG applied for and in 1995 were granted attainment status, or actually "Maintenance" area status under the federal Clean Air Act. But during the summer of 1995, the Bay Area experienced its worst ozone season in a decade, with 11 days over the standard. The next year, 1996, was somewhat cleaner with 8 days over the ozone NAAQS. And, although 1997 was the cleanest year ever, 1998 saw a renewal of ozone exceedances. Why these reversals occurred is not completely understood, but most of the effects

can be attributed to year-to-year differences in the number and severity of episodes of "ozone conducive" weather.

Weather Effects

In the San Francisco Bay Area, ozone precursor emission patterns are fairly stable and predictable from day to day—though there are day-of-week variations. Overall emission levels have declined significantly since 1990. Weather conditions, by contrast, can change markedly from day to day, as well as from year to year. Ambient ozone levels are higher on days with more sunlight, higher temperatures, lower wind speeds and stronger inversions. Such days are called "ozone-conducive" days. The ozone levels during a given summer are largely determined by the actual weather conditions during that year—the number and severity of ozone conducive days.

Air Quality Trends

Since 1990, there has been progress in the Bay Area in reducing emissions of both ozone precursors, VOC and NO_x, as well as ozone levels in ambient air. But the progress has been uneven over space and time. The time-related variations have been noted above. With respect to spatial variations, the south bay region, around San Jose, has shown more improvement than outlying downwind areas such as Livermore, Concord and Gilroy.

An analysis of ambient NO_x and carbon monoxide showed regionwide downward trends similar to downward trends projected in the emissions inventory. At several sites, however, the trends were considerably weaker. Livermore was one of those sites. Unfortunately, the BAAQMD does not have adequate data for a similar analysis of ambient VOC trends.

Airflow Patterns

In its evaluation of the 1995 and 1996 ozone seasons[7], the BAAQMD used trajectory analysis (analysis of wind patterns) to identify the morning (7:00 a.m. to 10:00 a.m.) source regions and transport pathways that led to exceedances of the national standard. In a majority of cases, the San Francisco-Oakland area was found to be the morning source area.

Ozone Formation and the Limiting Precursor

A number of investigators[8] [9] [10] have noted that Bay Area ozone levels tend to be higher on weekends than on weekdays. This phenomenon has been dubbed the "weekend effect". BAAQMD analysis has confirmed a statistically significant increase in ozone potential on weekends on the order of 5 ppb, and the increase is more pronounced on hot days (temperature > 90°F). One hypothesis for this phenomenon is that the influence of NO_x is different on the weekends. In particular, there is considerably less NO_x produced on weekends because manufacturing and commercial activities are reduced, and truck travel is greatly reduced. The reduction in VOC is not as great. The weekend effect may be evidence that reducing NO_x relative to VOC may increase local ozone levels, but further study is needed to demonstrate conclusively that NO_x controls are counterproductive in reducing ozone locally and downwind in transport areas.

MAPPER software was applied to past ozone exceedance days to assess the relative effects of VOC and NO_x emissions on Bay Area ozone. MAPPER applies the Smog Production Algorithm to estimate the extent of the reaction, and, by inference, which pollutant is the limiting precursor. The results showed that for most situations the level of VOC precursors was the limiting factor, and there was little evidence of NO_x -limiting conditions.

Analysis of the August 3-6, 1990 SARMAP episode in central California showed VOC-limitation in the Bay Area and NO_x -limitation in parts of the Central Valley. This suggests that the primary means to reduce ozone in the Bay Area in the short term is to reduce VOC emissions and the primary means to reduce ozone in the Central Valley is to reduce NO_x emissions. In the long term, the Bay Area will need to consider additional NOx controls to address its contribution to pollution in downwind areas and to meet the state and any new federal ozone and PM standards.

An analysis of 1996 and 1998 federal exceedance days showed that, with the exception of Bethel Island, all BAAQMD sites appear VOC-limited. Bethel Island appears to act similarly to Central Valley sites, many of which are NO_x-limited. Nevertheless, Livermore, although generally VOC-limited, may represent a transitional zone, making it uncertain what the effect would be of lowering NO_x.

The weight of evidence from these analyses suggests that, if additional controls are needed for attainment by November 2000 as set forth in the *Federal Register* notice, additional VOC reductions will be more effective than additional NO_x reductions in lowering local ozone.

[7] BAAQMD. *Evaluation of the 1995 and 1996 Ozone Seasons in the San Francisco Bay Area – with a Summary of the 1997 Season*, October 1997.

[8] Altshuler, S., T. D. Arcado, and D. R. Lawson. 1995. "Weekday vs. weekend ambient ozone concentrations: Discussion and Hypothesis with focus on Northern California." *J. Air & Waste Management Association* 45:976-972.

[9] BAAQMD, *Preliminary Evaluation of the 1995 Ozone Season in the San Francisco Bay Area*. May 1996.

[10] Fairley, D., and R. E. DeMandel. 1992. "Status and trends in ambient ozone and carbon monoxide in the San Francisco Bay Area 1978-1989." Bay Area Air Quality Management District, San Francisco, CA.

Precursor Reductions Needed for Attainment

EPA, in its final redesignation ruling, stated "...available data and technical analyses can be used to provide, within a very short period of time, a reasonable estimate of emission reductions needed to attain." (63 FR 37270, July 10, 1998)

The BAAQMD noted in previous comments to EPA[11] that staff has not been able to identify a sound technical procedure to estimate, with any degree of confidence, a specific emission reduction target that would ensure attainment of the standard by a specific year. The task of determining a specific emission target for NAAQS attainment is difficult and challenging under normal circumstances but is especially problematic under current circumstances. These circumstances include: 1) a lack of field study data, particularly upper air data, needed for modeling appropriate base year 1995 ozone episodes; 2) current lack of resources (staff time and funding) to conduct appropriate modeling; 3) a plan preparation schedule with shortened deadlines that will not accommodate the required modeling effort; and 4) the unavoidable dependence of ozone levels on weather patterns that are variable and uncontrollable.

Section 172(c)(1) of the CAA requires that a non-attainment area plan "provide for attainment." EPA's *Federal Register* notice (62 FR 66580) requires the Bay Area SIP revision to comply with this CAA requirement via an attainment 'assessment' rather than an attainment "demonstration". The notice explains that a "demonstration" generally involves new modeling, while the required "assessment" would be based on available (previous) modeling information. The notice explains that a new field study and new modeling effort could not be accomplished in the short time frame imposed for this planning effort.

Given these constraints, this section presents the co-lead agencies' best effort to estimate the emission reductions needed for attainment. Two general approaches were used, one based on past photochemical modeling and the other on empirical relationships between yearly peak ambient ozone levels and emissions projections. Three photochemical modeling approaches were considered, based on: (1) simulations of a 1989 ozone episode using the UAM model; (2) simulations of an August 1990 episode using the SAQM model; and (3) a 1993 application of the OZIP model to the Bay Area. The empirical approaches consisted of regression models to predict peak ozone concentrations from various combinations of Bay Area VOC and NO_x emissions and meteorology.

The second approach, empirical analysis of ambient trends vs. emissions, failed to produce useful results. This approach was based on the idea that one way to estimate how future emissions reductions will affect ozone is to analyze how they have worked in the past. Various regression models were applied to predict ambient peak Bay Area Air Basin or Livermore ozone from summer total VOC and NO_x emissions using data from 1980-98.

[11] BAAQMD Letter to Felicia Marcus re: BAAQMD's Comment to EPA's Proposed Redesignation of the San Francisco Bay Area, February 10, 1998.

The models produced a wide range of results with unacceptably large ranges of uncertainty, because of the limited number of data points from recent years, the meteorological variability in the data, and the generally weak ozone trend(s), especially for Livermore.

Of the three photochemical modeling approaches, the UAM simulations of a Bay Area episode were found to be the most appropriate because of important deficiencies in the other two approaches. The 1993 OZIP modeling was rejected because it produced an unrealistic prediction that the Bay Area would have attained the standard years ago. The SAQM simulations are not applicable because they were based on an episode during which Bay Area ozone levels were considerably below its design value.

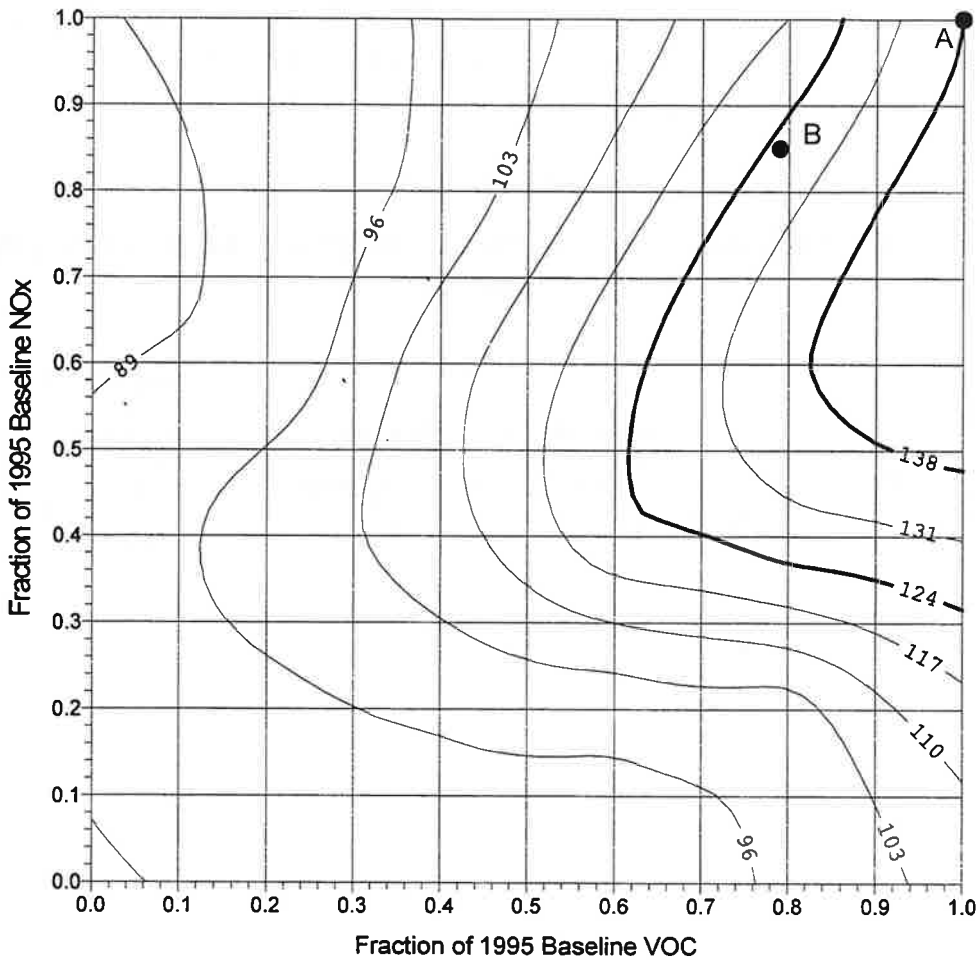
The modeling approach that was chosen is based upon a series of emission sensitivity simulations performed by the BAAQMD in 1991 using the UAM-IV photochemical model, the 9/14/89 Bay Area Field Study episode, and projected emissions for 1997. Contours of simulated regionwide maximum ozone concentrations were drawn on an Empirical Kinetic Modeling Approach (EKMA) isopleth diagram, where the x- and y-axes represent VOC and NO_x emissions, respectively. In a subsequent analysis, the BAAQMD's model was used to conduct a second series of sensitivity simulations to create an isopleth diagram for Livermore.

This analysis derives from a Bay Area ozone episode, a Bay Area field study intensive data set, local photochemical modeling, and ozone levels for Livermore, the Disrict's design site. Therefore, of the information and procedures currently available, this is the most appropriate tool for the required attainment assessment.

In order to apply the EKMA diagram to 1995, contour values were scaled by the ratio of the Bay Area Air Basin's 1995 design value (138 ppb) to the simulated Bay Area maximum ozone concentration for the 1997 base case. The scaled contours thus represent the modeled response of the Bay Area's 1995 design value to various combinations of precursor emission rates.

The resulting isopleth diagram, shown in Figure 3, shows model-based estimates of how peak Livermore ozone levels would change with reductions in VOC and NO_x, the chemical precursors that react to create ozone. The axes are scaled as a fraction of the values of the Bay Area's 1995 emissions of these precursors. Thus point A (at 1.0, 1.0) in the upper right-hand corner, represents the 1995 ozone design value and the precursor emissions that produced that ozone level. Point B represents the values projected for the year 2000. The coordinates of point B (about 0.78, 0.85) indicate that the future VOC and NOx emissions (considering growth and controls already submitted to EPA for the SIP) are projected to be 78% and 85%, respectively, of 1995 levels.

FIGURE 3
2000 LIVERMORE OZONE SIMULATION[12]



The curved lines on the plot represent isopleths of equal ozone concentration. Thus, for example, the isopleth going through point A represents precursor emission combinations that would produce Livermore peak ozone concentrations equal to the design value in 1995, namely 138 ppb. The 124 ppb line represents the precursor pairs that would allow Livermore to just reach attainment (a design value of 124 ppb). Note that point B is very close to the 124 ppb isopleth, suggesting that Livermore would be near attainment by the year 2000.

The plot was made using the output from a photochemical model that simulates the amount of ozone produced based on emissions, meteorology and taking into account ozone chemistry. The model represents an area that includes the Bay Area. This area is broken up into a grid of cells, 4 km in the north-south and east-west directions. Each square has several vertical layers of varying heights. The model is designed to replicate what actually happened on a particular high ozone day (in this case September 14, 1989). The model starts with initial estimates of concentrations of precursors and ozone. It then applies emissions, and simulates atmospheric chemical reactions and ozone formation in each grid cell. Then it uses estimates of wind speed and direction in each grid cell to simulate the dispersion and transport of these chemicals. It repeats the process minute by minute. The model actually produces a matrix of results for pollutant levels over the modeling domain for a range of times (hours of the day and sequential days of the simulated episode).

Use of a model allows the analyst to simulate a number of different scenarios. To produce an isopleth diagram of the kind shown above, the model is run for various combinations of precursor emission reductions. In this case, the model was run

[12] Isopleths of Livermore peak ozone concentrations (parts per billion) based on photochemical model future-year sensitivity simulations of a September 1989 ozone episode. The contours are scaled to reflect the 1995 design value of 138 ppb in Livermore. Point "A" represents the Bay Area's total anthropogenic emissions and ozone design value for 1995. Point "B" represents the projected emissions for year 2000 (considering growth and controls already submitted to EPA for the SIP). The 124 ppb isopleth represents the design value needed for attainment of the national 1-hour standard.

for twenty different combinations or precursor emission rates, (including, for example, 80% of VOC and 60% of NO_x, and 40% of VOC and 100% of NO_x). The isopleths in the figure were drawn based on Livermore's peak ozone values for each of these twenty pairs.

Then, based on regional VOC and NO_x projections for the year 2000, the diagram can be used to estimate the emission reductions that would be needed above and beyond those already accounted for by existing control programs and anticipated emission inventory changes to reduce the design value to below 125 ppb, the effective level of the standard. The results are shown in Table 8 below.

TABLE 8

ESTIMATED EMISSION REDUCTIONS NEEDED FOR ATTAINMENT (TONS/DAY)

Pollutant	1995 Base Year Inventory	Estimated 2000 Attainment Inventory	Estimated Emission Reductions Needed	Estimated 2000 Inventory Reductions with Current SIP Controls	Estimated Emission Reduction Target for Additional SIP Controls
VOC	562	434	128	117	11
NO_x	626	534	92	92	0

SECTION 6: CONTROL STRATEGY

EPA's *Federal Register* notice redesignating the Bay Area requires this SIP revision to include a "control strategy", i.e., the implementation actions that are required in order for the Bay Area to attain the 1-hour ozone standard (63 FR 37271-37272 and 37276). The strategy must consist of adopted regulations and/or control measures with enforceable commitments to adopt and implement the control measures in regulatory form by specified dates. Sufficient measures must be included in the control strategy to achieve the emission reduction target by the beginning of the ozone season in 2000.

The regulations and control measures included in the Plan will be implemented by the BAAQMD, MTC, ARB and EPA. These agencies have lead responsibility for stationary sources (BAAQMD), transportation control measures (MTC), on- and off-road motor vehicles (ARB) and off-road mobile sources (ARB and EPA).

Given the exceedances recorded at Livermore in 1998, it will not be possible to attain the standard with a 3-year attainment record by November 15, 2000. But, the Clean Air Act includes provisions for requesting an extension of the attainment deadline, and the co-lead agencies will seek such an extension next year. A second one-year extension is also allowed by law, should the region continue to experience exceedances.

Contingency measures are included in Section 7.

Stationary Source Control Measures

Many stationary and area source regulations have already been submitted to EPA for incorporation into the SIP. As shown in Table 9, nineteen regulations affect source categories for which there will be significant emission reductions between 1995 and 2000. VOC and NOx emissions from stationary and area sources are projected to decline by 23 tpd and 30 tpd, respectively.

In addition, ten stationary and area source control measures are proposed for inclusion in the SIP (Table 10). Five of these have already been adopted, but not submitted to EPA for inclusion in the SIP. Collectively, in 2000, these stationary and area source measures are estimated to reduce VOCs by approximately 11 tpd.

Control measure descriptions for those measures that have not been submitted to EPA are provided in Appendix B.

TABLE 9

INVENTORY REDUCTIONS FROM 1995 TO 2000:
STATIONARY AND AREA SOURCES WITH REGULATIONS SUBMITTED INTO THE SIP

Source Category (BAAQMD Regulation)	Reduction in Source Category VOC Emissions (tpd), 1995 to 2000	Reduction in Source Category NOx Emissions (tpd), 1995 to 2000
Adopted Measures (already part of the SIP)		
Miscellaneous Operations (8-2)	0.3	
Gasoline Dispensing Facilities (8-7)*	13.5	
Metal Container, Closure and Coil Coating (8-11)	0.6	
Light and Medium Duty Motor Vehicle Assembly Plants (8-13)	0.6	
Valves and Flanges at Petroleum Refinery Complexes (8-18)	0.7	
Surface Coating of Miscellaneous Metal Parts and Products (8-19)	0.3	
Graphic Arts Printing and Coating Operations (8-20)	1.5	
Pump and Compressor Seals at Petroleum Refinery and Chemical Plants (8-25)	0.2	
Semiconductor Manufacturing Operations (8-30)	0.1	
Wood Furniture and Cabinet Coatings (8-32)	0.1	
Solid Waste Disposal Sites (8-34)	0.3	
Aeration of Contaminated Soil and Removal of Underground Storage Tanks (8-40)	1.0	
Marine Vessel Loading Terminals (8-44)	0.3	
Adhesive and Sealant Products (8-51)	2.5	
Consumer Products (ARB)	0.9	
Industrial / Institutional / Commercial Boilers & Heaters (9-7)		20.0
Stationary Internal Combustion Engines (9-8)		4.4
Stationary Gas Turbines (9-9)		4.9
Glass Melting Furnaces (9-12)		0.4
SUBTOTAL	***22.9***	***29.7***

* Some types and models of vapor recovery equipment are not working as envisioned, resulting in excess VOC emissions. The BAAQMD will take necessary permitting and enforcement actions to ensure compliance with applicable regulations and reduce the majority of the excess VOC emissions by June 2000.

TABLE 10

STATIONARY AND AREA SOURCE CONTROL MEASURES

SIP # (CAP #)	BAAQMD Regulation #	Source Category	Adoption Date	Implementation Date	Estimated VOC Reduction (tpd), 1995 to 2000	Estimated NOx Reduction (tpd), 1995 to 2000
Adopted Measures (not yet submitted into the SIP)						
SS-01 (A7)	8-11	Can and Coil Coating	11/19/97	1/1/98, 1/1/2000	0.35	
SS-02 (C3b)	8-18	Equipment Leaks at Refineries and Chemical Plants	1/7/98	1/7/98	1.20	
SS-03 (C1)	8-28	Pressure Relief Devices	12/17/97 & 3/18/98	7/1/98	0.13	
SS-04 (A18)	8-16	Solvent Cleaning	9/16/98	9/1/99	2.10	
SS-05 (A18)	8-20	Graphic Arts Operations	3/2/99	7/1/99, 1/1/2000	0.80	
				SUBTOTAL	***4.58***	

SIP # (CAP #)	BAAQMD Regulation #	Source Category	Adoption Date	Implementation Date	Estimated VOC Reduction (tpd), 1995 to 2000	Estimated NOx Reduction (tpd), 1995 to 2000
Measures Not Yet Adopted						
SS-06 (A20)	8-52	Polystyrene Manufacturing	1999	6/2000	0.26	
SS-07 (B2h)	8-5	Organic Liquid Storage: Low Emitting Retrofits for Slotted Guide Poles	1999	6/2000	0.48	
SS-08 (B8)	8-7	Gasoline Dispensing Facilities	1999	6/2000	3.20	
SS-09 / SS-10	8-40	Prohibit Aeration of Petroleum Contaminated Soil or Industrial Sludge at Landfills (SS-09 – Contaminated Soil at Landfills Only; SS-10 all Contaminated Soil)	1999	6/2000	2.68	
				SUBTOTAL	***6.62***	
				TOTAL	***11.20***	

Mobile Source Control Measures

Mobile source measures generally encourage the retirement of older, more-polluting technologies and the introduction of new, less polluting technology. Transportation control measures (TCMs), discussed below, differ from mobile source measures in that TCMs attempt to reduce motor vehicle use or activity that leads to higher emissions.

Several mobile source regulations are already reflected in the SIP. As shown in Table 11, four regulations affect source categories where there will be significant emissions reductions between 1995 and 2000. VOC and NOx emissions are projected to decline by 108 tpd and 90 tpd, respectively.

ARB recently informed the BAAQMD that an improved estimate of effectiveness for cleaner burning gasoline shows greater VOC reductions than the previous estimate based on MVEI7G.[13] The VOC reductions shown in Table 11 include the additional benefits.

In addition, one mobile source control measure is proposed for inclusion in the SIP (Table 12). This measure – electric golf carts – has been adopted, but its associated emission reductions have not been included in the SIP inventory for the Bay Area. In 2000, the proposed control measure will reduce VOCs by 0.1 tpd. A description of this measure is provided in Appendix B.

[13] Letter from Gary Honcoop, California Air Resources Board, March 9, 1999.

TABLE 11

INVENTORY REDUCTIONS FROM 1995 TO 2000:
MOBILE SOURCE REGULATIONS REFLECTED IN THE SIP

Requirement	Reduction in Source Category VOC Emissions (tpd), 1995 to 2000	Reduction in Source Category NOx Emissions (tpd), 1995 to 2000
Adopted Measures		
On Road Motor Vehicles – Light & Medium Duty Cars and Trucks (ARB)	94.3	66.5
On Road Motor Vehicles – Heavy Duty Trucks (ARB)	4.2	12.7
Off Road Mobile Sources (ARB)	8.6	10.6
Gasoline-Powered Recreational Boats – Exhaust Emission Standards (EPA)	0.7	
TOTAL	*107.8*	*89.8*

TABLE 12

MOBILE SOURCE CONTROL MEASURE

SIP #	Control Measure	ARB (State) Adoption Date	Implementation Date	Estimated VOC Reduction (tpd), 1995 to 2000	Estimated NOx Reduction (tpd), 1995 to 2000
Adopted Measures (not yet reflected in the SIP inventory)					
MS-01	Electric Golf Carts: Require New Golf Cart Purchases to be Electric	1994	3/2000	0.1	
			TOTAL	*0.1*	

Transportation Control Measures

Since 1982, the Bay Area's SIP (State Implementation Plan) has included certain measures called transportation control measures (TCMs) to reduce automobile emissions. A total of 28 measures – including improved transit service and transit coordination, new carpool lanes, signal timing, freeway incident management, and increased state gas tax and bridge tolls – have been carried forward and are now largely completed. While these TCMs highlight selected strategies that all promote good mobility and air quality, they play only a small part in the Bay Area's overall strategy to reduce measurable emissions. Technological improvements in automobile engines and fuels required by California Air Resources Board (CARB) regulations have contributed and will continue to contribute the bulk of the quantifiable emission reductions from mobile sources.

Emissions from on road mobile sources are estimated to decline significantly between 1995 and 2000 (about 98 tons per day of VOC and 79 tons per day of NOx) due to California Air Resource Board (CARB) emission controls. By comparison, the effectiveness of most transportation control measures is measured in tenths or hundredths of a ton per day. These small emission reductions are due to the fact that any individual TCM affects only a small portion of regional travel as well as the fact that TCMs generally cannot change transportation costs, travel time, or convenience sufficiently to produce large scale changes in travel behavior.

Nonetheless, most air quality planners continue to agree that certain types of transportation programs contribute to cleaner air, if only modestly so. The Regional Transportation Plan supports these types of programs, such as: sustaining the Bay Area's extensive transit system and the key roads that are used by transit, enhancing the convenience of using transit, providing freeway carpool lanes to encourage ridesharing during peak commute periods, coordinating traffic signals to reduce high emissions from stop and go traffic, and quickly handling incidents that can clog Bay Area freeways anywhere from minutes to hours. Table 13 summarizes the *1998 Regional Transportation Plan* (RTP) investments over the full 20 year plan and highlights those aspects that are most positive for air quality. As an additional safeguard, federal regulations require that the RTP demonstrate "conformity" with the SIP's air quality objectives whenever the RTP is adopted or amended.

The timeline for implementing new control measures for this Plan requires that they be in effect by the 2000 ozone season. This deadline eliminates the possibility of crafting any major new transportation programs, projects, or control measures. Rather, emission reductions will need to come from transportation projects and programs which are already in the funding "pipeline". Table 14 summarizes the most relevant investments that will begin contributing to cleaner air around 2000. Additional federal funding available to the region through TEA-21 will be used to enhance and possibly expand a number of these programs beyond 2000.

Because it is anticipated that new stationary controls and further CARB mobile source controls will produce all of the required emission reductions to achieve the 1-hour ozone standard, no new transportation control measures are necessary. The TCMs shown in Table 15 are deleted from the SIP for one or more of the following reasons: (1) all implementation steps have been completed, (2) they are irreversible, or (3) the original purpose for the TCM was a carbon monoxide control measure, as opposed to an ozone measure. MTC believes that other TCMs may also qualify for deletion and will propose their deletion in a future SIP revision.

TABLE 13

1998 REGIONAL TRANSPORTATION PLAN: AIR QUALITY INVESTMENT SUMMARY

RTP Investments	Amount ($billions)	Percent
Transit Capital Rehabilitation	$ 9.8	11.1%
Transit Operations	37.0	41.8
Transit Enhancements and Expansion	3.1	3.5
Carpool Lanes	1.3	1.5
Traffic Management and Operations	.5	.6
Customer Services[14]	.6	.6
Bikes / Pedestrians / Transportation For Livable Communities (TLC)	.5	.6
Other		
• Highway Maintenance & Operations	10.7	12.1
• Local Street Maintenance	12.5	14.1
• Seismic Retrofit	2.6	2.9
• Other Corridor Improvements[15]	9.8	11.1
	$88.4	100%

TABLE 14

TRANSPORTATION IMPROVEMENTS BENEFITING AIR QUALITY IN 2000

CATEGORY	TRANSPORTATION IMPROVEMENT
Transit Capital Rehabilitation	• 534 buses replaced, producing lower emissions • Caltrain cars and locomotives rehabilitated • BART cars rehabilitated • Additional MUNI LRV replacement
Transit Operations	• Operators planning service increases between 1995 and 2000: BART, Caltrain, Santa Clara VTA, Golden Gate Ferry, MUNI Metro, Union City Transit, Sonoma County Transit, Eastern Contra Costa Transit, Capitol Corridor Intercity Rail (Source: Short Range Transit Plans)

[14] Ridesharing, TravInfo, Freeway Service Patrol, Call Boxes, TranLink, Transit Trip Planning and Transit Marketing

[15] Other STIP/Track 1 investments.

Transit Fleet Expansion	• 49 expansion buses and one new ferry added • Tasman West light rail extension completed • MUNI F-Line completed
Transit Enhancements	• Track replacement / rehabilitation (Caltrain, Muni) • Trolley overhead reconstruction and bus line electrification (MUNI) • New Train Control System (BART, Caltrain, MUNI) • New Automatic Fare Collection System (BART) • Numerous station / terminal / transit center improvements
Arterial Signal Improvements	• 327 signals interconnected/re-timed
Customer Service Programs:	• Ridesharing-increased marketing and improved ridematching system • Regional transit trip planning-extension of regional trip planning capability to all operators and fully functional trip planning over the Internet • Translink fare collection-demonstration phase with seven transit operators • Freeway Service Patrol-increase number of beats from 22 to 28 • Electronic toll collection - planned operation on all Bay Bridges by 2000
Bikes/Pedestrian	• At least $30 million in new funding available for various projects

Source: *1999 Transportation Improvement Program*

TABLE 15
TCMS DELETED FROM SIP

TCM	Reason
FTCM 6 Continue efforts to obtain funding to support long-range transit improvements.	The 1982 Plan specifically mentioned supporting efforts to obtain funding for construction of the Guadalupe light rail line in Santa Clara County and design work for the North Concord BART extension and Warm Springs extension. These activities have been completed, and the Guadalupe light rail line is permanent.
FTCM 11 Gasoline Conservation Awareness Program (GasCAP).	The measure is a carbon monoxide control strategy. The measure remains in the SIP for CO purposes.
FTCM 12 Santa Clara Commuter Transportation Program. (a carbon monoxide control strategy)	The measure is a carbon monoxide control strategy. The measure remains in the SIP for CO purposes.
FTCM 16 Implement MTC Resolution 1876, Revised – New Rail Starts Agreement. (BART Colma Extension only)	The BART Extension to Colma has been completed and is permanent.

Voluntary Measures

A voluntary measure is a program which is voluntary in nature, and/or for which a non-governmental entity may have responsibility for operation. Examples include ozone alert programs and public outreach. A maximum of 3 percent of the emissions reductions needed to attain the standard are allowed to be met through voluntary programs (see October 23, 1997 EPA guidance from Richard D. Wilson, Acting Administrator, Office of Air and Radiation). Two voluntary measures are proposed for inclusion in the SIP, as shown in Table 16. These voluntary programs are expected to reduce both VOC and NOx emissions; however no SIP credit for the emission reductions is

requested at this time. Control measure descriptions are provided in Appendix B.

Although SIP credit has not been requested, the BAAQMD will monitor participation in *Spare the Air* through telephone surveys and document effectiveness using ARB's method, when available. Technical support documentation for the *Spare the Air* program is provided in Appendix C. Evaluation reports for the program will be prepared for 1999 and 2000. This will help the BAAQMD gain experience with implementing voluntary measures under EPA guidelines.

TABLE 16
VOLUNTARY MEASURES

SIP # (CAP #)	Control Measure	Source Categories Affected	Adoption Date	Implementation Date	VOC Reductions (tpd), 1995 to 2000	NOx Reductions (tpd), 1995 to 2000
Measures Not Yet Submitted into the SIP						
VM-01 (TCM 16)	Spare the Air Program	Cars, light-duty trucks, lawn and garden equipment, consumer products	Not applicable	6/1999 – 10/1999; 6/2000 – 10/2000	No SIP Credit at this time*	No SIP Credit at this time*
VM-02 (TCM 17)	Low Emission Alternatively Fueled Vehicles and Infrastructure	On-Road Motor Vehicles	Not applicable	1999, 2000 & 2001, Depends on availability of funding	No SIP Credit at this time*	No SIP Credit at this time*
				TOTAL	***0.0***	***0.0***

* No SIP credit is requested because EPA has required that backstop (replacement) measures be provided if SIP credit is taken for voluntary measures; and there are no control measures above and beyond those already included in the Plan that could be implemented by June, 2000.

Emission Reduction Summary

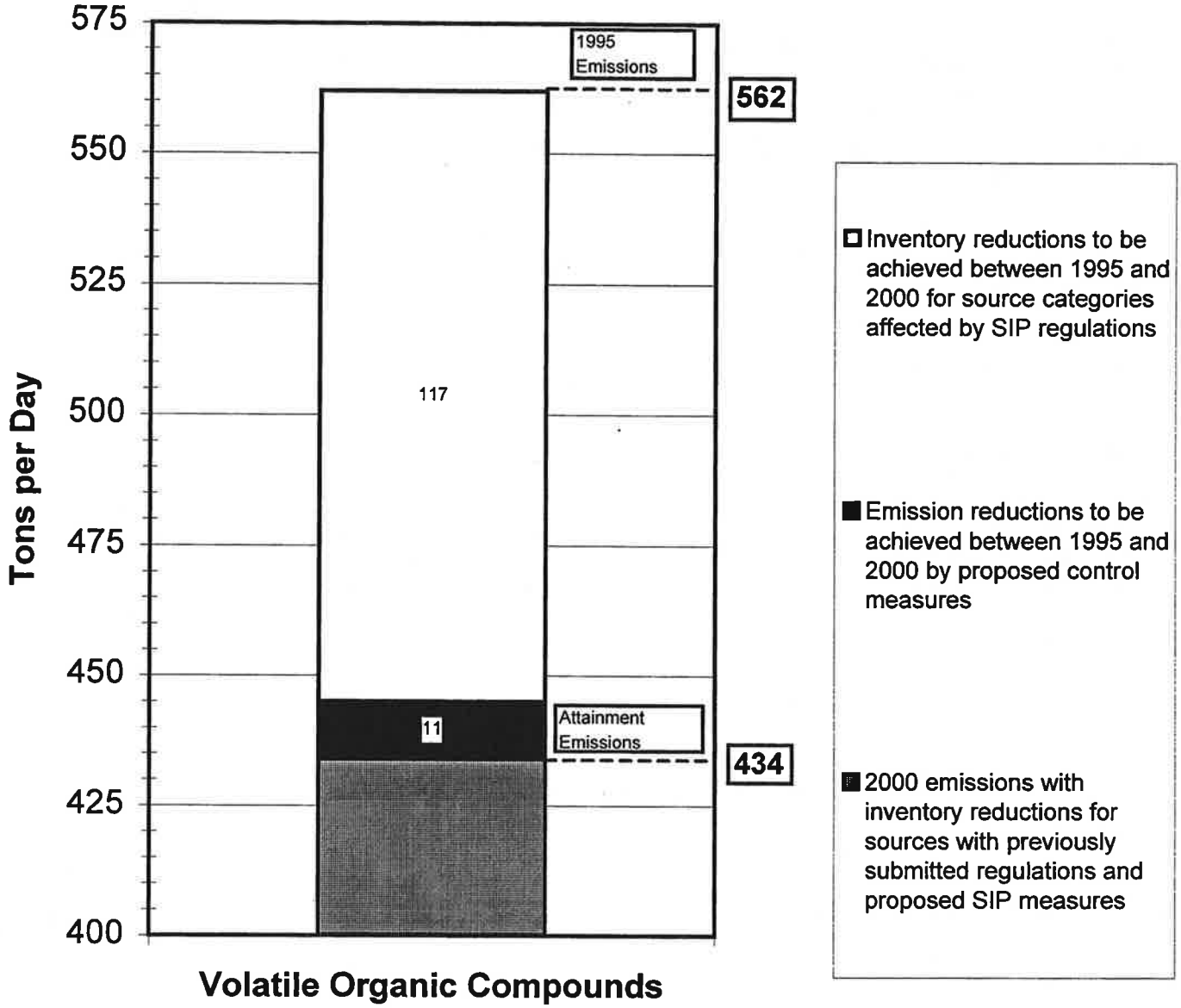
Table 17 provides a summary of the emission reductions expected from adopted regulations and proposed control measures. The reduction from the 1995 baseline for VOCs is illustrated in Figure 4. The Attainment Assessment concluded that reductions of 128 tpd of VOC and 92 tpd of NOx are needed between 1995 and 2000 to attain the 1-hour national ozone standard. Measures already in the SIP are estimated to reduce VOCs by 117 tpd and to reduce NOx by 92 tpd. This leaves an additional 11-tpd VOC reduction and no NOx reduction that is needed by 2000, over and above measures that are already in the SIP.

This SIP submittal reflects a commitment to achieve an additional 11 tpd reduction in VOC emissions by June 2000 through adoption and implementation of any combination of the control measures listed in Table 10 and Table 12. Adopted regulations will be submitted to EPA to fulfill this commitment.

TABLE 17
ESTIMATED EMISSION REDUCTIONS: 1995 - 2000

	VOC (tons/day)	NOx (tons/day)
Inventory Reduction for Stationary and Area Sources with Previously Submitted SIP Regulations	23	30
Inventory Reduction for Mobile Sources Regulations in the SIP	108	90
Projected Growth in Sources not Regulated by Previously Submitted SIP Regulations	(14)	(28)
Total Emissions Reduction from Previously Submitted SIP Measures	***117***	***92***
Stationary Source Measures	11	0
Mobile Source Measure	0.1	0
Total Emission Reduction from SIP Measures	***11***	***0***
Total Emission Reduction, 1995 to 2000	***128***	***92***
Emission Reduction Needed for Attainment	128	92

FIGURE 4
1995 VOC EMISSIONS AND REDUCTIONS NEEDED FOR ATTAINMENT



SECTION 7: CONTINGENCY MEASURES

EPA has required the identification of contingency measures to take effect if the control measures identified in this plan are not adequate to return the Bay Area to attainment of the 1-hour national ozone standard by the attainment deadline (63 FR 37275 pursuant to Clean Air Act Section 172(c)(9)). To be considered in attainment at the end of the ozone season in 2000, the Bay Area can not record more than three exceedances at a single air monitoring station during 1998, 1999 and 2000. Given that six exceedances were recorded at Livermore in 1998, attaining the standard by 2000 is not possible.

However, the federal Clean Air Act (Section 172(a)(2)(C)) provides for two, one-year extensions of the attainment deadline. With one extension, the Bay Area may attain based on air monitoring in 1999, 2000 and 2001. If two extensions are necessary, the Bay Area may attain in 2000, 2001 and 2002. If the Bay Area records zero or one exceedance at each monitoring site in 2000, the co-lead agencies will apply for an extension of the attainment deadline (and again in 2001, if needed).

If the Bay Area records more than one exceedance at a single monitoring site in 2000 (or in 2001), a requirement to implement contingency measures will be triggered. The contingency measures identified to meet this requirement are provided in Tables 18, 19 and 20. These measures are already adopted and will be implemented without further actions by the co-lead agencies, ARB or EPA.

This year, the ARB plans to adopt enhanced gasoline vapor recovery requirements, as well as an improved design of containers to reduce spillage when refueling off road vehicles. These two control measures may provide additional emission reductions prior to 2003.

TABLE 18

POST-ATTAINMENT YEAR (2000 - 2003) INVENTORY REDUCTIONS REFLECTED IN THE SIP

Source Category (BAAQMD Regulation)	Reductions in Source Category VOC Emissions (tpd), 2000 to 2001	Reductions in Source Category VOC Emissions (tpd), 2000 to 2002	Reductions in Source Category VOC Emissions (tpd), 2000 to 2003	Reduction in Source Category NOx Emissions (tpd), 2000 to 2001	Reduction in Source Category NOx Emissions (tpd), 2000 to 2002	Reduction in Source Category NOx Emissions (tpd), 2000 to 2003
Adopted Measures (already reflected in the SIP)						
Gasoline Dispensing Facilities (8-7)	0.5	0.9	1.1			
Graphic Arts Printing and Coating Operations (8-20)	0.8	0.7	0.7			
Aeration of Contaminated Soil and Removal of Underground Storage Tanks (8-40)	0.5	1.0	1.5			
On Road Motor Vehicles – Light and Medium Duty Cars and Trucks (ARB)	14.4	26.8	39.1	16.8	26.4	35.3
On Road Motor Vehicles – Heavy Duty Trucks	0.1	0.5	0.7	3.3	5.0	6.7
Off Road Mobile Sources (ARB)	0.1	0.1	0.2	3.8	7.8	9.5
Gasoline-Powered Recreational Boats – Exhaust Emission Standards (EPA)	0.7	1.6	3.6	(0.1)	(0.1)	(0.2)
Stationary Internal Combustion Engines (9-8)				1.0	1.0	0.9
Stationary Gas Turbines (9-9)				0.9	0.9	0.8
Glass Melting Furnaces (9-12)				0.2	0.2	0.1
TOTAL	***17.1***	***31.6***	***46.9***	***25.9***	***41.2***	***53.1***

TABLE 19
CONTINGENCY MEASURE: AREA SOURCES

SIP #	Regulation #	Source Category	VOC Reductions (tpd), 2000 to 2001	VOC Reductions (tpd), 2000 to 2002	VOC Reductions (tpd), 2000 to 2003	NOx Reductions (tpd), 2000 to 2001	NOx Reductions (tpd), 2000 to 2002	NOx Reductions (tpd), 2000 to 2003
Adopted Measure (not yet reflected in the SIP)								
SSC-01	ARB Regulation	Consumer Products – Phase III	0.6	1.8	2.6			
		TOTAL	***0.6***	***1.8***	***2.6***			

TABLE 20
CONTINGENCY MEASURES: MOBILE SOURCES

SIP #	ARB (State) Regulation	Requirement	VOC Reductions (tpd), 2000 to 2001	VOC Reductions (tpd), 2000 to 2002	VOC Reductions (tpd), 2000 to 2003	NOx Reductions (tpd), 2000 to 2001	NOx Reductions (tpd), 2000 to 2002	NOx Reductions (tpd), 2000 to 2003
Adopted Measures (not yet reflected in the SIP)								
MSC-01	Marine Pleasure Craft	Exhaust Emission Standards for Outboard 2-Stroke Engines (CA Standards Only)	0.3	0.7	1.6	0.0	-0.1	-0.2
MSC-02	Electric Golf Carts	Require New Golf Cart Purchases to be Electric	0.1	0.2	0.3	Unknown	Unknown	Unknown
MSC-03	Off Road Spark Ignition Engines	Exhaust Emissions Standards	0.0	0.2	0.4	0.2	0.9	2.0
		TOTAL	***0.4***	***1.1***	***2.3***	***0.2***	***0.8***	***1.8***

SECTION 8: FUTURE AIR QUALITY PLANNING

Federal Clean Air Act

In 1997, EPA published a new national ozone standard, 0.08 ppm, averaged over 8 hours (62 FR 38855-38896). For those areas that had attained the 1-hour standard, EPA revoked the 1-hour standard. The Bay Area co-lead agencies argued that the Bay Area had in fact attained the 1-hour standard even earlier from 1990 through 1994. Therefore, the 1-hour standard should be revoked for the Bay Area, allowing the region to focus its efforts on attaining the new 8-hour standard. EPA did not agree and redesignated the Bay Area as a non-attainment area for the 1-hour ozone standard.

A plan to attain the 8-hour standard would have been due in 2003, assuming the Bay Area does not attain the 8-hour ozone standard. However, on May 14, 1999, the U.S. Court of Appeals for the District of Columbia remanded the new ozone to EPA, based on constitutional grounds. The Court of Appeals ***did not*** vacate the new ozone standard like it did the new PM standard. The Court did not question EPA's authority to set standards, or the need or appropriateness of the new, more stringent standard. It is expected that the Court's issues will be resolved on appeal, and that planning to attain the new ozone standard will be required in the future. Control measures included in this Plan will be helpful in attaining the 8-hour standard.

In 1997, EPA also revised the national standards for particulate matter (PM_{10}), and published new national standards for fine particles ($PM_{2.5}$). The U.S. Court of Appeals vacated the revised PM_{10} standards. The Court has invited the litigants to brief the question of a remedy regarding the new fine particulate matter standard.

Given the evidence of the strong correlation between higher particulate matter levels and increased morbidity and mortality, it is expected that reducing PM will be a central focus of future air quality improvement efforts. The Bay Area has installed new monitors to collect additional $PM_{2.5}$ data, in order to better understand the extent of our PM problem when specific planning requirements are known.

California Clean Air Act

The California Clean Air Act's (CCAA) 1-hour standard for ozone, 0.09 ppm, is significantly (25%) more stringent than the national 1-hour standard, 0.12 ppm. Pursuant to Health and Safety Code Section 40924, the BAAQMD prepares a plan called the *Clean Air Plan* every 3 years to address requirements of the CCAA. The most recent plan was prepared in 1997. The *Clean Air Plan* strategy is to adopt all feasible control measures on an expeditious schedule. The BAAQMD will revise its *Clean Air Plan* in 2000.

APPENDIX A: ABBREVIATIONS AND TERMINOLOGY

ABAG	Association of Bay Area Governments
ARB	(California) Air Resources Board
AQP	(1982 Bay Area) Air Quality Plan
BAAQMD	Bay Area Air Quality Management District
BAR	Bureau of Automotive Repair
BEIS	Biogenic Emissions Inventory System
BURDEN	Refers to computer program that uses vehicle activity data along with EMFAC to calculate motor vehicle emissions
CAA	(Federal) Clean Air Act
CAAA	(Federal) Clean Air Act Amendments
CAP	(Bay Area 1997) Clean Air Plan
CCAA	California Clean Air Act
CMSA	Consolidated Metropolitan Statistical Area
DMV	(California) Department of Motor Vehicles
EITAC	Emission Inventory Technical Advisory Committee
EMFAC	Refers to emissions factors used in ARB's motor vehicle emissions inventory model
EPA	(United States) Environmental Protection Agency
I & M	(Motor Vehicle) Inspection and Maintenance Program
MTC	Metropolitan Transportation Commission
MVEI(7g)	ARB's Motor Vehicle Emissions Inventory ("7g" refers to the release number)
NAAQS	National Ambient Air Quality Standards
NO_x	Oxides of Nitrogen
O_3	Ozone
$PM_{2.5}$	Particulate Matter of Less than 2.5 microns (micrometers)
PM_{10}	Particulate Matter of Less than 10 microns (micrometers)
pphm	Parts per hundred million
ppm	Parts per million
SIP	State Implementation Plan
TCMs	Transportation Control Measures
TPD	Tons per day
VMT	Vehicle miles traveled
VOC	Volatile organic compounds

APPENDIX B: CONTROL MEASURE DESCRIPTIONS

Appendix B of the Bay Area 1999 Ozone Attainment Plan (Plan) includes a description of each control measure in the Plan (i.e., those measures that are not already reflected in the State Implementation Plan). For each measure, the description includes an estimate of the emission reductions to be achieved from implementing the measure, an estimate of cost effectiveness, the year of adoption, the implementation date, a description of the control requirements, and likely environmental, economic or social impacts of the measure. A description of each contingency measure is also provided.

Stationary Source Control Measures

SS-01	Metal Container, Closure, and Coil Coating Limitations
SS-02	Fugitive Emissions, Refinery and Chemical Plants
SS-03	Episodic Releases from Pressure Relief Devices, Refinery and Chemical Plants
SS-04	Low VOC Solvent, Cold Solvent Cleaners
SS-05	Graphic Arts Operations
SS-06	Polystyrene, Polypropylene and Polyethylene Foam Product Manufacturing
SS-07	Low Emitting Retrofits for Slotted Guide Poles, Organic Liquid Storage
SS-08	Emission Reductions from Gasoline Dispensing Facilities
SS-09	Prohibition of Contaminated Soil as Alternate Daily Cover at Landfills
SS-10	Prohibition of Contaminated Soil Aeration

Mobile Source Control Measure

MS-01	Electric Golf Carts (2000)

Voluntary Measures

VM-01	Spare the Air Program (1999 and 2000)
VM-02	Low Emission Alternatively Fueled Vehicles and Infrastructure

Area Source Contingency Measure

SSC-01	Consumer Products

Mobile Source Contingency Measures

MSC-01	Marine Pleasure Craft 2-Stroke Outboard Emissions Standards (California Standards Only)
MSC-02	Electric Golf Carts (post 2000)
MSC-03	Off Road Spark Ignition Engines

CONTROL MEASURE SS-01

Measure Name: **Metal Container, Closure, and Coil Coating Limitations**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
Can and Coil Coating	4.2	3.9	N/A	
Subject to Control				
Potential Reduction		0.35		

Cost Effectiveness: $ 8,400 / ton VOC

Year of Adoption: 1997

Implementation Date: 1/1/98, 1/1/2000

Description:

This control measure (Clean Air Plan measure A7) was fulfilled by adoption of amendments to Regulation 8, Rule 11: Metal Container, Closure and Coil Coating on November 19, 1997. The amendments require a reduction in the allowable VOC content limits for body spray coatings for both two and three piece cans; create a category and VOC limits for end sealing compound for non-food products; and create categories and VOC limits for interior and exterior body sprays used on drums, pail and lids. Additional future VOC limits become effective upon technology review and after the year 2000.

Other Impacts:

There were no adverse environmental impacts associated with this measure. It is not anticipated that the VOC limits imposed will be met with external abatement equipment.

CONTROL MEASURE SS-02

Measure Name: **Fugitive Emissions, Refinery and Chemical Plants**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
Petroleum refineries, also chemical manufacturing - fugitive emissions	11.5	10.63	N/A	
Subject to Control	1.45	1.45		
Potential Reduction		1.2		

Cost Effectiveness: $ 1,600 / ton VOC

Year of Adoption: 1998

Implementation Date: 1/7/98

Description:

This control measure (Clean Air Plan measure C3b) was fulfilled by adoption of amendments to Regulation 8, Rule 18: Equipment Leaks on January 7, 1998. Amendments extended the applicability of the rule to all fugitive emissions in subject facilities; petroleum refineries, chemical plants, bulk terminals and bulk plants. Equipment is subject to leak standards measured in parts per million concentration and given allowable repair times when leak standards are not met.

Other Impacts:

There were no adverse environmental impacts associated with this measure. It is not anticipated that the VOC limits imposed will be met with external abatement equipment.

CONTROL MEASURE SS-03

Measure Name: **Episodic Releases from Pressure Relief Devices, Refinery and Chemical Plants**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
*Episodic releases - petroleum refineries - pressure relief valves**	0.24	0.25	N/A	
Subject to Control	0.24	0.25		
Potential Reduction		0.13		

**Emissions developed from reported releases, 1993 - 1995*

Cost Effectiveness: $ 11,400 / ton VOC

Year of Adoption: 12/17/97, 3/18/98

Implementation Date: 7/1/98

Description:

This control measure (Clean Air Plan measure C1) was addressed by adoption of amendments to Regulation 8, Rule 28: Episodic Releases from Pressure Relief Devices at Petroleum Refineries and Chemical Plants on December 17, 1997, with subsequent amendments on March 18, 1998. The emission inventory contains a category for *petroleum refineries - fugitive emissions - pressure relief valves*, which does not include the emissions from releases. The rule requires each pressure relief device to be vented to abatement equipment or the implementation of a series of three prevention measures prior to a release. Should consecutive releases occur at any pressure relief device, venting to an abatement device becomes mandatory.

Other Impacts:

This control measure reduces potential impacts of releases of hazardous organic compounds. It is anticipated that there will be a less than significant increase in natural gas usage as a result of these measures.

CONTROL MEASURE SS-04

Measure Name: **Low VOC Solvent, Cold Solvent Cleaners**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
*Solvent Cold Cleaners**	6.0	6.0	N/A	
Subject to Control	6.0	6.0		
Potential Reduction		2.1		

*Emissions from industry data, adjusted EPA and industry emission factors

Cost Effectiveness: $ 2,170 / ton VOC

Year of Adoption: 9/16/98

Implementation Date: 9/1/99

Description:

This control measure partially fulfills Clean Air Plan measure A18. Amendments to Regulation 8, Rule 16: Solvent Cleaning Operations were adopted on September 16, 1998. The rule requires the use of low VOC (aqueous) cold solvent cleaners with the exception of one mineral spirits cold solvent cleaner per facility or solvent cleaners who are permitted under the BAAQMD's permitting process.

Other Impacts:

The increased use of aqueous solvents could have adverse water quality impacts if not recycled or disposed of properly, however, water quality restrictions apply to prevent such impacts. Used aqueous solutions will have to be treated as hazardous waste. A negligible increase in NOx emissions is anticipated due to increased electrical usage to heat aqueous systems.

CONTROL MEASURE SS-05

Measure Name: **Low VOC Cleaning Solvents, Graphic Arts Operations**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
Graphic Arts - Printing Operations	8.25	6.75	N/A	
Subject to Control	1.82	1.96		
Potential Reduction		0.8		

Cost Effectiveness: $ 1,100 / ton VOC

Year of Adoption: 3/3/1999

Implementation Date: 7/1/99; 1/1/2000

Description:

This control measure partially fulfills Clean Air Plan measure A18, and reflects the ARB's "All Feasible Measures" review of BAAQMD rules and regulations. Amendments to Regulation 8, Rule 20: Graphic Arts Printing and Coating Operations were adopted on March 3, 1999. This rule lowers the applicability level of the rule, subjecting more facilities to the control requirements. Also, low vapor pressure or low VOC limits were set for clean-up solvents associated with graphic arts operations.

Other Impacts:

There have been no adverse environmental impacts assciated with this control measure. Socioeconomic impacts are expected to be negligible.

CONTROL MEASURE SS-06

Measure Name: **Polystyrene, Polypropylene and Polyethylene Foam Product Manufacturing**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
*Foam Product Manufacturing**	0.73 - 0.89	0.73 - 0.89	N/A	
Subject to Control	0.73 - 0.89	0.73 - 0.89		
Potential Reduction		0.26		

*Emissions derived from specific facilities

Cost Effectiveness: $ 9,000 / ton VOC

Year of Adoption: 1999

Implementation Date: 6/2000

Description:

This control measure is derived from Clean Air Plan measure A20. Regulation 8, Rule 52: Polystyrene, Polypropylene and Polyethylene Foam Product Manufacturing Operations will require control of VOC emissions from specific point sources in foam product manufacturing operations. Emissions may be controlled by abatement equipment or reduction in VOC concentration of blowing agent.

Other Impacts:

The addition of abatement equipment to meet the requirements of this rule will generate a slight, but insignificant, increase in emissions of NOx.

CONTROL MEASURE SS-07

Measure Name: **Low Emitting Retrofits for Slotted Guide Poles, Organic Liquid Storage**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
Petroleum product evaporation - refinery - storage tanks, floating roof	2.96	3.3	N/A	
Subject to Control	0.53	0.53		
Potential Reduction		0.48		

Cost Effectiveness: $ 300 / ton VOC

Year of Adoption: 1999

Implementation Date: 6/2000

Description:

This control measure originally appeared in the 1997 Bay Area Clean Air Plan for the California Clean Air Act as Control Measure B2(h). Floating roof tanks are used to control emissions of organic liquids in large storage tanks typically found in refineries and bulk plants. Of the fittings in a roof, the largest source of fugitive emissions is from slotted guidepoles. New Source Performance Standards (NSPS) have been promulgated for storage tanks by the US EPA that prohibit slotted guide poles for new tanks. Retrofit kits for existing slotted guide poles are available to reduce fugitive emissions. The retrofit may be installed without taking tanks out of service. This measure would require retrofit of slotted guide poles in large, floating roof organic liquid storage tanks to a standard equivalent to NSPS tanks.

Other Impacts:

There have been no adverse environmental impacts identified with this measure. The measure will not require shutdown of existing tanks, and has a minimal cost to implement, so there should be no significant economic impact or disruption of petroleum fuel production or distribution associated with this control measure.

CONTROL MEASURE SS-08

Measure Name: **Emission Reductions from Gasoline Dispensing Facilities**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
Fuels Distribution - gasoline filling stations	23.40	9.80	N/A	
Subject to Control	7.15	6.74		
Potential Reduction		3.2		

Cost Effectiveness: $ 1,000 / ton VOC

Year of Adoption: 1999

Implementation Date: 6/2000

Description:

This control measure appeared as control measure B8 in the 1997 Clean Air Plan, revised from the 1994 Clean Air Plan. The measure would involve minor equipment modifications that will improve the efficiency of the existing vapor recovery equipment. In addition, the measure would mandate that only vapor recovery systems compatible with federal Onboard Refueling Vapor Recovery requirements for new cars be used, would set performance requirements for vapor recovery systems, would require pressure-vacuum valves on otherwise exempt tanks and would eliminate the Phase I vapor recovery exemption for low throughput tanks. This measure would be in addition to actions by the ARB and the BAAQMD to reduce excess emissions from bootless nozzles at some gasoline dispensing facilities.

Other Impacts:

There have been no identified adverse environmental impacts of this control measure. The socioeconomic impact is expected to be negligible.

References:

Kunaniec, K; 1997 Clean Air Plan, Control Measure # B8; BAAQMD; Oct. 29, 1997

CONTROL MEASURE SS-09

Measure Name: **Prohibition of Contaminated Soil as Alternate Cover at Landfills**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
Contaminated soil	3.26	2.46	N/A	
Subject to Control	3.26	2.46		
Potential Reduction		2.14		

Note: Emission reduction estimates are included in the estimates for control measure SS-10.

Cost Effectiveness: $ 8,000 / ton VOC

Year of Adoption: 1999

Implementation Date: 6/2000

Description:

Currently, landfills in the Bay Area accept contaminated soils for use as alternate daily cover, which is not taxed under Integrated Waste Management Board rules. Although Regulation 8, Rule 40 limits the amount of VOC containing soil that can be aerated on any given day, emissions are not reduced. The control measure would prohibit the use of VOC containing soil or industrial sludge as cover, it would require treatment either at the landfill or at offsite facilities, several of which already exist. Most states do not allow the use of contaminated soils as cover, consequently, many treatment options exist. South Coast currently requires treatment of soil either in-situ, ex-situ on site or at a treatment facility, if VOC containing soil exceeds exemption levels in the rule.

Other Impacts:

The best method of treating soils is with a rotary kiln drier controlled with an afterburner. This would generate some NOx emissions. Currently, landfills charge money for accepting contaminated soil unusable for building purposes. This may impact the landfill's profit margins, however, the overall socioeconomic effect is expected to be positive, as treatment facilities, including those operated at landfills, would generate additional jobs and tax revenue. In eastern states where the use of contaminated soil is not allowed as cover, disposal costs are comparable to California.

References:

Letter; Bigham,B., Chesapeake Environmental Group, Inc. to US EPA; Feb. 13, 1998
Letter; Bigham,B., Chesapeake Environmental Group, Inc. to BAAQMD; Jan. 13, 1999

CONTROL MEASURE SS-10

Measure Name: **Prohibition of Contaminated Soil Aeration**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
Contaminated soil	4.07	3.08	N/A	
Subject to Control	4.07	3.08		
Potential Reduction		2.68		

Note: Emissions and reduction estimates include the estimates for control measure SS-09.

Cost Effectiveness: $ 8,000 / ton VOC

Year of Adoption: 1999

Implementation Date: 6/2000

Description:

BAAQMD Regulation 8, Rule 40: Aeration of Contaminated Soil and Removal of Underground Storage Tanks was adopted in 1986 to reduce nuisance and prevent any one site from exceeding New Source Review standards of 150 lb emissions per day. Because 8-40 allowed aeration of VOC containing soil at certain rates depending on the concentration of contaminant, there were no emission reductions claimed for this rule. South Coast currently requires treatment of VOC containing soil either in-situ, ex-situ on site or at a separate treatment facility, if it exceeds certain exemption levels. This measure would prohibit aeration of VOC containing soils and require controlled treatment of contaminated soils and industrial waste sludges.

Other Impacts:

The best method of treating soils is with a rotary kiln drier controlled with an afterburner. This would generate some NOx emissions. Currently, landfills charge money for accepting contaminated soil unusable for building purposes. This may impact the landfill's profit margins, however, the overall socioeconomic effect is expected to be positive, as treatment facilities, including those operated by landfills, would generate additional jobs and tax revenue. In eastern states where the use of contaminated soil is not allowed as cover, disposal costs are comparable to California.

References:

Letter; Bigham,B., Chesapeake Environmental Group, Inc. to US EPA; Feb. 13, 1998
Letter; Bigham,B., Chesapeake Environmental Group, Inc. to BAAQMD; Jan. 13, 1999

CONTROL MEASURE MS-01

Measure Name: **Electric Golf Carts**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
Golf carts	3.4	3.0	0.06	0.06
Subject to Control	3.4	3.0	0.06	0.06
Potential Reduction		0.1		0.00

Cost Effectiveness: $ 700 / ton VOC

Year of Adoption: Adopted by California Air Resources Board (ARB) on 1/13/94

Implementation Date: 3/2000

Description:

Beginning March 1, 2000, new golf carts acquired by Bay Area golf courses will be required to be electric. In 1994, the ARB adopted regulations (Title 13, Section 2412(b)) that require new golf carts used in federal ozone nonattainment areas in California to have zero emissions (i.e. to be electric). Because the Bay Area was redesignated as nonattainment for the national 1-hour ozone standard in 1998, the Bay Area is now subject to the requirement for golf carts to be electric. In recognition of the time and expense associated with converting golf course facilities to accommodate electric golf carts, ARB will allow gasoline-powered golf carts to continue to be acquired by golf courses in the Bay Area through February 29, 2000. All new golf carts (i.e., produced on or after January 1, 1997) acquired by Bay Area golf courses on or after March 1, 2000, must be electric.

Other Impacts:

ARB staff estimates that within 10 years, turnover of the entire fleet of golf carts will have occurred and all carts will be electric. As more fleet turnover occurs, this measure will result in increasing VOC reductions. Use of electric golf carts also will reduce emissions of carbon monoxide. Electric golf carts are also quieter, and reduce the need for waste oil disposal and gasoline storage.

CONTROL MEASURE VM-01

Measure Name: **Spare the Air Program**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
On-road motor vehicles	273.7	175.3	326.3	247.1
Lawn, Garden and Other Utility Equipment	13.3	6.6	0.6	1.3
Consumer Products	42.2	41.7	0.0	0.0
Potential Reduction	No SIP credit at this time*		No SIP credit at this time*	

* During the summer of 1998, two surveys were conducted by ICF Kaiser on the evenings of Spare the Air advisories in the Bay Area to estimate the effectiveness of the Spare the Air program in reducing emissions. The results are estimated to be a reduction of 2.1 tons of volatile organic compounds per Spare the Air day and a reduction of 2.1 tons of nitrogen oxides per Spare the Air day. No credit is claimed at this time due to EPA's requirement that backstop (replacement) measures be identified, should the region fall short of the emission reductions claimed. No such measures are available.

Cost Effectiveness: Unknown

Year of Adoption: Not Applicable

Implementation Date: Summer 1999 and Summer 2000 (for SIP purposes)

Description:

The Spare the Air program asks individuals to curtail activities that pollute on days when excesses of national and state air quality standards are expected. Advisories are issued the day before an episode. The requests are made by the BAAQMD to the public via the media and paid radio spots, to a network of 1,000 employers via a fax broadcast network and to an e-mail list of 5,000 persons who register to receive the notification. Training workshops are held for employers and free materials for education are supplied. The Spare the Air program is one of approximately two dozen similar programs throughout the country. Locally, both the Sacramento and San Joaquin air districts have Spare the Air programs and coordinate with the Bay Area AQMD.

With CMAQ funding, the program is expected to substantially expand during the summers of 1999 and 2000. CMAQ funding would be used to increase advertising and provide incentives. This measure is proposed as a SIP control measure for two years – 1999 and 2000. Submittal of this measure into the SIP is contingent upon receiving adequate CMAQ funding from MTC for the Spare the Air program in summers 1999 and 2000. The BAAQMD will monitor and report on effectiveness in order to gain experience in implementing a voluntary program under EPA guidelines. Technical support documentation is provided in Appendix C.

Other Impacts:

No adverse impacts have been identified due to the Spare the Air program.

CONTROL MEASURE VM-02

Measure Name: **Low Emission, Alternatively Fueled Vehicles and Infrastructure**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)		Nitrogen Oxides (tons/day)	
Source Category:	1995	2000	1995	2000
On-road motor vehicles	273.7	175.3	326.3	247.1
Potential Reduction		No SIP credit at this time		No SIP credit at this time

Cost Effectiveness: Not available

Adoption Date: Not applicable

Implementation Date: 1999, 2000 and 2001 (For SIP Purposes), Implementation depends on availability of funding

Description:

This measure is intended to facilitate and accelerate projects that replace older, more polluting vehicles with cleaner, less polluting vehicles powered by fuels other than gasoline and diesel. Vehicle types with low emission, alternative fuel options include:

- Heavy-duty vehicles, such as garbage haulers, delivery trucks, long haul trucks
- Transit and school buses
- Medium duty trucks and vans
- Light duty cars and trucks

Development of infrastructure to support alternatively fueled vehicles is critical to the widespread use of these vehicles. Infrastructure includes compressed natural gas fueling facilities and electric vehicle recharging facilities.

To facilitate and encourage the use of low emission, alternatively fueled vehicles, funding is needed to offset the incremental cost of the vehicles, fueling infrastructure, and in some cases (such as buses) maintenance facilities. Public agency funding opportunities include the Congestion Mitigation and Air Quality Improvement Program, the Transportation Fund for Clean Air, the Carl Moyer Incentives, California Energy Commission grants, U. S. Department of Energy grants and other funding sources. Private sector funding is also available for infrastructure improvements.

No SIP credit is claimed for this voluntary measure. However, incentives for the expanded use of low emission, alternatively fueled vehicles will assist the region in meeting the expectations of the state for the introduction of low emission light duty vehicles and will help Bay Area organizations choose low emission, alternatively fueled vehicles for their fleets. Over time, the air quality benefits of cleaner vehicle technology in the Bay Area will be substantial.

Other Impacts:

None have been identified.

CONTINGENCY MEASURE SSC-01

Measure Name: **Consumer Products – Phase III**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)			Nitrogen Oxides (tons/day)		
Source Category:	1995	2000	2003	1995	2000	2003
Consumer Products, Aerosols and Non-aerosols	38.2	37.3	38.4	N/A		
Subject to Control	38.2	37.3	38.4			
Potential Reduction			2.6			

Cost Effectiveness: $ 500 / ton VOC

Adoption Date: 7/1997

Implementation Date: 1/2001 – 1/2005

Description:

In July 1997, ARB adopted a set of limitations on the VOC content of consumer products called the Phase III Consumer Products Standards. The Phase III standards, which are included in Section 94509 of the California Code of Regulations, include controls on consumer products such as automotive polishing compounds, carpet and upholstery cleaners, degreasers, heavy-duty hand cleaners, metal cleansers, lubricants, herbicides, paint strippers, and spot removers. The Phase III standards have effective dates ranging from January 1, 2001 to January 1, 2005, depending on the product category. For the Bay Area, emission reductions are estimated to total 0.6 tons/day in 2001, 1.8 tons/day in 2002, and 2.6 tons/day in 2003. In this time frame, ARB will consider additional controls on existing categories of consumer products or controls on new categories.

Other Impacts:

The ARB did not identify any adverse environmental impacts associated with the adoption of these standards.

CONTINGENCY MEASURE MSC-01

Measure Name: **Emission Reductions from Marine Pleasurecraft (California Regulation Only)**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)			Nitrogen Oxides (tons/day)		
Source Category:	1995	2000	2003	1995	2000	2003
Recreational Boats – Gasoline	16.9	16.4	18.6	1.41	1.71	3.84
Subject to Control	16.9	16.4	18.6	1.41	1.71	3.84
Potential Reduction			1.6			-0.20

Cost Effectiveness: $ 1940 / ton VOC and NOx

Adoption Date: 12/1998

Implementation Date: 2001 – 2008

Description:

In December, 1998, the ARB adopted new emission standards for gasoline-powered marine engines, including outboard motors and jet skis. The standards apply to new marine engines manufactured for the 2001 model year and later. Under ARB's new regulations, a typical marine engine will become 75% cleaner by 2001 and 90% cleaner by 2008. Nearly all personal watercraft and outboard motors use "two-stroke" engines, which burn gasoline inefficiently and discharge unburned gasoline to the environment.

Other Impacts:

This standard for marine watercraft will benefit both air and water quality. The ARB did not identify any adverse environmental impacts associated with the adoption of these standards.

CONTINGENCY MEASURE MSC-02

Measure Name: **Electric Golf Carts**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)			Nitrogen Oxides (tons/day)		
Source Category:	1995	2000	2003	1995	2000	2003
Golf carts	3.4	3.0		0.06	0.06	
Subject to Control	3.4	3.0		0.06	0.06	
Potential Reduction		0.1	0.3		0.00	0.00

Cost Effectiveness: $ 700 / ton VOC

Adoption Date: 1994

Implementation Date: 3/2000

Description:

Beginning March 1, 2000, new golf carts acquired by Bay Area golf courses will be required to be electric. In 1994, the ARB adopted regulations (Title 13, Section 2412(b)) that require new golf carts used in federal ozone nonattainment areas in California to have zero emissions (i.e. to be electric). Because the Bay Area was redesignated as nonattainment for the national 1-hour ozone standard in 1998, the Bay Area is now subject to the requirement for golf carts to be electric. In recognition of the time and expense associated with converting golf course facilities to accommodate electric golf carts, ARB will allow gasoline-powered golf carts to continue to be acquired by golf courses in the Bay Area through February 29, 2000. All new golf carts (i.e., produced on or after January 1, 1997) acquired by Bay Area golf courses on or after March 1, 2000, must be electric.

Other Impacts:

ARB staff estimates that within 10 years, turnover of the entire fleet of golf carts will have occurred and all carts will be electric. As more fleet turnover occurs, this measure will result in increasing VOC reductions. Use of electric golf carts also will reduce emissions of carbon monoxide. Electric golf carts are also quieter, and reduce the need for waste oil disposal and gasoline storage.

CONTINGENCY MEASURE MSC-03

Measure Name: **Off-Road Spark Ignition Engine Controls**

Emission Reduction Estimates:

	Volatile Organic Compounds (tons/day)			Nitrogen Oxides (tons/day)		
Source Category:	1995	2000	2003	1995	2000	2003
Farm, Heavy and Light Duty Industrial / Construction Equipment	25.63	25.85	26.76	111.04	101.05	91.97
Subject to Control	6.14	6.52	6.82	21.79	23.96	25.03
Potential Reduction			0.36			1.95

Cost Effectiveness: $ 240 - 460 / ton VOC and NOx

Adoption Date: 12/1998

Implementation Date: 2001

Description:

In October, 1998, ARB adopted emission standards for large off-road spark-ignition engines to implement Measure M11 of the California 1994 State Implementation Plan for Ozone. The new rules apply to off-road spark-ignition engines 25 horsepower or above. The rules apply to equipment such as forklifts, portable generators, large turf care equipment, scrubber/sweepers, airport ground support equipment, and a wide array of general industrial equipment, but exclude construction and farm equipment engines below 175 horsepower, marine propulsion engines, locomotives, and recreational vehicles. The rules establish exhaust emission standards for VOC and NOx combined, and for carbon monoxide (CO). Implementation of the rules begins in 2001 for engines with a displacement greater than 1.0 liter, and 2002 for engines 1.0 liter and below. It is expected that manufacturers of large spark-ignition engines use three-way catalysts with closed loop controls to meet the emission standards.

Other Impacts:

The ARB did not identify any adverse environmental impacts associated with the adoption of these standards.

APPENDIX C:
SPARE THE AIR PROGRAM TECHNICAL SUPPORT DOCUMENTATION

Bay Area Spare the Air Program*

The District's Spare the Air Program is included in the Bay Area Ozone Attainment Plan as control measure VM-01. No SIP credit is being requested for this measure at this time. Including the Spare the Air Program in the Plan will give the region experience with implementing voluntary measures under EPA guidelines. A table summarizing key elements of the Spare the Air Program from 1991 through 1998 is provided at the end of this appendix.

1. Program Participants

The Bay Area Air Quality Management District (BAAQMD) began the Spare the Air program in 1991. Since then, the program has received significant support from the Bay Area Clean Air Partnership (BayCAP), a public private partnership of the Air District, the Bay Area Council and the Silicon Valley.Manufacturing Group. In addition, the program has 1,000+ employers in the Employer Spare the Air program who pledge to educate their employees about air quality and notify them when Spare the Air days are declared. The number of employers in the program has steadily increased since the employer component was added in 1992. During the first summer, 250 employers participated. This grew to 400 employers in 1994 and to 1,021 employers in 1998.

A Spare the Air City and County campaign was added in 1996. In 1998, over 40 Bay Area cities and counties signed up to promote the program to their employees and residents.

2. How the Program Works

The BAAQMD was one of the first air districts in the country to target summertime ground-level ozone formation through a voluntary public education program. At its inception, the goal of the Spare the Air campaign was to educate the public about actions they could take to personally improve air quality on days when air quality was expected to be poor. The goals of the campaign have broadened over the years to include:

- Reducing motor vehicle emissions, the use of polluting consumer products and lawn and garden equipment on Spare the Air days.
- To measure the emission reductions achieved through the program.

The campaign's origins trace back to a 1990 regional household survey, in which 66% of respondents said they had never heard of anything they could personally do to help improve air quality. At the same time, an episodic control program was included in the BAAQMD's 1991 Clean Air Plan (prepared under the California Clean Air Act) as a voluntary program. The Spare the Air program was included in the 1991, 1994, and 1997 Bay Area Clean Air Plans as a Transportation Control Measure.

The BAAQMD's emissions inventory indicates that driving, consumer activities such as using pump sprays, painting, using gasoline powered garden equipment, and recreational boats accounts for over 250 tons per day of volatile organic compounds (VOCs). By reducing these emissions, the Bay Area can come closer to complying with federal and state health-based ozone standards.

The Spare the Air campaign elements include:

a) Calling Spare the Air Days

Air District meteorologists predict when conditions indicate the need to call a Spare the Air day. The BAAQMD has been calling Spare the Air days when levels of ozone were expected to exceed 9 pphm for one hour (the California one-hour ozone standard) in two or more locations, or when an ozone reading of 10 pphm for one hour is predicted at any air monitoring station in the Bay Area's network.

* background information includes research conducted for ARB project on voluntary mobile source emission programs.

b) Notification - Getting the Word Out

In 1991, public outreach was conducted through press releases and follow-up calls to television meteorologists and radio stations. In 1992, the BAAQMD began outreach through employers. Employers agreed to educate employees about Spare the Air through flyers, pay stuffers, brochures and announcements. The employer portion of the campaign has grown every year, with more employers registering for the campaign and increased support from business/economic groups such as the Bay Area Council and the Silicon Valley Manufacturing Group. The district contracts with a non-profit public relations firm, Community Focus, to provide support for the Spare the Air campaign.

Employers and the media are notified of Spare the Air days via a fax sent by 1:15 PM the afternoon before a Spare the Air day. Employers are asked to alert their employees by using a poster, via e-mail, voice mail or internal memos. In 1996, a Spare the Air web-site was developed which includes daily air quality readings and Spare the Air banners.

The web-site expanded in 1997 and 1998, allowing employees and the general public to sign-up for automatic notification of Spare the Air days through their e-mail addresses. In 1997, an automatic e-mail subscription capability was developed, so that employees of participating companies who have e-mail, but not web access, can also sign up for e-mail notification. In 1998, 5,000 people were registered for e-mail notification of Spare the Air. A total of 23 Spare the Days were called in 1998.

c) The Bay Area Clean Air Partnership (BayCAP)

The business community has partnered with the Air District in an effort to promote voluntary measures to help clean the air. As a result, the Bay Area Council and the Silicon Valley Manufacturing Group joined with the BAAQMD to form the Bay Area Clean Air Partnership (BayCAP) in February 1996. BayCAP's objectives are to:

- Implement voluntary actions to help avoid violations of the national ozone standard.
- Verify community-wide voluntary efforts to reduce emissions.
- Explore possible new voluntary strategies to reduce emissions.

d) Media and Advertising

In 1996, the Air District's media outreach efforts were augmented by private funds solicited through advertising co-operative formed by BayCAP. The advertising cooperative raised an additional $81,500 in 1996 (total budget = $325,000), $67,500 in 1997 (total budget = $700,000) and $100,000 in 1998 (total budget = $684,000) for the purchase of radio, billboard, and bus sign advertising.

In addition, the business partnership has helped the BAAQMD develop more creative ways to advertise Spare the Air, such as using Caltrans message signs, a Spare the Air milk carton, outdoor banners for cities to display on public streets and buildings and clean air messages on the electronic scoreboard at Giants' and A's baseball games. Corporate partnerships have also produced feature articles in Pacific Gas & Electric's *Spotlight* customer newsletter (distributed to 12 million households), Kaiser Permanente's *Member News* (distributed to 1 million households) and numerous employee in-house newsletters. Hundreds of media stories – TV, radio and print – have appeared each year on the Spare the Air program.

e) Special Outreach

The Spare the Air program has also initiated a "Youth Outreach" program to educate youth about air quality issues. Elements have included a coloring book for young children and setting up carpool programs at schools. The BAAQMD has also formed "Community Resource Teams" to disseminate clean air messages in their communities and also targeting the "non-commuter" population. The BAAQMD also began a "Clean Air Champions" and "Spare the Air Awards" programs. The "Clean Air Champions" awards recognize individuals in the community who improve air quality through their daily efforts. The "Spare the Air Awards" program honors those employers who have implemented successful programs to promote Spare the Air.

3. Activity Effects

The BAAQMD contracted with ICF Kaiser International to conduct 1998 evaluation studies of the effectiveness of the program. Emission reduction measurements were extrapolated from the ICF Kaiser data.

ICF Kaiser conducted random telephone surveys of the general population to obtain an unbiased measure of Spare the Air recognition and participation. ICF Kaiser also collected data from Spare the Air participants who were registered on e-mail for Spare the Air information and alerts. This latter data collection effort was intended to better understand behavior change of those in the Employer Spare the Air program or who support Spare the Air.

On a separate track, the California Air Resources Board (CARB) is developing a protocol for measuring the effectiveness and emission reductions associated with voluntary mobile source emission programs. The protocol is expected to be ready for the summer of 2000. The Air District expects to use the CARB protocol when it is available.

Four survey methods were used to assess participation in the 1998 Spare the Air Program. The methods are summarized in the table below:

1998 Data Collection Instruments

Method	Objective	Description	Spare the Air days on which data collected
Random phone survey on evenings of 2 Spare the Air days	Obtain an unbiased measure of participation from general public; Obtain measure of public recognition of program.	400 Random Digit Dial (RDD), 12-question, CATI phone surveys. 7 questions collect data on emission producing behavior change on Spare the Air days; 5 questions measure the public education value of the Spare the Air program.	July 16th (Thursday) August 31st (Monday)
Survey posted on Spare the Air Internet Web Site. The survey form was active on the web-site throughout entire season. Respondents were self-selected and not a random sample of the public.	Understand level of change from those participating	Same survey tool as above with the addition of demographic questions and questions designed to limit the overestimation of travel reduction. The public could go to BAAQMD's Spare the Air Web Site to get Spare the Air information and to complete the web survey.	July 16th (Thursday) August 4th (Tuesday) August 31st (Monday)
E-mail surveys sent to those who registered for e-mail notification of Spare the Air days.	Understand level of change from those participating	Same as web survey.	July 16th (Thursday) August 4th (Tuesday) August 31st (Monday)
Hardcopy survey distributed at employer sites throughout the season for employees without e-mail	Understand level of change from those participating	Same as web survey.	Not associated with specific Spare the Air days.

To measure behavior change that occurred because it was a Spare the Air day, the respondent must have 1) known it was a Spare the Air day; 2) reduced emission-producing activity on that day; and 3) changed his/her behavior in response to the Spare the Air program.

The questions asked to set up the test were:

- Did you drive your automobile more frequently, less frequently, or the same as you usually do?
- Did you use consumer products more frequently, less frequently, or the same as you usually do?
- Did you use gas-powered garden tools more frequently, less frequently, or the same as you usually do?
- Why did you make that change? (asked as follow-up questions to above questions)
- Did you know that today was a Spare the Air day?

In addition, the web and e-mail surveys asked two questions designed to reduce the overestimation of travel reduction. These questions were:

- Was the vehicle you normally drive used by someone else within your household instead?
- If you took transit or a carpool/vanpool, did you drive somewhere (such as to a transit stop or Park-and-Ride lot) to catch your ride?

Under the four data collection methods, the percentage of those surveyed that met all three tests were:

General Public Phone Survey

Response	July 16 (n = 400)	August 31 (n = 400)
1. Drove Less	2.5%	1.8%
2. Used consumer products less	2.8%	1.8%
3. Used gas garden equipment less	3.0%	2.0%

Internet Web Survey

Response	July 16 (n = 577)	August 4 (n=766)	August 31 (n = 489)
1. Drove less	52.9%	48.2%	40.3%
2. Drove less (minus overestimation)	43.2%	39.0%	35.0%
3. Used consumer products less	16.6%	21.0%	18.0%
4. Used gas garden equipment less	13.0%	15.4%	14.5%

E-Mail Survey

Response	July 16 (n = 1,081)	August 4 (n=1,474)	August 31 (n = 1,008)
1. Drove less	47.5%	42.6%	36.9%
2. Drove less (minus overestimation)	40.5%	34.6%	28.9%
3. Used consumer products less	15.7%	20.9%	16.8%
4. Used gas garden equipment less	12.7%	12.4%	13.7%

Hard Copy Survey

Response	(n = 912)
1. Drove less	23.0%
2. Used consumer products less	22.6%
3. Used gas garden equipment less	17.3%

1998 Awareness Responses

	July 16			August 4			August 31			N/A
Response	Phone	Web	E-mail	Phone	Web	E-mail	Phone	Web	E-mail	Hard Copy
Heard or seen the slogan "Spare the Air" (%)	73.3	98.1	98.4	N/A	95.7	98.6	76.8	98.0	98.8	81.7
Knew the purpose of a spare the air day (%) *	91.3	100	99.0	N/A	98.6	99.3	94.8	100	98.8	94.5
Knew the survey day was a Spare the Air day (%) *	38.8	95.7	96.3	N/A	98.0	96.2	38.3	93.3	91.4	N/A

* among respondents who had heard or seen the Spare the Air slogan

4. Emission Effects

Based on the results of the 1998 general public survey, the following assumptions were used to calculate emission reductions:

- There are 4.6 million adults (18+) in the Bay Area. (ABAG). Thirty-eight percent of Bay Area adults were aware of Spare the Air days in 1998. (ICF)

- Thirty-eight percent of 4.6 million = 1,748,000 adults knew it was a Spare the Air day. Six point five (6.5) percent of those who were aware of the Spare the Air day reduced driving for air quality reasons. (ICF)
- **Round 6.5 percent down to 6.0 percent**. Six percent of 1,748,000 adults = 104,880 adults who reduced their driving for air quality reasons on a Spare the Air day.
- Overall, 104,880 adults represents 2.2 percent of the total adults in the Bay Area. **Round 2.2 % down to 2 %.** This equates to 92,000 adults who reduced their driving for air quality reasons.
- Assume that each adult reduced one round trip. We assumed that 25% are work trips with average distance of 11.5 miles and 75% are non-work trips with an average distance of 5.37 miles. The work/non-work split and trip distances are based on trip diary surveys and data from the Metropolitan Transportation Commission (MTC)
- Based on these numbers, Air District planners calculated emissions reductions from reduced driving on Spare the Air days at 2.0 tons per day of volatile organic compounds and 2.1 tons per day of oxides of nitrogen (NOx).

5. Commitment for Evaluation and Reporting

The Air District received $775,000 in federal Congestion Mitigation and Air Quality Improvement (CMAQ) Program funding to augment the Spare the Air campaign in 1999. In addition, the Air District will receive $970,000 in CMAQ funding in 2000.

The total proposed budget for 1999 is $1.475 million ($775,000 in CMAQ and $700,000 in Air District funds), double the amount of funding available for the 1998 program.

Goals for the 1999 and 2000 program include:

- Greater outreach and support for the 1,000 + employers in the program,
- Development of new brochures and posters,
- Greater emphasis on e-mail sign-ups and notification, increase sign-ups from 5,000 in 1998 to 10,000 in 1999,
- Working with transit agencies to target using transit to weekend and special events,
- Development of television and cable TV ads,
- Development of radio advertising promoting transit use on SPARE THE AIR days, as well as real-time advertising the day before a Spare the Air day,
- A new Spare the Air video,
- Continuing and enhancing the 1999 evaluation methodologies including increasing the sampling size for public opinion surveys, increasing the number of surveys conducted from 2 in 1998 to 5 in 1999 including a baseline survey. Add questions to ascertain type of trip reduced and trip length. Increase evaluation budget from $20,000 in 1998 to $70,000 in 1999,
- Increasing awareness of Spare the Air days from 38 percent of Bay Area adults to 48 percent in 1999 and to 60 percent in 2000,
- Increasing the percentage of individuals who reduce their driving from 2 percent of Bay Area adults to over 3 percent in 1999 and to nearly 5 percent in 2000.

BAAQMD Spare the Air Campaign: Program Summary 1991 – 1998

Element	91	92	93	94	95	96	97	98
Threshold to call Spare the Air	10 pphm	10 pphm	10 pphm	10pphm	10 pphm	10 pphm	10pphm	10 pphm
Public Outreach	Media Only	Media & Employers	Media & Employers	Media & Employers	Media & Employers	Media, Employers, BayCAP	Media, Employers, BayCAP, Cities/Counti es	Media, Employers, BayCAP, Cities/Countie s Changeable Hwy. Message Signs, Transit
Media Campaign	Press release, Air Quality hotline phone #	Press release, Air Quality hotline phone #	'92 + $X radio			+ real-time radio ads	+ Traffic sponsorships + in-theater advertising	+ TV ads (cable) + wrapped STA bus
# of Employer Participants	N/A	250	325	380	600	630	650	1021
# City/County Participants							34	54
Notification	Media	Fax, Media	Fax, Media	Fax, Media	Fax, Media	+ "Telecommut e to STA web page	+ Air district STA web page (~ 1,700 on-line sign-ups)	+ ~5,000 on-line sign-ups
Timing of Employer Program		Sept. 1 – mid October	Aug. 1 – mid October	Aug. 1 – mid October	Aug. 1 – mid October	June 1 – mid October	June 1 – mid October	June 1 – mid October
Budget						$325,000 total ($81,500 employer contribution)	$700,000 total ($67,500 employer contribution)	$684,000 total ($100,000 employer contribution)
Monitoring & Evaluation						Capture the Credit, Santa Clara County employer pilot, RIDES RDD survey	None	ICF Kaiser RDD surveys, Web surveys, e-mail surveys, Hard copy employer surveys
Special Outreach					Youth Outreach, Community Resource Teams, Clean Air Champions	Youth Outreach, Community Resource Teams, Clean Air Champions	Youth Outreach, Community Resource Teams, Clean Air Champions	Youth Outreach, Community Resource Teams, Clean Air Champions
# of SPARE THE AIR Days Called	11	17	19	12	24 6/23,24,24, 26; 7/14,15,17, 27,28, 30,31; 8/1,8,9,13,1 4,20,21	25 6/2,3,4,5,6,30; 7/1,2,6,20,21,22 ,30 8/9,10,11,12,13, 29,30; 9/8,9 10/6,7,8	2 8/4, 5	23 6/15; 7/16,17,18,19, 27; 8/1,2,3,4,5,11, 12,13,28,29,3 0,31; 9/1,2,12,13,14
# of Federal Exceedanc es	2	2	3	2	11	8	0	8
# of State Exceedanc es	23	23	19	13	28	34	8	29

STA = Spare the Air

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