

**Development of an Air Emission Inventory for the  
Western Arizona Sonora Border Air Quality Study (WASBAQS)  
Part 2 – Mexico Emission Inventory**

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**ABSTRACT**

In response to concerns about high particulate matter (PM) and air toxics concentrations that have been measured along the U.S./Mexico border, the Arizona Department of Environmental Quality (ADEQ) is conducting the Western Arizona-Sonora Border Air Quality Study (WASBAQS) which is the third in a series of studies of pollution along the Arizona/Mexico border. The principal objectives of the WASBAQS are to: (1) Fully characterize the gaseous and particulate air pollutants, (2) Estimate the risk to human health for the populations of Yuma, Arizona; San Luis Río Colorado, Sonora; and rural northeastern Baja California areas, and (3) Evaluate proposed control strategies to improve air quality in the border region of southwest Arizona, southeast California, and Mexico (states of Sonora and Baja California) (WASBAQS Study Area). The WASBAQS seeks to achieve these objectives in four phases: 1) air quality monitoring, 2) development of a gridded emissions inventory, 3) air quality modeling, and 4) risk assessment.

The emission inventory includes estimates of all criteria pollutants, ammonia, particulate matter and hazardous air pollutants (HAPs) for calendar year 2005. All relevant emission sources within the study area were considered, including point sources (those emitting 10 or more tons of a relevant pollutant per year), area sources (e.g., agricultural tillage, pesticide and fertilizer usage, and disperse sources of VOCs such as gasoline dispensing facilities, etc.), on-road mobile sources (i.e., tailpipe exhaust, tire and brake wear, road dust from vehicles traveling on paved and unpaved roadways), and nonroad mobile sources (e.g., lawn and garden equipment, agricultural equipment, etc.). The inventory also includes emissions from wildfires and windblown fugitive dust. Where practical and available, local data sources and source-specific information were incorporated into the inventory. In addition, HAP emissions estimates were developed using speciation data from the most recent version of the U.S. EPA's SPECIATE database. The geographic extent of the inventory includes portions of Yuma County (AZ), Imperial County (CA), and the northern portions of the Mexican states of Sonora and Baja California.

This paper discusses the development of the WASBAQS emissions inventory for the Mexico portion of the study domain. The Mexico portion of the inventory includes many similar categories found in the U.S.; however, additional categories specific to Mexico (e.g., brick kilns, border crossings, etc.) are also estimated. The development of the WASBAQS emission inventory for the U.S. portion of the study region is presented in a companion paper (i.e., Part 1).<sup>1</sup>

## INTRODUCTION

### Background

The Western Arizona-Sonora Border Air Quality Study (WASBAQS) is being conducted by the Arizona Department of Environmental Quality (ADEQ) in response to concerns about high particulate matter (PM) and air toxics concentrations that have been measured along the U.S./Mexico border, and is the third in a series of studies of pollution along the Arizona/Mexico border. The principal objectives of the WASBAQS are to: (1) Fully characterize the gaseous and particulate air pollutants, (2) Estimate the risk to human health for the populations of Yuma, Arizona; San Luis Río Colorado, Sonora; and rural northeastern Baja California areas, and (3) Evaluate proposed control strategies to improve air quality in the border region of southwest Arizona, southeast California, and Mexico. The WASBAQS seeks to achieve these objectives in four phases: 1) air quality monitoring, 2) development of a gridded emissions inventory, 3) air quality modeling and control strategy evaluation, and 4) risk assessment.

### Inventory Scope

The overall WASBAQS study area encompasses approximately 1,275,073 acres (1,992 square miles). The U.S. portion of the study area includes the southern part of Yuma County, Arizona and the extreme southeastern corner of Imperial County, California. The Mexico portion of the study area includes the northwestern part of the municipality of San Luis Río Colorado (SLRC), Sonora and the northeastern part of the municipality of Mexicali, Baja California (See Figure 1). It should be noted that the large urban area of Mexicali is not included in the inventory domain; however, numerous Mexicali *ejidos* (agricultural communes) are located inside of the inventory domain. Figure 2 indicates all communities (including the San Luis Río Colorado urban area and Mexicali *ejidos*) located in the inventory domain with population greater than 1,000.

As described in the Part 1 paper, the WASBAQS emissions inventory includes industrial point sources, area sources, on-road motor vehicles, and off-road mobile sources. In addition, the Mexico portion of the inventory includes additional categories specific to Mexico that are not found in the U.S. (e.g., non-industrial brick kilns, border crossings, etc.). Finally, several domain-wide categories (i.e., windblown fugitive dust and ammonia area sources) were estimated in conjunction with the U.S. portion of the inventory (see Part 1), rather than separately.

Pollutants inventoried for the WASBAQS project include criteria pollutants ( $\text{NO}_x$ ,  $\text{SO}_x$ , VOC, CO,  $\text{PM}_{10}$ ,  $\text{PM}_{2.5}$ , and  $\text{NH}_3$ ) as well as the 189 Hazardous Air Pollutants (HAPs) listed in the 1990 Clean Air Act Amendments, under Title III. The temporal resolution of the emissions inventory is hourly for a typical weekday and typical weekend day for each season of calendar year 2005.

The emission estimation methodologies and data sources for the development of the Mexico portion of the WASBAQS inventory are presented below for each source category. Detailed discussions are provided for cases where local data were available and used. In the interest of brevity, for all other sources, only brief descriptions are provided; the reader is referred to the WASBAQS project report and documentation for more detailed information regarding estimation methodologies and data sources.

### Speciation

Unless otherwise noted, all emissions of pollutants not directly estimated based on emission factors were estimated using U.S. EPA's SPECIATE4.0 particulate and gaseous profiles. Emissions were generated based on SPECIATE4.0 profiles for species identified in the work plan for the study (i.e., 189 hazardous air pollutants, hydrogen sulfide, and identified additional  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  metal and aerosol species). For a given source category, VOC,  $\text{PM}_{2.5}$ , or  $\text{PM}_{\text{Coarse}}$  emissions were multiplied by the

selected SPECIATE4.0 profile weight fractions to estimate SPECIATE4.0-based emissions. U.S. EPA's latest cross reference table was used to identify appropriate speciation profiles available in the SPECIATE4.0 database. Although several PM<sub>10</sub>, PM<sub>2.5</sub>, and PM<sub>Coarse</sub> profiles are available in the SPECIATE4.0 database, the latest cross reference table only includes the simplified PM<sub>2.5</sub> profiles that carry five major PM components (i.e., sulfates, nitrates, organic carbons, elemental carbons, and other fine PM). For this study effort, more detailed profiles were acquired based on descriptions provided in the database. PM<sub>Coarse</sub> profiles not available in the database were replaced by PM<sub>2.5</sub> profiles for the same source category.

## STATIONARY POINT SOURCES – METHODS, DATA SOURCES, AND RESULTS

This section describes in detail all of the calculations, source data, and assumptions used to estimate point source emissions in the SLRC portion of the inventory domain; no point sources were identified in the Mexicali portion of the inventory domain.

Point source emissions data in Mexico are transmitted to the federal and/or state environmental agencies (depending upon sector-based jurisdiction) by means of the Annual Operating Certificate (*Cédula de Operación Annual – COA*). No point sources emitting 10 tons or more of a single pollutant were identified within the inventory domain as part of the 1999 Mexico NEI.<sup>2</sup>

However, several point sources that operate outside of federal and/or state jurisdictions are located in SLRC. A staff member of the SLRC Municipal Office of Economic Development and Tourism (*Desarrollo Económico y Turismo Municipal*) provided an initial list of 32 *maquiladoras* located in SLRC.<sup>3</sup> (A *maquiladora* is a factory or assembly plant operating in Mexico under preferential programs that allow importation of materials and equipment on a duty- and tariff-free basis for assembly or manufacturing and then re-exportation of the assembled product back to the originating country.) Of these 32 *maquiladoras*, 12 facilities were textile or clothing manufacturing facilities, which are scattered throughout the city and are thought to be negligible emission sources. The remaining 20 *maquiladoras* are primarily located in the Industrial Parque on the east side of town.

Subsequent interviews with the staff member of the SLRC Municipal Office of Economic Development and Tourism identified 15 *maquiladoras* thought to have the most significant emissions.<sup>3</sup> Note that one facility (i.e., Phoenix Textiles) was not on the initial list of 32 *maquiladoras* discussed above. A list of the 33 *maquiladoras* is shown in Table 1; the table also notes the 15 facilities identified as most significant.

A point source questionnaire was developed for obtaining activity data, operating schedules, and stack parameters. The questionnaire was initially mailed out to the environmental contacts for the 15 facilities by the SLRC Municipal Office of Economic Development and Tourism. Approximately a week after the mail-out, the 15 facilities were then contacted by industrial engineering students from CESUES (*Centro de Estudios Superiores del Estado de Sonora*). The eight CESUES students (in four 2-person teams) attempted to collect questionnaire responses in person, and answer any questions that the environmental contacts might have. A total of eight facilities eventually provided responses to the questionnaire, including one (i.e., Kims Packaging) that did not operate in 2005 (see Table 1). The remaining seven facilities either refused to meet with the CESUES students, or did not otherwise submit a response. Although all of the facilities surveyed received the same questionnaire, the format of the responses was varied. A brief summary of the data submitted by the seven facilities that operated in 2005 is provided in Table 2.

## **Emissions**

In general, fuel combustion emissions were estimated by using hourly emission rates obtained from stack testing results (i.e., GPI Mexicana, Phoenix Textiles, TSE de Mexico, and 1 distillate-fired source at SANA Internacional). For the other distillate-fired source at SANA Internacional, it was assumed that since equipment characteristics were similar (i.e., similarly sized diesel-fired equipment and monthly fuel use), then the emissions would be the same. For the three LPG-fired tortillerías at SANA Internacional, emissions were calculated using the commercial LPG combustion emission factors from AP-42, Section 1.5.<sup>4</sup>

Surface coating emissions were estimated for the four facilities that reported paint usage quantities (i.e., Mecox Resources, Demda Mexico, TSE de Mexico, and Acero Ameri-mex). Only the Demda Mexico facility provided paint VOC content (1.74 lbs VOC per gallon); a similar VOC content was assumed for the other three facilities.

The following adjustments were made to the area source inventory to avoid double-counting:

- The point source fuel use of 918,000 liters of distillate and 2,586,826 liters of LPG was subtracted from the estimated area source industrial fuel combustion categories;
- The point source surface coating emissions were reconciled with the area source industrial surface coating category by subtracting the reported facility employee counts from the area-wide employee counts (i.e., 247 employees from Mecox were subtracted from the automotive category and 350 employees from Demda were subtracted from the electronics and electrical equipment category).

Some additional materials (inorganic chemicals, soldering rods, etc.) were reported on the point source survey questionnaire. However, the information provided was insufficient to estimate emissions.

The facility-level emissions (both criteria and HAPs) for the seven point source facilities that responded to the point source survey questionnaire are presented in Table 3. In general, point source HAP emissions were estimated utilizing EPA SPECIATE4.0 particulate and gaseous profiles. Surface coating emissions at Acero Ameri-mex, Demda, and TSE were multiplied by industrial surface coating SPECIATE4.0 profile weight fractions to estimate HAP emissions. Surface coating emissions at Mecox Resources were multiplied by a HAP fraction of 0.2000 (i.e., 0.1500 xylene and 0.0500 ethyl benzene; based upon detailed MSDS information) to estimate HAP emissions. LPG combustion emissions at SANA Internacional were multiplied by the industrial LPG SPECIATE4.0 profile weight fraction to estimate HAP emissions.

## **Temporal Allocation**

Six of the seven facilities provided information regarding their operating schedule (i.e., Demda Mexico, GPI Mexicana, Mecox Resources, Phoenix Textiles, SANA Internacional, and TSE de Mexico). The temporal allocation for these facilities was based upon the submitted operating schedule data. Appropriate defaults were used for the other facility (i.e., Acero Ameri-mex).

## **Spatial Allocation**

Stack-specific global positioning system (GPS) readings were not obtained for any of the facilities due to a lack of facility access. Location assignments were based upon street address, satellite or land use images, and building centroids.

## AREA SOURCES – METHODS, DATA SOURCES, AND RESULTS

This section describes in detail all of the calculations, source data, and assumptions used to estimate area source emissions in the SLRC and Mexicali portions of the inventory domain.

### Industrial Fuel Combustion

#### Annual Emissions

Both distillate fuel oil and LPG industrial fuel usage were identified during the point source survey, but residual fuel oil usage was not identified. However, it appears that PEMEX does market residual fuel oil in SLRC.<sup>3</sup> Natural gas is not used because SLRC and Mexicali are not connected to Mexico's natural gas infrastructure. Therefore, in the SLRC and Mexicali portions of the inventory domain, it was assumed that industrial combustion of distillate fuel oil, residual fuel oil, and LPG occurs. Local industrial sales and usage statistics were requested from PEMEX and the four local LPG distributors (i.e., Baja Gas, Hidrogas, Kino Gas, and Zeta Gas). However, none of these distributors provided the requested statistics. In lieu of these statistics, national- and state-level statistics from Mexico's Secretariat of Energy (*Secretaría de Energía* – SENER) were used to estimate the quantity of industrial distillate fuel oil, residual fuel oil, and LPG fuel combustion in the SLRC and Mexicali portions of the inventory domain.

Northwest Region (i.e., the states of Baja California, Baja California Sur, Sinaloa, and Sonora) industrial distillate, residual, and LPG usage quantities<sup>5,6</sup> were ratioed down to the municipality-level (i.e., SLRC and Mexicali) based on 2004 employee estimates for the industrial sector.<sup>7</sup> It was originally intended to obtain 2005 employee data at the basic geostatistical area-level (i.e., *Área Geoestadística Básica* [AGEB]) to determine the fraction of SLRC and Mexicali employees that were within the inventory domain. Unfortunately, some problems were encountered in the AGEB data and shape files supplied by the National Institute of Statistics, Geography, and Information (*Instituto Nacional de Estadística, Geografía e Informática* – INEGI). These problems could not be resolved in time for development of the emissions inventory. In lieu of these AGEB data, domain population fractions for SLRC and Mexicali were obtained from locality-specific population statistics from the 2000 census (i.e., 89.84% for SLRC and 9.18% for Mexicali).<sup>8</sup>

The area source industrial fuel combustion source category also was reconciled with data collected from the point source survey. The point source survey identified 918,000 liters/year of LPG fuel use and 2,586,826 liters/year of distillate fuel use at SLRC point sources that responded to the point source survey. These point source fuel totals were subtracted from the estimated area source fuel totals.

After reconciling fuel use with the point sources, applying the relevant population ratios, and converting from liters to gallons, criteria pollutant emissions were then estimated using emission factors from AP-42, Section 1.3 (for distillate and residual fuel oil) and Section 1.5 (for LPG).<sup>4</sup> Weighted emission factors reflecting a typical Mexican LPG mix of 60% butane and 40% propane were calculated. The fuel sulfur contents for the distillate and residual fuel oils were previously obtained during the development of the 1999 Mexico NEI (i.e., 0.038% for distillate and 3.699% for residual).<sup>9</sup> Also, an LPG sulfur content of 0.4114 grains/100 ft<sup>3</sup> was assumed based upon the 1999 Mexico NEI.<sup>2</sup> Finally, it was assumed that the LPG PM<sub>10</sub> and PM<sub>2.5</sub> emission factors were equivalent to the PM emission factor listed in AP-42 due to the small particle size distribution associated with LPG combustion.

It should be noted that the industrial residual fuel combustion emissions might be overestimated. Industrial manufacturing employee statistics were previously used in the 1999 Mexico NEI to allocate national- and regional-level industrial fuel usage to the municipality-level.<sup>2</sup> However, no residual fuel usage was identified at the SLRC industrial point sources that responded to the survey. On the other

hand, it was determined that PEMEX markets industrial residual fuel in SLRC.<sup>3</sup> It is likely that the distribution of industrial manufacturing employees does not correspond exactly with the location of industrial facilities that use residual fuel. Many of these facilities will be large and will tend to be located in the urban area of Mexicali or other large cities within the Northwest Region (e.g., Tijuana, Hermosillo, Culiacán, etc.).

### Spatial and Temporal Allocation

The spatial allocation of industrial fuel combustion was assumed to correspond to the overall distribution of industrial employees. It was assumed that there was no significant seasonal variation in industrial fuel use.

## **Commercial/Institutional Fuel Combustion**

### Annual Emissions

The 1999 Mexico NEI identified commercial/institutional use of distillate and residual fuel oils<sup>2</sup>; however, recent PEMEX statistics do not specifically identify this sector.<sup>5</sup> In addition, SLRC and Mexicali are not connected to Mexico's natural gas infrastructure. Therefore, in the SLRC and Mexicali portions of the inventory domain, commercial and institutional fuel combustion is assumed to be predominantly LPG. The commercial/institutional LPG used in SLRC and Mexicali is distributed by four companies: Baja Gas, Hidrogas, Kino Gas, and Zeta Gas. Contacts were made with these distributors during the three SLRC site visits and commercial/institutional sales and usage statistics were requested. However, none of the LPG distributors provided the requested local statistics. In lieu of these statistics, national- and state-level statistics from SENER were used to estimate the quantity of commercial/institutional LPG used in the SLRC and Mexicali portions of the inventory domain.

Northwest Region commercial/institutional LPG usage statistics were ratioed down to the SLRC and Mexicali portions of the inventory domain using the methodology described above for industrial fuel combustion, except that commercial/institutional employees were used.

Criteria pollutant emissions were then estimated using the emission factors from the same sources described under industrial fuel combustion.

### Spatial and Temporal Allocation

The spatial allocation of commercial LPG combustion was assumed to correspond to the overall distribution of commercial employees. It was assumed that there was no significant seasonal variation in commercial/institutional LPG use.

## **Residential Fuel Combustion**

### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, residential fuel combustion is predominantly LPG; no other fuels are used in appreciable quantities. In addition, residential LPG usage is limited almost entirely to cooking; most heating during the mild winters is electric heating.<sup>10</sup> The residential LPG used in SLRC and Mexicali is distributed by four LPG companies: Baja Gas, Hidrogas, Kino Gas, and Zeta Gas. Contacts were made with these distributors during the three SLRC site visits and residential sales and usage statistics were requested. However, none of the LPG distributors provided the requested local statistics. In lieu of these statistics, national- and state-level

statistics from Mexico's Secretariat of Energy (SENER) were used to estimate the quantity of residential LPG used in the SLRC and Mexicali portions of the inventory domain.

Northwest Region residential LPG usage statistics were ratioed down to the SLRC and Mexicali portions of the inventory domain using the methodology described above for industrial fuel combustion, except that population was used.

Criteria pollutant emissions were then estimated using the emission factors from the same sources described under industrial fuel combustion.

### Spatial and Temporal Allocation

The spatial allocation of residential LPG combustion was assumed to correspond to the overall distribution of population and/or households. Because residential LPG combustion is limited to cooking, and does not include heating, there is assumed to be no appreciable seasonal variation.

### **Paved Road Dust**

#### Annual Emissions

Paved road dust emissions were estimated using the emission factor equation presented in AP-42, Section 13.2.1 (revised November 2006).<sup>4</sup> Annual and seasonal precipitation adjustment factors were developed using precipitation data from the Yuma-Mesa, Yuma-North Gila, and Yuma-Valley meteorological stations maintained by the Arizona Meteorological Network (AZMET).<sup>11</sup> Paved road dust silt samples were collected at 10 locations in SLRC by Ingeniería en Control Ambiental y Riesgo Industrial, S. de R.L. (ICAR) (i.e., an ERG subcontractor) in May 2007. These locations were as follows:

- Avenida Constitución between Calle Río Verde and Calle Rio Paxtla
- Avenida Jazmin between Calle 18 and Calle 22
- Avenida Libertad between Calle 28 and Calle 32
- Avenida Monterrey between Calle 3 and Calle 10
- Avenida Nuevo León between Calle 28 and Calle 32
- Avenida Obregón between Calle 8 and Calle 11
- Avenida Obregón between Calle 48 and Parque Industrial
- Calle 2 between Avenida Juárez and Avenida Felix Contreras
- Calle 7 between Avenida Tlaxcala and Avenida Quintana Roo
- Calle 42 between Avenida Durango and Avenida Tlaxcala

All samples were collected according to the sampling procedures presented in Appendix C.1 of AP-42. The samples were analyzed by a laboratory in Tijuana (Laboratorio de Muestreo y Analisis, S.A. de C.V.) according to the analytical procedures presented in Appendix C.2 of AP-42.

Daily paved vehicle mile traveled (VMT) estimates for the SLRC and Mexicali portions of the domain were provided by TransEngineering (ERG's subcontractor responsible for motor vehicle traffic modeling).<sup>12</sup>

In addition to the 10 paved road dust silt samples collected in SLRC, ERG collected 10 paved road dust silt samples in the U.S. (i.e., in Yuma and Somerton). The locations of these samples were as follows:

- Athens Way (northbound) at Lisbon Street, Yuma
- Avenue 5E (westbound) at East 16<sup>th</sup> Street (Highway 95), Yuma
- Avenue B (southbound) at 20<sup>th</sup> Street, Yuma
- County East 13<sup>th</sup> Street (eastbound) between Avenue 4E and Avenue 5E, Yuma
- East 32<sup>nd</sup> Street (westbound) at Avenue 5E, Yuma
- Madison Avenue (northbound) at 11<sup>th</sup> Street, Yuma
- Terra Mesa Avenue (northbound) at County 11<sup>th</sup> Street, Yuma
- Highway 95 at Avenue H, Somerton
- South Bingham Avenue (westbound) at East Cactus Street, Somerton
- South Federal Avenue (westbound) at Sunflower Street, Somerton

The measured silt values for SLRC varied from 0.78-3.80% with a range of silt loadings from 0.09-0.65 g/m<sup>2</sup>.<sup>13</sup> Likewise, the measured silt values for Yuma/Somerton varied from 5.5-28.9% with a range of silt loadings from 0.13-225 g/m<sup>2</sup>. This resulted in an average PM<sub>10</sub> emission factor of 0.004 lbs/VMT in SLRC and 0.059 lbs/VMT in Yuma/Somerton. The Yuma/Somerton paved emission factor was over an order of magnitude higher.

### Spatial and Temporal Allocation

The spatial allocation of paved road dust was assumed to correspond to the distribution of paved road travel and/or the paved road network. The only identified seasonal variation for paved road dust is due to the precipitation adjustment factor in the paved road dust emission factor equation. The estimated values vary from 0.97500 (winter) to 0.99451 (fall).

### **Unpaved Road Dust**

#### Annual Emissions

Unpaved road dust emissions were estimated using the emission factor equation presented in AP-42, Section 13.2.2 (revised November 2006).<sup>4</sup> Average vehicle speed was estimated to be 25 miles per hour (mph) based on observations from the three site visits. Annual and seasonal precipitation adjustment factors were developed using precipitation data from the Yuma-Mesa, Yuma-North Gila, and Yuma-Valley meteorological stations maintained by the Arizona Meteorological Network (AZMET).<sup>11</sup> Silt samples were collected at 10 locations in SLRC by Ingeniería en Control Ambiental y Riesgo Industrial, S. de R.L. (ICAR) (i.e., an ERG subcontractor) in May 2007. These locations were as follows:

- Avenida Benjamin Flores between Calle 7 and Calle 12
- Avenida Benjamin Flores between Calle 18 and Calle 21
- Avenida Dominican between Avenida San Esteban and Avenida San Amadeo
- Avenida Jalisco between Calle 13 and Calle 15
- Avenida México between Calle General Yucupicio and Calle Cuauhtemoc
- Avenida Pedro Bribiesca between Calle 13 and Calle 16
- Avenida Tlaxcala between Calle 35 and Calle 38
- Calle 17 between Avenida Camelias and Avenida Flores
- Calle 20 between Avenida Hidalgo and Avenida Kino
- Calle Paraguay between Avenida Escuadron 201 and Avenida Reforma

All samples were collected according to the sampling procedures presented in Appendix C.1 of AP-42. The samples were analyzed by a laboratory in Tijuana (Laboratorio de Muestreo y Analisis, S.A. de C.V.) according to the analytical procedures presented in Appendix C.2 of AP-42.

Daily unpaved VMT estimates were provided by TransEngineering.<sup>12</sup>

In addition to the 10 paved road dust silt samples collected in SLRC, ERG collected 10 paved road dust silt samples in the U.S. (i.e., in Yuma and Somerton). The locations of these samples were as follows:

- 22<sup>nd</sup> Lane (westbound) at Avenue 9E, Yuma
- 47<sup>th</sup> Avenue (northbound) at County 9<sup>th</sup> Street, Yuma
- Avenue 5E (southbound) at East 16<sup>th</sup> Street, Yuma
- County 13<sup>3/4</sup> Street (eastbound) at Avenue 5E, Yuma
- Dipper Street (westbound) at Avenue C, Yuma
- Fortuna Avenue (northbound) at County 11<sup>th</sup> Street, Yuma
- Pacific Avenue (southbound) north of 8<sup>th</sup> Street, Yuma
- Public Way (southbound) at 1<sup>st</sup> Street (westbound), Yuma
- Witt Drive (southbound) at County East 14<sup>th</sup> Street, Yuma
- Avenue H (westbound) at Highway 95 South, Somerton

The measured silt values for SLRC varied from 0.34-1.85% with a range of moisture contents from 0.03-0.57%.<sup>13</sup> Likewise, the measured silt values for Yuma/Somerton varied from 4.3-10.8% with a range of moisture contents from 0.2-0.8%. This resulted in an average PM<sub>10</sub> emission factor of 0.134 lbs/VMT in SLRC and 1.125 lbs/VMT in Yuma/Somerton. The Yuma/Somerton paved emission factor was over an order of magnitude higher. Visual observations during site visits to SLRC and Yuma support these estimated results (i.e., SLRC unpaved road dust felt and looked comparatively sandy, entrained plumes in SLRC were barely visible).

### Spatial and Temporal Allocation

The spatial allocation of unpaved road dust was assumed to correspond to the distribution of unpaved road travel and/or the unpaved road network. The only identified seasonal variation for unpaved road dust is due to the precipitation adjustment factor in the unpaved road dust emission factor equation. The estimated values vary from 0.90000 (winter) to 0.97802 (fall).

### **Architectural Surface Coatings**

#### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, architectural surface coating emissions were estimated using per capita emission factors of 0.728 pounds (lbs) VOC per person per year (for solvent-based coatings) and 0.391 lbs VOC per person per year (for water-based coatings). Both of these emission factors were used in the 1999 Mexico NEI and were derived from actual Mexican paint statistics provided by the National Association of Paint and Ink Manufacturers (*Asociación Nacional de Fabricantes de Pinturas y Tintas* [ANAFAPYT]).<sup>2</sup>

The 2005 intra-census population estimates indicate that 157,075 people live in the municipality of SLRC and 855,962 people live in the municipality of Mexicali.<sup>14</sup> Based upon locality-specific population statistics from the 2000 census<sup>8</sup>, municipality-level population was ratioed down to the

inventory domain. The estimated population within the domain was 141,120 for SLRC and 78,585 for Mexicali.

### Spatial and Temporal Allocation

The spatial allocation of architectural surface coating emissions (both solvent- and water-based) was assumed to correspond to the overall population distribution. Based upon the three SLRC site visits, no abnormal usage patterns associated with solvent- or water-based architectural surface coatings were observed or otherwise noted. Therefore, default temporal profiles were assumed to be applicable for this source category.

## **Degreasing**

### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, degreasing emissions were estimated using U.S.-based per employee emission factors from EIP guidance.<sup>15</sup> Municipality-level employee statistics for the NAICS codes indicated above were obtained for SLRC and Mexicali from the 2004 Economic Census.<sup>7</sup> Based upon locality-specific population statistics from the 2000 census<sup>8</sup>, municipality-level employee counts were ratioed down to the inventory domain.

Attempts were made to reconcile the area source degreasing emission with industrial point sources; however, specific information related to degreasing operations at the industrial point sources could not be identified. As a result, no adjustments were made to the area source degreasing emission estimates.

It should be noted that the degreasing emissions for Mexicali are likely overestimated. This is due to the use of locality-specific population statistics to allocate the municipality-level employee statistics. No large industrial facilities were identified in the Mexicali portion of the domain during the three site visits; this area is primarily agricultural in nature with a few small communities. Most, if not all, of the Mexicali industrial employees are likely located in the urban center of Mexicali, which is outside of the inventory domain. The use of U.S.-based per employee emission factors likely increases the uncertainty of the emission estimates.

### Spatial and Temporal Allocation

The spatial allocation of degreasing emissions was assumed to correspond to the employment distribution of NAICS 31xxxx, 32xxxx, and 33xxxx. Based upon the three SLRC site visits, no abnormal usage patterns associated with degreasing activities were observed or otherwise noted. Therefore, default temporal profiles were assumed to be applicable for this source category.

## **Graphic Arts**

### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, graphic arts emissions were estimated using a per capita emission factor of 0.811 lbs VOC per person per year that was used in the 1999 Mexico NEI.<sup>2</sup> This per capita emission factor was based upon actual Mexican ink statistics provided by ANAFAPYT. Based upon locality-specific population statistics from the 2000 census<sup>8</sup>, municipality-level population<sup>14</sup> was ratioed down to the inventory domain.

## Spatial and Temporal Allocation

The spatial allocation of graphic arts emissions was assumed to correspond to the overall population distribution. Based upon the three SLRC site visits, no abnormal usage patterns associated with graphic arts activities were observed or otherwise noted. Therefore, default temporal profiles were assumed to be applicable for this source category.

## **Consumer Solvents**

### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, consumer solvent emissions were estimated using the U.S.-based per capita emission factors identified in the EIIP guidance<sup>16</sup>, with two adjustments. There are seven product category-specific emission factors and the aggregate emission factor sums to 7.84 lbs/person-yr. Previous inventory experience in Mexico has indicated that consumer solvent use in Mexico might be less than in the U.S. due to a relatively lower standard of living; however, this has been limited to anecdotal information. However, two adjustments were made to the category-specific emission factors identified in the EIIP guidance.

The first adjustment was made to the automotive aftermarket products category emission factor. The emission factor was multiplied by the ratio of per capita vehicle kilometers traveled (VKT) in SLRC divided by per capita VKT in the U.S. The total 2005 U.S. VMT has been estimated to be  $2,989,807 \times 10^6$  miles<sup>17</sup> and the July 1, 2005 national population has been estimated to be 296,507,061.<sup>18</sup> This corresponds to an annual per capita VMT of 10,084 (i.e., per capita VKT of 16,224). The SLRC per capita VKT was estimated to be 1,885.<sup>12</sup> This results in automotive aftermarket products adjustment factor of 0.1162, so the automotive aftermarket products adjustment factor was reduced from 1.36 lbs/person-year to 0.16 lbs/person-year.

The second adjustment was made to the household products category emission factor based upon a binational household product survey conducted in San Luis, Arizona (SLAZ) and SLRC.<sup>19</sup> The survey actually focused on household exposure to pesticides, household cleaners, and other toxic materials. A total of 100 houses were surveyed in both SLAZ and SLRC (i.e., Ejido Independencia and Estación Riito) with questionnaires completed at the participants' homes. It was not possible to directly calculate adjustment factors from the raw questionnaire data; however, subsequent communication with one of the survey researchers indicated that bleach is commonly used in SLRC in place of household cleaning products typically found in the U.S. This finding was not quantitatively determined, but an adjustment factor of 0.25 was thought to be appropriate.<sup>20</sup> Thus, the household products emission factor was reduced from 0.79 lbs/person-year to 0.20 lbs/person-year. The effect of the two adjustments was to reduce the aggregated emission factor from 7.84 lbs/person-year to 6.05 lbs/person-year.

Based upon locality-specific population statistics from the 2000 census<sup>8</sup>, municipality-level population<sup>14</sup> was ratioed down to the inventory domain.

## Spatial and Temporal Allocation

The spatial allocation of consumer products emissions is assumed to correspond to the overall population distribution. Based upon the three SLRC site visits, no abnormal usage patterns associated with consumer products were observed or otherwise noted. Therefore, default temporal profiles were assumed to be applicable for this source category.

## **Dry Cleaning**

### Annual Emissions

Although national dry cleaning solvent use statistics were used in the 1999 Mexico NEI (ERG, 2006), local usage statistics were obtained for the SLRC portion of the inventory domain. There are only five dry cleaning facilities located in SLRC; this was confirmed through the local telephone directory. In addition, no facilities were identified in the Mexicali portion of the domain. The oldest dry cleaning facility in SLRC (i.e., El Nuevo Japon) controls approximately 50 percent of the dry cleaning market share. It is also the only facility that uses perchloroethylene. The facility also maintains solvent recycling equipment. Annual perchloroethylene usage was estimated as two 55-gallon drums per year.<sup>21</sup> The remaining 50 percent of the dry cleaning market share is handled by the other four dry cleaning facilities (i.e., Arizona Espresso Cleaners, Leyva Isabel Quiñonez, Lisamar, and Imperial). It was assumed that each of these facilities have an equal portion of the remaining 50 percent market share. An interview with a worker at one of the non-perchloroethylene cleaners indicated that typically one 55-gallon drum of petroleum dry cleaning solvent is used every week<sup>22</sup>; this usage rate was assumed for all four non-perchloroethylene dry cleaners.

### Spatial and Temporal Allocation

The spatial allocation of dry cleaning emissions is assumed to correspond to the physical locations of the five SLRC dry cleaning facilities. Based upon the two dry cleaning interviews, no significant temporal variations exist for SLRC dry cleaning operations.

## **Traffic Markings**

### Annual Emissions

Local traffic marking usage statistics were obtained for the SLRC portion of the inventory domain. In general, traffic markings are predominantly applied in the SLRC by the City Public Works Department. During the site visits, very minimal usage of traffic markings in the Mexicali portion of the domain was observed. Public Works staff indicated that they applied 65 200-liter drums of traffic markings in 2005.<sup>23</sup> A product specification for the traffic markings applied by the Public Works staff was obtained from a local paint distributor.<sup>24</sup> The specification provided a paint density of 1.40 for white markings and 1.45 for yellow markings; the specification also provided a solids content value of 69.5 wt% for white markings and 71.0 wt% for yellow markings. Because Public Works staff could not provide information regarding the distribution of white and yellow markings, average density and solids contents were calculated. The total paint volume was converted to a total weight using the average density, and then the paint weight was disaggregated into solids and liquids using the average solids content value. It was assumed that all liquids were evaporated VOC solvent (i.e., no water content).

### Spatial and Temporal Allocation

The spatial allocation of traffic markings emissions is assumed to correspond to the paved road network in SLRC. No traffic markings emissions were assigned to Mexicali. Based upon the three SLRC site visits, no abnormal usage patterns associated with traffic markings application were observed or otherwise noted. Therefore, default temporal profiles were assumed to be applicable for this source category.

## **Autobody Refinishing**

### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, autobody refinishing emissions were estimated using a per employee emission factor of 277.25 lbs VOC per employee per year. This per employee emission factor was based upon actual Mexican paint statistics provided by ANAFAPYT, and was used in the 1999 Mexico NEI.<sup>2</sup> The 2004 Economic Census indicated that there were 126 employees in the municipality of SLRC and 586 employees in the municipality of Mexicali that were employed in establishments classified as NAICS 811121.<sup>7</sup> Based upon locality-specific population statistics from the 2000 census<sup>8</sup>, municipality-level employee counts were ratioed down to the inventory domain.

### Spatial and Temporal Allocation

The spatial allocation of autobody refinishing emissions was assumed to correspond to the employment distribution of NAICS 81xxxx. Based upon the three SLRC site visits, no abnormal usage patterns associated with autobody refinishing activities were observed or otherwise noted. Therefore, default temporal profiles were assumed to be applicable for this source category.

## **Industrial Surface Coating**

### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, industrial surface coating emissions were estimated using seven category-specific per employee emission factors that were based upon actual Mexican paint statistics provided by ANAFAPYT, and were used in the 1999 Mexico NEI.<sup>2</sup>

Municipality-level employee statistics for the NAICS codes indicated above were obtained for SLRC and Mexicali from the 2004 Economic Census.<sup>7</sup> Based upon locality-specific population statistics from the 2000 census<sup>8</sup>, municipality-level employee counts were ratioed down to the inventory domain.

The industrial surface coating emissions were also reconciled with the point source emissions by subtracting the specific employee counts for point source facilities that responded to the point source survey. Only two point sources that had surface coating operations quantified the number of their employees; 247 employees from Mecox were subtracted from the automotive category and 350 employees from Demda were subtracted from the electronics and electrical equipment category.

It should be noted that the industrial surface coating emissions for Mexicali are likely overestimated. This is due to the use of locality-specific population statistics to allocate the municipality-level employee statistics. No large industrial facilities were identified in the Mexicali portion of the domain during the three site visits; this area is primarily agricultural in nature with a few small communities. Most, if not all, of the Mexicali industrial employees are likely located in the urban center of Mexicali, which is outside of the inventory domain.

### Spatial and Temporal Allocation

The spatial allocation of industrial surface coating emissions is assumed to correspond to the employment distribution of NAICS 31xxxx, 32xxxx, and 33xxxx. Based upon the three SLRC site visits, no abnormal usage patterns associated with industrial surface coating activities were observed or

otherwise noted. Therefore, default temporal profiles were assumed to be applicable for this source category.

## **Gasoline Distribution**

### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, gasoline distribution is conducted by PEMEX, the national petroleum monopoly. Local sales statistics were requested from PEMEX (both in SLRC and Mexicali, the location of the nearest petroleum bulk terminal), but PEMEX did not provide the requested statistics. In lieu of these statistics, national- and state-level statistics from Mexico's Secretariat of Energy (SENER) were used to estimate the quantity of gasoline deliveries in the SLRC and Mexicali portions of the inventory domain.<sup>5</sup> Northwest Region gasoline usage statistics were ratioed down to the SLRC and Mexicali portions of the inventory domain using the methodology described above residential LPG combustion. VOC emission factors from AP-42, Section 5.2 were used to estimate gasoline distribution emissions (i.e., Stage I, Stage II, underground tank breathing/emptying, spillage, and tank truck transit).

During the development of the 1999 Mexico NEI, municipality-level information regarding Stage I and Stage II controls was obtained from PEMEX staff.<sup>25</sup> Based on this information, in 1999, there were 19 PEMEX stations located in the municipality of SLRC and 105 PEMEX stations located in the municipality of Mexicali. All but one of the stations were identified as having Stage I controls, while none of the stations were identified as having Stage II controls. Subsequent follow-up to this information indicated that the Stage I controls were effectively equivalent to submerged filling. Visual observations of PEMEX stations during the three site visits did not identify any substantial changes to gasoline station operations since the 1999 Mexico NEI.

### Spatial and Temporal Allocation

The spatial allocation of gasoline distribution was assumed to correspond to the overall distribution of PEMEX gasoline stations. A list of 21 SLRC PEMEX stations was provided by city staff.<sup>10</sup> A total of 12 PEMEX stations were located during a drive-around survey in the Mexicali portion of the domain.<sup>26</sup> The 12 Mexicali PEMEX stations were located in the following communities: Ciudad Morelos (Cuervos), Benito Juárez (Tecolotes), Vicente Guerrero (Algodones), Poblado Paredones, Ejido Hermosillo, Ejido Bataquez, Ejido Monterrey, and Ejido Querétaro. It was assumed that there was no significant seasonal variation in gasoline distribution.

## **Landfills**

### Annual Emissions

There are currently two landfills located in SLRC – the old landfill that opened in 1991 and the new landfill that has not yet opened. The old landfill covers 32 hectares and is virtually full. The new landfill is ready to be opened, except that funds are needed to purchase the necessary earthmoving equipment for landfill operation.

Because location-specific information was generally unavailable for the old landfill, the theoretical first-order kinetic model of methane production detailed in AP-42, Section 2.4 was used.<sup>4</sup> Defaults were used for the following model parameters: methane generation potential, methane generation rate constant, concentration of NMOC in landfill gas, molecular weight NMOC, and temperature of landfill gas. The only location-specific data that were obtained was the average annual refuse acceptance rate and the time since initial refuse placement (i.e., 14 years – since 1991). Staff

from SLRC public works indicated that typically 120 metric tons of waste was collected and taken to the old landfill daily.<sup>27</sup>

### Spatial and Temporal Allocation

The spatial allocation of landfill emissions was assigned to the old landfill location; GPS coordinates were taken during one of the site visits. It was assumed that there was no significant seasonal variation in landfill emissions.

## **Wastewater Treatment**

### Annual Emissions

Very little information could be collected regarding wastewater treatment in SLRC. Construction on a new wastewater treatment plant commenced on September 10, 2004 with funding from the North American Development Bank (NADB)<sup>28</sup>; it is unclear if this facility actually started operation during 2005. Staff from the local water utility, *Organismo Operador Municipal de Agua Potable, Alcantarillado y Saneamiento de San Luis* (OOMAPAS), were contacted during one of the site visits. However, OOMAPAS did not provide any of the requested information.

State-level municipal and industrial statistics (i.e., number of plants, installed capacity, and treated flows) were obtained from the *Comisión Nacional del Agua* (CNA). The state of Sonora has 65 municipal wastewater plants with a treated flow of 2.58 cubic meters per second (m<sup>3</sup>/s) and 18 industrial wastewater plants with a treated flow of 0.10 m<sup>3</sup>/s. The state of Baja California has 26 municipal wastewater plants with a treated flow of 3.96 m<sup>3</sup>/s and 179 industrial wastewater plants with a treated flow of 0.39 m<sup>3</sup>/s.<sup>29</sup> A listing of municipal wastewater plants indicated that only 1 of the 91 total municipal wastewater plants in the states of Sonora and Baja California (Ciudad Morelos, Mexicali) is located within the inventory domain.<sup>30</sup> The Ciudad Morelos plant has a treated flow of only 7.12 liters/s. It should be noted that the NADB-funded SLRC wastewater plant is not included in the CNA plant listing. The number of industrial wastewater plants located within the inventory domain is not known. Municipality-level employee statistics from the 2004 Economic Census for industrial manufacturing sectors (NAICS 31xxxx, 32xxxx, and 33xxxx) were used to allocate treated flows to the municipalities of SLRC and Mexicali.<sup>7</sup> It was assumed that all treated flows located in the municipalities of SLRC and Mexicali were also located within the inventory domain. An U.S.-based emission factor of  $1.3 \times 10^{-5}$  kg/liter of treated wastewater was used<sup>31</sup>; this emission factor was previously used in the 1999 Mexico NEI.<sup>2</sup>

It should be noted that the wastewater treatment emissions are likely overestimated, particularly for the Mexicali portion of the domain. No large industrial facilities were identified in the Mexicali portion of the domain during the three site visits; this area is primarily agricultural in nature with a few small communities. Most, if not all, of the Mexicali industrial employees are likely located in the urban center of Mexicali, which is outside of the inventory domain.

### Spatial and Temporal Allocation

The spatial allocation of wastewater treatment emissions was assumed to correspond to the overall distribution of industrial employees. It was assumed that there was no significant seasonal variation in wastewater treatment emissions.

## **Agricultural Pesticides**

### Annual Emissions

Agricultural pesticides were estimated by applying pesticide-specific emission factors to the quantities of pesticides applied. Unlike the U.S., records of pesticide application are not routinely kept and maintained in Mexico. Typical crop-specific pesticide application rates were obtained from state-specific cost production estimates produced by the Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food (*Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación* [SAGARPA]).<sup>32</sup> The application rates were only available for a limited number of crops. For Sonora, the listed crops included: green alfalfa, cotton, broccoli, safflower, asparagus, corn, oranges, tomatoes, wheat, and raisin grapes. For Baja California, the listed crops included: garlic, green alfalfa, cotton, broccoli, asparagus, tomatoes, and wheat. Because typical application rates were only available for a small number of crops, it is likely that emissions from pesticide application are underestimated.

These pesticide application rates were applied to the crop-specific planted acres. An agricultural database maintained by SAGARPA indicates that the total municipality-level planted agricultural area in 2005 was 30,490 hectares in SLRC and 160,544 hectares in Mexicali.<sup>33</sup> An analysis of satellite data indicates that the agricultural area inside the domain boundaries is approximately 4,901 hectares in SLRC and 89,703 hectares in Mexicali.<sup>34</sup> This results in agricultural area domain fractions of 16.08% for SLRC and 55.87% for Mexicali. These agricultural area domain fractions were applied to the 10 SLRC crops and the 7 Mexicali crops that had crop-specific pesticide application rates.

The pesticide emission factors were obtained from EIIP guidance.<sup>35</sup> Active ingredients were identified based upon Mexico's Registry of Authorized Pesticides.<sup>36</sup> Formulation types were also assumed based upon the predominant formulation types listed in the Registry. Active and inactive ingredient fractions, as well as inert ingredient VOC fractions, were obtained from the EIIP guidance. Pesticide information (i.e., density, % active ingredient, and vapor pressure) were obtained from various databases maintained by California's Department of Pesticide Regulation.<sup>37</sup>

### Spatial and Temporal Allocation

The exact location of specific crops within the overall agricultural area is not known, so the spatial allocation for agricultural pesticides was assigned evenly to the overall agricultural area. Emissions from agricultural pesticide application are very seasonal. Agricultural contacts in Mexico provided crop-specific crop calendars for most crop types with detailed planting and harvesting durations.<sup>38</sup> However, it is not exactly clear when pesticide application occurs. Therefore, it was assumed that pesticide application occurs uniformly throughout the year.

## **Agricultural Burning**

### Annual Emissions

In the SLRC and Mexicali portions of the inventory domain, agricultural burning is limited to wheat fields after harvest. Occasionally, government subsidies may be available which encourage farmers not to burn their wheat fields. For instance, in 2006, approximately half of the wheat fields were not burned as a result of the government subsidies. However, government subsidies are typically not available. In 2005, essentially all wheat fields were burned.<sup>38</sup>

The area of the wheat fields located in the inventory domain was estimated by applying the fraction of agricultural area within the inventory domain to the state-level wheat area as described under the agricultural pesticides section.

The emission factors were obtained from the California Air Resources Board (ARB) Area Source Methodologies.<sup>39</sup> These factors are more recent than those in AP-42.<sup>4</sup> The default ARB fuel loading for wheat fields was 1.9 tons/acre.

### Spatial and Temporal Allocation

The exact location of wheat fields among the overall agricultural areas was not known, so the spatial allocation for agricultural burning was assigned evenly to the overall agricultural areas. Emissions from agricultural burning of wheat fields are very seasonal. Agricultural contacts in both Mexico and the U.S. indicate an approximate six week burning period from the end of May to the beginning of July.<sup>38,40,41</sup> Therefore, the seasonal profile for agricultural burning has two-thirds of the emissions occurring in June (i.e., four weeks of a six week burning period) and one-sixth of the emissions occurring in May and in July (i.e., one week each of a six week burning period). It was assumed that burning was conducted six days a week in 2005, with no burning occurring on Sunday. It was also assumed that agricultural burning of wheat fields occurs between 9 a.m. and 6 p.m. This assumption is based upon temporal profile used in a previous modeling study of the SLRC agricultural burning.<sup>41</sup>

### **Agricultural Tilling**

#### Annual Emissions

Agricultural tilling emissions were estimated by applying crop-specific emission factors to the areas of specific crops within the domain. The areas of specific crops were estimated as described under the agricultural pesticides section.

The PM<sub>10</sub> emission factors were obtained from the California Air Resources Board (ARB) Area Source Methodologies.<sup>42</sup> If an emission factor was not available for a specific crop, then suggested profile assignments from ARB's methodology were used. Engineering judgment was used in a few instances when ARB did not provide any suggested profile assignments. For instance, the lettuce emission factor was used for 11 different crops (e.g., cabbage, kale, cilantro, kohlrabi, etc.).

### Spatial and Temporal Allocation

The exact location of specific crops within the overall agricultural area was not known, so the spatial allocation for agricultural tilling was assigned evenly to the overall agricultural area.

Emissions from agricultural tilling are very seasonal. Agricultural contacts in Mexico provided crop-specific crop calendars for most crop types with detailed planting and harvesting durations.<sup>38</sup> It was assumed that agricultural tilling effectively overlapped the planting windows. Agricultural tilling emissions for a particular crop were evenly distributed over the entire planting window for that crop. In general, the greatest amount of tilling activity occurs during the fall and winter months with somewhat lesser amounts during the spring. Tilling activity during the summer is very minimal.

## **Agricultural Harvesting**

### Annual Emissions

Agricultural harvesting emissions were estimated by applying crop-specific emission factors to the areas of specific crops within the domain. The areas of specific crops were estimated as described under the agricultural pesticides section.

The PM<sub>10</sub> emission factors were obtained from the ARB Area Source Methodologies.<sup>43</sup> If an emission factor was not available for a specific crop, then suggested profile assignments from ARB's methodology were used. Engineering judgment was used in a few instances when ARB did not provide any suggested profile assignments. For instance, the lettuce emission factor was used for 11 different crops (e.g., cabbage, kale, cilantro, kohlrabi, etc.).

### Spatial and Temporal Allocation

The exact location of specific crops within the overall agricultural area was not known, so the spatial allocation for agricultural harvesting was assigned evenly to the overall agricultural area.

Emissions from agricultural harvest operations are very seasonal. Agricultural contacts in Mexico provided crop-specific crop calendars for most crop types with detailed planting and harvesting durations.<sup>38</sup> It was assumed that harvesting operation occurred during the harvest windows. Agricultural harvesting emissions for a particular crop were evenly distributed over the entire harvesting window for that crop. In general, the greatest amount of harvesting activity occurs during summer months with somewhat lesser amounts during the fall. Harvesting activity during the winter and spring months is very low.

## **Structure Fires**

### Annual Emissions

There were a total of 366 structural fires reported in 2006 in the SLRC City and Rural fire jurisdictions<sup>44</sup>; it was assumed that this number of fires was representative of 2005. It was also assumed that all of these fires occurred within the inventory domain. The number of Mexicali structural fires was calculated based upon the ratio of SLRC and Mexicali population within the inventory domain (i.e., 141,120 for SLRC and 78,585 for Mexicali).

Structural fire emission factors were obtained from EIIP guidance from the MOBILE6-Mexico model.<sup>45</sup> Mexico-specific assumptions used in the 1999 Mexico NEI were also used (ERG, 2006). These assumptions included the following: average house size of 100 m<sup>2</sup>, combustible content loading of 38.62 kg/m<sup>2</sup>, building not burned due to masonry construction, and an average content loss of 7.3%.

### Spatial and Temporal Allocation

The spatial allocation of structural fires was assumed to correspond to the overall distribution of population. Because no seasonal variation was identified in the reported number of structural fires, it is assumed that structural fire emissions are evenly distributed throughout the year.

## **Border Crossings**

### Annual Emissions

Emissions from border crossings are due to cars idling while waiting to cross the border from Mexico into the U.S. In SLRC, the queue to cross the border runs westbound along Avenida Carlos C. Calles. Depending upon the time of day, the wait times can be an hour or longer in length. Because there are not any significant wait times to cross from the U.S. into Mexico, this category was not included in the U.S. portion of the inventory domain. There are two border crossings within the inventory domain. The first border crossing is the San Luis Port of Entry, which connects SLRC to San Luis, Arizona. The San Luis Port of Entry consists of a 24-hour general port of entry and a cargo port of entry with limited hours. The second border crossing is the Andrade Port of Entry (south of Winterhaven), which connects the community of Algodones in Mexicali, with Imperial County. The Andrade Port of Entry has limited hours (i.e., 6 a.m. to 10 p.m.) and is not a port of entry for cargo. Hourly passenger and commercial vehicle counts and average wait times were obtained from Customs and Border Protection (CBP) officers.<sup>46,47</sup>

Border crossing emission factors were obtained from the MOBILE6-Mexico model.<sup>48</sup> These emission factors were already generated as part of the on-road motor vehicle methodology for this project. The emission factors used were for the slowest speed allowed by the MOBILE6-Mexico model (i.e., 3 miles per hour [mph]). For each hour, the respective vehicle counts and wait times were multiplied by the speed (i.e., 3 mph) and the appropriate gram per mile emission factor. In order to eliminate the potential double counting of emissions, the border crossing queues were not included in the transportation modeling conducted as part of the on-road motor vehicle methodology. This is appropriate because the transportation modeling most accurately represents flowing traffic conditions and the border crossing queue is start-and-stop in nature.

### Spatial and Temporal Allocation

The spatial allocation of border crossing emissions occurs at the queues entering the San Luis and Andrade port of entries. The temporal allocation was based upon the temporal variations in vehicle counts, which were obtained from CBP officers.

## **Restaurants/Charbroiling**

### Annual Emissions

There are a number of restaurants in the inventory domain that could be potential emission sources. Contacts with local residents suggested focusing on charbroiling facilities. Street vendors, which were previously estimated in the Mexico NEI and other Mexico emissions inventories, were not observed in SLRC. Contacts at the largest charbroiling facility in SLRC (i.e., Pollos el Correteado on Avenida Obregón) indicated that chicken charbroiling is the predominant type of charbroiling. They also indicated that they have approximately a 50 percent share of the charbroiled chicken market in SLRC. The quantity of chickens charbroiled at this restaurant is 150 chickens per day with weighing an average of 1.3 kg per chicken.<sup>49</sup> Charbroiling activity was not observed in the Mexicali portion of the inventory domain. The remaining 50 percent of the charbroiled chicken market is scattered over an unknown number of smaller restaurants in SLRC. The charbroiling emission factors were obtained from testing results from charcoal grilling in Mexicali.<sup>50</sup>

## Spatial and Temporal Allocation

The spatial allocation of charbroiling emissions was assumed to correspond to the population density in the urban area of SLRC. Based upon the interview with the charbroiling facility, there are no significant annual variations in charbroiling activity. Daily activity consists of 25 percent of the charbroiling being conducted between 8 and 9 a.m., 50 percent between 1 and 3 p.m., and 25 percent between 7 and 8 p.m.<sup>49</sup>

### **Brick Kilns**

#### Annual Emissions

There are three primary brick kiln areas (*ladrillería*) located within the inventory domain. These are described below:

- South part of SLRC in Colonia Mezquite – roughly bounded by Avenida Benjamin Flores, Avenida Jazmin, Calle 14, and Calle 22.
- Southwest part of SLRC in Colonia La Grullita – roughly bounded by Calzada Monterrey, Avenida Benjamin Flores, Avenida 3, Avenida 11, and the irrigation canal
- Southwest of Algodones in Mexicali

The total number of kilns is estimated to be approximately 185 (i.e., 65 in the Colonia Mezquite area, 100 in the Colonia La Grullita area, and 20 in the Algodones area).<sup>10,51</sup> The kilns are all temporary structures. After the bricks have been formed and stacked, then the kiln is built up around the stacked bricks. After the bricks have been fired, then the kiln is torn down to remove the bricks. The next kiln is then located on a different part of the brick maker lot where the new pile of formed bricks is stacked.

It was estimated by a leader of one of the brick maker groups that each brick maker in SLRC averages between 500 and 700 bricks formed per day.<sup>52</sup> Assuming an average value of 600 bricks per day and a six-day workweek, then a typical brick maker will form 15,000 bricks in a month. The number of bricks burned per kiln burn varies from between 20,000 to 100,000 bricks. However, 40,000 to 45,000 bricks is a reasonable average burn size.<sup>52</sup> Assuming a burn size of 45,000 bricks, then each brick maker will conduct a burn every three months (or four times a year). This corresponds to 260 annual burns in the Colonia Mezquite brick area and 400 annual burns in the Colonia La Grullita brick area.

The Algodones brick area does not strictly fire bricks in their kilns. Approximately 25 percent of the burns are bricks; the remaining 75 percent of the burns are shingle tiles. The 20 family kilns in the Algodones brick area are fired approximately every two months.<sup>51</sup> This corresponds to 120 annual burns in the Algodones brick area.

The fuel used by the SLRC brick makers is predominantly waste materials (e.g., particleboard, fiberboard, etc.) from the *maquiladoras* located in the SLRC Industrial Park. In fact, there are a number of brokers that purchase the waste materials from the *maquiladoras* and then sell the materials to the brick makers. The fuel used by the Algodones brick makers includes small quantities of *maquiladora* waste, but also primarily fallen trees and branches. Citrus prunings from the U.S. were previously used, but this fuel source is no longer available.<sup>51</sup>

None of the brick makers interviewed were able to estimate the amount of fuel used in each burn. An estimate was made based upon visual observations during the site visit. The amount of fuel used by

SLRC brick makers was estimated to consist of two piles of maquiladora waste with dimensions of 20 feet × 5 feet × 3 feet. The piles were assumed to have a pile packing density of 0.75 and a fuel density of 750 kg/m<sup>3</sup> (i.e., typical medium-density fiberboard). The amount of fuel used by the Algodones brick makers was estimated to consist of two piles of fallen trees with dimensions of 20 feet × 10 feet × 3 feet. The piles were assumed to have a pile packing density of 0.60 and a fuel density of 720 kg/m<sup>3</sup> (i.e., citrus or other trees).

Criteria pollutant emissions were estimated using fireplace emission factors from AP-42, Section 1.9.<sup>4</sup> However, the NO<sub>x</sub> emission factor was increased from 2.6 lb/ton to 7.0 lb/ton to account for the high nitrogen content in particleboard relative to normal wood.<sup>53</sup> The 1999 Mexico NEI estimated emissions from brick kilns. However, the brick kiln emission factors were for brick kilns located in Ciudad Juárez, Chihuahua. The Ciudad Juárez emission factors were not used because the Ciudad Juárez brick kilns are fundamentally different than those in SLRC and Mexicali in that they are much more permanent in nature and have enclosed roofs. A potential source of emission factors from similar brick kilns in San Luis Potosí<sup>54</sup>, but the local academic researcher was unable to be contacted.

### Spatial and Temporal Allocation

The spatial allocation of brick kiln emissions was assumed to correspond to the overall distribution of brick kilns. GIS coordinates have been obtained for both the SLRC and Algodones brick kiln lots. In general, brick kiln emissions are spread throughout year with burn postponements typically only occurring due to heavy rain or freezing weather.

### **Other Source Categories**

There were a number of other potential source categories that were identified in the Inventory Preparation Plan, but were ultimately not included in the area source inventory for the SLRC and Mexicali portions of the inventory domain. These source categories (and the reasons for not estimating) include the following:

- Residential wood combustion – residential heating is primarily electric<sup>10</sup>
- Petroleum storage – unable to make any contact with PEMEX fuel distributor
- On-site incineration – source category does not exist in SLRC<sup>10</sup>
- Open burning – approximately 98 percent of municipal waste is picked up through regular waste pickup; most of the remainder is illegally dumped<sup>27</sup>
- Stockyards – no stockyards exist within SLRC; one dairy exists, but outside of domain<sup>10</sup>
- Wildfires – source category does not exist in SLRC<sup>10</sup>
- Prescribed fires – source category does not exist in SLRC<sup>10</sup>
- Manure burning – source category does not exist in SLRC<sup>10</sup>
- Domestic water consumption – unable to determine if chlorination of domestic water occurs
- Fumigation – produce fumigation is not conducted in SLRC or Mexicali<sup>38</sup>
- Wire reclamation – insignificant amounts occur east of Industrial Parque<sup>10</sup>
- Asphalt application – applied asphalt is entirely hot mix (comparatively low emissions)<sup>23</sup>
- Construction dust – no significant construction activities in 2005<sup>10</sup>

### **Summary of Results**

The annual area source emissions (both criteria and HAPs) for SLRC and Mexicali are presented in Table 4 and 5, respectively. In general, area source HAP emissions were estimated utilizing EPA SPECIATE4.0 particulate and gaseous profiles. For brick kilns, annual VOC, PM<sub>2.5</sub>, and PMC emissions were multiplied by the fireplace SPECIATE4.0 profile weight fractions to estimate HAP

emissions. Likewise, for border crossings, annual emissions were multiplied by the on-road motor vehicle SPECIATE4.0 profile weight fractions to estimate HAP emissions. Because the reported border crossing emissions did not distinguish between gasoline and diesel vehicles, the profile for the predominant vehicle type (i.e., gasoline) was applied.

## **MOBILE SOURCES – METHODS, DATA SOURCES, AND RESULTS**

This section describes in detail all of the calculations, source data, and assumptions used to estimate on-road motor vehicle and nonroad mobile source emissions in the San Luis Río Colorado and Mexicali portions of the inventory domain.

### **On-Road Motor Vehicle Emissions**

The main roadways within the Mexican portion of the inventory domain have been identified in Figure 3, including the urban area of SLRC, as well as the rural areas. In the rural areas, the most important roadway is Federal Highway 2 (MEX 2), which connects SLRC to Mexicali (to the northwest) and to Hermosillo (to the southeast); the remaining roadways identified in Figure 3 are state highways. As part of the roadway infrastructure, two ports-of-entry (POEs) between Mexico and the U.S. have also been identified (i.e., the San Luis POE and the Andrade POE). Figure 4 presents a detailed map of the SLRC urban area. The urban and rural roadway systems were then converted into a travel demand model (TDM) to estimate daily vehicle traffic volumes. The travel demand modeling for SLRC and Mexicali was identical to that conducted for seven representative cities as part of the development of the Mexico NEI; the details of the travel demand modeling are explained in detail elsewhere.<sup>2,55</sup>

Some link-level results of the SLRC/Mexicali TDM are graphically shown in Figure 5. The link-level traffic and VKT estimates were then combined with link-level emission rates. Emission rates in grams per vehicle mile traveled were obtained from MOBILE6-Mexico for a range of vehicle speeds (i.e., from 3 to 65 mph at 1 mph increments) for a range of temperatures representing four different periods of the day during the four seasons of the year.<sup>48</sup> The periods of the day were as follows:

- Period 1 – 7 am to 9 am
- Period 2 – 9 am to 4 pm
- Period 3 – 4 pm to 8 pm
- Period 4 – 8 pm to 7 am

The entire matrix of cases run using MOBILE6-Mexico represented a total of 4,032 scenarios – 63 specific speeds, 4 time-of-day periods, 4 seasons, two activity day types (i.e., weekday and weekend day), and two PM settings (PM<sub>10</sub> and PM<sub>2.5</sub>). The base emission rates for the resulting combinations of speeds and temperatures were assigned to each link in the transportation network based upon the prevailing “congested” speed at a specific point in time during the day. For this, the daily non-directional traffic and 24-hour average speeds assigned to each link in the travel models was converted to time-of-day directional traffic and time-of-day directional speeds. This was done using a special computer program (PrepinPlus), which was coded in Visual Basic (VB) language, following the methodology developed by the Texas Transportation Institute (TTI) for its software PREPIN. The process was conducted for each of the four time-of-day periods. The directional speed on each link established for the four time-of-day periods was then used to determine the appropriate link-specific emission rates. The MOBILE6-Mexico emission rates were provided as a lookup table for the VB code and used to assign the resulting rates to each link. Having established the emission rates for each link, the emission rates were then multiplied by the link’s length and traffic volume (i.e. link VMT) for that period to obtain the link’s emissions per time-of-day period. Daily link-level emissions were then aggregated for the entire Mexican domain. Weekday and weekend emissions were aggregated by

season, assuming 13 weeks per season, with each week consisting of 5 weekdays and 2 weekend days and finally seasonal emissions for spring, summer, fall and winter were summed to calculate annual emissions. Emissions were estimated for U.S. EPA's eight main vehicle classifications (i.e., light-duty gas vehicles [LDGV], light-duty gas trucks 1 and 2 [LDGT12], light-duty gas trucks 3 and 4 [LDGT34], heavy-duty gas vehicles [HDGV], light-duty diesel vehicles [LDDV], light-duty diesel trucks [LDDT], heavy-duty diesel vehicles [HDDV], and motorcycles [MC]).

### Summary of Results

The estimated annual on-road motor vehicle emissions (both criteria and HAPs) are summarized in Table 6 (for SLRC) and Table 7 (for Mexicali). In general, on-road motor vehicle HAP emissions were estimated utilizing EPA SPECIATE4.0 particulate and gaseous profiles. For gasoline and diesel vehicles, annual exhaust VOC, evaporative VOC, PM<sub>2.5</sub>, and PM<sub>Coarse</sub> emissions were multiplied by the selected SPECIATE4.0 profile weight fractions to estimate HAP emissions. Because the reported PM<sub>2.5</sub>, and PM<sub>Coarse</sub> emissions did not distinguish between exhaust, brake wear, and tire wear emissions, the profile for the predominant contributor (i.e., exhaust) was applied to PM<sub>2.5</sub> and PM<sub>Coarse</sub> emissions.

### **Nonroad Mobile Source Emissions**

This section describes the calculations, source data, and assumptions used to estimate nonroad mobile source emissions in the San Luis Río Colorado (SLRC) and Mexicali portions of the inventory domain.

### Annual Emissions

Prior to the development of the 1999 Mexico NEI, nonroad equipment were typically not included in Mexico emissions inventories. It was thought that the emissions would be comparatively less relative to the U.S., but there were no data to back this up. In support of the 1999 Mexico NEI development effort, a Mexico-specific version of U.S. EPA's NONROAD emissions model was developed (i.e., NONROAD-Mexico).<sup>56</sup> Various parameters were adjusted to better reflect Mexico-specific conditions. These parameters included average annual temperature, altitude, and diesel sulfur content. In addition, the model was adjusted so that U.S.-based emission standards would not be implemented for Mexico. Finally, Mexico-specific state-level equipment populations were incorporated into the model. The NONROAD-Mexico model was developed for diesel-powered agricultural and construction equipment only. Other nonroad equipment types (lawn and garden, logging, airport support service, etc.) likely exist in Mexico, but agricultural and construction equipment were given highest priority during the development of the NONROAD-Mexico model. Also, the NONROAD-Mexico model was only set up for a 1999 base year.<sup>2</sup> The model cannot be used for future year projections, so municipality-level nonroad emissions from the 1999 Mexico NEI generated using the NONROAD-Mexico model were grown to 2005 and then adjusted for the inventory domain.

In order to estimate 2005 nonroad equipment emissions, 1999 municipality-level emissions from the 1999 Mexico NEI were first projected forward to 2005. For agricultural equipment, it was assumed that agricultural land area would be fairly stable over time. As a result, the agricultural equipment population was assumed to not would not grow between 1999 and 2005. For construction equipment, it was assumed that growth was proportional to population growth. The population of the municipality of SLRC grew from 145,006 to 157,076 between 2000 and 2005; this corresponds to a growth rate of 1.0832. The population of the municipality of Mexicali grew from 764,602 to 855,962 over the same time period; this corresponds to a growth rate of 1.1195.<sup>8,14</sup>

The fraction of the agricultural equipment emissions occurring within the inventory domain was estimated using agricultural area domain fractions. An agricultural database from SAGARPA indicates

that the total municipality-level planted agricultural area in 2005 was 30,490 hectares in SLRC and 160,544 hectares in Mexicali.<sup>33</sup> An analysis of satellite data indicates that the agricultural area inside the domain boundaries is approximately 4,901 hectares in SLRC and 89,703 hectares in Mexicali.<sup>34</sup> This results in agricultural area domain fractions of 16.08% for SLRC and 55.87% for Mexicali. The fraction of construction equipment emissions occurring within the inventory domain was estimated using domain population fractions for SLRC and Mexicali (i.e., 89.84% and 9.18%, respectively) that were based on locality-specific population statistics from the 2000 census.<sup>8</sup>

### Spatial and Temporal Allocation

The spatial allocation of agricultural equipment is assumed to correspond to the overall distribution of agricultural land, while the spatial allocation of construction equipment is assumed to correspond to the distribution of population.

Emissions from agricultural equipment are very seasonal. Agricultural contacts in Mexico provided crop-specific crop calendars for most crop types with detailed planting and harvesting durations.<sup>38</sup> It is assumed that agricultural equipment activity primarily corresponds with agricultural tilling operations. It is not clear when construction equipment operates; therefore, it was assumed that the equipment operates uniformly throughout the year.

### Other Nonroad Mobile Source Categories

In addition to the nonroad equipment described above, there were several other nonroad source categories that are typically included in emissions inventories, but were ultimately not inventoried for the SLRC and Mexicali portions of the inventory domain. These source categories (and the reasons for not estimating) include the following:

- Aircraft – there is an airport/airstrip in SLRC bounded by Calzada Monterrey, Prolongación Reforma Agraria, and Prolongación Tuxpan. Research on the Internet indicates that the airport is only available for general aviation activity. However, no aircraft activity was observed during the three site visits.
- Railroads – there is no railroad in the SLRC and Mexicali portions of the inventory domain. The nearest Mexican railroad extends southeast from the urban center of Mexicali to Puerto Peñasco, Sonora.
- Commercial marine vessels and other related activities – The municipalities of SLRC and Mexicali both border the Gulf of California; however, these bordering areas are located outside of the inventory domain.

### Summary of Results

The estimated annual nonroad mobile source emissions (both criteria and HAPs) are summarized in Table 8 (for SLRC) and Table 9 (for Mexicali). In general, nonroad mobile source HAP emissions were estimated utilizing U.S. EPA SPECIATE4.0 particulate and gaseous profiles. Because the 1999 municipality-level emissions from the 1999 Mexico NEI did not distinguish between exhaust and evaporative VOC, the exhaust VOC profile was conservatively applied to total VOC. The exhaust VOC profile has a higher fraction of total HAP species compared to the evaporative VOC profile (i.e., 0.3822 versus 0.1457).

## CONCLUSIONS

As described in the sections above, annual criteria and HAP pollutant emissions are presented in the tables at the end of this paper: point sources in Table 3, area sources in Tables 4 and 5, on-road motor vehicles in Tables 6 and 7, and nonroad mobile sources in Tables 8 and 9.

It should be reiterated that the point source results only include results for SLRC point sources that responded to the mailed out survey; no point sources were identified in the Mexicali portion of the inventory domain. In addition, windblown fugitive dust emissions and several types of ammonia emissions (i.e., livestock, fertilizer application, soil ammonia, and domestic ammonia) are not presented with the area sources in Tables 4 and 5; these emissions were estimated for the entire inventory domain (both Mexico and U.S. portions) and are presented in the Part 1 companion paper.<sup>1</sup>

This inventory represents the first bottom-up emissions inventory developed for SLRC and rural Mexicali. In general, every effort was made to gather local data; however, data limitations sometimes required the interpolation of national- or state-level data. Some potential areas for future improvement include the following:

- Confirmation of industrial residual fuel use. Interpolation of state-level data and anecdotal interviews regarding PEMEX fuel sales indicate that industrial residual fuel oil is used in SLRC and Mexicali. However, point source survey results and limited visual observations do not indicate industrial residual fuel use. Since industrial residual fuel oil combustion is the largest source of SO<sub>2</sub> in the area source inventory, this uncertainty should be resolved.
- More rigorous data collection. In some cases, local data collection consisted of in-person interviews (e.g., dry cleaning, charbroiling, etc.). At some facilities, the owner was interviewed; while at other facilities, the on-duty workers were interviewed. As a result, the data obtained from interviews is of variable quality.
- Better quantification of brick kiln fuel use. The brick kilns in SLRC and Mexicali are a significant source category in the emissions inventory. Interviews were conducted that identified the burn size and frequency. However, the quantification of a key measure of brick kiln activity (i.e., fuel use) was based upon rough visual observations. Controlled measurement of brick kiln fuel use would result in reduced emissions uncertainty.
- Increased focus on the Mexicali portion of the domain. Although SLRC was the only urban area in the Mexico portion of the inventory domain, additional focus should be given to the Mexicali portion of the domain. For some source categories, activity in the rural *ejido* communities in Mexicali was significant. For other source categories, it was simply assumed that activity in Mexicali was similar to that in SLRC.

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## KEYWORDS

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**Table 1.** Maquiladoras operating in San Luis Río Colorado, Sonora.

Facility	Initial List	Most Significant	Response Provided
Acero Ameri-mex, S.A. de C.V.	✓	✓	✓
Apex Furniture, S.A.de C.V.	✓	✓	
AVI de México, S.A. de C.V.	✓		
Bordados y Estampados de Mexico, S. de R.L. de C.V.	✓		
Bose, S.A. de C.V	✓	✓	
Componentes Estructurales	✓	✓	
Corimex Manufacturas, S.A. de C.V.	✓		
Demda México, S.A. de C.V.	✓	✓	✓
Exportex de México, S.A. de C.V.	✓		
Exportex Lavandería	✓		
Fantasy Lingerie de México, S.A. de C.V.	✓		
Fox Sport, S.A. de C.V.	✓		
Gabinetes Tapia, S.A. de C.V.	✓	✓	
GPI Mexicana, S.A. de C.V.	✓	✓	✓

Facility	Initial List	Most Significant	Response Provided
Health Sport de México, S.A. de C.V.	✓		
Industrias Frengo S.A. de C.V.	✓		
Kims Packaging	✓	✓	✓
Lemonde de México, S. de R.L. de C.V.	✓		
Manufactura Meca, S.A. de C.V. Olguitas del Norte S.A. de C.V.	✓		
Manufacturas del Desierto, S.A. de C.V.	✓	✓	
Manufacturas y Representantes BCJ, S.A. de C.V.	✓	✓	
Marees Mex, S.A. de C.V.	✓		
Mecox Resources, S.A. de C.V.	✓	✓	✓
Moreno Manufacturas, S.A. de C.V.	✓	✓	
Naheda, S.A. de C.V.	✓		
Phoenix Textiles, S.A. de C.V.		✓	✓
Plasticam del Noroeste, S. de R.L.	✓		
Rejonel de Mex., S.A. de C.V.	✓		
Río Colorado Textil, S.A. de C.V.	✓		
SANA Internacional, S. de R.L. de C.V.	✓	✓	✓
Textiles Jica	✓		
TSE de México, S.A. de C.V.	✓	✓	✓
Westling de México, S.A. de C.V.	✓	✓	

**Table 2.** Summary of data obtained from the point source questionnaire.

Facility	Location	Information provided
Acero Ameri-mex, S.A. de C.V.	Avenida Tamaulipas and Calle 16	<ul style="list-style-type: none"> <li>• Paint quantity used</li> </ul>
Demda México, S.A. De C.V. (Daewoo)	Industrial Parque	<ul style="list-style-type: none"> <li>• Paint quantity used</li> <li>• Operation schedule</li> <li>• Paint speciation and VOC content</li> </ul>
GPI Mexicana, S.A. de C.V.	Industrial Parque	<ul style="list-style-type: none"> <li>• Fuel quantity used (2 sources)</li> <li>• Hourly emission rates (2 sources)</li> <li>• Operation schedule</li> <li>• Stack parameters (incomplete – 2 sources)</li> </ul>
Mecox Resources, S.A. de C.V.	Industrial Parque	<ul style="list-style-type: none"> <li>• Paint quantity used</li> <li>• Operation schedule</li> <li>• Stack parameters (incomplete – 4 sources)</li> <li>• Paint speciation</li> </ul>
Phoenix Textiles, S.A. de C.V.	Calzada Constitución and Río Santiago/Río Verde	<ul style="list-style-type: none"> <li>• Hourly emission rates (11 sources)</li> <li>• Stack parameters (complete – 11 sources)</li> </ul>
SANA Internacional, S. de R.L. de C.V.	Industrial Parque	<ul style="list-style-type: none"> <li>• Hourly emission rates (1 source)</li> <li>• Fuel quantity used (5 sources)</li> <li>• Operation schedule</li> <li>• Stack parameters (incomplete – 1 source)</li> </ul>
TSE de México, S.A. de C.V.	Industrial Parque	<ul style="list-style-type: none"> <li>• Fuel quantity used (7 sources)</li> <li>• Hourly emission rates (7 sources)</li> <li>• Operation schedule</li> <li>• Stack parameters (complete – 7 sources)</li> </ul>

**Table 3.** Summary of emissions from seven point sources operating in San Luis Río Colorado (tons/year).

Description	NO <sub>x</sub>	SO <sub>2</sub>	VOC	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	Total HAPs
Acero Ameri-mex S.A. de C.V.	0.00	0.00	3.16	0.00	0.00	0.00	0.00	1.43
Demda Mexico S.A. de C.V. (Daewoo)	0.00	0.00	7.77	0.00	0.00	0.00	0.00	0.75
G.P.I. Mexicana S.A. de C.V.	0.05	0.01	0.00	0.30	0.00	0.00	0.00	0.00
Mecox Resources S.A. de C.V.	0.00	0.00	5.47	0.00	0.00	0.00	0.00	1.09
Phoenix Textiles S.A. de C.V.	19.74	0.00	0.00	10.37	0.00	0.00	0.00	0.00
SANA Internacional S. de R.L. de S.V.	4.21	12.53	0.03	27.51	0.04	0.04	0.00	<0.01
TSE de Mexico S.A. de C.V.	2.69	0.00	16.43	82.12	0.00	0.00	0.00	4.12
<b>Total</b>	<b>26.69</b>	<b>12.54</b>	<b>32.86</b>	<b>120.30</b>	<b>0.04</b>	<b>0.04</b>	<b>0.00</b>	<b>7.40</b>

**Table 4.** SLRC annual area source emissions (tons/year).

Description	NO <sub>x</sub>	SO <sub>2</sub>	VOC	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	Total HAPs
Industrial Distillate Combustion	14.3	3.5	0.1	3.0	1.4	0.9		0.1
Industrial Residual Combustion	133.0	1,643.3	0.8	14.1	95.8	63.9		0.4
Industrial LPG Combustion	3.0	0.0	0.1	0.5	0.1	0.1		0.0
Commercial LPG Combustion	8.6	0.0	0.2	1.2	0.3	0.3		0.0
Residential LPG Combustion	31.4	0.1	0.8	4.3	1.0	1.0		0.1
Paved Road Dust					270.8	19.3		0.4
Unpaved Road Dust					1,491.8	145.9		3.2
Charbroiling	0.7		0.2	24.8	1.5	1.4		0.0
Architectural Surface Coating			79.0					13.7
Autobody Refinishing			15.9					7.1
Traffic Markings			6.1					1.7
Industrial Surface Coating			174.4					37.8
Degreasing			426.2					133.6
Dry Cleaning			37.2					18.9
Graphic Arts			57.2					5.8
Consumer Solvents			426.8					61.6
Agricultural Pesticides			5.1					0.8
Gasoline Distribution			183.3					19.8
Landfill			30.3					0.2
Wastewater Treatment			5.0					2.0
Agricultural Tilling					33.1	7.3		0.0
Agricultural Harvesting					23.0	5.1		0.0
Agricultural Field Burning	23.0	4.8	40.7	662.3	56.8	54.1		12.1
Structure Fires	0.1		0.6	3.4	0.6	0.6		0.3
Border Crossing	8.3	0.1	66.1	186.7	0.5	0.4	0.3	19.6
Brick Kilns	24.3	1.4	796.2	878.3	120.3	115.8		317.4
<b>Total</b>	<b>246.7</b>	<b>1,653.3</b>	<b>2,352.1</b>	<b>1,778.6</b>	<b>2,096.9</b>	<b>416.1</b>	<b>0.3</b>	<b>656.2</b>

**Table 5.** Mexicali annual area source emissions (tons/year).

Description	NO <sub>x</sub>	SO <sub>2</sub>	VOC	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	Total HAPs
Industrial Distillate Combustion	7.7	1.9	0.1	1.6	0.7	0.5		0.0
Industrial Residual Combustion	59.7	737.7	0.4	6.4	43.0	28.7		0.2
Industrial LPG Combustion	3.1	0.0	0.1	0.5	0.1	0.1		0.0
Commercial LPG Combustion	5.3	0.0	0.1	0.7	0.2	0.2		0.0
Residential LPG Combustion	20.7	0.1	0.5	2.9	0.7	0.7		0.1
Paved Road Dust					536.2	38.2		0.8
Unpaved Road Dust					3,049.2	298.2		6.6
Architectural Surface Coating			44.0					7.7
Autobody Refinishing			7.2					3.2
Industrial Surface Coating			406.0					123.6
Degreasing			176.2					55.2
Graphic Arts			31.8					3.2
Consumer Solvents			237.7					34.3
Agricultural Pesticides			123.1					18.0
Gasoline Distribution			102.1					11.1
Wastewater Treatment			46.9					19.3
Agricultural Tilling					519.5	115.2		0.0
Agricultural Harvesting					436.2	96.7		0.0
Agricultural Field Burning	462.0	96.7	816.6	13,280.5	1,138.9	1,085.2		241.8
Structure Fires	0.0		0.3	1.9	0.3	0.3		0.2
Border Crossing	1.4	0.0	14.1	39.9	0.1	0.1	0.1	4.2
Brick Kilns	2.5	0.4	222.4	245.3	33.6	32.3		88.6
<b>Total</b>	<b>562.4</b>	<b>836.8</b>	<b>2,229.5</b>	<b>13,579.6</b>	<b>5,758.7</b>	<b>1,696.3</b>	<b>0.1</b>	<b>617.9</b>

**Table 6.** SLRC annual on-road motor vehicle emissions (tons/year).

Description	NO <sub>x</sub>	SO <sub>2</sub>	VOC	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	Total HAPs
LDGV	73.6	1.7	289.1	1,640.5	9.3	7.6	8.1	71.7
LDGT12	71.7	1.5	154.2	961.0	8.8	7.4	5.6	38.3
LDGT34	25.6	0.6	77.8	482.1	3.1	2.7	1.7	19.5
HDGV	23.3	0.3	26.6	132.2	0.5	0.4	0.2	6.4
LDDV	0.8	0.0	0.6	1.2	0.2	0.1	0.0	0.2
LDDT	0.5	0.0	0.4	0.7	0.1	0.1	0.0	0.1
HDDV	331.6	6.8	23.6	106.1	27.5	24.7	0.7	9.0
MC	2.3	0.0	5.4	24.3	0.1	0.0	0.0	1.4
<b>Total</b>	<b>529.3</b>	<b>11.0</b>	<b>577.7</b>	<b>3,348.0</b>	<b>49.5</b>	<b>43.1</b>	<b>16.3</b>	<b>146.8</b>

**Table 7.** Mexicali annual on-road motor vehicle emissions (tons/year).

Description	NO <sub>x</sub>	SO <sub>2</sub>	VOC	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	Total HAPs
LDGV	129.2	3.0	484.3	2,916.4	16.6	13.6	14.4	120.5
LDGT12	126.9	2.7	255.0	1,757.2	15.7	13.2	10.0	63.6
LDGT34	45.3	1.1	130.0	871.0	5.6	4.8	3.1	32.7
HDGV	44.3	0.5	41.8	199.1	1.0	0.8	0.4	9.9
LDDV	1.4	0.1	1.1	2.1	0.3	0.3	0.0	0.4
LDDT	0.9	0.1	0.6	1.2	0.2	0.2	0.0	0.2
HDDV	611.6	12.2	35.0	155.7	49.2	44.2	1.2	13.4
MC	4.4	0.0	9.1	36.0	0.1	0.0	0.0	2.4
<b>Total</b>	<b>963.9</b>	<b>19.7</b>	<b>956.9</b>	<b>5,938.7</b>	<b>88.6</b>	<b>77.0</b>	<b>29.2</b>	<b>243.1</b>

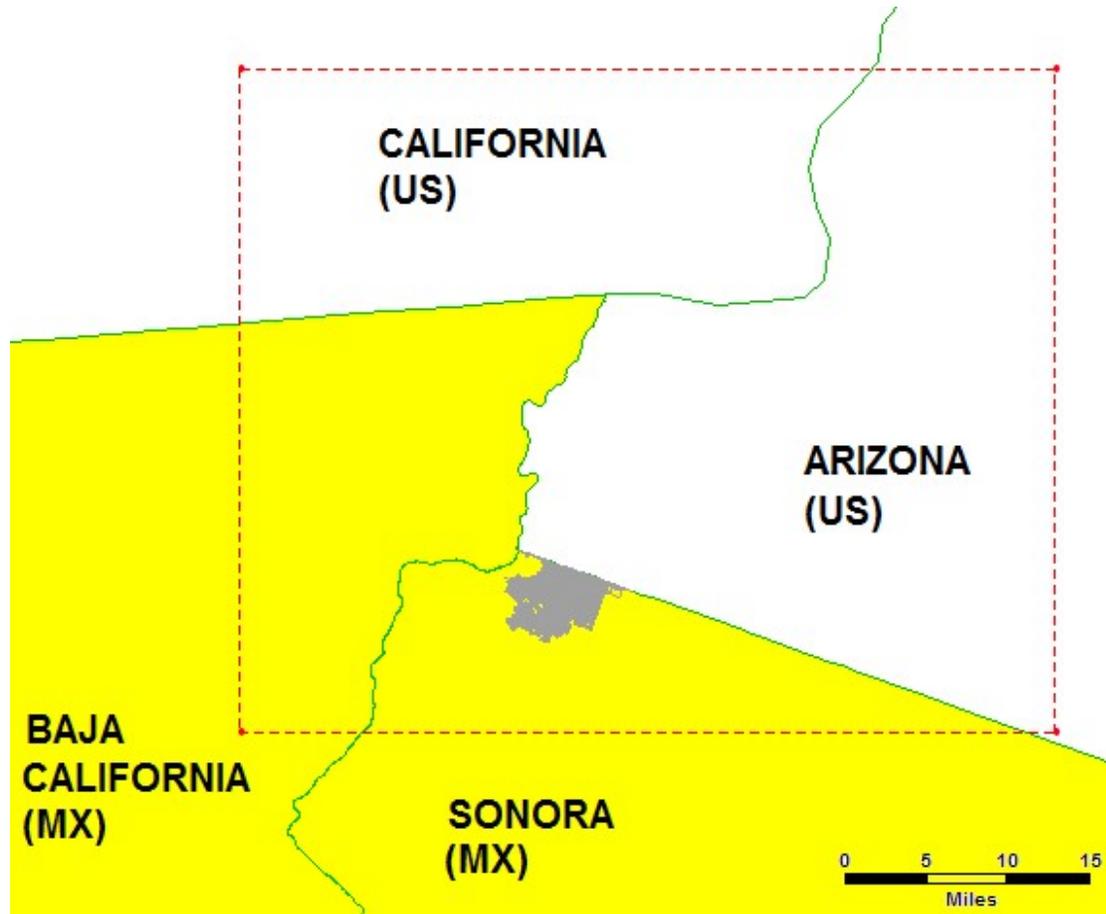
**Table 8.** SLRC annual nonroad mobile source emissions (tons/year).

Equipment Category	NO <sub>x</sub>	SO <sub>2</sub>	VOC	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	Total HAPs
Agricultural Equipment	86.1	1.1	14.4	58.1	14.5	14.1	-	5.5
Construction Equipment	416.0	5.6	43.0	208.4	46.8	45.4	-	16.4
<b>Total</b>	<b>502.1</b>	<b>6.7</b>	<b>57.4</b>	<b>266.5</b>	<b>61.4</b>	<b>59.5</b>	<b>-</b>	<b>22.0</b>

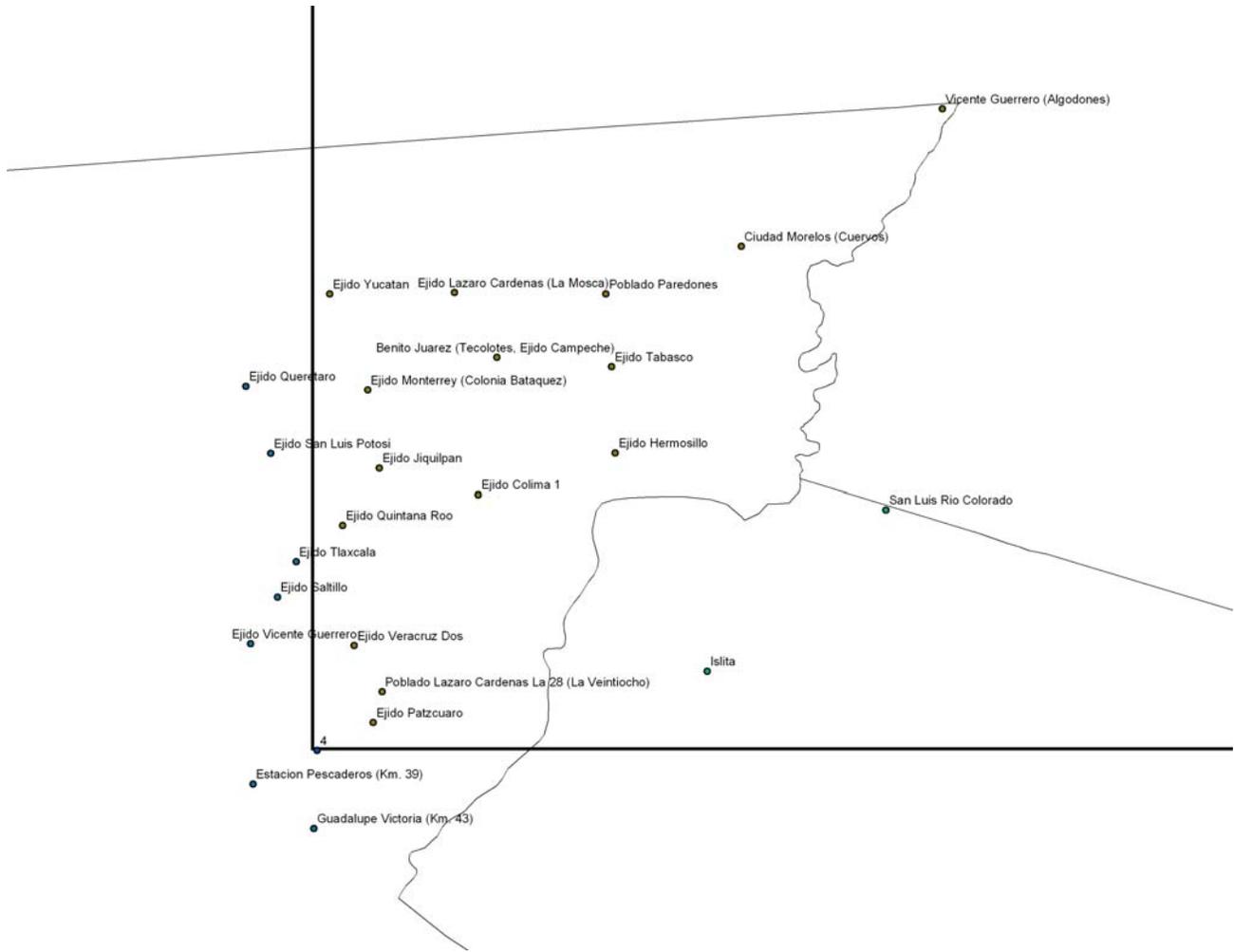
**Table 9.** Mexicali annual nonroad mobile source emissions (tons/year).

Equipment Category – Location	NO <sub>x</sub>	SO <sub>2</sub>	VOC	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	Total HAPs
Agricultural Equipment	587.2	7.4	99.2	398.0	99.2	96.2	-	37.9
Construction Equipment	258.2	3.5	26.7	129.3	29.1	28.2	-	10.2
<b>Total</b>	<b>845.4</b>	<b>10.9</b>	<b>125.9</b>	<b>527.3</b>	<b>128.3</b>	<b>124.4</b>	-	<b>48.1</b>

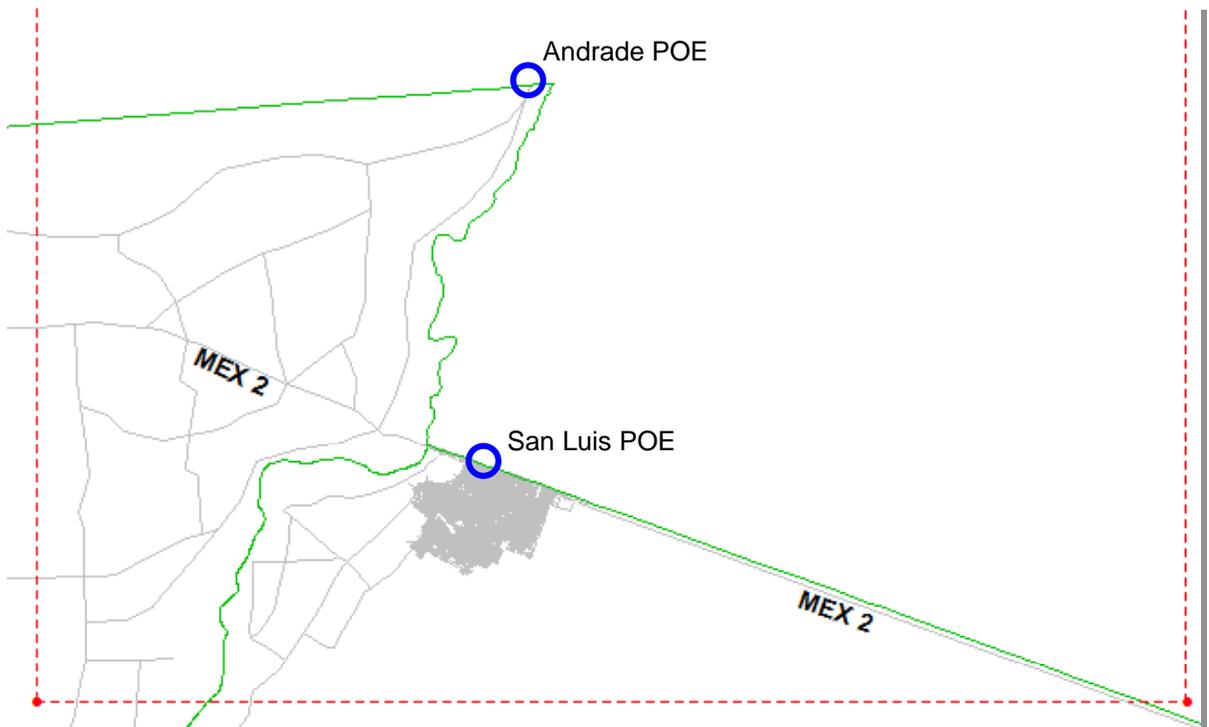
**Figure 1.** WASBAQS inventory domain.



**Figure 2.** Mexico communities located in WASBAQS inventory domain.



**Figure 3.** Urban and rural roadways in the SLRC and Mexicali portion of the inventory domain.



**Figure 4.** Detailed map of the SLRC urban roadway.



**Figure 5.** Loaded roadway network under weekday conditions for the SLRC and Mexicali portion of the inventory domain.

