Appendix B-1

Review of West Oakland Health Impact Studies

Memorandum

Date:	June 6, 2013
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Subject:	**Review of West Oakland Health Impact Studies Relevant to the Proposed Gateway Park**

Introduction

This memorandum reviews current available studies that provide relevant information for evaluating the potential health impacts from major air pollutant sources on future persons who may recreate within the proposed Gateway Park project. The project area spans from the main park area at the westernmost portion of West Oakland at the I-80 Bay Bridge toll plaza eastward and south underneath the I-880 freeway. While the Environmental Impact Report (EIR) for the project will examine all relevant air quality issues, the focus of this memo is on the potential long-term carcinogenic impacts of diesel particulate matter (DPM). Thus, the purpose of this review is to review and summarize study findings relevant to DPM.

Major diesel emissions sources addressed in this review include:

- The Port of Oakland, including emissions from
  - Ocean Going Vessels (OGV)
  - Diesel trucks, and
  - Short line rail locomotives;
- Union Pacific Railyard, including emissions from
  - Freight locomotives;
- Adjacent highways, such as I-80, including emissions from
  - Diesel trucks
- Neighboring industries, including emissions from
  - Diesel-powered generators.

The Port of Oakland and neighboring freeways have been the subject of several studies, evaluating the long term health effects of these emission sources on neighboring communities, such as West Oakland. ICF reviewed these studies and data prepared by the California Air Resources Board (ARB), University of California-Berkeley, University of California-Davis, Caltrans, and the Bay Area Air Quality Management District (BAAQMD).

The impact of local air pollution in the Gateway Park project area is affected by several factors including, meteorology, distance between receptors and emission sources, pollutant levels and concentration, and current and future regulations that may reduce DPM from diesel vehicles and marine craft. The studies that were reviewed suggest that on-road truck traffic, both port and non-port related, is the most significant contributor of DPM in the area. DPM from ocean going vessels (OGV) and other marine-craft are also significant sources of DMP, but generally emit at greater distances from the proposed park area than local truck traffic, thereby reducing exposure and associated health effects when compared to local truck traffic sources. Also, the air quality in the project area has been shown to be improving over recent years and is anticipated to improve further in the future due to a variety of Federal and State regulations that control diesel vehicles, vessels, and the fuels themselves.

This literature review focuses on the findings related to cancer health risks associated with DPM and addresses the relative impact to visitors in the proposed Gateway Park. With respect to the long term effects on residents, the state's Office of Environmental Health Hazard Assessment (OEHHA) measures the cancer health risks as the chances in a population of a million that some number of persons may develop cancer over a 70-year lifetime exposure period. While most of the studies examine the long-term cancer risks of DPM on local residents, the proposed Gateway Park project does not include any residential facilities that would experience long-term exposure to DPM emissions. Instead, it would involve recreational visitors that would experience short-term transitory exposure to ambient DPM emissions. Therefore, conclusions made from the reviewed studies on the cumulative impact of DPM on local resident cancer risks were extrapolated in this memorandum to reflect shorter exposure periods experienced by Gateway Park patrons.

Review of Data Sources

Studies and Key Findings

ARB's West Oakland Study

ARB published a study, *Diesel Particulate Matter Health Risk Assessment for the West Oakland Community*, in 2008 addressing and quantifying the health impacts of air emissions of diesel particulate matter on West Oakland and overall Bay Area communities, which include impacts to the Gateway Park project area in the west end of West Oakland. These impacts were calculated using emissions inventories[1] from the year 2005 and dispersion models and were forecasted using available growth and control factors, such as future regulations, to project the same health risks in

[1] Developed by ARB, BAAQMD, and Union Pacific Railroad.

2010, 2015, and 2020. This study examined the DPM emissions from major sources in the area: the Maritime Port of Oakland (the Port), the Union Pacific Railyard, neighboring marine vessels, and local diesel truck traffic. Health impacts were measured by estimating a lifetime cancer risk the surrounding populating using OEHHA's Tier 1 analysis with an average risk factor to reflect upon the general population, including visitors, not just residents.[2]

This study presents the health risks findings by source and overall impacted area in both data tables and isopleth maps. The isopleth in Figure 1, below, shows an overall cancer risk in the range of 1,000 to over 1,500 in one million within the Gateway Project area (California Air Resources Board 2008: Figure 10). This cancer risk is similar to that of the main West Oakland community located between the I-880, I-580, and I-980 freeways. Emissions from diesel truck activity outside of the Port have the greatest impact on cancer risk, contributing to a cancer risk in the range of 500 to over 1,000 in a million from the overall predicted cancer risk of 1,000 to over 1,500 in one million. Emissions from the Port were estimated to contribute to a cancer risk in the range of 200 to over 500 in a million. The contributions to the overall cancer risk shown in Figure 1 from the various local sources are also summarized in Table 1. The average, population weighted, cancer risk in the West Oakland area in 2005 was estimated to be 1,187. The study found that even though the DPM emissions at the point of exhaust were far greater for ocean going marine vessels at the port, the actual effect it had on the cancer risk of local residents was less due to the distances between the marine vessels and the general population, as opposed to the proximity between trucks and general population.

The ARB West Oakland Study also noted that regulatory actions to reduce DPM emissions from trucks and marine vessels will dramatically reduce DPM emissions and their associated cancer risks. The study's forecasts include the implementation of ARB's 2000 Diesel Risk Reduction Plan and other regulations, which, when combined with population growth estimates, may reduce overall population weighted DPM cancer risk by 80% by 2015 and 75%[3] by 2020 from 2005 levels. These regulations are summarized in a later section on the applicable regulations affecting diesel emissions in the port and state. (California Air Resources Board 2008)

As shown in a 2008 BAAQMD study and addressed below, federal, state, and local regulations have made and continue to make a significant impact on local DPM emissions. This means that the DPM cancer risks at both the Gateway Park and West Oakland communities by the opening year of the Gateway Park project in 2015 will be significantly lower than those estimated in 2005. However, an 80% reduction in 2015 would result in a lowered cancer risk of between 200 and 300 in a million in the West Oakland area, which is still a significant cancer risk when compared to the BAAQMD cumulative health risk assessment (HRA) CEQA threshold of 100 in a million from all sources (Bay Area Air Quality Management District 2010a)[4]. Additionally, as the values presented in Figure 1 and

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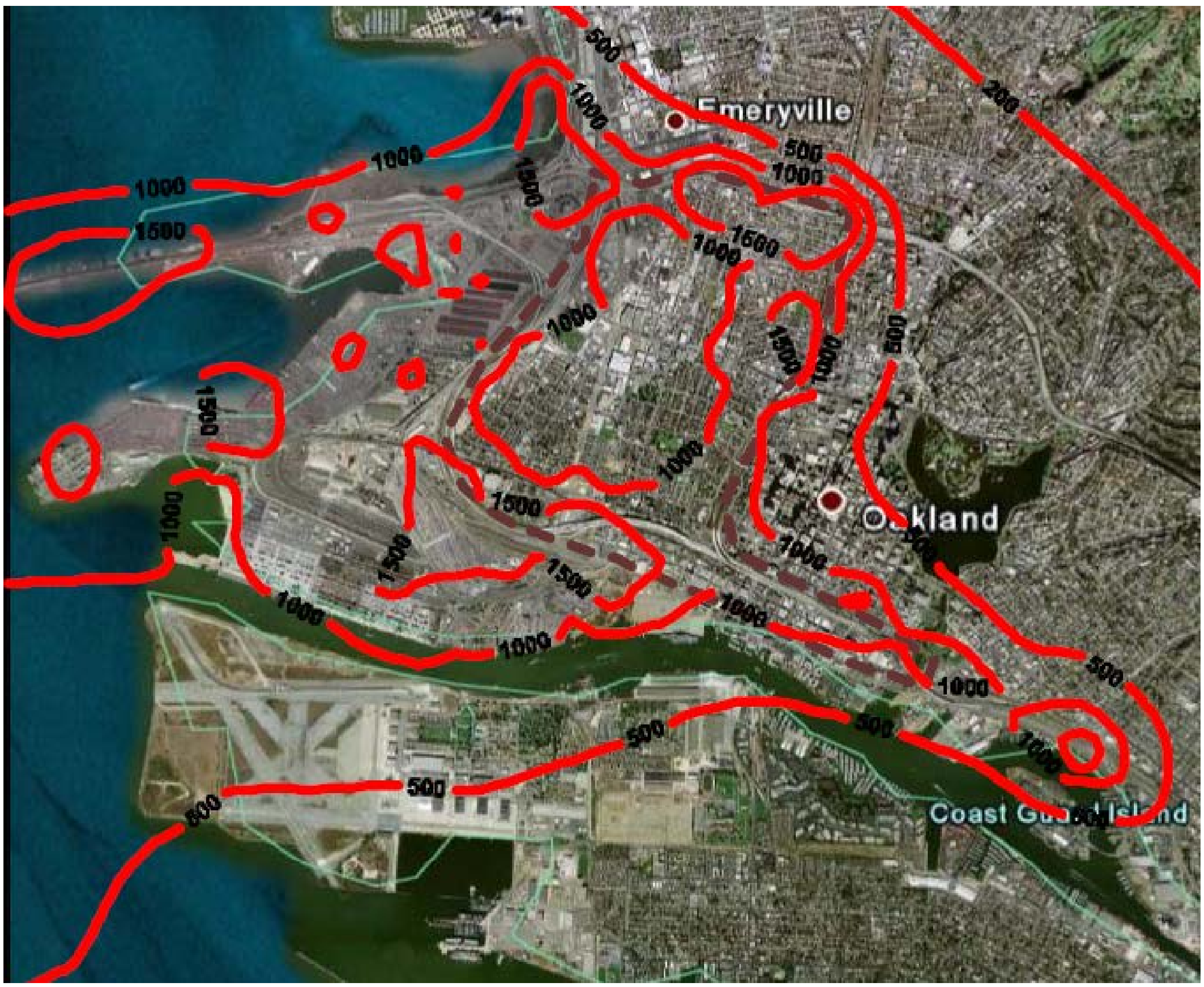
[2] In this memorandum, however, we assume that the cancer risk values presented by the ARB West Oakland Study represent just the residential population.

[3] The ARB study assumes that the increased population and activity growth in 2020 combined will exceed the diesel emissions reductions required by the regulatory program, thus resulting in an increase in emissions from 2015.

[4] The BAAQMD 2010 CEQA Guidelines have been formally suspended due to a court order which found that BAAQMD had to complete a CEQA evaluation of the CEQA guidelines before their adoption. BAAQMD's CEQA guidelines are not mandatory but CEQA lead agencies may choose to use them or not, as appropriate.

Table 1 are based on long-term exposure (i.e., 24-hours per day, 350 days per year, 70 years of exposure), an adjustment factor, discussed later, would need to be applied to the values presented in Figure 1 and Table 1 to characterize lower potential cancer risks for recreational visitors to the Gateway Park project, based on a lower exposure duration associated with the transitory use of Gateway Park.

Figure 1 - Estimated West Oakland Community Potential Cancer Risk from All Diesel PM Emissions Sources in 2005 (CALIFORNIA AIR RESOURCES BOARD 2008: Figure 10)[5]



5 The ARB West Oakland Report assumes "[t]he risk levels are based on the 80th Percentile Breathing Rate. Total Modeled Emissions = 845 T/Y in 2005. Modeling Domain = 10 km x 10 km. Resolution = 250 m x 250 m. The dashed line represents the boundary for the West Oakland community."

Table 1 - Cancer Risks and Annual DPM emissions in 2005 by Emissions Source and Gateway Park location

Source	Diesel PM Emissions (TPY)	Residential[a] Cancer Risk to Gateway Park core area (by the Bay Bridge toll plaza)		Residential[a] Cancer Risk to Gateway Park east area (by the I-880 section between the Port and West Oakland)	
		min	max	min	max
All Sources	**845**	**1,000**	**>1,500**	**1,000**	**>1,500**
PART I - Port Operations	265	200	500	200	500
Port OGV	*209*	*100*	*225*	*100*	*200*
Port Trucks	*20*	*10*	*100*	*10*	*100*
Cargo Handling Equipment Activity	*21*	*10*	*100*	*10*	*100*
Commercial Harbor Craft	*13*	*10*	*100*	*10*	*100*
Port Locomotive	*2*	*1*	*10*	*1*	*>10*
PART II - UP Oakland Railyard	11	10	100	100	200
Cargo Handling Equipment Activity	2.2	-	-	-	-
Heavy Diesel Trucks	1.9	-	-	-	-
Locomotives	3.9	-	-	-	-
Transportation Refrigeration Units	3.2	-	-	-	-
PART III - Non-Port/Non-UP Activity	568	500	>1,000	500	>1,000
Off-Port On-Road Trucks	*90*	*200*	*>1,000*	*200*	*>1,000*
Off-Port OGV	*218*	*25*	*75*	*25*	*50*
Off-Port Commercial Harbor Craft	*238*	*100*	*500*	*100*	*200*
Amtrak	*3.4*	*<10*	*n/a*	*10*	*100*
Cargo Handling Equipment Activity	*4.3*	*1*	*10*	*1*	*10*
Off-Port Locomotive	*1.3*	*1*	*10*	*10*	*>10*
Stationary Sources	*0.2*	*<1*	*n/a*	*0*	*1*
Bay Bridge Construction	*13*	*1*	*25*	*1*	*10*
Distribution Center Truck Activity	-	*1*	*100*	*10*	*100*

Note:
TPY = Tons per Year.
- denotes value unavailable in report.
[a] These cancer risk values are based off of the isopleth maps available in the ARB West Oakland Study which looks at the overall cancer risk for the general population over a 70 year lifetime period. Patrons of the Gateway Park will be active at the park for short periods of time and will not reside there, thus the actual cancer risk at the park is anticipated to be lower. The values included here present an understanding of the contribution emissions sources to the overall health risks.
Source: Table 2 and Figures in Appendix D from the ARB West Oakland Study (California Air Resources Board 2008)

BAAQMD West Oakland Monitoring Study

Subsequent to the 2008 ARB West Oakland Study, in 2010, the BAAQMD published the *West Oakland Monitoring Study*[6] with the purpose of providing supplemental air quality monitoring data of Toxic Air Contaminant and diesel emissions concentrations in areas within and around the Port of the Oakland. Measurements of elemental carbon were used as surrogates to estimate the ambient levels of diesel emissions, as 70 to 90% of elemental carbon emissions were from diesel exhaust[7]. Sixteen air quality monitors were placed throughout West Oakland and measured over a four week period in two seasons: Summer 2009 and Winter 2009/2010. No monitors were located within 1,000 feet of the Gateway Park area by the Bay Bridge toll plaza; however, six monitors were located along I-880 east of the Port of Oakland. The study found that:

- Emissions concentrations were greater at locations closer to roadways with higher traffic levels and decreased at distances further from those roadways.
- DPM emissions by roadways were over five times higher than the West Oakland community average.
- Emissions from trucks were generally limited to well-established truck routes, whereas autos travel more ubiquitously through the area.
- The decrease in emissions measured between 2005[8] and 2009/2010[9] fell within the 20 to 50% reduction in DPM emissions sources projected by the 2008 ARB West Oakland study. According to the BAAQMD study, this was likely due to the impact of private fleet diesel truck and marine main engine clean fuel regulations which were adopted in 2008.
- West Oakland DPM concentrations in West Oakland were an average of 1.4 $\mu g/m^3$, which translates to a cancer risk of just under 450 in a million[10], in comparison to the average cancer risk estimated for 2005 of 1,187 in a million as estimated by the ARB West Oakland Study, a 62% reduction. (Bay Area Air Quality Management District 2010a).

The BAAQMD *West Oakland Monitoring Study* provides a confirmation of the effect of regulations and policies on air quality in reducing DPM emission in the real world. The findings also reaffirm that those living in close proximity to freeways and other major truck routes are exposed to a greater health risk than those living further from such sources. The study does not, however, make projections as to the future cancer risks or pollutant concentrations based on the monitoring data

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[6] This draft report was prepared by the Desert Research Institute. As of May 30, 2013, no final report was available on the BAAQMD website.

[7] Based on a Chemical Mass Balance analysis in the same report.

[8] Values from ARB's 2008 West Oakland Study

[9] Values from the BAAQMD West Oakland Monitoring study

[10] The BAAQMD report estimated 2005 concentrations of DPM in $\mu g/m^3$ by dividing the modeled potential cancer risk isopleths values by 318 (BAAQMD 2010b: 4-3). Accordingly, the average 2009-2010 concentration of 1.4$\mu g/m^3$ was multiplied by 318 to calculate the associated cancer risk for West Oakland in 2009-2010. This adopted calculation is supported by the fact that both the ARB study and the BAAQMD study used the same cancer risk methodology, the OEHAA Tier 1 Analysis.

performed. Based on these findings, the portions of Gateway Park that are closer to the I-80, I-880, and I-580 freeways will have greater exposure to DPM than areas further from these sources, as close proximity to freeways and other major truck routes was found in this study to have a strong effect on local DPM concentrations and associated health risks.

Effects of Diesel Particle Filter Retrofits and Accelerated Fleet Turnover on Drayage Truck Emissions at the Port of Oakland

Researchers from the UC Berkeley published an article in the Journal of Environmental Science and Technology in 2011 (Dallmann, et. al. 2011) which documented a more recent effect of government regulations on real world diesel exhaust emissions. The purpose of this work was to measure the effect of ARB's drayage truck emissions control regulations, which became in effect in 2010, by measuring diesel emissions concentrations along major truck routes by the Port of Oakland before and after the regulation's adoption. Trucks affected by ARB's regulation consist of those that transport goods to or from California Ports and intermodal rail yards (California Air Resources Board 2012a). The ARB drayage regulation mainly required:

- A ban on all affected trucks with vehicle engine model years of 1993 or older by 2010,
- Diesel Particulate Filters (DPF) to be installed on all engines of model years between 1994 and 2003 by 2010, and
- Trucks of model years 2004 through 2006 are required to be retrofitted with DPFs by between 2010 and 2013, depending on the model year. [11]

The authors, Dallmann, et. al, measured the black carbon, a surrogate for diesel exhaust emissions at an overpass crossing over a major non-freeway surface street during a weekday day time period of 4-5 hours in November 2009 and June 2010[12]. Dallmann, et. al. 2011 findings included:

- Black carbon (from DPM) decreased by about 50% between 2009 and 2010 from Drayage trucks entering the Port.
- The fraction of very low-emitting trucks with lower black carbon emission rates was 3 times higher in 2010 than in 2009 within a span of 7 months.

The authors reasoned that the reduction in emissions from trucks was related to the accelerated turnover of older, more polluting vehicles and DPM filters requirement on the newer vehicle models. This conclusion was further supported by verifying the truck age distributions before and after the 2010 ARB regulations went into effect.

As discussed earlier, on road diesel trucks accounted for the majority of sources of cancer risk in the West Oakland and Gateway Park area. This study emphasized the importance and real-world impact

[11] Additionally, the regulation also provides incentives for the replacement of older trucks with 2007 or newer model year trucks that meet the strictest current emissions standards.
[12] The study assumed that retrofits were 95% complete by June 2010, based on a personal communication with Cleaire Advance Emission Controls in San Leandro.

of such regulations as the ARB Drayage Truck rules. Thus these and similar regulations should be taken into account when projecting future truck emissions.

Practical Mitigation Measures for Diesel Particulate Matter: Near-Road Vegetation Barriers (Fuller et. al. 2009)

A joint report between UC Davis and Caltrans was published in 2009 addressing the efficacy of using vegetative road-side barriers as mitigation for DPM from vehicular sources. The motivation for this report was based on the concern over siting sensitive receptor land uses (e.g., parks, schools, residences) near freeways and heavily trafficked roadways. The concern was further prompted by ARB policy recommendations to "avoid siting new sensitive land uses within 500 feet of a freeway, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles/day"(California Air Resources Board 2005) and the fact that many existing schools and other sensitive land uses were already within the 500 foot suggested buffer. The proposed Gateway Park area may be located as close as 15 feet from the nearest roadway, and the entire Gateway Park area is entirely within 1,600 feet of major freeways[13].

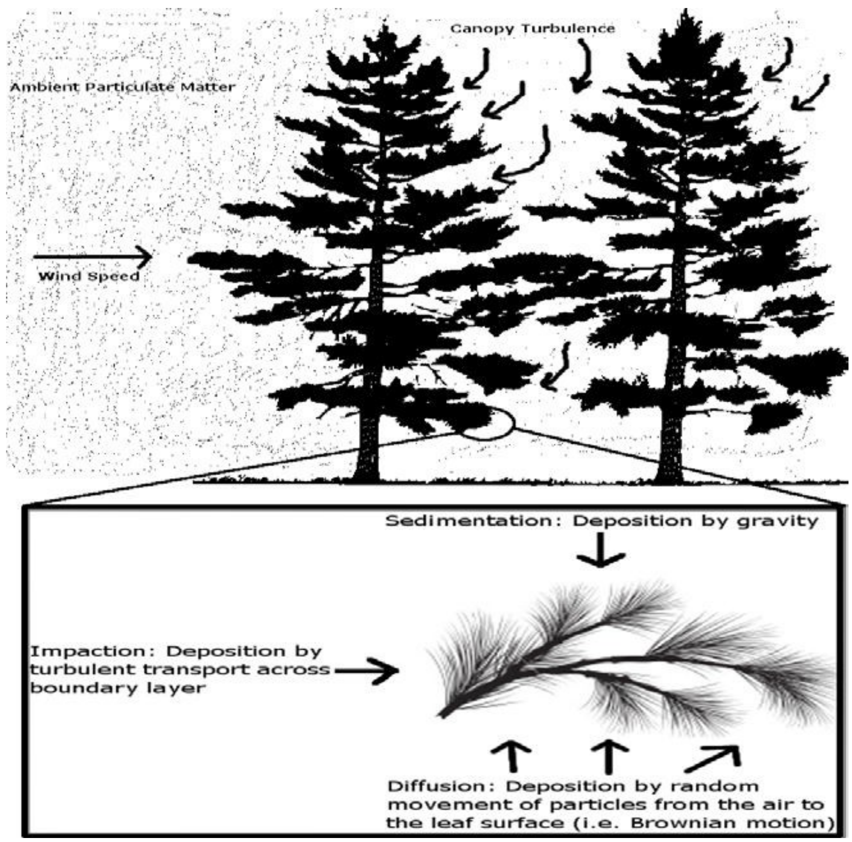
This study hypothesized that configurations of specific types of vegetation planted by the roadway source, between the roadway and receptors, would lessen the DPM concentration at the receptor through the absorption of DPM by the vegetation. The researchers modeled the gradient of DPM concentration perpendicular to a roadway for a variety of tree species and planting configurations and had the following findings:

- Vegetation captures airborne particulate matter that contacts coarse and sticky surfaces on the vegetation.
- Tall evergreen trees with greater surface area on foliage, branches, and trunk provide the most effective absorption of DPM. Evergreen trees also tend to be longer living and have coarse bark that maximizes surface area on the tree.
- Trees sited close to the emissions source (i.e., at the roadway) are more effective at reducing pollutant concentrations at the receptor than trees sited further from the roadway (i.e., at the receptor) due to the dispersion of the pollutants by the time they reach the vegetative barriers.
- Through a literature review, the study found that redwood trees could reduce between 83 and 99% of PM sized between 0.10 and 0.015μm, respectively at a wind speed of 1.0 m/s (Fuller et. al. 2009:7, Cahill 2008).
- Tree planting configuration significantly affects the wind flow through the vegetative barrier[14]. The study recommends specific spacing patterns for the best PM capture rate through a semipermeable barrier configuration to allow enough flow to the trees as to

[13] The furthest point perpendicular to the I-80 is located at the southern end of Gateway Park core area, where a small pier is currently located. This point is just under 1,500 feet from the edge of the I-80 to the north. All other areas of the park are located within 1,500 feet of either I-80, I-560, or I-880.
[14] The reasoning is based on of a wind tunnel study performed by Cahill (Cahill 2008).

facilitate greater contact between particles and tree surfaces. Trees that are planted too close together create an impermeable barrier that could cause higher concentrations of pollutants at 80 feet away from the barrier and beyond.

Figure 2 - Dry Deposition Illustration (UC Davis, Caltrans 2010:Figure 2.3)



The study explains the capture of pollutants via the dry deposition method, shown in Figure 2, which characterizes the transport of the particles through tree canopies via sedimentation, impaction, and diffusion. Table 2 shows published estimated PM removal rates of wind flow through redwood trees for various PM sizes.

Table 2 - Estimated PM Removal By Redwood Vegetation

Particle Diameter (μm)	Percent Removal by Redwood Vegetation
0.1	83%
0.075	86%
0.05	90%
0.035	95%
0.015	99%
Source: Cahill 2008, Fuller et. al. 2009:7	

Data Sets

The following selected data sets present relevant data that can be used to determine the transport and risk of pollutants from the major sources in the West Oakland and project area.

BAAQMD Windrose Data

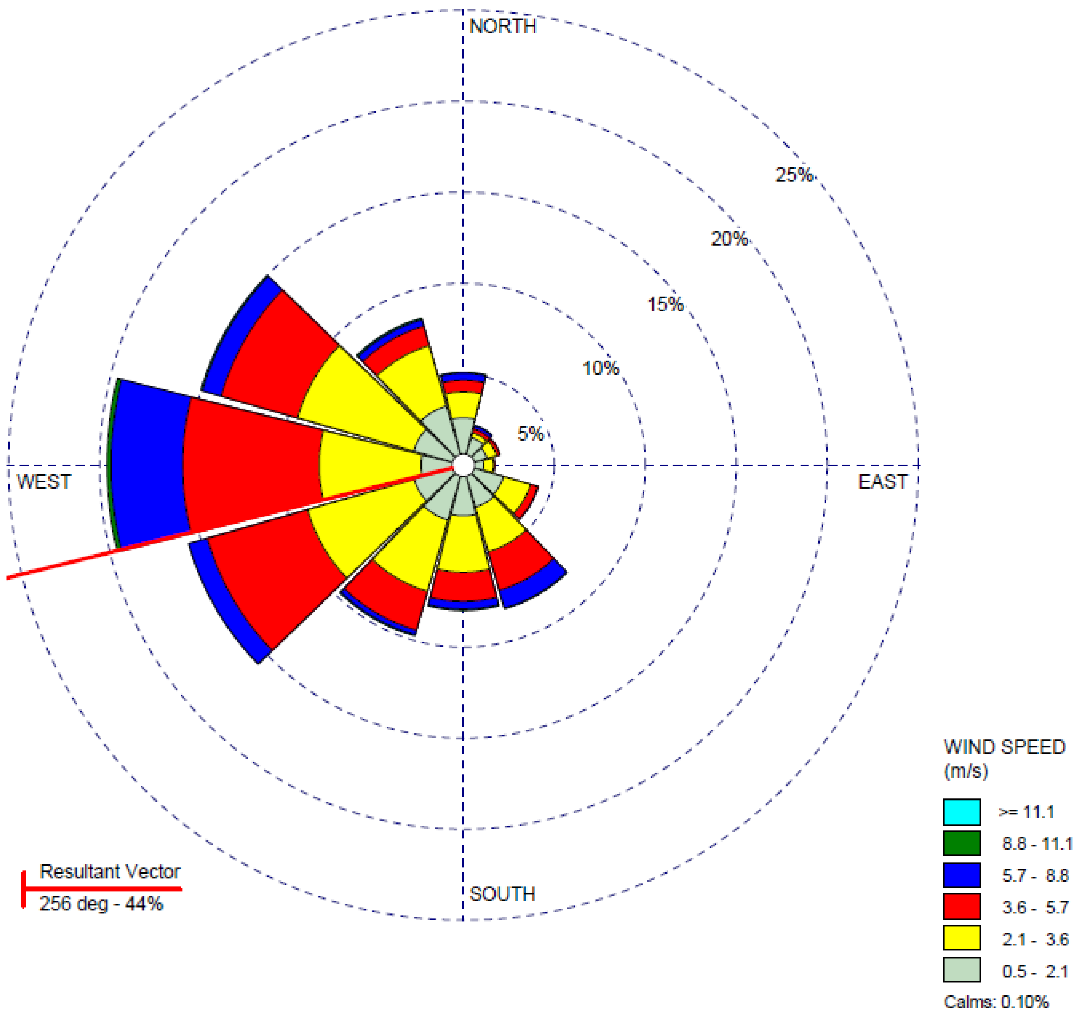
The BAAQMD gathers meteorological data, including wind speed and directional data, from monitoring sites throughout the Bay Area (Bay Area Air Quality Management District n.d.). Two monitoring sites are located within 1 mile of project area: at the Port of Oakland (0.8 mi) and the Oakland Sewage Treatment Plant (STP) located on East Bay Municipal Utility District property directly adjacent to the east of the Gateway Park project area (150 feet). Data from these sites were input into the WRPLOT View™ wind rose plot program to view individual and combined wind rose data (Lakes Environmental 2011). At both sites, wind speed and direction in the West Oakland area blow from the west around 20% of time and from the southwest and northwest at around 15% of the time from each direction. The majority of wind speeds range between 2.1 and 8.8 meters/s (m/s), with an average speed of 3.25 m/s heading in the east northeasterly direction 44% of the time[15], as shown in the wind rose in Figure 3. Additional wind rose figures are attached at the end of this memorandum.

Given this information, the Gateway Park core area would be most affected by latitudinal travel of marine and ocean going vessels west of the park area in the San Francisco Bay. The Gateway Park east area, as it is located underneath and around the I-880 and I-880/580/80 Maze (east of the Port of Oakland), would be most impacted by pollutants traveling eastward from activities at the Port of Oakland[16]. The impact of these meteorological factors is taken into account in the synthesis of the cancer risks from the ARB West Oakland Study.

[15] The most recent data available from the BAAQMD meteorological site was obtained in 2000 (Bay Area Air Quality Management District n.d.). However, a recent air monitoring network report published in 2012 with 2011 meteorology data for the Oakland STP site shows wind patterns that are consistent with those reported for 2002 (Bay Area Air Quality Management District 2012b).

[16] Additionally, the technical documents supporting the air dispersion model, CALINE 4, suggest that a greater concentration of pollutants would be present at receptors located close to and below freeways than in a typical at-grade situation at the same perpendicular distance from the freeway (Benson 1989:95).

Figure 30 - Combined Wind Rose Plot for the Wind Patterns Monitored at the Port of Oakland and the Oakland Sewage Treatment Plant. (Direction blowing from)



BAAQMD Cancer Risk Data

The BAAQMD 2010 CEQA guidelines recommends that a Lead Agency identify all $PM_{2.5}$ sources located within a 1,000 foot radius of a proposed project site, and recommends enlarging that radius if there are major sources beyond the 1,000 foot radius. Additionally, the Air District also provides a Google Earth™ based screening tool, used for addressing district PM thresholds, that characterizes cancer risks from various transportation and stationary sources (Bay Area Air Quality Management District 2012c). This screening tool shows the location of major sources and the associated health risks. The top three stationary and highway sources and their health risks are summarized in Table 3 below.

Table 3 - Nearby Stationary Sources and Their Associated Cancer Risks

Source	Source Location	Receptor Location	Cancer Risk per Million at Receptor
Top three Stationary Sources[a]			
EBMUD[b]– Wastewater Treatment Plant and Disposal Facility	2020 Wake Avenue, Oakland, CA	Not Available[c]	853
Caltrans – SF Bay Bridge	Toll Plaza	Not Available[c]	87
Alameda County Public Works Agency	3455 Ettie Street, Oakland, CA	Not Available[c]	36
Top Three Highway Sources[c]			
Link 815	I-80 near the Bay Bridge Toll Plaza	Bike/Pedestrian path located 25 feet south of link	123
		Transportation Museum outdoor facilities located at 175 south of link	56[c]
		Touchdown Pavilion located 200 feet south of link	50
		Baywalk at The Point located 400 feet south of link	31
Link 819	I-80 link 1 mile east of the Toll Plaza	Bike Path at 50 feet south of link	93
Link 822	I-80, between Link 819 and the I-580 and I-880 interchange	Bike Path at 50 feet south of link	92

[a] The BAAQMD database does not indicate what pollutants cause the cancer risks from these stationary sources. Therefore, it cannot be determined that these cancer risks are specifically due to DPM emissions or not.
[b] East Bay Municipal Utility District
[c] The screening-level risk and hazard impacts in the stationary source screening tool do not represent actual impacts. The values are based on worst case assumption scenarios to determine whether or not a refined modeling analysis may be needed. The calculations used in the screening analysis do not include source specific exhaust information such as stack height, exhaust gas exit velocity, exhaust gas temperature, nor do they account for actual distances from receptors.
[d] For the purposes of data accessibility, the BAAQMD divides major highways into links of approximately 0.5 to 2km in length, depending on continuity, and publishes the estimated health risks associated with each link and the receptor distance and orientation from each link on their website (Bay Area Air Quality Management District 2012c). The District also provides different health risk data depending on whether the receptor would be located at-grade (6-foot height above the ground) or elevated in a building 2 stories or higher (20-foot height above the ground). The top three links with the greatest health risks assume a receptor height of 6 feet. Note that these cancer risks represent residential cancer risks. Actual risks due to recreational activity and exposure rates may reduce these cancer risks.
[e] Extrapolated between cancer risks at 100 feet and 200 feet.
Sources: Bay Area Air Quality Management District 2012c

As shown by the cancer risks posed by major nearby sources to the project area, the cumulative cancer risks are well beyond the BAAQMD's recommended cumulative threshold of 100 per million. Stationary source emissions from the EBMUD Wastewater Treatment Plant and disposal facility alone would result in health risks well in excess of the air district's threshold, at 853 per million. Because the pollutants that cause the stationary source health risks are unknown, cancer risks from stationary sources are excluded from following cancer risk analysis at Gateway Park below. [17] The cancer risks from highway sources, on the other hand, are included along with other local diesel emissions sources addressed in the scope of the ARB West Oakland Study in the cancer risk analysis below.

Applicable Regulations and Policies

The following summarizes applicable federal, state, and local regulations that impact diesel emissions in the present and future. Adopted or amended dates are in parenthesis.

Federal Regulations

- Stricter federal vehicle emissions standards for vehicle model years 2007 and newer (U.S. Environmental Protection Agency 2000).
- Low Sulfur and Ultra-Low Sulfur Fuel (2000)
    - These low sulfur fuels are phased-in for applicable nonroad, locomotive, and marine diesel engines from 2007 to 2014.
    - Ultra Low Sulfur Diesel was phased in for highway diesel fuel from 2006 to 2010. (U.S. Environmental Protection Agency 2000).
- Ocean Going Vessel regulations
    - North American Emission Control Area (ECA) (U.S. EPA 2010)
        - Fuel sulfur must be 35,000 ppm or lower by 2012
        - 5,000 ppm by 2020 depending on fuel availability[18]

State Regulations

- Diesel Risk Reduction Plan (DRRP) (2000)
    - Goal of reducing diesel PM emissions by 75% by 2010 and 85% in 2020 from 2000 values by requiring filters and greater vehicle turnover of older more polluting highway diesel vehicles. (California Air Resources Board 2000)
    - The DRRP supports a variety of other regulations, including:

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[17] Despite the high cancer risk from EBMUD, this memorandum excludes stationary source cancer risks from the quantification of potential future cancer risks at Gateway Park because it is unknown whether or not the stationary source pollutants are diesel exhaust. Also, the ARB West Oakland study does not for these stationary sources in the calculation of the overall cancer risks.

[18] "The 2015 fuel sulfur standard of 0.1 percent fuel sulfur (1,000 ppm) is expected to reduce PM and SO_X emissions by more than 85 percent from today's levels. " (U.S. Environmental Protection Agency 2010).

    - Truck and Bus Regulation (2008)[19]
        - 100% of heavier trucks will need to comply with the PM Filter regulation by 2016.
        - Starting January 1, 2012, heavier trucks must be retrofitted with PM filters.
        - Starting January 1, 2015, older trucks would need to be replaced with newer trucks.
        - By January 1. 2023, all otherwise non-exempt trucks and buses, including drayage trucks, will need to have a 2010 model year engine or the equivalent. (California Air Resources Board 2013).
    - Port Drayage Truck Regulation (2010)
        - Ban on vehicle engine models older than 1994 which are not suitable for retrofitting
        - DPFs on all engines between the 1994 and 2003 model years by 2010. DPFs on 2004-2006 models by between 2010 and 2013, depending on the vehicle.
        - Incentives to encourage older engines (from 1994 and newer) to be replaced by 2007 or newer model year trucks that meet the strictest exhaust PM emissions standards.
        - All drayage trucks are to follow the truck and bus regulation as applicable. (California Air Resources Board 2011b)
- Goods Movement Emissions Reduction Plan (2006) (Proposition 1B)
    - Allots money for grants to air districts to assist ports in improving energy efficiency, electrification, or other emissions reduction efforts through new technologies.
    - As of December 2012, the BAAQMD's early grant project has completed the installation of install grid-based electrical power for three ship berths at the Port of Oakland. The installations of such power at nine additional berths have commenced. (California Air Resources Board 2012b).
- Ocean Going Vessel regulations
    - As of August 1, 2012, ships must comply with both the California OGV fuel regulation and North American Emission Control Area (ECA).
        - California OGV Fuel Regulation
            - Phase II Fuel requirements effective in 2014 Marine Gas oil <= 0.1% sulfur, marine diesel oil <= 0.1% sulfur. (California Air Resources Board 2012c)
- Harbor Craft

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[19] "The regulation applies to nearly all diesel-fueled trucks and buses with a gross vehicle weight rating (GVWR) greater than 14,000 pounds that are privately or federally owned and for privately and publicly owned school buses." Municipal service vehicles do not count. (California Air Resources Board 2011a)

- All non-exempt harbor craft are to meet the engine emissions standard compliance schedule outlined in ARB's Final Regulation Order: Title 17, Section 93118.5 effective June 20, 2011. Compliance standards will vary depending on craft type, engine model year, and engine fuel.
- Any in-use diesel fueled harbor craft must comply with the low sulfur fuel use requirement in section 93118.5(e)(1) effective June 20, 2011. (California Air Resources Board 2012d).

Additional state policies, as summarized by the 2008 ARB West Oakland study, are summarized in Table 4, below.

Table 4 – Additional ARB Regulations that Reduce Emissions from Diesel PM On- and Off-Road Vehicles and Equipment (adoption date provided in parenthesis) (California Air Resources Board 2008:30)

Additional Adopted State Regulations	
Regulation	Adopted Date
New on-road heavy-duty diesel engine standards	October 2001
Tier 4 standards for new off-road diesel equipment	December 2004
California diesel fuel for harbor craft and intrastate locomotives	November 2004
Low-sulfur diesel fuel for vehicles and off-road equipment	July 2003
Heavy-duty engine manufacturers diagnostics	May2004
Heavy-duty on-board diagnostics	July 2005
Cleaner fuel for ship auxiliary engines	December2005
2005 California Rail MOU	
Transport refrigeration units	February 2004
Diesel truck operational idling limits	July 2004
Clean up existing diesel cargo handling equipment at ports and intermodal railyards	December 2005
Clean up existing fleet of off-road diesel equipment	July 2007
Clean up existing fleet of harbor craft	November2007
Cold ironing regulations	December 2007
Clean up port truck fleets	December 2007
Cleaner fuel for ship main engines, auxiliary engines and auxiliary boilers	July 2008
Clean up existing private fleets of diesel trucks	December 2008

Relevant State Policies (not requirements)

- Air Quality and Land Use Handbook: A Community Health Perspective recommends
    - "avoid[ing] siting new sensitive land uses within 500 feet of a freeway, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles/day." (California Air Resources Board 2005)

Local Regulations

In addition to supporting ARB's Diesel Risk Reduction Plan, the BAAQMD has local regulations to limit PM emissions from a variety of sources via permits as well CEQA thresholds for planned projects. The threshold applicable to this Project is as follows.

- BAAQMD Health Risk Thresholds: Cumulative Thresholds[20] A project is considered significant if a new receptor is placed within 1000 feet of a source and results in:
    - An increased cancer risk of greater than 100 in one million,
    - An increased non-cancer risk of greater than 10.0 hazard index, and
    - An increase in ambient PM2.5 concentration by 0.8 µm/m^3 from all local sources. (Bay Area Air Quality Management District 2010b:2-2)
- Port of Oakland's Maritime Air Quality Improvement Plan (April 2009)
    - The plan supports the implementation of the Port Maritime Air Quality Policy Statement which sets a goal of reducing the excess community cancer health risk related to exposure to DPM emissions associated with the Port's maritime operations by 85% from 2005 to 2020.
    - The plan set interim goals of reducing emissions in 2012 and 2020.
        - On and near shore PM emissions were to be reduced by 65% by 2012 and 85% by 2020 from 2005 values.
        - Off-shore emissions were to only to increase by 2% by 2012 and were to be reduced by 85% by 2020 from 2005 values. (Port of Oakland 2009)

Analysis and Discussion

Background Health Risks

Health risks from existing diesel emissions sources were conveniently summarized into the overall cancer risks by location as shown by the isopleths from the ARB West Oakland Study. The air dispersion modeling of the 2005 cancer risks took into account local wind speed and direction and other meteorological conditions. Total cancer risk from the port operations, rail yard, and other freight activity was between 1,000 and 1,500 in a million in 2005 for all areas of the Gateway Park project. Under 2005 scenarios, the majority of DPM is from On-Road Trucks which contributes from 20% to over 60% of the project area's cancer risk. The ARB projects that diesel emissions will be reduced by 80% from all sources by 2015 due to state regulations (California Air Resources Board 2008).

[20] In March 2012, an Alameda County Superior Court ruled that BAAQMD needed to comply with CEQA prior to adopting their 2010 Air Quality CEQA Guidelines, which included significance thresholds for criteria air pollutants and greenhouse gases. The Superior Court did not determine whether the thresholds were valid on the merits, but found that the adoption of the thresholds was a project under CEQA. While the BAAQMD is no longer recommending its significance thresholds for use by local agencies at this time, the BAAQMD thresholds are well-grounded on air quality regulations, scientific evidence, and scientific reasoning concerning air quality and greenhouse gas emissions

Park Health Risks

Anticipated health risks at the Gateway Park will likely be lower than those estimated in the ARB's West Oakland Study due to differences in the operational year analyzed (2005 in the ARB study compared to anticipated 2015 opening for the year), which affects the impact of applicable diesel emissions regulations, the exposure rate of the park patrons to pollutants, as well as the level of activities occurring in the Port in 2005 compared to 2015. The Park is scheduled to be open to the public in 2015, by which time the ARB estimates that diesel emissions and associated cancer risks will be 80% less than 2005 values (and 85% less by 2020). An 80% reduction in 2015 would result in a 70-year lifetime cancer risk of between 200 and 300 in a million (between 150 and 225 in 2020). Because this project's land use is transitory in nature, the use of such lifetime cancer risks substantially overestimates the health risks in the park area.

A more realistic cancer health risk can be scaled based on the estimated exposure rates between typical park patrons and the permanent resident characterized in the 70-year lifetime exposure scenario. The 70-year lifetime scenario assumes the standard OEHHA approach, which characterizes an extreme case of a resident who spends 350 days a year[21], or 8,400 hours per year[22], in the area. On the other hand, most Park visitors will likely be at the Park for far less time. As an example, park visitation of 2 hours per week or 104 hours per year would result in an exposure level of 1.2% of the lifetime occupancy rate. Using this exposure scenario, the scaled cancer risk for visitors to Gateway Park area in 2015 is estimated to be between 2.38 to 7.66 in one million, as shown in Table 5, depending on the type of patron (e.g., whether the patron is a child or adult visitor, or a passing bicycle commuter).

The cancer risks estimated for the Park visitors (using the exposure assumption of 2 hours per week) are well below the BAAQMD cumulative threshold of 100 in a million for increased cancer risk to a new receptor. In order to exceed the 100 in a million threshold at Gateway Park (using the profile of DPM exposure used in this memo), visitation would have to be more on the order of 30 times the example case (or approximately 60 hours per week).

However, it is important to note that these calculations are based on diesel emissions sources identified by the ARB West Oakland Study and do not include the effect of local stationary sources emitting other toxic air contaminants, such as those from the nearby EBMUD wastewater treatment plant located on the eastern side of the Park (See Table 3). In addition, this memorandum has not looked at potential exposure from port and freight operations associated with the adjacent Oakland Army Base redevelopment project.

A further consideration is the relative risk level of park visitors. As described above, West Oakland residents, depending on location, experience substantially elevated exposures to DPM. Since the Gateway site has similar levels of potential DPM exposure, West Oakland residents would likely not increase their DPM exposure level by visiting Gateway Park, compared to exposure from recreating within West Oakland itself. Thus, risks shown in Table 5 also need to be considered in the context of DPM exposures at existing or alternative recreational locations.

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[21] OEHHA accounts for times not present due to holidays and vacation.

[22] Assumes 24 hours per each of the 350 days per year.

Table 5 - Scaled Cancer Health Risks in 2015 for Selected Gateway Park Patrons

Receptor Type	Hours per week	Hours per year	Percent of Lifetime Exposure[a]	% of normal adult breathing rate[b]	Cancer Risk (Low)	Cancer Risk (High)
2005 Background - 70 year Lifetime[c]	168	8,400	100%	100%	1,000	>1,500
2015 Projected - 70 year Lifetime[d]	168	8,400	100%	100%	200	>300
Visitor - Adult in 2015	2	104	1.2%	100%	2.48	>3.71
Visitor - Child in 2015	2	104	1.2%	150%	3.71	>5.56
Bicycle Commuter in 2015[e]	1.67	86.67	1.0%	130%	2.69	>4.03

[a] The percent of lifetime exposure is calculated on an hours of exposure per year basis.

[b] According to the OEHHA's *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*, the average adult breathing rate is 302 liters/kg per day for an 85th percentile, while the average child breathing rate is 452 liters/kg per day. Bicycle commuter breathing rates assume a high end adult breathing rate of 393 liters/kg per day. (California Environmental Protection Agency 2003:5-15,5-16)

[c] Only the cancer risks are based on values from the ARB West Oakland Study (California Air Resources Board 2008: 23). Hours per year assume 350 days per year, accounting for holidays and vacations, per OEHHA guidance.

[d] Adjusted cancer risks assume a proportional change with the 80% reduction in PM emissions anticipated for 2015. Hours per year assume 350 days per year, accounting for holidays and vacations, per OEHHA guidance.

[e] Assumes a bicyclist travels an average of 12 mph and the bicycle path way from the Gateway Point to the I-80/I-560 junction is 2 miles, which will take the bicyclist 10 minutes. This assumes a daily weekday round trip through the same bike path.

Recommendations

As previously mentioned, government regulations aimed to curb DPM emissions from diesel vehicles and vessels have shown to be successful in mitigating DPM in recent years and are expected to continue to do so in the future. A projected 80% reduction in DPM emissions in the West Oakland area by 2015 in addition to low exposure rates at the Park would reduce estimated cancer risks to visitors to well under maximum levels established by the BAAQMD. Despite the likely low incremental health risk (due primarily to the limited exposure duration) and planned emissions regulations, the potential DPM levels would likely remain elevated due to the number and proximity of pollutant sources surrounding the area, especially emissions sources from the adjacent freeways.

The EIR/EA analysis will determine whether or not the health risks are or are not considered significant through consideration of all existing and future sources and site exposures. If the EIR/EA determines that impacts are significant, then feasible mitigation will be evaluated. The analysis in this memorandum is preliminary at this time.

The application of additional control measures at Gateway Park could help to further reduce emissions from these sources, whether the EIR analysis finds significant impacts or not:

1. Plant vegetative barriers between the park and I-80 per configurations suggested by the UC Davis/Caltrans study on DPM vegetative barriers (Fuller et. al. 2009, 2013). Proper vegetative barriers may reduce DPM emissions by between 83% and 99%.[23]

2. Avoid locating areas where persons are expected to be spend relatively more time (such as assembly areas or picnic areas) directly adjacent to freeways.

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[23] While on-road diesel trucks, as shown in Table 1, have been identified as the most significant source of DPM cancer risk in the project area, commercial harbor craft and OGVs are also significant contributors. However, because marine vessels would generally emit diesel exhaust over bodies of water some distance away from the shore of the Park, pollution from these sources are likely to be too diffused by the time it reaches the Park area for a vegetative barrier to work against this source of DPM. Fuller et.al. 2009 and 2013 strongly suggest planting vegetative barriers as close to the source as possible.

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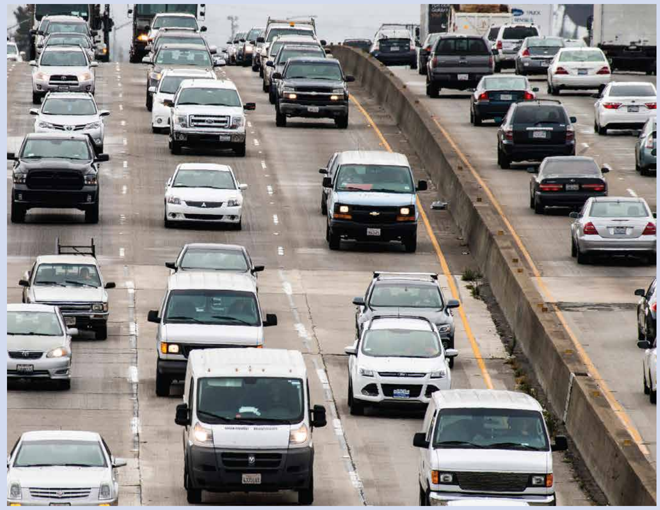
Appendix B-2

Excerpt of Air Pollutant Dispersion Analysis Results from the West Oakland Community Action Plan

FINAL



Owning Our Air

The West Oakland Community Action Plan – **Volume 2: Appendices**

October 2019

A joint project of the Bay Area Air Quality Management District and West Oakland Environmental Indicators Project

Bay Area Air Quality Management District

West Oakland Environmental Indicators Project
know which way the wind blows

5. Results

Annual average local $PM_{2.5}$, DPM, and cancer risk results derived from dispersion modeling are presented in this section in a series of maps. Additionally, a source apportionment is performed where information is provided on the relative contributions of the source categories described in previous sections: permitted stationary sources, on-road mobile sources (by road type and vehicle category), Port-related sources (e.g., OGVs, CHE), locomotives on rail lines and at railyards, and other sources (e.g., truck-related businesses). All results are presented with respect to the total emissions represented in the community-scale emissions inventory as noted in **Section 2.1.5**, unless otherwise specified.

5.1 $PM_{2.5}$ Concentrations

Based on combined AERMOD results from all sources, the annual average $PM_{2.5}$ concentration associated with local sources in the West Oakland averaged over the community domain[89] was 1.71 µg/m^3, with local concentration contributions exceeding 4.0 µg/m^3 in areas that are proximate to large emission sources and roadways (**Figure 5-1**). This annualized value reflects an average of all receptors in the domain; when the calculation is weighted by population in Census blocks (i.e., residential areas), the annual average local $PM_{2.5}$ concentration increases slightly to 1.73 µg/m^3, largely due to the higher levels of road dust emissions in the residential areas.

The average local $PM_{2.5}$ concentration was 1.71 µg/m^3, whereas the background concentration was 6.9 µg/m^3 (**Section 3.6**), resulting in a total average $PM_{2.5}$ concentration of 8.61 µg/m^3. This value compares well with the annual average $PM_{2.5}$ concentration of 8.7 µg/m^3 measured at the West Oakland monitoring site (in 2016). Based on this modeling analysis, local sources account for ~ 20% of the annual average $PM_{2.5}$ concentration in West Oakland.[90]

5.2 DPM Concentrations

The annual average DPM concentration associated with local sources in the West Oakland community domain was 0.39 µg/m^3, with concentrations exceeding 1.0 µg/m^3, namely in areas that are proximate to the Port and railyards (**Figure 5-2**). When the calculation is limited to receptors in residential areas, the annual average local DPM concentration decreases to 0.25 µg/m^3, as the highest local DPM concentrations are generally near the Port rather than residential areas.

The average local DPM concentration was 0.39 µg/m^3, whereas the background concentration (**Section 3.6**) was estimated as 0.46 µg/m^3, resulting in a total average DPM concentration of 0.85 µg/m^3 in West Oakland. Based on this modeling analysis, local sources account for about ~ 46% of the annual average DPM concentration in West Oakland.

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[89] Results averaged over the "community domain" include all receptors within the Receptor Domain that intersect the Community Boundary (*c.f.* **Figure 1-1**, **Figure 5-1**). The Receptor Domain does not completely cover the Community Boundary; the areas that are excluded are mainly in the Port and over the Bay Bridge.

[90] This local contribution only accounts for directly emitted $PM_{2.5}$ emissions. However, it is likely that the secondary formation of $PM_{2.5}$ from precursor emissions in the West Oakland domain will largely occur beyond the boundaries of the domain.

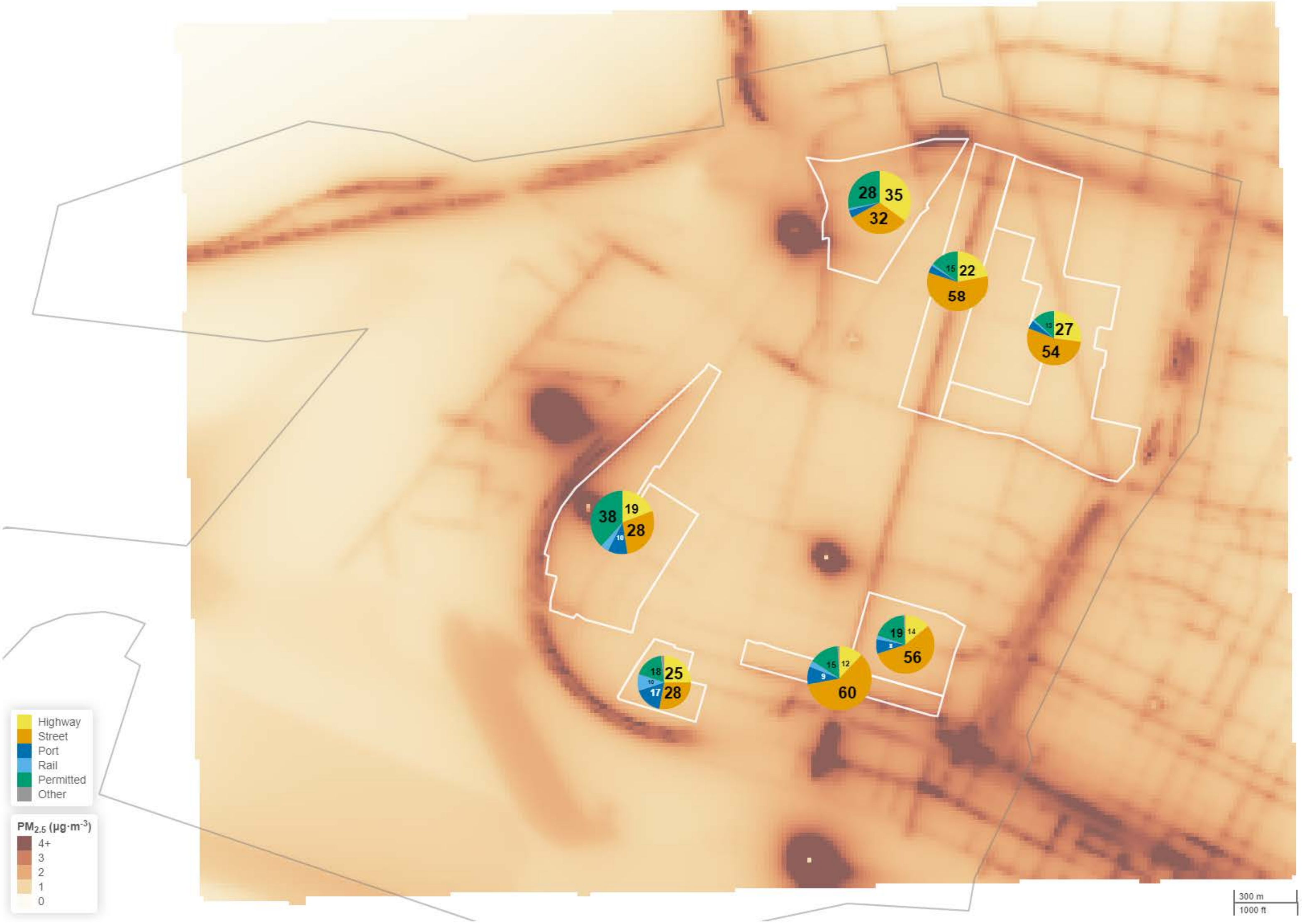

Figure 5-1. Annual average $PM_{2.5}$ concentrations associated with modeled local sources in the West Oakland Receptor Domain (colored extents). Pie charts indicate the percentage of concentrations contributed from specific Source Categories in each zone (white polygons, **Figure 4-1**); the size of the pie chart indicates the total magnitude of the concentration. The grey line indicates West Oakland Community Boundary. Outlines of other geographical features (roadways, etc.) are omitted for clarity.

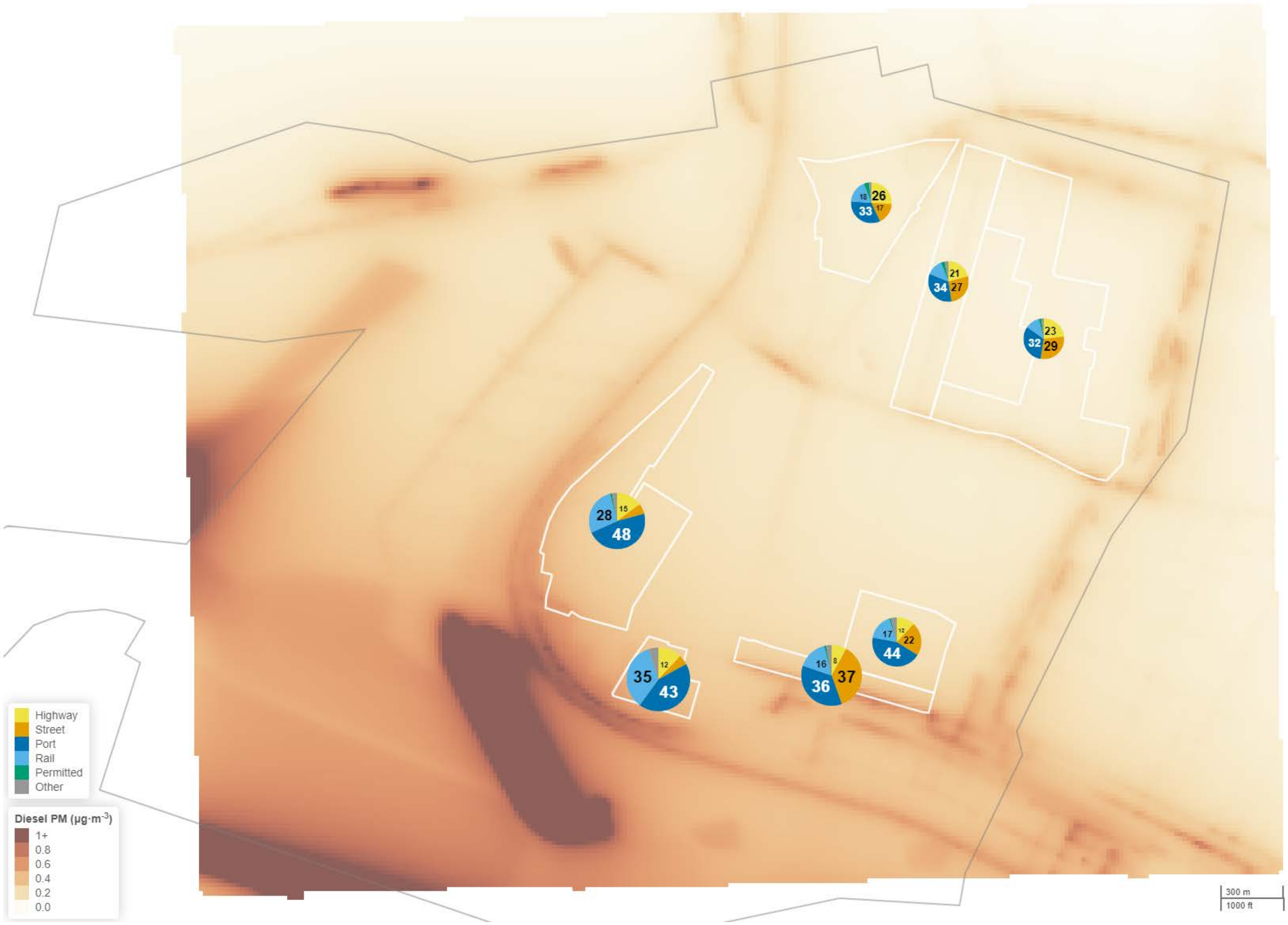

Figure 5-2. Annual average DPM concentrations associated with modeled local sources in the West Oakland Receptor Domain (colored extents). Pie charts indicate the percentage of concentrations contributed from specific Source Categories in each zone (white polygons, **Figure 4-1**); the size of the pie chart indicates the total magnitude of the concentration. The grey line indicates West Oakland Community Boundary. Outlines of other geographical features (roadways, etc.) are omitted for clarity.

5.3 Cancer Risk

Based on combined AERMOD results from all sources, the excess (local) cancer risk associated with local emissions sources in the West Oakland Source Domain was 303 in-a-million people, with risk values exceeding 1,000 in-a-million in areas that are proximate large emission sources, especially those that emit high levels of DPM (**Figure 5-3**). Furthermore, the annual excess cancer risk decreases to 199 in-a-million when weighted by population, as the highest air toxic concentrations are generally near the Port and the Schnitzer Steel facility rather than residential areas.

The total excess cancer risk in West Oakland is than 724 in-a-million, based on a background value of 421 in-a-million (**Section 3.6**) and a local value of 303 in-a-million. Based on this modeling analysis, local sources account for ~ 42% of the excess cancer risk in West Oakland.

5.4 Source Apportionment

To support source apportionment analyses, AERMOD results for all sources were combined in a series of interactive digital maps that allow users to click on a location of interest and view a tabular summary of the contributions of individual local sources to the $PM_{2.5}$ concentration, DPM concentration, and excess cancer risk at that location.[91] The percentage contribution from source categories to the domain-wide averages, and by location or zone were also generated (as depicted by the pie charts in **Figures 5-1**, **5-2**, and **5-3**).

Source contributions to annual average local $PM_{2.5}$ concentration (1.71 µg/m^3), annual average local DPM concentration (0.39 µg/m^3), and excess cancer risk (303 in-a-million) are tabulated by emissions source category in **Table 5-1**. For $PM_{2.5}$, the main sources include road dust, passenger vehicles (especially on highways) and MHDT/HHDTs. Some stationary sources (e.g., Pinnacle Ag Services, Schnitzer Steel) also contribute a comparable amount. For DPM and cancer risk, the main source include MHDT/HHDTs, assist tugs, OGVs, and locomotives and railyard activity.

Source contributions to local $PM_{2.5}$ concentrations, DPM concentrations, and excess cancer risk within Zones in the West Oakland domain vary by location, and the interactive maps described above allowed users to investigate those variations. For example, while Zone 2 (3rd Street) and Zone 3 (7th Street) are close to each other (< 1 km), the proportions of difference source categories to the overall excess cancer risk within the zones varies considerably (**Figure 5-3**, **Table 5-1**).[92] Within Zone 2, key sources include those in the Port (especially assist tugs and OGVs) and rail (UP railyard and locomotives on rail lines). In contrast, within Zone 3, key sources include those in the Port (assist tugs and OGVs) and on-road mobile sources on surface streets (especially MHDTs/HHDTs).

[91] See: http://www.baaqmd.gov/ab617woak.
[92] The results within two zones are presented here. Results at other sensitive receptors in West Oakland are available elsewhere.

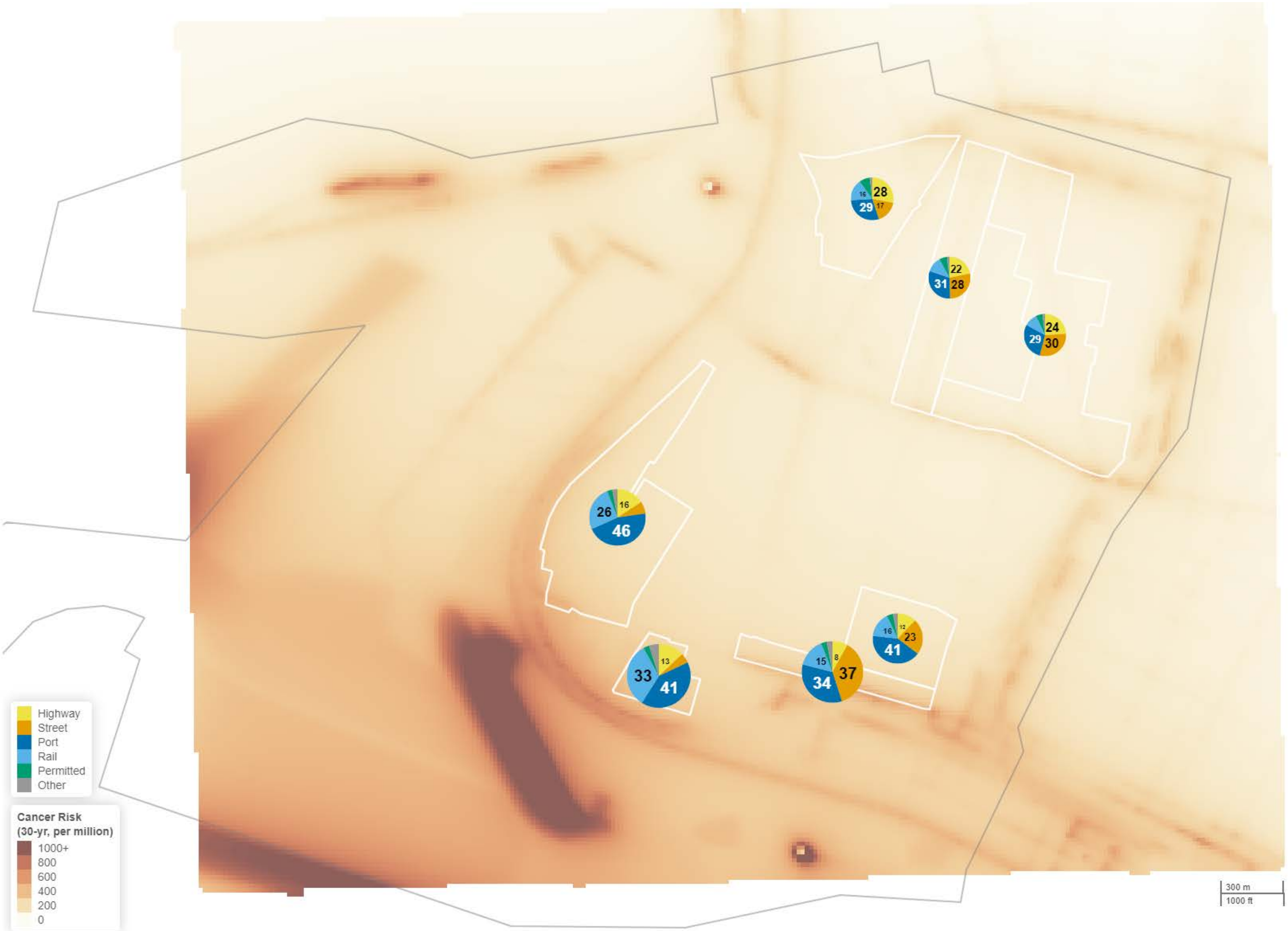

Figure 5-3. Annual average excess cancer risk associated with modeled local sources in the West Oakland Receptor Domain (colored extents). Pie charts indicate the percentage of risk contributed from specific Source Categories in each zone (white polygons, **Figure 4-1**); the size of the pie chart indicates the total magnitude of the risk. The grey line indicates West Oakland Community Boundary. Outlines of other geographical features (roadways, etc.) are omitted for clarity.

Table 5-1. Source contributions to the annual average $PM_{2.5}$ and DPM concentrations and excess cancer risk across the West Oakland community area. Port Truck contributions represent those from Port Trucks on all roads and within Port terminals.

Source Category	$PM_{2.5}$		DPM		*risk*	
	μg/m³	**% of total**	**μg/m³**	**% of total**	**per million**	**% of total**
Highway						
Non-Trucks	0.242	14	0.004	1	7	2
LHDT	0.009	1	0.002	1	2	1
MHDT/HHDT	0.058	3	0.043	11	33	11
Road dust	0.103	6	–	–	–	–
Surface Streets						
Non-Trucks	0.107	6	0.002	1	4	1
LHDT	0.005	< 1	0.001	< 1	1	< 1
MHDT/HHDT	0.038	2	0.029	8	22	7
Road dust	0.395	23	–	–	–	–
Port						
OGV – maneuvering	0.023	1	0.023	6	17	6
OGV – berthing	0.048	3	0.026	7	20	7
Dredging	0.020	1	0.020	5	15	5
Assist Tugs	0.071	4	0.073	19	55	18
Bunkering (tugs, pumps)	0.005	< 1	0.005	1	4	1
CHE	0.027	2	0.027	7	20	7
Port Trucks	0.023	1	0.012	3	10	3
Road dust	0.043	3	–	–	–	–
Railyard – OGRE	0.004	< 1	0.005	1	4	1
Railyard – BNSF	0.009	1	0.010	3	8	2
Rail						
Locomotives	0.026	2	0.028	7	21	7
Railyard – UP	0.057	3	0.062	16	46	15
Permitted						
CA Waste (10th Street)	0.029	2	–	–	–	–
California Cereal	0.034	2	–	–	< 1	< 1
CASS	0.005	< 1	–	–	< 1	< 1
Dynegy	0.001	< 1	< 0.001	< 1	< 1	< 1
EBMUD	0.056	3	0.002	1	2	1
Pinnacle Ag Services	0.095	6	–	–	–	–
Schnitzer Steel – stationary	0.090	5	–	–	5	2
Sierra Pacific	0.054	3	–	–	–	–
Other	0.022	1	< 0.001	< 1	2	1
Other						
Ferry/Excursion vessels	0.006	< 1	0.006	2	5	2
Schnitzer Steel – OGV	0.002	< 1	0.002	1	2	1
Schnitzer Steel – trucks	0.001	< 1	< 0.001	< 1	< 1	< 1
Truck-related businesses	0.002	< 1	0.002	1	2	1
Total	**1.710**	**100**	**0.385**	**100**	**303**	**100**

Table 5-2. Residential (population-weighted) source contributions to excess cancer risk within Zone 2 (3rd Street) and Zone 3 (7th Street). Values have been rounded and may not necessarily sum to the values indicated in the Total row. Port Truck contributions represent those from Port Trucks on all roads and within Port terminals.

Source Category	**Zone 2**		**Zone 3**	
	per million	**% of total**	**per million**	**% of total**
Highway				
Non-Trucks	5	1	4	1
LHDT	2	< 1	1	< 1
MHDT/HHDT	38	11	22	7
Surface Streets				
Non-Trucks	4	1	8	3
LHDT	1	< 1	3	1
MHDT/HHDT	13	4	108	34
Port				
OGV – maneuvering	20	6	16	5
OGV – berthing	23	7	17	5
Dredging	14	4	10	3
Assist Tugs	54	16	42	13
Bunkering (tugs, pumps)	4	1	3	1
CHE	11	3	6	2
Port Trucks	8	2	13	4
Railyard – OGRE	3	1	2	1
Railyard – BNSF	5	2	2	1
Rail				
Locomotives	37	11	21	7
Railyard – UP	79	23	27	8
Permitted				
EBMUD	1	< 1	1	< 1
Schnitzer Steel – stationary	7	2	8	2
Other	1	< 1	2	< 1
Other				
Ferry/Excursion vessels	6	2	6	2
Schnitzer Steel – OGV	3	1	2	1
Schnitzer Steel – trucks	< 1	< 1	< 1	< 1
Truck-related businesses	8	2	1	< 1
Total	**346**	**100**	**323**	**100**