Technical Support Document
for Recommendation that
the Nogales, Arizona Area
Be Designated as a $PM_{2.5}$ Nonattainment Area

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

EPA has requested Governors to recommend designation of nonattainment areas in their jurisdictions under the revised $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS) and submit these recommendations to EPA by December 18, 2007. The $PM_{2.5}$ monitor in Nogales, Arizona, operated by ADEQ, has recorded two exceedances of the 24-hour average $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$ and one exceedance of the annual average $PM_{2.5}$ NAAQS of 15 $\mu g/m^3$ during eight years of $PM_{2.5}$ monitoring at that site. As a result of these exceedances, ADEQ is recommending that the Nogales, Arizona area be designated as a $PM_{2.5}$ Nonattainment Area. To select boundaries for the proposed Nogales $PM_{2.5}$ Nonattainment Area, ADEQ examined the following ten criteria: (1) $PM_{2.5}$ monitoring data, (2) geography and topography, (3) demographics, (4) jurisdictional boundaries, (5) planned developments, (6) meteorology, (7) transport of $PM_{2.5}$ emissions, (8) emission sources, (9) commuting patterns, and (10) control measures (EPA 2007). This document is organized into ten sections corresponding to the preceding ten criteria.

$PM_{2.5}$ MONITORING

The following table summarizes the 24-hour $PM_{2.5}$ measurements recorded at the Nogales Post Office monitor in Nogales, Arizona.

Table 1 - Nogales, Arizona $PM_{2.5}$ Monitoring Data (EPA AQS Site ID: 04-023-0004)
24-Hour and Annual Averages for Years 1999 - 2006

Year	1st 24-Hour Maximum	2nd 24-Hour Maximum	3rd 24-Hour Maximum	4th 24-Hour Maximum	Annual Average
1999	45.9	39.1	27.9	21.4	12.52
2000	36.0	34.4	31.5	27.6	12.80
2001	35.2	25.7	20.2	17.6	10.71
2002	29.7	25.4	25.3	24.0	12.18
2003	37.0	35.0	25.1	23.4	11.30
2004	28.0	25.1	22.0	18.2	10.83
2005	49.7	33.0	31.8	28.9	13.11
2006	79.8	56.2	48.5	47.0	16.19

On October 17, 2006, EPA lowered the 24-hour $PM_{2.5}$ standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. The effective date of the new standard was December 18, 2006. The annual $PM_{2.5}$ standard remained the same at 15 $\mu g/m^3$.

24-hour $PM_{2.5}$ Exceedances are highlighted and bolded:

- 79.8 $\mu g/m^3$ on December 31, 2006
- 56.2 $\mu g/m^3$ on December 25, 2006

Note: A 48.5 $\mu g/m^3$ $PM_{2.5}$ measurement occurred on June 16, 2006, and a 47.0 $\mu g/m^3$ $PM_{2.5}$ measurement occurred on January 11, 2006. These were not considered 24-hour $PM_{2.5}$ exceedances because these dates were before the December 18, 2006 effective date for the lower 24-hour $PM_{2.5}$ standard of 35 $\mu g/m^3$.

Annual $PM_{2.5}$ Exceedance is highlighted and bolded: 16.19 $\mu g/m^3$ in Year 2006

Data Source: USEPA AQS website (www.epa.gov/ttn/airs/airsaqs/aqsweb/)

Analysis of Monitoring Data

Review of the 24-hour $PM_{2.5}$ monitoring data in Table 1 shows that only two years of the 1999 – 2006 monitoring record had 24-hour maximums less than the current EPA $PM_{2.5}$ standard of 35 $\mu g/m^3$. Time lapse photography of the pollutant plume from Nogales, Sonora and emission analyses studies conducted in the Nogales PM_{10} Nonattainment Area (Arizona Department of Environmental Quality, 1993; ENSR, 1999) indicated that the current location of the Nogales PM_{10} Monitor at the Nogales, Arizona Post Office is adequate for measuring PM_{10} levels in the nonattainment area. Based on previous air quality studies that show the current location of the Nogales, Arizona PM_{10} monitor is adequate for measuring PM_{10} levels in the Nogales PM_{10} Nonattainment Area, ADEQ concluded that the current location of the $PM_{2.5}$ monitor at the Nogales, Arizona Post office is also adequate for measuring $PM_{2.5}$ levels in the proposed Nogales $PM_{2.5}$ Nonattainment Area.

GEOGRAPHY AND TOPOGRAPHY

Nogales, Arizona is located 60 miles south of Tucson, Arizona in the mid-southernmost portion of Santa Cruz County. Nogales, Sonora, México lies directly south of Nogales, Arizona across the international border. Nogales, Sonora is 140 miles north of Hermosillo, Sonora.

Referred to as Ambos Nogales, the communities of Nogales, Arizona and Nogales, Sonora, México comprise the largest international border community in Arizona, with a combined population of 177,732 inhabitants as of the 2000 U.S. and Mexican censuses (U.S. Census Bureau 2000, Instituto Nacional de Estadistica Geografia e Informatica 2000). Ambos Nogales is located in the Sonoran Desert; this desert covers 120,000 square miles and has a minimum elevation of 2,500 feet (McGinnies 1976). The Sonoran Desert is in the Basin and Range topographic province, characterized by north-south elongated valleys surrounded by mountain ranges. Ambos Nogales is located in such a valley created by the Nogales Wash, a tributary of the Santa Cruz River. The narrow valley topography can trap air pollutants, especially during the evening hours when diurnal wind flow is out of the south from Nogales, Sonora, México. The mean elevation in Nogales, Arizona is 3,865 feet, while that in Nogales, Sonora is 4,265 feet (Instituto Nacional de Estadistica Geografia e Informatica 2005).

Major highways in the Nogales, Arizona area are Arizona State Route 82, which connects Nogales, Arizona with Patagonia, Arizona (19 miles) and Sonoita (31 miles) to the northeast, and U.S. Interstate 19 which connects Tucson, Arizona to Nogales, Arizona and continues south into México, where it becomes Federal Highway 15. See Map 1 for highway system in Arizona and Sonora. The Alvaro Obregón Boulevard, Luis Donaldo Colosio Boulevard, and the Corredor Fiscal toll road are the main transportation routes in Nogales, Sonora. The Alvaro Obregón Boulevard runs the length of the narrow Nogales Wash valley, and is a highly congested route used by local and some cross-border commercial traffic. The Corredor Fiscal is a toll road for cross-border commercial traffic, and its on- and off-ramp access is limited to the border junction at Mariposa Road, and in the south outside of the city limits of Nogales, Sonora. This road absorbs the majority of cross-border commercial traffic.

Mountain ranges near Ambos Nogales include the Patagonia Mountains to the east and the Tumacacori, Atascosa, and Pajarito mountains to the west. Approximately 25 miles to the north are the Santa Rita Mountains and Madera Canyon in the Coronado National Forest, where Mount Wrightson rises to an elevation of 9,432 feet. Northwest of Interstate 19 are the Cerro Colorado, Las Guijas, and Sierrita Mountain Ranges. In Nogales, Sonora the highest elevation areas (5,380 feet) are in the Cerro de los Nogales (Nogales' Hill), west of where the Obregón and Colosio routes meet, near the southern end of the city. See Map 2 for the topography of the Ambos Nogales Area; city boundaries of Nogales, Arizona and Nogales, Sonora; boundaries of the Nogales PM_{10} Nonattainment Area, and location of the $PM_{2.5}$ monitor in Nogales, Arizona.

Analysis of Geography and Topography
From the preceding discussion and review of Map 2, it can be seen that the current Nogales PM_{10} Nonattainment Area encompasses both the mountain valley where Nogales, Arizona is located and a buffer area of mountains outside of this valley. Thus, the Nogales PM_{10} Nonattainment Area contains topographic features that form an airshed that traps emissions generated in the nonattainment area. Based on the topography of the area, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries should coincide with the current boundaries of the Nogales PM_{10} Nonattainment Area.

DEMOGRAPHICS

This section presents the demographics of the Ambos Nogales area, including degree of urbanization, population growth (past, present, and future), and population density. The Mexican population has consistently exceeded the U.S. population in Ambos Nogales by an order of magnitude, and this is expected to continue for the foreseeable future.

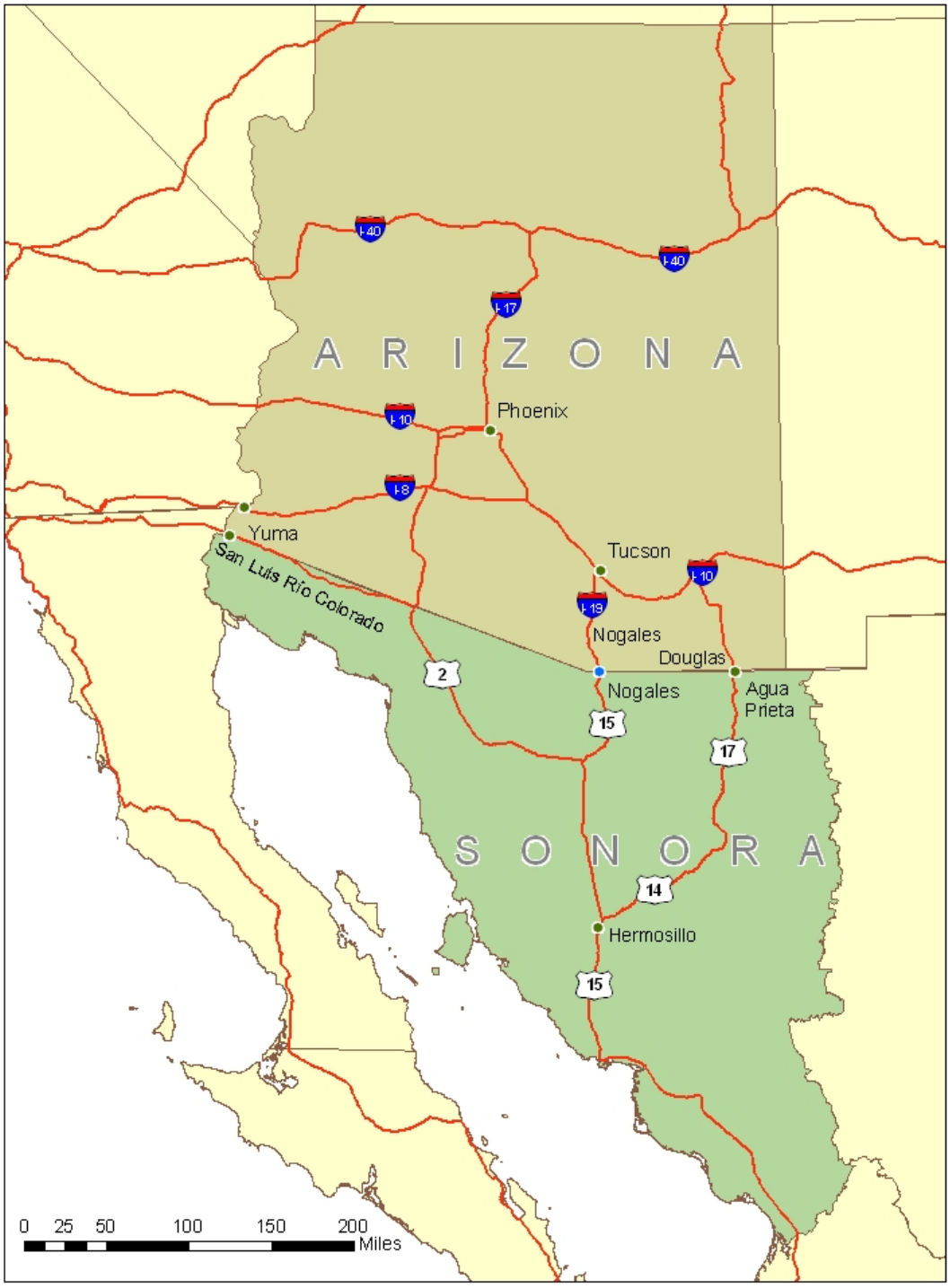
Santa Cruz County, Arizona and Nogales, Arizona
The 2000 U.S. Census classified the population of Santa Cruz County as 68 percent urban and the population of Nogales, Arizona as 94 percent urban (U.S. Census Bureau 2000). The urbanized population is expected to continue to grow. Between 1980 and 2007, Santa Cruz County grew from a population of 20,459 to 46,907 persons, representing a growth rate of 129 percent.

Santa Cruz County contains a total of 791,632 acres. Land ownership in Santa Cruz County consists of a mix of private land, US Forest Service, Bureau of Land Management, and State of Arizona Trust Land. Table 2 lists the number of acres and percent of Santa Cruz County by land ownership

Table 2 - Land Ownership in Santa Cruz County

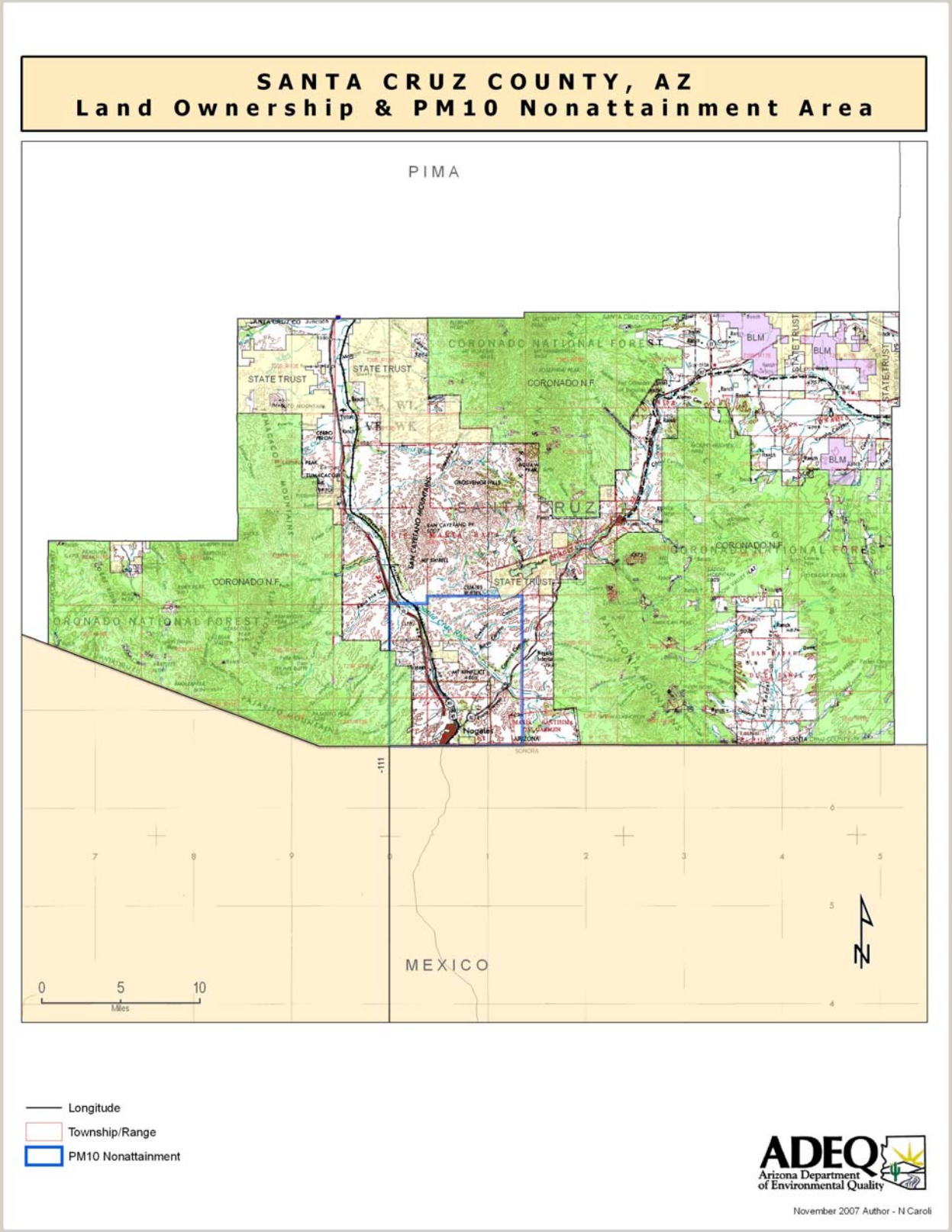
Land Ownership	Acres	Percent
Coronado National Forest	417,738	52.769
Private Land	297,816	37.621
State Trust Land	61,706	7.795
Bureau of Land Management.	13,550	1.712
Parks and Recreation	600	0.076
Other	212	0.027
Tumacacori National Monument	10	0.001
Total Acres	791,632	100
Data Source: Arizona State Land Department, Arizona Land Resources Information System. 1994		

See Map 3 for land ownership in Santa Cruz County, Nogales PM_{10} Nonattainment Area boundaries, township and range, and location of Longitude 111° West in relation to the nonattainment area.



Map 1 Arizona & Sonora Highway System

Map 2 Topography of Ambos Nogales



Map 3 Land Ownership in Santa Cruz County

The mid-year 2007 population estimate for Nogales, Arizona, is 21,746, compared to a population of 19,489 in 1990 and 15,683 in 1980. Compared to the County's growth rate, this represents a relatively slow growth of about 39 percent over the 27-year time frame, or one-third the growth rate of Santa Cruz County. The County is estimated to have grown by 22 percent compared to only 4 percent growth for Nogales, Arizona from 2000 to 2007 (Table 3). This growth trend is expected to continue (Arizona Department of Economic Security 2007). Due to the greater growth in Santa Cruz County, the proportion of the county population residing in Nogales, Arizona, has steadily declined from about 77 percent in 1980 to 46 percent in 2007.

Between 2007 and 2015, the population of Santa Cruz County is projected to increase 20 percent to 56,144 residents, compared to a significantly slower growth rate of 10 percent, or 23,858 residents for Nogales, Arizona (Table 4). Regardless, Nogales, Arizona will still represent a plurality of the population of Santa Cruz County.

About 82 percent of the resident population of Santa Cruz County is classified as "Minority" (other than White). Persons of "Hispanic or Latino" ethnicity comprise more than 98 percent of the minority population. In comparison, more than 94 percent of the resident population of Nogales, Arizona, is classified as "Minority" with 99 percent comprising the category of "Hispanic or Latino" ethnicity (U.S. Census Bureau, Census 2000 Redistricting Summary File).

In 2000, the population of the Nogales PM_{10} Nonattainment area was estimated at 22,500 persons, comprising 59 percent of Santa Cruz County's population of 38,381. The nonattainment area includes the City of Nogales, Arizona, the southern part of Rio Rico, and unincorporated portions of Santa Cruz County. The population residing in the nonattainment area was estimated using a Geographic Information System (GIS) to determine the census blocks and block groups contained in the nonattainment area and summing the population counts.

Nogales, Sonora, México

The residents of Nogales, Sonora, México reside on the slopes of the narrow Nogales Wash valley that extends from south to north, as well as in the southern portion of the city. The entirety of the population of Nogales, Sonora is classified as urban by the Mexican Census, although many neighborhoods — and specially those in the urban fringe — lack basic urban services, such as paved roads, potable water, and adequate housing stock (Declet 2006). The Mexican Census of 2000 reported a population of 156,854 for Nogales, Sonora (INEGI 2005). This represents a growth rate of approximately 50 percent since 1990. The intradecadal household population survey of 2005 reported that the Nogales, Sonora population had increased to 193,517 (INEGI 2005). Due to the potential for census undercounts on both sides of the border, the resident populations of Ambos Nogales could be higher than documented.

Nogales, Sonora experienced a growth rate of more than 23.4 percent during the five years between 2000 and 2005, which averages an annual growth rate of 4.7 percent. If that same growth rate continues, by 2015, the population of the city could reach more than 300,000, although the official projections are slightly more conservative and predict 242,335 residents (Table 4). If growth for Nogales, Sonora stays within these values the city would have a population that would be 10 to 11 times the size of Nogales, Arizona. Such a large disparity in population size between Nogales, Arizona, and Nogales, Sonora, México will mean a higher potential for transport of air pollutants, including $PM_{2.5}$, from Nogales, Sonora into Nogales, Arizona.

Rio Rico, Arizona

Río Rico is an unincorporated community in Santa Cruz County that is located 12 miles north of the U.S.-México border and 57 miles south of Tucson. It is made up of 39,000 acres on the foothills of the Santa

Rita Mountains and has an elevation of 3,418 feet above sea level. Río Rico was part of the Baca Float, a 100,000-acre U.S. Congress grant to the descendants of Luis María Baca honoring an earlier Spanish government grant (Arizona Department of Commerce 2007). The community began in 1969.

According to the U.S. Census, Río Rico is listed as four Census Designated Places (CDPs): Rio Rico Northeast, Rio Rico Northwest, Rio Rico Southeast, and Rio Rico Southwest. As of 2000, the total number of inhabitants in the four Rio Rico CDPs was listed as 10,413 inhabitants (U.S. Census 2000). Economic activities include light manufacturing, and produce staging and distribution in the industrial facilities of the Río Rico South Industrial Park. Most of Rio Rico Southeast CDP and a portion of Rio Rico Southwest CDP are in the Nogales PM_{10} Nonattainment Area.

Summary of Population Data

Table 3 summarizes historical and current population data for the Ambos Nogales area.

Table 3 - Population Data for Ambos Nogales

	1980	1990	2000
Nogales, AZ	15,683	19,489	20,878
Santa Cruz County	20,459	29,676	38,381
Nogales, AZ / Santa Cruz County	77%	66%	54%
Nogales, Sonora	65,603	105,873	156,854
Sonora Municipio	1,513,700	1,823,600	2,217,000
Nogales, Sonora / Sonora Municipio	4%	6%	7%

Table 4 summarizes population projections for the Ambos Nogales area. It is not known how much of Santa Cruz County's population increase will occur in the Nogales PM_{10} Nonattainment Area, but it is likely that the nonattainment area's population growth will be minimal because the population projections for Nogales, Arizona are relatively small.

The population of Sonora is expected to increase by 7 percent to 2,631,985 persons, while Nogales, Sonora's population is projected to increase from 203,719 to 242,335 residents, a jump of 19 percent.

Table 4 - Population Projections for Ambos Nogales

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Nogales, AZ	21,746	22,454	22,659	22,863	23,065	23,265	23,465	23,662	23,858
Santa Cruz County	46,907	47,777	48,998	50,210	51,418	52,607	53,800	54,973	56,144
Nogales, AZ / Santa Cruz County	48%	47%	46%	46%	45%	44%	44%	43%	42%
Nogales, Sonora	203,719	208,901	213,976	218,948	223,820	228,591	233,266	237,845	242,335
Sonora Municipio	2,463,707	2,487,608	2,510,562	2,532,639	2,553,919	2,574,433	2,594,255	2,613,415	2,631,985
Nogales, Sonora / Sonora Municipio	8%	8%	9%	9%	9%	9%	9%	9%	9%

Data Sources:
(1) Arizona Department of Economic Security, July 2, 2007 Population Estimates for Arizona's Counties, Incorporated Places, and Balance of County.
(2) Nogales, Arizona population projections submitted to POPTAC by SEACOG.
(3) CONAPO (Mexican Population Projections, 2005-2050).

Table 5 lists the population projections for the unincorporated community of Rio Rico. The majority of the Rio Rico SE CDP (89%) is in the Nogales PM_{10} Nonattainment Area and a portion of the Rio Rico SW CDP (19%) is in the Nogales PM_{10} Nonattainment Area. Moderate population growth is projected for the Rio Rico CDPs from 2007 to 2015.

Table 5 - Population Projections for Rio Rico CDPs

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Rio Rico NE CDP	4,376	4,559	4,741	4,921	5,100	5,277	5,454	5,628	5,802
Rio Rico NW CDP	4,625	4,888	5,149	5,408	5,666	5,920	6,175	6,425	6,675
Rio Rico SE CDP	2,866	3,059	3,249	3,439	3,628	3,814	4,000	4,183	4,366
Rio Rico SW CDP	4,469	4,724	4,977	5,228	5,479	5,725	5,972	6,215	6,458
Total	16,336	17,230	18,116	18,996	19,873	20,736	21,601	22,451	23,301

Data Source: "Arizona Subcounty Population Projections July 1, 2006 to July 1, 2055 by County, Census County Division, Place, and Reservation," Arizona Department of Economic Security, Research Administration, Population Statistics Unit, 12/01/06

Table 6 lists the population projections for the Nogales PM_{10} Nonattainment Area and the percent of the Nogales PM_{10} Nonattainment Area population in Santa Cruz County. The relative percentage of the Nogales PM_{10} Nonattainment Area's population to Santa Cruz County's population remains fairly constant between years 2007 to 2015.

Table 6 – Population Projections for Nogales PM_{10} Nonattainment Area

City	% Area in Nonattainment Area	2007	2008	2009	2010	2011	2012	2013	2014	2015
Nogales, Arizona	100.0%	21,746	22,454	22,659	22,863	23,065	23,265	23,465	23,662	23,858
Rio Rico SE CDP	88.7%	2,542	2,713	2,882	3,050	3,218	3,383	3,548	3,710	3,873
Rio Rico SW CDP	19.1%	854	902	951	999	1,046	1,093	1,141	1,187	1,233
Total Population in Nonattainment Area	--	25,142	26,070	26,491	26,912	27,330	27,741	28,154	28,559	28,964
Nonattainment Area Population / Santa Cruz County Population	--	54%	55%	54%	54%	53%	53%	52%	52%	52%

Data Sources:

(1) Percent of surface area of Rio Rico SE CDP and Rio Rico SW CDP in the Nogales PM_{10} Nonattainment Area were based on surface area data calculated using GIS.

(2) Population projections derived from Tables 4 and 5.

Population Density

Past and projected population densities for Ambos Nogales, and projected population densities for Rio Rico and the Nogales PM_{10} Nonattainment Area are illustrated in Table 7. The population density of Rio Rico is less than that of Santa Cruz County. This illustrates that the population of Rio Rico has a rural rather than urban population density.

Table 7 – Population Density for Ambos Nogales and Rio Rico (persons / square mile)

	1990	2000	2007	2010	2015
Santa Cruz County	24	31	38	41	45
Nogales, Arizona	937	1,004	1,046	1,099	1,147
Nogales, Sonora	11,764*	13,392	17,411	18,713	20,712
Rio Rico	--	--	26	30	37
PM_{10} Nonattainment Area			320	342	369

Data Sources:

(1) Population density data for Ambos Nogales derived from Tables 3 and 4 using 1,236 square miles for Santa Cruz County, 20.8 square miles for Nogales, Arizona and 11.7 square miles for Nogales, Sonora.

(2) Population estimates for Nogales, Sonora are 203,719 for 2007, 218,948 for 2010, and 242,335 for 2015 (CONAPO 2007), and assuming densification of the existing built up land base will occur.

* Note: Nogales, Sonora's population in 1990 was 105,873 and the urban area was 9 square miles (INEGI 2005).

(3) Population density data for Rio Rico derived from Table 5 and using 39,000 acres (62.4 square miles) for Rio Rico.

(4) Population density data for Nogales PM_{10} Nonattainment Area derived from Table 6 and using 78.6 square miles in the nonattainment area (area calculated using GIS).

Analysis of Demographics

Population growth for Nogales, Arizona and the Nogales PM_{10} Nonattainment Area is projected to be small, while population growth for Santa Cruz County is projected to be moderate. The unincorporated community of Rio Rico is also projected to have moderate growth. The ratio of the population of the Nogales PM_{10} Nonattainment Area versus the population of Santa Cruz County is relatively constant for years 2007 – 2015 (Table 6). The population density of Santa Cruz County increases 7 persons per square mile, while the population density of the Nogales PM_{10} Nonattainment Area increases by 49 persons per square mile between years 2007 and 2015. The population growth of Nogales, Sonora is projected to be large resulting in a population that will be eleven times larger than that of Nogales, Arizona.

ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries should coincide with the current Nogales PM_{10} Nonattainment Area boundaries, because: (1) Ratio of future population growth between the Nogales PM_{10} Nonattainment Area and Santa Cruz County remains relatively constant, and (2) Changes in future population density of Santa Cruz County is relatively constant, while the future population density of the Nogales PM_{10} Nonattainment Area shows a moderate increase.

JURISDICTIONAL BOUNDARIES

Santa Cruz County, comprising 1,236 square miles of land, was created by the 20th Territorial Assembly in 1899, thirty-six years after Arizona became a separate territory. The county is named after the Santa Cruz River that flows into México and then back across the border to the U.S.

Commercial and cultural ties between Nogales, Arizona and Nogales, Sonora, México are strong. Nogales, Arizona was founded in 1882 along a north-south rail line to promote trade between the U.S. and México. Nogales, Sonora officially became a municipality on July 11, 1884 by Public Law No. 29, which was signed the prior day by Governor of Sonora, Luis Emeterio Torres. Nogales, Arizona was declared a city on January 1, 1920. Ambos Nogales represents the first railroad connection between the U.S. and México.

Fast population and economic growth in Nogales, Sonora began with tariff exemptions and the stimulation of the manufacturing sector through México's Border Industrialization Program (BIP) of 1965. In this year, the first *maquiladora* in México was established in Nogales, Sonora. Maquiladoras import raw materials primarily from the United States, assemble them into value-added products, and ship them across the border for distribution to markets outside of México (Lorey 1999). Since this time, the maquiladora sector has thrived in México, receiving a big boost after the Mexican *peso* devaluation of 1982—making Mexican labor cheaper—and more recently due to the signature of the North American Free Trade Agreement (NAFTA) of 1994. The NAFTA deregulated many of the existing trade barriers between Canada, México and the U.S., and has been a driver of dramatic increases in urban and industrial growth in Nogales, Sonora and other border communities. Today, Ambos Nogales is one of the most important ports of entry for NAFTA-related trade.

The U.S. Congress National Highway Systems Designation Act of 1995 designated Nogales, Arizona as part of the Canada-México (CANAMEX) trade corridor, implemented by Public Law 104-59. As the CANAMEX project develops, it is expected that Ambos Nogales will continue in its role as a vital hub as a transshipment node in U.S.-México trade (Lara *et al.* forthcoming).

Nogales, Arizona, contains 20.8 square miles, See Map 4 for city boundaries of Nogales, Arizona and Nogales, Sonora; boundaries of the current Nogales PM_{10} Nonattainment Area; and locations of ports of entry and Nogales, Arizona $PM_{2.5}$ monitor.

Analysis of Jurisdictional Boundaries

The Nogales PM_{10} Nonattainment Area is located in Santa Cruz County. The southern boundary of the nonattainment area is the U.S./ México border. Nogales, Arizona is the largest city in the nonattainment area. Portions of the Coronado National Forest are near the east and west boundaries of the Nogales PM_{10} Nonattainment Area. Because the current boundaries of the Nogales PM_{10} Nonattainment Area encompass all major population centers, most of the private land, and existing and planned $PM_{2.5}$ emission sources in Santa Cruz County, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries should coincide with the Nogales PM_{10} Nonattainment Area boundaries.

The City of Nogales, Sonora is located directly south of Nogales, Arizona across the international border. Although the City of Nogales, Sonora is not in the Nogales PM_{10} Nonattainment Area, its emissions have a large impact on the air quality of the Nogales PM_{10} Nonattainment Area.

PLANNED DEVELOPMENTS

The following section describes planned developments in Nogales, Arizona and Nogales, Sonora, México.

Nogales, Arizona

The following development projects are planned for Nogales, Arizona (Nogales Community Development 2007):

- Mariposa Port of Entry Expansion
- Construction of a hospital between Nogales and Exit 12 on Interstate 19
- Morley Avenue Entrepreneurial Development Area
- Northern Meadow Hill Industrial Park
- Construction of Candlewood Suites (100 – 200 rooms) next to Holiday Inn Express
- Commercial and industrial development in various residential, commercial, and industrial areas in western Nogales, Arizona

See Map 5 for locations of the planned development projects listed above in relation to the Nogales, Arizona city boundaries and Nogales PM_{10} Nonattainment Area, and township range sections.

The Mariposa Port, constructed in 1973 on a 43-acre site, sits on a plateau at an elevation of about 50 feet higher than the surrounding ground. It is located on Arizona State Route 189, Mariposa Road, and Mexican Federal Highway 15. State Route 189 connects to Interstate 19 four miles to the north. The port is the main commercial crossing between the U.S. and México. The Mariposa Port of Entry Expansion is a U.S. General Services Administration project for improving truck throughput at the Nogales Mariposa U.S. Port of Entry by speeding the inspection of commercial trucks that have been certified by the U.S. Customs and Border Protection for hauling freight from México to the U.S (AZTEC & GSA 2007).

Nogales, Sonora, México

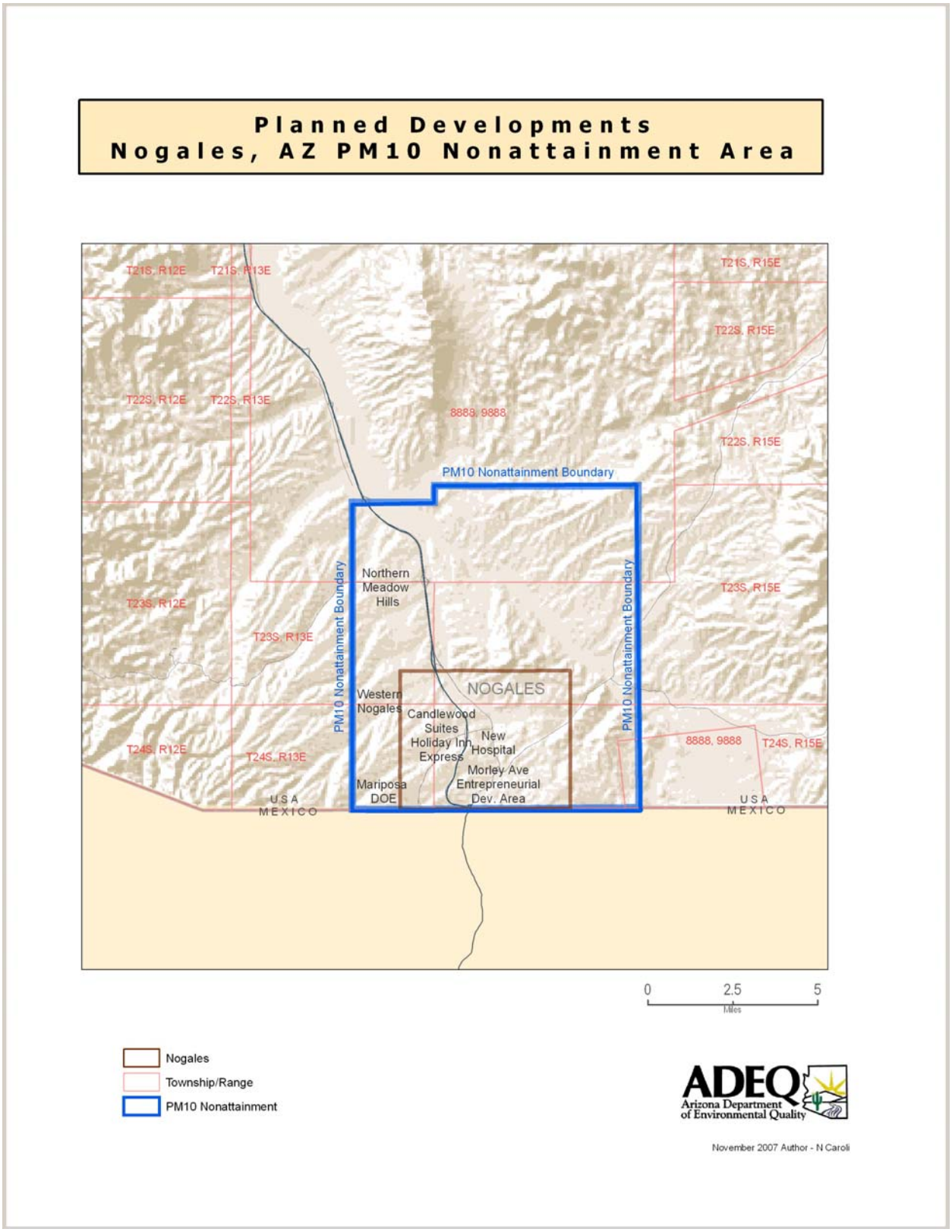
The following development projects are planned for Nogales, Sonora, México (Nogales Community Development 2007):

- Industrial park expansion
- Residential development (12,000 residential units by 2009)
- Expansion of maquiladora program (numerous maquiladora operations have received ISO 9002 certification)

Analysis of Planned Developments

The preceding discussion and review of Map 5 shows that the major planned developments in Santa Cruz County will occur within the Nogales PM_{10} Nonattainment Area. Because these planned developments are within the current Nogales PM_{10} Nonattainment Area, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries should coincide with the current boundaries of the Nogales PM_{10} Nonattainment Area. Future planned developments in Nogales, Sonora may impact air quality in the Nogales PM_{10} Nonattainment Area.

Map 4 Jurisdictional Boundaries of Ambos Nogales



Map 5 Planned Developments in Nogales, Arizona

METEOROLOGY

The following section describes the meteorological conditions observed in the Ambos Nogales area.

Temperatures

The average high temperature in the winter time is about 65°F with the average low winter-time temperature in the upper 20s. The coldest temperature recorded at the Nogales International Airport was -4°F in December of 1978. During the summer, the average high temperature is around 93°F with the average low in the mid to upper 70s. The hottest temperature recorded there was 112°F in June of 1990. There is not much difference in elevation between the Nogales International Airport and Nogales, Arizona, thus the temperatures at the airport are representative of those in Nogales, Arizona.

Geography and Drainage

The City of Nogales, Arizona encompasses 21 square miles (54 square kilometers) and lies 3,865 feet above sea level. With the Pajarito and Atascosa Mountains about 7 miles west and the Patagonia Mountains roughly 13 miles east, Nogales, Arizona rests between the two mountain ranges in the Nogales Wash. The elevation decreases from south of the U.S./México border heading north towards Tucson and ultimately Phoenix, Arizona. Thus, under calm wind conditions, the nighttime drainage is typically from south to north along the Nogales Wash. See Map 6 for depiction of elevation change from Nogales, Sonora to Nogales, Arizona.

Variations in Localized Winds

Due to the complex terrain in the Ambos Nogales area, wind patterns can be extremely localized (i.e., there may be very different winds from one wash to another). The Nogales International Airport is located about 8 miles to the northeast of the Nogales, Arizona's city center. The airport is in a separate wash that flows northeast to southwest and is different from the conditions in the Nogales Wash. Therefore, it is not appropriate to use the airport winds to represent typical local winds in Nogales, Arizona. Upper levels winds are generally uniform across the region, thus Tucson's upper-level wind data will be representative for the Ambos Nogales area.

ADEQ Wind Monitoring in Nogales, Arizona

The Arizona Department of Environmental Quality maintains a meteorological site located at the Nogales Post Office. As previously mentioned, it is more appropriate to use surface weather data within the city of Nogales, Arizona to represent the winds along the Nogales Wash than to use wind data from the Nogales International Airport. Review of four years of hourly wind data, from the meteorological site at the Nogales Post Office (June 2003 – November 2007), indicates that 47% of the winds were out of the south (between 145° and 225°). Winds out of the north (315° through 45°) occurred 18% of the time, east (45° through 145°) 20%, and west (225° through 315°) 15% of the time. These data show a definitive south to north wind flow along the Nogales Wash, likely aided by the decrease in elevation from the south to the north (see Table 8).

Table 8 - Wind Climatology for Nogales, Arizona (June 2003-November 2007)

	North (315°-45°)	**South** (145°-225°)	**East** (45°-145°)	**West** (225°-315°)	**Total**
Number of Observations	6,956	17,755	7,675	5,639	38,146
% of Occurrence	18%	47%	20%	15%	100%

Map 6 Drainage from Nogales, Sonora to Nogales, Arizona

Synoptic Weather Patterns in the Southwest U.S.

During the spring months (March-May) the southwestern U.S. experiences trough passages with associated cold fronts. As these systems approach the region, winds are typically out of the south and southwest. Once the cold front moves through, the winds shift out of the west and decrease. Cooler, drier air replaces warmer, moist air. High pressure usually returns for a short time before the next system moves through. Winds are generally lighter under high pressure, allowing localized winds patterns to take effect.

During the summer months (June-August), temperatures are the warmest of the year and mixing heights are at their highest levels, promoting afternoon mixing of the air. By July, high pressure sets up near the Four Corners region (Utah/Arizona/New Mexico/Colorado). This shifts the dominant wind flow out of the southeast and east. Moisture from México is drawn into the region producing the potential for afternoon thunderstorms nearly every day. These Monsoon thunderstorms can generate extremely localized wind gusts and periods of blowing dust, many times followed by rain.

The weather pattern shifts once again during the fall months (September-November) with high pressure retreating to the south. This allows trough passages to again push through the region from west to east.

Like the troughs during the spring, winds come out of the south and southwest ahead of the cold front, turning out of the west and northwest once the front pushes through. Lighter winds return under high pressure allowing local terrain to influence the wind direction.

Finally, during the winter months (December-February), high pressure tends to be the dominant weather feature. Centered off the coast of southern California, it directs most disturbances north through Washington and Oregon, then southeast through Wyoming, Nevada and Utah, and occasionally into Arizona. If the high pressure system strengthens and moves over the region, these disturbances are generally deflected away from Arizona, and lighter winds prevail. It is during the winter months that mixing heights are at their lowest levels during the year with inversions that trap accumulated pollution. With the established south-to-north drainage flow from México into the United States along the Nogales Wash, emissions from Nogales, Sonora, México are frequently transported north into Nogales, Arizona.

Analysis of Meteorology

The preceding discussion and Map 6 show that the typical meteorological conditions associated with high PM_{10} and $PM_{2.5}$ levels in the Nogales PM_{10} Nonattainment Area are nighttime drainage of emissions from Nogales, Sonora along the Nogales Wash into Nogales, Arizona. The nighttime drainage is strongest during the winter months when there are strong temperature inversions and light to no winds.

Because the nighttime drainage from Nogales, Sonora into Nogales, Arizona follows the mountain valley(s) within the Nogales PM_{10} Nonattainment Area, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries should coincide with the current boundaries of the Nogales PM_{10} Nonattainment Area.

TRANSPORT OF EMISSIONS – MÉXICO TO U.S.

$PM_{2.5}$ emissions are generated from various sources, which include open burning, residential heating – both wood burning and natural gas, and tailpipe emissions from on-road and off-road vehicles. The 1993 Nogales PM_{10} State Implementation Plan (ADEQ 1993) indicated that 94 percent of the PM_{10} emissions in Nogales, Arizona originated from Nogales, Sonora, México. This finding was based on PM_{10} monitoring data, emissions inventory data, terrain and meteorological analyses, and a time lapse camera study that showed a plume of air pollutants being transported from Nogales, Sonora, México into Nogales, Arizona primarily during the evening hours (ADEQ 1993).

In addition, intensive monitoring studies of ambient PM_{10} levels along a south-north transect from Nogales, Sonora into Nogales, Arizona (ADEQ 1993; ENSR 1999) and air quality modeling of the transport of Mexican emissions (ENSR 1999) indicate that PM_{10} levels decrease with distance to low levels as these emissions move north. Similarly, it is reasonable to expect that $PM_{2.5}$ levels would also decrease with distance to low levels at the northern boundary of the Nogales PM_{10} Nonattainment Area. Thus, areas outside of the Nogales PM_{10} Nonattainment Area, such as Rio Rico, should not be impacted by the northward transport of $PM_{2.5}$ emissions from Nogales, Sonora.

A recent air quality study in the Nogales, Arizona area by Arizona State University (ASU) researchers also indicated that the majority of $PM_{2.5}$ emissions in Nogales, Arizona are a result of transport of these emissions from Nogales, Sonora, México into Nogales, Arizona (See Appendix A for this report by Dr. Allen, Dr. Anderson, and Dr. Herckes that describes their preliminary findings from the Nogales Winter 2005-2006 Study). The ASU study suggests that the main sources of $PM_{2.5}$ emissions are wood burning, food cooking and dust emissions. Because the Nogales, Sonora population exceeds the Nogales, Arizona population by approximately an order of magnitude, the vast majority of these emissions originate on the Mexican side of the border.

Analysis of Transport of Emissions
Based on two air quality studies of the Ambos Nogales area, ADEQ concluded that the Nogales, Sonora area is the largest contributor to $PM_{2.5}$ levels in the proposed Nogales $PM_{2.5}$ Nonattainment Area. This may lead to a Section 179B demonstration that, but for international transport of emissions, the Nogales, Arizona area would attain the $PM_{2.5}$ NAAQS.

EMISSION SOURCES

The following section describes the major emission sources in the Ambos Nogales area according to their locations – Nogales, Arizona and Nogales, Sonora, México. See Map 7 for locations of industrial point sources; highways; railroad lines; ports of entry; $PM_{2.5}$ monitor in Nogales, Arizona; Nogales PM_{10} Nonattainment Area boundaries; US/ México boundary; and city boundaries of Nogales, Arizona and Nogales, Sonora. Major $PM_{2.5}$ emission sources are within the Nogales PM_{10} Nonattainment Area, except for those sources in Nogales, Sonora, México.

Industrial Point Sources

Nogales, Arizona

There are no major $PM_{2.5}$ point sources in the Nogales PM_{10} Nonattainment Area. Table 9 lists the fourteen ADEQ permitted industrial sources in Santa Cruz County. Of these fourteen sources, only three sources - portable rock crusher / screener plants - appear to be operating outside of the Nogales PM_{10} Nonattainment Area. EPA's 2005 National Emissions Inventory lists the following annual $PM_{2.5}$ emissions for Santa Cruz County: 1 ton of $PM_{2.5}$ from electrical generating units and 295 tons of $PM_{2.5}$ from other stationary sources (www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#F-2).

Nogales, Sonora, México

The "Development of the Hazardous Air Pollutant Emissions Inventory for Ambos Nogales" (ENSR 1997) lists 49 point sources for the Nogales, Sonora, México. Currently, there may be fewer than 49 point sources in Nogales, Sonora, México due to sources closing or moving to other locations.

Growth of Point Sources

Communications with ADEQ Southern Regional Office staff based in Tucson, Arizona indicate little potential for future increases in the number of point sources in Nogales, Arizona. However, there is a potential for an increase in the number of point sources in Nogales, Sonora, México based on that numerous maquiladora operations have received ISO 9002 certification (Nogales Community Development 2007).

Map 7 Locations of Emission Sources

Table 9 - $PM_{2.5}$ and PM_{10} Emissions from Industrial Point Sources – Santa Cruz County			
Facility Name	**Address**	**Year 2005**	
		$PM_{2.5}$ Emissions (tons/year)	**PM_{10} Emissions (tons/year)**
C.S. McCrossan Construction, Inc. • Asphalt Batch Plant • Rock Crusher/Screener	91 Old Ruby Road Nogales, AZ 85621	Not Reported	4.12
Coronado Group – Todd Pit (Coronado Group LLC) • Portable Rock Crusher / Screener Plant	Santa Cruz County **Note: Source may be located outside of nonattainment area**	0.07	0.14
Granite Construction Company • Portable Asphalt Batch Plant	Rio Rico	Not Reported	0.02
GRG Construction Rock (Rio Rico Aggregates & Asphalt) • Portable Rock Crusher / Screener Plant	Rio Rico	0.31	1.65
Kino Crusher Plant (Huachuca Concrete, Inc.) • Portable Rock Crusher / Screener Plant	Santa Cruz County **Note: Source may be located outside of nonattainment area**	0.22	1.72
Padilla Sand & Gravel Redi-Mix (CPC Southwest Materials, Inc.) • Portable Rock Crusher / Screener Plant	Rio Rico	Not Reported	0.34
Rio Rico Hot Mix Asphalt Plant (Rio Rico Aggregates and Asphalt) • Portable Asphalt Batch Plant	Rio Rico	Not Reported	0.26
Santa Cruz County Health Dept. • Boiler • Diesel Generators - 2	2150 North Congress Drive Nogales, AZ 85621	Not Reported	0.01
Steris Isomedix Services • Boilers • Oxidation Systems • Hot Cells	1370 Industrial Park Drive Nogales, AZ 85621	Not Reported	0.59
Superstition Crushing Plant #23 (Superstition Crushing, LLC) • Portable Rock Crusher / Screener Plant	Santa Cruz County • **Note: Source may be located outside of nonattainment area**	0.27	1.80
United Metro Materials (Rinker) • Portable concrete batch plant	Nogales, Arizona	Not Reported	2.5
United Metro Materials (Rinker) • Concrete Batch Plant	91 Old Ruby Road Nogales, AZ 85621	Not Reported	2.5
Valencia Power Plant (Unisource, Inc.)	1741 North Grand Avenue Nogales, AZ 85621	Not Reported	0.11
Wash 'n Clean World • Dry Cleaner / Laundry	1989 North Grand Avenue Nogales, AZ 85621	Not Reported	Not Reported
Data Source: Annual Emissions Inventory Questionnaires submitted to ADEQ AQD Compliance Section			

Area Sources

Nogales, Arizona

The 1993 Nogales PM_{10} SIP (ADEQ 1993) and the 1997 Development of the Hazardous Air Pollutant Emissions Inventory for Ambos Nogales, ENSR report (ENSR 1997) listed the following $PM_{2.5}$ area sources for the Nogales, Arizona area: (1) Residential Fuel Combustion (e.g., natural gas, kerosene), (2) Residential Wood Combustion, and (3) Structural fires. EPA's 2005 National Emissions Inventory lists 287 tons of annual $PM_{2.5}$ emissions from fires in Santa Cruz County. (www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#F-2).

Nogales, Sonora, México

The 1993 Nogales PM_{10} SIP (ADEQ 1993) and the 1997 Development of the Hazardous Air Pollutant Emissions Inventory for Ambos Nogales, ENSR report (ENSR 1997) listed the following $PM_{2.5}$ area sources for the Nogales, Sonora, México area: (1) Residential Fuel Combustion (e.g., natural gas, propane, kerosene), (2) Residential Wood Combustion, (3) Structural Fires, (4) Charbroiling, (5) Wire Reclamation, (6) Open Burning, and (7) Residential Biomass / Waste Combustion.

Growth of Area Sources

From review of census data and other population data for Nogales, Arizona, it appears that the Nogales, Arizona's population will not increase substantially over the next 10 to 15 years. Thus, ADEQ assumes that the corresponding growth of area sources in the Nogales, Arizona will be minimal. ADEQ SRO staff concur that the growth of area sources in Nogales, Arizona will be minimal.

The Nogales Community Development report (Nogales Community Development 2007) and communications with ADEQ SRO staff indicate that the population of Nogales, Sonora, México is expected to increase in the next ten to fifteen years with a concurrent increase in residential wood combustion and residential fuel combustion (natural gas, propane, kerosene), and the potential for increases in structural fires. By Year 2015, the population of Nogales, Sonora, México is projected to be 11 times larger than the population of Nogales, Arizona.

Onroad Mobile Sources

The "Plan of Action for Improving Air Quality in Ambos Nogales" report (Border 2012 Ambos Nogales Air Quality Task Force and the Border Liaison Mechanism Economic and Social Development Subgroup 2005) listed the number of registered vehicles in Santa Cruz County and Nogales, Sonora, México as shown in Table 10. However, the report did not list which year the vehicle data refers to and did not provide gasoline and diesel fuel classifications.

Table 10 - Registered Vehicles in Santa Cruz County and Nogales, Sonora, México

Region	Vehicle type	Location	Number of Vehicles
U.S.	Passenger Vehicles	Santa Cruz County	39,882
	Buses	Santa Cruz County	160
	Commercial Trucks	Santa Cruz County	3,091
México	Passenger Vehicles	Nogales, Sonora	41,073 + 15,000 unregistered
	Buses + Light Trucks	Nogales, Sonora	16,015
	Heavy Commercial Trucks	Nogales, Sonora	1,072

Data Source: Plan of Action for Improving Air Quality in Ambos Nogales, 2005

Every six months, the Arizona Motor Vehicle Division (MVD) generates vehicle registration reports for Arizona vehicles. Table 11 lists the vehicles registered in Santa Cruz County, as of July 2007, by vehicle year and vehicle type (e.g., 4 light-duty diesel cars of vehicle year 2007 and 23 light duty diesel cars of vehicle year 2006 were registered in Santa Cruz County according to MVD's July 2007 records).

Table 11 - Santa Cruz County July 2007 Vehicle Registration Report

Year of Vehicle	Total	Light-Duty Cars		Light-Duty Trucks			Heavy-Duty Vehicles		Buses		Other Vehicles		
		Gas	Diesel	Gas TK1	Gas TK2	Diesel	Gas	Diesel	Gas	Diesel	Elec-tric	Alt Fuel	Motor -cycle
2007	1,723	1,129	4	402	12	43	5	55	0	14	0	0	59
2006	2,550	1,670	23	588	17	78	11	50	4	9	1	1	98
2005	2,552	1,784	12	541	16	45	11	53	3	8	2	0	77
2004	2,534	1,704	12	642	18	67	9	17	7	3	0	0	55
2003	2,356	1,636	11	517	27	53	4	31	3	10	1	0	63
2002	2,515	1,789	13	541	28	47	8	19	2	9	0	0	59
2001	2,528	1,730	16	611	15	50	9	46	5	4	0	3	39
2000	2,878	2,014	14	653	23	49	15	49	5	1	9	7	39
1999	2,701	1,944	8	506	32	67	19	79	6	3	0	3	34
1998	2,515	1,808	13	551	25	17	15	54	2	1	2	3	24
1997	2,442	1,607	11	611	34	52	22	81	6	0	0	0	18
1996	1,943	1,315	5	468	31	29	5	70	3	0	0	1	16
1995	2,143	1,466	4	490	38	31	15	69	3	3	1	1	22
1994	1,879	1,251	8	483	31	21	9	60	1	2	1	2	10
1993	1,616	1,109	4	341	35	29	7	74	2	1	0	0	14
1992	1,231	841	3	273	25	13	10	50	1	2	0	0	13
1991	1,204	854	1	264	26	14	6	32	0	0	0	1	6
1990	1,190	841	2	256	24	11	7	39	2	1	1	0	6
1989	1,169	768	7	290	34	5	9	42	1	2	0	1	10
1988	952	608	2	247	24	1	13	47	4	1	0	0	5
1987	818	543	3	201	15	7	11	30	1	2	0	0	5
1986	837	458	2	278	19	9	15	35	4	0	0	0	17
1985	736	398	10	235	24	9	14	27	2	1	0	0	16
1984	552	298	9	173	24	17	2	22	0	0	0	0	7
1983	322	155	12	110	15	10	6	5	1	0	0	0	8
1982	3,574	1,650	35	1,415	179	43	88	56	17	2	1	1	87
Totals	47,460	31,370	244	11,687	791	817	345	1,192	85	79	19	24	807

Data Source: Arizona Motor Vehicle Division. 2007 Vehicle Registration Report

Growth of Onroad Mobile Sources

The number of registered vehicles in Santa Cruz County has grown from 41,527 in January 2004 to 47,460 in July 2007 (Arizona Motor Vehicles Division 2007). This increase in the number of vehicles in Santa Cruz County may not directly correspond to growth in the number of vehicles in the Nogales PM_{10} Nonattainment Area because the population of Nogales, Arizona has not grown as fast as the surrounding Santa Cruz County. Although it is not known what proportion of the vehicles listed in Table 11 are owned by residents in the Nogales PM_{10} Nonattainment Area, in Year 2000, 80 percent of Santa Cruz County's population resided in Nogales, Arizona and Rio Rico, Arizona (Nogales, Arizona, the majority of Rio

Rico Southeast CDP, and a portion of Rio Rico Southwest CDP are in the Nogales PM_{10} Nonattainment Area).

According to the "Plan of Action for Improving Air Quality in Ambos Nogales," (Border 2012 Ambos Nogales Air Quality Task Force and the Border Liaison Mechanism Economic and Social Development Subgroup 2005), traffic congestion, resulting in increased tailpipe emissions, is a result of the following conditions: (1) Volume of the port of entry traffic and local traffic, (2) Design of local streets and limited available parking, and (3) Route of the Union Pacific/Grupo México railroad.

Thus, the mix and volume of vehicles on both sides of the border result in excess traffic lines and congestion. For example, produce trucks that enter the U.S. at the Mariposa Port of Entry travel on local streets destined for warehouses (e.g., Mariposa Avenue and northern Grand Avenue). Local passenger traffic also occurs along these streets since most of the commercial development in Nogales, Arizona is located along these streets.

EPA's 2005 National Emissions Inventory lists 23 tons of annual $PM_{2.5}$ emissions from onroad mobile sources in Santa Cruz County (www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#F-2).

Nonroad Mobile Sources

Union Pacific Railroad operates railroad lines in Santa Cruz County. Table 12 lists the annual number of trains that travel between Nogales, Arizona and Nogales, Sonora, México.

According to the "Plan of Action for Improving Air Quality in Ambos Nogales," (Border 2012 Ambos Nogales Air Quality Task Force and the Border Liaison Mechanism Economic and Social Development Subgroup 2005), the Union Pacific railroad tracks split the Ambos Nogales area into a western half and an eastern half in both Nogales, Arizona, and Nogales, Sonora, México. Train activity along this route often results in several blocked intersections when trains pass through Ambos Nogales increasing idling time for motor vehicles. In Nogales, Arizona, there is only one vehicle-bridge crossing over the railroad tracks. The first vehicle-bridge crossing over the railroad tracks in Nogales, Sonora was constructed only as recently as 2005.

EPA's 2005 National Emissions Inventory lists 25 tons of annual $PM_{2.5}$ emissions from nonroad mobile sources in Santa Cruz County (www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#F-2).

Growth of Nonroad Mobile Sources

Union Pacific Railroad staff do not expect growth in train traffic in Santa Cruz County over the next ten years (communication with Union Pacific Railroad 2007).

Analysis of Emission Sources

All of the major industrial point sources and area sources, and most of the onroad mobile and nonroad mobile sources in Santa Cruz County are within the Nogales PM_{10} Nonattainment Area. Because minimal $PM_{2.5}$ emissions in Santa Cruz County originate outside of the Nogales PM_{10} Nonattainment Area, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries should coincide with the current boundaries of the Nogales PM_{10} Nonattainment Area.

It is important to note that the largest contributor to $PM_{2.5}$ emissions in the Nogales PM_{10} Nonattainment Area are those emission sources located in Nogales, Sonora.

COMMUTING PATTERNS

Two ports of entry connect the Nogales, Arizona area with Sonora, México. These ports of entry are the Mariposa Port of Entry, which primarily handles commercial truck traffic, and the DeConcini Port of Entry, which primarily handles passenger cars, buses, and non-commercial trucks. Table 12 lists the annual number of vehicles and trains that used these ports of entry during years 2000 through 2006.

According to the "Draft Environmental Assessment, Nogales Mariposa U.S. Port of Entry, 2007" (AZTEC & GSA September 2007), the number of commercial trucks passing through the Mariposa Port of Entry has increased steadily since 2002. In 2006, 289,590 trucks passed through this port of entry. By comparing this number with the figure in Table 11, it can be inferred that in 2006, commercial trucks exclusively used the Mariposa Port of Entry and not the DeConcini Port of Entry. The report also mentions that bus traffic at the Mariposa Port of Entry has doubled since 2002 to 8,920 in 2006. Comparing this number with the Year 2006 bus traffic number in Table 11, it can be inferred that 77% of the buses entered the U.S. through the Mariposa Port of Entry and 23% entered through the DeConcini Port of Entry.

Table 12 – Nogales, Arizona Ports of Entry – Vehicle and Train Traffic

Year	Personal Vehicles	Trucks	Buses	Total Vehicles	Trains
2000	4,681,567	254,694	8,899	4,693,240	774
2001	4,590,933	249,327	7,238	4,600,807	635
2002	3,978,640	242,237	6,796	3,988,045	607
2003	3,836,372	243,365	6,705	3,845,537	457
2004	3,571,230	247,553	6,842	3,580,520	444
2005	3,445,984	266,233	8,988	3,457,762	785
2006	3,282,781	289,590	11,521	3,296,961	653

Data Source: U.S Bureau of Transportation Statistics, http://www.transtats.bts.gov

The "Development of the Hazardous Air Pollutant Emissions Inventory for Ambos Nogales, July 1997" report by ENSR (ENSR 1997) states that typically the wait times / idling times for vehicles crossing from Nogales, Arizona to Nogales, Sonora, México were minimal. However, wait times/idling times for vehicles crossing from Sonora, México to the Nogales, Arizona area can be substantial. ADEQ SRO staff report that at the DeConcini Port of Entry, wait times range between 25 minutes to 1 hour during weekdays and more than one hour on weekends. The "Economic Benefits of Expanding the Border-Crossing for Commercial Vehicles at the Mariposa Crossing in Nogales, Arizona, Final Report, June 2007" by RTI International (RTI 2007) states that the wait times at the Mariposa Port of Entry range from 22 minutes to over four hours, with a midpoint wait time of 2.35 hours. The longest wait times occur during the months of November through January.

Analysis of Commuting Patterns

The preceding discussion notes that the major commuting pattern in Nogales, Arizona area is the vehicle traffic that crosses the U.S./ México border at two ports of entry: (1) Mariposa Port of Entry, which primarily handles commercial truck traffic, and (2) DeConcini Port of Entry, which primarily handles passenger cars, buses, and non-commercial trucks. Because there are no other major commuting patterns within the Nogales PM_{10} Nonattainment Area or within Santa Cruz County, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries should coincide with the current boundaries of the Nogales PM_{10} Nonattainment Area.

CONTROL MEASURES

ADEQ permitted sources in the Nogales PM_{10} Nonattainment Area are in full compliance with the control measures listed in their permits (ADEQ AQD Compliance Section).

Nogales, Arizona paved 5 miles of unpaved roads in 2006 and plans to pave similar amounts of unpaved roads in the next five years (Internet search of Nogales, Arizona news stories by ADEQ SRO staff). Nogales, Sonora, México also plans to pave 37 kilometers (23 miles) of unpaved roads in the next 3 years (Nogales, Sonora, México city officials provided these data to ADEQ SRO).

The Mariposa Port of Entry is close to completion of construction of additional "Free and Secure Trade Program" (FAST) lanes to speed the inspections of commercial trucks that have been certified by the US Customs and Border Protection for hauling freight from México to the U.S. (RTI International 2007). These FAST lanes are expected to reduce the wait times associated with inspecting commercial trucks from México.

Analysis of Control Measures

The main $PM_{2.5}$ control measure found for the proposed Nogales $PM_{2.5}$ Nonattainment Area was the expansion of the Mariposa Port of Entry to increase the number of lanes for inspecting commercial trucks that have been certified by the U.S. Customs and Border Protection for hauling freight from México to the U.S. This control measure will decrease the idling times of commercial truck and the resulting $PM_{2.5}$ emissions from truck exhaust.

SUMMARY OF ANALYSES

ADEQ examined the following ten criteria in order to recommend boundaries for the proposed Nogales $PM_{2.5}$ Nonattainment Area:

- $PM_{2.5}$ Monitoring Data
- Geography and Topography
- Demographics
- Jurisdictional Boundaries
- Planned Developments
- Meteorology
- Transport of $PM_{2.5}$ Emissions
- Emission Sources
- Commuting Patterns
- Control Measures

ADEQ also examined air quality and transportation studies conducted for the Ambos Nogales area and communicated with ADEQ SRO staff who participated in many of these studies and have a working knowledge of the area, its emission sources, and meteorology.

The following list summarizes ADEQ's analyses of the above criteria:

1. $PM_{2.5}$ Monitoring Data - Previous air quality studies by ADEQ and ENSR indicate that the current location of the Nogales, Arizona PM_{10} monitor is adequate for measuring $PM_{2.5}$ levels in the Nogales $PM_{2.5}$ Nonattainment Area.

2. Geography and Topography - The current Nogales PM_{10} Nonattainment Area encompass both the mountain valley, where Nogales, Arizona is located, and a buffer area of mountains outside of this valley. Based on the geography and topography data, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries do not need to be extended beyond the current boundaries of the Nogales PM_{10} Nonattainment Area.

3. Demographics - Based on projected population growth in and near the Nogales PM_{10} Nonattainment Area, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries do not need to be extended beyond the current boundaries of the Nogales PM_{10} Nonattainment Area.

4. Jurisdictional Boundaries - The current boundaries of the Nogales PM_{10} Nonattainment Area encompasses all major cities and most of the private land in Santa Cruz County. Based on these jurisdictional boundary data, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries do not need to be extended beyond the current boundaries of the Nogales PM_{10} Nonattainment Area.

5. Planned Developments – Data on planned developments were found only for Nogales, Arizona (and Nogales, Sonora). Based on these planned development data, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries do not need to be extended beyond the current boundaries of the Nogales PM_{10} Nonattainment Area.

6. Meteorology - Based on that the nighttime drainage from Nogales, Sonora into Nogales, Arizona follows the mountain valley(s) in the Nogales PM_{10} Nonattainment Area, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries do not need to be extended beyond the current boundaries of the Nogales PM_{10} Nonattainment Area.

7. Transport of Emissions – México to U.S. - Based on two air quality studies of the Ambos Nogales area, ADEQ concluded that the Nogales, Sonora area is the largest contributor, 94%, to $PM_{2.5}$ levels in the proposed Nogales $PM_{2.5}$ Nonattainment Area.

8. Emission Sources - Based on that minimal $PM_{2.5}$ emissions in Santa Cruz County originate outside of the Nogales PM_{10} Nonattainment Area, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries do not need to be extended beyond the current boundaries of the Nogales PM_{10} Nonattainment Area.

9. Commuting Patterns - The major commuting pattern in the Nogales PM_{10} Nonattainment Area is the traffic in Nogales, Arizona area that crosses the U.S. / México border at two ports of entry: (1) Mariposa Port of Entry, which primarily handles commercial truck traffic, and (2) DeConcini Port of Entry, which primarily handles passenger cars, buses, and non-commercial trucks. Based on that there are no other major commuting patterns in the Nogales PM_{10} Nonattainment Area, or in Santa Cruz County, ADEQ concluded that the Nogales $PM_{2.5}$ Nonattainment Area boundaries do not need to be extended beyond the current boundaries of the Nogales PM_{10} Nonattainment Area.

10. Control Measures - The expansion of the Mariposa Port of Entry will increase the number of lanes for inspecting commercial trucks that have been certified by the U.S. Customs and Border Protection for hauling freight from México to the U.S. This control measure will decrease the idling times of commercial trucks and the resulting $PM_{2.5}$ emissions from truck exhaust.

ADEQ did consider including all of the unincorporated community of Rio Rico (39,000 acres) in the proposed Nogales $PM_{2.5}$ Nonattainment Area, but did not for the following reasons:

- **Low Population Density**: The Year 2007 population density of Rio Rico is estimated at 26 persons per square mile, while the Year 2007 population density of Santa Cruz County is 38 persons per square mile (see Table 7 in the preceding Demographics section of this report). Thus, Rio Rico's population density is more rural than urban in nature.

- **No Major Permitted Industrial Sources** – ADEQ's records show no major permitted industrial sources in Rio Rico. There may be portable asphalt batch plants and portable rock crusher / screener plants that move in and out of Rio Rico as needed for construction projects.

- **Small Number of Businesses** – Rio Rico has three businesses: Rio Rico Market, Ryan's Sports Pub, and the Las Trankas Mexican Restaurant. All three businesses are located at 1131 West Frontage Road; Rio Rico, AZ 85648 (frontage west of Interstate 19).

- **Minimal $PM_{2.5}$ Emissions** – The main source of $PM_{2.5}$ emissions in Rio Rico is vehicle traffic. Due to the low population density, these emissions will be dispersed over a large area. Also, because Rio Rico is north of Nogales, Arizona, Rio Rico will not contribute to the elevated $PM_{2.5}$ levels recorded at the Nogales $PM_{2.5}$ monitor that occur when there is nighttime drainage of emissions from Nogales, Sonora into Nogales, Arizona (i.e., emissions are being transported from south to north along the Nogales Wash).

Most of the Rio Rico Southeast CDP (89%) and a portion of the Rio Rico Southwest CDP (19%) are within the Nogales PM_{10} Nonattainment Area.

CONCLUSIONS

Based on the above analyses, data, studies, and communications, ADEQ recommends that the boundaries of the proposed Nogales $PM_{2.5}$ Nonattainment Area coincide with the boundaries of the current Nogales PM_{10} Nonattainment Area as listed in the Code of Federal Regulations, 40, Parts 81 to 85, Revised as of July 1, 2006, page 82:

The portions of the following Townships which are within the State of Arizona and lie east of 111 degrees longitude:

T23S, R13E
T23S, R14E
T24S, R13E
T24S, R14E

As previously discussed, the large majority of $PM_{2.5}$ emissions in the proposed Nogales $PM_{2.5}$ Nonattainment Area are due to transport of $PM_{2.5}$ emissions from Nogales, Sonora, México and it is these emissions that are the major cause of the $PM_{2.5}$ exceedances in Nogales, Arizona.

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APPENDIX A – ARIZONA STATE UNIVERSITY'S NOGALES WINTER STUDY

Preliminary Summary of Findings from Nogales Winter 2005-2006 Study

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17 Oct 2007

Between 29 December 2005 and 13 January 2006 our research team measured particulate matter (PM) using on-line instruments and collected PM samples for off-line analyses. The sampling site was the Nogales Post Office air quality monitoring site which is located approximately 0.5 km north of the U.S.-México border. The sampling site is near the main road through Nogales, AZ, and downslope from Nogales, Sonora. Due to downslope flow from higher ground to the south, winds were generally from the south from approximately an hour after sunset until the breakup of the nocturnal boundary layer at approximately 1000 the next morning.

Data from all the on-line aerosol instruments (BAMs, DusTrak, SMPS, AMS) reflect high $PM_{2.5}$ concentrations between ~1900 and ~1000. $PM_{2.5}$ concentrations during these periods routinely exceed 35 μg/m3 and for short periods exceed 100 μg/m3. Overnight $PM_{2.5}$ concentrations were the main contributors to the daily average $PM_{2.5}$ concentrations which were in the range 10-38 $\mu g/m^3$ during this study.

Samples collected during the study have been analyzed for bulk composition by ion chromatography (sulfate, nitrate), colorimetry (ammonium), carbon evolution (organic carbon and elemental carbon), and scanning electron microscopy (mineral dust). Inorganic ions, sulfate, nitrate and ammonium, were present at very low concentrations indicating little contribution to PM from gas-phase SOx, NOx, and NH_3 emissions. Carbonaceous PM contributions were 17-37 $\mu g/m^3$ with approximately 85% of this organic carbon, and the remainder elemental carbon. A substantial fraction of the 25,000 particles analyzed by SEM were mineral dust particles; these results suggest $PM_{2.5}$ mineral dust concentrations of ~10 $\mu g/m^3$.

Based on the correlation of high $PM_{2.5}$ measurements with light southerly winds, and the small number of emission sources between the sampling site and the U.S.-México border, the predominant sources of $PM_{2.5}$ at the sampling site were in México. This is consistent with emission inventory results that indicate 94% of $PM_{2.5}$ at the sampling site is from Nogales, Sonora. Based on the bulk composition data, the main sources of $PM_{2.5}$ are open burning, food cooking, and dust emissions. Carbonaceous emissions with ~15% EC are consistent with wood burning or food cooking, and not consistent

with an aerosol dominated by diesel emissions for which EC makes up ~60% of the carbonaceous emissions.

Please note that these conclusions apply to the Post Office monitoring site during winter high PM events. Diesel engine emissions, for example, may be important at the main truck border crossing located ~3 km west of the sampling site. Because the main truck border crossing is located in an adjacent valley, movement of air from this crossing to the sampling site may be limited, especially on winter nights.

We have analyzed the Nogales samples for organic tracer species by GC/MS and for mineral dust composition by SEM. Using these data in addition to the bulk $PM_{2.5}$ composition data we will provide a more accurate and precise $PM_{2.5}$ source apportionment.