CHAPTER 5

FUTURE AIR QUALITY

INTRODUCTION

Air quality modeling is an integral part of the planning process to achieve clean air. As mentioned in Chapter 1, the submittal of the 2003 California Ozone SIP served as the ozone attainment demonstration for the South Coast Air Basin and those portions of the Southeast Desert Modified Nonattainment Area which are under the District's jurisdiction. The attainment demonstrations provided in this Proposed Modifications to the Draft 2007 AQMP reflect the updated emissions baseline estimates, new technical information, enhanced air quality modeling techniques, and the control strategy provided in Chapter 4.

The Basin is currently designated Nonattainment for PM2.5, and Severe-17 nonattainment for ozone. The District will request that U.S. EPA accept a voluntary reclassification for the Basin from "Severe-17" to "Extreme" nonattainmnet through the Governing Board's adoption of this Draft Final AQMP and resolution. This action will enable the use of long-term measures in the control strategy and extend the attainment date to June 15, 2024. These two pollutants PM2.5, and ozone - are linked to common precursor emissions. The District's goal is to develop an integrated control strategy which: 1) ensures that ambient air quality standards for all criteria pollutants are met by the established deadlines in the federal Clean Air Act (CAA); and 2) achieves an expeditious rate of reduction towards the state air quality standards. The overall control strategy is designed so that efforts to achieve the standard for one criteria pollutant do not cause unnecessary deterioration of another. A two-step modeling process has been conducted for the Draft 2007 AQMP. First, future year annual and 24-hour average PM2.5 is simulated to demonstrate attainment by 2015. The future year 8-hour average ozone emissions control strategy then builds upon the PM2.5 strategy to demonstrate attainment of the federal 8-hour average ozone standard in 2024. This two-step approach is consistent with the approach used in the 2003 AQMP to first demonstrate attainment in 2006 of the PM10 standard and subsequent attainment of the 1-hour average ozone standard in 2010.

During the development of the 2003 Plan, the District convened a panel of seven experts to independently review the regional air quality modeling conducted for ozone and PM10. The consensus of the panel was for the District to move to the more current state-of-the-art dispersion platforms and chemistry modules. The model selected for the Draft 2007 AQMP attainment demonstrations is the Comprehensive Air Quality Model with Extensions (CAMx) [Environ, 2002], using SAPRC99 chemistry. Moreover, this model and chemistry package is consistent with the previous advice of the outside peer reviewers. CAMx is a state-of-the-art air quality model that can simulate ozone and PM2.5 concentrations together in a "one-atmosphere" approach for the attainment demonstrations.

On February 24, 2006, CARB forwarded the District's request to U.S. EPA to redesignate the Basin attainment for carbon monoxide. Air quality monitoring data measured from 2001 through 2005 indicated that the standard had been achieved and currently continues to be met. Future year projections of CO provided in the 2003 AQMP and projections from CARB's EMFAC2002 emissions model were used to support the redesignation request and provide the basis for a CO maintenance plan for the Basin. EPA's final approval of the redesignation request is currently pending.

On September 21, 2006 the U.S. EPA administrator signed the final documents that eliminated the existing annual PM10 standard. Only one Basin monitoring station (Riverside-Rubidoux) reports annual levels of PM10 that exceeds the revoked standard. It is expected that the Rubidoux will continue to nominally exceed the federal standard in 2006. In spite of EPA's recent decision on the annual PM10 standard, efforts are underway to work towards meeting the attainment target to protect public health and assist in on-going compliance of the retained 24-hour PM10 standard in the Basin.

Detailed information on the modeling approach, data gathering, model development and enhancement, model application, and interpretation of results is presented in Appendix V. The following sections summarize the results of the modeling efforts. Future ozone air quality projections for the Coachella Valley are presented in Chapter 8 and in Appendix V.

MODELING APPROACH

Design Values and Relative Response Factors (RRF)

The Draft 2007 AQMP modeling approach to demonstrate attainment of the air quality standard relies heavily on the use of design values and relative response factors to translate regional modeling simulation output to the form of the air quality standard. Both ozone and PM2.5 have standards that require three consecutive years of monitored data, averaged by a designed form, to assess compliance. In the case of ozone, compliance to the standard is determined from a three year average of the 4^{th} highest daily ozone 8-hour average concentration. The PM2.5 annual design value is determined from quarterly average PM2.5 concentrations, averaged by year, for a three year period. For the 24-hour average PM2.5 design value, the 98^{th} percentile daily concentration sampled from a year is selected and then averaged for a three year period. The complexity of the design values does not lend itself to a direct attainment demonstration that relies on explicit air quality model simulation predictions of future air quality based on one or several meteorological episodes.

Design Value Selection

EPA guidance recommends the use of multiple year averages of design values, where appropriate, to dampen the effects of single year anomalies to the air quality trend due to factors such as adverse or extremely favorable meteorology or radical changes in the local emissions profile. For Basin 8-hour average ozone, the trend of the design values (depicted in Figure 5-1a.) is relatively unchanged between 2001 and 2005. Given this configuration, a three-year weighted average of the design values is representative of the design value centered around 2002, the preferred year for the baseline inventory development and is used in the ozone attainment demonstration.

The trend in the Basin PM2.5 design values from 2001 through 2005 (Figure 5-1b) is significantly different from ozone, depicting a sharp reduction in concentration over the period. The design value for 2001 is 30.1 μg/m3 while the 2005 design value (based on data from 2003, 2004 and 2005) is 22.6 μg/m3. The reduction of seven and one half micrograms per cubic meter occurred for the same meteorology as the ozone design trend. Similar reductions can be observed in the component contributions of nitrate and sulfate in the PM10 FRM data over the same period. Since the trend in PM2.5 is ~~consistently~~ steadily moving in the direction of air quality improvement, it is more reasonable to use a representative design value that is not locked in a multiple year average that overly reflects data that are not consistent with the current air quality trend. The 2005 design value includes the speciated data (monitored in 2005) that is used in the attainment demonstration. Furthermore, if the preliminary 2006 PM2.5 data are included in the analysis, the revise weighted design value centered around 2005 (including data from 2003 through 2006) would be 22.7 $\mu g/m^3$, essentially the same value as the 2005 design of 22.6 $\mu g/m^3$~~. It is more consistent to use a design that reflects the speciated data (monitored in 2005) that is used in the attainment demonstration.~~ To reflect the ambient trend of PM2.5 and preserve data consistency, the PM2.5 attainment demonstration is based on the 2005 design value.

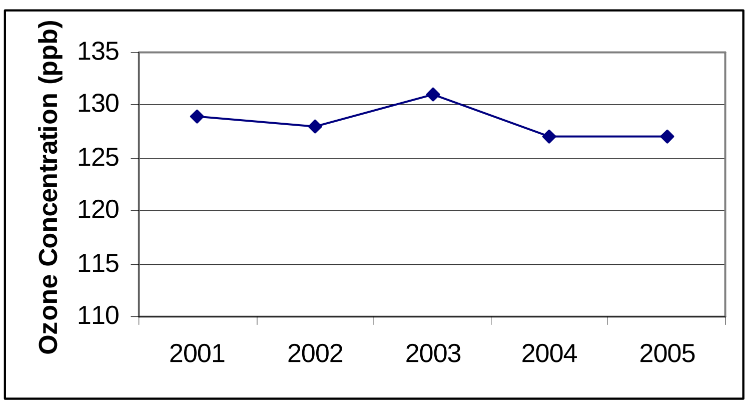

FIGURE 5-1a

South Coast Air Basin 8-Hour Ozone Design Values
(Each value represents the 3-year average of the 4th highest ozone concentration)

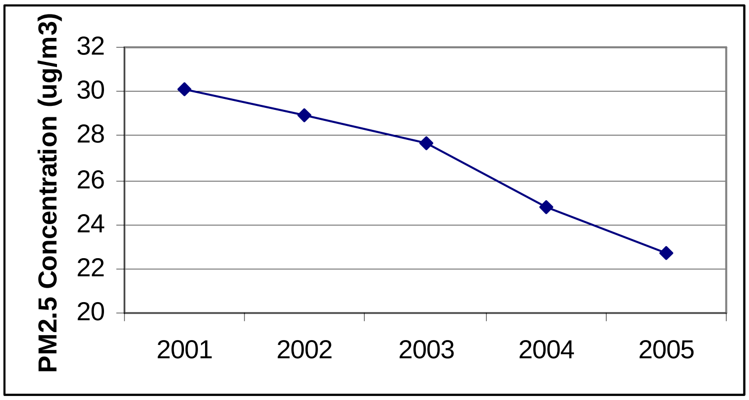

FIGURE 5-1b

South Coast Air Basin Annual PM2.5 Design Values
(Each value represents the 3-year average of the highest annual average PM2.5 concentration)

<u>Relative Response Factors and Future Year Design Values</u>

To bridge the gap between air quality model output evaluation and applicability to the health based air quality standards, EPA guidance has proposed the use of relative response factors (RRF). The RRF is simply a ratio of future year predicted air quality with the control strategy fully implemented to the simulated air quality in the base year. The attainment demonstration consists of multiplying the non-dimensional RFF to the base year design value to predict the future year design value. Thus, the simulated improvement in air quality, based on one or more meteorological episodes, is translated as a metric that directly determines compliance in the form of the standard. Equations 5-1 and 5-2 summarize the calculation.

Eq 5-1.

RRF = Future-Year Model Prediction / Base-Year Model Prediction

Eq 5-2.

Attainment Demonstration = RRF X Design Value ≤ Air Quality Standard

The modeling analyses described in this chapter use the RRF and design value approach to demonstrate future year attainment of the standards.

PM2.5

Within the Basin, PM2.5 particles are either directly emitted into the atmosphere (e.g., primary particles), or are formed through atmospheric chemical reactions from precursor gases (e.g., secondary particles). Primary PM2.5 includes road dust, diesel soot, combustion products, and other sources of fine particles. Secondary products, such as sulfates, nitrates, and complex carbon compounds are formed from reactions with oxides of sulfur, oxides of nitrogen, VOCs, and ammonia.

The Draft 2007 AQMP employs CAMx using the "one atmosphere" approach comprised of the CB-IV gas phased chemistry and a static two-mode particle size aerosol module as the particulate modeling platform. The CAMx "one atmosphere" chemistry approach preserves mass consistency and takes advantage of an advanced dispersion platform. Parallel testing was conducted to evaluate the CAMx/AERO-LT performance against CAMx and the results indicated that the two model/chemistry packages performance were similar.

Speciated PM2.5 data measured at 8-sites from the Multiple Air Toxic Evaluation Program (MATES-III) conducted during 2005 provided the characterization for evaluation and validation of the CAMx annual and episodic demonstrations.

The following section summarizes the PM2.5 modeling approach conducted in preparation for this Plan. Details of the PM2.5 modeling are presented in Appendix V.

Annual PM2.5 Modeling Approach

The Draft 2007 AQMP annual average PM2.5 modeling employs a deterministic approach to demonstrate attainment of the PM2.5 in 2015. CAMx was used to simulate 2005 meteorological and air quality to determine Basin annual average and episodic PM2.5 concentrations. Model performance was evaluated against speciated particulate PM2.5 air quality data for ammonium, nitrates, sulfates, secondary organic matter, elemental carbon, primary and total particulate mass for eight MATES-III monitoring sites (Los Angeles, Anaheim, Wilmington, Long Beach, Compton, Burbank, Rubidoux, and Fontana). The future year attainment demonstration was analyzed for 2015, the target set by the federal CAA. The 2015 simulation relied on projected controlled emissions for 2014, thus enabling a full year-long demonstration based on a control strategy that would be fully implemented by January 1, 2015.

Future year PM2.5 air quality was determined using site and species specific relative response factors applied to 2005 PM2.5 design values per EPA guidance documents. The air monitoring station design values were calculated using the federal reference method Source Selective Inlet (SSI) High-Vol PM2.5 data measured from 2003-2005. The SSI PM2.5 data were apportioned by species based on the distribution observed in the MATES-III data. This enabled a direct comparison of the total PM2.5 mass to the design value and standard. The breakdown by species provided guidance to the development and effectiveness of the control strategy.

CAMx was simulations used the same region (5 km squared grid, 280 easting and 3650 northing, 65 by 40 grid cells) as that used for the 2003 UAMAERO-LT analyses. The vertical structure was increased to 11 layers (compared with the 5-layer analysis of UAMAERO-LT) but less than the 19 layers used for the MM5 simulations in effort to conserve computational resources. MM5 was used to generate the meteorological profile for each day in 2005. The MM5 simulations were generated for the larger SCOS97 modeling domain employing a 5 km square grid and fit to the smaller PM2.5 grid. The MM5 simulations were initialized from NCEP analyses and run for 5-day increments without the option for four dimensional data assimilation (FDDA).

Point source emissions were extracted from the District stationary source and RECLAIM inventories. Mobile source emissions included weekday, Saturday and Sunday profiles based on CALTRANS weigh-in-motion and vehicle population data. Monthly anthropogenic and biogenic emissions were temperature and humidity corrected. Monthly boundary conditions were derived from the Western Regional Air Partnership Regional Haze CMAQ simulations. As with the 2003 AQMP, the simulations benefited from enhancements made to the emissions inventory including updated an ammonia inventory, improved emissions characterization that split organic compounds into coarse, fine and primary categories, and updated spatial allocation of primary paved road dust emissions.

Calculation of the future year design value for the eight sites was based on quarterly modeling performance (base and future year controlled) and the 2005 quarterly design values (based on 2003, 2004 and 2005 observed data). Table 5-1 provides the 2005 quarterly, annual and 24-hour average annual PM2.5 design values for the Basin.

Episodic 24-Hr Average PM2.5 Modeling Approach

Per PM2.5 guidance, two options are provided to determine RRFs for the future year 24-hour average PM2.5 attainment demonstration. The first option uses episodic modeling with day-specific emissions for representative meteorological episodes to calculate RRFs. The Draft 2007 AQMP uses the second approach proposed by EPA that relies on the annual model performance.

For this approach, the 2005 observational data are sorted by quarter of year and further into the top 25 percent of days in each quarter. PM2.5 RRFs ~~are~~were calculated on a quarterly basis from the future and base year annual simulations for only those days in the top 25 percentile per quarter. The quarterly RRFs are then applied to the quarterly 24-hour average PM2.5 design values to develop quarterly future year design values which are later aggregated into an annual 24-hour future year design value to assess attainment. (The quarterly 24-hour average PM2.5 design values were comprised of the

98th percentile data in each quarter for the years 2003, 2004 and 2005). ~~The quarterly 24-hour average PM2.5 design values are presented in Appendix V).~~

Weight of Evidence

PM2.5 modeling guidance strongly recommends the use of corroborating evidence to support the future year attainment demonstration. The weight of evidence demonstration for the 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. Detailed discussions of all model results and the weight of evidence demonstration are provided in Appendix V.

TABLE 5-1

PM2.5 2005 Design Values* (μg/m^3)

Monitoring Site	Quarter-1	Quarter-2	Quarter-3	Quarter-4	Annual	24-Hours
Anaheim	17.6	12.4	15.4	20.0	16.3	47.0
Azusa	16.2	15.9	21.1	19.6	18.2	54.2
Big Bear	12.8	8.0	7.7	14.7	10.8	30.3
Burbank	18.7	15.2	20.7	24.3	19.7	53.3
Los Angeles	19.7	16.3	20.2	22.2	19.6	60.7
Fontana	18.7	19.2	20.2	23.2	20.3	54.8
Long Beach	18.0	12.7	15.7	22.9	17.3	44.6
Lynwood	19.3	14.6	18.3	22.9	18.8	51.3
Mission Viejo	12.0	10.2	12.7	12.9	11.9	33.5
Ontario	21.0	17.9	20.5	25.3	21.2	58.8
Pasadena	15.5	14.6	18.6	18.5	16.8	46.0
Pico Rivera	20.3	14.4	18.8	23.2	19.2	52.2
Reseda	14.3	13.4	15.9	17.8	15.4	47.0
Magnolia	18.9	19.8	20.6	22.5	20.5	49.0
Rubidoux	21.2	21.9	22.6	24.9	22.6	64.8
San Bernardino	18.2	20.3	21.6	21.8	20.5	58.1

* Calculated based on quarterly observed data between 2002 - 2005

Ozone

The CAA requires that ozone nonattainment areas designated as serious and above use a photochemical grid model to demonstrate attainment. As previously discussed, the 2003 AQMP ozone attainment demonstration relied upon UAM as the photochemical modeling platform for the analysis. Responding to the recommendations of the expert panel as well as EPA updated ozone modeling guidance, the Draft 2007 AQMP 8-hour ozone standard attainment demonstration was conducted using CAMx (version 4.4) with SAPRC99 as the primary modeling tool. Performance statistics and model inputs are discussed extensively in Appendix V.

Modeling Approach

CAMx simulations were conducted using a Lambert Conformal grid projection overlayed on the 5 km squared grid over the SCOS97 modeling domain. The modeling analyses were run using 16 vertical layers up to 5000 m above ground level. Per EPA modeling guidance, since the CAMx regional modeling is based on a 5 km squared grid, the ozone performance evaluation and peak RRF calculation is based on a comparison of the observed concentration and the predicted concentration within a 15 km radius of the grid hosting the observation. (Data are evaluated for a 7 X 7 grid area).

CAMx simulations were generated for six meteorological episodes: one in 2004, four in 2005 and one in 1997. The August 1997 SCOS97 meteorological episode was retained for this analysis to provide linkage to the 2003 AQMP attainment demonstration. Table 5-2 characterizes the episodes two ways: first by an assessment of the meteorological profile using a statistical model to rank the episodes based on meteorological stagnation potential and second by comparing observed 8-hour average maximum ozone concentrations to the annual design values. The meteorological classification is based on an empirical analysis presented in the 2003 AQMP which provides both a stagnation severity rank (1 being the highest) and the percentile the meteorological episode had in a 22-year distribution. The observed maximum 8-hour average concentrations on each episode day, and the average of the 8-hour maximum concentrations observed for each multi-day episode are also provided for comparison to the annual 4th highest 8-hour average ozone value observed in the year that the episode takes place.

Briefly, the selected episode days mostly rank in the 95th percentile or higher for meteorological stagnation potential. (Note: the meteorological classification scheme was developed using 1-hour maximum ozone as the classifying variable. Confirmatory analyses indicate that in the Basin the 1-hour ozone episodes are a subset of the 8-hour episodes and that the meteorological profile required to generate each event are essentially equivalent). As shown in Table 5-2, the episode average of the 8-hour maximum concentrations is either equal to or with 12 ppb of the annual 4th highest 8-hour observed concentration for four of the six simulation periods. The episodes failing to meet this criterion were characterized by more severe stagnation and higher average concentrations.

The five episodes observed in 2004 and 2005 occurred during MATES-III, a period of enhanced air quality monitoring in the Basin. Supporting MATES-III, the District operated three radar wind profilers in the Basin, with radio acoustic sounders. Additional profiler data was obtained from operating sites in Ventura and San Diego Counties. Routinely monitored surface and upper air measurements augmented the enhanced field program sampling.

Selection of episodes from 2004 and 2005 attempted to minimize the impact of Phase III California Fuel Reformulation in 2003 where the primary oxygenate was changed from MTBE to ethanol. Commingling of ethanol and non-ethanol based fuels leads to enhanced evaporative VOC emissions and thus more ozone. Quantification of the amount of commingling taking place on a daily or episodic basis was nearly impossible. Implementation of the fuel switch from MTBE to ethanol took place in California during 2003 and was assumed to be completed by December 31, 2003. Selecting meteorological episodes post 2003 reduced the uncertainty associated with the estimation of the VOC emissions inventory due to commingling.

The meteorological fields used for the CAMx ozone simulations were generated using MM5 with the FDDA option. The meteorological fields were developed using a Lambert Conformal grid that roughly overlaid the SCOS97 modeling domain. MM5 was simulated using 34 vertical layers and simulations were initialized using NCEP global weather forecast model analysis. The MM5 fields were post processed to layer averaged winds to the levels defined for the CAMx simulations. ~~and to adjust coordinates to the UTM system.~~

TABLE 5-2

Ozone Meteorological Episodes Used for the Ozone Attainment Demonstration
Ranking Applied to Historical 22-Year Period (1981-2002)

Episode	Stagnation Severity Rank	Percentile	8-Hour Maximum Ozone (ppb)	Episode Average 8-Hour Maximum Ozone (ppb)	Annual 4th Highest Observed 8-Hour Maximum Ozone /Station (ppb)
8/4/1997	570	93	110	124	127 San Bernardino
8/5/1997	198	98	124		
8/6/1997	203	97	130		
8/7/1997	515	95	130		
8/7/2004	331	96	127	125	116 Crestline
8/8/2004	144	98	122		
5/21/2005	389	95	112	129	125 Crestline
5/22/2005	50	99	145		
7/15/2005	265	96	143	132	
7/16/2005	22	99	141		
7/17/2005	15	99	141		
7/18/2005	73	99	127		
7/19/2005	567	93	110		
8/4/2005	270	97	108	113	
8/5/2005	399	95	110		
8/6/2005	288	96	119		
8/7/2005	341	96	114		
8/27/2005	160	98	130	126	
8/28/2005	138	98	121		

Day specific point, mobile and area emissions inventories were generated for each meteorological episode. Mobile source emissions were temperature corrected by grid using a VMT weighted scheme. County-wide area source emissions were temperature corrected and gridded using the spatial emissions surrogate profiles developed for the 2003 AQMP. Appendix V presents a more detailed description of the meteorological episode selection, meteorological modeling and validation and the episodic emissions inventory development.

Application of RRF's

Unlike the regional ozone modeling conducted for the 2003 AQMP that based the attainment demonstration on the direct results of a future year simulations, the procedure for determining future year attainment of the 8-hour ozone standard for the Draft 2007 AQMP relies on the use of site specific RRF's determined from a series of simulations for the 2002 and 202~~0~~3 controlled emissions. The basic procedure is outlined earlier in this chapter. The ozone attainment demonstration is anchored by the 2002 base-year emissions. The meteorological episodes are first validated based on model performance in the using day-specific emissions for each base-case (e.g. 1997, 2004 or 2005). The suites of validated episodes are then simulated using the 2023 controlled and 2002 emissions to determine a site specific average set of RRFs. The site specific RRF is applied to the 2002 design value to determine whether attainment has been satisfied.

A minimum of 5-episode days are recommended to determine the site specific RRF. The evaluation requires that the model performance for the day is within specific performance goals. The criteria to select an episode station day to be used in the RRF calculation included:~~ing~~ (1) the base-year observed concentration lie with 25 percent of the station design value, (2) the absolute prediction accuracy (predicted minus observed in the base- year) is within 25 percent and (3) that a minimum base-year observed concentration at each site used in the analysis ~~exceeds 70 ppb or~~ is ~~simulated at~~ 85 ppb or greater. A maximum of 19 episode days were evaluated for inclusion in the RRF calculation. If a site did not meet the 5-episode day threshold, the smaller reduction determined from either the average of the RRFs for all Basin sites or the 19 day average RRF from that site, regardless of model performance, was applied to estimate the future design value at that station.

Weight of Evidence

As with PM2.5 the modeling guidance strongly recommends the use of corroborating evidence to support the future year ozone attainment demonstration. The weight of evidence demonstration for the Draft 2007 AQMP includes the trends of ozone air quality (see Chapter-2 and Appendix II), population exposure (Chapter-6) and emissions trends analyses (Chapter-3 and Appendix III), and supplemental air quality simulations for 2010 (1-hour and 8-hour average impacts), 201~~3~~2 and 201~~8~~7. Additional model sensitivity simulations including stress tests and varying base and future year modeling emissions are presented ~~and discussed. Detailed discussions of all model results and the weight of evidence demonstration are provided~~ in Appendix V.

Carbon Monoxide

As discussed above, the request to re-designate the Basin attainment for the 8-hour federal CO standard has been forwarded to U.S. EPA and is currently being evaluated. No additional regional or hot-spot monitoring is provided in the Draft 2007 AQMP to further demonstrate attainment of the 8-hour average ozone standard.

PM10

~~As previously discussed, o~~On September 21, 2006 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 µg/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).

For this analysis, the annual second maximum concentration is used for the attainment demonstration (given the standard allows for one violation annually). Riverside Rubidoux has been the PM10 24-hour design site in nine of the past ten years when high wind days have been excluded from the analysis. The 2005 design value at Rubidoux is 86 percent of the federal standard. The standard attainment demonstration is conducted to assure that the Basin will continue to be in compliance in future years.

As a conservative analysis, only emissions reductions associated with the PM2.5 portion of the 24-hour PM10 concentration are assumed to be impacted by future year emission controls. Future year predictions of maximum and second maximum 24-hour average PM10 are calculated using the site specific annual average PM2.5 RRFs applied to the PM2.5 portion of the PM10 design concentration. The average PM2.5 RRFs calculated for the eight sites are applied to the fine portion of the 24-hour PM10 distribution for sites other than the MATES III which have the PM2.5 speciation. The coarse portion of the PM10 is assumed to be held constant in this analysis. The predicted reductions to the fine portion are then added to the coarse to estimate a 2015 second maximum PM10 24-hour average concentration.

Visibility

In July 1999, U.S. EPA adopted the federal Regional Haze Regulations [40 CFR Part 51] to address Section 169A of the CAA which set forth a national goal for future visibility with specific focus to remedy any visibility impairments to Class I areas nationwide. States are required to provide to EPA emissions reduction strategies to improve visibility in all mandatory Class I national parks and wilderness areas. In response to the requirements of the regulations, California joined the Western Regional Air Partnership (WRAP), a multi-agency organization that is coordinating implementation of the regional haze rules. States with PM2.5 non-attainment areas are require to submit "haze plans" to EPA within 3-years following PM2.5 designation and develop future year (2018) inventories of emissions that lead to visibility reduction. The ARB has assumed the responsibility for the plan and inventory development requirements for the state.

The emissions reductions needed to attain the PM2.5 standard in the Basin will directly contribute to improved future year visibility. California continues to maintain a state standard for visibility structured to reduce aerosol particles (8-hour average) that contribute to an extinction coefficient value of 0.23 per kilometer (or 10 miles of visual range) when relative humidity is less than 70 percent. The previous form of the standard assessed the number of days when visual range was less than 10 miles for the same humidity consideration. Visibility is among the strongest indicators to air quality and its value is paramount. As such, future year visibility is used in the socioeconomic evaluation of the AQMP to estimate monetary benefits that arise from improved visual range through the implementation of the plan. Future-year visibility in the Basin is projected empirically using the results derived from a regression analysis of visibility with air quality measurements. The regression data set consisted of aerosol composition data collected during a special monitoring program conducted concurrently with visibility data collection (prevailing visibility observations from airports and visibility measurements from District monitoring stations). A full description of the visibility analysis is given in Technical Report V-C of the 1994 AQMP.

FUTURE AIR QUALITY

PM2.5

Under the federal Clean Air Act, the Basin must comply with the federal PM2.5 air quality standards by April, 2010 [Section 172(a)(2)(A)]. An extension of up-to five years could be granted if attainment cannot be demonstrated and all feasible measures have been adopted and incorporated~~several other conditions are satisfied~~. A simulation of 2010 annual average PM2.5 was conducted to substantiate the severity of the PM2.5 problem in the Basin. The simulation used the projected emissions for 2009 which included all proposed and adopted control measures that will be implemented prior to 2010. The resulting 2010 future-year design value (17.9 $\mu g/m^3$) failed to meet the federal standard. As a consequence and as indicated in Chapter 1, the District is formally requesting U.S. EPA to grant the five-year extension based upon the severity of the problem and the modeled attainment demonstration that clearly indicates that significant reductions in daily emissions of PM2.5, NOx, VOC and SOx are required to meet the 2015 attainment date.

Figure 5-2-depicts future annual average PM2.5 air quality projections at eight PM2.5 monitoring sites having comprehensive particulate species characterization compared to federal and state annual PM2.5 standards, respectively. Shown in the figure, are the baseline design for 2005 along with projections for 2015, and 2024 with control measures in place. All sites will attain the federal annual standard by the year 2015. None of the sites will meet the state annual PM2.5 standard (12 $\mu g/m^3$) by 2015.

Implementation of the 8-hour ozone control strategy will continue to lower annual PM2.5 concentrations.

The projections for the 24-hour state and federal standards are shown in Figure 5-3. The results are similar to those for the annual standards. All areas will be in attainment of the federal 24-hour standard (65 $\mu g/m^3$) by 2015. However, as shown in Figure 5-3, the Draft 2007 AQMP does not achieve the revised 24-hour PM2.5 standard (35 $\mu g/m^3$) by 2015 or 2024. Additional controls are needed. California does not have a separate 24-hour PM2.5 standard.

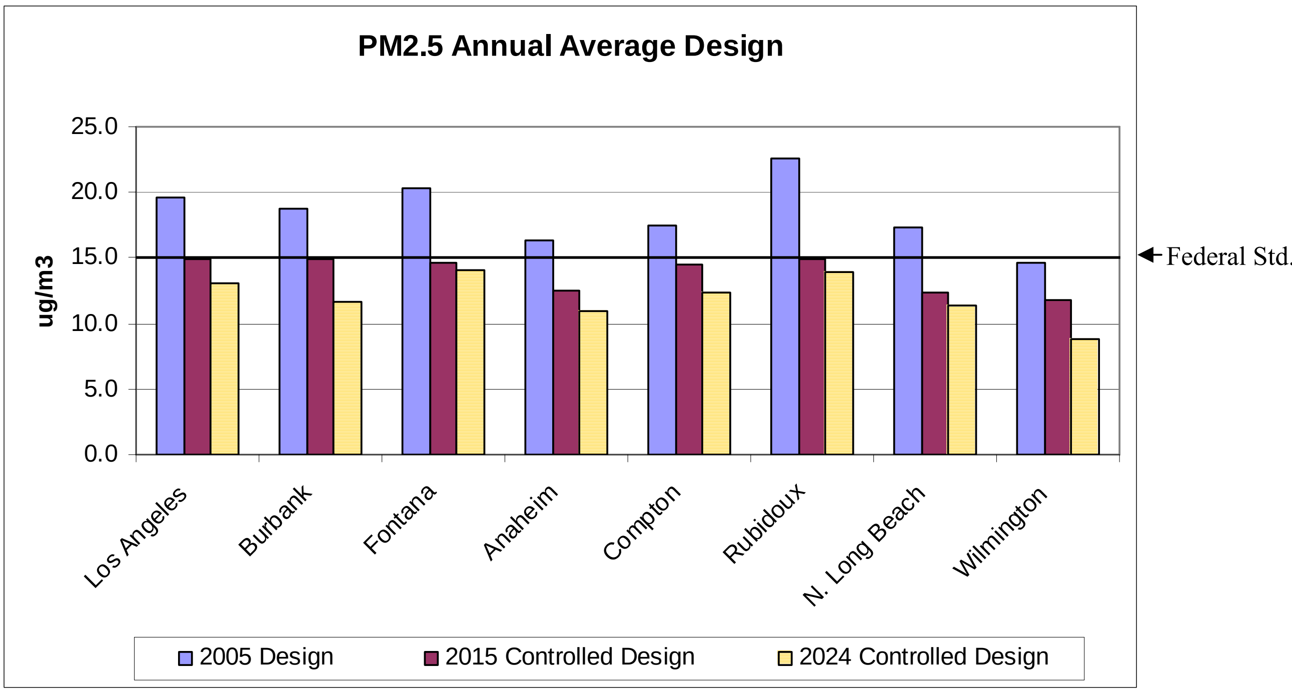

FIGURE 5-2

Annual Average PM2.5 Design Concentrations:
2005, 2015 Controlled, and 202~~1~~4 Controlled

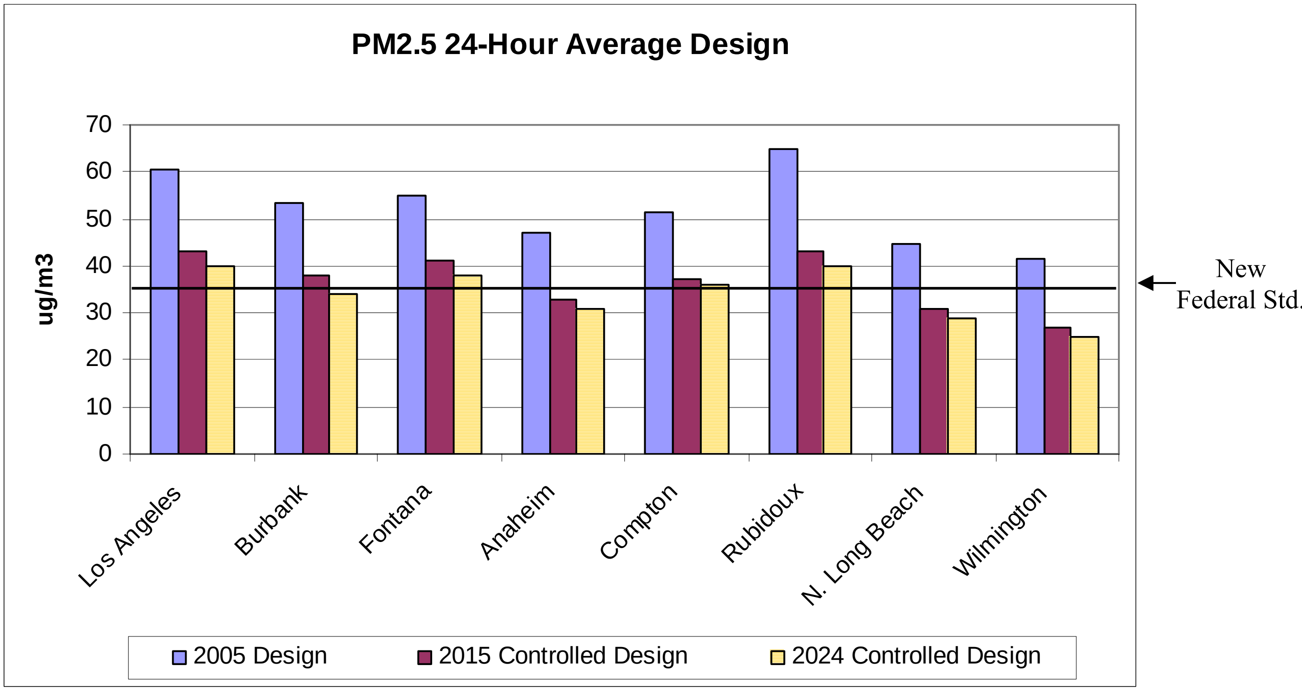

FIGURE 5-3

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

Spatial Projections of PM2.5 Design Values

Figures 5-4 through 5-6 provide a Basin perspective of the spatial extent of annual average PM2.5 impact in the base year 2005 and in 2015, with and without the control strategy being implemented. In each figure the PM2.5 annual average design values based on either observations at the air monitoring stations (2005) or simulations (2015) are interpolated throughout the Basin. Figure 5-4, depicts the 2005 distribution based on observation data, where the design value concentrations range from below 10 µg/m^3 to above 22 µg/m^3. As discussed in Chapter 2, the peak concentrations occur in the east Basin communities of northwest Riverside and Southwest San Bernardino Counties. ~~By 2015, w~~Without implementing the control strategy (Figure 5-5), 2015 projected ~~simulated~~ PM2.5 design values will be reduced. However, projected concentrations will continue to exceed the standard through a large portion of the Basin. With the control strategy implemented in 2015, (see Figure 5-6), all areas of the Basin will meet the federal standard.

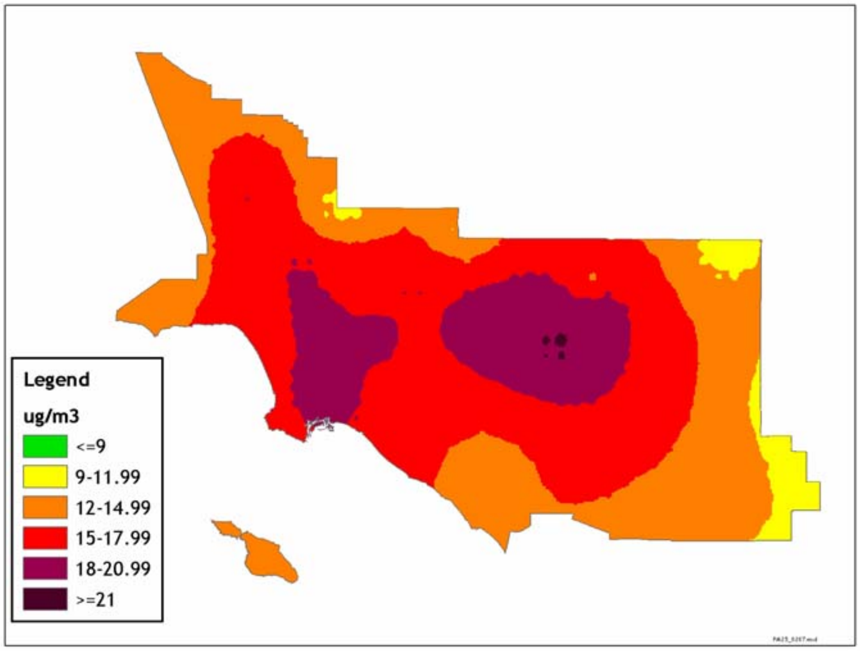

FIGURE 5-4

2005 Baseline Annual PM2.5 Design Concentrations (µg/m^3)

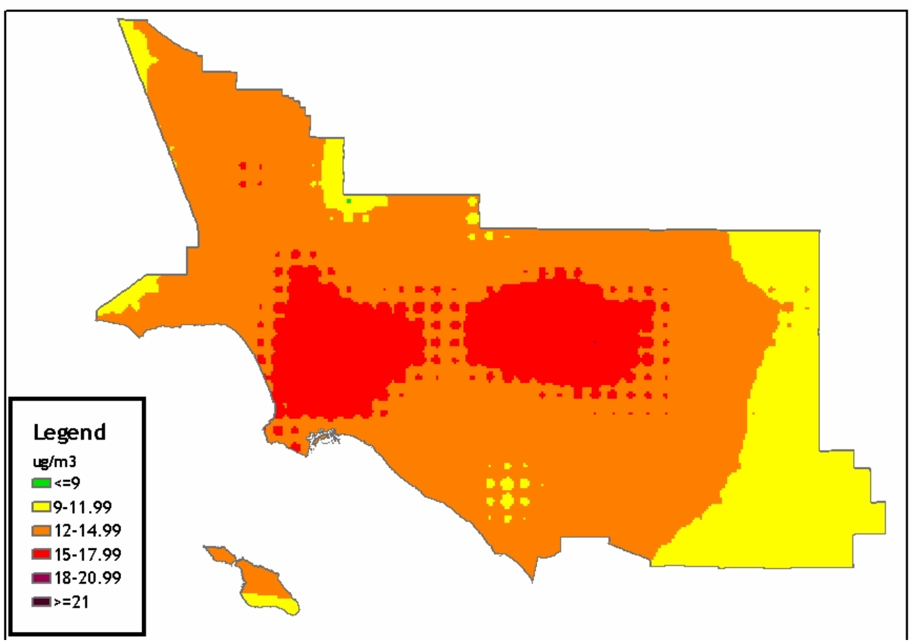

FIGURE 5-5

2015 Baseline Annual PM2.5 Design Concentrations (µg/m^3)

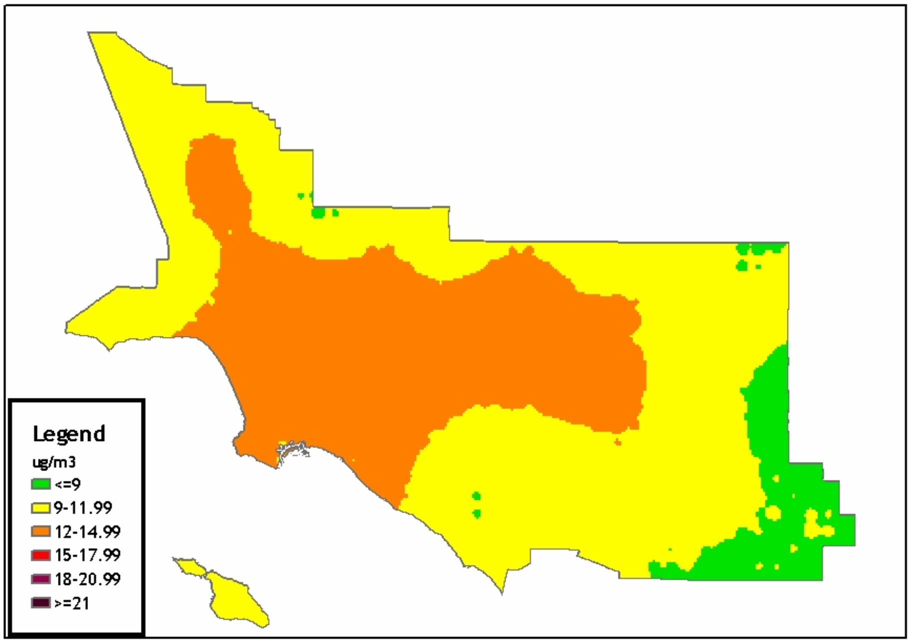

FIGURE 5-6

2015 Controlled Annual PM2.5 Design Concentrations (µg/m^3)

Control Strategy Choices

PM2.5 has five major precursors that contribute to the development of the aerosol including ammonia, NOx, SOx, VOC, and directly emitted PM2.5. Various combinations of reductions in these pollutants could all provide a path to clean air. The attainment strategy presented in this Draft 2007 AQMP relies on the maximum extent possible reductions of SOx, direct PM2.5, followed by VOC and NOx. As discussed in Chapter 4, the proposed strategy focuses on the reductions of SOx and primary PM2.5 through cleaner marine fuels and extensive diesel trap retrofits respectively.

It is useful to weigh the value of the per ton precursor emissions to microgram reductions of PM2.5. Recent trends of PM2.5 and NOx emissions suggest a direct response between lower emissions and improving air quality. This weight of evidence discussion is valuable to the control strategy development however, the formation of PM2.5 is non-linear and as such individual precursors contribute differently to the overall mass. The CAMx simulations provide a relative rate of reduction per ton of emissions reduced based on complex aerosol chemistry. Similarly, linear rollback can also provide a weight of evidence directional rate of reduction but no interaction among species is assumed in the analysis. This is a major limitation because interactions between VOC and NOx are critical to secondary aerosol formation and the competition between SOx and NOx for ammonium sets the rate of formation of sulfates and nitrates. In general, the rollback calculation will provide a ballpark estimate of the range of emissions reductions needed to attain the standard but can't be relied on for an attainment demonstration. Using the simulated chemistry provides individual precursor to pollutant weighting to estimate a per ton reduction currency. For PM2.5, the simulations determine that VOC emissions reductions have the lowest return in terms of micrograms reduced per ton reduction. NOx reductions are approximately three times more effective in lowering PM2.5 concentrations but not as effective as ~~sulfate~~ SOx and direct PM2.5 emissions reductions. Table 5-34 summarizes the relative importance of precursor emissions reductions to the analysis.

The District's proposed control strategy maximizes reductions of direct PM2.5 and SOx to the extent possible due to their effectiveness as well as the likelihood schedule of implementation within the next seven years. Substantial additional VOC and NOx emissions reductions are also required for attainment. However the strategy, nonetheless attempts to maximize the potential PM2.5 concentration reduction per identified ton precursor emissions reduction. Table 5-4 lists the mix of the four primary precursor's emissions reductions targeted for the SOx – PM2.5 focused approach.

During Plan preparation a series of sensitivity model runs were performed indicating that it is possible to demonstrate attainment using lower SOx (50%), VOC (10%) and direct PM2.5 (5%) emissions while substantially higher NOx controls (50%). It would require an additional 105 TPD of NOx emissions reductions.

TABLE 5-34

Relative Contributions of Precursor Emissions Reductions to Simulated Controlled Future-Year PM2.5 Concentrations

Precursor (TPD)	PM2.5 Component (μg/m^3)	Standardized Contribution to Mass
VOC	Organic Carbon	Factor of 1
NOx	Nitrate	Factor of 3
PM2.5	Elemental Carbon & Others	Factor of 5
SOx	Sulfate	Factor of 10

TABLE 5-45

Draft 2007 AQMP
PM2.5 Attainment Strategy
Allowable Emissions (TPD)

	VOC	NOx	SOx	PM2.5
2014 Baseline	5278	654	43	102
Allowable Emissions	469	454443	19	887
Reduction	11%	31%	56%	145%

PM10

Dependent upon the PM10 sampling protocol (one-in-six days, one-in-three days, or daily) either the annual maximum or 2^{nd} maximum is used to determine compliance. As such, the future year (2015) assessment of the PM10 compliance to the 24-hour standard is conducted by examining the both the predicted maximum and 2^{nd} maximum for all Basin stations. Table 5-56 summarizes the results of the analysis.

In general, all monitoring locations in the Basin are predicted to continue to meet the federal 24-hour PM10 standard through 2015. While the bulk of the sites are predicted to have concentrations less than half of the current federal standard only one quarter of the locations are projected to meet the more restrictive California 24-hour average PM10 standard of 50 $\mu g/m^3$.

Ozone

As previously discussed in this chapter, the District will seek voluntary reclassification from Severe-17 to Extreme non-attainment. The reclassification request requires that a demonstration of the severity of the problem be made indicating that attainment would not be demonstrated using the 2020 controlled emissions and that long-term measures and additional time are required to meet the standard. A set of simulations were generated for the 2020 controlled emissions and with full implementation of all available short-term control measures the projected 2021 Basin maximum 8-hour average ozone design value (101 ppb) fails to meet the federal standard. With redesignation, the Basin will be ~~designated~~ classified as an Extreme non-attainment area, and must meet the federal 8-hour ozone air quality standard by 2024. The attainment demonstration shown here addresses this requirement.

~~As discussed earlier,~~ Days selected ~~days~~ from six meteorological episodes are used in the ozone attainment demonstration. The ozone modeling discussion differs from previous AQMP's in that future year attainment is projected using modeling results applied to a base year design value as opposed to being explicitly compared to the standard. The analysis is structured to address the form of the 8-hour standard which allows the standard threshold concentration (80 ppb) to be exceeded on three or more days in any year, under varying meteorological conditions. The design value accounts for the historical frequency of meteorological episodes that lead to higher ozone concentrations. In this analysis, base year (2002) and future year emissions (2023) are simulated for several meteorological episodes to develop an average response to reducing ozone precursor emissions. The response factor or RRF is calculated for each site that has a base year design value that exceeds the federal standard. The site-specific RRFs are applied to the base year design to estimate the future year (2024) design value for comparison to the standard.

Control Strategy Choices

Table 5-6~~7~~ summarizes the emissions inventories used for the 2002 and 202~~0~~3 baseline and the 202~~0~~3 controlled scenarios with and without long-term control measures. Without long-term measures, the regional modeling results indicate that the federal 8-hour ozone standard would not be attained. Attainment will require additional long-term emissions reductions based upon the development of new technology. The inclusion of the additional long term-control measures will require the District petition U.S. EPA prior to or at submittal of this Plan to revise the current attainment status from Severe-17 to Extreme to enable the use of long-term measures under Section 182(e)(5) of the CAA.

Episode-day-specific specific inventories that are temperature and humidity corrected are provided in Appendix V.

TABLE 5-56

24-Hour Average Maximum and Average 2nd Maximum Basin PM10:
2003-2005 Baseline Design and 2015 Controlled

City	2003-2005		2015 Controlled	
	Average Maximum (μg/m^3)	Average 2nd Maximum (μg/m^3)	Average Maximum (μg/m^3)	Average 2nd Maximum (μg/m^3)
Azusa	93	79	81	68
Burbank	82	73	72	62
Long Beach	96	63	76	50
Los Angeles	74	69	61	56
Santa Clarita	60	54	52	47
Hawthorne	53	61	46	53
Anaheim	78	67	68	58
Mission Viejo	51	44	42	40
Rubidoux	141	129	112	111
Perris	102	88	88	76
Banning Airport	79	55	68	48
Crestline	49	47	42	41
Fontana	105	96	97	87
San Bernardino	96	85	82	76
Redlands	80	70	69	61
Mira Loma	90	77	80	64

TABLE 5-6~~7~~

2002, 2023 Base Year and 2023 Future Year Controlled Emissions Scenarios (TPD)

Year	Scenario	VOC	NOx	CO
2002	Baseline	844	1096	4819
2023	Baseline	536~~496~~	506~~515~~	2057~~8~~
2023	Controlled without Long-Term Measures	448~~402~~	302~~317~~	2039~~2058~~
2023	Controlled with Long-Term Measures	420	114	2039~~1966~~

Table 5-7~~8~~ provides the 2002 base year design value, the predicted 2024 base year with out additional controls and the predicted 2024 design values with the control strategy implemented for the required monitoring sites in the Basin. With controls in place, it is expected that all stations in the Basin will meet the federal 8-hour ozone standard. The east Basin stations of Crestline and Fontana are projected to have the highest 8-hour controlled design values. Both sites are downwind receptors along the primary wind transport route that moves precursor emissions and developing ozone eastward during by the daily sea breeze. Future year projections of ozone along the northerly transport route through the San Fernando Valley indicate that the ozone design value in the Santa Clarita Valley will be approximately 12 percent below the standard.

It is important to reiterate that the form of the ozone standard allows for at least 3-days to have 8-hour average concentrations that exceed 80 ppb in any year. So, although the demonstration satisfies the criteria for attainment, areas of the Basin are likely to experience occasional higher ozone days (greater than 80 ppb) under severe meteorological conditions.

2010 1-Hour Average Ozone

Equally important, is the rate of progress specified by the timing of the new standard. The 2003 AQMP 1-hour ozone demonstration set a 2010 attainment carrying capacity of 330 TPD of VOC and 540 TPD of NOx. Sensitivity simulations were conducted to assess progress towards attaining the revoked 1-hour ozone standard for a current 2010 baseline emissions estimate. The 2003 AQMP simulations were conducted using UAM for the August 1997 meteorological. CAMx simulations were adjusted to account for the difference in model performance noted between the two platforms in the 2003 AQMP for the August episode, (CAMx under-predicting the peak concentration compared with UAM). The results of the sensitivity analysis indicated that the currently predicted 1-hour average ozone concentrations for 2010 are expected to be approximately 32 percent above the revoked 1-hour federal standard assuming implementation of the 2007 AQMP District and CARB mobile and port-related measures prior to 2010. Table 5-89 summarizes the comparison. It is estimated that the former 1-hour ozone standard will not be met until 2020.

Spatial Projections of 8-Hour Ozone Design Values

The spatial distribution of ozone design values for the 2002 base year is shown in Figure 5-65-7. Future year ozone air quality projections for 2024 with and without implementation of all control measures are presented in Figures 5-75-8 and 5-85-9. The predicted ozone concentration will be significantly reduced in the future years in all parts of the Basin with the implementation of proposed control measures in the South Coast Air Basin.

Appendix V provides base year model performance statistics, grid level spatial plots of simulated ozone (base cases and future year controlled) as well as weight of evidence discussions to support the modeling attainment demonstration.

TABLE 5-78

Model-Predicted 8-Hour Ozone Concentrations

City	2002 Design (PPB)	2023 Base Design (PPB)	2024 Controlled Design (PPB)
Azusa	101	82	6980*
Burbank	92	86	6370*
Reseda	104	86	68
Pomona	96	85	75
Pasadena	96	78	7374*
Santa Clarita	122	95	74
Glendora	112	91	79
Riverside	112	92	78
Perris	112	94	78**
Lake Elsinore	107	80	64
Banning	115	88	70
Upland	110	92	78
Crestline	129	100	83
Fontana	118	97	81
San Bernardino	116	92	78
Redlands	125	98	81

* Based on the city-station specific RRF's determined from the 19 episode day average.

** Based on the average of the RRF's determined from the stations meeting the criteria having more than 5 episode days.

TABLE 5-89

Model-Predicted 2010 1-Hour Maximum Ozone Concentrations:
August 5, 1997 and August 6, 1997 Meteorological Episode

Simulation	AQMP	VOC (TPD)	NOX (TPD)	Maximum Ozone (ppb) August 5, 1997	Maximum Ozone (ppb) August 6, 1997
UAM	2003	310	530	123	120
CAMx Adjusted	2007	578	818	143	158

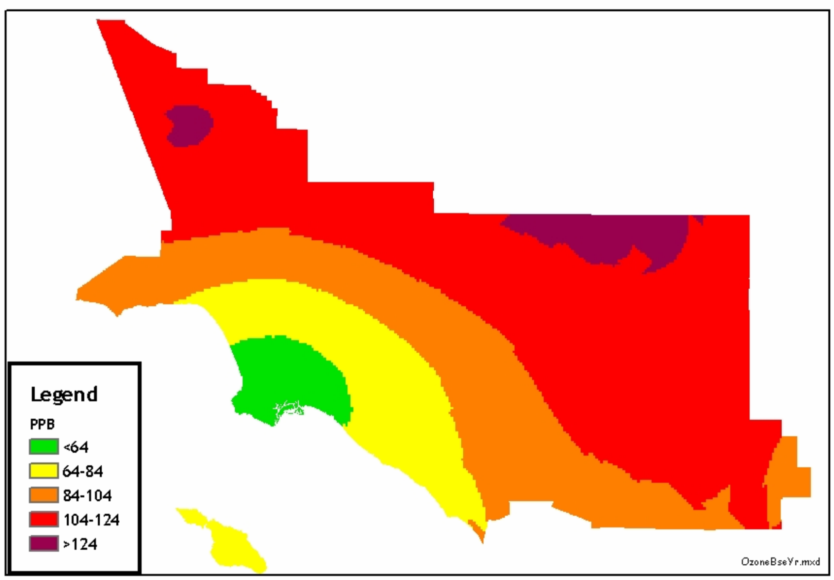

FIGURE 5-65-7

2002 Baseline 8-Hour Ozone Design Concentrations (ppb)

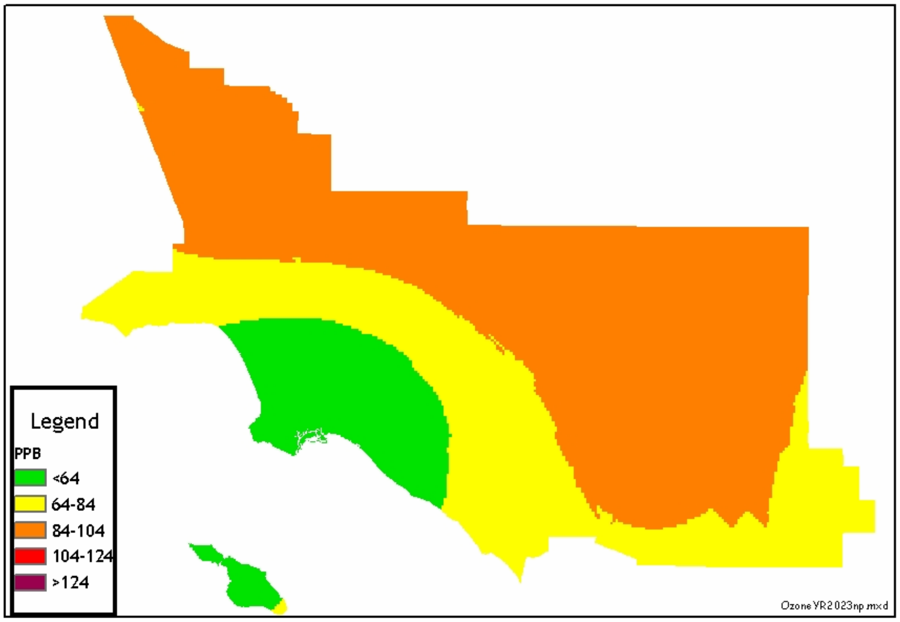

FIGURE ~~5-7~~5-8

Model-Predicted 2024 Baseline 8-Hour Ozone Design Concentrations (ppb)

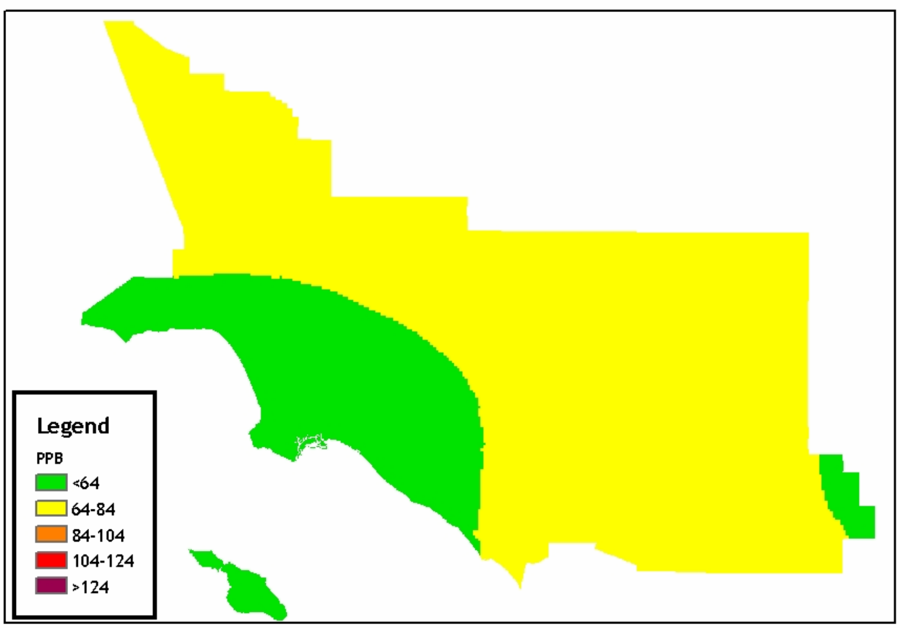

FIGURE ~~5-8~~5-9

Model-Predicted 2024 Controlled 8-Hour Ozone Design Concentrations (ppb)

Visibility

The results of the visibility analysis for Rubidoux are illustrated in Figure ~~5-9~~5-10. With future year reductions of PM2.5 from implementation of all proposed emission controls for 2015, the annual average visibility would improve from 12 miles (calculated for 2005) to over 20 miles at Rubidoux.

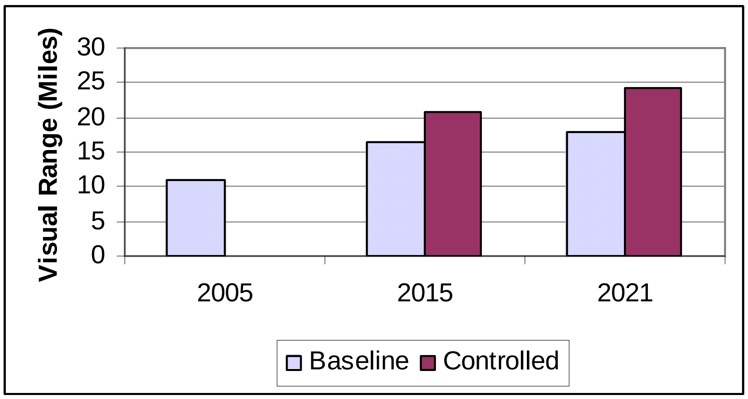

FIGURE ~~5-9~~5-10
Annual Average Daytime Visibility Projections at Rubidoux

Visual range in 2021 ~~is estimated Visibility~~ at all other Basin sites is expected to equal or exceed the Rubidoux visual range. Visual range is expected to double from the 2005 baseline due to reductions of secondary PM2.5, ~~(by more than one third),~~ directly emitted PM2.5 ~~emissions (~~including diesel soot) and lower nitrogen dioxide concentrations as a result of 2007 AQMP controls.

SUMMARY AND CONCLUSIONS

Figure ~~5-10~~5-11 shows the 2002 observed and model-predicted regional peak concentrations for the three nonattainment criteria pollutants, as percentages of the most stringent federal standard, for the years 2010, 2015, and 2024, (with and without further emission controls). Figure ~~5-11~~5-12 shows similar information related to the most stringent California state standards. Note: the revoked federal 1-hour standard comparison has been included for reference. The 2010 baseline 1-hour average ozone concentrations are projected to exceed the revoked standard.

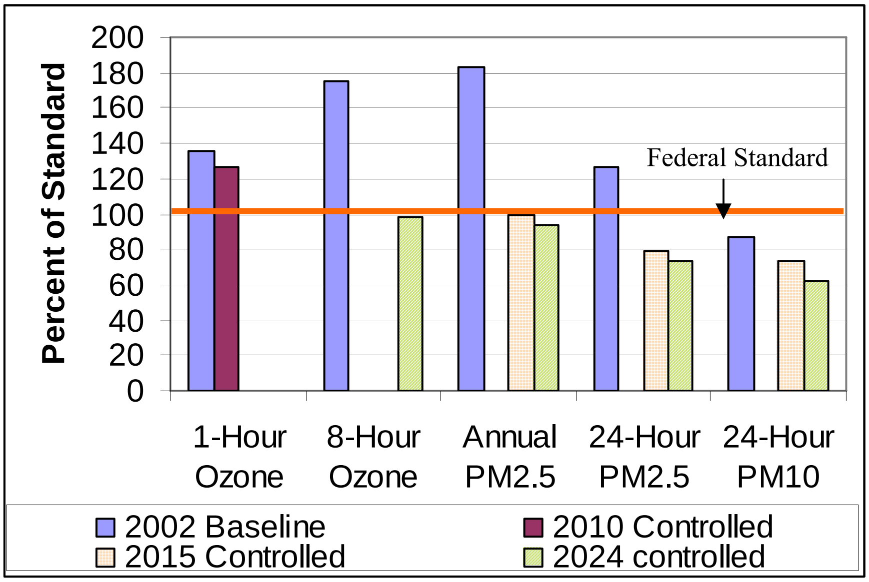

FIGURE ~~5-10~~5-11

Projection of Future Air Quality in the Basin in Comparison with the Most Stringent Federal Standards.

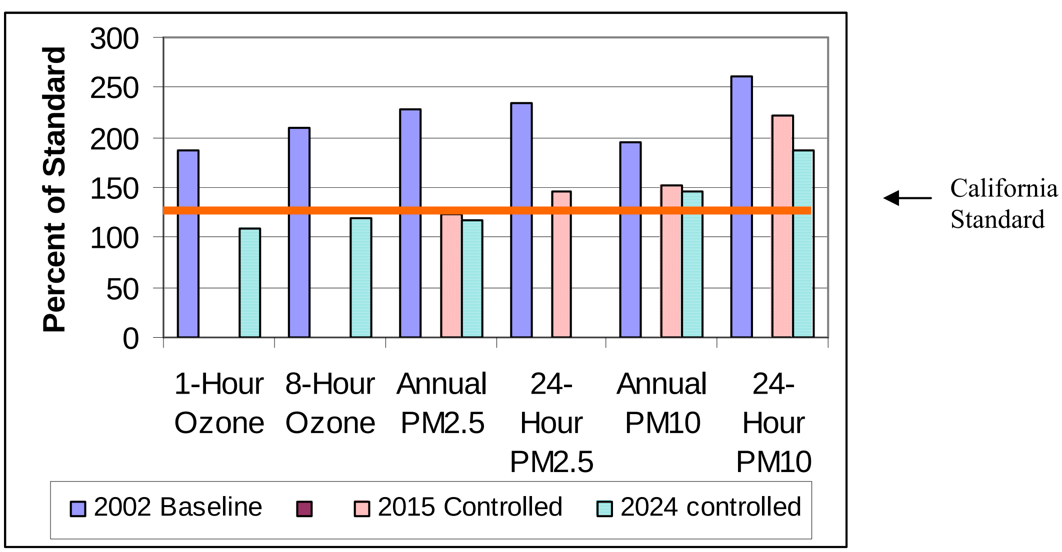

FIGURE ~~5-11~~5-12

Projection of Future Air Quality in the Basin in Comparison with Most Stringent California State Standards

Table 5-910 summarizes the expected year for attainment of the various federal and state standards for the four pollutants analyzed. As shown, the Basin will be in compliance with federal standards by the year 2024. The Basin will require additional time beyond 2024 to meet the state ozone, PM2.5 and PM10 standards.

BASIN EMISSIONS CARRYING CAPACITY (EMISSIONS BUDGET)

The District is required to separately identify the emission reductions and corresponding type and degree of implementation measures required to meet federal and state ambient air quality standards. Section 40463(b) of the California State Health and Safety Code specifies that, with the active participation of the Southern California Association of Governments, a South Coast Air Basin emission carrying capacity for each state and federal ambient air quality standard shall be established by the South Coast District Board for each formal review of the Plan and shall be updated to reflect new data and modeling results.

A carrying capacity is defined as the maximum level of emissions that enable the attainment and maintenance of an ambient air quality standard for a pollutant. Emission carrying capacity for state standards shall not be a part of the State Implementation Plan requirements of the Clean Air Act for the South Coast Air Basin.

Emission carrying capacity as defined in the Health and Safety Code is an overly simplistic measure of the Basinwide allowable emission levels for specific ambient air quality standards. It is highly dependent on the spatial and temporal pattern of the emissions. Because of the multi-component nature of PM2.5, the carrying capacity for the contributing emittants can vary significantly and like ozone it is a non-linear function among their precursors.

The federal Clean Air Act requires that plans contain an emissions budget that represents the remaining emissions levels that achieve the applicable attainment deadline. Based on the modeling results, a set of carrying capacities can be defined corresponding to federal and state ambient air quality standards for annual PM2.5, and ozone. VOC and oxides of nitrogen are used for ozone. PM2.5 additionally requires reductions of sulfur oxides and directly emitted PM2.5. Table 5-101 shows the emissions carrying capacities for the Basin to meet federal air quality standards. These estimates are based on emission patterns estimated for each of the federal attainment years: 2015 for PM2.5, and 2024 for ozone.

TABLE 5-9~~10~~

Expected Year of Compliance with State and Federal Standards for the Four Criteria Pollutants

Pollutant	Standard	Concentration Level	Expected Compliance Year
Ozone	NAAQS 8-hours	84 ppb	2024
	CAAQS 1-hour	90 ppb	beyond 2024
	CAAQS 8-hours	70 ppb	beyond 2024
$PM_{2.5}$	NAAQS Annual	15 ug/m^3	2015
	NAAQS 24-hours	65 ug/m^3	2005
	NAAQS 24-hours*	35 ug/m^3	beyond 2020
	CAAQS Annual	12 ug/m^3	beyond 2024
PM_{10}	NAAQS 24-hours	150 ug/m^3	2000
	CAAQS 24-hours	50 ug/m^3	beyond 2024
	CAAQS Annual	20 ug/m^3	beyond 2024
CO**	NAAQS 1-hour	35 ppm	1990
	NAAQS 8-hours	9 ppm	2002
	CAAQS 8-hours	9 ppm	2002
NO2	NAAQS Annual	0.0534 ppm	1995
	CAAQS Annual	0.030 ppm	beyond 2005
	CAAQS 24-hours	0.18~~25~~ ppm	2003

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

** On May 11, 2007, EPA redesignated the Basin as attainment for carbon monoxide.~~The Basin has been achieving the federal 1-hour CO air quality standard since 1990. In 2002, the Basin achieved the 8-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 EPA.~~

TABLE 5-10~~1~~

Emissions Carrying Capacity Estimations[1] for the South Coast Air Basin (tons/day) based on the Planning Inventory

a) PM2.5 Attainment Strategy to meet NAAQS (2015)

VOC	NOx	SOx	$PM_{2.5}$
469	454~~443~~	19	8~~8~~7

b) Ozone Attainment Strategy to meet NAAQS (2024)

VOC	NOx	CO
420	114	2039~~1966~~

PROJECTED EMISSION TRENDS THROUGH 2030

Figures ~~5-12~~5-13 through ~~5-15~~5-16 show the projected emission trends for both NOx and VOC through the year 2030. Depicted are scenarios for the baseline cases (e.g., no further rules), and for the controlled cases (with the 2007 AQMP Measures). Categories are described slightly different than most emission inventory summaries in that permitted sources (e.g., those emission sources which are permitted with the District) are specifically delineated. These figures show that emission levels continue to decrease through the year 2030, especially for the 2024 controlled case, when attainment with the federal ozone standard is expected. For VOCs, emissions are initially dominated by mobile sources, but in the later periods area sources will become an equal fraction. For NOx emissions, mobile sources are expected to be the dominant source through the ozone attainment year.

[1] On October 6, 2006, CARB released its preliminary estimates of the Basin carrying capacity for PM2.5. Based on rollback, CARB estimated that new regional emissions reductions of at least 25 percent NOx, 10 percent VOC and 50 percent SOx would be needed in beyond the 2014 baseline to meet the 2015 standard. CARB also stated that further reductions beyond those previously defined may be required to achieve attainment in areas of the Basin with the most persistent PM2.5 problems. CARB did not release any preliminary target for future year Basin 8-hour average ozone attainment .

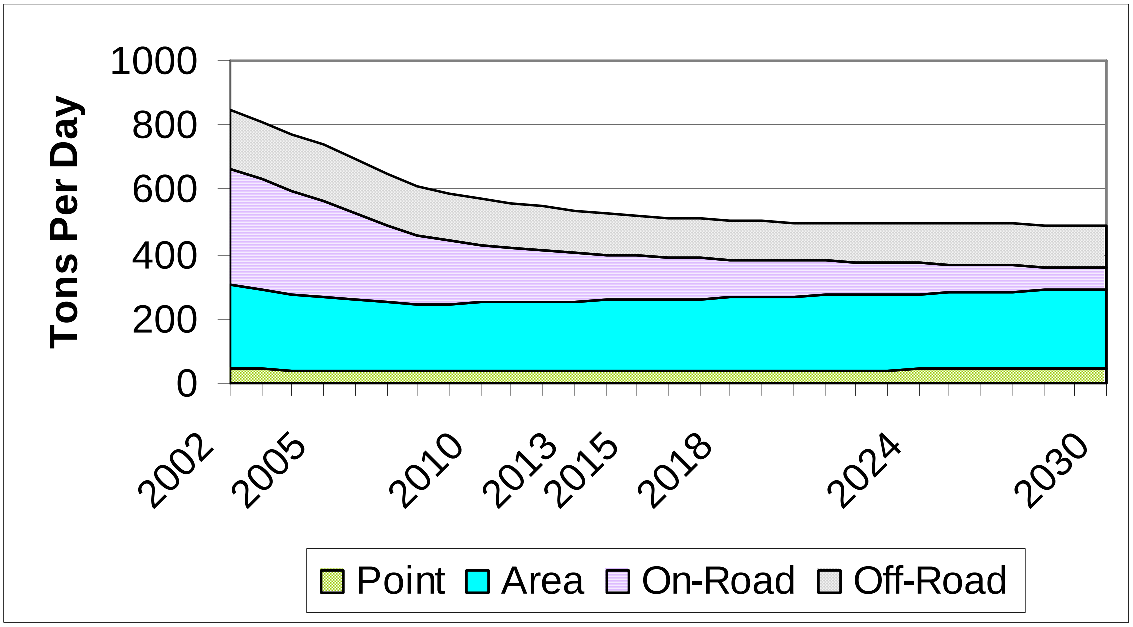

FIGURE ~~5-12~~5-13

VOC Emissions - Baseline Scenario

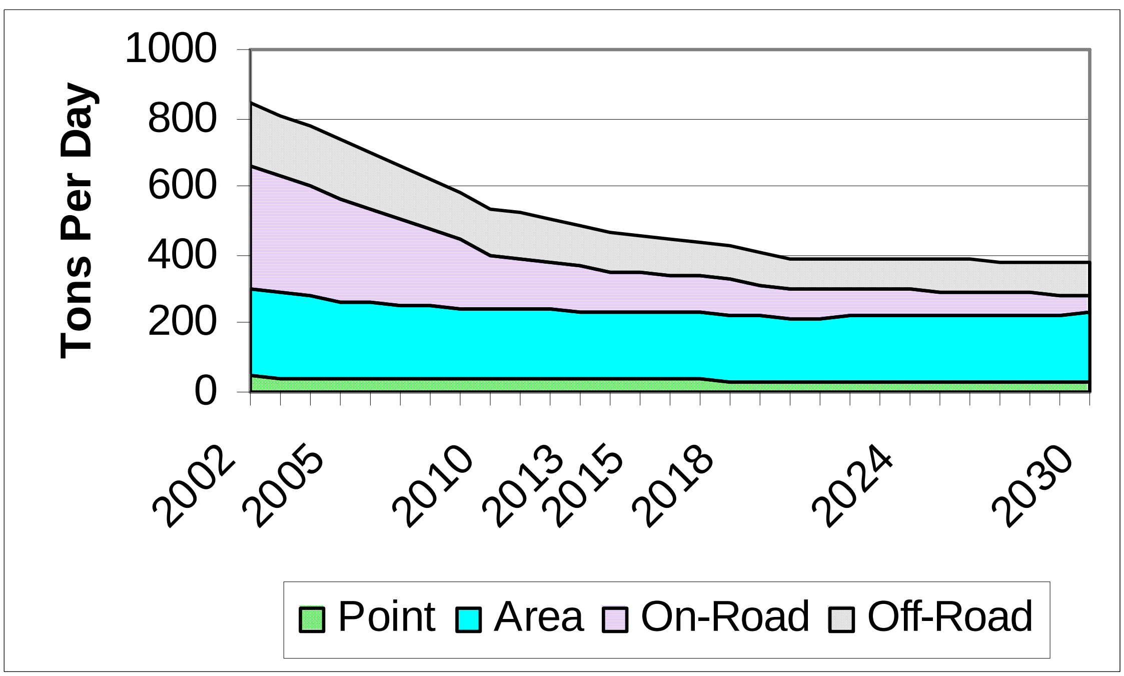

FIGURE ~~5-13~~5-14

VOC Emissions - Under 2007 AQMP

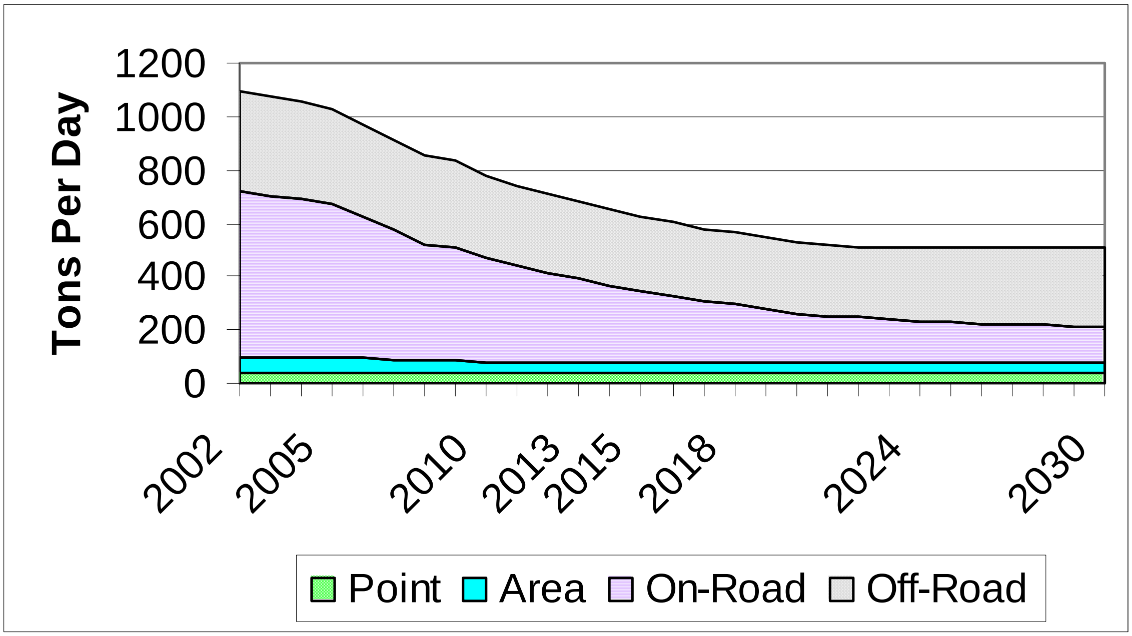

FIGURE ~~5-14~~5-15

NOx Emissions - Baseline Scenario

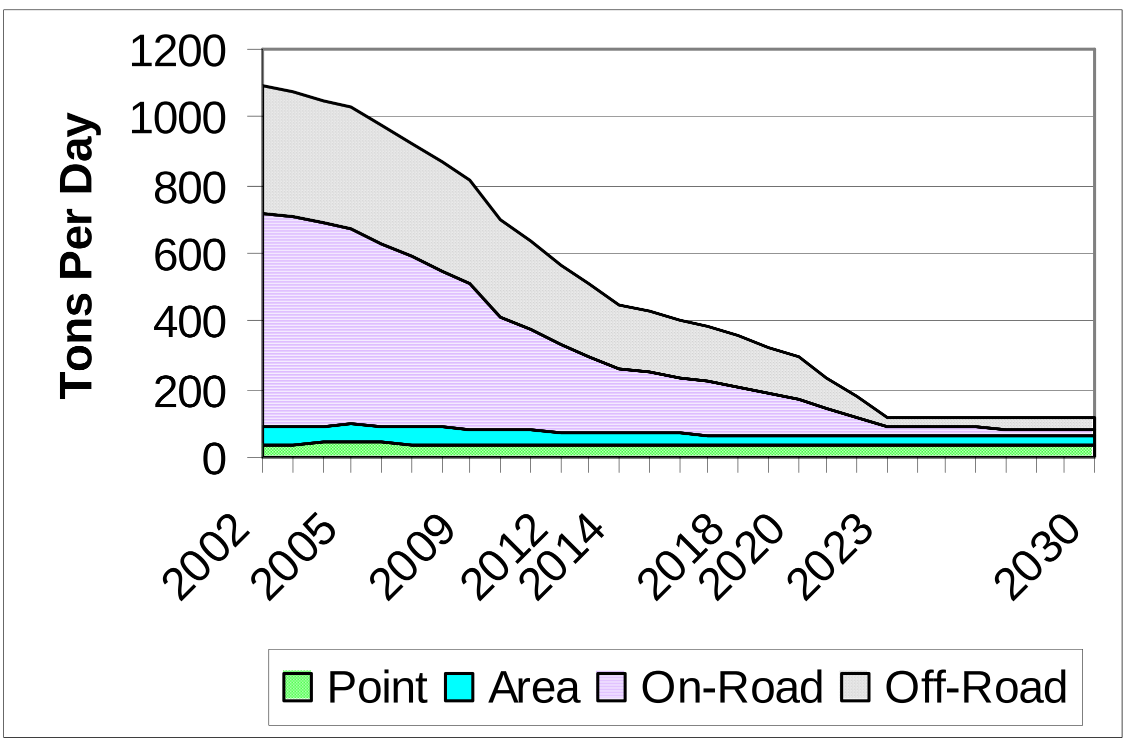

FIGURE ~~5-15~~5-16

NOx Emissions - Under 2007AQMP