



## 2006 Area Source Emissions Inventory Methodology

### 670 – NON-AGRICULTURAL OPEN BURNING

#### I. Purpose

This document describes the Area Source Methodology used to estimate emissions of carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), fine particulate matter less than 10 microns (PM<sub>10</sub>), volatile organic gas (VOC), and sulfur oxides (SO<sub>x</sub>), from **non-agricultural burning** in the San Joaquin Valley Air Basin. **Previously this area source category was used for backyard barrel burning. Since this practice has been prohibited by District Rule 4103 since 1994, this category will now be used to calculated emissions from hazard reduction burns.**

An area source category is a collection of similar emission units within a geographic area (i.e., a County). An area source category collectively represents individual sources that are small and numerous and that may not have been inventoried as specific point, mobile, or biogenic sources. The California Air Resources Board (CARB) has grouped these individual sources with other like sources into area source categories. These source categories are grouped in such a way that they can be estimated collectively using one methodology.

#### II. Applicability

The emission calculations from this Area Source Methodology apply to sources that are identified by the following Category of Emission Source (CES) code and Reconciliation Emission Inventory Code (REIC):

**Table 1. Emission inventory codes.**

CES	REIC	Description
47290	670-670-0200-0000	Non-Agricultural Open Burning

#### III. Point Source Reconciliation

Emissions from the area source inventory and point source inventory are reconciled against each other to prevent double counting. This is done using relationships created by the California Air Resources Board (CARB) between the area source REIC and the point sources' Standard Industry Classification (SIC) code and emissions process Source Category Code (SCC) combinations. The area source in

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this methodology is not represented within our point source inventory so reconciliation is not necessary.

### IV. Methodology Description

Previously this area source category was used for backyard barrel burning. There has been no backyard barrel burn data collected since 1994 due to the implementation of District Rule 4103 - Open Burning on June 18, 1992. This rule states that,

*"...no person shall set, permit, or use an open outdoor fire for the purpose of disposal or burning of petroleum wastes; demolition or construction debris; residential rubbish; garbage or vegetation; tires; tar; trees; wood waste; or other combustible or flammable solid, liquid or gaseous waste; or the metal salvage or burning of motor vehicle bodies".*

Per Section 2.0 of Rule 4103<sup>a</sup> it "... applies to all non-permitted open burning conducted in the San Joaquin Valley Air Basin." Because backyard barrel burning is not allowed within the District, this area source category will now be used to calculate emissions from burns conducted for the purpose of hazard reduction.

The State of California under Public Resources Code section 4291, requires that any,

*"person who owns, leases, controls, operate, or maintains a building or structure in, upon, or adjoining a mountainous area, forest-covered lands, brush-covered lands, grass-covered lands, or land that is covered with flammable material, shall at all times,...maintain a defensible space no greater than 100 feet from each side of the structure, but not beyond the property line unless allowed by state law, local ordinance, or regulation and as approved..."*

The owners or operators of a property that is subject to the California Public Resource Code Section 4291 may as an option utilize burning for clearing the debris collected from the property. In order to do so owners/operators must obtain a hazard reduction burn permit issued by local fire department or California Department of Forestry (CDF) stations. These hazard reduction burn permits are collected by the District and entered into a District developed Hazard Reduction Burn Database. The number of active permits is multiplied by an emission factor to estimate emissions from hazard reduction burns conducted in the San Joaquin Valley.

## V. Activity Data

The following table illustrates the number of permits issued in 2006 along with those permits issued prior to 2006, yet not expired.

**Table 2. Hazard Reduction Burn Permits, 2006**

Hazard Reduction Permits	Number of Permits
Permits issued prior to 2006 but still valid in 2006	3,394
Permits issued in 2006	5,362
Total	8,756

Unless site specific data is available, the District assumes a fuel loading of 1 ton of material burned per permit per year. This assumption is based on the experiences of the District's Compliance Department from inspections of burn piles.

## VI. Emission Factors

The Air Resources Board compiled a list of emission factors by crop type based on AP-42 values and from a study conducted by B.M. Jenkins (Gaffney, 2000). Fuel loading values from AP-42 (EPA, 1992) are also associated with each emission factor. Some of the factors and values were adjusted as needed by the District to better reflect the conditions in the San Joaquin Valley. For hazard reduction burns, the District assumes piles are composed of 50% grassland vegetation and 50% chaparral.

**Table 3. Emission factors for brush piles calculated as 50% grassland and 50% chaparral (lbs/ton)**

Emission Factors (lbs/ton)					Fuel Loading (tons/acre)
NO <sub>x</sub>	CO	SO <sub>x</sub>	VOC	PM <sub>10</sub>	
4	133.85	0.35	12.55	18	13.1

## VII. Emissions Calculations

The following equation can be used to calculate emissions from hazard reduction burns:

$$Emission (tons) = \frac{1 \text{ Ton Fuel Burned}}{\text{Permit-Year}} \times \frac{\text{Pounds of Pollutant}}{\text{Ton of Fuel Burned}} \times \frac{1 \text{ Ton}}{2,000 \text{ Pounds}}$$

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### Example PM<sub>10</sub> Emissions:

For a hazard reduction burn permit without any site specific information provided, assume fuel loading of 1 ton of material per year and an emission factor of 18 pounds of PM<sub>10</sub> per ton of fuel burned.

$$PM_{10} \text{ Emission (tons)} = \frac{1 \text{ Ton Fuel Burned}}{\text{Permit-Year}} \times \frac{\text{Pounds of Pollutant}}{\text{Ton of Fuel Burned}} \times \frac{1 \text{ Ton}}{2,000 \text{ Pounds}}$$

$$PM_{10} \text{ Emission (tons)} = \frac{1 \text{ Ton Fuel Burned}}{\text{Permit-Year}} \times \frac{18 \text{ Pounds of PM}_{10}}{\text{Ton of Fuel Burned}} \times \frac{1 \text{ Ton}}{2,000 \text{ Pounds}}$$

$$PM_{10} \text{ Emission} = 0.009 \text{ tons}$$

## VIII. Temporal Variation

### A. Daily

CARB Code 24. 24 hours per day - uniform activity during the day.

### B. Weekly

CARB Code 7. 7 days per week - uniform activity every day of the week

### C. Monthly

Local Fire and Department of Forestry Stations may implement their own monthly burn schedule specific to Hazard Reduction burns, in conjunction with the District's burn and no burn days. Regulatory agencies in high fire hazard regions may prohibit all Hazard Reduction Burn activity during the summer seasons while others may allow occasional burns. The District assumes that Hazard Reduction Burns conducted within the San Joaquin Valley best correlates to agricultural burns. Monthly activity of all agricultural burns in the San Joaquin Valley for 2006 will be used as a surrogate to estimate monthly hazard reduction burn activity as represented in Table 4.

**Table 4. Hazard reduction monthly burn activity in the District, 2006.**

Month (2006)	Activity Level (% of annual)
January	19.96
February	18.44
March	13.90
April	10.30
May	8.52
June	2.58
July	0.96
August	0.69
September	1.77
October	3.50
November	5.79
December	13.57
<b>Total</b>	<b>100.00</b>

## IX. Spatial Variation

Hazard reduction burns permits are issued by corresponding local fire and California Department of forestry stations. Burn locations are defined by street addresses in the District’s Hazard Reduction Burn Database. The following table illustrates the spatial distribution of valid hazard reduction permits issued in and before 2006.

**Table 5. Number of valid hazard reduction burn permits per county, 2006.**

County	Hazard Reduction Burn Permits
Fresno	3,453
Kern	154
Kings	4
Madera	3,676
Merced	0
San Joaquin	0
Stanislaus	38
Tulare	1,431
<b>TOTAL</b>	<b>8756</b>

## X. Growth Factor

Growth factors are developed by either the District’s Planning Department or CARB for each EIC. These factors are used to estimate emissions in future years. The growth factors associated with this emissions category may be obtained from the Air Quality Analysis Section of the District’s Planning Department.

## XI. Control Level

Control levels are developed by either the District's Planning Department or CARB for each EIC. Control levels are used to estimate emissions reductions in future years due to implementation of District rules. These control levels take into account the effect of control technology, compliance and exemptions at full implementation of the rules.

The emissions in this category are subject to District Rule 4106 Prescribe Burning and Hazard Reduction Burning and Rule 4103 Open Burning. Control levels associated with this emissions category may be obtained from the Air Quality Analysis Section of the District's Planning Department.

## XII. CARB Chemical Speciation

CARB has developed organic gas profiles in order to calculate reactive organic gasses (ROG), volatile organic compounds (VOC) or total organic gas (TOG) given any one of the three values. For each speciation profile, the fraction of TOG that is ROG and VOC is given. The organic gas profile codes can also be used to lookup associated toxics. The District proposes to use the same organic gas profile used for Range Improvement Burning since fuel types are similar. The proposed organic gas profile is presented in Table 6.

**Table 6. CARB organic gas speciation profile for hazard reduction burning.**

ARB Organic Gas Profile Description	Profile#	Fractions	
		ROG	VOC
Forest Fires	307	0.57	0.57

CARB has also developed particulate matter speciation profiles in order to calculate particulate matter (PM), particulate matter with a diameter less than or equal to 10 microns (PM<sub>10</sub>) or particulate matter with a diameter less than or equal to 2.5 microns (PM<sub>2.5</sub>) given any one of the three values. For each speciation profile, the fraction of PM that is PM<sub>10</sub> and PM<sub>2.5</sub> is given. The particulate matter profile codes can also be used to lookup associated toxics. The District proposes to use the particulate matter profile used for Range Improvement Burning since fuel types are similar. The proposed particulate matter profile is presented in Table 7.

**Table 7. CARB particulate matter speciation profile for hazard reduction burning.**

ARB PM Profile Description	Profile#	Fractions	
		PM <sub>10</sub>	PM <sub>2.5</sub>
Range Improvement Burning	441	0.9825	0.9316

### **XIII. Assessment Of Methodology.**

As stated in Section IV of this document, backyard barrel burning has been prohibited within the San Joaquin Valley Air District since the implementation of District Rule 4103 Open Burning. Therefore, all of the emissions in this area source category will be from Hazard Reduction burns. Hazard Reduction burn permits are not issued by the District, therefore the quality of this methodology is subject to the quality of data provided to the District by the local regulatory agencies. Due to the limited information available, the District has made the following conservative assumptions necessary to formulate an estimate of emissions from Hazard Reduction burns conducted in the San Joaquin Valley Air Pollution Control District.

1. All local fire department and California Department of Forestry stations accurately collect and regulate the Hazard Reduction Burn permits.
2. For Hazard Reduction permits that do not specify a burn site, burns for that permit are assumed to be conducted at the mailing address listed on the permit.
3. Hazard Reduction permits that do not specify a permit expiration date are assumed to be valid for one year from the date of issuance.
4. All Hazard Reduction permits are assumed to be active up to the date of expiration. Therefore, emissions for these permits are considered in each corresponding emission year in which the permit is valid.
5. Fuel loading for Hazard Reduction burns is assumed to be 1 ton of materials burned per permit.
6. Materials burned are assumed to be brush piles comprised of 50% grassland and 50% chaparral.
7. Emission factors obtained from EPA are accurate.
8. Since the District designates burn days within the San Joaquin Valley, temporal variations for Hazard Reduction burns are assumed to correlate with agricultural burns.

## XIV. Emissions

Following is the 2006 area source emissions inventory for REIC 670-670-0200-0000 estimated by this methodology. Emissions are reported for each county in the District.

**Table 8. Area source emissions for REIC 670-670-0200-0000 (2006).**

County	Emissions (tons/year)					
	NOx	CO	SOx	VOC <sup>(1)</sup>	PM <sub>10</sub>	PM <sub>2.5</sub> <sup>(2)</sup>
Fresno	6.91	231.09	0.60	21.67	31.08	N/A
Kern	0.31	10.31	0.03	0.97	1.39	N/A
Kings	0.01	0.27	0.00	0.03	0.04	N/A
Madera	7.35	246.02	0.64	23.07	33.08	N/A
Merced	0.00	0.00	0.00	0.00	0.00	N/A
San Joaquin	0.00	0.00	0.00	0.00	0.00	N/A
Stanislaus	0.08	2.54	0.01	0.24	0.34	N/A
Tulare	2.86	95.77	0.25	8.98	12.88	N/A
<b>TOTAL</b>	<b>17.51</b>	<b>586.00</b>	<b>1.53</b>	<b>54.94</b>	<b>78.80</b>	<b>N/A</b>

(1) The District only reports ROG to CARB. As noted in Section XII, ROG is the same as VOC.

(2) At this time, the District does not calculate PM2.5 emissions. PM2.5 emissions can be estimated using the speciation profiles found in Section XII.

## XV. Revision History

2006. This is a new District methodology based on the addition of emissions from hazard reduction burns. The previous methodology only included emissions from backyard barrel burns.

2005. This methodology was reformatted to the new District standard. The 2005 area source emissions methodology only estimated emissions from backyard barrel burning.



## XVI. Update Schedule

In an effort to provide inventory information to CARB and other District programs and maximize limited resources, the District has developed an update cycle based on emissions within the source category as shown in Table 12.

**Table 9. Area source update frequency criteria.**

Total Emissions (tons/day)	Update Cycle (years)
≤1	4
>1 and ≤ 2.5	3
>2.5 and ≤5	2
>5	1

Since PM<sub>10</sub> and NO<sub>x</sub> emissions do not exceed 1 ton per day, this area source estimate will be updated every four years.

## XVII. References

1. San Joaquin Valley Unified Air Pollution Control District Rules and Regulations (2005).
2. Environmental Protection Agency. 1995. AP-42 Chapter 2, Section 2.5.2.3: Open burning, agricultural waste.
3. Gaffney, P. 2000. California Air Resources Board [pgaffney@arb.ca.gov](mailto:pgaffney@arb.ca.gov) (916) 322-7303 <http://www.arb.ca.gov/ei/see/mngdburnemissionfactors.pdf>.