San Joaquin Valley
Air Pollution Control District

APR – 1965
Aggregation Methodology

Approved By:	Signed Arnaud Marjollet, Director of Permit Services	Date:	March 3, 2016

I. Background

Health risk modeling and the collection of emissions inventory are necessary for various District and state programs. Emissions inventory reporting and modeling for small quantities of emissions sources are typically expeditious compared to projects with numerous emissions sources. In some cases, facilities or projects can involve hundreds or thousands of emissions sources or components. Due to resource constraints, it may not be practical to report and/or model that many components or emission sources individually. In order to manage the reporting and/or modeling of emissions from a large number of components, aggregation of similar components into a single source for reporting and/or modeling can be beneficial. Aggregation means the grouping and consolidation of the emissions from any number of individual components or sources into a single source. Historically, analyses associated with the AB2588 (Air Toxic "Hot Spots" Assessment Act) program utilized such a method.

II. Purpose

The purpose of this policy is to provide guidance on determining if and how emission sources may be aggregated for the purposes of performing health risk modeling for District Risk Management Reviews (RMR), California Environmental Quality Act (CEQA) projects, Emissions Inventory (EI), and AB2588 (Air Toxic "Hot Spots" Assessment Act).

III. Applicability

This policy may apply to a facility or project with multiple fugitive emission sources or components with fugitive emissions, and qualify under Section IV.A below. This policy does not apply to combustion sources, or emissions sources with stacks, which should all be reported and evaluated separately.

IV. Guidance (see Appendix B for examples)

A. General Requirements and Qualifications

To qualify to be aggregated, each source of emissions must meet all of the following requirements:

1. Aggregation of components should only occur if there are five (5) or more of any single component (e.g. piping valves at an oilfield) or source type (e.g. storage tanks). Note, there can be numerous components within a permit unit, and there can be numerous components that are permit-exempt.

2. The aggregated components must have the same Source Classification Code (SCC) and emissions estimation methodology, as well as similar release parameters.

3. Each aggregated source shall use the same toxic emission profile(s) for toxic emissions estimation purposes. Aggregated sources that do not have the same toxic emission profiles require approval from the District before proceeding.

4. The location of the aggregated source must remain within the same Section, ¼ Section, ¼ of a ¼ Section, or the area in which the actual sources reside. The location should be determined according to Sections IV. B and C below.

5. The location of the aggregated source cannot reside in an area not owned or controlled by the facility.

6. Aggregated fugitive components should be modeled as area sources.

7. The height above ground or elevation of the area source will depend on the sources that have been aggregated.

B. Aggregation of Components or Sources with a Uniform Spatial Distribution

1. Components that are within a single section (~1609 x ~1609 meters or 1x1 mile square) can be aggregated into a single source, if:

   a. The components are not separated by more than 800 meters and are equally spread over the entire section, and

   b. The aggregated source location would be the center of the section.

   The modeled area source size should be no greater than 100 meters by 100 meters.

2. Components that are within a single quarter section (~804 x ~804 meters or ½ x ½ mile) can be aggregated into a single aggregated source, if:

a. The components are not separated by more than 400 meters and are equally spread over the entire quarter section, and

b. The aggregated source location would be the center of the ¼ section.

The modeled area source size should be no greater than 50 meters by 50 meters.

3. Components that are within a single quarter of a quarter section (~402 x ~402 meters or 1/4 x 1/4 mile) can be aggregated into a single aggregated source, if:

a. The components are not separated by more than 200 meters and are equally spread over the entire quarter of a ¼ section, and

b. The aggregated source location would be the center of the quarter of the quarter section.

The modeled area source size should be no greater than 25 meters by 25 meters.

Other aggregation schemes and sizes may be used with the approval of the District.

C. Aggregation of Components or Sources with a Non-Uniform Spatial Distribution

Components that are not equally distributed over a section, quarter section, or sub quarter section can still be aggregated as long as the requirements of sub item IV.A have been satisfied. Two methods are described below with the "Weighted Mean Center Method" considered more accurate than the "Conservative Method". Other methods may be used with the approval of the District.

1. Weighted Mean Center Method

The weighted mean center method provides a procedure by which geospatial data can be represented by a single data point or location. This method takes into account the location of each source being aggregated and the emissions being released. In order to use this technique, three data points from each source being aggregated are required: 1) the toxicity based emission rate (TBER), 2) UTM North coordinate, and 3) UTM East coordinate. An example calculation is included in Appendix A.

a. Toxicity Based Emission Rate

In the early 1990's, when the Air Toxic "Hot Spots" Act (AB2588) program started to require HRAs, no system existed for calculating a source's exposure to nearby receptors. At that time modelers used what has come to be known as a toxicity based emission rate. There

are two methods for determining the toxic emission rates; one for when carcinogenic (cancer) impacts are the most significant and one for when non-carcinogenic (chronic and acute) impacts are the most significant.

The carcinogenic method takes the Unit Risk Factor (URF) for each toxic air contaminant (TAC) and multiplies it by its calculated annual emissions in lbs/year or g/sec. Then the carcinogenic TBERs for each source are summed. This method provides a single emissions rate that represents the overall toxicity of the emissions from a given source. This method is also useful for comparing sources irrespective of their dispersion parameters.

i. To determine the carcinogenic toxicity based emission rate of each source, use the following equation:

Eq. 1 – Toxicity Based Emission Factor (Carcinogenic)

$$w = \sum_{i=1}^{n} P_i T_i$$

Where:

w	=	Sum of the toxicity based emission rates
P_i	=	Source pollutant emissions
T_i	=	Pollutant toxicity (URF)
n	=	Number of pollutants for the source
i	=	Represents each pollutant

The non-carcinogenic method takes the calculated max hour (acute) or annual emissions (chronic) for each TAC in lbs/hour or lbs/year or g/sec and divides it by its Relative Exposure Level (REL) value. Then the non-carcinogenic TBERs for each source are summed. This method provides a single emissions rate that represents the overall toxicity of the emissions from a given source. This method is also useful for comparing sources irrespective of their dispersion parameters.

ii. To determine the carcinogenic toxicity based emission rate of each source, use the following equation:

Eq. 2 – Toxicity Based Emission Factor (Non-Carcinogenic)

$$w = \sum_{i=1}^{n} \frac{P_i}{R_i}$$

Where:

w	=	Sum of the toxicity based emission rates

P_i = Source pollutant emissions
R_i = Pollutant toxicity (REL)
n = Number of pollutants for the source
i = Represents each pollutant

For the purpose of determining where an aggregated source will be located and to minimize the resources needed, the emissions do not have to be converted into grams per second, but can be left in the units that will be reported to the District.

b. To determine the weighted mean center location of the aggregated source, use the following equations:

Eq. 3. Weighted UTM East coordinate

$$\overline{X}_w = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$$

Where:
X_w = Weighted mean UTM East coordinate
x = UTM East coordinate
w = Sum of the toxicity based emission rates
n = Number of emissions sources to be aggregated
i = Represents each source coordinate

Eq. 4. Weighted UTM North coordinate

$$\overline{Y}_w = \frac{\sum_{i=1}^{n} w_i y_i}{\sum_{i=1}^{n} w_i}$$

Where:
Y_w = Weighted mean UTM North coordinate
y = UTM North coordinate
w = Sum of the toxicity based emission rates
n = Number of emissions sources to be aggregated
i = Represents each source coordinate

c. In order to minimize the number of sources and resources needed to perform this method, sources clustered within 25 meters of each other may be grouped together and the center location of the cluster maybe used.

2. Conservative Method

This method places the location of the aggregated source at the location of the nearest source receptor combination.

Appendix A –

Weighted Mean Center Method

The example project has six tank sources.
The coordinates for each source are indicated below:

Table 1. Source Coordinates

Source	UTM East	UTM North
Tank 1	276857.7	3882747.7
Tank 2	276952.2	3882751.6
Tank 3	277055.0	3882748.3
Tank 4	277049.0	3882649.4
Tank 5	276851.8	3882560.5
Tank 6	276952.5	3882554.6

Step 1: Calculate the toxicity based emission rate using equation 1:

Table 2. Example of Toxicity Based Emission Rates

Device Name	CAS	Pollutant	URF	Emission Rate (lbs/yr)	Toxicity Based Emission Rate
Tank 1	7783064	H_2S		1.79E-01	0.00E+00
Tank 1	1330207	Xylenes		8.75E-02	0.00E+00
Tank 1	108883	Toluene		4.25E-02	0.00E+00
Tank 1	71432	Benzene	2.90E-05	4.38E-02	1.27E-06
Tank 2	7783064	H_2S		5.37E-01	0.00E+00
Tank 2	1330207	Xylenes		2.63E-01	0.00E+00
Tank 2	108883	Toluene		1.28E-01	0.00E+00
Tank 2	71432	Benzene	2.90E-05	1.31E-01	3.81E-06
Tank 3	7783064	H_2S		2.69E-01	0.00E+00
Tank 3	1330207	Xylenes		1.31E-01	0.00E+00
Tank 3	108883	Toluene		6.38E-02	0.00E+00
Tank 3	71432	Benzene	2.90E-05	6.57E-02	1.91E-06
Tank 4	7783064	H_2S		1.07E+00	0.00E+00
Tank 4	1330207	Xylenes		5.25E-01	0.00E+00
Tank 4	108883	Toluene		2.55E-01	0.00E+00
Tank 4	71432	Benzene	2.90E-05	2.63E-01	7.62E-06
Tank 5	7783064	H_2S		5.37E-01	0.00E+00
Tank 5	1330207	Xylenes		2.63E-01	0.00E+00
Tank 5	108883	Toluene		1.28E-01	0.00E+00
Tank 5	71432	Benzene	2.90E-05	1.31E-01	3.81E-06
Tank 6	7783064	H_2S		1.79E-01	0.00E+00
Tank 6	1330207	Xylenes		8.75E-02	0.00E+00
Tank 6	108883	Toluene		4.25E-02	0.00E+00
Tank 6	71432	Benzene	2.90E-05	4.38E-02	1.27E-06

Step 2: Determine the Weighted Mean Center (WMC) UTM Coordinates for the Aggregated Source

Using Equation 2:

$$X_w = \frac{[(1.27E-6)*276857.7]+[(8.81E-9)*276952.2]+[(1.91E-6)*277054.0]+[(7.62E-6)*277049.0]+[(3.81E-6)*276851.8]+[(1.27E-6)*276952.5)}{(1.27E-6)+(3.81E-6)+(1.91E-6)+(7.62E-6)+(3.81E-6)+(1.27E-6)}$$

$$X_w = 276974.1$$

Using Equation 3:

$$Y_w = \frac{[(1.27E-6)*3882747.7]+[(8.81E-9)*3882751.6]+[(1.91E-6)*3882748.3]+[(7.62E-6)*3882749.4]+[(3.81E-6)*3882560.5]+[(1.27E-6)*3882554.6)}{(1.27E-6)+(3.81E-6)+(1.91E-6)+(7.62E-6)+(3.81E-6)+(1.27E-6)}$$

$$Y_w = 3882661.8$$

Figure 1 displays the approximate location of the six fugitive tank sources (T1-T6), and the weighted mean center (WMC) for the aggregated source.

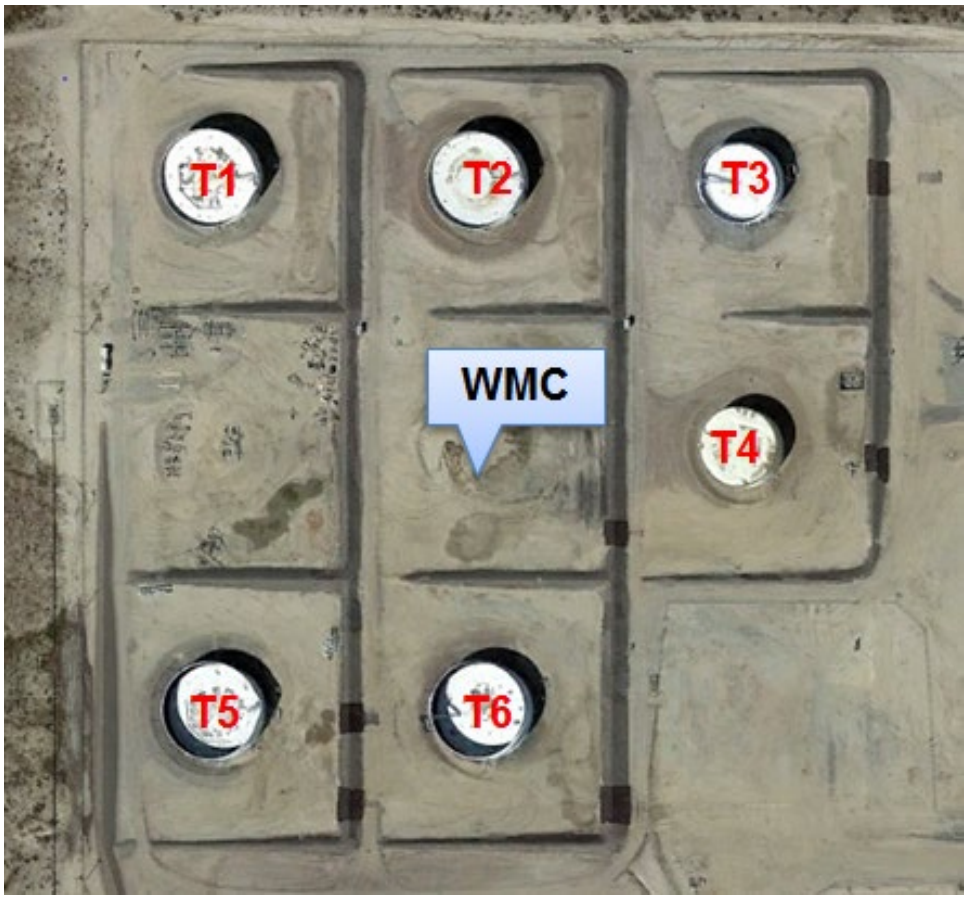

Figure 1. Weighted Mean Center (WMC) Source Location

Appendix B

Examples of Aggregated Source Placement

Example 1: Emissions that are evenly distributed across a Section, ¼ Section, or ¼ of a ¼ Section.

If the emissions from your sources are evenly distributed across the Section, ¼ Section, or ¼ of a ¼ Section, your aggregated source should be placed near the center of the Section, ¼ Section, or ¼ of a ¼ Section, respectively. This is illustrated in Figure 2 below:

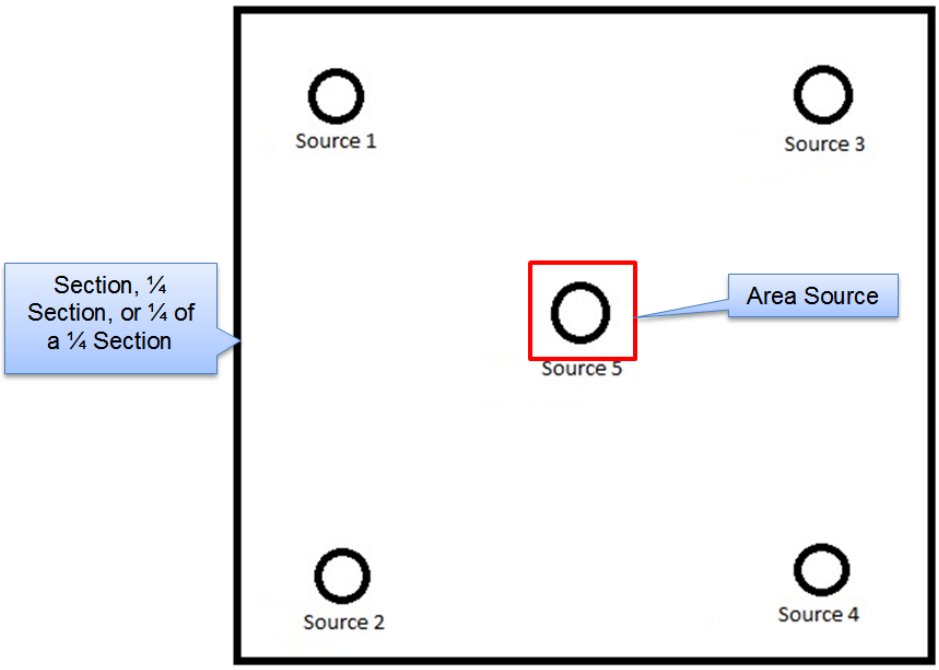

Figure 2. Location of an Aggregated Source for Evenly Distributed Sources

Example 2: Emissions that are <u>not</u> evenly distributed across a Section, ¼ Section, or ¼ of a ¼ Section.

If the emissions from your sources are not evenly distributed across a Section, ¼ Section, or ¼ of a ¼ Section, your aggregated source should be placed based on the recommended weight mean center method described in Section IV.C.1 above. Assuming that the sources in Figure 3 are identical and with identical emissions, your aggregated source would be placed similarly to what is shown below:

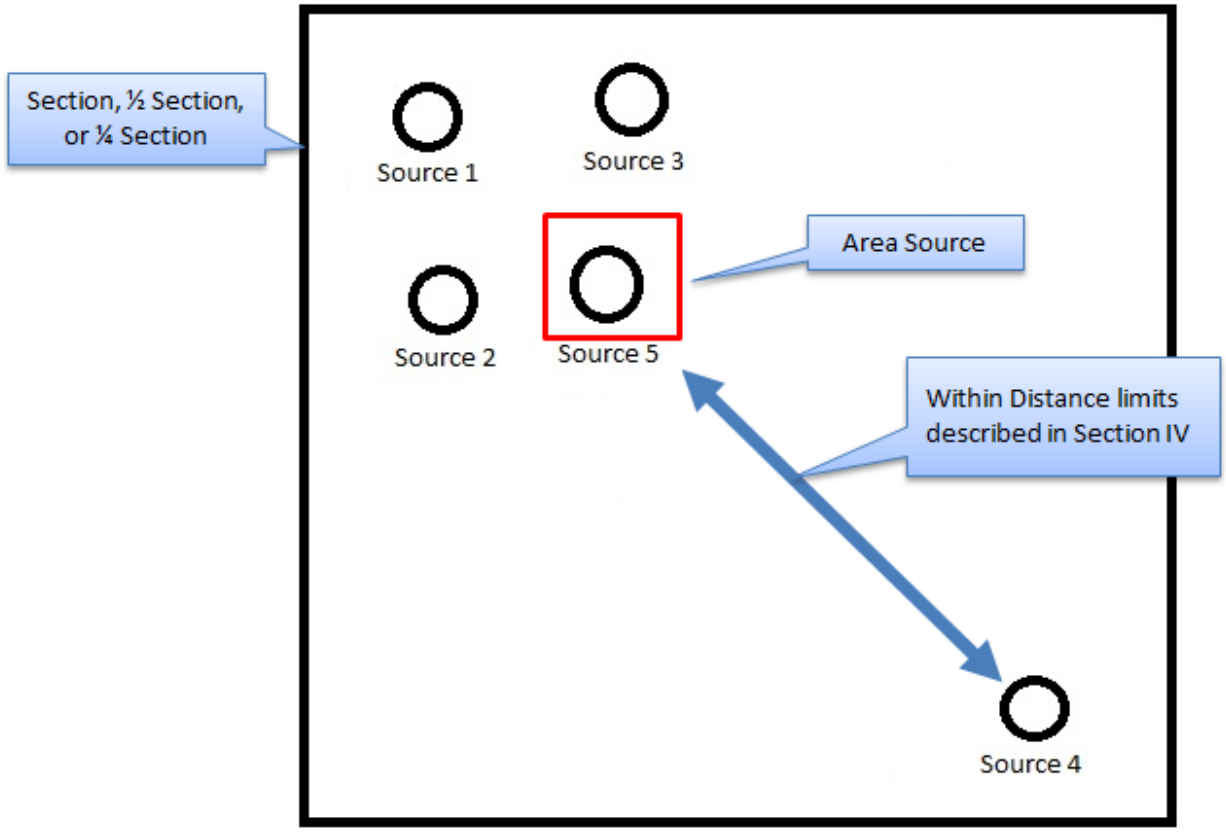

Figure 3. Location of an Aggregated Source for Non-Uniformly Distributed Sources

Example 3: Multiple clusters of the same source type within a Section, ¼ Section, or ¼ of a ¼ Section.

In Figure 4, there are two distinct clusters of sources within the same Section, ¼ Section, or ¼ of a ¼ Section. The two clusters have sources that are identical and have identical emissions, but fall outside the distance limitation(s) listed in Section IV. In this case each of the two clusters would not be combined into a single aggregated source, but would be separated into two distinct aggregated sources. This would ensure that emissions are not inadvertently located improperly. For this scenario, the aggregated sources would be placed similarly to what is shown below using the weighted mean center method.

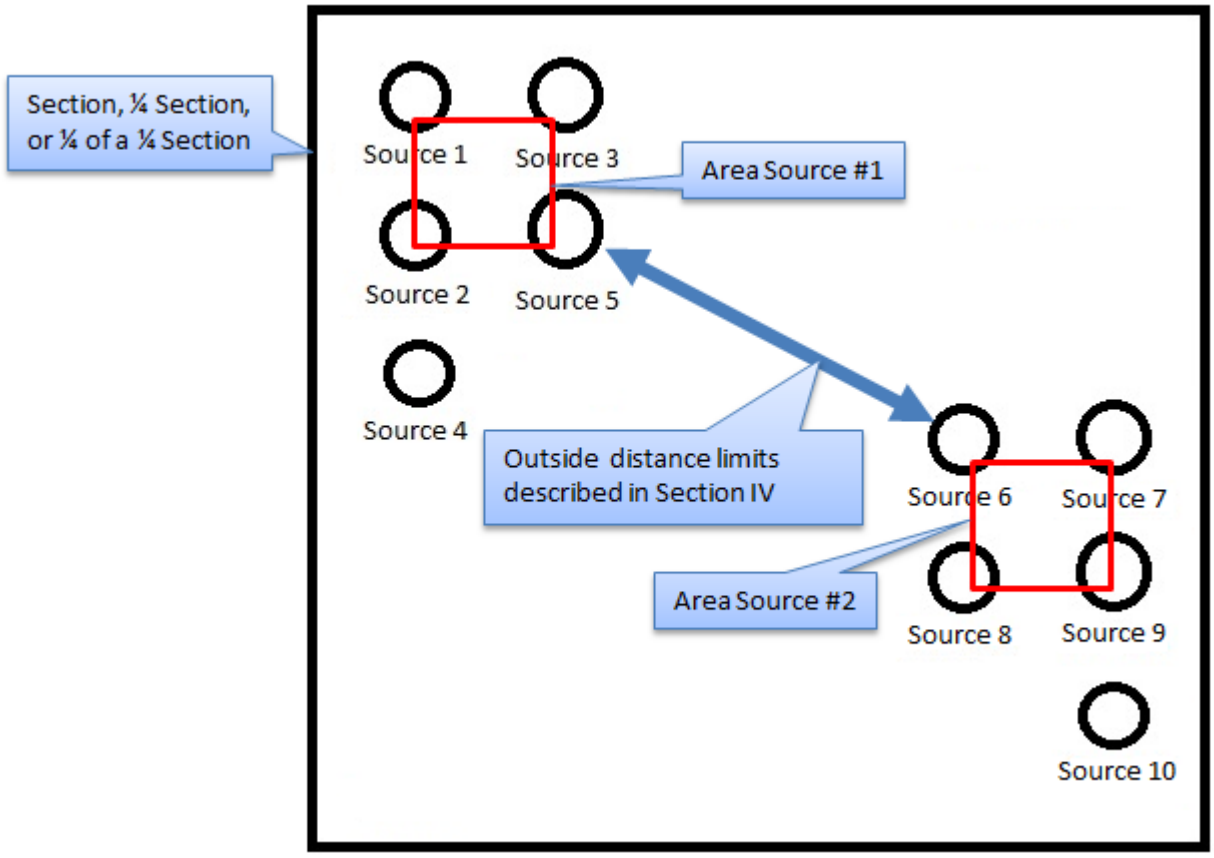

Figure 4. Multiple Clusters of Sources