Applied Method for Developing Polygon Boundaries for CARE Impacted Communities

Technical Memorandum
Bay Area Air Quality Management District
December 2009

This memorandum describes a methodology for identifying communities within the San Francisco Bay Area that are likely to face the highest health risks from toxic air contaminants (TAC). The methodology was developed through the Bay Area Air Quality Management District's (BAAQMD or District) Community Air Risk Evaluation (CARE) program. The methodology is based on identifying areas that (1) are close to or within areas of high TAC emissions, (2) have sensitive populations, defined as youth and seniors, with significant TAC exposures, and (3) have significant poverty.

Step 1 – Development of Datasets

TAC Emissions. Starting in 2006, the District developed gridded TAC emissions inventories (Reid et al. 2006, Reid 2008) for year 2005 on a one kilometer by one kilometer grid system for the entire Bay Area. TAC emissions estimates include more than 90 gaseous and particulate compounds (Reid et al. 2006) from stationary sources, such as power plants, refineries, back-up diesel generators, and gas stations, as well as both on- and off-road mobile sources, such as cars, trucks, construction equipment, locomotives, and ships.

Modeling Cancer Risk and Exposure of Sensitive Populations. In 2009, the District completed regional modeling of TAC concentrations using the gridded TAC emissions (Emery et al. 2008, Tanrikulu et al. 2009). The modeling yielded estimates of annual concentrations of five key compounds that collectively contributed more than 90 percent of the potential cancer risk from TAC emissions: diesel particulate matter, benzene, 1,3-butadiene, formaldehyde, and acetaldehyde. Like the emissions, the modeled concentrations approximated conditions in 2005 for each one kilometer grid cell. The concentrations for each compound were multiplied by the corresponding unit cancer risk factor for the compound, as established by the State's Office of Environmental Health Hazard Assessment (OEHHA) to assign an estimated excess cancer risk per million people from these compounds to each grid cell (Figure 1).

Sensitive populations from the 2000 U.S. Census database were identified as youth (under 18) and seniors (over 64) and mapped to the same one kilometer grid used for the toxics modeling. Excess cancers from TAC exposure were determined by multiplying these sensitive populations by the model-estimated excess risk to establish a data set representing sensitive populations with high TAC exposures.

<u>Poverty</u>. Block-group level household income data from the U.S. Census database were used to identify block groups with family incomes where more than 40% of the population was below 185% of the federal poverty level (FPL).

Step 2 – Mapping

1. The three datasets were mapped to a common projection and plotted together (Figure 2).
2. The top quartile of emissions was plotted as outlined grid cells.
3. The top two quartiles of sensitive population exposure data were plotted as shaded grid cells.
4. The poverty level data were plotted as shaded block-group polygons.

Step 3 – Identification of Impacted Communities

1. High exposure cells (top 50%) that are within one grid cell of a high emissions cell (top 25%) and that intersect high poverty level polygons were used to identify impacted areas.
2. Polygon boundaries (colored polygons in Figure 2) were constructed along major roads, highways, shorelines, or county boundaries that encompass nearby high exposure cells, high emission cells, and low income areas (as defined above).
3. Knowledge of local areas was used to make judgments in selecting bounding roadways.

Impacted Communities

This method identified the following six areas as impacted communities (Figure 3):

1. portions of the City of Concord;
2. western Contra Costa county, including portions of the Cities of Richmond and San Pablo;
3. western Alameda County along the Interstate-880 corridor, including portions of the Cities of Berkeley, Oakland, San Leandro, San Lorenzo, and Hayward;
4. portions of the City of San Jose;
5. eastern San Mateo County, including portions of the Cities of Redwood City and East Palo Alto; and
6. eastern portions of the City and County of San Francisco.

An electronic shapefile that can be used with geographical information systems software provides the polygon boundaries of the CARE impacted communities. This file is available on the Internet via anonymous ftp at ftp://ftp.baaqmd.gov/CARE/Impacted_communities_boundaries/impacted_boundaries.zip.

References

Bay Area Air Quality Management District (2006). *Community Air Risk Evaluation Program, Phase I Findings and Policy Recommendations Related to Toxic Air Contaminants in the San Francisco Bay Area.* San Francisco. September 2006. Available online: <http://www.baaqmd.gov/Divisions/Planning-and-Research/Planning-Programs-and-Initiatives/~/media/54D434A0EB8348B78A71C4DE32831544.ashx.> Accessed October 7, 2009.

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Reid, S.B. (2008) *Final documentation of the preparation of year-2005 emission inventories of toxic air contaminants for the San Francisco Bay Area.* Technical Memorandum prepared for the Bay Area Air Quality Management District, San Francisco, CA, by Sonoma Technology, Inc., Petaluma, CA, (Bay Area Air Quality Management District Contract No. 2006-019; STI-906020.08-3288). February 15, 2008.

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Legend:

Air Distric Boundaries	
Cancer Risk	
Expected number per million	
0 - 100	300 - 400
100 - 200	400 - 600
200 - 300	600 - 800
	800 - 1000
	1000 - 1200
	> 1200
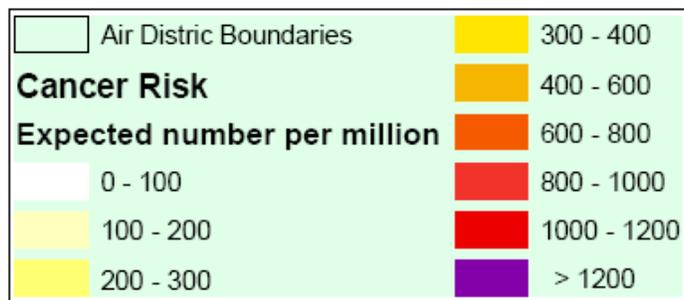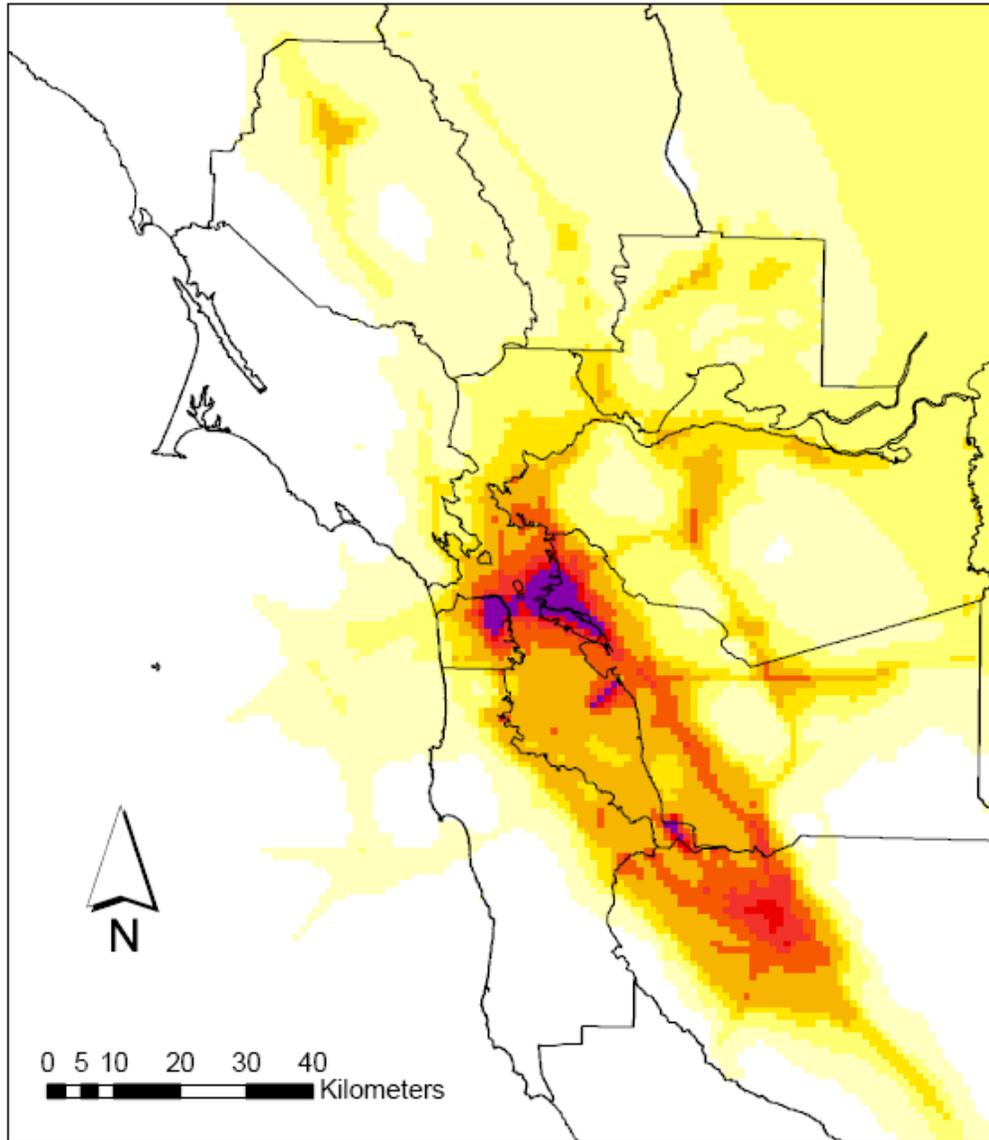
Figure 1. Model-estimated excess cancer risk in 2005 from inhalation of diesel particulate matter, benzene, 1,3-butadiene, formaldehyde, and acetaldehyde in the Bay Area, assuming a 70-year lifetime exposure.
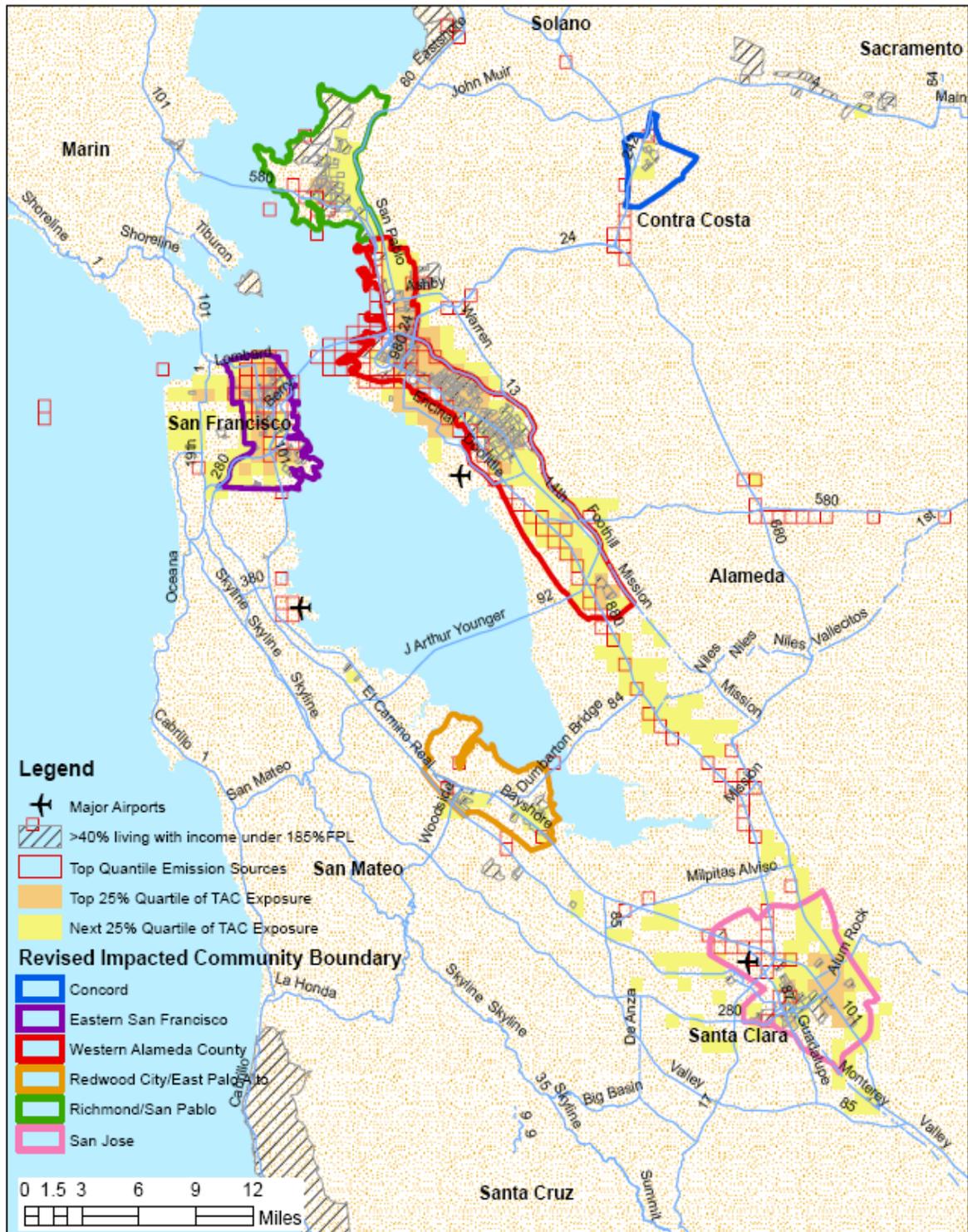
Figure 2. Boundaries of impacted communities based on emissions, poverty level, and exposure of sensitive populations in Bay Area counties in 2005 to toxic air contaminants. Sensitive population includes people under the age of 18 and over 64. Toxic air contaminants include diesel PM, benzene, 1,3-butadiene, formaldehyde, and acetaldehyde.
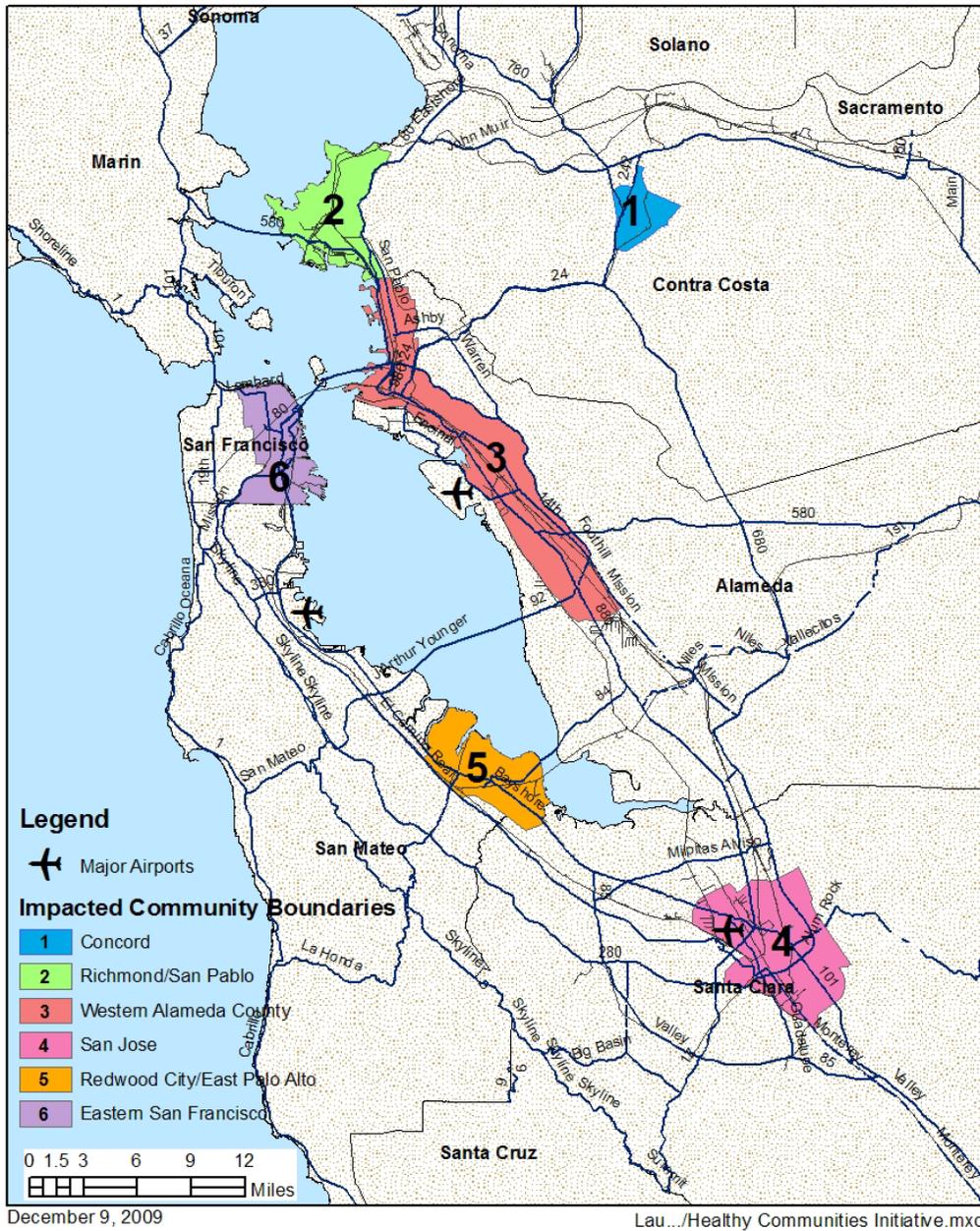
Figure 3. Impacted Community Boundaries.