Appendix E: Air Quality Analysis Methodology

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Local Pollutant Methodology

To estimate and evaluate potential health risks due to increased toxic air contaminant (TAC) and fine particulate matter ($PM_{2.5}$) concentrations throughout the Transit Priority Project (TPP) areas[1], a geospatial analysis was designed and conducted using ArcGIS software and health risk data on stationary and mobile sources of TAC and/or $PM_{2.5}$ emissions. The health risk data was derived from the Bay Area Air Quality Management District (BAAQMD). Stationary sources of pollution in the Bay Area are required to obtain annual permits to operate from BAAQMD; accordingly, BAAQMD maintains a database which houses the geographic location of every permitted stationary source in the Bay Area and associated emissions information. In addition, BAAQMD estimated the health risks associated with exposure to mobile sources of TACs and/or $PM_{2.5}$ including major roadways, freeways, railroads and rail stations, and ferry terminals. This information is integrated into the geospatial analysis. Additional information on the methodology used by BAAQMD to estimate potential health risks from the various stationary and mobile sources of TAC's and/or $PM_{2.5}$ is detailed below.

The potential health risks due to increased TAC and/or $PM_{2.5}$ concentrations within the TPP areas are assessed cumulatively. The geospatial analysis was conducted using a 20 meter by 20 meter receptor grid. The maximum potential health risks for each cell in the receptor grid were estimated by summing all TAC's and or $PM_{2.5}$ concentrations from all sources, both mobile and stationary, which were present in any given cell. The final result from the geospatial analysis identifies areas where the cumulative cancer risk and $PM_{2.5}$ concentrations of the data sets exceed MTC's air quality significance thresholds for TACs and $PM_{2.5}$. Additional information on the geospatial analysis is detailed below.

STATIONARY SOURCES

BAAQMD developed a geographical database of estimated cancer risks and $PM_{2.5}$ concentrations for stationary sources permitted by BAAQMD in the year 2008. Using emissions data specific to each stationary source, BAAQMD calculated screening-level cancer risks (referred to as screening values) using health effect values adopted by the Office of Environmental Health Hazard Assessment

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[1] The geospatial analysis also included a 1,000 foot "area of influence" around the TPP areas. The area of influence is defined as the areas containing sources of TAC and/or PM2.5 that should be evaluated in relation to the TPP areas. Including the area of influence ensures that the geospatial analysis conducted to evaluate cumulative health risks takes into account sources of pollution *outside* of the TPP areas that may, however, impact the TPP areas themselves. In this document, the term "TPP areas" refers to both the TPP areas as defined by the Sustainable Communities Strategy for the Bay Area, as well as the 1,000 foot area of influence.

(OEHHA); health protective assumptions relating to the extent of an individual's exposure, including age sensitive factors; and a conservative modeling procedure to establish the extent to which a TAC is dispersed in the atmosphere after its release from the source. For permitted sources which emit $PM_{2.5}$, the screening-level health risk and $PM_{2.5}$ concentrations (referred to as screening values) are based on the same screening-level dispersion modeling procedure that was used to develop the trigger levels in BAAQMD's Regulation 2, Rule 5, Table 2-5-1, Toxic Air Contaminant Trigger Levels. For more specific information on the methodology used to estimate cancer risks and $PM_{2.5}$ concentrations from stationary sources, refer to BAAQMD's "Recommended Methods for Screening and Modeling Local Risks and Hazards" document[2]. The estimated health risk screening values represent cancer risks and concentrations near the fence-line of the plant. The database was initially created to provide jurisdictions and interested stakeholders with information on BAAQMD's stationary sources for land use planning and environmental review documents. The screening values are intentionally conservative and are based upon worst-case assumptions and are not intended to be used to assess the actual health risk for all land development projects, but rather are intended to be used at the screening level. The database can be downloaded from BAAQMD's website[3] and viewed in Google Earth (free) or ArcGIS.

For the purpose of the local pollutant analysis, BAAQMD staff updated and refined the database's stationary source data. Select screening values in the database were updated in 2012 with BAAQMD's most current emissions inventory data. Other refinements to the stationary source data include:

- Removing listings for facilities closed since 2008;
- Assessing and correcting the geographic location of stationary sources;
- General assumptions on estimated health risks for spray booth facilities; and
- Including decay factors for gas stations, diesel engines, and dry cleaners to reflect decreasing cancer risk and $PM_{2.5}$ values based on distance from the source.

For a select few stationary sources, BAAQMD staff conducted health risk assessments (HRSA) which include estimates of increased cancer risk derived from air dispersion modeling of the emissions at the facility as part of BAAQMD's permit requirements. These HRSA's conducted by BAAQMD staff represent the best available increased cancer risk values associated with the stationary source. When available, these site-specific cancer risks and $PM_{2.5}$ concentrations for stationary sources are included in both the database and in the local pollutant analysis.

Closed Stationary Sources: BAAQMD maintains permit records that are updated annually. Over time, some facilities close, or are transferred to a different plant number. BAAQMD staff reviewed BAAQMD permit records to identify any facilities that may have closed since 2008 located in the TPP areas. Any updates for closed, transferred, or changed plant numbers are reflected in the local pollutant analysis.

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[2] Available at http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Risk%20Modeling%20Approach%20May%202012.ashx?la=en

[3] Available at http://www.baaqmd.gov/Divisions/Planning-and-Research/CEQA-GUIDELINES/Tools-and-Methodology.aspx

Geographic Location of Stationary Sources: The geographic location of stationary sources in the database is based on information from BAAQMD permit records. The location is expressed in Universal Transverse Mercador (UTM) coordinates, and typically represents the coordinate location of each permitted source. However, the coordinates were collected over many years, and were sometimes recorded in different datums (a set of reference points on the Earth's surface against which position measurements are made). Due to the difference in datums used over several years, the geographic representation of the stationary source is inaccurate in some cases. To address this issue, BAAQMD staff geocoded (process of finding associated geographic coordinates, typically expressed in latitude and longitude, from other geographic data such as street addresses or zip codes) stationary source facility addresses using ArcGIS 10.1. The geocoded locations represent a facility's address and not the actual location of where a source, such as a boiler or exhaust vent, is located within the facility. Corrected locations of stationary sources are included in the local pollutant analysis. BAAQMD staff manually moved (using Google Earth) the location of permitted stationary sources which do not have a "true" address in BAAQMD permit files (for example: intersection of x road, y drive; or San Francisco International Airport) to the correct geographic location, and recorded the coordinates provided by Google Earth.

Spray Booths: Due to limited permit data on a number of facilities which operate spray booths, BAAQMD staff estimated cancer risk and $PM_{2.5}$ concentrations (for the facilities with limited data) based on health risk trends from existing permitted spray booths for which BAAQMD did have emissions and estimated health risk information from permits. BAAQMD staff assigned the most conservative (highest) health risk screening values to the spray booth facilities with limited permit data from the trends observed from all permitted spray booth facilities in the Bay Area. In general, spray booth facilities do not represent significant health risks to nearby sensitive receptors.

Decay Factors: Decay factors are included in the local pollutant analysis for gas stations, diesel engines, and dry cleaners to reflect the fact that cancer risks and $PM_{2.5}$ concentrations decrease with distance from a source. The further away a sensitive receptor is from a source, the less exposure they will experience. For all other source categories, it is conservatively assumed that the screening values remain constant from the fence line of the facility out to 1,000 feet in every direction. Decay factors were not developed for other types of facilities, because the majority of other permitted facilities (except gas stations, dry cleaners and diesel engines) contain a variety of different source types which makes it infeasible to provide a decay factor with the acceptable degree of accuracy because it would require too many generic assumptions. For example, hospitals (a common permitted facility) may contain diesel engines, boilers, chemical sterilization equipment, and more. Recycling and waste management facilities are common in the Bay Area as well, and include a variety of permitted source types such as material handling, incinerating, and more.

Diesel engines: To develop the decay factors for stationary back-up diesel engines, BAAQMD staff analyzed thousands of health risk values determined from over 150 air dispersion modeling runs. The modeling runs included assumptions for a worst-case stationary diesel engine exhaust configuration which addressed more than two dozen building dimensions for downwash considerations, and six different meteorological data sets. Modeling was conducted using AERMOD, an atmospheric dispersion model created by US EPA. The worst-case stationary diesel engine health risk values and the corresponding diesel engine decay factors for the worst case diesel engine health risk values were determined from the modeling data. The decay factors represent the decreased cancer risk and $PM_{2.5}$

concentrations (that BAAQMD staff would expect to see) from the fenceline of a facility out to 1,000 feet (in every direction).

To verify the accuracy of the decay factors, BAAQMD staff reviewed several BAAQMD permit applications and compared the residential cancer risk from the Health Risk Screening Assessment (HRSA) to the estimated health risks of the screening values adjusted to the closest resident (according to the HRA) using the decay factors. The results are detailed in **Table 1**. All of the values are shown with the age sensitivity factor (1.7) removed. In the majority of cases, the screening value results (adjusted with the decay factors) compared fairly well with the HRSA risks. In only three cases (15 percent of the sample), the cancer risks from the screening values (adjusted using the decay factors) were actually below the HRSA risk. However, in these three cases, the cancer risks from both the HRSA and the screening values were quite low (all less than nine chances in one million), and the estimates were fairly comparable. Overall, based on this assessment, BAAQMD staff feels that the screening values, when adjusted with the decay factors, are a conservative estimate in comparison to the actual HRA values.

TABLE 1: DECAY FACTOR ANALYSIS

Plant No	Application No	Project Description	Plant Name	City	County	Distance from stack to receptor boundary	Stack height	Estimated Risk from Google Earth Using Multiplier	HRA Risk Resident (million)
19245	18676	1 generator 250 bhp	New Enterprises Associates, Inc.	Menlo Park	San Mateo	800 ft	12 ft	2.32	1.28
19223	18614	1 generator 1482 bhp	Advent Software	San Francisco	San Francisco	310 ft	14.5 ft	6.7	4.49
19180	18462	3 generators sets with abatements - 2937 bhp	San Francisco PUC	San Francisco	San Francisco	260 ft	7.3 ft 26.5 ft 26.5 ft	3.56	2.5
19216	18596	1 generator - 99 bhp	City of Novato	Novato	Marin	246 ft	7 ft	5.83	3.6
19187	18514	1 generator - 130 bhp	Walnut Creek Endoscopy Center	Walnut Creek	Contra Costa	260 ft	9 ft	5.1	0.78
19181	18461	3 generators sets with 3 abatement - 2937 bhp	Comstock Data Center	Santa Clara	Santa Clara	200 ft	21 ft	7.63	3.3
19236	18645	1 generator - 385 bhp	Marin County	San Rafael	Marin	790 ft	8 ft	2.76	2.4
19232	18637	1 generator - 49 bhp	Verizon Wireless	Danville	Contra Costa	303 ft	8 ft	7.4	0.32
19096	18163	1 generator - 145 bhp	Marin County	Mill Valley	Marin	27 ft	8 ft	8.16	2.2
19143	18341	1 generator - 2220 bhp	Myers' Peninsula Ventures	South San Francisco	San Mateo	840 ft	11 ft	0.57	2.8
19156	18379	1 generator - 315 bhp	North Bay Regional Surgery Center	Novato	Marin	218 ft	8 ft	2.48	8.3

TABLE 1: DECAY FACTOR ANALYSIS

Plant No	*Application No*	*Project Description*	*Plant Name*	*City*	*County*	*Distance from stack to receptor boundary*	*Stack height*	*Estimated Risk from Google Earth Using Multiplier*	*HRA Risk Resident (million)*
19131	18308	1 generator - 916 bhp	City of Sebastopol	Sebastopol	Sonoma	780 ft	12 ft	2.89	0.48
19201	18540	1 generator - 157 bhp	BioSeek	South San Francisco	San Mateo	5000 ft	30 ft	0.16	0.17
19110	18227	1 generator - 399 bhp	Richmond Hall of Justice	Richmond	Contra Costa	504 ft	9 ft	1.02	2.3
19157	18380	1 generator - 364 bhp	List Labs	Campbell	Santa Clara	683 ft	10 ft	1.41	0.34
19164	18388	1 generator - 314 bhp	Kindred Hospital	San Leandro	Alameda	526 ft	14 ft	3.75	0.43
19170	18405	1 generator - 619 bhp	North Coast County Water District	San Bruno	San Mateo	100 ft	13 ft	10.96	3.1
19135	18319	1 generator - 157 bhp	Kasier Hospital	Napa	Napa	308 ft	7 ft	4.12	0.4
19136	18320	1 generator - 157 bhp	Kasier Hospital	Fairfield	Solano	1048 ft	7 ft	0.4	0.3

Source: BAAQMD, 2013

Table 2 lists the decay factors which were used in the geospatial analysis to calculate cancer risks and $PM_{2.5}$ concentrations out to 1,000 feet in every direction.

TABLE 2: DIESEL ENGINE DECAY FACTORS

Distance in meters	*Diesel Engine Distance Adjustment*
20	.90
25	.85
30	.73
35	.64
40	.58
50	.50
60	.41
70	.31
80	.28
90	.25
100	.22
110	.18
120	.16
130	.15
140	.14
150	.12
160	.10
180	.09
200	.08
220	.07
240	.06
260	.05
280	.04
300	.03
305	.02

Source: BAAQMD, 2013

Gas stations: Similar to diesel engines, BAAQMD staff created decay factors for gas stations based upon numerous modeling runs using meteorological data collected from five counties throughout the Bay Area. Emissions of benzene, ethylbenzene, hexane, xylene, and toluene were estimated based on actual throughput data when available. TAC emission factors used in the health risk calculations depended on the type of emission controls at the various facilities. Some health risk values were updated from a February 2011 survey conducted (except values that were lower or were at BAAQMD permit levels). A worst-case Chi/Q (predicted concentration based on an emission rate of one g/s) was used, which was derived from worst-case AERMOD modeling results based upon a number of factors, including: building dimensions around the meteorological towers which were used to collect/process the meteorological data; no complex terrain or flagpole receptors; over 4,000 receptor locations; assigned vent and volume parameters; and assigned emission ratios between vent and volumes. .

Table 3 lists the decay factors that were used in the geospatial analysis to calculate cancer risks and $PM_{2.5}$ concentrations out to 1,000 feet in every direction. The decay factor is only applied to cancer risks associated with gas stations; gas stations do not generate $PM_{2.5}$ emissions.

TABLE 3: GAS STATION DECAY FACTORS

Distance in meters	*Gas Station Distance Adjustment Multiplier*
20	1.0
25	.728
30	.559
35	.445
40	.365
45	.305
50	.260
55	.225
60	.197
65	.174
70	.155
75	.139
80	.126
85	.114
90	.104
95	.096
100	.088
110	.076
115	.071
120	.066
125	.062
130	.058
135	.055
140	.052
145	.049
150	.046
155	.044
160	.042
165	.040
170	.038
175	.036
180	.034
185	.033
190	.031
195	.030
200	.029

TABLE 3: GAS STATION DECAY FACTORS

Distance in meters	*Gas Station Distance Adjustment Multiplier*
205	.028
210	.027
215	.026
220	.025
225	.024
230	.023
235	.022
240	.022
245	.021
250	.020
255	.020
260	.019
265	.018
270	.018
275	.017
280	.017
285	.016
290	.016
295	.015
300	.015
305	.015

Source: BAAQMD, 2013

Dry Cleaners: The decay factor for dry cleaners differ from the decay factors applied to gas stations and diesel engines because the reduction in risks are not attributed to meteorological conditions diluting the source emissions, but on ARB's regulation requiring the gradual phase-out of perchloroethylene (perc) in dry cleaning facilities by January 1, 2023. The decay factor relies on adjustment to the age sensitivity factor that accounts for reduction in the exposure duration due to the compliance date of the regulation. The age sensitivity factors, which account for the increased susceptibility of infants and children to carcinogens, is a factor of 10 for exposures that occur from the third trimester of pregnancy to two years of age. A factor of three was applied for exposures that occur from two years through 15 years of age and a factor of one was applied for all subsequent years leading up to a 70 year exposure. Summing the age sensitivity factors for all 70 years of exposure produces a factor of 1.7 that is then multiplied by the non-adjusted cancer risk (also referred to as the screening value). Because the regulation prohibits the use of perc after January 1, 2023, the exposure duration is reduced to 13 years (rather than 70 years) and subsequent cumulative age sensitivity factor becomes 0.775 over 70 years. Consequently, the cancer risk for dry cleaners using perc was adjusted by multiplying the non-adjusted cancer risk (screening value) by (0.775/70). A decay multiplier (similar to the one used for diesel engine) was then applied to the new screening values to represent a decrease in cancer risk with distance up to 1,000 feet. $PM_{2.5}$ concentrations were not calculated because dry cleaners do not emit $PM_{2.5}$.

Mobile Source Data

BAAQMD provided estimated cancer risk and $PM_{2.5}$ concentration data for mobile sources located in and within 1,000 feet of TPP areas for use in the local pollutant analysis. Mobile sources include freeways, roadways with over 30,000 annual average daily trips (AADT), and railroads/rail stations.

Roadways: BAAQMD conducted air dispersion modeling to estimate cancer risks and $PM_{2.5}$ concentrations for roadways based on annual average daily traffic (AADT) for each of the nine Bay Area counties. The county specific tables provide estimated $PM_{2.5}$ concentrations and cancer risk values by distance from each roadway (categorized by AADT), up to 1,000 feet. Information (specific to each county) included in the air dispersion modeling includes AADT, percentage of heavy trucks and truck profiles, ARB emission factors (EMFAC 2007) and meteorological data from BAAQMD monitoring stations in each county. The estimated cancer risks and $PM_{2.5}$ concentrations were found to be minimal for roadways with less than 30,000 AADT; as such, BAAQMD staff only included the estimated cancer risks and $PM_{2.5}$ concentrations for roadways exceeding 30,000 AADT (within the TPP areas) in the local pollutant analysis.

Freeways: BAAQMD staff developed a freeway screening tool (available for download in Google Earth as well as ArcGIS) which maps each State freeway link in the Bay Area, where freeway links are defined by Caltrans mileposts. BAAQMD staff modeled cancer risks and $PM_{2.5}$ concentrations for each link using the CALINE3 model developed by the California Department of Transportation. The cancer risks and $PM_{2.5}$ concentrations were modeled at various distances (out to 1,000 feet) from the edge of the right of way (ROW) of each freeway link. Information specific to each county is incorporated in the modeling including: AADT, fleet mix and profiles, vehicle speeds from MTC's travel demand model, and meteorological data from BAAQMD monitoring stations. This information is available at elevations of six feet and 20 feet to represent sensitive receptors on the first and second floors of buildings respectively. For purposes of the local pollutant analysis, BAAQMD staff utilized the estimated health risk data at the six foot elevations only, as this is the most conservative scenario.

BAAQMD staff updated the original freeway screening tool using EMFAC2011, rather than EMFAC 2007, to estimate increased cancer risks and $PM_{2.5}$ concentrations. $PM_{2.5}$ emissions from exhaust, and tire and brake wear, as well as emissions from re-suspended road dust are included as part of the EMFAC2011 update. For additional information on the methodology used in the freeway modeling see BAAQMD's document entitled "*Recommended Methods for Screening and Modeling Local Risks and Hazards.*"

Railroads/Rail Stations: Similar to the methodology used for freeways, BAAQMD staff estimated cancer risk and $PM_{2.5}$ concentrations from railroads and rail stations using the CALINE3 model. Rail emissions were estimated for existing freight and passenger lines as well as proposed future lines in Marin County (i.e., SMART line) and eBART along Highway 4 in Contra Costa County. Emissions for freight corridors were estimated based on fuel consumption along specific lines provided by industry. Passenger rail emissions were weighted based on the rail activity, idling times, and speeds of individual trains. Freight and passenger emissions that run on parallel or share tracks were aggregated to estimate total emissions along rail corridors. Site-specific meteorological conditions for each rail link were then input into the model to estimate receptor-specific cancer risk and $PM_{2.5}$ concentrations. Cancer risk and $PM_{2.5}$ concentrations were estimated at various distances from the edge of the rail lines, up to 1000 feet, demonstrating reduced risks based on distance from the emissions source.

GIS Cumulative Analysis

BAAQMD staff conducted a geospatial analysis using GIS software to evaluate potential increased cancer risks and $PM_{2.5}$ concentrations due to TAC and $PM_{2.5}$ emissions from mobile and stationary sources in Transit Priority Project (TPP) areas[4]. The geospatial analysis was designed and executed in ArcGIS 10.1 using BAAQMD's estimated cancer risk and $PM_{2.5}$ concentration data on stationary and mobile sources of TACs and $PM_{2.5}$ (described above). BAAQMD contracted with ICF, Inc. (ICF) for assistance in designing and executing the geospatial analysis.

The geospatial analysis identifies areas where the cumulative cancer risk and $PM_{2.5}$ concentrations of the data sets exceed MTC's air quality significance thresholds for TACs and $PM_{2.5}$ using a spatial additive process. The spatial additive process involves three data sets: a regularized raster dataset representing the spatial extent of the TPP areas, to which all pollution values associated with the stationary and mobile sources are added; raster datasets representing the TAC/$PM_{2.5}$ plumes associated with each stationary source that were decayed to a specified distance (described in section above); and raster datasets representing TAC emissions and $PM_{2.5}$ concentrations generated by mobile sources, including freeways, major roadways (defined as roads with AADT counts exceeding 30,000), and railroads/rail stations.

DISTANCE RECOMMENDATION FROM SENSITIVE RECEPTORS SUMMARY

To help identify the appropriate distances that sensitive receptors should be protected from these stationary and mobile sources, MTC utilized work prepared by the California Air Resource's Board (ARB) 2005 *Air Quality and Land Use Handbook: A Community Health Perspective* (Handbook), and BAAQMD permit data. ARB developed the Handbook to bring attention to the potential health impacts associated with locating sensitive receptors in close proximity to air pollution sources. Using available health data, air quality modeling, and monitoring studies, the Handbook provides recommendations for how far sensitive land uses should be located away from some specific sources of air pollution. The ARB recommended distances are based primarily on data showing that air pollution exposure from TACs and $PM_{2.5}$ can be reduced as much as 80 percent when sensitive land uses are set back the recommended distance. The distance recommendations were based on existing health studies and data available at that time. ARB distance recommendations were only made when the relative exposure and health risk from a source could be reasonably characterized from the available data. For each source type, the Handbook summarizes the key health and distance related findings that helped form the distance recommendation for that source.

ARB recommends using local air pollution source data, where appropriate and if available, to better determine specific health risk near local TAC and $PM_{2.5}$ sources, especially for sources not included in ARB's Handbook, or to identify more appropriate distance recommendations than they provide in the Handbook.

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[4] The geospatial analysis also included a 1,000 foot "area of influence" around the TPP areas. The area of influence is defined as the areas containing sources of TAC and/or PM2.5 that should be evaluated in relation to the TPP areas. Including the area of influence ensures that the geospatial analysis conducted to evaluate cumulative health risks takes into account sources of pollution *outside* of the TPP areas that may, however, impact the TPP areas themselves. In this document, the term "TPP areas" refers to both the TPP areas as defined by the Sustainable Communities Strategy for the Bay Area, as well as the 1,000 foot area of influence.

For sources of TACs and $PM_{2.5}$ not included in ARB's Land Use Handbook or for sources where Air District data was more site specific than ARB's data, MTC worked with BAAQMD to develop distance recommendations for siting new sensitive land uses for use in this analysis. BAAQMD provided site specific stationary source permit data or existing studies to support the distance recommendations for diesel generators, refineries, sea ports, airports, railroads, rail stations, and ferry terminals.

The specific set distances recommended for avoiding locating sensitive land uses are listed below in Table 2.2-10. For detailed explanations of set distances recommended by ARB, see the 2005 Air Quality and Land Use Handbook: A Community Health Perspective. Recommended distances used for this analysis and how they are derived are described in detail below.

Diesel Generators

The ARB's Handbook does not contain a distance recommendation for diesel generators. There are over 3,000 diesel generators in the Bay Area, many of which may pose some increased cancer risk and $PM_{2.5}$ concentration to nearby sensitive receptors. Installations of new generators in the Bay Area are required to obtain and meet Air District permit requirements. Under Air District permitting requirements, new generators are required to install Toxic Best Available Control Technology (T-BACT) and demonstrate an increased cancer risk impact of less than 10 in a million to the closest sensitive receptor. However, many older existing generators operating in the Bay Area may not have T-BACT installed and generate much higher cancer risks than 10 in a million.

A 350 foot distance for siting new sensitive residents near existing diesel generators that have an estimated cancer risk of over 10 in a million is used for this analysis, based on MTC/ABAG consultation with the BAAQMD. The methodology used for developing this distance recommendation for diesel generators is consistent with ARB's methodology. ARB's set distance recommendations are based upon the distance at which risk would be reduced by 80 percent. BAAQMD analyzed their inventory of diesel generators in the stationary source screening tool and estimated the distance, using the diesel multiplier tool[5], where cancer risk tends to drops off by approximately 80 percent. Location of sensitive receptors within 350 feet of diesel generators may result in a potentially significant impact.

Railroad and Rail Stations

The ARB's Handbook does not contain distance recommendations for railroad lines or rail stations. Most of the passenger rail lines in the Bay Area are located within TPP areas and will likely attract new land use development with sensitive receptors as part of the proposed land use plan. Rail lines, including Caltrain, Amtrak, Capital Corridor, and the future SMART line in Marin County, generate diesel PM emissions, a known TAC and $PM_{2.5}$ source, from locomotive exhaust.

BAAQMD estimated cancer risk and $PM_{2.5}$ concentrations for railroads and rail stations within the Bay Area. Rail emissions were estimated along existing freight and passenger lines. Emissions along freight corridors were estimated based on fuel consumption; and passenger rail emissions were estimated based on the rail activity, idling times at stations, and speeds of individual trains. Freight and passenger emissions that run on parallel or shared tracks were aggregated to estimate total emissions along rail

[5] Available on BAAQMD's website, http://baaqmd-s/Divisions/Planning-and-Research/CEQA-GUIDELINES/Tools-and-Methodology.aspx

corridors. The emissions and train activity data were combined with county-specific meteorological data for each rail link in the dispersion modeling to estimate cancer risk and $PM_{2.5}$ concentrations at various distances from the edge of the rail lines (up to 1,000 feet).

Based on BAAQMD's dispersion modeling, the maximum distance where the estimated cancer risk[6] dropped below the threshold occurs at approximately 200 feet. Therefore, this analysis uses a set distance of 200 feet from every railroad line and rail station. Location of sensitive receptors within 200 feet of railroad lines and rail stations may result in a potentially significant impact.

Ferry Terminals

The ARB Handbook does not contain distance recommendations for ferry terminals. The six ferry terminals in the Bay Area are located within TPP areas and could potentially include future new land use developments with sensitive receptors. Similar to rail stations, the primary TAC of concern at ferry terminals is diesel PM from ferry boat exhaust.

BAAQMD estimated cancer risk and $PM_{2.5}$ concentrations for each of the region's ferry terminals based on the number of ferry departures, assumed idling times at each ferry terminals, and modeling outputs from dispersion modeling conducted by BAAQMD for two ferry terminals in the City of San Francisco. The cancer risk and $PM_{2.5}$ concentrations were estimated at varying distances for each ferry terminal. The maximum distance where the estimated cancer risk[7] dropped below the cumulative threshold is at approximately 500 feet. Based on BAAQMD modeling, this analysis uses a set distance of 500 feet from every ferry terminal. Location of sensitive receptors within 500 feet of ferry terminals may result in a potentially significant impact.

Port of Oakland and UP Railyard

The ARB's Handbook recommends that lead agencies "avoid siting of new sensitive land uses immediately downwind of ports in the most heavily impacted zones." ARB does not contain more specific distance recommendation, rather the Handbook recommends consulting with the local air district or ARB on the status of any pending analyses of health risks associated with a specific port. It should be noted that ARB has prepared health risk assessments for several ports in the state, including the Port of Oakland, as part of a larger West Oakland Study.

In 2008, ARB completed a health risk assessment (HRA) for the West Oakland community. The study was designed to evaluate the potential public health risk to both residents of West Oakland and the broader Bay Area from exposure to diesel PM. The West Oakland HRA looked at emissions from the Port, railyard and the freeways individually and collectively. The report concluded that the "zone of impact" for potential risk levels above 100 in a million resulting from either the Port or the surrounding freeways encompass the entire West Oakland community (approximately 0.5 miles from Port property). The emissions from on-road heavy-duty trucks result in the largest contribution, over 71 percent, to the overall potential cancer risks levels in the West Oakland community.

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[6] The cancer risk threshold was triggered sooner than the PM2.5 threshold in the railroad modeling estimates.

[7] The cancer risk threshold was triggered sooner than the PM2.5 threshold in the ferry terminal modeling estimates.

ARB acknowledges, however, that the estimates for truck emissions in their HRA are uncertain, especially relative to the other categories of emissions studied, i.e. the Port and UP Railyard. Their uncertainty is due to limitations in the availability of data describing the magnitude and intensity of trucking operations in the West Oakland community. These data limitations may have led to an overestimate in the overall magnitude of truck-related emissions in the West Oakland community, and an underestimate of the fraction of total trucking emissions and risks attributable to trucks that service the Port of Oakland.

Based in part on the 2008 West Oakland HRA, and on Air District monitoring data that demonstrates TAC and $PM_{2.5}$ pollution levels are similar to background levels at approximately half mile from the Port and UP Railyard, this analysis uses a set distance of half a mile of the Port of Oakland and sensitive new land uses. Location of sensitive receptors within a half a mile of the Port of Oakland may result in a potentially significant impact.

Other Ports

For smaller ports in the region, including ports in Richmond, Redwood City, and Benicia, MTC recommends a set distance of 1,000 feet between these ports and sensitive land uses. These smaller ports have limited TAC and $PM_{2.5}$ emissions relative to the Port of Oakland. Cancer risk and $PM_{2.5}$ exposure from diesel truck activity associated with these ports are estimated to be significantly lower than found at the Port of Oakland. The Port of Richmond produces 6.3 tons per year of diesel PM, Benicia 5.0 tons per year, and Redwood City 10.2 tons per year[8] – compared to nearly 250 tons per year from the Port of Oakland. The small ports in the region, therefore, are not considered a substantial source of PM relative to the Port of Oakland. A distance of 1,000 feet is comparable to the distance ARB recommends for other large sources of PM, and the point at which, for most sources, pollution drops to background levels. Location of sensitive receptors within 1,000 feet of other ports may result in a potentially significant impact.

Refineries

In regards to refineries, ARB recommends that lead agencies "avoid siting new sensitive land uses immediately downwind of petroleum refineries." ARB also recommends that lead agencies consult with local air districts and other local agencies to determine an appropriate separation.

A petroleum refinery is a complex facility where crude oil is converted into petroleum products (primarily gasoline, diesel fuel, and jet fuel), which are then transported through a system of pipelines and storage tanks for final distribution by delivery truck to fueling facilities throughout the state. In California, most crude oil is delivered either by ship or via pipeline from oil production fields within the state. The crude oil then goes through numerous complex chemical and physical processes, which include distillation, catalytic cracking, reforming, and finishing. These refining processes have the potential to emit TACs and $PM_{2.5}$, and are subject to extensive controls by local air district regulations.

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[8] *SF Bay Area Seaports Air Emissions Inventory*, Bay Area Air Quality Management District, 2009: http://www.baaqmd.gov/Divisions/Planning-and-Research/Emission-Inventory/Small-Ports-Inventory.aspx

According to ARB and Air District staff, there is no current air quality modeling or monitoring data that provides a quantifiable basis for recommending a specific separation between refineries and new sensitive land uses. In the Bay Area, refineries were last analyzed for emissions and cancer risk in the 1990s, as part of ARB's Air Toxics "Hot Spots" Program, enacted by the state legislature in 1987. Since then, oil refining facilities in the Bay Area have changed substantially, thereby making the findings from the 1990's assessment obsolete. However, in view of the amount of, and potentially hazardous nature of, many of the pollutants released as part of the oil refining process, ARB suggest that the siting of new sensitive land uses immediately "downwind" of refineries should be avoided.

BAAQMD does not have current facility wide health risk assessments on which a set distance recommendation for Bay Area refineries and locating new sensitive land uses could be made. Therefore, this analysis considers a set distance of a half mile to be a precautionary distance where cancer risk would be expected to fall below 100 in a million and a $PM_{2.5}$ concentration of 0.8 ug/m3. Location of sensitive receptors within a half a mile of refineries may result in a potentially significant impact.

Airports

ARB's Land Use Hand book makes no mention of airports. However, airports are significant sources of air pollution. Airports generate numerous pollutants, including lead, 1,3-Butadiene, diesel PM, ultrafine PM (UFP), and $PM_{2.5}$, from a complex mix of mobile and stationary sources such as jet fuel, transport equipment, and power generation. Daily airport runway congestion especially contributes to local pollution levels that may compromise the health of residents living nearby and downwind from airports.

The South Coast Air Quality Management District prepared a *General Aviation Airport Air Monitoring Study* in August 2010[9], which studied the Van Nuys and Santa Monica Airports, and found that overall, the most significant airport-related impacts on air quality were observed for lead and for UFPs. However, diesel PM has been attributed as the leading driver for cancer risk[10] from airports, according to a Berkeley study that reviewed CEQA-prepared health risk assessments for Los Angeles (LAX), San Diego (SDIA) and the proposed El Toro (OCX) airport.

MTC/ABAG has not been able to identify any set distance recommendations from the limited studies surrounding air emissions from airports. Therefore, this analysis considers a set distance of a half mile to be a precautionary distance where cancer risk would be expected to fall below 100 in a million and a $PM_{2.5}$ concentration of 0.8 ug/m3. Location of sensitive receptors within a half a mile of airports may result in a potentially significant impact.

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[9] http://www.smgov.net/uploadedFiles/GA%20report_final%20(081710).pdf

[10] Vanderbilt, Pamela; Lowe, John *Health Risk Assessment of Air Toxics from Airports: The State of the Science & Strategies for the Future,* Airport Air Quality Symposium, February 28, 2002

Toxic Air Contaminant Mitigation Measures

The following section provides background information on air quality mitigation measures recommended in the DEIR to address localized impacts related to Toxic Air Contaminants (TACs), listed under Mitigation Measure 2.2(d).

Mitigation Measure Point 1: Install air filtration to reduce cancer risks and $PM_{2.5}$ exposure for residents and other sensitive populations in buildings that are in close proximity to freeways, major roadways, diesel generators, distribution centers, railyards, railroads, rail stations, and/or ferry terminals. Air filtration devices should be rated MERV-13 or higher. MERV-13 air filters are considered high efficiency filters able to remove 80 percent of fine particulate matter from indoor air.[11] MERV 13 air filters may reduce $PM_{2.5}$ concentrations from diesel PM from stationary and mobile sources by approximately 53 percent; and cancer risk by 42 percent. As part of implementing this measure, an ongoing maintenance plan for the building's HVAC air filtration system is required.

Air filtration protects residents and other sensitive receptors from exposure to pollutants by reducing the pollutant concentration in indoor air circulated from outdoor air. Air filtration places a control on a building's mechanical ventilation system that filters particles from the air. The effectiveness of a filter depends on its (1) efficiency to remove particles from passing air; (2) a ventilation system's air flow rate; and (3) the path the clean air follows after it leaves the filter. To ensure adequate health protection to sensitive receptors, a ventilation system should meet the following minimal design standards:

- A MERV-13, or higher, rating that represents a minimum of 90 percent efficiency to capture fine particulates;
- At least one air exchange(s) per hour of fresh outside filtered air;
- At least four air exchange(s) / hour recirculation; and
- At least 0.25 air exchange(s) per hour in unfiltered infiltration.[12]

The effectiveness of air filtration is highly variable and based upon a building's design and maintenance. For example, the presence of operable windows, the placement of the air intakes, operation and maintenance of the ventilation system, and proper sealings will impact the effectiveness of air filtration and thus residents' exposure to TACs and $PM_{2.5}$ from nearby sources of emissions. In addition, residential behavior such as unvented cooking and cigarette smoking (that affect indoor air quality) as well as the amount of time occupants spend outdoors versus indoors impact the effectiveness of air filtration. BAAQMD recommends that the homeowners/lease agreement and other property documents require cleaning, maintenance, and monitoring of the buildings for air flow leaks, assurance that new owners and tenants are provided information on the ventilation system, and that fees associated with

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[11] EPA webpage on residential air cleaners, http://www.epa.gov/iaq/pubs/residair.html,

[12] DPH, *Assessment and Mitigation of Air Pollutant Health Effects from Intra-Urban Roadways: Guidance for Land Use Planning and Environmental Review*. May 2008. Original reference: Fisk WJ, Faulker D, Palonen J, Seppanen O. Performance and Costs of Particle Air Filtration Technologies Indoor Air 2002; 12(4):223-234.

owning or leasing a unit(s) in the building include funds for cleaning, maintenance, monitoring, and replacements of the filters, as needed.

The Air Resources Board (ARB) recently studied the effectiveness of air filtration, along with other mitigation measures, as a strategy to reduce exposure to nearby traffic pollution.[13] The study finds that the use of air filtration tends to be relatively effective and represents a promising mitigation measure; however, additional research on the issue is needed. The study notes that air filtration could be especially effective in residences with consideration to California's requirement that new homes have mechanical ventilation systems installed. ARB is funding a project entitled, "Reducing In-Home Exposure to Air Pollution," that will measure the benefits of air filtration in reducing exposure to indoor and outdoor air pollutants.

Installation of MERV-13 filters in residential buildings represents a feasible option that is recommended by a number of entities. The City and County of San Francisco requires MERV-13 filters be installed in residential buildings located in air quality hot spots as defined by San Francisco's Health Code Article 38.[14] In addition, the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), recommends, in their green building guide, that a minimum of MERV-13 rated air filtration be required in building locations where the air quality is designated to be in non-attainment with the National Ambient Air Quality Standards for $PM_{2.5}$.[15] The United States Green Building Council (USGBS) requires that new construction be equipped with a MERV-13 or higher rated air filter in new construction for buildings and homes to receive air filtration green building credit points.[16]

Mitigation Measure Point 2: Phase residential developments located within the set distance of 500 feet from freeways until 2023, or as late as feasible. In 2008, ARB adopted a regulation that requires diesel trucks to retrofit or replace their engines so that by 2023, nearly all trucks would have a 2010 or newer model year engine. Therefore, starting in 2014, PM emissions from diesel trucks will decline by approximately 80 percent by 2023.

This measure allows proposed projects to avoid exposing sensitive receptors to high levels of diesel particulate matter from heavy duty trucks on freeways. As ARB's On-Road Heavy Duty Diesel Vehicles Regulation gets implemented, diesel particulate matter emissions will decrease over time, which will reduce cancer risk near freeways.

Mitigation Measure Point 3: Design buildings and sites to limit exposure from sources of TAC and/or $PM_{2.5}$ emissions. Design the site layout to locate sensitive receptors as far as possible from any freeways, roadways, diesel generators, distribution centers, and railroads/railyards. Locate operable windows,

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[13] "Status of Research on Potential Mitigation Concepts to Reduce Exposure to Nearby Traffic Pollution," ARB, August 2012.

[14] City and County of San Francisco 2011 Green Building Requirements Summary and Verification Form, http://sfdbi.org/Modules/ShowDocument.aspx?documentid=354

[15] ASHRAE Journal's Guide to Standard 189.1, Balancing Environmental Responsibility, Resource Efficiency and Occupant Comfort, June 2010.

[16] LEED 2009 for New Construction Rating System, http://new.usgbc.org/leed/rating-systems

balconies, and building air intakes as far away as is feasible from emission sources. If near a distribution center, residents shall not be located immediately adjacent to a loading dock or where trucks concentrate to deliver goods.

Building design can be an important factor in improving indoor air quality, especially when considering the location of the air intake for air ventilation. In general, $PM_{2.5}$ concentrations decrease with distance and with building height, therefore air intake locations should be located farthest away from emission sources as possible to provide the cleanest ventilation to building occupants.

Other minimal design features may further improve indoor air quality. For example, operable windows and balconies should be installed away from high volume roadways or other sources of air pollution. If emissions sources are located on the west of the building, these amenities should be installed on the east side of the building where the exposure concentrations are likely to be lower. Similarly, if mechanical ventilation is installed in a building, the project sponsor can consider installing inoperable windows along the side of the building downwind of the source. This strategy will reduce the possibility of higher polluted air from entering the building and also increases the efficiency and performance standard of the mechanical filter.

Mitigation Measure Point 4: Limit ground floor uses in residential or mixed-use buildings that are located within the set distance of 500 feet to a non-elevated highway or roadway. Sensitive receptors should be restricted from the ground floor and be limited to second floors and above.

Avoiding residential development on the ground floor of buildings is an effective strategy for reducing exposure to $PM_{2.5}$ and/or cancer risk from a highway, interstate or roadway. This strategy is often applied to infill development, where the ground floor is reserved for commercial and/or retail space and the second and subsequent levels are used for residents. Limiting ground floor residential development, as an exposure reduction strategy, is only effective when the adjacent roadway is not elevated. If the roadway is elevated at approximately the height of the second floor occupancy, then residents would be exposed to the same level of pollution as if they were at ground level.

For pollutants released at ground level, being on the second floor (or higher) of a building can reduce exposure to air pollution by as much as 50 percent within 10 feet of the roadway and by 15 percent within 100 feet. As part of its Freeway Screening Tool, BAAQMD staff modeled cancer risk and $PM_{2.5}$ concentrations at six feet (ground floor), 20 feet (second floor), and 30 feet (third floor) elevations. Future projects should apply the appropriate height concentrations to their project to reflect potential exposure reductions. The six- foot concentration data should be used when the freeway is elevated and at approximately the same height as where occupancy will occur.

Mitigation Measure Point 5: Plant trees and/or vegetation between sensitive receptors and pollution sources. Large, evergreen trees (those with foliage year-round) with long-life spans work best in trapping $PM_{2.5}$. In addition, trees with branches and leaves that have a sticky surface and trees with a fine, complex foliage structure that allow significant in-canopy airflow also perform well. Specific tree recommendations include: Pine (*Pinus nigra* var. *maritima*), Cypress (X *Cupressocyparis leylandii*), Hybrid popular (*Populus deltoids X trichocarpa*), and Redwoods *(Sequoia sempervirens*)

Planting certain trees can be an effective strategy for reducing exposure to air pollution. With certain trees, coarse and fine particulates become trapped and filtered by the leaves, stems, and twigs of the trees.

Trapped pollution particles are eventually washed to the ground by rainfall. Trees also lower the air temperature by providing shade over streets and parking lots, thereby reducing evaporative emissions from vehicles and energy consumed on air conditioning during summer months.

Research supports a reduction in particulate matter concentration ranging from 0.5 to 5 percent from planting trees near a source of $PM_{2.5}$. District staff recommends taking a 0.5 percent reduction from $PM_{2.5}$ concentration estimates when implementing this measure. If taking a larger reduction, the reasons for doing so should be supported and documented.

The effectiveness of $PM_{2.5}$ removal depends on the tree species planted. As mentioned, large, evergreen trees (those with foliage year-round) with long-life spans are best, and trees with branches and leaves that have a sticky surface are better at trapping particulate matter than those without. Trees with a fine, complex foliage structure that allows significant in-canopy airflow will also perform better at trapping particulate matter.

Specific tree recommendations include:

- Pine (Pinus nigra var. maritima),
- Cypress (X Cupressocyparis leylandii),
- Hybrid popular (Populus deltoids X trichocarpa),
- Redwoods (Sequoia sempervirens),

In addition to the type of tree, the placement of the trees, relative to major roadways, and how densely they are planted are important considerations in using trees as a strategy to reduce air pollution exposure. The $PM_{2.5}$ removal effectiveness of trees is greatest when the trees are planted closest to the edge of the roadway or stationary source, for this is where pollution concentrations are highest. Beyond 500 feet, concentrations begin to diminish considerably, thereby diminishing the need for or effectiveness of tree planting as a strategy. Ideally, trees should be planted within 500 feet from a roadway to be considered an effective strategy. In regards to density, trees should be planted so that they are grouped as close together as possible to ensure a rather dense collection of tree stands. The denser the trees, the more effective the foliage, trunks and canopies will be in collecting particulate matter.

Some trees emit various "biogenic volatile organic compounds" or BVOCs. BVOCs, such as isoprenes and monoterpenes, contribute to the formation of ozone. Only "low emitting" BVOC trees should be considered in a tree planting strategy. Oak trees, in particular, would not be recommended due their ability to emit large volumes of BVOCs. The amount of BVOCs that are emitted by a tree species should be determined before utilizing the species in a tree planting strategy.

Mitigation Measure Point 6: Plan sensitive receptors away from truck activity areas including loading docks and delivery areas. Requiring loading dock electrification and/or prohibiting all idling of heavy duty diesel trucks should be considered as appropriate.

Residences should not be located immediately adjacent to a loading dock on a neighboring parcel or a planned loading dock within a mixed use development. If loading docks are not used in the development but there will be areas where trucks concentrate to deliver goods, then a separation should be provided between the two uses. Requiring loading dock electrification and/or prohibiting all idling of heavy duty diesel trucks are complimentary measures that could be implemented to ensure adverse health impacts do not occur.

Mitigation Measure Point 7: If within the project site, replace or retrofit diesel generators that are not equipped with Best Available Control Technology to meet ARB's Tier 4 emission standards. New or retrofitted diesel generators may reduce $PM_{2.5}$ emissions by up to 90 percent.

This strategy reduces emissions by retrofitting or replacing generators to meet ARB's most stringent emission standards. This measure may be applied to generators used to provide electricity in construction sites and to back-up generators (also known as stationary, standby, or emergency generators) used to provide emergency power in buildings.

Generators replaced or retrofitted to meet ARB's Tier 4 emission standards can reduce $PM_{2.5}$ emissions, and therefore $PM_{2.5}$ concentrations and cancer risk, by up to 90 percent. Actual emission reductions and reductions in $PM_{2.5}$ concentrations and cancer risk depend on the number of, size, frequency and intensity-of-use of the generators.

Generators, specifically older ones, can have significant diesel particulate matter emissions. As part of its diesel risk reduction program, the California Air Resources Board adopted an air toxics control measure for or generators, in 2004. The measure requires that new generators, including back-up generators and generators used in construction, be certified to meet emission standards set by ARB and EPA (ARB and EPA have identical emission standards for generators). ARB/EPA emission standards apply to generators with more than 50 engine horse power and are set forth as Tiers 1 through 4, with Tier 4 engines being the cleanest. Generator engines certified at Tier 4 reduce PM emissions 85 to 90 percent over a non-tiered engine (whereas Tier 1 only reduces PM emissions by 25 percent). To achieve ARB's emission standards, older generators may be replaced with a new generator or retrofitted with control technologies such as diesel particulate filters. Engines meeting the Tier 4 standard began to be manufactured in 2008. By 2015, all new generator engines must meet Tier 4 emission standards.

To implement this measure, existing generators may be replaced, retrofitted, or otherwise upgraded to meet ARB Tier 4 emissions standards.

Mitigation Measure Point 8: If within the project site, reduce emissions from diesel trucks through the following measures:

- Install electrical hook-ups for diesel trucks at loading docks. The provision of electrical outlets at loading docks provide truck operators, whose trucks are equipped to utilize grid power, the ability to shut off their main engines while maintaining power refrigeration systems. Grocery stores, delivery centers, shopping malls, and other commercial land uses attract heavy-duty delivery trucks which may contain perishable items that must be kept refrigerated, or at a fixed temperature. While the frequency of heavy-duty trucks delivering goods in one place produces a high amount of air pollution in and of itself, the impact is exacerbated when truck operators must keep the main engine of the truck running while delivering refrigerated goods. The provision of electrical outlets at loading docks would give truck operators, whose trucks are equipped to utilize grid power, the ability to shut off their main engines while maintaining power to the refrigeration systems. Installing electrical outlets can lead to localized reductions in diesel emissions, thereby decreasing the potential for health risks to those that live and work in the area.

- Require trucks to use Transportation Refrigeration Units (TRU) that meet Tier 4 emission standards. TRUs are refrigeration systems powered by diesel internal combustion engines designed to refrigerate perishable products that are transported in various containers, including semi-trailers, truck vans, shipping containers, and rail cars. Although TRU engines are relatively small, ranging from nine to 36 horsepower, significant numbers of these engines congregate at distribution centers, truck stops, and other facilities, resulting in the potential for health risks to those that live and work nearby. The use of TRU's in lieu of running the main engine on delivery trucks, maintains refrigeration while minimizing diesel emissions. This measure may result in a 50 to 80 percent reduction in diesel particulate emissions at the project-level, relative to trucks without TRUs. Require truck-intensive projects to use advanced exhaust technology (e.g. hybrid) or alternative fuels.

  The use of hybrid and battery-electric vehicles or the use of clean fuels such as propane or natural gas has the potential to dramatically decrease $PM_{2.5}$ and TAC emissions in new development projects or land uses that include a fleet of heavy-duty trucks.. Requiring advanced drive trains or alternative fuels has the potential to decrease diesel emissions from heavy-duty trucks by 35 to 100 percent at the project-level.

  Truck manufacturers have begun offering diesel electric hybrids for all but the heaviest trucks; gasoline hybrids are available for lighter weight heavy-duty trucks. The availability of propane and natural gas powered trucks is somewhat limited in terms of weight class and usage, although there are some well-established markets for natural gas buses and garbage trucks. Trucks powered by battery or fuel cell hybrid electrics are currently limited to demonstration projects, but when commercialized will present the lowest emission option.

- Prohibit trucks from idling for more than two minutes as feasible. Clear signage to this effect shall be provided for truck drivers.

  Prohibiting trucks from idling for more than two minutes reduces emissions by limiting the amount of time that trucks operate while idling. This measure could apply to all types and sizes of trucks that spend extended periods of time idling when loading and unloading, staging, or when not in active use. Limiting truck idling times has the potential to decrease local diesel idling emissions from heavy-duty trucks by up to 60 percent at the project-level.

  An idling measure can be enforced by ARB, local air quality management districts and local police departments. BAAQMD has an active enforcement program to regulate ARB's five minute idling measure mostly at sea ports, rail yards and distribution yards within BAAQMD's designated CARE areas.

- Establish truck routes to avoid residential neighborhoods or other land uses serving sensitive populations. A truck route program, along with truck calming, parking and delivery restrictions, should be implemented to direct traffic activity at non-permitted sources of TAC and/or $PM_{2.5}$ emissions, as well as large construction projects. This strategy can reduce exposure from truck activity, but unlike the measures above, it does not directly reduce emissions of toxic air contaminants and particulate matter.

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