Guidance Document for the Mobile Sources Air Toxics Protocol

V1

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Sacramento Metropolitan Air Quality Management District

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1. Purpose and Need

Freeways, high volume roadways, and railways within Sacramento County are sources of toxic air contaminant (TAC) emissions. TACs, as defined by the California Health and Safety Code Section 39655, are "air pollutants which may cause or contribute to an increase in mortality or serious illness, or which may pose a present or potential hazard to human health known to cause cancer or other human health impacts."[1]

Traditionally, these risks were analyzed and disclosed through the environmental review process as prescribed by the California Environmental Quality Act (CEQA). However, following the California Supreme Court decision *California Building Industry Association v. Bay Area Air Quality Management District*[2], the court held that CEQA does not require the analysis or mitigation of health impacts from existing sources or environmental conditions on a project's future users or residents, unless required by existing law. However, local governments do have the authority to consider TACs impact on health through their police powers to protect the general welfare of their communities.[3,4]

The Sacramento Metropolitan Air Quality Management District (Sac Metro Air District) recommends that lead agencies analyze TACs where proposed developments may expose receptors to existing sources, and that exposure reduction measures be considered and applied as appropriate. To assist in these efforts, the Sac Metro Air District developed the Mobile Sources Air Toxics Protocol (MSAT Protocol), which encompasses the following:

- The Mapping Tool which discloses localized health risks
- This Guidance document which discusses how to use and understand the Mapping Tool
- The appended Sac Metro Air District board-adopted Methodology which explains how the concentrations and risks were calculated
- Suggested exposure reduction measures and resources which propose interventions lead agencies, developers, business owners and residents can take to reduce risk

The MSAT Protocol includes health risk data from TAC exposures from Interstate 5; Interstate 80; Interstate 80 Business; US Highway 50; State Route 99; and segments of State Route 160, Sunrise Boulevard, Watt Avenue and Hazel Avenue that exceed 100,000 Average Daily Traffic; and all railways in Sacramento County except for the SSRR and SVRR subdivisions. The Mapping tool does not include stationary sources, all other roads, and existing background risk.

2. Emissions Analyzed

The TACs of concern from railway and roadway sources are diesel particulate matter (DPM), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) and total organic gases (TOG). Locomotive exhaust contains DPM and $PM_{2.5}$. Heavy duty truck or light duty diesel exhaust contains DPM. TOG emissions result from gasoline vehicle exhaust and fuel evaporation. $PM_{2.5}$ emissions result from roadway dust, brake wear, tire wear, and engine exhaust.

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[1] California Health and Safety Code. 1992. Article 2. Definitions. http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=39655.

[2] BIA v BAAQMD (2015) 62 Cal. 4th 369

[3] California Constitution, Article XI, Section 7 https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=CONS&sectionNum=SEC.%207.&article=XI

[4] Pleasant Hill Bayshore Disposal, Inc. v. Chip-It Recycling, Inc. (2001) 91 Cal.App.4th 678, 689.

Diesel engine exhaust is a complex mixture of hundreds of individual constituents, including small carbon particulate matter (i.e. DPM) coated with inorganic and organic substances.[5] DPM was identified by the State of California as a known carcinogen in 1998, and the National Toxicology Program, the National Institute of Occupational Safety and Health, and the U.S. Environmental Protection Agency (USEPA) have also concluded that diesel exhaust is carcinogenic.[6]

Under California regulatory guidelines,[7, 8] DPM is used as a surrogate measure of exposure for the mixture of chemicals that make up diesel exhaust as a whole. Cal/EPA and others that use this surrogate approach indicate that it is preferable to a component-based approach. A component-based approach estimates risks for each of the individual components of a mixture. This may underestimate the risks associated with diesel exhaust as a whole, since there may be additional harmful chemicals in the mixture that the scientific studies have not yet identified. Furthermore, Cal/EPA has concluded that "potential cancer risk from inhalation exposure to whole diesel exhaust will outweigh the multi-pathway [e.g., oral or dermal] cancer risk from the speciated components"[9]. Thus, the Mapping Tool uses DPM as a surrogate for exposure to total diesel exhaust to estimate cancer risk impacts from roadway and railway sources. Conservatively, all particulate matter less than 10 microns in diameter (PM_{10}) emitted from locomotives and diesel-fueled on-road vehicles is treated as DPM.

$PM_{2.5}$ is one of six US/EPA "criteria" pollutants considered harmful to public health and the environment. A safe threshold for $PM_{2.5}$ has not been established and research indicates that health effects still exist at low concentrations.[10] In 2009, the US/EPA concluded that for both short-term and long-term exposure-there is a causal relationship between $PM_{2.5}$ concentrations and cardiovascular effects and mortality, and, a likely causal relationship between $PM_{2.5}$ concentrations and respiratory effects.[11] In addition, the US/EPA concluded that there is a suggestive relationship between long-term exposure to $PM_{2.5}$ and cancer, mutagenicity, genotoxicity, and reproductive and developmental health impacts. Therefore, the Mapping Tool estimates $PM_{2.5}$ concentrations from railway and roadway sources.

TOG emissions from gasoline vehicle tailpipe emissions and evaporative losses are composed of a number of toxic components such as benzene, naphthalene and acetaldehyde. Unlike DPM, no surrogate method is currently approved to estimate health impacts from TOG as a whole. Thus, TOG impacts must be calculated using a component based method. Total TOG emissions from roadways are split into individual toxic components using the Bay Area Air Quality Management District's

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[5] California Air Resources Board (ARB). "Initial Statement of Reasons for Rulemaking. Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant." 1998.

[6] California Air Resources Board (ARB). "Summary: Diesel Particulate Matter Health Impacts." 2016. https://ww2.arb.ca.gov/resources/summary-diesel-particulate-matter-health-impacts.

[7] California Air Resources Board (ARB). "Initial Statement of Reasons for Rulemaking. Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant". 1998.

[8] Cal/EPA. Office of Environmental Health Hazard Assessment. "Air Toxics Hot Spots Program Risk Assessment Guidelines: Part II Technical Support Document for Describing Available Cancer Potency Factors". 2009.

[9] Cal/EPA. "The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. Office of Environmental Health Hazard Assessment". 2003.

[10] BAAQMD. "Understanding Particulate Matter: Protecting Public Health in the San Francisco Bay Area". 2012. http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/Plans/PM%20Planning/ParticulatesMatter_Nov%207.ashx?la=en.

[11] United States Environmental Protection Agency (US/EPA). "Integrated Science Assessment for Particulate Matter". EPA/600/R-08/139F. 2009.

recommended gasoline speciation.[12] Cancer risks from each of these toxic components are summed together to estimate TOG cancer risk from roadway sources.

2.1. Appropriate Use

To ensure the information in the MSAT Protocol and its Mapping Tool is used only for appropriate applications, below is a summary of what it is designed for and what the data represents.

What It Is

The MSAT Protocol is designed to assist lead agencies, land use jurisdictions and other interested parties in making land-use siting and design decisions near major roadways and railways within Sacramento County. The Mapping Tool includes Interstate 5; Interstate 80; Interstate 80 Business; US Highway 50; State Route 99; and segments of State Route 160, Sunrise Boulevard, Watt Avenue and Hazel Avenue. It also includes most commercial railway tracks within and immediately adjacent to the County. The tracks are split up into rail subdivisions based on Caltrans' California Rail Network GIS data[13]. Each rail subdivision is assigned an abbreviation for labelling in the Mapping Tool consistent with the naming scheme shown in the Rail Subdivision table. For modeling purposes, most subdivisions are further segmented into sections of track with the same train volumes, each of which is given a suffix (A, B, C, etc.). (Short or less frequently traveled subdivisions did not need to be segmented.) The health impacts estimated from the roadways and railways in the Mapping Tool incorporate data on existing traffic and train volumes, except for the SVRR and SSRR subdivisions, where we were not able to obtain the data necessary for modeling.

Label	Rail Subdivision
CTC	Central California Traction
FRES	Fresno
IONE	Ione Industrial Lead
JOIN	join between Wye 1 and Wye 2
MART	Martinez
PLAC	Placerville Industrial Lead
POLK	Polk Industrial Lead
SACR	Sacramento
SNRR	Sierra Northern Railroad
SSRR	Sacramento Southern Railroad (no data)
STOC	Stockton
SVRR	Sacramento Valley Railroad (no data)
WYE1	link between Sacramento and Martinez
WYE2	link between Martinez and Sacramento
WYE3	link between Martinez and Fresno
WYE4	link between Fresno and Martinez

Cancer risk (from TOG and DPM exposure) and $PM_{2.5}$ concentrations from the modeled roadway and railway emissions are estimated at 20 meter gridded intervals out to 2 kilometers away from the modeled railway or roadway sources.

The cancer risk and $PM_{2.5}$ concentration estimates are driven by the modeled roadway and railway traffic volumes, speeds, future technological emission reduction advancements[14], and modeled dispersion of emissions (impacted by terrain and meteorological conditions[15]). Locomotive and roadway traffic emissions are based on current emission factors from the Vision 2.0 Locomotive Inventory and ARB's California EMission

[12] BAAQMD. "Recommended Methods for Screening and Modeling Local Risks and Hazards". 2011.

[13] California Department of Transportation. "Caltrans GIS Data – California Rail Network". 2013. http://www.dot.ca.gov/hq/tsip/gis/datalibrary/Metadata/Rail_13.html

[14] Locomotive and on-road vehicle fleet emission reduction advancements are reflected in the emission factor databases used in this analysis (VISION 2.0 Locomotive Inventory and ARB's California Emission FACtor 2014 database). See the technical appendix to this MSAT Protocol document for more details.

[15] For more details on the air dispersion modeling conducted, please see the technical appendix. Terrain elevation data comes from the National Elevation Dataset (NED) maintained by the United States Geological Survey. Rural land use is conservatively assumed for all modeling. Surface and upper air meteorological data come from the Sacramento Executive Airport for years 2011 through 2015.

FACtor (EMFAC) 2014 database, respectively. Cancer risks were calculated consistent with residential exposure assumptions from the 2015 Office of Environmental Health Hazard Assessment risk assessment guidelines (see Section 4.1 for more discussion of cancer risk).[16] Sac Metro Air District staff will update the cancer risk and $PM_{2.5}$ estimates in the Mapping Tool as new input data become available, approximately once a year. For a more detailed discussion of the technical methodology, see the Technical Appendix.

What It Isn't

To prevent improper understanding or misuse of the data, discussion of potentially inappropriate applications or interpretations of the MSAT Protocol and its Mapping Tool are presented below.

Mapping Tool Limitations

The Mapping Tool estimates increased cancer risk and $PM_{2.5}$ concentrations from the modeled roadway and railway TAC emissions. Thus, it does not include or represent regional background risk[17]; the risk values presented are in addition to existing background levels. Also, it does not estimate any other health effects that could result from emissions from these sources (for example, heart disease and asthma). The modeling does not take into account the beneficial effects of sound walls, vegetation, existing buildings or features that may affect pollutant dispersion and reduce exposure, such as building filtration or the simple effect of being indoors. The cancer risk estimates, while conservative for the general population, do not take into account singular characteristics that make individuals more susceptible to pollution health effects. For example, individuals with heart disease or other chronic conditions, or other factors related to individual health status may affect their susceptibility to developing cancer. With respect to rail, the locomotive emission data is based on the average locomotive in the air basin, so potential variations among individual locomotives traveling on a subdivision may be more or less.

Inappropriate Applications/Interpretations

The MSAT Protocol and Mapping Tool was designed specifically to assist interested parties in making land-use siting and design decisions on sites located near Interstates 5 and 80, Interstate 80 Business, State Routes 50 and 99, along with sections of State Route 160, Hazel Avenue, Sunrise Boulevard and Watt Avenue, and all commercial tracks within and immediately adjacent to the county except SSRR and SVRR, for which there is no data available. Any other application of the data may not be consistent with the methods used to establish the MSAT Protocol and its Mapping Tool. For example, it should not be used to identify environmental justice areas or to direct funding decisions based on how communities may be impacted.

The Mapping Tool estimates cancer risk by conservatively assuming all exposed individuals are "residents," as defined by the California Environmental Protection Agency (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) guidance (see Section 4.1 for more details). This assumption, combined with a number of additional conservative assumptions made in calculating TAC emissions, means that the cancer risk and $PM_{2.5}$ concentration estimates are health protective with the goal of avoiding underestimation of risk to the public.

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[16] Cal/EPA. "OEHHA/ARB Consolidated Table of Approved Risk Assessment Health Values". 2018. http://www.arb.ca.gov/toxics/healthval/contable.pdf

[17] Air Resources Board and California Air Pollution Control Officers Association. "Risk Management Guidance for Stationary Sources of Air Toxics". 2015. http://www.capcoa.org/wp-content/uploads/2016/04/Risk%20Management%20Guidance%20for%20Stationary%20Sources%20of%20Air%20Toxics%207.23.2015.pdf

The Mapping Tool does not provide the expected rate of disease in the exposed population, but rather an estimate of potential for disease based on current knowledge and conservative assumptions.

Risks and $PM_{2.5}$ concentrations are calculated out to 2 km away from the modeled railway and roadway sources. This should not be construed to mean that there is no cancer risk or $PM_{2.5}$ concentration from the roadway or railway beyond 2 km. Similarly, only portions of Sunrise Boulevard, Watt Avenue and Hazel Avenue that exceed 100k ADT within the County are included. This does not suggest that other roadways with less traffic have no associated health risks. Additionally, when a roadway in the Mapping Tool reaches its modeled endpoint (e.g. the model assumes that Sunrise Boulevard terminates at the American River crossing due to traffic volume drop-off), it does not imply that health risks taper off after the modeled terminus of the roadway. This drop in health risk impacts is due our limiting the roadway length in the dispersion model, and may not accurately reflect impacts at these locations. As such, impacts at Sunrise Boulevard, Watt Avenue and Hazel Avenue less than 2 km from the terminus of the modeled roadway source may require additional analysis.

2.2. User Instructions

General Mapping Tool Instructions

When you first open the Mapping Tool, you will be greeted with a zoomed-out view of Sacramento County. Some general instructions are given in the blue box at the top of the webpage.

First, navigate to your location of interest using either your mouse to drag and zoom in, or the navigation tools located in the top left hand corner of the map. Once you find the location of interest, you can display health risk results simply by clicking the mouse at the location. Health risks are only calculated at locations within the 2km radius of a modeled source, indicated by the gray buffer zones surrounding the roadway and railway sources in Sacramento County. To most accurately identify your location, zoom in on the map until you see a grid of points or “receptors.” These are the points at which health risks are calculated in the model. Select the receptor nearest to your location of interest for the most accurate results.

When you click the mouse and once the data are successfully loaded, which may take a few seconds, a figure will pop up on the right hand side of the map. Reading the results table from left to right, the figure shows the pollutants as “Health Risk Variable” (PM10, PM2.5, and TOG), and the resulting Estimated Value, for which DPM and TOG are expressed, in per million cancer risk. The results shown in this figure represent total impacts for each pollutant from the modeled roadway and railway sources impacting your location of interest. Total increased risk for the receptor can be attained by summing the risk for DPM with TOG.

Other Mapping Tool Capabilities

There are two toggle buttons on the top left of the map that control which source types are displayed on the map. Use these toggle buttons to override the default display and selectively display whether the modeled roadways or railways are displayed on the map. If the toggle button is highlighted in green, that source type is displayed on the map. Conversely, if the toggle button is greyed out, that source type is not presented.

3. Understanding Health Impacts

As mentioned previously, the Mapping Tool estimates health risk impacts from the modeled roadway and railway TAC emissions. The health impacts are estimated for 1) increased cancer risk, and 2) exposure to $PM_{2.5}$ concentration because they reflect current knowledge about the human health effects of the specific TACs of concern from these sources (DPM, TOG and $PM_{2.5}$).

3.1. Cancer Risk

The cancer risk health impacts estimated in Mapping Tool are a conservative upper-bound estimate of the increased probability that an individual will develop cancer over a lifetime as a direct result of exposure to the carcinogens (DPM and TOG). The estimated risk is expressed as a probability of developing cancer per million people. The risks are calculated consistent with the most recent Air Toxics Hot Spots Program Risk Assessment Guidelines[18] released by California Environmental Protection Agency (Cal/EPA), Office of Environmental Health Hazard Assessment (OEHHA). A discussion of the new guidance's impact on cancer risk calculations compared to previous methodologies can be found below.

Cancer risk is calculated by multiplying the human chemical intake or dose by the chemical-specific cancer potency factor (CPF).

Chemical Intake

The chemical intake estimate for airborne chemicals is a function of the concentration of a chemical in the air and the human air intake rate. Chemical concentrations in the air are estimated by conducting air dispersion modeling of emissions from the roadway and railway sources, and the human intake is estimated using OEHHA residential exposure factors.

Chemical-Specific Cancer Potency Factor (CPF)

The chemical-specific cancer potency factors (CPFs) characterize the relationship between the magnitude of exposure (i.e. chemical intake) and the magnitude of adverse health effects. The CPFs are based on the Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values.[19] For mathematical details of the cancer risk calculations, please see the technical appendix.

2015 OEHHA Guidance

Cancer risks were calculated based on the most recent (2015) Air Toxics Hot Spots Program Risk Assessment Guidelines. The guidance includes updated breathing rates, which are significantly higher than the previous guidance for ages 16 and under. Additionally, the new guidance estimates excess lifetime cancer risks using age sensitivity factors (ASFs). This approach accounts for the "anticipated special sensitivity to carcinogens" of infants and children. Cancer risk estimates are weighted by a factor of ten for exposures that occur from the third trimester of pregnancy to two years of age and by a factor of three for exposures that occur from two years through 15 years of age. No weighting factor (i.e., an ASF of one, which is equivalent to no adjustment) is applied to ages 16 and above. These updates to cancer risk calculations in the new guidance generally yield cancer risks 2-3 times higher than health risk assessments conducted under the pre-2015 Guidelines.

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[18] Cal/EPA, Office of Environmental Health Hazard Assessment. "Air Toxics Hot Spots Program Risk Assessment Guidelines" 2015. https://oehha.ca.gov/media/downloads/crnr/2015guidancemanual.pdf.

[19] California Air Resources Board (ARB). "Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values" 2017. https://www.arb.ca.gov/toxics/healthval/healthval.htm.

3.2. $PM_{2.5}$ Concentration

As outlined in Section 1 of the MSAT Protocol, $PM_{2.5}$ concentrations have been shown to be harmful to public health. $PM_{2.5}$ is regulated both on the state and federal level, and has an annual average ambient air quality standard of 12 µg/m^3 in California.[20] However, no safe threshold for exposure to $PM_{2.5}$ has yet been established. Epidemiological studies have shown that even $PM_{2.5}$ exposure below the current standards could cause health effects.[21]

Due to the complexity of $PM_{2.5}$, no toxicity values are currently approved for health risk calculation purposes by OEHHA. Thus, $PM_{2.5}$ health impacts cannot be calculated. Instead, consistent with CEQA guidelines in many California Air Districts, $PM_{2.5}$ impacts are typically reported simply as a concentration in µg/m^3. Thus, the Mapping Tool presents $PM_{2.5}$ impacts from roadway and railway emissions as a concentration.

3.3. Interpreting Health Risks

The Sac Metro Air District does not recommend any health risk or concentration-based thresholds for use with the MSAT Protocol. Instead, Sac Metro Air District defers to the local jurisdiction to determine appropriate risk levels for intervention.

For reference, below are some relevant thresholds for cumulative impacts for various agencies:

- The Bay Area Air Quality Management District (BAAQMD) suggests a cumulative cancer risk threshold of 100 in a million from all local sources, and a cumulative $PM_{2.5}$ threshold of 0.8 µg/m^3.
- San Joaquin Valley Air Pollution Control District (SJVAPCD) has a CEQA threshold of 20 in a million for both cumulative and project specific impacts. Additionally, SJVAPCD considers any $PM_{2.5}$ concentration above the California Ambient Air Quality Standard to be a significant impact.[22]
- The California Air Resources Board Air Quality and Land Use Handbook (ARB Handbook) recommends not siting new sensitive land uses within 500 feet of urban roads with 100,000 or more vehicles/day. This is based on health risk studies and modeling that showed risks as high as 100 in a million at 300 ft downwind of a freeway. Additionally, the ARB recommends not siting new receptors within 1,000 ft of a major service and maintenance rail yard due to estimated risks of 500 in a million.[23] *Please note that the ARB Handbook was based on OEHHA guidance that has since been superseded, so is not directly comparable to the methodology and results found in the MSAT Protocol and its Mapping Tool.*

4. Exposure Reduction Measures

In accordance with the ARB Handbook, Sac Metro Air District recommends the consideration of exposure reduction measures for any project proposed within 500 feet of a freeway or major roadway in order to minimize pollutant exposure. Jurisdictions and developers may wish to consider exposure reduction measures beyond 500 feet. Potential exposure reduction measures include city scape/urban

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[20] Cal/EPA. "Particulate Matter – Overview". 2005. https://www.arb.ca.gov/research/aaqs/caaqs/pm/pm.htm.

[21] BAAQMD. "Understanding Particulate Matter: Protecting Public Health in the San Francisco Bay Area". 2012. http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/Plans/PM%20Planning/ParticulatesMatter_Nov%207.ashx.

[22] SJVAPCD. "CEQA Thresholds of Significance". http://www.valleyair.org/transportation/ceqa_idx.htm.

[23] California Air Resources Board (ARB). "Air Quality and Land Use Handbook". 2005. https://www.arb.ca.gov/ch/handbook.pdf.

design dispersion techniques, solid barrier dispersion techniques, vegetative barrier dispersion techniques, and indoor high efficiency filtration and air cleaning. These measures are outlined below.

a. Urban Design Dispersion Techniques

Urban design characteristics can impact pollutant dispersion, concentration, and exposure.[24] Air flow and pollutant movement are influenced by the physical layout of urban streetscapes. These parameters include building geometry, street canyon dimensions, architectural design, and building location. Pollutant dispersion and air quality can be improved when urban streetscapes have buildings with varying shapes and heights, building articulation (design elements such as edges and corners), and open spaces such as parks. Adding wider sidewalks, bike lanes, and dedicated transit lanes creates additional space which allows for more dispersion and therefore fewer concentrated emissions. More information can be found here: https://www.arb.ca.gov/ch/rd_technical_analysis_fact_sheet.pdf.

b. Solid Barrier Dispersion Techniques

Studies have found that solid barriers (such as sound walls) increase the vertical dimension of vehicle emissions and consequently reduce downwind concentrations near roadways.[24] Reductions range from 10% to 50%. These reductions have been confirmed in field measurements, wind tunnel studies, and modeling exercises.[22] More information can be found here: https://www.arb.ca.gov/ch/rd_technical_analysis_fact_sheet.pdf.

c. Vegetative Barrier Dispersion Techniques

Plants and trees can also be used as a barrier to reduce pollutant concentrations by altering pollutant transport and dispersion.[24] In 2016, the US/EPA summarized current research results and best practices for using vegetation barriers near roadways to improve air quality.[25] Sac Metro Air District developed the document *Landscaping Guidance for Improving Air Quality near Roadways* to provide direction specific to the Sacramento area.[26] It offers direction on evaluating a potential vegetation barrier site; gives vegetation planning recommendations appropriate to the Sacramento region to meet height, thickness and porosity goals; provides a recommended plant species list; addresses planting best practices; and offers suggestions for effective long term maintenance.

d. Indoor High Efficiency Filtration/Air Cleaning

High-efficiency filtration systems with mechanical ventilation or portable high efficiency air cleaners can reduce indoor air pollution. Particulate concentrations can be reduced by 50 to 99 percent with high-efficiency filtration systems and 30 to 90 percent with portable high efficiency air cleaners, but effectiveness for VOCs is variable. The Minimum Efficiency Reporting Value (MERV) rating system developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) is used to rate most filters based on their particle removal efficiency. There is no recognized standard for rating the gaseous or chemical vapor removal rate of filters. The MERV ratings range from 1 (low) to 20 (high). Each MERV rating corresponds to a different removal efficiency for specific particle size ranges (0.3 to 1.0

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[24] California Air Resources Board (ARB). “Technical Advisory: Strategies to Reduce Air Pollution Exposure Near High-Volume Roadways”. 2017.

[25] US/EPA. “Recommendations for Constructing Roadside Vegetation Barriers to Improve Near-Road Air Quality”. 2016.

[26] SMAQMD. “Landscaping Guidance for Improving Air Quality near Roadways”. 2017.

microns, 1.0 to 3.0 microns, and 3.0 to 10.0 microns). MERV ratings of 1 to 4 indicate less than 20% removal efficiency for particles between 3.0 and 10.0 microns, whereas a MERV rating of 19 or 20 indicates a removal efficiency of greater than or equal to 99.999% for particles between 0.3 and 10.0 microns. In general, as the MERV rating increases, the power required to pump air through the filtration system also increases. More information: https://www.arb.ca.gov/research/indoor/acdsumm.pdf.

Please contact Rachel DuBose of Sac Metro Air District if you have questions about this document at rdubose@airquality.org or (916) 874 – 4876.