

## **CHAPTER 4**

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### **ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

Introduction  
Air Quality Impacts  
Energy Impacts  
Hazards  
Hydrology/Water Quality  
Solid/Hazardous Waste

## 4.0 INTRODUCTION

The CEQA Guidelines require EIRs to identify significant environmental effects that may result from a proposed project [CEQA Guidelines §15126.2(a)]. Direct and indirect significant effects of a project on the environment should be identified and described, with consideration given to both short- and long-term impacts. The discussion of environmental impacts may include, but is not limited to, the resources involved; physical changes, alterations of ecological systems; health and safety problems caused by physical changes; and other aspects of the resource base, including water, quality, public services, etc. If significant adverse environmental impacts are identified, the CEQA Guidelines require a discussion of measures that could either avoid or substantially reduce any adverse environmental impacts to the greatest extent feasible (CEQA Guidelines §15126.4).

The CEQA Guidelines indicate that the degree of specificity required in a CEQA document depends on the type of project being proposed (CEQA Guidelines §15146). The detail of the environmental analysis for certain types of projects cannot be as great as for others. For example, the EIR for projects, such as the adoption or amendment of a comprehensive zoning ordinance or a local general plan, should focus on the secondary effects that can be expected to follow from the adoption or amendment, but the analysis need not be as detailed as the analysis of the specific construction projects that might follow. As a result, this program EIR analyzes impacts on a regional level, impacts on the subregional level, and impacts on the level of individual industrial or individual facilities only where feasible.

This chapter analyzes the potential environmental impacts of the 2007 AQMP. This chapter is subdivided into the following sections based on the area of potential impacts: air quality, energy, hazards, hydrology/water quality, and solid/hazardous waste.

Included for each impact category is a discussion of project-specific impacts, project-specific mitigation (if necessary and available), and impacts remaining after mitigation.

In order to address the full range of potential environmental impacts several assumptions were made for purposes of evaluation. First, to provide a “worst-case” analysis, the environmental analysis contained herein assumes that the control measures contained in the AQMP apply to the entire district (i.e., the Basin and those portions of the MDAB and SSAB under the SCAQMD’s jurisdiction).

If control equipment which has secondary adverse environmental impacts could be used to comply with a particular control measure, it was assumed that such equipment would be used even if it may not be the most appropriate technology or method of compliance. This approach was taken for each environmental topic. In practice, there are typically a number of ways to comply with requirements of SCAQMD rules, but only one type of compliance option will actually be implemented. This approach has the potential to substantially overestimate impacts because only a single type of control equipment will be used.

Every control measure in the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP was evaluated to determine whether or not it has the potential to generate adverse environmental impacts. Each environmental topic subchapter in Chapter 4 contains a table identifying those control measures that have the potential to generate significant adverse impacts to that environmental topic. Table 4.0-1 lists the various control measures, which were evaluated and determined not to have significant adverse impacts on the environment and, therefore, were not evaluated further.

**TABLE 4.0-1**

**Control Measures With No Significant Adverse Environmental Impacts**

<b>Control Measure</b>	<b>Control Measure Description</b>	<b>Reason Not Significant</b>
<b>MEASURES TO BE IMPLEMENTED BY THE SCAQMD</b>		
CTS-02	Clean Coating Certification Program	1,2
CTS-03	Consumer Product Labeling and Emission Reductions from Use of Consumer Products at Institutional and Commercial Facilities	1,2
FUG-01	Improved Leak Detection and Repair	2,3
FUG-02	Emission Reductions from Gasoline Transfer & Dispensing Facilities	2,3
CMB-04	Natural Gas Fuel Specifications	1,2
MCS-02	Urban Heat Island	1
MCS-06	Improved Startup, Shutdown, & Turnaround Procedures	1,2
MOB-04	Emissions Reduction from Carl Moyer Program	1,4
MOB-07	Concurrent Reductions from Global Warming Strategies	1,2
<b>MEASURES FOR SOURCES UNDER STATE AND FEDERAL JURISDICTION</b>		
ARBONRD-1, SCONRD-2	Smog Check Improvements	2,3
OFFRD-09 ARB-OFFRD-1	Vessel Speed Reduction	1,2

- 1 Control technologies do not generate significant adverse impacts.
- 2 Changes in operating practices with no impact identified.
- 3 Changes in testing, inspection, or enforcement procedures with no impact identified.
- 4 Existing program that provides air quality benefits.

There are several reasons why the control measures in Table 4.0-1 are not expected to generate significant adverse impacts. First, the primary control methods of compliance do not involve control equipment that would generate any adverse secondary or cross media impacts. For example, FUG-01 and FUG-02 would largely control VOC emissions through enhanced inspection and maintenance practices to reduce fugitive emissions from material transfer, storage, and processing. Inspection and maintenance practices are not expected to generate secondary impacts because these are procedures to ensure proper operation of equipment, for example.

Another reason control measures in Table 4.0-1 were determined to have no significant adverse impacts is because they consist primarily of changes in operating practices, are primarily administrative in nature, and upon evaluation, no adverse impacts were identified. For example, improved startup and shutdown procedures that avoid flaring are primarily expected to be accomplished by reducing loads, recycling feeds, and better decontamination procedures, which would ultimately reduce the number of flaring events and would not generate secondary impacts.

A third reason control measures in Table 4.0-1 were determined to be insignificant was that some measures would require changes to testing, inspection, or enforcement procedures. Since testing, inspection and enforcement entail procedures that ensure proper operation of equipment, as opposed to installing control equipment, no secondary impacts were identified, e.g., implementing ARB-ONRD-1 and SCONRD-2 would improve smog check requirements and compliance with vehicle emission requirements but would not generate secondary environmental impacts.

In addition, there are several control measures proposed in the 2007 AQMP for which there is insufficient information regarding compliance options or how they would be implemented to determine the potential impacts (see Table 4.0-2). These control measures require investigation or pilot testing to determine appropriate control technologies. They may even require further development of technologies that is currently unknown. Further, in some cases control options may be available, but these are unknown at this time. For example, the control measure that would impose fees (i.e., FLX-01, EGM-02, EGM-03 and MOB-01) does not indicate how the fees would be used. Implementation of these control measures is expected to result in neutral impacts or provide air quality benefits. They could be used for educational purposes or purchasing control equipment. Because the control measure is general in nature, it is difficult to determine what, if any, impacts could be expected from this control measure. Therefore, the impacts of the control measures identified in Table 4.0-2 would be considered speculative and no further environmental analysis is required (CEQA Guidelines §15145).

**TABLE 4.0-2**

**Control Measure Whose Impacts are Speculative**

<b>Control Measure</b>	<b>Control Measure Description</b>
CTS-05	2010 Standard – Emission Charges of \$5,000 per Ton for Stationary Sources with Potential to Emit Over 10 Tons per Year
FLX-01	Economic Incentive Programs
FLX-02	Petroleum Refinery Pilot Program
EGM-02	Emission Budget and Mitigation for General Conformity Projects (All Pollutants)
EGM-03	Emissions Mitigation at Federally-Permitted Projects (All Pollutants)
MOB-01	Mitigation Fee Program for Federal Sources (All Pollutants)
MCS-07	Application of all Feasible Measures (All Pollutants)



## **SUBCHAPTER 4.1**

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### **AIR QUALITY IMPACTS**

Introductions  
Future Air Quality Baseline  
Significance Criteria  
Potential Impacts and Mitigation  
Ambient Air Quality  
Summary of Secondary Air Quality Impacts

## **4.1 AIR QUALITY IMPACTS**

### **4.1.1 INTRODUCTION**

The purpose of the 2007 AQMP is to establish a comprehensive program to lead the region into compliance with federal eight-hour ozone and PM<sub>2.5</sub> air quality standards through implementation of different categories of control measures. The 2007 AQMP is also expected to satisfy the planning requirements of the federal Clean Air Act and to develop transportation emission budgets using the latest approved motor vehicle emissions model and planning assumptions. The 2007 AQMP proposes potential attainment demonstration of the federal PM 2.5 standards by 2014 through a more focused control of SO<sub>x</sub>, directly-emitted PM<sub>2.5</sub>, and NO<sub>x</sub> supplemented with VOCs emission reductions. The eight-hour ozone control strategy builds upon the PM<sub>2.5</sub> strategy, augmented with additional VOC reductions to meet the standard by 2023. The 2007 AQMP contains measures based on current technology assessments.

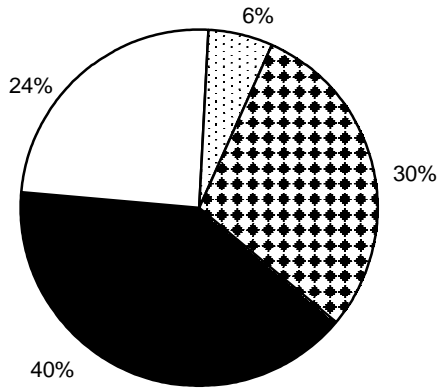
The federal Clean Air Act requires an eight-hour ozone non-attainment area to prepare a SIP revision by June 2007 and a PM<sub>2.5</sub> non-attainment area to submit by April 2008. In addition, the U.S. EPA requires that transportation conformity budgets be established based on the most recent planning assumptions (i.e., within the last five years) and approved motor vehicle emission model. The 2007 AQMP is based on assumptions provided by both CARB and SCAG reflecting the computer model, EMFAC2007, for motor vehicle emissions and demographic updates.

This subchapter evaluates secondary air pollutant emissions that could occur as a consequence of efforts to improve air quality (e.g., emissions from control equipment such as afterburners). The analysis is divided into the following sections: Future Air Quality Baseline, Significance Criteria, Potential Impacts and Mitigation, Ambient Air Quality, and Summary of Secondary Air Quality Impacts.

### **4.1.2 FUTURE AIR QUALITY BASELINE**

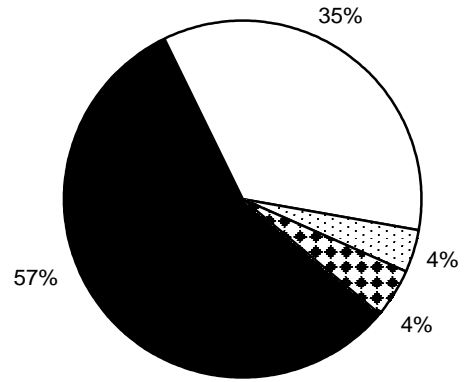
Figures 4.1-1 and 4.1-2 show baseline and future projected emissions, respectively, by major source categories. These figures are included here to show projected air quality trends through 2023. Baseline emissions for major source categories (i.e., point, area, on-road, and off-road) in 2002 are provided in Figure 4.1-1. Figure 4.1-2 shows the projected future baseline that would be expected if no new AQMP control measures are promulgated as rules. It does, however, reflect emission reductions for existing rules with future compliance dates. A comparison of Figures 4.1-1 and 4.1-2 indicates that the on-road mobile category continues to be a major contributor to CO and NO<sub>x</sub> emissions. However, due to the adopted regulations, by 2023 on-road mobile accounts for about 19 percent of total VOC emissions compared to 40 percent in 2002. Meanwhile, area sources become the major contributor to VOC emissions from 30 percent in 2002 to 44 percent in 2023.



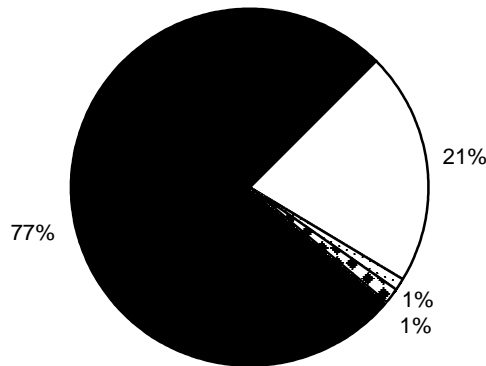


**VOC Emissions: 897 Tons/Day**

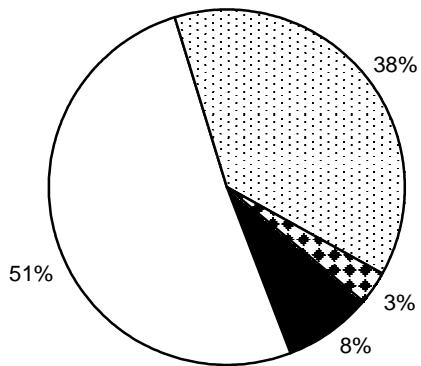
Note: Consumer products and architectural coatings under the area source category represent 110 and 57 tons per day of VOC emissions, respectively.



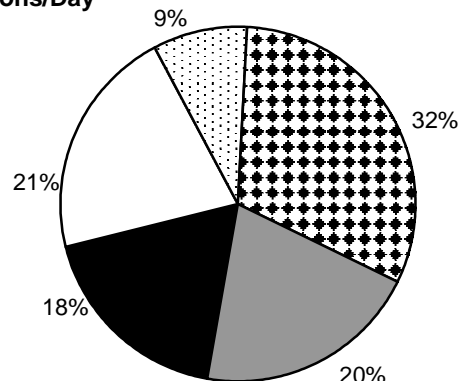
**NOx Emissions: 1,079 Tons/Day**



**CO Emissions: 4,819 Tons/Day**



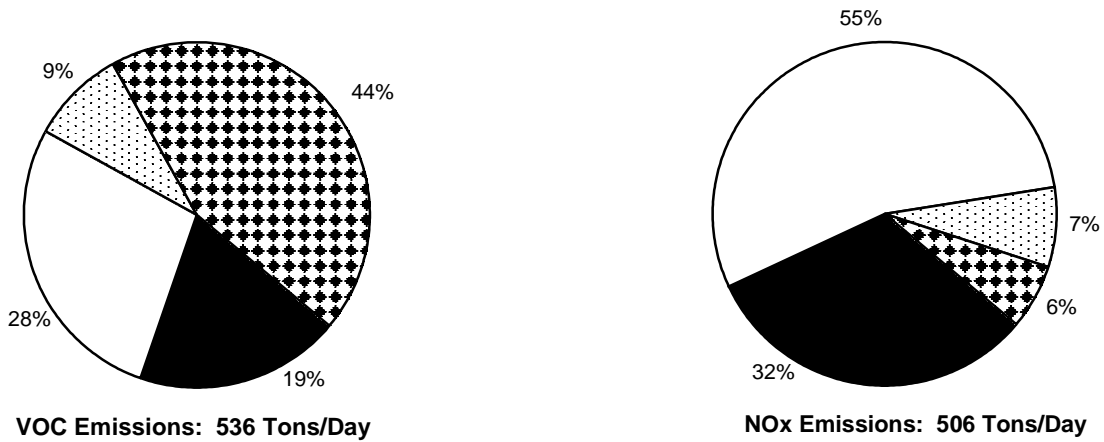
**SOx Emissions: 53 Tons/Day**



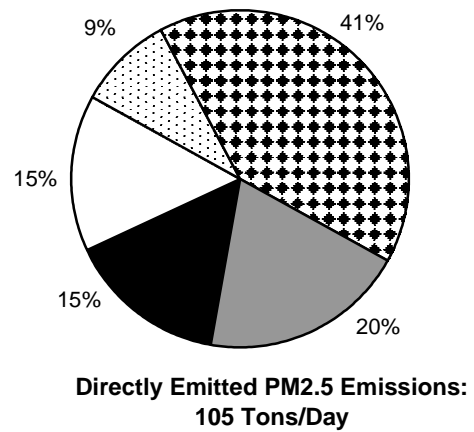
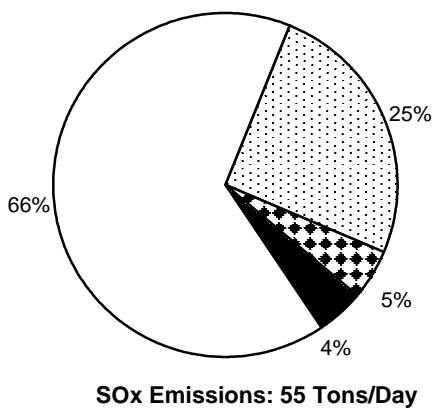
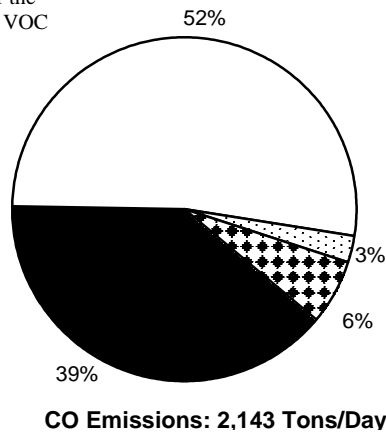
**Directly Emitted PM2.5 Emissions: 99 Tons/Day**



**FIGURE 4.1-1**  
**Relative Contribution by Source Category to 2002 Emissions Inventory**  
 (VOC & NOx – Summer Planning; CO, SOx & PM2.5 – Annual Average Inventory)



Note: Consumer products and architectural coatings under the area source category represent 114 and 31 tons per day of VOC emissions, respectively.



**FIGURE 4.1-2**  
**Relative Contribution by Source Category to 2023 Emissions Inventory**  
**(VOC & NOx - Summer Planning; CO, SOx & PM2.5 - Annual Average Inventory)**

### 4.1.3 SIGNIFICANCE CRITERIA

To determine whether or not air quality impacts from the proposed project are significant, impacts will be evaluated and compared to the significance criteria in Table 4.1-1. If impacts equal or exceed any of the following criteria, they will be considered significant.

**TABLE 4.1-1  
Air Quality Significance Thresholds**

<b>Mass Daily Thresholds</b>		
<b>Pollutant</b>	<b>Construction</b>	<b>Operation</b>
NO <sub>x</sub>	100 lbs/day	55 lbs/day
VOC	75 lbs/day	55 lbs/day
PM10	150 lbs/day	150 lbs/day
PM2.5	55 lbs/day	55 lbs/day
SO <sub>x</sub>	150 lbs/day	150 lbs/day
CO	550 lbs/day	550 lbs/day
Lead	3 lbs/day	3 lbs/day
<b>TAC, AHM, and Odor Thresholds</b>		
Toxic Air Contaminants (TACs)	Maximum Incremental Cancer Risk $\geq$ 10 in 1 million Hazard Index $\geq$ 1.0 (project increment)	
Odor	Project creates an odor nuisance pursuant to SCAQMD Rule 402	
<b>Ambient Air Quality Standards for Criteria Pollutants</b>		
NO <sub>2</sub> 1-hour average annual average	SCAQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards: 0.25 ppm (state) 0.053 ppm (federal)	
PM10 24-hour annual geometric mean annual arithmetic mean	10.4 ug/m <sup>3</sup> (recommended for construction) 2.5 ug/m <sup>3</sup> (operation) 1.0 ug/m <sup>3</sup> 20 ug/m <sup>3</sup>	
PM2.5 24-hour	10.4 ug/m <sup>3</sup> (recommended for construction) 2.5 ug/m <sup>3</sup> (recommended for operation)	
Sulfate 24-hour average	1 ug/m <sup>3</sup>	
CO 1-hour average 8-hour average	SCAQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards: 20 ppm (state) 9.0 ppm (state/federal)	

lbs/day = pounds per day; ug/m<sup>3</sup> = microgram per cubic meter; ppm = parts per million; > greater than or equal to.

#### 4.1.4 2007 AQMP AIR QUALITY MODELING RESULTS

The objective of the 2007 AQMP is to attain and maintain ambient air quality standards. Based upon the modeling analyses described in this subsection implementation of all control measures contained in the 2007 AQMP is anticipated to bring the district into compliance for all pollutants, except for the state ozone, PM10, and PM2.5 air quality standards, by the year 2023 (see Table 4.1-2).

**TABLE 4.1-2**

**Expected Year of Compliance with State and Federal Standards**

Pollutant	Standard	Threshold Concentration Level	Expected Compliance Year
Ozone	NAAQS 8-hour	84 ppb	2024
	CAAQS 1-hour	90 ppb	Beyond 2024
	CAAQS 8-hour	70 ppb	Beyond 2024
PM10	NAAQS 24-hour	150 ug/m <sup>3</sup>	2000
	CAAQS 24-hour	50 ug/m <sup>3</sup>	Beyond 2024
	CAAQS Annual	20 ug/m <sup>3</sup>	Beyond 2024
PM2.5	NAAQS Annual	15 ug/m <sup>3</sup>	2015
	NAAQS 24-hour	65 ug/m <sup>3</sup>	2005
	NAAQS 24-hour <sup>(1)</sup>	35 ug/m <sup>3</sup>	Beyond 2024
	CAAQS Annual	12 ug/m <sup>3</sup>	Beyond 2024
CO <sup>(2)</sup>	NAAQS 8-hour	9 ppm	2002
	NAAQS 1-hour	35 ppm	1990
	CAAQS 8-hour	9 ppm	2002
NO <sub>2</sub>	NAAQS Annual	0.0534 ppm	1995
	CAAQS 1-hour	0.25 ppm	2003

(1) EPA adopted the new 24-Hour PM2.5 standard in September 2006. The current SIP requirements address the 65 ug/m<sup>3</sup> standard in place in 2005 when national area attainment designations were adopted.

(2) The Basin has been achieving the federal one-hour CO air quality standard since 1990. In 2002, the Basin achieved the eight-hour CO air quality standard. The Basin is still considered nonattainment until a petition for redesignation is submitted by the state and is approved by U.S. EPA.

##### 4.1.4.1 Ozone Air Quality

Ozone modeling techniques described in the 2007 AQMP (see Chapter 5 and Appendix V of the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP) were used to assess the effects of the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP on ozone concentrations. The methodology employed for demonstrating attainment using the Comprehensive Air Quality Model with Extensions (CAMx, version 4.4) with SAPRC99 chemistry as the primary modeling tool.

#### 4.1.4.2 PM10 Air Quality

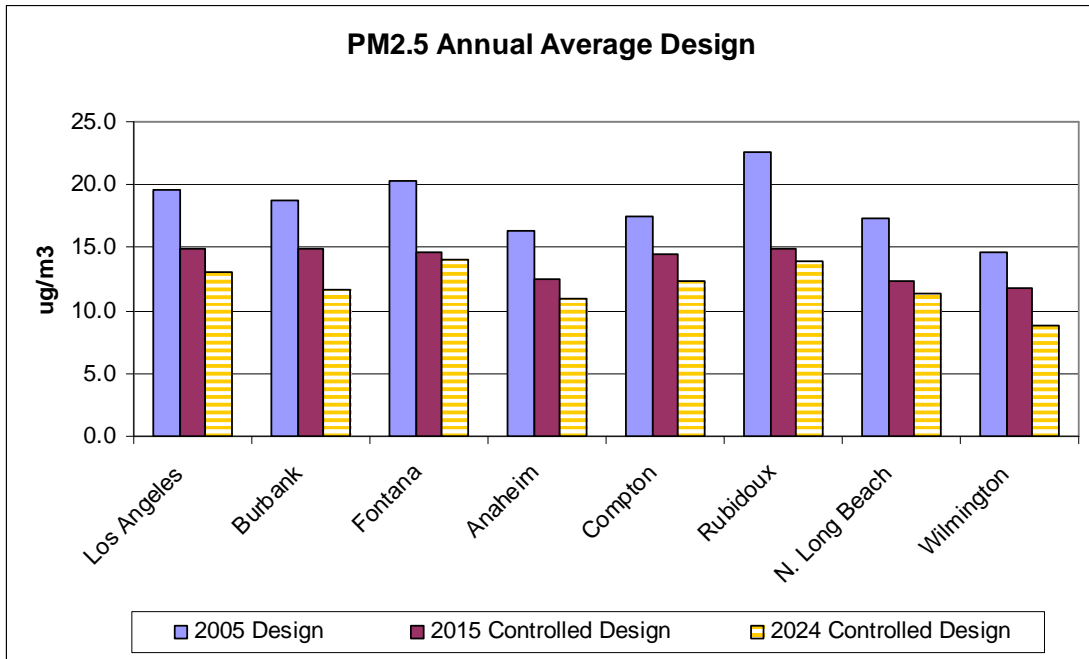
As discussed in the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP (see Chapter 5 of the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP), the U.S. EPA administrator signed the final documents that eliminated the existing annual PM10 standard. The action retained 24-hour PM10 standard at its existing concentration of 150  $\mu\text{g}/\text{m}^3$ . The form of the 24-hour PM10 standard allows for one violation of the standard annually. The Basin currently meets the 24-hour average federal standard. (The only days that exceed the standard are associated with high wind natural events or exceptional events due to wildfires).

#### 4.1.4.3 PM2.5 Air Quality

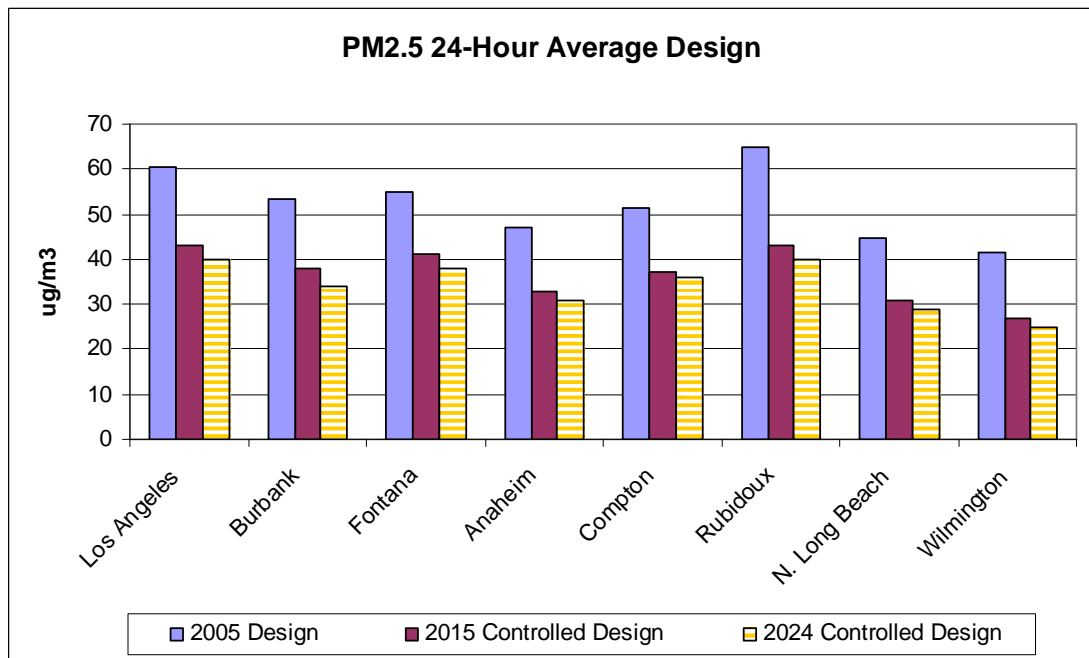
PM2.5 modeling techniques used in the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP (see Chapter 5 and Appendix V of the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP) were used to assess the effects of the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP on PM2.5 concentrations. The Proposed Modifications to the Final ~~Draft~~ 2007 AQMP annual average PM2.5 modeling employs a deterministic approach to demonstrate attainment of the PM2.5 standard in 2015. CAMx was used to simulate 2005 meteorological and air quality data to determine Basin annual average and episodic PM2.5 concentrations. Future year PM2.5 air quality was determined using site and species specific relative response factors (RRFs) applied to 2005 PM2.5 design values per U.S. EPA guidance documents. The weight of evidence demonstration for the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP includes emissions trends analysis, speciated linear rollback analyses, as well as future year PM2.5 predictions at "hot spot" grids, where emissions have significant uncertainty. The annual average PM2.5 design concentrations for 2005 baseline year, 2015 controlled, and 2024 controlled are shown in Figure 4.1-3. The maximum 24-hour average PM2.5 design concentrations for 2005 baseline year, 2015 controlled, and 2024 controlled are shown in Figure 4.1-4. The future year attainment demonstration was analyzed for 2015 (the target set by the federal CAA) and projected controlled emissions for 2014, thus enabling a full year demonstration based on a control strategy.

#### 4.1.4.4 CO Air Quality

On February 24, 2007, U.S. EPA published in the Federal Register its proposed decision to re-designate the Basin from non-attainment to attainment for CO. The comment period on the re-designation proposal closed on March 16, 2007 with no comments received by the U.S. EPA. On May 11, 2007, U.S. EPA published in the Federal Register its final decision to approve the SCAQMD's request for re-designation from non-attainment to attainment for CO, effective June 11, 2007. ~~The district is in attainment for the eight-hour federal CO standard and has requested redesignation.~~ No additional regional or hot-spot monitoring is provided in the Proposed Modifications to the Final Draft 2007 AQMP to further demonstrate attainment of the eight-hour CO standard.



**FIGURE 4.1-3**  
**Annual Average PM2.5 Design Concentrations:**  
**2005, 2015 Controlled, and 2024 Controlled**



**FIGURE 4.1-4**  
**Maximum 24-Hour Average PM2.5 Design Concentrations:**  
**2005 Baseline, 2015 Controlled, and 2024-Controlled**

#### 4.1.4.5 NO<sub>2</sub> Air Quality

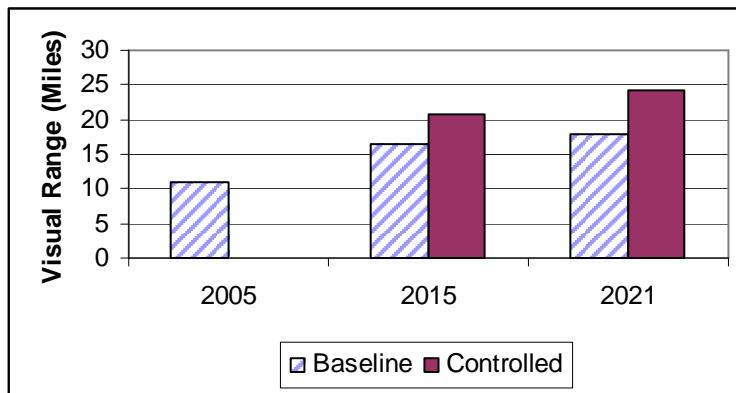
The SCAQMD is currently in compliance with state and federal ambient air quality standards for NO<sub>2</sub>. Since the 2007 AQMP includes further reductions in NO<sub>2</sub> emissions, it is expected that the district will remain in compliance with state and federal NO<sub>2</sub> standards. NO<sub>2</sub> emissions, however, contribute to PM10 and PM2.5 formation. The PM10 and PM2.5 air quality impacts are discussed in Sections 4.1.4.2 and 4.1.4.3.

#### 4.1.4.6 SO<sub>2</sub> Air Quality

The district is currently in compliance with state and federal ambient air quality standards for SO<sub>2</sub>. Since the 2007 AQMP includes further reductions in SO<sub>2</sub> emissions, it is expected that the district will remain in compliance with state and federal SO<sub>2</sub> standards. SO<sub>2</sub> emissions, however, contribute to PM10 and PM2.5 formation. The PM10 and PM2.5 air quality impacts are discussed in Sections 4.1.4.2 and 4.1.4.3.

#### 4.1.4.7 Visibility

The visibility for 2005 for Rubidoux is 12 miles. With future year reductions of PM2.5 from implementation of all proposed emission controls for 2015, the annual average visibility would improve to over 20 miles at Rubidoux (see Figure 4.1-5).



**FIGURE 4.1-5**  
**Annual Average Daytime Visibility Projections at Rubidoux**

#### 4.1.4.8 Policy Options

Additional reductions in mobile source emissions beyond the reductions identified in CARB's mobile source control strategy are needed in order for the South Coast Air Basin to attain the federal PM2.5 ambient air quality standard by 2014. The SCAQMD has identified three different policy options to achieve attainment of the PM2.5 standard by 2014. The first option is the District staff's proposed additional control measures as a menu of selections to further reduce emissions from sources primarily under State and

federal jurisdiction that local authorities, CARB, and the District could implement in order to attain applicable air quality standards. The proposed additional control measures represent a menu of measures that the State could implement and are intended to complement CARB's mobile source control strategy with defined short-term and mid-term control measures needed for reaching attainment by 2015 and to meet legal requirements. The rate of progress for NO<sub>x</sub> emission reductions under Policy Option 1 is shown in Figure 4.1-6.

The second option is to have the state fulfill its NO<sub>x</sub> emission reduction obligations under the 2003 AQMP by 2010, which will be at an emission level of 650 tons per day (representing CARB's short-term defined control measures under the 2003 AQMP). An additional 203 tons per day would be needed to meet the NO<sub>x</sub> emission target between 2010 and 2014. Under this option the state could include some of the proposed measures under the first option or other measures that the state identifies as part of the SIP public process. The rate of progress for NO<sub>x</sub> emission reductions under Policy Option 2 is shown in Figure 4.1-6.

The third option is based on the same rate of progress under Policy Option 1, but it relies heavily on public funding assistance to achieve the needed NO<sub>x</sub> reductions via accelerated fleet turnover to post-2010 on-road emission standards or the cleanest off-road engine standards in effect today or after 2010. Under Policy Option 3 the District would assume the responsibility of implementing the incentive programs based on specific funding levels designated for this purpose. Based on the analysis performed for the Carl Moyer program, up to an estimated \$730 million per year is needed between 2009 and 2014.

#### **4.1.5 POTENTIAL IMPACTS AND MITIGATION**

Secondary air quality impacts are potential increases in air pollutants that occur indirectly from implementation of control measures in the 2007 AQMP. SCAQMD evaluated all 2007 AQMP control measures to identify those control measures that have the potential to generate secondary adverse air quality impacts. Table 4.1-3 identifies all control measures that have the potential to generate secondary air quality impacts. All air quality impacts identified in this subchapter are based on impacts from control measures identified on Table 4.1-3.

The potential environmental impacts associated with implementing the three policy options summarized in 4.1.4.8 are essentially the same because, ultimately, they all have to obtain emissions reductions to reach the same carrying capacity. Mobile source policy option 1 is what is included in the 2007 AQMP that includes CARB's control measures plus additional mobile source control measures proposed by the SCAQMD (see Table 2-11). For goods movement source categories such as marine vessels, trucks, rail, and cargo handling equipment, the control measures proposed by the District are primarily based on a hybrid approach that relies on measures and strategies outlined in CARB's Goods Movement Emissions Reduction Plan and the adopted San Pedro Bay Ports Clean



TABLE 4.1-3

## Control Measures with Potential Secondary Air Quality Impacts

Control Measures	Control Measure Description (Pollutant)	Control Methodology	Air Quality Impact
<b>MEASURES TO BE IMPLEMENTED BY THE SCAQMD</b>			
CTS-01	Emission Reductions from Lubricants	Reduce VOC emissions from industrial lubricants. Low-VOC lubricants.	Potential change in use of VOC and toxic air contaminants from reformulation.
CTS-04	Emission Reductions from the Reduction of VOC Content of Consumer Products not Regulated by the State Board	Reduce VOC emissions from reformulated, lower VOC content products	Potential change in use of VOC and toxic air contaminants from reformulation.
FUG-04	Emission Reductions from Pipeline & Storage Tank Degassing	Vapor space exhaust to be vented to air pollution control device. Enhanced control technology; increased control efficiency; establish concentration limits; expand source categories (smaller tank, etc.).	Control equipment could generate combustion emissions, e.g., flare/afterburners.
CMB-01	NO <sub>x</sub> Reductions from Non-RECLAIM Ovens, Dryers & Furnaces	Use low-NO <sub>x</sub> burners through retrofit or replacement.	Emission increases from electricity to operate equipment.
CMB-02	Further SO <sub>x</sub> Reductions from RECLAIM	Identifies control approaches for (BARCT) for reduction in SO <sub>x</sub> allocation. SO <sub>x</sub> reduction controls (i.e., sulfur recovery, etc).	Emission increases from electricity to operate equipment. Combustion emissions from heaters.
BCM-01	PM Control Devices (Baghouses, Wet Scrubbers, Electrostatic Precipitators, Other Devices)	Install Continuous Opacity Monitor System or Bag Leak Detection System for top process emitters. Baghouse filter; ventilation/hood systems.	Emission increases from electricity to operate equipment.
BCM-02	PM Emission Hot Spots-Localized Control Program	Supplement the regional approach to address PM hot spots. Fencing; mowing; paving; soil stabilization; street sweeping; housekeeping.	Construction activities to pave roads and parking areas. Increase in water truck emissions. Electricity to operate equipment.
BCM-03	Emission Reductions from Wood Burning Fireplaces & Woodstoves	Voluntary or mandatory wood burning curtailment during poor air quality. Prohibit burning of non-wood fuel (e.g., waste, garbage, etc.).	Construction emissions to replace equipment.
BCM-04	Additional PM Emission Reductions from Rule 444-Open Burning	Reduce PM emissions from open burning. Prohibit burns; alts to burn (shipping, grinding, composting, etc).	Increased emissions to transport agricultural wastes.
BCM-05	Emission Reductions from Under-fired Charbroilers	Stimulate technology for PM emissions from under-fired charbroilers.	Electricity to operate equipment; afterburner combustion emissions.

TABLE 4.1-3 (continued)

Control Measures	Control Measure Description (Pollutant)	Control Methodology	Air Quality Impact
MCS-01	Facility Modernization	Equipment retrofitted or replaced with BACT at the end of a pre-determined lifespan & use of super-compliant materials/process change.	Potential change in VOC and toxic air contaminants. Electricity to operate equipment. Potential ammonia emissions. Construction emissions to replace equipment.
MCS-04	Emissions Reduction from Greenwaste Composting	Develop BMPs for reducing PM10, VOC, & NH3.	Electricity to operate enclosures, biofilters, in-vessel treatment equipment. Increase in construction emissions.
MCS-05	Emission Reductions from Livestock Waste	Air pollution control devices for larger facilities, reductions from smaller facilities (i.e. use of belt/drying system); enclosures; VOC/odor control (i.e. afterburner).	Electricity to operate equipment. Increase in construction emissions. Combustion emissions from drying systems.
EGM-01	Emission Reductions from New or Redevelopment Projects	Mitigate impacts new/redevelop projects. Dust control; alternative fuel; diesel PM filter; low-emitting engines; low VOC coatings; energy conservation; mitigation fee.	Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> . Potential change in all criteria pollutants and toxic air contaminants.
MOB-02	Expanded Exchange Program	Expand lawn mower/leaf blower exchange programs. Low-emitting engines/electrical engines.	Electricity to operate equipment.
MOB-03	Backstop Measure for Indirect Sources of Emissions from Ports & Port-Related Facilities	Address emissions stationary & mobile sources at ports & related facilities. PM filter/catalysts; use of non-diesel equipment (i.e., electrical, fuel cells, LNG, CNG, etc); alternative diesel fuel (i.e. low sulfur, emulsified, etc); hoods, shoreside power (SCR); vessel speed reduction.	Electricity to operate equipment. Afterburner combustion emissions. Potential change in use of VOC and toxic air contaminants. Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> . Potential increase in ammonia emissions. Potential increase in refinery emissions to produce alternative fuels.
<b>MEASURES FOR SOURCES UNDER STATE AND FEDERAL JURISDICTION</b>			
ARB-ONRD-03 SCFUEL-01	CA Phase 3 Reformulation Gasoline Modifications	Offset impacts of ethanol in low level blended gasoline through gasoline reformulation; remove ethanol.	Production of reformulated fuels could increase emissions at refineries. Increase in emissions from haul trucks and construction.

TABLE 4.1-3 (continued)

Control Measures	Control Measure Description (Pollutant)	Control Methodology	Air Quality Impact
<b>MEASURES FOR SOURCES UNDER STATE AND FEDERAL JURISDICTION</b>			
SCFUEL-02	Greater use of Diesel Fuel Alternatives and Diesel Fuel Reformulation	Two-phase approach to achieve additional emissions from diesel fuel engines. Fuel reformulation; diesel alternatives (Fischer-Tropsch, biodiesel, emulsified).	Production of reformulated fuels could increase emissions at refineries. Increase in emissions from haul trucks and construction. Potential change in criteria pollutants (trade-off).
ARB-ONRD-04 SCONRD-03	Cleaner In Use Heavy Duty Vehicles	Accelerate retrofits for vehicles, fleet modernization and enhanced screening and repair, including out-of-state vehicles.	Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> .
ARB-ONRD-05 SCONRD-04	Further Emissions Reductions from Heavy-Duty Trucks Providing Freight Drayage Services	Retrofit or replace existing over-the-road trucks providing drayage services at marine ports, intermodal facilities, or warehouses.	Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> .
ARB-OFFRD-04 SCOFRD-01	Construction/Industrial Equipment Fleet Modernization	New off-road diesel engines meet more stringent emissions standards. Accelerated engine replacement/retrofit/repower; alternative fuels.	Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> .
ARB-OFFRD-05 SCOFRD-06	Accelerated Turnover & Catalyst Based Standards for Pleasure Craft	By 2014 outboard engines and personal watercraft meets Tier 3 standard levels. Accelerated retirement/retrofit engines.	Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> .
ARB-OFFRD-06	More Stringent Exhaust Standards for Off-Road Recreational Vehicles	New emission standards and accelerated fleet turnover are proposed to reduce emissions from this category. Catalyst technology.	Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> .
ARB-OFFRD-02 SCOFRD-03	Further Emission Reductions from Locomotives	Operating in the Basin to meet Tier 3 equivalent emissions by 2014. Accelerated replacement; control technology (SCR, PM filters, hybrid battery engines).	Electricity to operate shore-side control equipment, e.g., SCRs. Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> . Potential increase in ammonia emissions.

TABLE 4.1-3 (continued)

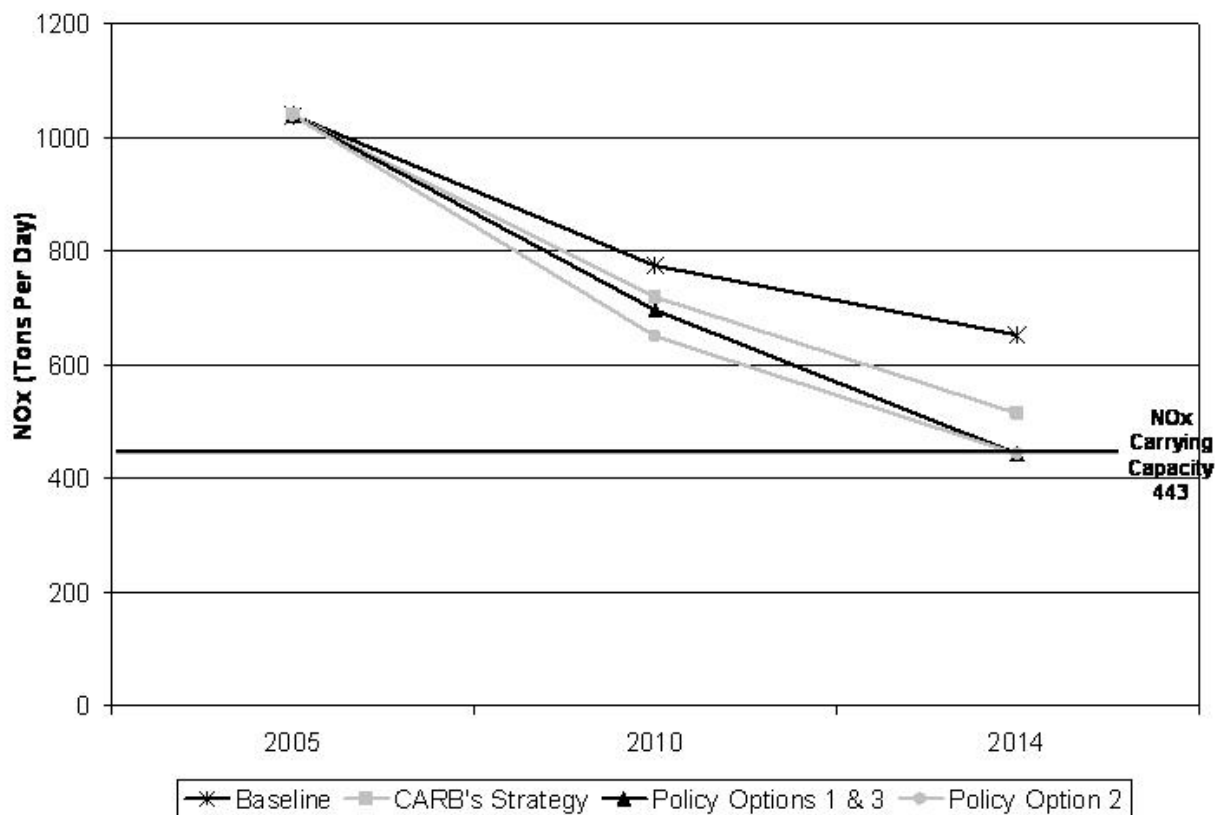
Control Measures	Control Measure Description (Pollutant)	Control Methodology	Air Quality Impact
ARB-OFFRD-01	Auxiliary Ship Engine Cold Ironing and Other Clean Technology. Cleaner Main Ship Engines and Fuel.	Reduce emissions from ships at berth cold ironing (electrical power) and other clean technologies. Further reduce emissions from main engines through added retrofits such as selected catalytic reduction. Accelerate use of cleaner ships and rebuilt engines through tools such as lease restrictions. Require ships to use low sulfur diesel fuel in main engines when operating within 24 nautical miles of shore.	Production of reformulated fuels could increase emissions at refineries. Construction and truck emissions. Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> . Potential increase in ammonia emissions.
ARB-OFFRD-03	Clean Up Existing Commercial Harbor Craft	Require owners of existing commercial harbor craft to replace old engines (both propulsion and auxiliary) with newer cleaner engines and/or add emission control technologies that clean up engine exhaust.	Electricity to operate equipment. Potential for passive filters to emit higher levels of NO <sub>2</sub> . Potential increase in ammonia emissions. Construction emissions.
SCOFFRD-02	Further Emission Reductions from Cargo Handling Equipment	Additional emission reductions from cargo handling equipment beyond the state regulation. Accelerated retirement/retrofit (i.e., catalysts, PM traps, alternative fuel-emulsified diesel).	Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> . Production of reformulated fuels could increase emissions at refineries. Construction emissions.
SCLTM-02	<del>Emission Reductions from Aircraft</del>	<del>Federal government to establish more stringent emissions for aircraft engines. New emission standards; cleaner fuel; emission fees.</del>	<del>Production of reformulated fuels could increase emissions at refineries. Construction emissions.</del>
SCOFFRD-04	Emission Reductions from Airport Ground Support Equipment	Reduce airport ground support equipment emissions primarily through electrification and emission standards.	Electricity to operate equipment.
ARB-CONS-01 SCLTM-03	Further Emission Reductions from Consumer Products	Achieve the maximum technologically & commercially feasible VOC emission reductions from consumer products. Ultra low VOC products.	Potential change in toxic air contaminants from reformulated products.

TABLE 4.1-3 (continued)

Control Measures	Control Measure Description (Pollutant)	Control Methodology	Air Quality Impact
SCOFFRD-05	Emission Reductions from Truck Refrigeration Units	Provide electricity to eliminate use of diesel engines at truck stops.	Electricity generation to operate truck cooling refrigeration.
<b>LONG-TERM (“BLACK BOX MEASURES”)</b>			
SCLTM-02	Further Emission Reductions from Off-Road Mobile Sources	Further Reductions from Off-Road Mobile Sources through 1) accelerated turn-over of existing equipment and vehicles and replacement with new equipment meeting the new engine standards; 2) retrofit of existing vehicles and equipment with add-on controls such as SCR; and 3) develop new engine standards (e.g., aircraft, ships)	Potential decrease in engine efficiency could reduce fuel economy and increase emissions. Potential for passive filters to emit higher levels of NO <sub>2</sub> .
SCLTM-03	Further Emission Reductions from Consumer Products	Implement low-VOC technologies from stationary sources into categories with similar uses in consumer products. Use of lower reactive VOC compounds could achieve equivalent reductions.	Potential change in toxic air contaminants from reformulated products.

Air Action Plan. However, where warranted, a number of measures from these plans have been revised to reflect a higher level of stringency or fleet penetration in order to achieve the necessary reductions for attainment.

Option 2 would likely result in placing CARB’s share of the necessary emission reduction on an accelerated schedule (by 2010 instead of 2014) but would likely occur using the same control strategies included in the 2007 AQMP. Option 3 would include transferring funding from CARB to the SCAQMD to obtain the necessary emission reductions; however, the funds would likely be used to obtain emission reductions using the same strategies as those in the 2007 AQMP. The Rate-of-Progress required under the three options are shown in Figure 4.1-6. The net environmental effects of all three strategies are generally equivalent, although option 2 would obtain emission reductions at a faster rate than options 1 and 3. Therefore, the environmental analyses in the following sections and subchapters would generally apply to any of the three options.



**FIGURE 4.1-6**

**NOx Rate-of-Progress for the Three Policy Options**

**4.1.5.1 Criteria Pollutants – Construction Impacts**

**Dust Suppression**

**PROJECT-SPECIFIC IMPACTS:** Several control measures are aimed at suppressing dust formation during construction including BCM-02 and EGM-01 and implementation of these control measures could result in an increase in water truck trips for dust suppression. Additional truck trips could cause an increase in mobile source emissions of VOC, NOx, CO and PM10. Water trucks are generally supplied water from a site source, thereby, allowing the truck to remain on the site for the duration of the facility operation. Truck emissions are minimal as the truck remains within the boundaries of the construction site or disturbed area site and travels less than one mile a day. The emissions to and from the site are considered negligible as the trucks otherwise would be used to travel to another unrelated site.

**PROJECT-SPECIFIC MITIGATION:** No significant secondary air quality impacts from dust suppression activities have been identified so no mitigation measures are required.

### **Secondary Impacts from Mobile Sources**

**PROJECT-SPECIFIC IMPACTS:** A number of control measures are aimed at controlling emissions from mobile sources by using alternative fuels or reformulated fuels, by using retrofit controls on engines, and by installing or encouraging the use of new engines.

Control measures that require or encourage the use of reformulated diesel fuels, removal of oxygenate from gasoline fuels, lower sulfur marine distillate fuels, and other types of alternative fuels include: MOB-03, ARB-ONRD-03/SCFUEL-01, SCFUEL-02, ARB-OFFRD-01, SCOFFRD-02, and SCLTM-02. These types of control measures may require modifications at refineries to produce reformulated or additional fuels. Cleaner alternative diesel formulations may require additional hydrodesulfurization which would require new or expansion of existing hydrotreaters, hydrogen plants, and sulfur recovery plants. However, the environmental effects of refinery modifications to produce low sulfur diesel fuels have already been addressed as part of the September 2000 amendments to SCAQMD Rule 431.2. The reader is referred to the June 5, 2000, Final Program Environmental Assessment for the Proposed Fleet Vehicle Rules and Related Amendments (SCAQMD 2000). This Final Environmental Assessment concluded that refinery modifications to produce low sulfur diesel would generate significant adverse construction and operation air quality impacts. Further, low sulfur diesel fuels were required to be in general use as of September 1, 2006, and, therefore, are considered to be part of the existing setting.

Ethanol is currently the only approved oxygenate for use in fuels in California. Control measures ARB-ONRD-03/SCFUEL-01 would require reformulation of gasoline to remove ethanol. The control measure would require refinery modifications including added hydrogen capacity, hydrotreating, hydrocracking, and alkylation, while reduced octane requirements would tend to improve refinery efficiency slightly. The refinery modifications are expected to be similar to those modifications made for compliance with the CARB Phase 2 reformulated fuel requirements.

Control measures ARB-OFFRD-01 and SCOFFRD-02 would require reformulation of marine and jet fuels. Similar impacts from refinery modifications are expected to produce lower sulfur marine fuels and lower aromatic jet fuels. It is expected that construction emissions would exceed the SCAQMD significance thresholds. However, the indirect impacts of the reformulated fuels programs have resulted in large emission reductions from mobile sources using the fuels which serve to offset the emission increases from the refineries to a certain extent.

**Regulation of Port and Port-Related Sources:** The governing boards of the Ports of Los Angeles and Long Beach approved the San Pedro Bay Ports Clean Air Action Plan

(CAAP) on November 20, 2006. The CAAP proposes to utilize the authorities of the ports, including powers to establish lease conditions, port rules, tariffs, and incentives, to implement emission control strategies. The CAAP was created as a result of the ports Clean Port Initiatives that also called for the SCAQMD to develop and adopt "backstop" rules that would take effect if the ports did not take actions that, in conjunction with standards adopted by CARB, U.S. EPA, SCAQMD, and the International Maritime Organization (IMO), would achieve sufficient, timely emission reductions. The MOB-03 control measure is the "backstop" for the CAAP.

MOB-03 will implement SCAQMD rules directed at the Ports or operators of port facilities (e.g., marine terminals and railyards). MOB-03 will become effective if the Ports or facilities do not take action sufficient to achieve the standards detailed in the CAAP. MOB-03 will establish enforceable nonattainment pollutant emission reduction goals for the Ports.

The overall impact of the CAAP is beneficial to air quality; however, implementation of some of the control measures in the CAAP will generate secondary impacts to air quality from infrastructure construction, increased electricity usage, and increase production of alternatives fuels. Although the secondary air quality impacts from construction of infrastructure projects can not be quantified from data in the CAAP, it is expected that construction to install the electrical distribution network in the Port of Long Beach will require an intensive effort and is expected to have short-term significant impacts. The construction of an alternative fueling station and centralized maintenance facility on Terminal Island is also expected to require considerable construction, such that short-term significant impacts are anticipated.

### **General Construction Emissions from Control Measures**

While implementing the 2007 AQMP control measures is expected to reduce operational emissions, construction-related activities associated with installing or replacing equipment, for example, are expected to generate emissions from construction worker vehicles, trucks, and construction equipment. Implementation of some of the measures in the 2007 AQMP will require construction of new infrastructure including: (1) additional infrastructure to support alternative-fueled vehicles (electric, hydrogen, natural gas); (2) additional infrastructure to support electrification of new sources (e.g., additional on-road vehicles, marine vessels, and airport ground support equipment); (3) construction of controls at stationary sources (e.g. SCRs, particulate controls, and vapor recovery systems); (4) modifications to refineries to manufacture reformulated fuels; and (5) additional infrastructure at airports.

The inventory prepared for the 2007 AQMP includes emissions estimates associated with construction activities, which are summarized in Table 4.1-4. The inventory prepared for the 2007 AQMP includes estimates of the emission inventory for construction activities in 2002 and 2023. It is assumed that the following types of construction activities to implement AQMP control measures contribute to construction activities emission inventories: (1) additional infrastructure to support electric and alternative fuel vehicles;



(2) additional infrastructure for stationary source controls; and (3) additional infrastructure to support electrification of new sources.

It is expected that 2007 AQMP control measures, in particular emission standards for off-road mobile sources (including construction equipment), contribute to the reduction in combustion emissions from off-road equipment. It is also assumed that implementing the 2007 AQMP control measures contributes to the construction and demolition emissions. The estimated VOC, CO, NO<sub>x</sub>, SO<sub>x</sub>, and PM<sub>2.5</sub> emissions associated with construction and demolition in the district are expected to be reduced between the 2002 and 2023 inventories, resulting in an air quality benefit. The estimated PM<sub>10</sub> emissions associated with construction activities are expected to increase between 2002 and 2023, and exceed the SCAQMD daily PM<sub>10</sub> significance threshold. (see Table 4.1-4). Since a portion of the PM<sub>10</sub> construction air quality impacts are associated with implementing the 2007 AQMP control measures, the PM<sub>10</sub> construction emissions are considered to be significant.

**TABLE 4.1-4**

**Annual Average Construction Emissions by Source Category in the District  
(Tons/Day)**

Source Category	VOC	CO	NO <sub>x</sub>	SO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>
<b>2002 Emission Inventory</b>						
Construction and Demolition	-	-	-	-	39.91	4.0
Off-Road Equipment	86.54	734.79	231.46	1.25	13.66	12.29
Total	86.54	734.79	231.46	1.25	53.57	16.29
<b>2023 Emission Inventory</b>						
Construction and Demolition	-	-	-	-	67.72	6.79
Off-Road Equipment	36.46	723.33	63.97	0.19	3.61	3.03
Total	36.46	723.33	63.97	0.19	71.33	9.82
Emissions Reductions (emissions in 2002 - emissions in 2023)	-50.08	-11.46	-167.49	-1.06	(17.76) <sup>(1)</sup>	-6.47
Pounds per Day	-100,160	-22,920	-334,980	-2,120	(35,520)	-12,940
SCAQMD Significance Thresholds (lbs/day)	75	550	100	150	150	55
Significant?	NO	NO	NO	NO	YES	NO

Source: SCAQMD, Proposed Modifications to the Draft 2007 AQMP, Appendix III

(1) Numbers in parenthesis represent emission increases. Negative numbers denote emission reductions.

The SCAQMD has developed localized significance thresholds (SCAQMD, 2003b). The localized significance thresholds are used to determine whether or not a project may generate significant adverse localized air quality impacts. An analysis of localized air quality impacts, however, is not required at the program EIR because the details of the individual projects to implement the 2007 AQMP are not known at this time. It is

expected that analyses of the localized air quality impacts can be completed when project-specific construction activities are determined.

**PROJECT-SPECIFIC MITIGATION:** Mitigation measures are required to minimize the significant air quality impacts associated with the potential significant construction impacts on air quality. The following feasible mitigation measures are required:

On-Road Mobile Sources:

- AQ-1 Develop a Construction Emission Management Plan for the proposed project. The Plan shall include measures to minimize emissions from vehicles including, but not limited to consolidating truck deliveries, prohibiting truck idling in excess of five minutes, description of truck routing, description of deliveries including hours of delivery, description of entry/exit points, locations of parking, and construction schedule.

Off-Road Mobile Sources:

- AQ-2 Prohibit trucks from idling longer than five minutes at construction sites pursuant to state law.
- AQ-3 Use electricity or alternate fuels for on-site mobile equipment instead of diesel equipment to the extent feasible.
- AQ-4 Maintain construction equipment by conducting regular tune-ups and retard diesel engine timing.
- AQ-5 Use electric welders to avoid emissions from gas or diesel welders at sites where electricity is available.
- AQ-6 Use on-site electricity rather than temporary power generators in portions of the project sites where electricity is available.
- AQ-7 Prior to construction, the project applicant will evaluate the feasibility of retrofitting the large off-road construction equipment that will be operating for significant periods. Retrofit technologies such as selective catalytic reduction, oxidation catalysts, air enhancement technologies, etc., will be evaluated. Such technologies will be required if they are commercially available and can feasibly be retrofitted onto construction equipment.
- AQ-8 Diesel powered construction equipment will be fueled with an emulsified diesel fuel or an alternative diesel fuel throughout construction of the proposed project, if commercially available.

- AQ-9 Suspend the use of all construction activities during first stage smog alerts. This mitigation measure does not apply to emergency activities associated with essential public services.

#### **4.1.5.2 Criteria Pollutants – Operation Impacts**

##### **Secondary Impacts from Increased Electricity Demand**

**PROJECT-SPECIFIC IMPACTS:** Electricity is often used as the power source to operate various components of add-on control equipment, such as electrostatic precipitators, ventilation systems, fan motors, vapor recovery systems, etc. Increased demand for electrical energy may require generation of additional electricity, which in turn could result in increased indirect emissions of criteria pollutants in the district and in other portions of California. The stationary source measures that may result in increased demand for electrical energy due to operation of add-on control equipment are included in Table 4.1-3.

Control measure BCM-01 and BCM-05 calls for emission reductions from PM control devices (e.g., baghouses) and restaurant operations, respectively, which could increase demand for electricity. Other control measures that could result in an increase in electricity use include measures that would require add-on controls or retrofit and replacement of equipment, including CMB-01, CMB-02, MCS-01, MCS-05, ARB-OFFRD-02/SCOFFRD-03, ARB-OFFRD-03, and SCOFFRD-02. The required emissions reduction may be achieved through various types of add-on control equipment such as selective catalytic reduction (SCR) technology or PM Filters. Each of the possible control types may have potential adverse energy impacts because the control technology has electrical demand. The analysis of the effects of energy resources and electricity demand from implementing the 2007 AQMP can be found in Subchapter 4.3 of this EIR.

Several of the control measures would require support facilities and potentially increased use of electricity for off-road vehicles, e.g., ARB-OFFRD-03, SCOFFRD-05, and OFFRD-12. An increase in the use of electric vehicles would require the generation of additional electricity in the district and other areas of California. In addition, shore side electricity may be required associated with “cold ironing” of marine vessels (i.e., use of shore side electricity while at berth, instead of use of auxiliary engines). The potential increase and amount of electricity is unknown.

A number of control measures target emission reductions from transportation measures that would encourage the development of vehicle control technology to meet or exceed ultra-low emission vehicle standards. Such technology would include electric and advance hybrid electric vehicles as a result of advanced battery technology and development of property support infrastructure. The emissions from traditional vehicles would be reduced substantially. The increased demand for electrical energy may require generation of additional electricity, which in turn may result in increased indirect emissions of all criteria pollutants (due to the increase in natural gas combustion used to

generate more electricity). The amount of electricity generated is described in the energy impacts Subchapter 4.3 of this EIR.

Electrification of motor vehicles and other commercial and industrial equipment will greatly reduce fossil fuel usage in the district. At that time, there may be an increase in emissions due to increased electric power generation due to increased demand. The number of electric vehicles is unknown at this time and will need to be calculated during the rule development for these control measures. The SCAQMD will need to compensate for the potential increase in secondary NO<sub>x</sub> emissions, the pollutant of primary concern from electricity generation. While the control measures may cause an increase in NO<sub>x</sub> emissions, overall the 2007 AQMP should achieve net NO<sub>x</sub> emission reductions to attain ambient air quality standards, since combustion emissions from gasoline or diesel engines is higher than combustion emissions from natural gas (use to produce electricity).

An incremental increase in electricity demand is not expected to create significant adverse air quality impacts compared to emission reductions from mobile and stationary sources. However, if electricity demand exceeds available power, additional sources of electricity would be required. Electricity generation within the district is subject to applicable SCAQMD rules such as Rule 1134 – Emissions Oxides of Nitrogen from Stationary Gas Turbines, Rule 1135 – Emissions of Oxides of Nitrogen from Stationary Gas Turbines, and Regulation XX – RECLAIM. These rules and regulations regulate NO<sub>x</sub> emissions (the primary pollutant of concern from combustion to generate electricity) from existing power generating equipment. Both Rule 1135 and Regulation XX establish mass caps on the allowable NO<sub>x</sub> emissions from electric generating facilities. As a result, NO<sub>x</sub> emissions from existing electric generating facilities will not increase substantially, regardless of increased power generation for add-on control equipment or electrification activities.

New power generation equipment would be subject to either Rule 2005 or Regulation XIII. New power generating equipment is not expected to result in air quality impacts because they would be subject to BACT requirements; air quality modeling would be required to demonstrate that new emissions would not result in significant ambient air quality impacts (so there would be no localized impacts), and all emission increases would have to be offset (through either emission reduction credits or RECLAIM trading credits) before permits could be issued. Further, emissions from the combustion of gasoline or diesel fuels are generally the emissions that would be reduced when electrification is proposed and replaced with emissions from the combustion of natural gas (as would generally occur from electricity generating facilities in the district). Emissions from diesel combustion (e.g., marine vessel engines) are orders of magnitude higher than emissions from the combustion of natural gas. So, overall emissions are expected to decrease. No significant adverse impacts to air quality are expected from control measures requiring increased demand for electricity.

There could be an increase in emissions from generators that may be used to charge batteries in remote locations where no grounded power source is available. Generators are regulated sources in the district. Existing SCAQMD regulations that apply to

generators and emergency generators would apply to generators used to charge batteries. New generators would be subject to Regulation XIII or Rule 2005. Existing generators are subject to SCAQMD Rule 1110.2 – Emissions from Gaseous and Liquid Fueled Internal Combustion Engines. Rule 1110.2 does not establish a facility emission cap, but establishes a stringent NOx emission rate. Portable equipment may also be regulated under the state registration program (Rule 2100 – Registration of Portable Equipment), which establishes emission limitations on NOx, VOCs, and CO.

The emissions from electrical generation have been included in the emissions inventory prepared for the 2007 AQMP. Table 4.1-5 summarizes the emissions associated with electric generation in 2002 and 2023.

**TABLE 4.1-5  
Annual Average Operational Emissions for Electric Generation in the District from  
Non-RECLAIM Facilities (tons/day)**

<b>Source Category</b>	<b>VOC</b>	<b>CO</b>	<b>NOx</b>	<b>SOx</b>	<b>PM10</b>	<b>PM2.5</b>
<b>2002 Emissions Inventory</b>						
Electric Utilities	1.72	16.13	1.31	0.45	1.40	1.40
Cogeneration	0.12	0.80	0.06	0.01	0.70	0.70
<b>Total 2002</b>	<b>1.84</b>	<b>16.93</b>	<b>1.37</b>	<b>0.46</b>	<b>2.10</b>	<b>2.10</b>
<b>2023 Emissions Inventory</b>						
Electric Utilities	1.51	14.20	0.79	0.37	1.22	1.22
Cogeneration	0.09	0.67	0.04	0.01	0.05	0.05
<b>Total 2023</b>	<b>1.60</b>	<b>14.87</b>	<b>0.83</b>	<b>0.38</b>	<b>1.27</b>	<b>1.27</b>
Emissions Reductions (emissions in 2002-emissions in 2023) (tons/day)	-0.24	-2.06	-0.54	-0.08	-0.83	-0.83
Pounds per Day	-480	-4,120	-1,080	-160	-1,660	-1,660
SCAQMD Significance Threshold (lbs/day)	75	550	100	150	150	55
Significant?	NO	NO	NO	NO	NO	NO

Source: SCAQMD, Proposed Modifications to the Draft 2007 AQMP, Appendix III

(1) Assumes that overall increase in electricity associated with the AQMP control measures is a one percent increase. (Negative numbers denote emissions reductions)

The inventory prepared for the 2007 AQMP includes estimates for electric utilities and cogeneration facilities in 2002 and 2023. It is assumed that the emissions associated with electrical generation that are part of the AQMP control measures would partially contribute to the emission changes identified in the emission inventories. The inventory also accounts for growth in population. It has been estimated that implementation of all the control measures is expected to result in an overall increase in electricity in 2023 of less than one percent, relative to the projected peak electricity demand in 2023. The

estimated NO<sub>x</sub> and SO<sub>x</sub> emissions due to increased electrical demand associated with implementation of the 2007 AQMP are expected to be reduced between the 2002 and 2023 inventories. The estimated VOC, CO, NO<sub>x</sub>, SO<sub>x</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions are expected to decrease between 2002 and 2023 due to additional controls on electric generating facilities (see Table 4.1-5). Based on Table 4.1-5 and due to the existing regulations that would apply to the generation of electricity in the district, emissions from power generating equipment in the district are not expected to be significant.

The SCAQMD does not regulate electricity generating facilities outside of the district so the rules and regulations discussed above do not apply to electricity generating facilities outside of the district. About 85 percent of the electricity used in California is generated in-state and about 15 percent is imported (see Section 3.2.2). While these electricity generating facilities would not be subject to SCAQMD rules and regulations, they would be subject to the rules and regulations of the local air pollution control district and the U.S. EPA. These agencies also have established New Source Review regulations for new and modified facilities that generally require compliance with BACT or lowest achievable emission reduction technology. Most in-state electricity generating plants use natural gas, which provides a relatively clean source of fuel (as compared to coal- or diesel-fueled plants). The emissions from these power plants would also be controlled by local, state, and federal rules and regulations, minimizing overall air emissions. These rules and regulations may differ from the SCAQMD rules and regulations because the ambient air quality and emission inventories in other air districts are different than those in the district. Compliance with the applicable air quality rules and regulations are expected to minimize emission increases in the other air districts to less than significant.

Electricity in California is also generated by alternative sources that include hydroelectric plants (about 16.5 percent), geothermal energy (about five percent), wind power (one percent), and solar energy (less than one percent) which are clean sources of energy. These sources of electricity generate little, if any, air emissions. Increased use of these and other clean technologies will continue to minimize emissions from the generation of electricity. State law requires increasing use of renewable energy, a minimum of 20 percent by 2010. Further, recently adopted state laws will prohibit using electricity produced by coal-fired plants.

**PROJECT-SPECIFIC MITIGATION:** No significant secondary air quality impacts from increased electricity demand have been identified so no mitigation measures are required.

#### **Secondary Impacts from Control of Stationary Sources**

**PROJECT SPECIFIC IMPACTS:** Emission reductions from the control of emissions at several stationary sources could result in secondary emissions. CMB-02 includes further SO<sub>x</sub> emissions reduction such as reducing the SO<sub>x</sub> allocation for some SO<sub>x</sub> RECLAIM facilities and lowering the allowable sulfur content in liquid fuels. Under the RECLAIM regulations, operators of affected facilities are currently able to choose how to reduce SO<sub>x</sub> emissions. Options to further reduce SO<sub>x</sub> emissions could include addition

of control equipment (wet gas scrubbers or catalyst), process changes to reduce SO<sub>x</sub> formation (e.g., hydrotreaters to improve sulfur recovery), or SO<sub>x</sub> RECLAIM Trading Credits (RTCs). Reworking sulfur recovery processes could result in additional emissions.

FUG-04 would require emission reductions from fugitive emission from pipeline and storage tank degassing. The methods to control fugitive emissions could include additional controls (afterburners or incinerators) enhanced control technology, increased control efficiency, and establishing concentration limits for gases vented to the atmosphere. SCAQMD Rule 1149 could also be amended to include smaller tanks, other source categories, and other degassing operations. MCS-04, and MCS-05 could result in additional stationary source controls. These previously unregulated source categories may use vapor recovery devices, e.g., afterburners, incinerators, or flares, which might also be installed resulting in combustion emissions, including NO<sub>x</sub>, CO, and CO<sub>2</sub> emissions.

While some control measures may cause a small increase in CO and NO<sub>x</sub> emissions, the 2007 AQMP will achieve enough NO<sub>x</sub> reductions overall to attain and maintain ambient air quality standards. The emissions from vapor recovery devices are generally controlled by using efficient combustion practices, so that the secondary impacts from such devices are expected to be less than significant.

Selective catalytic reduction (SCR) has been used to control NO<sub>x</sub> emissions from stationary sources for many years. More recently, it has been applied to mobile sources including trucks, marine vessels, and locomotives. Several of the measures, e.g., EGM-01, could encourage the use of SCR units. Like an oxidation catalyst, SCR promotes chemical reactions in the presence of a catalyst. However, unlike oxidation catalysts, a reductant is added to the exhaust stream in order to convert NO<sub>x</sub> to elemental nitrogen and oxygen in an oxidizing environment. The reductant can be ammonia but in mobile source applications, urea is normally preferred. As exhaust gases along with the reductant pass over the catalyst, 75 to 90 percent of NO<sub>x</sub> emissions, 50 to 90 percent of the VOC emissions, and 30 to 50 percent of the PM<sub>10</sub> emissions are reduced.

There is the potential for secondary particulate formation from ammonia slip in sources that use SCR for control. Anticipating that SCR units would become widespread to comply with the NO<sub>x</sub> control rules under development over 15 years ago, the CEQA documents prepared by the SCAQMD for these new NO<sub>x</sub> control rules evaluated the potential for secondary PM<sub>10</sub> formation from SCR systems. As part of analyses prepared for the EIRs for the NO<sub>x</sub> control rules, the SCAQMD conducted an extensive literature review and contacted a number of SCR manufacturers and vendors. The results of this data collection effort indicated that ammonia slip depends on a variety of factors including space velocity, ammonia to NO<sub>x</sub> molar ratio, temperature, and NO<sub>x</sub> inlet concentration.

The analysis also indicated that, SCRs in use at that time typically had an ammonia slip level ranging from approximately 10-20 ppm. Ammonia slip levels in this range were the

result of the following factors. First, to ensure maximum NO<sub>x</sub> reduction efficiency, SCR operators at that time typically injected excess ammonia, that is, a higher ammonia to NO<sub>x</sub> molar ratio, into the flue gas to ensure achieving the appropriate NO<sub>x</sub> reduction reaction. The excess ammonia that does not react with the NO<sub>x</sub> passes or “slips” through the reactor vessel and is released into the atmosphere. With a decline in catalyst activity, to achieve the same NO<sub>x</sub> reductions, it often became necessary to increase the amount of ammonia injected into the flue gas, which in turn increases ammonia slip. Similarly, the analysis found that one of the main operational problems that contributed to ammonia slip was the uneven distribution of NO<sub>x</sub> in the duct ahead of the catalyst, creating a non-uniform mixture of ammonia and NO<sub>x</sub> over the entire cross-section of the duct and resulting in high levels of ammonia slip. Finally, the early NO<sub>x</sub> control EIRs prepared by the SCAQMD indicated that formation of ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>) could be a problem if temperatures were less than 169° C.

The SCAQMD’s early NO<sub>x</sub> control EIRs concluded that ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>) formation would not be a significant adverse air quality impact if ammonia slip is reduced to 10 ppm or less by maintaining uniform ammonia injection. Ensuring adequate mixing of ammonia in the flue gas can alleviate this problem. Ammonia slip can also be reduced by maintaining the proper ammonia to NO<sub>x</sub> molar ratio, decreasing the exhaust gas flow rate, maintaining consistent exhaust velocity, and maintaining an optimal temperature regime.

The SCR technology has progressed such that ammonia slip can now be limited to five ppm. For example, SCR vendors have developed better injection systems that result in a more even distribution of NO<sub>x</sub> ahead of the catalyst so that the potential for ammonia slip has been reduced. Similarly, ammonia injection rates are more precisely controlled by model control logic units that are a combination of feed-back control and feed forward control using a proportional/integral controller that sets flow rates by predicting SCR outlet ammonia concentrations and calibrating them to a set reference value.

Secondary PM<sub>10</sub> formation related to oxidation of SO<sub>2</sub> to SO<sub>3</sub> in SCR systems also was reviewed more than 15 years ago in conjunction with the adoption of Rule 1135 and other NO<sub>x</sub> control rules. SO<sub>3</sub> is highly reactive, thus, enhancing the formation of secondary particulates. As discussed in the 1989 EIR for Rule 1135, for example, this type of secondary PM<sub>10</sub> formation is affected by the amount of sulfur in the fuel (sulfur can oxidize to SO<sub>2</sub> and subsequently to SO<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), and ammonia. In addition, the SCAQMD’s early EIRs for the NO<sub>x</sub> control rules evaluated the potential for SCR catalysts to enhance the oxidation of SO<sub>2</sub> to SO<sub>3</sub>. SCR units were first used in a wide-scale application on large, coal-fired heaters and boilers in Japan. Coal has inherently high sulfur content and the sulfur can clog and poison the catalyst, reducing catalyst efficiency. When the control efficiency degraded, the operator typically would increase the amount of ammonia injected, in turn increasing the potential for ammonia slip and thus secondary particulate formation. Sulfur particulates are primarily a problem with coal-fired units, of which there are none in the South Coast Air Basin (SCAQMD, 1989). The 1989 EIR for Rule 1135 concluded that catalyst clogging from sulfur particulates would not create a significant adverse air quality impact for units firing



natural gas or low sulfur fuels, such as fuels meeting the sulfur limits in District Rules 431.1 and 431.2 (Final Environmental Assessment for District Rules 431.1 and 431.2, District No. 900504SK). Limiting the problems that cause clogging and poisoning the catalyst, e.g., high sulfur fuels, increasing catalyst efficiency and reducing the amount of ammonia required, reduces the potential for ammonia slip.

Subsequent to the preparation of the early EIRs for the SCAQMD's NO<sub>x</sub> control rules, catalyst research has focused on reducing SO<sub>2</sub> oxidation. Even 15 years ago, SCR vendors reported that SO<sub>2</sub> oxidation of their catalyst was less than one to four percent (SCAQMD, 1990). SO<sub>2</sub> to SO<sub>3</sub> conversion has been reduced by decreasing the amount of active ingredient (typically vanadium pentoxide), adding an active element as a promoter and improving the dispersion of active elements. SCR vendors have indicated that problems with ammonium particulates tend to be minimal if the amount of ammonia slip in the flue gas averages less than 5 to 10 ppm. Particulate problems with ammonium bisulfate (NH<sub>4</sub>HSO<sub>4</sub>), and ammonium sulfate ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>), can be alleviated by reducing ammonia slip (SCAQMD, 1990).

In summary, in the early EIRs for the SCAQMD's NO<sub>x</sub> control rules, e.g., the EIR for Rule 1135, SCAQMD staff determined that the impacts related to secondary PM10 formation would be less than significant if ammonia slip were limited to five to 10 ppm because ammonia would then be a limiting factor in producing secondary particulates. Based on substantial improvements in the SCR control technology, as well as improvements in ammonia monitoring equipment, minimizing ammonia slip to five ppm or less is feasible and is now a standard design parameter for SCR and catalyst manufacturers and secondary particulate emissions from SCR units has ceased to be a potentially significant adverse air quality impact with the standard imposition of ammonia limits less than 10 ppm.

The SCAQMD has permitted numerous SCR systems within the district since the early 1990's and, therefore, has a longstanding practice of imposing permit conditions limiting ammonia slip. The current SCAQMD limit for ammonia slip for new, modified, or relocated equipment is five ppm, thus, minimizing the potential formation of secondary particulates, ammonium nitrate, in particular.

Based on the above, no new or substantially more severe significant air quality impacts related to ammonia emissions and secondary PM10 formation from the increased use of SCR systems is expected. The five ppm ammonia limit will be included as an enforceable permit condition on the SCAQMD permit to construct/operate. Operators will be required to monitor ammonia slip by conducting an annual source test and maintain a continuous monitoring system to accurately indicate the ammonia-to-emitted-NO<sub>x</sub> mole ratio at the inlet of the SCR.

**PROJECT-SPECIFIC MITIGATION:** No significant secondary air quality impacts from control of stationary source have been identified so no mitigation measures are required.

## Secondary Impacts from Change in Use of Lower VOC Materials

**PROJECT-SPECIFIC IMPACTS:** Several control measures are aimed at reducing VOC emissions by reformulating certain products including industrial lubricants (CTS-01), coatings and solvents (CTS-04, MCS-01), and consumer products (ARB-CONS-01 and SCLTM-03). A consumer product is defined as a chemically formulated product used by household and institutional consumers. Consumer products include, but are not limited to: detergents; cleaning compounds; polishes; floor finishes; cosmetics; personal care products such as antiperspirants and hairsprays; home, lawn, and garden products; disinfectants; sanitizers; automotive specialty products; and aerosol paints.

The analysis of secondary emissions from changes in use of lower VOC materials is focused on emissions from reformulated products (lubricants, coatings, solvents and consumer products). To obtain further VOC emissions from these products it is expected that products would be reformulated with water-based or exempt compound formulations. The following subsection identifies potential air quality impacts from lowering the VOC content limit of coating products. Although the following discussions focus primarily on coating products, some of its topics, e.g., substitution, more reactivity, and low vapor pressure, could apply to other types of consumer products.

### More Thickness

**PROJECT SPECIFIC IMPACT:** Reformulated compliant water- and solvent-borne coatings are typically more viscous than similar high VOC products (e.g., are formulated using a high-solids content) and, therefore, may be difficult to handle during application, tending to produce a thick film when applied directly from the can. A thicker film might indicate that a smaller surface area is covered with a given amount of material, thereby increasing VOC emissions per unit of area covered.

**ANALYSIS:** To evaluate this issue in connection with amendments to Rule 1113 – Architectural Coatings, SCAQMD staff evaluated product data sheets for approximately 340 conventional and low-VOC coatings to compare solids content by volume, coverage area, drying time, pot life, shelf life, and durability. Table 4.1-6 is a summary of these coating characteristics grouped by coating categories as defined by Rule 1113. A coating with more solids will actually cover a greater surface area (SCAQMD, 2003). Low-VOC quick-dry enamels; primers, sealers, and undercoatings; quick-dry primers, sealers, and undercoatings; rust preventative coatings; and, stains, on the average, generally have a lower solids content and a lower area of coverage than conventional coatings. Low-VOC nonflats have a solids content and area of coverage comparable to conventional coatings. Low-VOC floor coatings and industrial/maintenance coatings, on the average, have a higher solids content with a comparable to slightly less area of coverage than conventional coatings (SCAQMD, 2003).

These results demonstrate that low-VOC coatings are not necessarily formulated with a higher solids content. Further, a higher solids content does not result in a significant

reduction in the coverage area. The information from the coating product data sheets tends to corroborate a positive correlation between solids content and the coverage area.

A more recent study was completed for CARB that evaluated the effect of volume and type of solids on coverage and hiding for water-based and solvent-based architectural coatings (Censullo, et al., 2004). The study compared four separate classes of water-based and solvent-based coatings: flat, eggshell, gloss, and semigloss. For the coatings tested, the water-based coatings hide better than solvent-based coatings, at equivalent percent non-volatiles by volume. The cause for this observation may be found in the more efficient dispersion of the pigment in the water-based carrier (Censullo, et al., 2004).

**TABLE 4.1-6  
Summary of Coating Characteristics**

Coating Category	# of samples	Range of VOC Content (gm/l)	Average VOC Content (gm/l)	Average % Solids by Volume	Average Coverage (sq ft/gal) @ ~3 mil	Average Drying Time hrs) Between Coats	Average Pot Life* @70 deg. (hrs)	Average Shelf Life (yrs)
Floor Coatings (420-100 g/l)	9	114-420	338	47.5	356	n/a	8.5	2.3
Floor Coatings (100-50 g/l)	13	56 -100	82	54.8	309	n/a	2.2	1.8
Floor Coatings (< 50 g/l)	24	0 - 29	2	79	328	n/a	1.5	1.3
Industrial Maintenance Coatings (420-250 g/l)	47	257-420	354	58.1	352	n/a	6.3	1.6
Industrial Maintenance Coatings (250-100 g/l)	45	101-250	188	55.2	296	n/a	7.4	1.9
Industrial Maintenance Coatings (<100 g/l)	114	0-108	24	82.8	391	n/a	1.4	1.3
Nonflats (250-150 g/l)	26	153-250	215	37.7	382	7.1	n/a	2.2
Nonflats (150-50 g/l)	69	56-150	106	35	346	7.8	n/a	2.7
Nonflats (<50 g/l)	37	0-50	4.4	40.6	385	5.7	n/a	1
Quick Dry Enamels (400-150 g/l)	11	164-400	267	48.3	365	4.9	n/a	1
Quick Dry Enamels (<150 g/l)	4	88-154	120	35.8	407	3.2	n/a	1

**TABLE 4.1-6**

**Summary of Coating Characteristics (Concluded)**

Coating Category	# of samples	Range of VOC Content (gm/l)	Average VOC Content (gm/l)	Average % Solids by Volume	Average Coverage (sq ft/gal) @ ~3 mil	Average Drying Time (hrs) Between Coats	Average Pot Life* @70 deg. (hrs)	Average Shelf Life (yrs)
Primer, Sealer, Undercoater (350-200 g/l)	29	209-350	310	51.4	387	13	7.5	1.7
Primer, Sealer, Undercoater (200-100 g/l)	14	113-206	151.7	42.4	306	5	6	2.4
Primer, Sealer, Undercoater (<100 g/l)	51	0-109	70.6	41.3	346	5.1	2.4	2.1
Quick Dry Primer, Sealer, Undercoater (exempt – 200 g/l)	9	340-560	464	40.4	401	2	7	1.9
Quick Dry Primer, Sealer, Undercoater (200-100 g/l)	6	115-141	124	45.1	353	2.1	n/a	2.7
Quick Dry Primer, Sealer, Undercoater (<100 g/l)	21	0-108	67.7	39.3	370	3.9	n/a	1.1
Water Proofing Wood Sealer (400-250 g/l)	6	282-400	380	13.3	175	n/a	n/a	1.0
Water Proofing Wood Sealer (<250 g/l)	10	0-241	71.2	46.8	214	n/a	4.7	1.4
Stains (350-250 g/l)	4	350	350	49.2	350	18.8	n/a	5.3
Stains (<250 g/l)	23	0-250	116.5	25.7	275	4.2	n/a	4
Rust Preventative Coatings (350-100 g/l)	6	198-350	313	61.1	435	n/a	4	2.7
Rust Preventative Coatings (<100 g/l)	5	0-94	24.8	50	305	n/a	2.5	2.0

\* For two-component coatings only

Table 4.1-7 summarizes the average VOC content and the percent solids for a variety of coatings. The survey does not show any trend of higher solids in lower VOC coatings.

**TABLE 4.1-7**

**Summary of 2005 CARB Survey**

Coating Types	Sales-Weighted Average VOC Regulatory (g/l)			Sales-Weighted % by Volume Solids		
	2001	2005	%change	2001	2005	%change
Bituminous Roof	120	38	69%	59	51	-13%
Bituminous Roof Primer	211	324	54%	55	56	2%
Bond Breakers	244	302	24%	14	18	22%
Clear Brushing Lacquer	667	666	0%	19	19	0%
Concrete Curing Compounds	145	166	14%	22	17	-23%
Dry Fog	258	233	-10%	41	42	1%
Faux Finishing	261	257	-2%	28	29	3%
Fire Resistive	45	124	177%	51	57	13%
Fire Retardant – Clear	4	531	13838%	30	39	29%
Fire Retardant – Opaque	94	325	245%	41	54	33%
Flat	96	82	-15%	36	36	0%
Floor	101	104	4%	60	41	-32%
Form Release Compounds	213	233	9%	67	65	-4%
Graphic Arts	274	350	28%	43	48	11%
High Temperature	401	407	2%	49	43	-12%
Industrial Maintenance	298	209	-30%	58	61	6%
Lacquers	567	456	-20%	23	25	6%
Low Solids	59	60	2%	8	9	14%
Magnesite Cement	443	446	1%	34	33	-3%
Mastic Texture	133	98	-26%	52	52	0%
Metallic Pigmented	409	301	-26%	42	55	31%
Multi-Color	227	103	-55%	22	23	2%
Nonflat – High Gloss	244	156	-36%	42	35	-16%
Nonflat – Low Gloss	129	118	-8%	36	35	-1%
Nonflat – Medium Gloss	171	128	-25%	34	34	-2%
Other	1	65	4601%	35	19	-44%
Pre-Treatment Wash Primer	252	275	9%	31	19	-38%
Primer, Sealer, and Undercoater	155	128	-17%	39	34	-14%

**TABLE 4.1-7 (concluded)**

Coating Types	Sales-Weighted Average VOC Regulatory (g/l)			Sales-Weighted % by Volume Solids		
	2001	2005	%change	2001	2005	%change
Quick Dry Enamel	358	380	6%	51	49	-5%
Quick Dry Primer, Sealer, and Undercoater	364	361	-1%	41	42	2%
Recycled	204	193	-6%	33	41	25%
Roof	68	46	-33%	47	45	-5%
Rust Preventative	339	369	9%	50	51	3%
Sanding Sealers	471	399	-15%	29	30	3%
Shellacs – Clear	600	617	3%	23	21	-9%
Shellacs – Opaque	538	521	-3%	30	31	4%
Specialty Primer, Sealer, and Undercoater	120	281	135%	46	51	13%
Stains – Clear/Semitransparent	349	338	-3%	43	45	4%
Stains – Opaque	180	106	-41%	37	36	-3%
Swimming Pool	274	250	-9%	50	57	15%
Swimming Pool Repair and Maintenance	573	588	3%	34	35	1%
Traffic Marking	116	101	-13%	62	57	-8%
Varnishes – Clear	375	397	6%	39	38	-3%
Varnishes – Semitransparent	431	422	-2%	42	42	0%
Waterproofing Concrete/Masonry Sealers	209	206	-2%	41	50	23%
Waterproofing Sealers	251	187	-26%	38	31	-19%
Wood Preservatives	345	325	-6%	54	57	7%

Source: CARB, 2006

Based upon the results of the SCAQMD and CARB surveys, compliant low-VOC coatings are not necessarily formulated with a higher solids content than conventional coatings. A lower VOC coating is expected to cover the same or larger surface area than a higher VOC coating. Further, there is no evidence that there is an inverse correlation between solids content and coverage area.

### **Illegal Thinning**

**PROJECT SPECIFIC IMPACT:** It has also been asserted that, because reformulated compliant water- and solvent-borne coatings are more viscous (e.g., high-solids content), painters have to adjust the properties of the coatings to make them easier to handle and

apply. In particular for solvent-borne coatings, this adjustment consists of thinning the coating as supplied by the manufacturer by adding solvent to reduce its viscosity. It has been asserted that added solvent increases VOC emissions back to or sometimes above the level of higher VOC formulations.

It has been further asserted that manufacturers will formulate current noncompliant coatings by merely increasing the solids content, which would produce a thicker film. Industry claims that a thicker film means less coverage. Therefore, thinning will occur to get the same coverage area as high VOC coatings resulting in more VOC emissions per area covered. As shown in Table 4.1-7 (see also the "More Thickness" discussion), based upon manufacturer's claims regarding coverage, low-VOC coatings have comparable coverage area compared to conventional coatings. Similarly, low VOC coatings are not necessarily formulated with a high solid content. As a result, the data indicate that it is not true that a painter will have to thin low-VOC solvent-borne coatings to obtain the same coverage.

Many of the reformulated compliant coatings are water-borne formulations or will utilize exempt solvents, thereby eliminating any concerns of thinning the coating as supplied and increasing the VOC content as applied beyond the compliance limit. Since exempted solvents are not considered a reactive VOC, thinning with them would, therefore, not increase VOC emissions. Water based coatings are thinned with water and would also not result in increased VOC emissions.

Extensive research has been conducted prior to 1998 to determine whether or not thinning of materials beyond the allowable levels occurs in the field. The SCAQMD staff has conducted over 100 unannounced site visits to evaluate contractor practices relating to thinning, application, and clean up. During these site visits, samples were collected for coatings actually being utilized, as applied and as supplied, for laboratory analysis and subsequent study of impacts of thinning. Of the 59 samples collected, 36 were waterborne and 23 were solvent-borne. Of the 23 solvent-borne coatings, six represented three sets, which were for the same coating as supplied and as applied. All three sets that were thinned with solvent prior to use were analyzed, with none exceeding the compliance limit. All three sets were Industrial Maintenance Coatings (SCAQMD, 2003).

Phase II of the field study consisted of purchasing and analyzing paint samples from various retail outlets. Since January 1996, 42 samples, consisting of various coating categories, were purchased and analyzed. All of the coatings analyzed were found to be in compliance with the applicable rule limit. Laboratory tests indicated that the reported VOC content on the container was generally higher than the VOC content as tested. The difference in the actual VOC content versus the reported VOC content ranged from five percent to over 60 percent. A trend of listing a maximum VOC content at the actual compliance limit was noted to be the practice. Of the samples purchased, seven were found to be in violation of SCAQMD limits, mostly waterproofing sealers. The SCAQMD believes that part of the reason for these violations is confusion over the

definition of waterproofing sealers, which was clarified as part of the December 2002 amendments to SCAQMD Rule 1113 (SCAQMD, 2003).

The CARB 2005 Architectural Coatings Survey provided results of compliance with the CARB adopted Suggested Control Measure (SCM) for Architectural Coatings. Data from the 2005 survey were analyzed to determine what percentage of coating sales volumes complied with the VOC limits in the SCM (see Table 4.1-8). Approximately 75 percent of the total products sold complied with the applicable VOC limits and about 92 percent of the total sales complied. Complying marketshares from the 2005 survey were compared to the results from the previous 2001 survey. In most cases the percent complying marketshare from the 2005 survey had improved or was approximately the same, when compared to the 2001 survey (CARB, 2006). In 2001, about 54 percent of the total products sold complied with the applicable VOC limits and about 69 percent of the total sales complied (CARB, 2006).

In summary, field investigations of actual painting sites in areas of California that have VOC limits for coatings indicate that thinning of specialty coatings exists but rarely beyond the actual compliance limits. Even in cases where thinning does occur, it is rarer still for paints to be thinned to levels that would exceed applicable VOC content limits. The conclusion is that widespread thinning does not occur often; when it does occur, it is unlikely to occur at a level that would lead to a substantial emissions increase when compared with emissions from higher VOC coatings. It is, therefore, not likely that the proposed control measures would increase this practice.

Thinning is not expected to be a problem because a majority of the coatings that would comply with future limits will be waterborne formulations. This is illustrated by the increase in waterborne coating volumes from the Draft 2001 Survey with a concurrent decrease in solvent based coatings. Other compliant coatings are expected to be available and may be applied without thinning. Even if some thinning occurs, thinning would likely be done with water or exempt solvents. Finally, current practice indicates that coating applicators do not engage in widespread thinning, and even when thinning occurs, the coatings VOC content limits are usually not exceeded. As a result, claims of thinning resulting in significant adverse air quality impacts are unfounded.

### **More Priming**

**PROJECT SPECIFIC IMPACT:** Conventional coatings are currently used as part of a three, four, or five part coating system, consisting of one or more of the following components; primer, midcoat, and topcoat. Coating manufacturers and coating contractors have asserted that reformulated compliant low-VOC water- and solvent-borne topcoats do not adhere as well as higher-VOC solvent-borne topcoats to unprimed substrates. Therefore, the substrates must be primed with typical solvent-borne primers to enhance the adherence quality. It has been asserted that the use of water-borne compliant topcoats, could require more priming to promote adhesion. Additionally, it has been asserted that water-borne sealers do not penetrate and seal porous substrates like wood, as well as traditional solvent-borne sealers. This allegedly results in three or four



**TABLE 4.1-8**  
**Compliance with Suggested Control Measure Limits for Architectural Coatings<sup>(1)</sup>**

<b>Coating Category</b>	<b>VOC Limit (g/l)</b>	<b>SWA<sup>(2)</sup> VOC Reg. (g/l)</b>	<b>Total No. of Products</b>	<b>No. of Complying Products</b>	<b>Percent of Complying Products</b>
Bituminous Roof	300	37	81	77	95
Bituminous Roof Primer	350	324	31	15	48
Bond Breakers	350	302	13	9	69
Clear Brushing Lacquer	680	666	4	4	100
Concrete Curing Compounds	350	166	115	103	90
Driveway Sealer	100	3	45	41	91
Dry Fog	400	235	70	70	100
Faux Finishing	350	204	273	261	96
Fire Resistive	350	124	7	6	86
Fire Retardant – Clear	650	531	4	4	100
Fire Retardant – Opaque	350	325	11	11	100
Flat	100	81	2438	2,131	87
Floor	250	104	411	321	78
Form Release Compounds	250	233	39	34	87
Graphic Arts	500	314	91	91	100
High Temperature	420	366	81	57	70
Industrial Maintenance	250	208	2958	1,606	54
Lacquers	550	458	724	418	58
Low Solids	120	60	32	32	100
Magnesite Cement	450	446	16	16	100
Mastic Texture	300	98	78	76	97
Metallic Pigmented	500	300	190	184	97
Multi-Color	250	94	12	9	75
Nonflat-High Gloss	250	153	315	195	62
Nonflat-Low Gloss	150	118	1,106	1,056	95
Nonflat-Medium Gloss	150	127	1,956	1,727	88
Other	100	64	44	19	43
Pre-Treatment Wash Primer	420	167	5	3	60
Primer, Sealer, and Undercoater	200	127	664	541	81
Quick Dry Enamel	250	380	120	46	38
Quick Dry Primer, Sealer and Undercoater	200	356	33	6	18
Recycled	250	193	7	7	100
Roof	250	46	210	193	92
Rust Preventative	400	362	372	286	77
Sanding Sealers	350	203	30	13	43
Shellacs-Clear	730	617	8	8	100
Shellacs-Opaque	550	521	2	2	100
Specialty Primer, Sealer, and Undercoater	350	280	89	76	85

**TABLE 4.1-8 (Concluded)**

<b>Coating Category</b>	<b>VOC Limit (g/l)</b>	<b>SWA<sup>(2)</sup> VOC Reg. (g/l)</b>	<b>Total No. of Products</b>	<b>No. of Complying Products</b>	<b>Percent of Complying Products</b>
Stains-Clear/Semitransparent	250	279	767	309	40
Stains-Opaque	250	106	423	327	77
Swimming Pool	340	250	34	27	79
Swimming Pool Repair and Maintenance	340	588	3	0	0
Traffic Marking	150	101	245	214	87
Varnishes-Clear	350	308	408	215	53
Varnishes-Semitransparent	350	292	44	20	45
Waterproofing Concrete/Masonry Sealers	400	204	271	250	92
Waterproofing Sealers	250	187	189	131	69
Wood Preservatives	350	325	29	26	90
<b>Totals</b>			<b>15,098</b>	<b>11,273</b>	<b>75%</b>

1 Source: CARB, 2006

2 SWA = sales weighted average

coats of the sealer per application, compared to one coat for a solvent-borne sealer that would be necessary, resulting in an overall increase in VOC emissions for the coating system.

Regarding surface preparation, SCAQMD staff evaluated this characteristic as part of the evaluation of coating product data sheets mentioned above and recent studies conducted. Information from the coating product data sheets indicated that low-VOC coatings do not require substantially different surface preparation than conventional coatings. According to the product data sheets, conventional and low-VOC coatings require similar measures for preparation of the surface (i.e. apply to clean, dry surfaces), and application of the coatings (i.e. brush, roller or spray). Both low-VOC coatings and conventional coatings for both architectural and industrial maintenance applications have demonstrated the ability to adhere to a variety of surfaces. As a part of the technology assessment, staff analyzed the product data sheets for a variety of low-VOC primers, including stain-blocking primers, primers that adhere to alkyds, and primers that have equal coverage to conventional solvent-borne primers, sealers, and undercoaters.

Low-VOC coatings do not tend to require any special surface preparation different from what is required before applying conventional coatings to a substrate. As part of good painting practices for any coating, water-borne or solvent-borne, the surface typically needs to be clean and dry for effective adhesion. These conclusions are supported by the University Missouri-Rolla (UMR), National Technical Systems (NTS) and other coating studies.

As a result, based on the coating manufacturer's coating product data sheets, the material needed and time necessary to prepare a surface for coating is approximately equivalent for conventional and low-VOC coatings. More primers are not needed because low-VOC coatings possess comparable coverage to conventional coatings, similar adhesion qualities and are consistently resistance to stains, chemicals and corrosion. Low-VOC coatings tend not to require any special surface preparation different from what is required before applying conventional coatings to a substrate. As part of good painting practices for any coating, water-borne or solvent-borne, the surface typically needs to be clean and dry for effective adhesion. Consequently, claims of significant adverse air quality impacts resulting from more priming are unfounded.

### **More Topcoats**

**PROJECT-SPECIFIC IMPACTS:** Another issue raised in the past relative to low VOC coatings is the assertion that reformulated compliant water- and low-VOC solvent-borne topcoats may not cover, build, or flow-and-level as well as the solvent-borne formulations. Therefore, more coats are necessary to achieve equivalent cover and coating build-up.

Technology breakthroughs with additives used in recent formulations of low-VOC coatings have minimized or completely eliminated flow and leveling problems. These flow and leveling agents mitigate flow problems on a variety of substrates, including plastic, glass, concrete and resinous wood. These additives even assist in overcoming flow and leveling problems when coating oily or contaminated substrates. According to the product data sheets for the sampled coatings, water-borne coatings have proven durability qualities. Comparable to conventional coatings, water-borne coatings for architectural applications are resistant to scrubbing, stains, blocking and UV exposure. Coating manufacturers, such as Dunn-Edwards, ICI, Pittsburgh Paints and Sherwin Williams, formulate low-VOC nonflat coatings (<150 g/l) with high build and excellent scrubability. Most of the coatings are mildew resistant and demonstrate excellent washability characteristics. The coverage of the coatings average around 400 square feet per gallon, which is equivalent to the coverage of the conventional nonflat coatings. Con-Lux, Griggs Paint and Spectra-Tone also formulate even lower VOC (<50 g/l) coatings that also demonstrate excellent durability, washability, scrubability and excellent hide. The coverage is again equivalent to the conventional coatings around 400 square foot per gallon. As already noted in the "More Thickness" discussion, low-VOC coatings that have a high solids content have equivalent or slightly superior coverage compared to high VOC coatings.

According to the coating manufacturer's product data sheets, water-borne coatings for IM applications are resistant to chemicals, corrosion, chalk and abrasion. Both water-based and low-VOC solvent-based IM coating formulations have passed abrasion and impact resistance tests, such as ASTM test methods D4060 and G14, respectively. Similar to their conventional counterparts, water-borne IM coatings also tend to retain gloss and color, as well as have good adhesion to a variety of substrates. A majority of the low-VOC (<100 g/l) IM coatings passed adhesion tests, such as ASTM test methods D4541,

D3359-78, D2197 or D412. Low-VOC IM coatings tend to have comparable coverage (approximately 300 square feet per gallon) to conventional IM coatings.

Manufacturers and current users of water-borne automotive coatings have indicated that coverage is superior to that of solvent-borne coatings and do not require the application of additional coats to achieve the necessary coverage (CARB, 2005).

Both low-VOC and conventional coatings have comparable coverage and superior performance. These low-VOC coatings possess scrub and stain resistant qualities, blocking and resistance to UV exposure for the exterior coatings. Both low-VOC and conventional IM coatings tend to have chemical and abrasion resistant qualities, gloss and color retention, and comparable adhesion qualities. These conclusions are supported by the UMR, NTS and other coating studies. With comparable coverage and equivalent durability qualities, additional topcoats for low-VOC coatings should not be required.

Both low-VOC and conventional coatings have comparable coverage and superior performance. These low-VOC coatings possess scrub and stain resistant qualities, blocking and resistance to ultraviolet (UV) exposure for the exterior coatings. Both low-VOC and conventional IM coatings tend to have chemical and abrasion resistant qualities, gloss and color retention, and comparable adhesion qualities. With comparable coverage and equivalent durability qualities, additional topcoats for low-VOC coatings should not be required.

### **More Touch-Ups and Repair Work**

**PROJECT-SPECIFIC IMPACTS:** Another potential issue related to low VOC coatings is the assertion that reformulated compliant water- and low-VOC solvent-borne formulations dry slowly, and are susceptible to damage such as sagging, wrinkling, alligatoring, or becoming scraped and scratched. It is also claimed that the high-solids solvent-borne alkyd enamels tend to yellow in dark areas, that water-borne coatings tend to blister or peel, and also result in severe blocking problems. As a result, additional coatings for repair and touch-up would be necessary.

Extra touch-up and repair and more frequent coating applications are related to durability characteristics of coatings. Based on information in the coating product data sheets, comparable to conventional coatings, water-borne coatings for architectural applications are resistant to scrubbing, staining, blocking and UV exposure. They were noted for excellent scrubability and resistance to mildew. The average drying time between coats for the low-VOC coatings (<150 g/l) was less than the average drying time for the conventional coatings (250 g/l). The average drying time for the lower-VOC coatings (<50 g/l) did increase compared to the conventional coatings. However, with the development of non-volatile, reactive diluents combined with hypersurfactants, performance of these nearly zero-VOC coatings has equaled, and for some characteristics, outperformed traditional, solvent containing coatings (SCAQMD, 2003).

Water-borne coatings for industrial/maintenance applications are resistant to chemicals, corrosion, chalk, impact and abrasion. Similar to their conventional counterparts, water-

borne industrial/maintenance coatings also tend to retain gloss and color, as well as have good adhesion to a variety of substrates. Further, both low-VOC coatings and conventional coatings tend to be comparable with regards to passing abrasion and impact resistance tests, and are considered to have proven durability qualities. Some industrial/maintenance low-VOC epoxy and urethane systems perform significantly better than their alkyd-based counterparts (SCAQMD 2003).

Therefore, based on the durability characteristics information contained in the coating product data sheets, low-VOC coatings and conventional coatings have comparable durability characteristics. These conclusions are supported by the UMR, NTS and other coating studies. As a result, it is not anticipated that more touch up and repair work will need to be conducted with usage of low-VOC coatings. Consequently, claims of significant adverse air quality impacts resulting from touch-up and repair for low-VOC coatings are unfounded.

### **More Frequent Recoating**

**PROJECT-SPECIFIC IMPACT:** An issue raised in past rulemaking is the assertion that the durability of the reformulated compliant water- and low-VOC solvent-borne coatings is inferior to the durability of the traditional solvent-borne coatings. Durability problems include cracking, peeling, excessive chalking, and color fading, which all typically result in more frequent recoating. As a result, it is possible more frequent recoating would be necessary resulting in greater total emissions than would be the case for conventional coatings.

The durability of a coating is dependent on many factors, including surface preparation, application technique, substrate coated, and exposure conditions. Again, as mentioned above, key durability characteristics, as discussed in coating product data sheets, include resistance to scrub or abrasion, corrosion-, chemicals-, impact-, stain-, and UV-resistance, are similar between conventional and low-VOC coatings. Both coating types pass abrasion and impact resistance tests, and have similar durability qualities. According to the coating product data sheets, low-VOC coatings reportedly would not need additional surface preparation than what needs to be done to prime the surface for conventional coatings (see also “More Priming” discussion above). The technique to applying the coatings did not significantly differ either. It is expected that if applied using manufacturers’ recommendations, compliant low-VOC coatings should be as durable as conventional coatings and, therefore, no additional recoating is required from the usage of low-VOC coatings. Furthermore, overall durability is dependent on the resin used in the formulation as well as the quality of pigment, instead of just the VOC content of the coating.

The durability of a coating is governed by the nature of the binders used in its formulation, which are also known as film formers or resins. Table 4.1-9 shows the two main resin types currently in use. Acrylic resins are generally associated with low VOC coatings and alkyd resins are typically associated with high VOC coatings. These coatings are exposed to a variety of influences of daily life, including mechanical

stresses, chemicals and weathering, against which they serve to protect the substrate. The major impact on the coating film is oxidation by exposure to light, causing the film to first lose color and gloss, and gradually become brittle and incoherent. This is mainly caused by a process known as photochemical degradation. This is especially the case for coatings used for exterior painting.

The coatings industry has developed a variety of additives that act as UV light absorbers or free radical scavengers that ultimately slow down the photo-oxidative process, thereby increasing the coating life. Antioxidants and sterically hindered amines are two classes of free radical scavengers, also known as hindered amine light stabilizers (HALS). These can be used with solvent-free or waterborne coatings. Other additives that have positive effects on durability of coatings include adhesion promoters, corrosion inhibitors, curing agents, reactive diluents, optical brighteners, and algicides/mildewcides.

**TABLE 4.1-9**

**Performance Comparison of Acrylic (Low VOC) and Alkyd (High VOC) Resin Systems**

<b>Acrylic Coatings</b>	<b>Alkyd Coatings</b>
Low-VOC and solvent-free formulations available	Higher VOC formulations
Excellent exterior durability because of high degree of resistance to thermal, photooxidation, and hydrolysis – Pendant groups are ester bonds, but body is C-C bonds, which are much harder to break.	Limited exterior durability because prone to hydrolysis.
Very good color and gloss retention, and resistance to embrittlement	Embrittlement and discoloration issues with age
Require good surface preparation. Since the surface tension is high, the substrate surface needs to be cleaner before application	Minimal surface preparation requirements due to low surface tension. Relatively foolproof applications
Acrylic coatings are generally higher in cost	Lower costs
Polyurethane modified acrylics perform even better, especially in flexibility	Rapid drying, good adhesion, and mar resistance. Silicone modified alkyds have higher performance

There are numerous types of binders used in the formulation of coatings. However for architectural uses, acrylics dominate the market whereas alkyds are used for some niche products only. Table 4.1-9, extracted from material provided as part of the Durability and Performance of Coatings seminar held by Eastern Michigan University, describes some typical characteristics of the two main resin types and highlights strengths and weaknesses of each resin type. But, clearly Table 4.1-9 emphasizes the superior durability of acrylic coatings. Utilizing the additives available for improving application and durability characteristics, waterborne acrylic systems have overcome their limitations, and generally outperform solvent-borne coatings, when properly formulated.

Coatings manufacturers' own data sheets indicate that the low-VOC coatings for both architectural and industrial maintenance applications are durable and long lasting. Any durability problems experienced by the low-VOC coatings are not different than those

seen with conventional coatings. Recent coating technology has improved the durability of new coatings. Because the durability qualities of the low-VOC coatings are comparable to the conventional coatings, more frequent recoatings would not be necessary.

### **Substitution**

**PROJECT-SPECIFIC IMPACT:** Substitution is the assertion that since reformulated compliant water- and low-VOC solvent-borne coatings are inferior in durability and are more difficult to apply, consumers and contractors will substitute better performing high VOC coatings in other categories for use in categories with low compliance limits. An example of this substitution could be the use of a rust preventative coating, which has a higher VOC content limit requirement, in place of an industrial/maintenance coating or a nonflat coating.

There are several reasons why widespread substitution is not expected to occur. First and foremost, based on staff research of resin manufacturers' and coating formulators' product data sheets as well as studies conducted, there are, generally, a substantial number of low-VOC coatings in a wide variety of coating categories that are currently available, that have performance characteristics comparable to conventional coatings. Second, CARB and SCAQMD rules prohibit the application of certain coatings in specific settings. For example, industrial maintenance coatings cannot be used in residential, commercial, or institutional setting. Third, the type of performance (e.g., durability) desired in some settings would prohibit the use of certain coatings. For example, in an industrial/maintenance setting a coating with a life of 10 years or more is typically desired due to the harshness of the environment. Therefore, it is unlikely that an alkyd-based rust preventative coating with a typical life of five years would be used in place of an industrial/maintenance coating. Thus, it is highly unlikely that coating applicators will violate future coatings rules by substituting higher-VOC coatings for lower-VOC coatings.

As discussed above, it is not expected that low-VOC coatings used for specific coating applications will be substituted by higher-VOC coatings used for other specific types of coating applications. Currently, there are a substantial number of low-VOC coatings in a wide variety of coating categories that have performance characteristics comparable to conventional coatings. Moreover, the type of performance desired in some settings would prohibit the use of certain coatings in those settings. Finally, manufacturers market coatings (especially automotive coatings) as a system and will not warranty the products' performance if the user deviates from the recommended usage.

If in the rare event that substitution does occur, it is expected that future coatings would still achieve overall VOC emission reductions. Substitution would only result in lesser emission reductions than expected, it would not increase emissions as compared to the existing setting. Consequently, it is not expected that control measures requiring a lower overall VOC content of coatings will result in significant adverse air quality impacts from the substitution of low-VOC coatings with higher-VOC coatings.

### **More Reactivity**

Different types of solvents have different degrees of "reactivity," which is the ability to accelerate the formation of ground-level ozone. Coating manufacturers and coating contractors assert that the reformulated compliant low-VOC water- and solvent-borne coatings contain solvents that are more reactive than the solvents used in conventional coating formulations. Furthermore, water-borne coatings perform best under warm, dry weather conditions, and are typically recommended for use between May and October. Since ozone formation is also dependent on the meteorological conditions, use of waterborne coatings during this period increases the formation of ozone.

The use of reactivity as a regulatory tool has been debated at the local, state, and national level for over 25 years. For example, CARB incorporated a reactivity-based control strategy into its California Clean Fuel/Low Emissions Vehicle regulations, where reactivity adjustment factors are employed to place regulations of exhaust emissions from vehicles using alternative fuels on an equal ozone impact basis. CARB has also approved reactivity-based regulations for aerosol coatings. CARB is evaluating a similar strategy for consumer products and industrial emissions, and contracted with Dr. William Carter, University of California at Riverside, Center for Environmental Research and Technology, College of Engineering, for several studies to assess the reactivities of VOC species found in the consumer products emissions inventory. The studies have been aimed at determining the specific VOC speciation for products, and developing more accurate data on compounds commonly found in either water borne coatings, solvent-borne coatings, or both (e.g., glycol ethers, esters, isopropyl alcohol, methyl ethyl ketone (MEK), and an octanol.

As an active member of the Reactivity Research Working Group (RRWG), a public-private partnership with a charter to conduct research on reactivity-based controls to determine whether it is feasible as an alternative compliance option, staff has coordinated their current efforts with CARB and RRWG. The RRWG's efforts to date have found that different VOC species have varying reactive properties to form ozone under the same NO<sub>x</sub> environment. However, RRWG's efforts have also highlighted the need for additional work needed to reduce the uncertainty associated with the reactivity values determined using an environmental chamber, especially for the most commonly used solvents in architectural coatings formulations, and their impacts relative to impacts of mobile source emissions. The overall goal is to assess the feasibility of this optional strategy that could potentially allow manufacturers to use greater quantities of less reactive solvents, and reduce the quantity of higher reactive solvents to achieve the same level of ozone reductions, as those achieved through mass reduction. The environmental chambers previously used to develop the existing models had a number of limitations, particularly for evaluating effects on some VOC species. Because of this, in 1998, the U.S. EPA provided \$3 million funding to the College of Engineering Center for Environmental Research and Technology (CE-CERT) at the University of California at Riverside (UCR) for the design, construction and operation of a state-of-the-art, next-generation environmental chamber facility capable of obtaining the data needed for



assessing the use of reactivity data as an alternative ozone control strategy to the established mass reduction method (Carter et al, 1999; Carter, 2002a). This chamber was completed in 2003 and successfully employed to evaluate mechanisms for photochemical O<sub>3</sub> formation under low NO<sub>x</sub> conditions (Carter 2004) and for other projects.

CARB, along with the SCAQMD, contracted CE-CERT to utilize the new chamber to improve reactivity assessments of some solvent species, with each group funding the evaluation of certain VOC species most commonly used in architectural coatings. Due to limited funding available to both agencies, CARB funded a subset of VOCs most commonly used in solvent-based coating formulations as well as Texanol®, whereas the SCAQMD funding was used exclusively for the most common VOC species used in waterborne formulations.

The CARB project involved conducting ozone reactivity experiments on seven different types of coatings VOCs, which were to be determined in consultation with the CARB staff and the CARB's Reactivity Research Advisory Committee (RRAC). As is the case with the RRWG, the RRAC consists of representatives of industry and regulatory groups, including the SCAQMD. The compounds chosen for study for that project included Texanol®<sup>1</sup>, an important compound in water-based coatings, and six different types of petroleum distillates that are utilized in solvent-based and (to a lesser extent) water-based coatings. A report on the CARB study has recently been completed (Carter and Malkina, 2005). The results of the study yielded useful information concerning the atmospheric ozone impacts of these compounds and the ability of the current SAPRC-99 detailed chemical mechanism (Carter, 2000a) to accurately simulate these impacts (Carter and Malkina, 2005).

In addition to the verifying the reactivity data for solvents found in waterborne coatings, the SCAQMD study also evaluated the issue of availability of low volatility or highly hydrophilic solvents to react in the gas phase and promote ozone formation is another area of potential concern when assessing ozone impacts of VOCs. If these compounds tend to be absorbed to any significant extent on surfaces or PM before they have a chance to react in the gas phase, then their actual impact on ozone formation would be less than predicted using gas-phase mechanisms in current models. In 1999, the RRWG identified the need for this type of assessment but has funded research focusing on modeling. The SCAQMD study is the first actual environmental chamber experiments for assessing availability of the VOC species and evaluating model predictions of availability. Furthermore, the SCAQMD study included an objective to assess the PM formation potential of all the solvents studied for the CARB and SCAQMD projects. The specific objectives and work carried out for this project are described below.

- Conduct environmental chamber experiments for reactivity assessment and chemical mechanism evaluation for several types of coatings or solvent VOCs selected by the SCAQMD in conjunction with discussions with the CE-CERT

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<sup>1</sup> Texanol is a registered trademark of Eastman Chemical Company. It is used throughout this report rather than the generic chemical name for simplicity.

investigators and RRAC. The compounds chosen for study were propylene and ethylene glycols, diethylene glycol n-butyl ether (2-(2-Butoxyethoxy)-ethanol, or dipropylene glycol butyl ether, DGBE), and benzyl alcohol. The two glycols were considered not to have uncertain mechanisms but were studied because of their extreme importance in the emissions inventories. DGBE was studied because it is also important in the water-based coatings inventory and has not been experimentally studied previously. Benzyl alcohol was studied because it is also emitted to some extent and had extremely high chemical mechanism uncertainty.

- Conduct measurements of PM formation in reactivity assessment and mechanism evaluation experiments not only for this project but also for the experiments carried out for the CARB coatings reactivity project. The data obtained can then be used to evaluate, at least in a qualitative sense, the PM formation potentials of the types of VOCs studied, and be available for potentially developing and evaluating models for their impacts on PM formation in the atmosphere.
- Carry out a limited number of experiments to characterize background effects related to PM formation that can be used when interpreting or modeling the PM formation in the chamber experiments discussed above, and that can serve as a basis for designing future PM studies in this chamber.
- Evaluate the potential utility of the environmental chamber for testing models for availability of emitted VOCs to react in the atmosphere to form O<sub>3</sub> and secondary PM. After discussion with members of the atmospheric availability subgroup of the RRWG it was decided to focus on conducting several experiments to assess the effects of humidity and seed aerosol on availability, decay rates and reactivities of ethylene and propylene glycol.

Results of reactivity studies are summarized in Table 4.1-10.

**TABLE 4.1-10**

**Summary of Solvents Studied in the Environmental Chamber Experiments and the Conclusions from the Results**

Compound or Mixture	Estimated MIR <sup>(a)</sup>		PM Impact or Approximate SOA Yields <sup>(b)</sup>	Discussion of Mechanism Evaluation Results <sup>(c)</sup>
	Previous	Revised		
<b>Water Based Coatings VOCs</b>				
Ethylene Glycol	3.36	3.63	Lower PM than base case	The glycolaldehyde product now represented explicitly. This mechanism still underpredicts glycol reactivity by 25-30% in experiments with aromatics in the base ROG surrogate, but there is no chemical justification for glycol mechanism adjustments

TABLE 4.1-10 (cont.)

**Summary of Solvents Studied in the Environmental Chamber Experiments and the Conclusions from the Results**

Compound or Mixture	Estimated MIR <sup>(a)</sup>		PM Impact or Approximate SOA Yields <sup>(b)</sup>	Discussion of Mechanism Evaluation Results <sup>(c)</sup>
	Previous	Revised		
Propylene Glycol	2.74	No change	Lower PM than base case	This mechanism underpredicts glycol reactivity by ~20% in experiments with aromatics in the base ROG surrogate, but there is no chemical justification for glycol mechanism adjustments
Texanol® (Isobutyrate monoesters of 2,2,4-trimethyl-1,3-pentanediol) <sup>(d)</sup>	0.88	No change	No net effect on PM formed evident	Experimental results for Texanol® and DGBE generally consistent with chamber data.
2-(2-butoxyethoxy)-ethanol (DGBE)	2.86	No change	14 - 26%	The OH radical rate constants found to be in good agreement with the estimated values used in the mechanism.
Benzyl Alcohol	None	4.89	~30%	Mechanism developed for this project and adjusted to fit the chamber data. Mechanism performance comparable to that for other aromatic compounds.
<b>Hydrocarbon Solvents Studied for CARB Project<sup>(e)</sup></b>				
VMP Naphtha, Primarily C <sub>7</sub> -C <sub>9</sub> mixed alkanes	1.41	1.35	0.1 - 0.7%	The experimental results for the primarily alkane, petroleum distillate-derived hydrocarbon solvents were generally consistent with the chamber data.
Dearomatized Mixed Alkanes, Primarily C <sub>10</sub> -C <sub>12</sub> (ASTM-1C)	0.91	0.96	~0.2%	

TABLE 4.1-10 (cont.)

Compound or Mixture	Estimated MIR <sup>(a)</sup>		PM Impact or Approximate SOA Yields <sup>(b)</sup>	Discussion of Mechanism Evaluation Results <sup>(c)</sup>
	Previous	Revised		
Reduced Aromatics Mineral Spirits, Primarily C <sub>10</sub> -C <sub>12</sub> mixed alkanes with 6% aromatics (ASTM-1B)	1.21	1.26	0.6 - 0.7%	
Regular mineral spirits, Primarily C <sub>10</sub> -C <sub>12</sub> mixed alkanes with 19% aromatics (ASTM-1A)	1.82	1.97	0.3 - 0.8%	The experimental results were generally consistent with the chamber data.
Synthetic isoparaffinic alkanes, primarily C <sub>10</sub> -C <sub>12</sub> branched alkanes (ASTM-3C1)	0.81	1.1 - 1.5 [f]	No net effect on PM formed evident	Data not well simulated by the model. Model probably underpredicts atmospheric ozone formation by 25-75%, depending on the cause of the discrepancy.
Aromatic 100 (Primarily C <sub>9</sub> -C <sub>10</sub> alkylbenzenes)	7.51	7.70	0.3 - 0.4%	Experimental results representing MIR conditions generally consistent with model predictions. But model underpredicted O <sub>3</sub> inhibition in low NO <sub>x</sub> conditions and has other problems.

[a] Maximum incremental reactivity in gm O<sub>3</sub> per gm VOC. Calculated as described by Carter (1994a,b). Values in "Previous" column are the MIR values incorporated in CARB regulations. The values for the compounds were from the most recent complete MIR tabulation given by Carter (1003). The values for the hydrocarbon solvents were derived using the CARB Bin assignments developed by Kwok et al (2000). No mechanism or MIR value previously existed for benzyl alcohol. Values in the "Revised" column are the best estimate MIRs based on the results of the current study. The changes in MIRs that may result when the mechanism is updated are unknown.

[b] For compounds with measurable positive PM impacts, the secondary organic aerosol (SOA) yields were derived from differences between PM volume levels in the base case and added test compound incremental reactivity experiments after 5 hours of irradiation. These approximate yields were estimated based on assuming same molecular weight for SOA as the starting material, assuming that the PM formed has the same density as water, and using approximate corrections for PM wall losses and approximate estimates of amounts of test compound or hydrocarbon solvent constituents reacted.

[c] Ozone prediction evaluation results are applicable to the SAPRC-99 mechanism (Carter, 2000a).

[d] Texanol was studied for the CARB project; see Carter and Malkina (2005) for details. Texanol is a registered trademark of Eastman Chemical Company.

- [e] See Carter and Malkina (2005) for a discussion of the experimental and calculated data for the hydrocarbon solvent reactivities. The ASTM designations are based on the D 235-02 specification (ASTM, 2003).
- [f] Range of MIRs for alternative mechanisms adjusted to fit the chamber data with this solvent. The available data are inadequate to distinguish between these mechanisms. See Carter and Malkina (2005).

The conclusion reached by the study indicates that there was no evidence that humidity and aerosol affects glycol availability at the relatively low aerosol loadings and humidities examined.

The following recommendations/concerns are summarized by the researcher pertaining to reactivity, availability, and PM assessment:

- Aromatics mechanisms need to be improved to further reduce uncertainties in reactivity assessments (e.g., glycols)
- Extrapolation of current mechanisms to higher aromatics, such as Aromatics 200, still highly uncertain
- Direct reactivity measurements needed to reduce uncertainties for some VOCs, particularly mixtures of branched alkanes.
- A modified base case experiment that gives better correlations between chamber and atmospheric reactivity would be useful
- No compelling need to change current bin assignments, except perhaps for those with light cycloalkanes and synthetic mixtures. But new procedure will be needed when reactivity scale updated
- Well-characterized environmental chamber data needed to develop predictive secondary PM models. Work needed on background PM characterization in chambers

Using the Maximum Incremental Reactivity (MIR) scale as the basis for comparing reactivities of VOCs it is true that, on a per gram basis, some VOCs used in water-borne coatings are more reactive than some VOCs used in solvent-based coatings. For example, using the MIR scale as a basis, a typical VOC used in water-borne coatings, such as propylene glycol, is two to three times more reactive than typical mineral spirits. Less reactive solvents such as mineral spirits are not extensively used in automotive coatings. Automotive coatings tend to have solvents with higher reactivity such as xylenes and toluene. The reactivity of propylene glycol is approximately one-third the reactivity on a gram for gram basis of xylenes and toluene. It is anticipated that manufacturers will incorporate the use of water and exempt solvents when formulating to meet the lower VOC limits (CARB, 2005).

Another factor to be considered in the reactivity based approach, and probably the most important, is an accurate speciation profile of waterborne and solvent-borne coatings. CARB, in its effort to get more detailed information about the speciation profiles, required speciation profiles of all coatings included in the 2005 CARB Survey (CARB, 2006) as was conducted in the 2001 Survey. The results of the speciation data are still

under evaluation, and could potentially be used for future reactivity-based architectural coatings control. However, a draft analysis shows that existing VOC levels are already so low that the use of a reactivity-based approach at higher limits would not result in greater ozone reductions.

Furthermore, there are a number of uncertainties involved in using a reactivity-based approach. One source of uncertainty in the reactivity scales comes from the fact that ozone impacts of VOCs depend on the environment where the VOC is emitted. A second source of uncertainty is variability in the chemical composition of the VOC source being considered. Complex mixtures such as “mineral spirits” may be more difficult to characterize and may vary from manufacturer to manufacturer though in principal the composition of a given lot can be determined and reasonably assumed to be constant regardless of how the product is used. A third source of uncertainty comes from the complexity and uncertainties in the atmospheric processes by which emitted VOCs react to form ozone (Carter, 1995).

Although the science of VOC reactivity has matured, more comprehensive studies are still being conducted to resolve the uncertainties of reactivity data. The SCAQMD is participating in the industry-sponsored PACES process to address performance, availability, PM and reactivity issues. CARB is considering revisions to the 2000 Suggested Control Measure for Architectural Coatings to incorporate lower mass-based VOC limits, and possibly reactivity-based approach. However, other AQMDs and Air Pollution Control Districts have concern about coast impacts and enforceability of this approach. Until the results of this research and studies are completed and peer reviewed, it would not be prudent to implement a reactivity-based ozone reduction strategy based on incomplete science.

In the absence of actual reactivity numbers for the compounds contained in “traditional” solvent formulations and compliant, low-VOC coatings, emissions must be calculated in the standard manner of total VOC per unit of coating applied manner.

CARB has implemented a limited reactivity-based rule and the U.S.EPA has also issued a guidance to have states evaluate reactivity-based approaches. CARB is finalizing their new survey which will include revised speciation data and will evaluate the feasibility of reactivity-based approach as part of their next SCM. However, based on the 2001 survey, mass-based VOC control approach was deemed effective for most categories and shows a lower SWA-MIR value for low-VOC coatings.

In July 2001, the CARB conducted a survey of companies that sold architectural coating products in California in 2000. This report contains a detailed analysis of the photochemical reactivity associated with architectural coatings, based on results from that survey. This document is intended to provide different options for evaluating the reactivity of architectural coatings, but it is not a formal regulatory document. CARB’s 2001 Architectural Coating Survey gathered detailed sales information and speciation of VOCs in product formulations, with ingredients reported to the 0.1 weight percent level. When coatings are applied, they release different types of organic compounds that can

react in the atmosphere to produce different amounts of ozone. This ozone forming potential is called hydrocarbon reactivity and it is determined by the photochemical reactions in the atmosphere. If a coating contains a small amount of a highly reactive compound, it could have a relatively high reactivity rating even if it has a low level of volatile organic compounds (VOCs). Similarly, a coating that has a high VOC content may have a relatively low reactivity rating, if it contains compounds that aren't very reactive.

On June 16, 1995, the U.S. EPA determined that acetone, p-chlorobenzotrifluoride (PCBTF), VMS as well as other solvents have low photochemical reactivity and should be exempted from consideration as a VOC. Oxsol 100 (PCBTF), manufactured by Occidental Chemical Corporation, was also delisted as a VOC in 1995. This solvent can be used to extend or replace many organic solvents, including toluene, xylene, mineral spirits, acetone, methyl ethyl ketone, trichloroethylene, and perchloroethylene. Toxicity data of PCBTF was assessed by OEHHA and it was not considered to have a significant toxic risk. This product is less toxic than toluene, is not considered a Hazardous Air Pollutant or an Ozone-Depleting Substance. The U.S. EPA has also delisted t-butyl acetate (TBAC), which may also help coating formulators in utilizing exempt solvents in their formulations. The SCAQMD has also recognized TBAC exemption for automotive refinishing and industrial maintenance coatings.

The long term strategy of the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP considers reducing the VOC ozone forming potential of consumer products through reducing the overall reactivity of VOC containing materials. This control measure, however, concludes that further study is required to evaluate the reactivity of different compounds under various meteorological conditions to develop a systematic approach for regulatory programs.

CARB and SCAQMD will continue to assess the draft report recently completed by CE-CERT and will work with industry in resolving remaining concerns with the draft results. In the meantime, CARB staff has initiated another architectural coating survey to collect sales and ingredient data for calendar year 2004. This survey would reflect the coatings being sold in California after all of the SCM VOC limits have taken effect. It is expected that results from this survey would be finalized during 2006. Data from that survey will be analyzed similarly to how the 2001 survey data were analyzed in this report. After the 2005 Architectural Coating Survey data are analyzed, CARB staff will begin the process to revise the 2000 SCM to incorporate lower mass-based VOC limits, or new reactivity-based limits, or some combination of both. This process is anticipated to occur in the 2006-2007 timeframe.

SCAQMD staff will continue to monitor all reactivity-related research at the RRWG, and plans to work closely with CARB staff on the survey and subsequent SCM. However, based on the latest research and analysis, as well as the recommendations of the researched to conduct additional analysis, staff supports the continuation of a mass-based ozone control strategy, with future consideration for a reactivity-based approach.

### **Synergistic Effects of the Eight Issues**

It has been asserted in the past that not only should each of the eight issues (e.g., more thickness, illegal thinning, more priming, more topcoats, more touch-up and repair, more frequent recoating, more substitution, and more reactivity) be analyzed separately but that the synergetic effect of all issues be analyzed. As discussed above, the SCAQMD's research and analysis of resin manufacturers' and coating formulators' product information sheets and further corroborated by the numerous technology assessments conducted by AQMD contracts, concludes that on each separate issue that the low-VOC compliant coatings have comparable performance as conventional coatings or the specific assertions are unfounded and unsupported by any data or other evidence.

SCAQMD's research and analysis of resin manufacturers' and coating formulators' product information sheets concludes that on each separate issue that the low-VOC compliant coatings have comparable performance as current coatings or industry's specific assertions are unfounded. Individually each issue does not result in a significant adverse air quality impact and the synergistic effect of the above issues is not expected to result in significant adverse air quality impacts. Therefore, since individually each issue does not result in a significant adverse air quality impact, the synergistic effect of all eight issues will not result in significant adverse air quality impacts. Even if it is assumed that some of the alleged activities do occur, e.g., illegal thinning, substitution, etc., the net overall effect of reducing the VOC content of coatings and other consumer products is expected to be a reduction in VOC emissions.

### **Low Vapor Pressure**

Some coatings manufacturers have asserted that coating solvents should not be regulated as a VOC at all. These solvents currently used in consumer products and architectural coatings are considered low volatility compounds, meaning that they have a vapor pressure of less than 0.1 millimeter of mercury (mm of Hg) at 20 degrees Celsius. While CARB has included a low vapor pressure (LVP) exemption in its Consumer Products regulation, its staff indicates that the LVP exemption was placed into the rule for some additives found in consumer products, such as surfactants, paraffin, and other heavier compounds that do not readily evaporate into the atmosphere and are typically washed away into the sewer. Since the VOCs in paints do and are intended to evaporate into the atmosphere, CARB does not support the LVP exemption for architectural coatings and did not include the LVP exemption into its Aerosol Coatings rule. U.S.EPA staff also does not support an LVP exemption for the architectural coatings rule and did not include such an exemption in the National Architectural Coatings Rule. Based upon its test methodology, U.S.EPA concluded that VOCs from architectural coatings do evaporate into the air and therefore should not be exempted. The SCAQMD concurs with U.S.EPA and CARB decisions to not include a LVP exemption for architectural coatings. Nevertheless, the SCAQMD will continue to work with CARB staff in identifying issues, participating in future studies, and monitoring the result of any studies.



### **Technology Assessment Studies**

A study by the National Technical System (NTS) in 1998 was initiated to assess application and durability characteristics of zero-VOC, low-VOC, and high-VOC coatings in order to supplement information collected by the SCAQMD, as part of a technology assessment. The results from the NTS study are consistent with SCAQMD's own technology assessment. The results of the study show that zero-VOC coatings available today, when compared to high-VOC coatings are equal, and in some cases, superior in performance characteristics, including coverage, mar resistance, adhesion, abrasion resistance, and corrosion protection. However, the NTS results also highlight application characteristics of some zero-VOC nonflat and primers, sealers, and undercoatings (PSU) coatings that are somewhat limited when compared to solvent-based, high-VOC coatings. Those characteristics include lower rankings for leveling, sagging and brushing properties. However, for industrial/maintenance coatings, zero and low-VOC coatings performed better than high-VOC coatings. In addition to the laboratory results, the NTS study was expanded with additional testing, including accelerated actual exposure, real time actual exposure, and actual field application characteristics. In sum, the results of the NTS study indicates that some, but not all of the zero-VOC coatings may have some application characteristics.

In 2001, KTA Tutor conducted a detailed performance testing on floor, non-flats, primers, etc. This study also supported the conclusions from the NTS study. In 2006, the University of Missouri-Rolla conducted another technology assessment of a variety of coating categories and also further corroborated with the findings of the NTS study.

This means that when promulgating coatings rules or rule amendments sufficient research and development time should be allowed to correct potential coating application problems.

### **Overall Conclusion**

Based on the preceding analysis of potential air quality impacts from implementing future coatings rules, it is concluded that the overall air quality effects will be a VOC emission reduction.

**PROJECT-SPECIFIC MITIGATION:** No significant secondary air quality impacts from coatings or consumer product regulations have been identified so no mitigation measures are required.

### **Secondary Impacts from Mobile Sources**

**PROJECT-SPECIFIC IMPACTS:** A number of control measures are aimed at controlling emissions from mobile sources by using alternative fuels or reformulated fuels, by using retrofit controls on engines, and by installing or encouraging the use of new engines.

### **Impacts at Refineries**

Ethanol is currently the only approved oxygenate for use in fuels in California. Control measures ARB-ONRD-03 and SCFUEL-01 would require reformulation of gasoline to remove ethanol. The control measure would require refinery modifications including added hydrogen capacity, hydrotreating, hydrocracking, and alkylation, while reduced octane requirements would tend to improve refinery efficiency slightly. The refinery modifications are expected to be similar to those modifications made for compliance with the CARB Phase 2 reformulated fuel requirements. The emissions from refinery modifications would require the use of Best Available Control Technology, and require offsets. (It should be noted that there are exemptions from the SCAQMD offset requirements for projects required to comply with local, state or federal rules and regulations. Typically, refinery projects designed to comply with reformulated fuel requirements have been exempt from offsets). All refineries in the district are subject to RECLAIM regulations, including the RECLAIM emission cap, although the cap can be adjusted for projects required to comply with local, state and federal rules and regulations. Most of the projects completed at refineries for compliance with CARB Phase 2 and CARB Phase 3 compliance were significant for air quality impacts on an individual project basis. It is expected that refinery modifications to comply with certain reformulated or alternative fuels also would be significant, i.e., exceed the SCAQMD significance thresholds. However, the indirect impacts of the reformulated fuels programs have resulted in large emission reductions from mobile sources using the fuels which serve to offset the emission increases from the refineries to a certain extent.

Control measures ARB-OFFRD-01 and SCOFFRD-02 would require reformulation of marine and jet fuels. Similar impacts from refinery modifications are expected to produce lower sulfur marine fuels and lower aromatic jet fuels. Potential increases in refinery emissions are also expected due to installation of new equipment to remove sulfur, e.g., hydrotreating facilities and sulfur recovery plants. However, the indirect impacts of the reformulated fuels programs have resulted in large emission reductions from mobile sources using the fuels which serve to offset the emission increases from the refineries to a certain extent.

Overall, the emission benefits associated with the use of reformulated fuels can be compared to the emission increases from refinery modifications. In general, the overall use of reformulated fuels can result in large emission decreases associated with its use in mobile sources. The use of alternative fuels is a potential control measure for trucks, marine vessels, airplanes, and railcars which are large sources of emissions. Therefore, the overall impacts of reformulated/alternative fuel control measures would be expected to have large overall emission reductions on mobile sources that use the fuels so that overall emission benefits are expected.

### **Biodiesel**

Some of the control measures would encourage the use of alternative fuels including biodiesel. Biodiesel is the generic name for a variety of diesel fuel alternatives based on

methyl esters of vegetable oil or fats. Biodiesel fits under the category of a renewable fuel because it is made from agricultural feedstocks such as soybean or grapeseed. Other possible feedstocks for biodiesel include bio-oils from corn, cottonseed, peanut, sunflower, canola, and rendered animal fat (SCAQMD, 2000a).

Biodiesel is made by a catalytic chemical process called transesterification, using an alcohol (such as methanol) and a catalyst. Biodiesel can be made at industrial facilities and does not need to be produced at refineries. Methanol is mixed with sodium hydroxide and then with soybean oil, letting the glycerine that is formed settle. This process forms fatty esters, which are then separated into two phases, which allows easy removal of glycerol in the first phase. The remaining alcohol/ester mixture called methyl soyate is then separated, and the excess alcohol is recycled. The esters are sent to the clean-up or purification processes which consists of water washing, vacuum drying, and filtration.

The final fuel closely resembles conventional diesel fuel, with higher cetane number (a number that rates its starting ability and antiknock properties). Energy content, viscosity and phase changes are similar to petroleum-based diesel fuel. The fuel is typically blended with 20 percent low sulfur diesel fuel. The fuel is essentially sulfur free, emits significantly less smoke, hydrocarbons, and carbon monoxide. NO<sub>x</sub> emissions are similar to or slightly higher when compared to diesel. Biodiesel has a high flash point and has very low toxicity if digested. It is also biodegradable.

The biggest drawback of biodiesel is cost. Before biodiesel can be a major fuel for vehicle use, the price needs to become much more competitive with diesel. Other drawbacks are that vehicle fuel lines and other components that would come in contact with the fuel would have to be changed because biodiesel can dissolve some rubber. The fuel also clouds and stops flowing at higher temperatures than diesel, so fuel-heating systems or blends with diesel fuel would be needed in lower temperature climates (SCAQMD, 2000). Finally, as briefly mentioned already, another drawback of biodiesel is that there is a slight increase in NO<sub>x</sub> emissions, which makes it less desirable than other alternative fuels.

### **Oxidation Catalysts**

Several of the measures, e.g., EGM-01, MOB-01, MOB-03, MOB-04, ARB-ONRD-04/SCONRD-03, ARB-ONRD-05/SCONRD-04, ARB-OFFRD-04/SCOFFRD-01, ARB-ARB-OFFRD-02/SCOFFRD-03, SCOFFRD-06, ARB-OFFRD-06, ARB-OFFRD-02/SCOFFRD-03, ARB-OFFRD-03, and SCOFFRD-02, could require the use of diesel particulate filters, add-on devices that are mounted on the exhaust pipe. In the case of exhaust pollutants, Manufacturers of Emission Controls Association (MECA) reports that the use of oxidization catalysts to reduce PM<sub>10</sub> emissions from diesel-fueled vehicles should not increase other exhaust pollutants. In fact, combining an oxidation catalyst with engine management techniques can be used to reduce NO<sub>x</sub> emissions from diesel engines. This is achieved by adjusting the engine for low NO<sub>x</sub> emissions, which is typically accompanied by increased CO, VOC, and PM<sub>10</sub> emissions. An oxidation

catalyst can be added to offset these increases, thereby lowering the exhaust levels for all of the pollutants. Often, the increases in CO, VOCs, and PM10 can be reduced to levels lower than otherwise could be achieved. In fact, a system which uses an oxidation catalyst combined with proprietary ceramic engine coatings and injection timing retard can achieve significant NOx reductions (e.g., greater than 40 percent) while maintaining low PM10 emissions (MECA, 1999).

Additionally, potential air quality impacts could arise if the use of ultra low sulfur diesel fuel in combination with oxidation catalysts could result in infrastructure changes (e.g., fuel supply or delivery). More recently, it has been applied to mobile sources including trucks, marine vessels, and locomotives.

### **Selective Catalytic Reduction (SCR) Devices**

The 2007 AQMP includes strategies to reduce NOx from diesel engines that may include using SCR. SCR has been used to control NOx emissions from stationary sources for many years. More recently, it has been applied to mobile sources including trucks, marine vessels, and locomotives. Potential adverse air quality impacts associated with the use of SCRs in diesel-fueled vehicles could occur if this technology resulted in the increase of other exhaust pollutants at the expense of reducing PM10 or a reduction in fuel economy. However, applying SCR to diesel-powered vehicles provides simultaneous reductions of NOx, PM10, and VOC emissions.

Like an oxidation catalyst, SCR promotes chemical reactions in the presence of a catalyst. However, unlike oxidation catalysts, a reductant is added to the exhaust stream in order to convert NOx to elemental nitrogen and oxygen in an oxidizing environment. The reductant can be ammonia but in mobile source applications, urea is normally preferred. As exhaust gases along with the reductant pass over the catalyst, 75 to 90 percent of NOx emissions, 50 to 90 percent of the VOC emissions, and 30 to 50 percent of the PM10 emissions are reduced. SCR also reduces the characteristic odor produced by a diesel engine and the diesel smoke.

No operational-related infrastructure changes are expected from the use of ultra low sulfur diesel fuel in combination with SCRs. Existing piping and storage tanks can be used to supply and store the additional demand for ultra low sulfur diesel fuel. Therefore, no significant adverse air quality impacts were identified from the use of SCRs in conjunction with ultra low sulfur diesel fuel to potentially reduce emissions from mobile sources.

In the case of exhaust pollutants, the catalyst composition of SCR and its mode of operation are such that sulfates could form. However, with the use of ultra low sulfur diesel fuel, which has been required for stationary and on-road applications since September 2006, sulfate formation are expected be negligible. In particular, even at temperatures in exceeding 500 degrees Centigrade, only five percent of the sulfur in the fuel would be converted to sulfate, which still allows for significant net PM10 emission

reductions. Applying SCR to diesel-powered vehicles also provides simultaneous reductions of NOx, PM10, and VOC emissions.

As to a reduction in fuel economy, because of the large NOx reductions afforded by SCR, it is possible that low NOx emissions can be achieved with an actual fuel economy benefit. Compared to internal engine NOx abatement strategies like exhaust gas recirculation and timing retard, SCR offers a fuel economy benefit in the range of three to 10 percent as a result of being able to optimize engine timing for fuel economy and relying on the SCR system to reduce NOx emissions.

Therefore, no significant adverse air quality impacts were identified from the use of SCRs in conjunction with ultra low sulfur diesel fuel to potentially comply with the applicable control measures.

Mobile source control measures are expected to result in changes in emissions related to mobile sources. The inventory prepared for the Proposed Modifications to the Final ~~Draft~~ 2007 AQMP includes emissions estimates associated with mobile sources, which are summarized in Table 4.1-11.

**TABLE 4.1-11**

**Annual Average Emissions for On-Road Mobile Sources in the District  
(Tons/Day)**

<b>Source Category</b>	<b>VOC</b>	<b>CO</b>	<b>NOx</b>	<b>SOx</b>	<b>PM10</b>	<b>PM2.5</b>
<b>2002 Emission Inventory</b>						
Total On-Road Motor Vehicles	454.86	4,149.78	642.26	4.22	24.58	17.93
<b>2023 Emission Inventory</b>						
Total On-Road Motor Vehicles	127.29	866.75	180.55	2.36	21.03	13.77
Emissions Reductions (emissions in 2002 - emissions in 2023)	-327.57	-3,283.03	-461.71	-1.86	-3.55	-4.16
Pounds per Day	-655,140	-6,566,060	-923,420	-3,720	-7,100	-8,320
SCAQMD Significance Thresholds (lbs/day)	75	550	100	150	150	55
Significant?	NO	NO	NO	NO	NO	NO

Source: SCAQMD, Proposed Modifications to the Draft 2007 AQMP, Appendix III  
Negative numbers denote emission reductions.

The inventory prepared for the 2007 AQMP includes estimates of on-road motor vehicles in 2002 and 2023. The inventory also accounts for growth in population that also includes growth in the number of mobile sources and an increase in the vehicle miles traveled. The estimated VOC, CO, NOx, SOx, PM10, and PM2.5 emissions associated with on-road mobile sources in the district are expected to be reduced between the 2002 and 2023 inventories. Therefore, the overall impacts of mobile source control measures is expected to be a beneficial impact on air quality.

**PROJECT-SPECIFIC MITIGATION:** The operational air quality impacts at local refineries resulting from modifications of existing equipment or installation of new equipment would be necessary to manufacture clean fuels. Modifications of existing equipment and installation of new equipment would both be subject to Regulation XIII – New Source Review, or Rule 2005 – New Source Review for RECLAIM, and Lowest Achievable Emission Rate (LAER) requirements. New or modified equipment is subject to LAER, by definition no additional emission reductions can be achieved by this equipment. The overall impact of mobile source control measures is expected to be beneficial by providing large emission reductions from mobile sources. Therefore, no significant adverse air quality impacts associated with mobile source control measures are expected and no mitigation measures are required.

### **Port and Port-Related Sources**

**Regulation of Port and Port-Related Sources:** The CAAP proposes to utilize the authorities of the ports, including powers to establish lease conditions, port rules, tariffs, and incentives, to implement emission control strategies. The CAAP was created as a result of the ports Clean Port Initiatives that also called for the SCAQMD to develop and adopt "backstop" rules that would take effect if the ports did not take actions that, in conjunction with standards adopted by CARB, U.S. EPA, SCAQMD, and the International Maritime Organization (IMO), would achieve sufficient, timely emission reductions. The MOB-03 control measure is the "backstop" for the CAAP.

MOB-03 will implement SCAQMD rules directed at the Ports or operators of port facilities (e.g., marine terminals and railyards). MOB-03 will become effective if the Ports or facilities do not take action sufficient to achieve the standards detailed in the CAAP. MOB-03 will establish enforceable nonattainment pollutant emission reduction goals for the Ports.

The CAAP reports emission reductions of PM, NO<sub>x</sub>, and diesel particulate matter. The reductions are based on 2002 emissions as the base year. The reported emission reductions from CAAP measures by 2010 are shown in Table 4.1-12.

The overall impact of the CAAP is beneficial to air quality, following construction of the necessary infrastructure.

There are incentive programs to purchase/retrofit diesel ship engines to clean fuels, e.g., the Carl Moyer Program, Rule 1632, etc., but since these are voluntary programs they do not guarantee that marine vessel and train emissions will be reduced to less than significant levels and are not considered further.

**TABLE 4.1-12**

**CAAP MEASURES EMISSION REDUCTIONS<sup>(1)</sup>**

Source	NO <sub>x</sub>		SO <sub>x</sub>		DPM <sup>(2)</sup>	
	Emissions (tons/yr)		Emissions (tons/yr)		Emissions (tons/yr)	
	2002	2010	2002	2010	2002	2010
Heavy Duty Vehicles	10,269	6,228	9	2	966	782
Reduction		61		27		81
Ocean going Vessels	13,574	5,281	7,749	2,207	1,231	331
Reduction		40		39		29
Cargo Handling Equipment	3,916	376	8	8	152	11
Reduction		15		0		19
Total	26,119	11,885	6,753	2,210	2,295	1,125
Reduction		46		38		52

(1) Source: SPBCAAP Technical Report, Table 5.27 – 5.29 (November 2006).

(2) DPM = diesel particulate matter.

**PROJECT-SPECIFIC MITIGATION:** Operational project specific impacts associated with the transportation control measures are not expected to exceed any SCAQMD significant thresholds. Therefore, mitigation measures are not required.

**Secondary Impacts from Miscellaneous Sources**

**PROJECT-SPECIFIC IMPACTS:** Miscellaneous source control measures would regulate a variety of different types of emission sources including both area and point sources. As a result, these control measures are expected to reduce VOC, criteria pollutant, and precursor emissions. The following control measures were identified as having the potential to generate secondary air quality impacts.

MCS-05 would require control of ammonia and VOC emissions from handling of non-dairy livestock waste. The predominant control options are expected to be to vent the animal housing to a VOC control device, using a belt litter removal/drier system or use a tunnel ventilated house door litter drying systems, storing manure in an enclosure vented to a control device, or shipping manure to composting facilities within the district. In the past, the most likely compliance option for this control measure would be to haul manure out of the district to the San Joaquin Valley or some other area of the state, generally to spread on agricultural cropland. However, the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD, 2006) has adopted similar rules. Further, regional water quality control boards are adopting stringent requirements that limit the amount of manure that can be spread on agricultural cropland. As a result shipping manure outside the district is not expected.

ARB-ONRD-03/SCFUEL-01 could result in the reformulation of gasoline to revise gasoline specifications and remove ethanol. Ethanol is generally produced in the mid-west portion of the United States so that the addition of ethanol into gasoline generated significant air quality impacts associated with the transport of ethanol into California and the Basin. Removal of ethanol would eliminate the transportation-generated emissions, thus providing a beneficial air quality impact. However, if another oxygenate replaces ethanol or if additional blending components are required (to replace the volume of gasoline loss due to the loss of ethanol), secondary air quality impacts could still be generated by the transport of these components into the Basin. Overall, the control measure is expected to result in a decrease in emissions associated with vehicles that use the reformulated fuels by reducing the volatility of gasoline, among other changes. The emission benefits from implementation of ARB-ONRD-03/SCFUEL-01 are expected to be about 11.6 tons per day of VOC and 16.1 ton per day of NO<sub>x</sub> by 2010. Thus, the emission benefits are expected to exceed any emission increases.

**PROJECT-SPECIFIC MITIGATION:** No mitigation measures are required because no significant impacts were identified.

#### 4.1.5.3 Non-Criteria Pollutants

**PROJECT SPECIFIC IMPACTS:** A number of control measures that are proposed in the 2007 AQMP may result in the substitution of reactive solvents with exempt compounds. A number of VOCs currently used in consumer product formulations have also been identified as TACs, such as ethylene-based glycol ethers, TCE, and toluene. When a product is reformulated to meet new VOC limits, however, a manufacturer could use a chemical, not used before, that may be a toxic air contaminant. This potential impact will need to be evaluated and mitigated as reformulation options are reviewed during the development of new VOC limits.

Two particular TACs used in some consumer products, methylene chloride and perchloroethylene, are specifically exempted from the VOC definition because of their very low ozone-forming capabilities. As a result, some manufacturers may choose to use methylene chloride or perchloroethylene in the reformulations to reduce the VOC content in meeting future limits. When a product is reformulated to meet new VOC limits, a manufacturer could use chemicals that may be considered TACs. Product liability and regulations such as California's Proposition 65 are expected to minimize the use of toxic materials because manufacturer's would have to provide public notices if any Proposition 65 listed-material is used. In addition, SCAQMD's Rule 1401 sets forth limitations of certain TACs, including methylene chloride and perchloroethylene, that would be expected to minimize TACs at stationary sources.

There is a potential that the exempt compounds may create air quality impacts if the exempt solvents contain toxic compounds that are not regulated by the state and federal TAC programs or by the SCAQMD's TAC rules. However, previous SCAQMD analyses, as shown above, do not indicate this to be the case. The potential impacts will need to be analyzed for each control measure during the rulemaking process. See 4.3-2



in the Hazard Section for a summary of typical hazards related to chemicals that tend to be used in reformulated coating products.

In general, it is expected that the AQMP control measures will reduce emissions of TACs. The basis for this conclusion is that many TACs are also classified as VOCs. To the extent that control measures reduce VOC emissions, associated TAC emission reductions could occur as well. Some measures for motor vehicle and transportation source categories would reduce emissions of toxic components of gasoline such as benzene, toluene, and xylene. Use of alternative fuels may increase methanol and aldehyde emissions. Electrification may cause greater emissions of benzene, aldehydes, metals, and polynuclear aromatic hydrocarbons from fuel-based power generating facilities. However, if the process being electrified was previously powered by direct combustion of fossil fuels, then electrification is expected to result in an overall decrease in toxic emissions.

The overall impacts associated with implementation of the 2007 AQMP is an overall reduction in non-criteria pollutants. Therefore, no significant impacts on non-criteria pollutants have been identified.

**PROJECT-SPECIFIC MITIGATION:** No significant secondary air quality impacts were identified from non-criteria pollutants so no mitigation measures are required.

#### **4.1.5.4 Global Warming and Ozone Depletion**

The 2007 AQMP as a whole is expected to promote a net decrease in greenhouse gases. The SCAQMD's proposed control measures and the recommended state and federal control measures that promote fuel efficiency and pollution prevention will also reduce greenhouse gas emissions. Measures that stimulate the development and use of new technologies such as fuel cells will also be beneficial. In general, strategies that conserve energy and promote clean technologies usually also reduce greenhouse gas emissions. As shown in Table 3.1-17, the fuel combustion and the generation of electricity are responsible for a large portion of greenhouse gases produced in California.

A number of control measures have been suggested for the control of mobile sources including SCONRD-01 (increased use of electric or zero emission vehicles), ARB-ONRD-04/SCONRD-03 (engine replacement and use of natural gas), ARB-OFFRD-1 (reduce ship hotelling emissions, reduce emissions from ocean-going vessels), and SCOFFRD-04 (reduced emissions from airport ground support equipment through electrification). All of these control measures would reduce both criteria pollutant and greenhouse gas emissions from mobile sources through alternative fuels (electricity or natural gas) or through the use of more efficient engines.

Among all the control measures developed for mobile and stationary sources, the following sources are identified to have greenhouse gas emission reductions.

1. Mobile Sources: The Control Measure # SCONRD-01 (Accelerated Penetration of Partial Zero-Emission and Zero Emission Vehicle), ARB-OFFRD-1 (Emission Reduction from Marine Vessels), and SCOFFRD-4 – Emission Reductions from Airport Ground Support Equipment are the only control measures with significant impact on CO2 emissions.
2. Stationary Sources: Among all the control measures developed for stationary sources, the Control Measure BCM-03 (Emission Reductions from Wood Burning Fireplaces) is the only one with GHG emission reductions that can be quantified.

The estimated greenhouse gas emission reductions from the above control measures are summarized in Table 4.1-13.

**TABLE 4.1-13**

**Summary of 2007 AQMP Estimated Greenhouse Gas Emission Reductions**

<b>CO2 Reductions (Metric Tons)</b>		
<b>Control Measures</b>	<b>2014</b>	<b>2020</b>
Control Measure SCONRD-01-Accelerated Penetration of Partial Zero-Emission and Zero Emission Vehicle	115,425	1,154,250
Control Measure BCM-03-Emission Reductions from Wood Burning Fireplaces	4,759	10,288
Control Measure ARB-OFFRD-04/SCOFFRD-01 - Emission Reduction from Marine Vessel while at Berth (Hotelling)	274,320	335,280
Control Measure SCOFFRD-4 – Emission Reductions from Airport Ground Support Equipment	33,345	34,627
<b>TOTAL EMISSION REDUCTIONS</b>	<b>427,849</b>	<b>1,534,445</b>

**Control Measure SCONRD-01-Accelerated Penetration of Partial Zero-Emission and Zero Emission Vehicles**

The following assumptions and procedures were used to estimate the total targeted GHG emissions (CO2) reductions in 2014 & 2020:

- Total estimated travel mile per vehicle per year of about 15,000;
- Total estimated fuel consumption per car of 22.3 miles per gallon, which is based on the assumption of running the 2007 EMFAC model for 2014 model and calendar year;

- Assuming a 25% increase in fuel efficiency resulted from converting to hybrid cars;
- Total estimated fuel consumption of approximately 27.9 miles per gallon for the hybrid cars, considering the 25% fuel efficiency and fuel consumption of 22.3 miles per gallon for 2014 model car;
- It was also assumed that the average fuel consumption economy for 2020 model cars would not change;
- Assuming a replacement rate of 100,000 cars in 2014 & 1,000,000 in 2020, as stated in the body of control measures ONRD-01;and,
- Total gallons of fuel saved in 2014 & 2020, based on the above assumptions, was estimated to be 13.5 and 135 million gallons, respectively, as calculated below:

**2014**

Total gallons of gasoline saved in 2014 = 15,000 miles/year/per car x 100,000 cars x (1/22.3 – 1/27.9) = 13,501,133 ~ 13.5 mmgal

**2020**

Total gallons of gasoline saved in 2020 = 15,000 miles/year/per car x 1,000,000 cars x (1/22.3 – 1/27.9) = 135,011,331 ~ 135 mmgal

**CO2 Reductions**

The CO2 emission reductions are estimated by multiplying fuel consumptions by the emission factor (EF), and converting to metric tons, using the calculation procedures outlined in the General Reporting Protocol of the California Climate Action Registry as listed below:

Total CO2 emissions (metric tons) = Fuel consumed (gallons) x EF (kg CO2/gallon) x 0.001 (metric tons/kg)  
Where EF = 8.55 kg CO2/gallon for reformulated gasoline

**2014**

Total CO2 emission reductions (metric tons) =  
 $13.5 \times 10^6 \times 8.55 \times 0.001 = \mathbf{115,425 \text{ metric tons}}$

**2020**

Total CO2 emission reductions (metric tons) =  
 $135 \times 10^6 \times 8.55 \times 0.001 = \mathbf{1,154,250 \text{ metric tons}}$

The above estimate could be also verified using following scientific formula:  
CO2 Emissions = fuel consumptions (gallon) x % carbon in fuel x gasoline density (lb/gal) x MW ratio (CO2/C) x 1 tons/2000 lb

CO<sub>2</sub> emissions = 135 x 10<sup>6</sup> gal x 0.865 x 6.15 lb/gal x 44/12 x 1 ton/2000 lbs = 1,316,638 tons

### **Control Measure BCM-03-Emission Reductions from Wood Burning Fireplaces**

The following assumptions were used to estimate the GHG reductions for BCM-03.

- There are about 4,355 natural gas units installed per year;
- The total number of units installed by 2014 is 26,130 (4,355 x 6) starting 2008;
- The total number of units installed by 2020 is 52,260 (4,355 x 12); and,
- The natural gas consumption per unit is estimated to be 2,600 cubic feet per year which is based on the assumptions that the units, on average, are rated at 30,000 btu/hr and are operated 2 hrs/day for 45 days per year. This value (2,600 ft<sup>3</sup>) is similar to the one included in the Sacramento Metropolitan AQMD staff report. Based on proposed Rule 445-Wood Burning Appliances staff report, the units range from 20,000 to 65,000 BTU per hour and the units are assumed to be operated for 3 hours per day x 90 days per year (worse case).
- Total natural gas consumption by 2014 for all the units = 2,600 ft<sup>3</sup>/unit x 26,130 units = 68 mscf;
- Total natural gas consumption by 2020 for all the units = 2,600 ft<sup>3</sup>/unit x 56,615 units = 147 mscf;
- According to the Sacramento Metropolitan AQMD staff report, the use of wood in the traditional fireplace releases 2.3 times more CO<sub>2</sub> than natural gas; and,
- The CO<sub>2</sub> emission reductions from this control measure are estimated based on the assumption that the natural gas consumption will increase by approximately 68 mmscf & 147 mmscf by 2014 and 2020, respectively.

### **CO<sub>2</sub> Reductions**

Total CO<sub>2</sub> emissions from burning natural gas (metric tons) = Fuel consumed (mmbtu) x EF (kg CO<sub>2</sub>/mmbtu) x 0.001 (metric tons/kg), Where EF = 52.78 kg CO<sub>2</sub>/mmbtu

#### **2014**

Total CO<sub>2</sub> emission from natural gas (metric tons) = 68 mmscf x 1020 mmbtu/mmscf x 52.78 kg CO<sub>2</sub>/mmbtu x 0.001 metric tons/kg = 3,661 metric tons  
Total CO<sub>2</sub> emissions from wood burning = 2.3 x 3,661 metric tons = 8,420 metric tons

Total CO<sub>2</sub> emission reductions (metric tons) = 8,420 – 3,661 = **4,759 metric tons**

#### **2020**

Total CO2 emission from natural gas (metric tons) = 147 mmscf x 1020 mmbtu/mmscf x 52.78 kg CO2/mmbtu x 0.001 metric tons/kg = 7,914 metric tons  
 Total CO2 emissions from wood burning = 2.3 x 7,914 metric tons = 18,202 metric tons

Total CO2 emission reductions (metric tons) = 18,202 – 7,914= **10,288 metric tons**

**Control Measure ARB-OFFRD-01 - Emission Reductions from Marine Vessels**

Ships use auxiliary diesel engines to provide electricity for hotelling operations while berthed at ports, and to provide electrical power and steam while the ship is in operation. Hotelling includes operations on a marine vessel that require electrical energy to power operations that include, but are not limited to lights, ventilation, heating, cooling, and loading and unloading operations. This control measure requires ships to cold iron, which is a technology that is used to provide on-board power from the shore, while berthed at the port.

The diesel fuel consumptions was estimated based on NOx emissions from hotelling operations as follows. Total NOx emissions for SCAB from hotelling operations in 2002, 2014, and 2020 are shown in Table 4.1-14.

**TABLE 4.1-14  
 Total NOx Emissions from Hotelling Operations  
 (tons per day)**

<b>Year</b>	<b>NOx</b>
2002	12.647
2014	28.791
2020	34.863

**2002**

Total diesel fuel consumption in 2002 (metric tons) = 12.647 ton NOx/day x 365 days/yr x 2000 lb NOx/ton NOx x 454 g NOx/lb NOx x kw-hr/14.7 g NOx x 227 g fuel/kw-hr x lb fuel/454 g fuel x ton fuel/2000 lb fuel x tonne fuel/1.1 ton fuel = 64,803 ~ 64,000

Total diesel fuel consumption in 2002 (gallon) = 64,000 metric tons x 306 gallon/metric ton = 19,890,000 ~ 20 mmgal

**2014**

Total diesel fuel consumption in 2014 = 20 mmgal x 28.791/12.647 = 45 mmgal

Total diesel fuel saved by 2014 = 45 mmgal x 60% = 27 mmgal

**2020**

Total diesel fuel consumption in 2020 = 20 mmgal x 34.863/12.647 = 55 mmgal

Total diesel fuel saved by 2014 = 55 mmgal x 60% = 33 mmgal

**CO2 Reductions**

The CO2 emission reductions are estimated by multiplying fuel consumptions by the emission factor (EF), and converting to metric tons, using the calculation procedures outlined in the General Reporting Protocol of the California Climate Action Registry as listed below:

Total CO2 emissions (metric tons) =  
 Fuel saved (gallons) x EF (kg CO2/gallon) x 0.001 (metric tons/kg)  
 Where EF = 10.16 kg CO2/gallon for distillate fuel

**2014**

Total CO2 emission reductions (metric tons) = 27,000,000 x 10.16 x 0.001 = 274,320 metric tons

**2024**

Total CO2 emission reductions (metric tons) = 33,000,000 x 10.16 x 0.001 = 335,280 metric tons

**Control Measure SCOFFRD-4 – Emission Reductions from Airport Ground Support Equipment**

The following data, the population of gasoline spark ignited engines in 2014 & 2020, its rating capacity, average operating hours, average brake specific fuel consumptions, gasoline fuel density, and percent load efficiency were estimated using the off road model:

HP	15	50	120	175	250	500
Populations in 2014:	13	215	1550	400	317	15
Populations in 2020:	13	221	1589	410	325	16
Average operating hours:	834 hours per year					

The average brake specific fuel consumption is 0.55 lb/bhp-hr, using OFFROAD 2007 (made available in November of 2006) which is based on 50 percent load efficiency.

The average brake specific fuel consumption is 0.0887 gal/bhp-hr, based on gasoline fuel density of 6.2 lb/gal.

CY 2014: Total hp-hr = 13 x 15 + 215 x 50 + 1550 x 120 + 400 x 175 + 317 x 250 + 15 x 500 = 353,695

CY 2020: Total hp-hr =  $13 \times 15 + 221 \times 50 + 1589 \times 120 + 410 \times 175 + 325 \times 250 + 16 \times 500 = 362,925$

CY 2014: total gasoline consumptions in 2014 =  $353,695 \text{ hp-hr} \times 0.0887 \text{ gal/hp-hr} \times 834 \text{ hrs/yr} = 26,164,871 \text{ gallon} \sim 26 \text{ mmgal}$

CY 2020: total gasoline consumptions in 2020 =  $362,925 \text{ hp-hr} \times 0.0887 \text{ gal/hp-hr} \times 834 \text{ hrs/yr} = 26,847,667 \text{ gallons} \sim 27 \text{ mmgal}$

Assuming 15% electrification, then

**Total gasoline consumption saved in 2014 =  $26 \text{ mmgal} \times 15\% = 3.9 \text{ mmgal}$**

**Total gasoline consumption saved in 2020 =  $27 \text{ mmgal} \times 15\% = 4.05 \text{ mmgal}$**

### **CO2 Reductions**

Total CO2 emissions (metric tons) = Fuel consumed (gallons) x EF (kg CO2/gallon) x 0.001 (metric tons/kg)

Where EF = 8.55 kg CO2/gallon for reformulated gasoline

#### **2014**

Total CO2 emission reductions (metric tons) =  $3.9 \times 10^6 \times 8.55 \times 0.001 =$   
**= 33,345 metric tons**

#### **2020**

Total CO2 emission reductions (metric tons) =  $4.05 \times 10^6 \times 8.55 \times 0.001 =$   
**= 34,627 metric tons**

MCS-02 is expected to result in a decrease in energy use and a related decrease in greenhouse gases. MCS-02 is expected to result in a decrease in energy use associated with using reflective/lighter colored roofing and paving materials, as well as increased tree planting to reduce urban temperatures. It has been estimate that in Los Angeles energy loads for both the Los Angeles Department of Water and Power and Southern California Edison increase by about two percent per each degree Fahrenheit with respect to base load. (AQMP Appendix IV-A). Any measures that contribute to reducing the microclimate temperatures during the summer months are expected to result in a decrease in energy use and a related decrease in greenhouse gases.

MCS-03 will encourage energy efficiency and conservation. MCS-03 is expected to provide incentives for businesses and residents to use energy efficient equipment in the district and increase the effectiveness of existing energy conservation programs. Monetary incentives could be provided to accelerate the retirement of existing equipment (e.g., boilers, water heaters) and replacement of these equipment with higher fuel efficiency units. An increase in energy efficiency will result in a decrease in energy use and a related decrease in greenhouse gases.

MCS-04 is expected to provide additional emission controls from greenwaste composting. Greenwaste composting releases dust, VOC, ammonia, carbon dioxide, water vapor and methane (a greenhouse gas) emissions. Therefore, controlling emissions from composting is also expected to reduce emissions of greenhouse gases.

The SCAQMD has proposed several control measures that are expected to reduce emissions from mobile sources including MOB-01, MOB-03, and MOB-04, which would reduce emissions from ships, aircraft, trains, and trucks. A reduction in fuel combustion emissions from the affected sources is expected to result in a reduction in greenhouse gas emissions as well. In addition, MOB-07 encourages energy efficiency and promotes greenhouse gas reductions through more efficient building and energy standards, through the use of alternative energy sources (e.g., solar power), and through the development of alternative fuels (e.g., hydrogen).

Since the 1991 AQMP was adopted, SCAQMD rules that have the potential to impact global warming or ozone depletion are evaluated for such impacts during the rulemaking process. The proposed 2007 AQMP control measures will undergo the same evaluation in the rulemaking process. The proposed 2007 AQMP is consistent with the SCAQMD policy on Global Warming and Stratospheric Ozone Depletion and the Montreal Protocol. Therefore, the 2007 AQMP is expected to have a net effect of reducing emissions of compounds that contribute to global warming and ozone depletion.

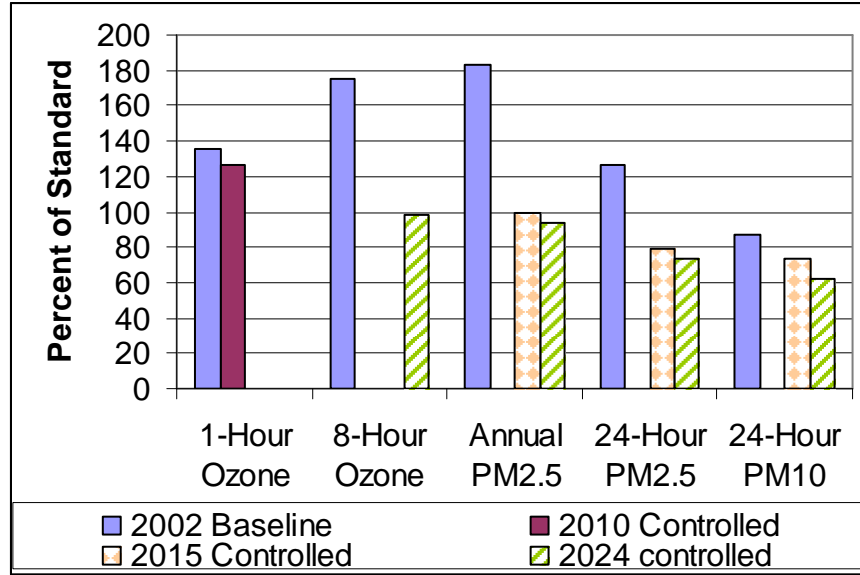
#### **4.1.6 SUMMARY OF AIR QUALITY IMPACTS**

The following is the summary of the conclusions of the analysis of secondary impacts associated with implementation of the 2007 AQMP.

- **Construction Activities:** No significant secondary air quality impacts from dust suppression activities were identified. The emissions associated with construction activities due to the implementation of the control measures in the 2007 AQMP were considered to be significant for PM10 emissions.
- **Secondary Emissions from Increased Electricity Demand:** While there may be an increase in electricity, the existing air quality rules and regulations are expected to minimize emissions associated with increased generation of electricity. The impacts associated with secondary emissions from increased electricity demand are expected to be less than significant.
- **Secondary Emissions from the Control of Stationary Sources:** No significant secondary air quality impacts from control of stationary sources were identified associated with implementation of the 2007 AQMP.
- **Secondary Emissions from Change in Use of Lower VOC Materials:** The secondary air quality impacts associated with reformulated products are expected to be less than significant.

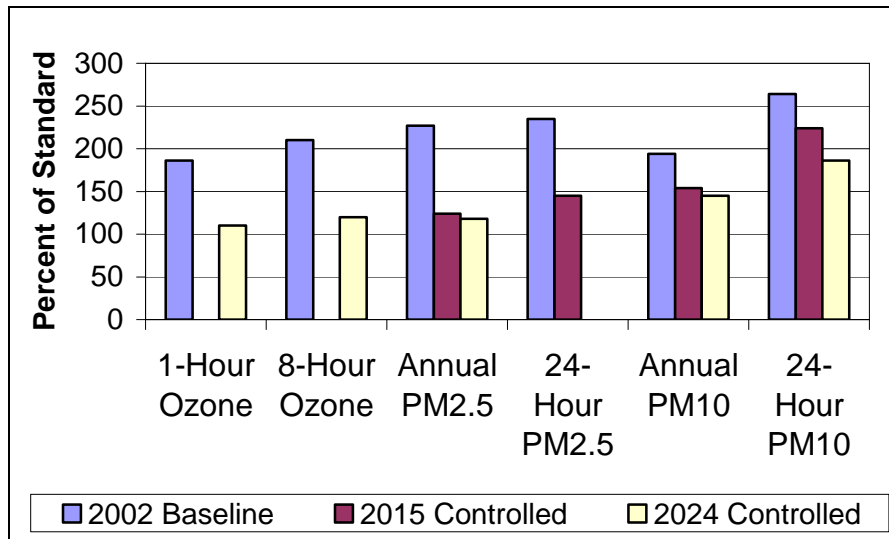


- Secondary Emissions from Mobile Sources: The overall impact of mobile sources due implementation of the control measures has been considered less than significant for all pollutants. These emissions were largely associated with the increased transportation of oxygenates.
- Secondary Emissions from Miscellaneous Sources: The impacts of the short-term control measures on secondary emissions from miscellaneous sources were determined to be less than significant.
- Non-Criteria Pollutants: There is a potential that the exempt compounds may create air quality impacts if the exempt solvents contain toxic compounds that are not regulated by the state and federal TAC programs or by the SCAQMD's TAC rules. The potential impacts will need to be analyzed for each control measure during the rulemaking process. Some measures for motor vehicle and transportation source categories would reduce emissions of toxic components of gasoline such as benzene, toluene, and xylene. Use of alternative fuels may increase methanol and aldehyde emissions. Electrification may cause greater emissions of benzene, aldehydes, metals, and polynuclear aromatic hydrocarbons from fuel-based power generating facilities. However, if the process being electrified was previously powered by direct combustion of fossil fuels, then electrification may result in an overall decrease in toxic emissions. No significant secondary air quality impacts were identified from non-criteria pollutants, so no mitigation measures are required.
- Global Warming and Ozone Depletion: The 2007 AQMP is expected to have a net effect of reducing emissions of compounds that contribute to global warming and ozone depletion so that no significant adverse impacts are expected.
- Ambient Air Quality: The 2007 AQMP is expected to (1) attain the eight-hour federal ozone standard by 2024; (2) maintain compliance with state and federal NO<sub>2</sub> standards (even considering the increase in population growth); (3) maintain compliance with state and federal SO<sub>2</sub> standards (even considering the increase in population growth); (4) maintain compliance with the federal 24-hour average PM<sub>10</sub> standard; (5) attain the federal annual PM<sub>2.5</sub> standard by 2015; and, (6) maintain compliance with the federal 24-hour PM<sub>2.5</sub> standard (see Figures 4.1-7 and 4.1-8).



**FIGURE 4.1-7**  
**Projection of Future Air Quality in the Basin in Comparison with the Most Stringent Federal Standards**

As shown in Figure 4.1-7, the 2007 AQMP is not expected to change compliance with the most stringent California state standards.



**FIGURE 4.1-8**  
**Projection of Future Air Quality in the Basin in Comparison with Most Stringent California State Standards**