Appendix D

Air Quality Technical Report for San Diego Forward: The 2021 Regional Plan Program Environmental Impact

APPENDIX D

AIR QUALITY TECHNICAL REPORT FOR SAN DIEGO FORWARD: THE 2021 REGIONAL PLAN PROGRAM ENVIRONMENTAL IMPACT REPORT

PREPARED FOR:

San Diego Association of Governments
401 B Street, Suite 800
San Diego, CA 92101
Contact: Kirsten Uchitel
619-699-7335

PREPARED BY:

ICF
525 B Street, Suite 1700
San Diego, CA 92101
Contact: Kathie Washington
858-444-3565

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Acronyms and Abbreviations

2015 Regional Plan	San Diego Forward: The 2015 Regional Plan
2019 Federal RTP	2019 Federal Regional Transportation Plan
AADT	average annual daily traffic
AAQS	ambient air quality standards
ABM	activity-based model
ASFs	age sensitivity factors
ASL	above sea level
Caltrans	California Department of Transportation's
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CPF	cancer potency factor
CVA	Chula Vista
DPM	diesel particulate matter
DTN	San Diego-Beardsley Street
DVN	Otay Mesa-Donovan
DVs	PM design values
ED	exposure duration
EIR	environmental impact report
EPA	United States Environmental Protection Agency
ESC	Escondido
ETW	Equivalent Test Weight
FAH	fraction of time at home
FEM	Federal Equivalent Method
FHWA	Federal Highway Administration
FR	Federal Register
FSD	Floyd Smith Drive
GLC	ground-level concentrations
GVWR	gross vehicle weight rating
HARP	Hotspots Analysis and Reporting Program
HI	Hazard Indices
HQ	hazard quotient
HRA	Health Risk Assessment
KVR	Kearny Villa Road
MSATs	mobile source air toxics
NAAQS	National Ambient Air Quality Standards
NATA	National Air Toxics Assessment
NKX	Miramar Marine Corps Air Station

OEHHA	Office of Environmental Health Hazard Assessment
PAH	polycyclic aromatic hydrocarbons
PEF	potency equivalency factors
PEN	Camp Pendleton
PES	Perkins Elementary School
PM10	particulate matter up to 10 microns
PM2.5	particulate matter up to 2.5 microns in size
POM	polycyclic organic matter
proposed Plan	San Diego Forward: The 2021 Regional Plan
PSD	Prevention of Significant Deterioration
REL	Reference Exposure Level
RH	Release Height
RSEI	Risk-Screening Environmental Indicators
SAFE	Safer Affordable Fuel-Efficient
SANDAG	San Diego Association of Governments’
SCAQMD	South Coast Air Quality Management District
SDAPCD	San Diego Air Pollution Control District
SILs	significant impact levels
TACs	toxic air contaminants
TOG	Total Organic Gases
TRI	Toxics Release Inventory
URF	Unit Risk Factor
VH	Vehicle Height
VMT	vehicle miles traveled
VOC	volatile organic compounds
ZEV	zero-emission vehicle
ZMU	zero-emission multiple units

1 INTRODUCTION

San Diego Forward: The 2021 Regional Plan (proposed Plan) serves as San Diego Association of Governments' (SANDAG) update to *San Diego Forward: The 2015 Regional Plan* (2015 Regional Plan), adopted in October 2015, and the 2019 Federal Regional Transportation Plan (2019 Federal RTP), adopted in October 2019. The proposed Plan includes land use and transportation improvements to increase mobility and transportation connectivity, reduce single-occupancy passenger car travel, and support increased population growth.

ICF worked with SANDAG to develop a comprehensive technical study to evaluate the potential impacts of air pollution on the region to support the proposed Plan's environmental impact report (EIR). This technical report documents the approach, technical methods, and results of the air quality technical work.

2 TECHNICAL METHODOLOGY

This section provides an overview of the general approach used in this analysis. It is followed by a more detailed discussion of the analysis approach for the emissions (Chapter 3), air quality (Chapter 4), and health risk assessment (Chapter 5) modeling.

2.1 OVERVIEW OF APPROACH

The analysis performed in this report includes the following general steps:

1. Quantify emissions for all sources of criteria pollutants and toxic air contaminants (TACs) associated with the proposed Plan.
2. Conduct dispersion modeling for base and regional plan years to estimate ambient PM10 and PM2.5 concentrations resulting from the operational emissions under the proposed Plan.
3. Perform dispersion modeling for base and regional plan years to estimate TAC concentrations at sensitive receptors.
4. Quantify human health risk based on exposure to the modeled TAC concentrations.

The methodologies used in these assessments are described below. This technical report focuses on the methodologies, data sources, analysis methods, and results pertaining to the Localized Particulate Matter (PM) Impact Analysis (Impact AQ-4) and Health Risk Assessment (HRA) (Impact AQ-5) in support of the findings in the EIR.

2.1.1 GENERAL PARAMETERS: MODELED YEARS AND CASES

A baseline year and three future years were modeled for the proposed Plan: the baseline year is 2016, and the future years are 2025, 2035, and 2050.

All four cases are similar but differ in that the pollutant source and, potentially, the receptor location could change over time with implementation of the Plan (e.g., if a roadway is widened or new residential land uses are developed within assessment domains).

2.2 POLLUTANTS

Air pollutants negatively impact air quality and subsequently human and environmental health. The EIR analysis included emissions projections for all criteria air pollutants, with additional analysis of concentrations and risks associated with two categories of air pollutants: PM and TACs, as these are the pollutants most likely to cause significant air quality impacts under the proposed Plan. Both are described below.

2.2.1 PARTICULATE MATTER

This analysis addresses concentrations of the criteria pollutants PM10 and PM2.5 that would result from the proposed Plan. Particulate matter is a complex mixture of materials that can include metals, soot, soil, dust, and other organic and inorganic particles. Particulate matter can be divided into many size fractions, measured in microns (a micron is one-millionth of a meter). The California Air Resources Board (CARB) and the United States Environmental Protection Agency (EPA) have developed air quality standards for two size classes of particles: particles up to 10 microns in size (PM10) and particles up to 2.5 microns in size (PM2.5). PM2.5 particles are a subset of PM10 (CARB 2021a).

2.2.2 TOXIC AIR CONTAMINANTS

This analysis also addresses health risk changes from concentrations of the non-criteria TACs associated with Plan implementation. A TAC is an air pollutant for which an air quality standard has not been set but which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health (Section 39655 of the California Health and Safety Code). CARB has formally identified over 200 substances and groups of substances as TACs (CARB 2021b).

Internal combustion engines, including diesel and gasoline fueled, emit TACs. Engine exhaust includes a complex mixture of air pollutants, including both gaseous and solid materials. The solid material in diesel exhaust is known as diesel particulate matter (DPM). More than 90% of DPM is less than one micron in size. Thus, DPM is a subset of both PM10 and PM2.5 (CARB 2021a). Other TACs are also emitted from fuel combustion. In total, the Federal Highway Administration (FHWA) has identified nine priority TACs from mobile sources, called mobile source air toxics (MSATs):[1]

- 1,3-butadiene
- acetaldehyde
- acrolein
- benzene
- DPM
- ethylbenzene
- formaldehyde
- naphthalene

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[1] FHWA's MSAT guidance is available at: https://www.fhwa.dot.gov/environMent/air_quality/air_toxics/policy_and_guidance/msat/.

- polycyclic organic matter (POM) / polycyclic aromatic hydrocarbons (PAH)[2]

CARB notes that the top three TACs for potential cancer risk are DPM; 1,3-butadiene; and benzene. These TACs are primarily generated by fossil fuel–powered motor vehicles (CARB 2002). CARB considers the risk from whole diesel exhaust to be represented by DPM concentrations.

This analysis includes all nine priority MSATs identified by FHWA for the sake of completeness and full disclosure, as these nine priority MSATs include CARB's top three emitters. Along with mobile on-road and rail sources, stationary sources that may influence incremental risks due to changes in land use under the proposed Plan are included in the HRA, as described below. Risks from TAC emissions from those sources are included, based on available information, even if they are not in the list of priority MSATs.

3 EMISSION SOURCES

As a first step in performing this assessment, ICF developed an emissions inventory of the pollutants used in the air quality and health risk analyses, including link-based emissions for on-road mobile sources and source-based emissions for passenger and freight rail and other major stationary sources. The emissions inventory was compiled using a combination of best available and industry-accepted protocols and tools developed by CARB, EPA, and other agencies.

The analysis focused on sources of emissions that will be affected by the two components of the proposed Plan: (1) regional growth and land use changes that could modify the location of sensitive receptors in the region, and (2) changes in the location and activity along the transportation network that could modify the quantity of emissions along passenger and freight corridors, as well as the changes in the emissions rate of the fleet over time. Particulate matter and TAC emissions are included from the following sources:

- On-road vehicle exhaust, which includes PM10, PM2.5, and MSATs.
- On-road fugitive brake wear, tire wear, and re-entrained PM10 and PM2.5 road dust emissions.
- Passenger rail and freight rail exhaust as indicated by SANDAG, which includes PM10, PM2.5, and MSATs (mainly DPM).
- Stationary sources and additional sources identified for cumulative risk.

3.1 ON-ROAD SOURCES

This section discusses both exhaust and fugitive emissions from on-road mobile sources. The emissions inventory for mobile on-road sources on the regional highway and roadway networks considered parameters in SANDAG's activity-based model (ABM), such as vehicle speeds, vehicle types, and time of day. The mobile source PM and TAC emissions inventory generally followed the following steps:

1. Determine baseline PM10, PM2.5, organic gas, and DPM speed-resolved emission factors from CARB's latest Emission Factor model (EMFAC2017[3]) representing the fleet described by the ABM and EMFAC2017 for the San Diego region and corresponding to the vehicle types considered in SANDAG's ABM.

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[2] See Section 3.1 for information on treatment and reporting of these compounds.

[3] EMFAC2017 was used for all road-link emissions modeling per SANDAG direction on February 2, 2021.

2. Determine emission factors for the priority MSATs[4] from literature values, applied to PM and organic exhaust emissions, and brake and tire wear emissions, as appropriate.[5,6,7]
3. Determine road dust PM10 and PM2.5 emission factors using CARB methods.
4. Extract activity data from the ABM outputs to determine vehicle activity on specific roadway segments.
5. Link the activity and emissions factors and develop a database of emissions by link, time of day, and bus, light- and heavy-duty vehicles for major links, and spatially aggregated emissions for the less trafficked "minor links."

For both PM and TACs, ICF first built a complete, link-based emissions inventory database for the entire San Diego region for the modeled scenario in each analyzed year. SANDAG provided data for vehicular traffic on all roadway links in the ABM model in the same five daily periods simulated by the model and for the three vehicle types modeled.[8] The output of this database is emissions by link, resolved by vehicle type and hour. Only direct PM emissions were considered. Secondary PM was not included.[9]

Speciation[10] of MSATs for non-diesel vehicles was based on standard, accepted models and approaches (identified above).[6] Only exhaust emissions were speciated.[5, 11] Of the nine MSATs identified in Section 2.2.2, *Toxic Air Contaminants,* one applies only to diesel vehicles: DPM, which is defined as whole exhaust particulate matter from diesel vehicles. All cancer risk from diesel exhaust was included in the California Office of

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[4] Both gasoline and diesel were speciated into MSATs in the modeling. Cancer and chronic risk from diesel exhaust was captured by DPM, so only gasoline was speciated for the risk endpoints to avoid double counting diesel risk diesel. However, for acute non-cancer risk, the speciated components of all fuels are added together.

[5] Organic gases were specified according to their emissions of total organic gases (TOG), tracked separately by fuel type and bus, light-, and heavy-duty vehicle categories. The parameters were set by the speciation profiles selected.

[6] There are various sources for developing speciation, which include CT-EMFAC, MOVES, SPECIATE, or other sources, such as those used by CARB. Each has advantages and disadvantages. ICF used MOVES2014b in the EIR as it was the most comprehensive and consistent available source at the time of analysis.

[7] Due to uncertainty and relative risk, ICF did not speciate fugitive sources, such as brake wear, tire wear, or road dust to include in health risk. See footnote 11.

[8] Only a single average day type was available and used. Higher resolution is not likely to dramatically alter the long-term concentrations for HRA or annual PM concentrations, although it could affect the 24-hour average PM and acute risk results. Also, vehicle types from EMFAC and the activity-based model (ABM) were harmonized and emissions aggregated to the three modeled vehicle types—bus, light, and heavy duty.

[9] Secondary PM is particulate matter formed in the atmosphere through chemical reactions, especially nitrogen and sulfur oxides (NO_X and SO_X, respectively), including emissions from mobile sources. CARB has estimated secondary PM to be nearly half of total PM in the San Diego Air Basin. See: https://www.sdapcd.org/content/dam/sdc/apcd/PDF/Air%20Quality%20Planning/PM-Measures.pdf. However, the approach here was not for complete regional photochemical assessment, but an analysis of nearby, direct impacts, similar to a hotspot assessment and following Caltrans guidance for project-level assessments (http://www.dot.ca.gov/env/air/aq-analysis.html). Per EPA guidance, "PM hot-spot analyses include only directly emitted $PM_{2.5}$ or PM_{10} emissions. $PM_{2.5}$ and PM_{10} precursors are not considered in PM hot-spot analyses, since precursors take time at the regional level to form into secondary PM." EPA-420-B-15-084, November 2015. Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NMXM.pdf.

[10] Speciation provides a breakdown of the chemical composition of PM and organic gas (VOC) emissions into its various components, such as MSATs.

[11] Brake and tire wear can be significant contributors to overall PM, but cancer risk is typically driven by diesel exhaust PM concentrations. Furthermore, speciation profiles of brake and tire wear are uncertain (e.g., see U.S. Environmental Protection Agency. 2014. *Brake and Tire Wear Emissions from On-road Vehicles in MOVES2014*. EPA-420-R-14-013. December. Available: https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=525701).

Environmental Health Hazard Assessment's (OEHHA) assigned Unit Risk Factor (URF) for DPM (OEHHA 2019a); no further speciation of diesel exhaust was included for cancer risk. Likewise, chronic risk from diesel exposure was captured in OEHHA's Reference Exposure Level (REL)[12] for diesel particulate exhaust, which was used (OEHHA 2019a). Speciation of gaseous components of diesel exhaust (which are minor) could contribute to the overall acute non-cancer characterization and was included. The remaining eight species apply only to non-diesel engines, which are primarily gasoline. Of these, six have speciation factors available through the California Department of Transportation's (Caltrans) CT-EMFAC model. Another MSAT, POM, has both particulate and gaseous components and, while recently included in CT-EMFAC, its speciation does not show variations after 2021. Caltrans has posted guidance on determining POM and naphthalene emissions based on U.S. Department of Transportation's Federal Highway Administration policies,[13] but it relies on older EPA speciation data. To use a consistent source and rely on current data for speciation factors for all MSATs and the different vehicle and fuel types, ICF determined and applied speciation factors from EPA's MOVES2014b mobile source emission model, current at the time of analysis, for all on-road mobile sources (EPA 2015a, 2016). Although not California-specific, ICF concluded this represents the most current and consistent set of available data for speciation of MSAT emissions.

Multiple species that are components of POM and polycyclic aromatic hydrocarbons (PAH) are included. For emissions calculations, ICF summarized PAH emissions as benzo[a]pyrene equivalents through toxicity weighting. This calculation was done by multiplying the emissions of PAHs that ICF had previously speciated out using MOVES with the benzo[a]pyrene-normalized potency equivalency factors (PEF) according to OEHHA guidance.[14] If a particular PAH was not listed in the OEHHA guidance document then OEHHA has not determined its cancer potency, and for the purposes of this assessment ICF did not include that PAH's emissions in the HRA. These PAH emissions, weighted by their individual PEF's, were summed to create the benzo[a]pyrene equivalent. Table 1 outlines components of PAH according to EPA's substance registry as well as those used specifically in the toxicity weighting calculations, and their corresponding PEF.[15]

Table 1. Polycyclic Aromatic Hydrocarbon Species and Corresponding Potential Equivalency Factors

Species of Polycyclic Aromatic Hydrocarbon	Potency Equivalency Factor
Acenaphthene	Not available
Acenaphthylene	Not available
Anthracene	Not available
Benzo[a]anthracene	0.1
Benzo[a]pyrene	1.0
Benzo[b]fluoranthene	0.1
Benzo[g,h,i]perylene	Not available
Benzo[k]fluoranthene	0.1

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[12] An REL is the concentration level at or below which no adverse non-cancer health effects are anticipated for the specified exposure duration. RELs are based on the most sensitive, relevant, and adverse health effect reported in the medical and toxicological literature, and RELs are meant to err on the side of public health protection.

[13] http:// www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/msat/2016msat.pdf.

[14] *OEHHA Technical Support Document for Cancer Potency Factors, Appendix A*. Available: https:/ /oehha.ca.gov/media/downloads/crnr/appendixa.pdf.

[15] EPA substance registry, PAH entry: https://sor.epa.gov/sor_internet/registry/substreg/substance/details.do?displayPopup=&id=6012.

Species of Polycyclic Aromatic Hydrocarbon	Potency Equivalency Factor
Chrysene	0.01
Dibenzo[a,h]anthracene	1.05
Fluoranthene	Not available
Fluorene	Not available
Indeno[1,2,3-c,d]pyrene	0.1
Phenanthrene	Not available
Pyrene	Not available

3.1.1 SAFER AFFORDABLE FUEL-EFFICIENT (SAFE) VEHICLES RULE

The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule was issued in two parts jointly by the National Highway Traffic Safety Administration and EPA. Part 2 (SAFE-2), enacted March 2020, reduced progress in fuel economy and carbon dioxide standards for model years 2021–2026 passenger cars and light trucks. Part 1 (SAFE-1), enacted in September 2019, withdrew California's waiver of preemption under Section 209 of the Clean Air Act, which in part eliminated California's ability to enact its zero-emission vehicle (ZEV) mandate. CARB has concluded that the loss of the ZEV sales requirement will increase gasoline vehicle emissions and thus will lead to an underestimate in emissions starting in 2021 when predicted with the EMFAC2017 model. CARB has released off-model adjustment factors that may be applied to gasoline vehicle emissions from calendar year 2021 to correct for the impacts of the SAFE rule.[16] In April 2021, in response to President Biden's Executive Order 13990, the EPA began the process of repealing SAFE-1,[17] with plans to begin the repeal of SAFE-2 in summer 2021.

The SAFE rule does not affect the 2016 baseline emissions included in this analysis. The rule would increase emissions for horizon years under the Plan: 2025, 2035, and 2050. However, the status of the rule is highly uncertain given the current presidential Executive Order calling for its repeal. Even if the rule were maintained, the impact on emissions is very small. CARB correction factors for 2050—the year with the largest magnitude—are 1.0318 for PM Exhaust and 1.0257 and 1.0117 for Evaporative and Exhaust Total Organic Gas (TOG) emissions, respectively, for gasoline vehicles. When applied to the total San Diego regional fleet in 2050, these factors are reduced to increases of 1.2% and 0.7% in PM and TOG exhaust. The proposed Plan anticipates approximately 82% reduction in exhaust PM between 2016-2050 (Section 7.1). When including emissions of brake wear, tire wear, and road dust, the SAFE factors for exhaust PM have a negligible impact on PM emissions and thus on air quality. Similarly, the factors have negligible impact for health risk as they do not apply to diesel exhaust and would lead to only a very small increase in gasoline TACs. Thus, the SAFE Rule correction factors were not applied to emissions projections in this analysis due to uncertainty in SAFE Rule implementation and its insignificant impact on results.

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[16] California Air Resources Board (CARB). 2019. *EMFAC Off-Model Adjustment Factors to Account for the SAFE Vehicle Rule Part One*. November 20. Available: https://www.arb.ca.gov/msei/emfac_off_model_adjustment_factors_final_draft.pdf.

[17] U.S. Environmental Protection Agency (EPA). 2021. *EPA Reconsiders Previous Administration's Withdrawal of California's Waiver to Enforce Greenhouse Gas Standards for Cars and Light Trucks*. April 26. Available: https://www.epa.gov/newsreleases/epa-reconsiders-previous-administrations-withdrawal-californias-waiver-enforce.

3.1.2 MAJOR LINKS

Major links are those links in the ABM with significant amounts of traffic that justified modeling as individual sources. The distinction between major and minor links was based on vehicle activity (average annual daily traffic [AADT]) thresholds. Per SANDAG direction, ICF used a threshold of 100,000 vehicles per day (both directions), consistent with CARB guidance for urban roads (CARB 2005).[18] A threshold of 50,000 vehicles per day was used for one-way links. Links considered zone connectors were not included in major links.

The shape of major links was determined from the geospatial data provided by SANDAG and consistent with that in the ABM. To simplify modeling without notable impacts on risk results, ICF reprocessed the geospatial data so that the vertices of each polyline were 60 feet apart or more; for a curvy link, this can have the effect of straightening the roadway in nominal 60-foot increments while also creating sources the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) can accept. ICF assigned each major link to the modeling subdomain(s) it intersected (see Section 4.2, *Assessment Domain*). Major links intersecting multiple modeling subdomains were assigned to each of those modeling subdomains, and in such cases, ICF modeled the whole major link for each modeling subdomain (even the parts of the link lying beyond a modeling subdomain's boundary). In these cases, though some emissions technically occurred outside a given modeling subdomain, those "outside" sections of links were relatively short, and their emissions were released relatively close to the modeling subdomain boundary line.[19] Major links were converted to polygons by buffering each link 6 feet on each side of the link for every lane (Uchitel pers. comm.). This creates a 12-foot width for each lane of traffic.

Exhaust emissions on major links were calculated according to the general equation:

$$E = EF \times AD$$

where EF is the pollutant-, vehicle type-, and speed-specific emission factor, in grams per vehicle mile, while AD is activity data, in terms of vehicle miles traveled. Emissions were calculated for all hours of the day. SANDAG provided available information regarding on-road activity for determining these emissions, to include ABM outputs describing traffic and speeds on each link in the modeled road network. All hours within one ABM time period were assigned that period's traffic values (e.g., if the a.m.-peak in the ABM represents 6–9 a.m., those 3 hours will all be assigned that period's traffic uniformly). The 3–4 p.m. hour was split between two ABM time periods; ICF recalculated emissions for the 3–4 p.m. hour as the time-weighted average of the emissions of those two periods.

Emissions were aggregated into three vehicle types: light-duty vehicles, heavy-duty vehicles, and buses, based on those reported in the ABM. Fuel mix for each was based on EMFAC2017 defaults for the region. ICF considered light-duty vehicles to be vehicles below 8,500 pounds gross vehicle weight rating (GVWR), consistent with EMFAC. The EMFAC vehicle class breakdown by GVWR is shown in Table 2.

Table 2. Vehicle Type, Descriptions, and EMFAC Category

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[18] This document recommends thresholds of 100,000 vehicles per day for urban and 50,000 for rural roads. Given the focus on developed areas, ICF used the urban threshold throughout the assessment domain.

[19] No double counting of these impacts occurs in concentrations as each modeling subdomain is modeled separately.

Vehicle Type	Description	EMFAC Vehicle Category
Light-Duty Vehicles	Passenger Cars	LDA
	Light-Duty Trucks (GVWR <6,000 pounds and ETW ≤3,750 pounds)	LDT1
	Light-Duty Trucks (GVWR <6,000 pounds and ETW 3,751–5,750 pounds)	LDT2
	Motorcycles	MCY
	Motor Homes	MH
Heavy-Duty Vehicles	Medium-Duty Trucks (GVWR 6,000–8,500 pounds)	MDV
	Light-Heavy-Duty Trucks (GVWR 8,501–10,000 pounds)	LHD1
	Light-Heavy-Duty Trucks (GVWR 10,001–14,000 pounds)	LHD2
	Medium-Heavy Duty Diesel (GVWR 14,001–33,000 pounds)	MHDT
	Heavy-Heavy Duty Diesel (GVWR >33,000 pounds)	HHDT
Buses	School Buses, Urban Buses, Motor Coach, Other Buses, and All Other Buses	SBUS, UBUS, OBUS

Source: CARB 2015a.

Notes: GVWR is the maximum operating weight of a vehicle, including cargo and passengers. Equivalent Test Weight (ETW) is equal to GVWR plus one-half of the difference between the GVWR and the curb weight (i.e., weight at purchase without cargo or passengers) of the vehicle.

ICF considered trucks heavy-duty vehicles, and, consistent with EMFAC classifications, considered motor homes to be light-duty. Buses were modelled as a separate category from heavy-duty vehicles to more accurately represent EMFAC emission factors for buses. SBUS and OBUS categories were not provided in the ABM. SBUS and OBUS vehicle miles traveled (VMT) were spread throughout all links, with the contribution of SBUS/OBUS VMT to each link proportional to the VMT of the link VMT compared to the total VMT of the ABM. SBUS was only added to morning and late afternoon minor links, to reflect school pick-ups and drop-offs within neighborhoods and residential areas. OBUS was only added to morning, midday, and late afternoon major links, in order to reflect routes of bus operators, such as Greyhound.[20]

3.1.3 MINOR LINKS

Minor links[21] were classified as those links in the ABM below the 100,000 AADT (for two-way segments, or 50,000 AADT for one-way links) count threshold used to determine major links. Emissions on minor links were calculated as they were for major links, based on emission factors and activity data. The same vehicle and time designations employed for major links were used for minor links. However, unlike major links, minor links were aggregated at the U.S. census tract level. Mapping of links to census tracts was based on the link's centroid. ICF aggregated the emissions from individual minor links to an area, defined as the census tract boundary. Because the boundaries of the modeling subdomains (discussed in Section 4.2 below) did not align with the tracts, to limit inter-domain influences ICF clipped at the modeling subdomain boundaries any tract intersecting more than one modeling subdomain, creating partial tracts within each of the intersecting modeling subdomains. Each partial tract carried with it the emissions of the minor links within it. As with major links, to simplify modeling without notable effects on risk results, ICF reprocessed the tract geospatial data so

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[20] Sample Greyhound schedules are available at: http://extranet.greyhound.com/revsup/schedules2/pageset.html.

[21] Minor links may have a small impact only. Areas with minor links were chosen based on SANDAG's needs, provided data, and feedback on the approach.

that the vertices of each polygon were 300 feet apart or more. For curvy areas of a tract boundary, this can have the effect of straightening the tract boundary in nominal 300-foot increments but was able to be modeled within AERMOD.

3.1.4 OUTPUT

The output of this emissions modeling was a database of emissions for the designated pollutants by link (for major links) or by census tract (for minor links). This emissions database reported emissions by vehicle type (light and heavy) and hour.[22] This represented the emissions strength and temporal profile of the sources in the dispersion model.

Comparisons were drawn between the emissions modeling performed, SANDAG's conformity results, and default EMFAC inventory outputs. SANDAG's conformity results used the same data as the time-, speed- and link-resolved activity data used in the emissions modelling, except for EMFAC categories SBUS and OBUS. SBUS and OBUS were allocated according to the method described in Section 3.1.2, *Major Links,* in the emissions model, while the conformity results added EMFAC emissions data for SBUS and OBUS directly to their emissions results, without spatial or temporal allocation. The conformity results also represented natural gas buses with gasoline emission factors. ICF compared the inventory to that from SANDAG's conformity results to verify that the time-, speed, and link-resolved emissions estimation methods were comparable to those used elsewhere. Percent difference of total emissions was used as a comparison tool between these methods, with percent difference calculated as the difference between the emissions model and the conformity results, normalized to the conformity results. A difference of less than 5% was seen between most pollutants, except for TOG, which saw differences of 20% in 2035 and 2050. This difference in TOG is attributed to the difference in estimating bus emissions. The bus fleet in San Diego is composed of buses that use natural gas, diesel, and gasoline as fuel. Though buses make up less than 1% of the total VMT, emissions from natural gas buses are responsible for over 20% of the total emitted TOG within San Diego County. For this reason, small deviations in the calculation of bus emissions can result in major differences in estimations of TOG, which is why the method to allocate bus emissions in Section 3.1.2 was used.

3.2 PASSENGER AND FREIGHT RAIL

The analysis also included emissions from rail sources identified by SANDAG. SANDAG provided ICF with the activity and geospatial polygons for future rail lines, while for existing (2016) rail lines SANDAG provided rail lines by type of rail. Existing rail lines were selected to remove any that were used only for light rail. The remaining existing rail lines were simplified by removing points less than 60 feet apart. The simplified rail lines were buffered by 25 feet to create 50-foot-wide rail corridors to match the size of the future rail corridors. The existing rail polygons were combined with the future planned rail polygons for each year to get the full extent of rail for each of the planned future years. Rail sources were assigned to the modeling subdomain in which they are located, except some rail geospatial segments were relatively long, so ICF clipped the rail segments at modeling subdomain boundaries, creating a defined portion in each modeling subdomain.

Emissions were estimated based on the projected rail activity for the various analysis years and relevant emissions factors from CARB and EPA. MSAT and PAH emission factors were calculated based on EPA emission

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[22] Note that the ABM presents traffic volumes by five daily time periods. The database translated these into hourly outputs for use in the AERMOD.

factors.[23] Gaseous MSATs were calculated as a component of volatile organic compounds (VOC), while gaseous and particulate PAHs were calculated as components of VOC and PM2.5, respectively. For passenger rail, the analysis considered locomotive fleet turnover and rail activity for each analysis year, as provided by SANDAG staff. Freight rail emissions were taken directly from CARB's freight emissions model in EMFAC.[24] Countywide rail emissions were calculated by rail line for each year, and each line was assigned the same spatial emission rate. The 3–4 p.m. hour was split between two ABM time periods; ICF recalculated emissions for the 3–4 p.m. hour as the time-weighted average of the emissions of those two periods.

Passenger (commuter) rail emissions were estimated based on estimated fuel consumption, which were derived from daily train and daily train mile activity, provided by SANDAG, and assumed fuel economy for each rail line, based on rail line reporting to the U.S. Department of Transportation. Table 3 summarizes the estimated passenger line fuel consumption by line and by year under the Plan. All results are unmitigated and do not account for zero emission efforts in the Plan years.

Table 3. Passenger Rail Fuel Use, Gallons per Day

Rail Line	Year			
	2016	2025	2035	2050
398 (COASTER)	2,624	5,027	7,399	7,131
399 (SPRINTER)	869	869	1,738	2,818
Amtrak/Pacific Surfliner	3,173	4,231	4,760	4,760
Metrolink	886	886	1,107	1,107
581A	0	0	0	8,702
581B	0	0	0	7,901
582	0	0	10,410	17,723
583	0	0	0	11,638
Total	7,553	11,013	25,414	61,780

3.3 STATIONARY AND OTHER SOURCES

In the HRA, ICF also considered chronic and cancer risks from stationary sources. The proposed Plan would not directly affect the emissions strength or profile of these sources, and no data is readily available to project future emissions from stationary sources; thus, the analysis assumed future pollutant concentrations from these sources remains static in time. As a consequence of this assumption, the only influence the proposed Plan was assumed to have on incremental concentrations from stationary sources is when sensitive receptors are new or relocated as a result of the proposed Plan. (See Section 4.5 for discussion of receptor types and locations.)

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[23] MSAT and PAH emission factors available in tables 11 and 12: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100PUQI.pdf.

[24] The *2016 Line haul Locomotive Model & Update* and the *2017 Passenger Rail Emissions Model* are available at: https://www.arb.ca.gov/msei/ordiesel.htm.

ICF attempted to obtain current risk and/or facility information from the San Diego Air Pollution Control District (SDAPCD). However, ICF was informed[25] that limited data exists and that which does is often extremely dated. SDAPCD did not provide any data for use. Instead, current concentrations from stationary sources were determined from EPA's Risk-Screening Environmental Indicators (RSEI) model.[26] RSEI is a screening-level model that assesses the potential risk from industrial emissions, as captured in EPA's Toxics Release Inventory (TRI). The most current data currently available is for year 2016. An intermediate product of the RSEI model is estimated annual average pollutant concentrations by emitting facility on an 810-meter by 810-meter grid across the entire country modeled with AERMOD.[27] ICF extracted and processed this data for the modeling subdomains. ICF then modeled existing cancer and chronic risk from these concentrations with California-specific risk values using CARB's Hotspots Analysis and Reporting Program (HARP). As this approach does not predict short-term concentrations, no acute risks were attributed to stationary sources. ICF assigned concentrations on this 810-meter grid to any sensitive receptors where incremental changes are likely due to the Plan. Given the lack of available information, ICF relied on RSEI long-term average concentration data only from major stationary sources and did not conduct any emission or dispersion modeling for stationary sources specific to this analysis. Note that while these stationary sources do influence the cumulative risk impact analysis, they are already captured in existing background concentrations for PM and are thus only included in the incremental risk calculation to support risks from new sensitive-receptor locations. ICF was also unable to identify similar sources of concentration data from sources operating south of the U.S.-Mexican border. Thus, these sources were not included in this analysis. ICF also did not model emissions from other source categories, including general area sources or from industrial and goods movement facilities not affected by the proposed Plan, such as Port of San Diego activities, the airport, landfills, or other major stationary sources that were outside the proposed Plan and unavailable through SDAPCD or RSEI.

4 DISPERSION MODELING

ICF conducted dispersion modeling with the emissions discussed in Chapter 3, *Emission Sources,* to estimate localized PM10, PM2.5, and TAC concentrations under baseline (2016) conditions and three future-year (2025, 2035, and 2050) conditions with implementation of the proposed Plan.

4.1 MODELING PLATFORM

ICF conducted dispersion modeling using AERMOD (EPA 2019)—EPA's preferred model for near-field pollutant dispersion calculations for distances up to 50 kilometers from emission sources. AERMOD is widely used for assessments of dispersion of emissions from stationary and mobile sources. It is a steady-state plume dispersion model that utilizes hourly meteorological data, local land-cover conditions, and elevation data, along with spatiotemporal characterizations of emissions, to estimate air pollutant concentrations at locations that the user specifies. It also has built-in processing features that assist in evaluating concentrations of PM against the forms of the 24-hour National Ambient Air Quality Standards (NAAQS). The model is updated periodically to repair bugs and add enhancements based on revised understandings of the parameters impacting pollutant dispersion. ICF used the most current version available when model setup began (version 19191).

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[25] Meeting with Archi dela Cruz, APCD September 5, 2018.

[26] https://www.epa.gov/rsei. Specific guidance and custom outputs for California were provided by Cynthia Gould, EPA contractor at Abt Associates per personal communication October 8, 2018.

[27] Complete information on the calculation approach in RSEI is available in *EPA's Risk-Screening Environmental Indicators (RSEI) Methodology, RSEI Version 2.3.6*, January 2018.

4.2 ASSESSMENT DOMAIN

ICF developed an assessment domain covering the more populated areas (western portion) of the county. Due to the size limitations of the AERMOD model, ICF divided this overall assessment domain into six modeling subdomains. Each of these was modeled as an individual case (Figure 1) with associated meteorological data and background data on air pollutants. Because some of these have background that exceed the appliable standard, some modeling subdomains are modeled compared to a significant impact level based on the applicable PM design values (DVs) for each. These are broadly consistent with work done in the previous EIR (SANDAG 2015) and based on available data from meteorological stations and air quality monitors. ICF designed these modeling subdomains to reflect the different population centers, land uses, terrain features, meteorological conditions, and ambient PM air quality across the populated areas of San Diego County, while also keeping the modeling as efficient as possible and limiting modeling subdomain size so that most receptors were not farther than 50 kilometers from emission sources (per *Federal Register* [FR] EPA guidance for AERMOD [82 FR 5182 Jan. 17, 2017]). ICF has also assigned each modeling subdomain a name for reference purposes.

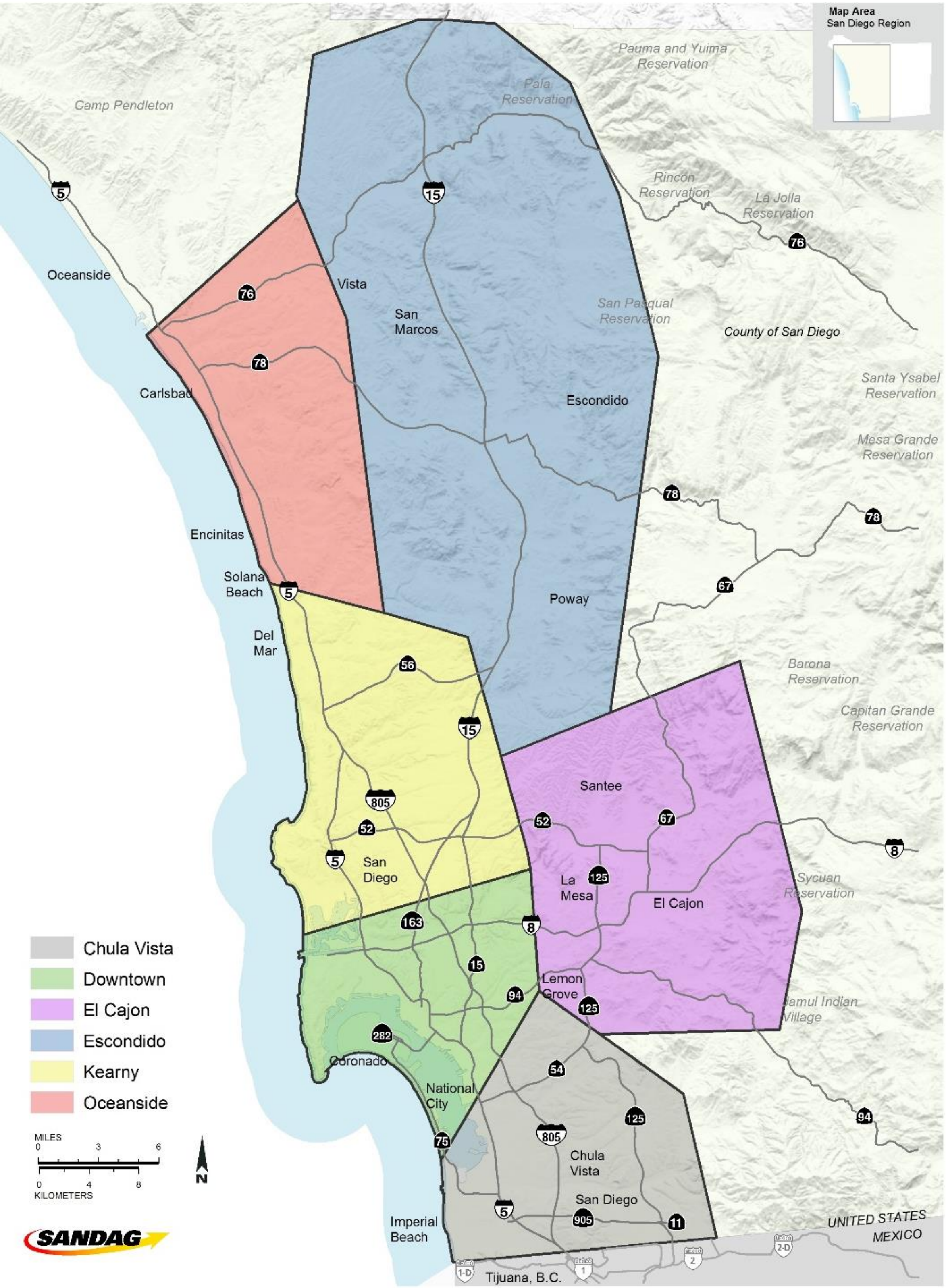

Figure 1. Subdomains for Dispersion Modeling

In the following subsections, ICF provides brief discussions of the characteristics of each modeling subdomain and the meteorological and PM stations selected for each. Section 4.3, *Meteorology,* provides further discussion of the meteorological stations and their data used for each modeling subdomain. Section 4.7, *Background Concentrations Data,* provides further discussion of the PM monitors and their respective DVs assigned for each modeling subdomain.

4.2.1 OCEANSIDE

The Oceanside modeling subdomain consists of the coastal region between the cities of Encinitas and Oceanside. The northern border runs along Camp Pendleton but does not include it (consistent with the analysis in the EIR for the 2015 Reginal Plan [SANDAG 2015]). Most areas are within about 14 kilometers of the coast, with some substantial terrain features peaking near 200 meters above sea level (ASL).

ICF used SDAPCD's Camp Pendleton (PEN) station for meteorology and SDAPCD's Kearny Villa Road (KVR) monitor for PM DVs. Although not within this modeling subdomain, the KVR monitor is the closest one that has adequately complete data to calculate 2016 DVs for the NAAQS and CAAQS.

4.2.2 ESCONDIDO

This inland modeling subdomain along the Interstate 15 corridor generally has rough terrain with most elevations at 100–400 meters ASL. The northern edge of this modeling subdomain incorporates the Fallbrook area and abuts the county border, while the southern edge is near Poway and is intended to align with the ridge that lies between the cities of Escondido and El Cajon. The north-south extent of this modeling subdomain, at about 60 kilometers, is longer than the 50 kilometers recommended AERMOD distance between a source and a receptor. That AERMOD limitation is related to the effectiveness and accuracy of the model's steady-state Gaussian dispersion calculations at long distances of plume travel within a model timestep of 1 hour. However, unlike tall smokestacks where the impact on air quality can be on the scale of tens of kilometers, the direct impact of near-ground roadway emissions is on the scale of hundreds of meters, such that the impact of their emissions will be negligible several kilometers away, let alone 50 or 60 kilometers away. This will minimize the impact of any possible model errors on the contribution, say, of major-link emissions near Poway to the air quality in Fallbrook (as a hypothetical example).

ICF used SDAPCD's Escondido (ESC) station for meteorological data and SDAPCD's KVR monitor for PM DVs for this modeling subdomain. Though the KVR monitor is not located within this modeling subdomain, the ESC PM monitor was shut down in 2015, preventing the calculation of 2016 DVs for all NAAQS and CAAQS.

4.2.3 KEARNY

This modeling subdomain features coastal cities extending from Pacific Beach in the south to Solana Beach in the north, and inland communities such as Mira Mesa and Kearny Mesa surrounding Marine Corps Air Station Miramar. This modeling subdomain has coastal and inland rugged terrain, with some elevations in the eastern portion at greater than 200 meters ASL.

ICF used SDAPCD's KVR station for meteorology and SDAPCD's KVR monitor for PM DVs in this modeling subdomain.

4.2.4 EL CAJON

This inland modeling subdomain is centered around the city of El Cajon. The terrain in this area is generally 100–300 meters ASL and features an inland valley surrounded by mountainous features.

ICF used SDAPCD's Lexington Elementary School (LES) station in El Cajon for meteorological data and SDAPCD's KVR monitor for most of the ambient air quality standards (AAQS) for this modeling subdomain. For the 24-hour PM10 CAAQS, the highest observed value in the year is compared with the standard level. During 2016, SDAPCD's Floyd Smith Drive (FSD) monitor was moved to its current LES location (SDAPCD 2017). Considering the FSD and LES datasets together, the 2016 record of PM10 data is 95% complete, and the highest 24-hour PM10 value from that superset (actually from the LES location) is larger than at the KVR monitor. To be health-protective, ICF utilized the LES station for the 24-hour PM10 CAAQS. All other AAQS require at least 3 full years of data; accordingly, ICF used the KVR site to determine the remainder of DVs for the El Cajon modeling subdomain.

4.2.5 DOWNTOWN

This urban modeling subdomain encompasses downtown San Diego, the Port of San Diego, Point Loma, Mission Valley, and Mid-City, with an eastern edge just east of San Diego State University and a southern edge following a diagonal from the Silver Strand to west of Lemon Grove. Most terrain elevations are less than 150 meters ASL. This is a primarily coastal area that extends 20 kilometers inland.

For this modeling subdomain, ICF used SDAPCD's Perkins Elementary School (PES) station in downtown for meteorological data and the San Diego-Beardsley Street (DTN) SDAPCD monitor for most PM DVs. Although DTN was permanently closed on November 24, 2016, the data still meet completeness requirements for calculating 2016 DVs for most of the AAQS.[28] ICF used DVs from the Chula Vista (CVA) SDAPCD monitor (which is not within this modeling subdomain) for the AAQS, which require a more complete dataset than what is available from DTN—that is, the 2016 $PM_{2.5}$ 24-hour and annual NAAQS.

4.2.6 CHULA VISTA

This modeling subdomain covers the southernmost extent of San Diego County, south of the Downtown modeling subdomain and north of the International Border and extends from Imperial Beach along the coast to the Otay Mesa area, including the Port of Entry. This area is coastal and extends inland approximately 20 kilometers, with terrain in the eastern portion of this modeling subdomain around 160–200 meters ASL.

ICF used CVA for meteorology and PM DVs in this modeling subdomain. While the Otay Mesa-Donovan (DVN) monitor had higher DVs, ICF did not utilize it because it is non-FEM (Federal Equivalent Method), and ICF is aware of some technical issues with the monitor that caused reporting problems.

4.3 METEOROLOGY

AERMOD requires meteorological data as input for the model. These typically are processed using AERMET, a pre-processor to AERMOD. AERMET requires observed surface meteorological data, upper-air meteorological data, and surface parameter data. SDAPCD provided three consecutive years of AERMET-processed, AERMOD-

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[28] Beardsley Street station closed in November 2016 (https://ww3.arb.ca.gov/qaweb/site.php?s_arb_code=80142). Sherman Elementary station opened in its place in 2019. There are no PM data for this area during this time gap.

ready meteorological files from SDAPCD-operated stations near to or within each modeling subdomain, supplemented as needed with data from other stations, as indicated in Figure 2 and Table 4. These data utilized the latest AERMET version at the time (v19191), 1-minute-averaged wind data where available (via EPA's AERMINUTE preprocessor), and the sigma-theta AERMET option coupled with onsite measurements of turbulence. Calm winds occurred 3% or less of the time at each station, and missing hours of meteorological data occurred less than 2% of the time. Upper-air data were from the Miramar Marine Corps Air Station (NKX).

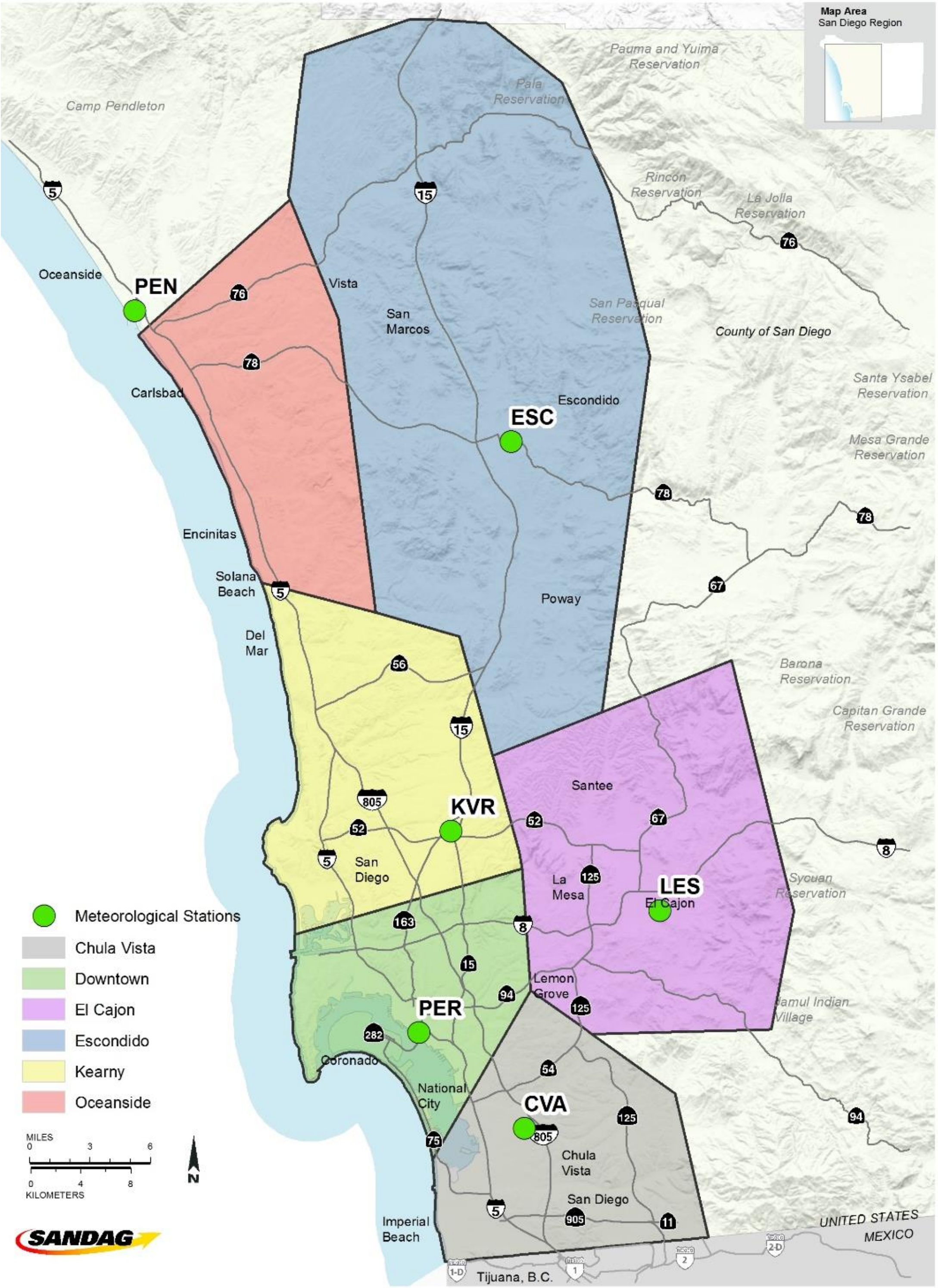

Figure 2. Sources of Meteorological Data

Note that the labels in the map indicate the station abbreviation for the onsite station (see Table 4). All onsite stations are managed by SDAPCD.

Table 4. Metadata on Each Meteorological Station

Modeling Subdomain (Abbreviation)	Station Metadata					
	Name	Latitude	Longitude	Elevation. (meters)[1]	ASOS 1-Minute Winds/Cloud-Cover Substitutions/ Temperature Substitutions[2]	Period
Oceanside (OCE)	On site: SDAPCD’s Camp Pendleton (CMP) Supplemental Surface: CARB’s McClellan-Palomar Airport (CRQ)	33.217	-117.396	16	Yes/ Yes/ Yes	2010–2012
Escondido (ESC)	On site: SDAPCD’s Escondido (ESC) Supplemental Surface: Ramona Airport (RNM)	33.128	-117.075	200	Yes/ Yes/ Yes	2010–2012
Kearny (KVR)	On site: SDAPCD’s Kearny Villa Rd. (KVR) Supplemental Surface: Marine Corps Air Station (NKX)	32.836	-117.129	134	No/ No/ Yes	2014–2016
El Cajon (LES)	On site: SDAPCD’s Lexington Elementary School (LES) Supplemental Surface: Marine Corps Air Station (NKX)	32.791	-116.942	144	No/ Yes/ Yes	2010–2012
Downtown (DTN)	On site: SDAPCD’s Perkins Elementary School (PES) Supplemental Surface: San Diego Int’l Airport (KSAN)	32.701	-117.150	8	Yes/ Yes/ Yes	2010–2012
Chula Vista (CVA)	On site: SDAPCD’s Chula Vista (CVA) Supplemental Surface: San Diego Int’l Airport (KSAN)	32.631	-117.059	55	Yes/ Yes/ Yes	2010–2012

[1] Elevations were supplied by SDAPCD directly.

[2] “ASOS 1-Minute Winds” refers to whether the meteorological processing utilized 1-minute data on winds (applies only to ASOS stations). “Cloud-cover Substitutions” and “Temperature Substitutions” refers to whether the meteorological processing utilized interpolation to fill in small gaps of missing cloud-cover or temperature data.

ASOS = Automated Surface Observing System .

4.4 SOURCE REPRESENTATION

As discussed earlier (Sections 3.1, *On-Road Sources,* and 3.2, *Passenger and Freight Rail*), ICF modeled emission sources as polygons, from data supplied by SANDAG which ICF simplified to reduce the number of vertices without substantially impacting concentration gradients (which also improves model runtime). The spatial representations of the major links and the rail were mostly contiguous segments, while ICF modeled minor-link emissions aggregated to partial tract polygons (the portions of a tract within a given modeling subdomain). Because major-link segments were relatively short, ICF allowed them to cross beyond the boundaries of the modeling subdomain and be modeled as part of both modeling subdomains; rail segments were longer and ICF clipped them at modeling subdomain boundaries.

For efficiency in modeling, ICF aggregated emissions from on-road brake wear, tire wear, road dust, and exhaust into total PM10 and total PM2.5 emissions. ICF also aggregated TAC emissions based on toxicity weighting to benzene, utilizing OEHHA reference values—see the toxicity reference values and corresponding toxicity-equivalency factors in Table 5 that ICF used to aggregate TAC emissions to benzene-equivalents. ICF used actual emissions for each road and rail source (in units of grams per square meter per second), with temporal profiles based on those in the ABM, utilizing the AERMOD HROFDAY profile to represent the hourly variation in emissions throughout the day.[29]

Table 5. Inhalation Toxicity Reference Levels Used to Aggregate Emissions of Toxic Air Contaminants Based on Toxicity Weighting to Benzene

Chemical	Acute REL (µg/m^3)	Chronic REL (µg/m^3)	CSF (mg/kg-d)$^{-1}$	Acute Non-Cancer TEF	Chronic Non-Cancer TEF	Cancer TEF
1,3-Butadiene	660	2	0.6	2.44E+01	6.67E-01	1.67E-01
Acetaldehyde	470	140	0.01	1.74E+01	4.67E+01	10
Acrolein	2.5	0.35		9.26E-02	1.17E-01	
Benzene	27	3	0.1	1	1	1
DPM		5	1.1		1.67E+00	9.09E-02
Ethylbenzene		2000	0.0087		6.67E+02	1.15E+01
Formaldehyde	55	9	0.021	2.04E+00	3	4.76E+00
Naphthalene		9	0.12		3	8.33E-01
POM as Benzo[a]pyrene			3.9			2.56E-02

Sources: RELs: OEHHA 2019b, CSFs: OEHHA, 2019a.

DPM = diesel particulate matter; POM = polycyclic organic matter; REL = non-cancer reference exposure level; CSF = cancer slope factor; TEF = toxicity-equivalency factor (ICF multiplied emissions by these TEFs to toxicity-weight them to benzene); µg = microgram; m^3 = cubic meter; mg = milligram; kg = kilogram; d = day.

The absence of an REL or CSF means that OEHHA has not promulgated a value, and therefore ICF did not include that chemical in that risk metric (e.g., ICF did not include ethylbenzene emissions in assessments of acute risk). ICF used DPM only from diesel engines and the other TACs only from non-diesel engines. As noted earlier in Section 3.1 *On-Road Sources*, emissions of POM were already aggregated and toxicity-weighted to benzo[a]pyrene.

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[29] Consistent with the ABM annualized vehicle-travel information, ICF did not include weekday/weekend variation in release profiles in the dispersion modeling.

ICF modeled two of each major- and minor-link polygon—one polygon for activity from light-duty vehicles and another for activity from heavy-duty vehicles. When SANDAG characterized north- and south-bound links from the same roadway as separate segments, ICF kept them separate in the modeling. ICF set the source release heights and the parameter for the initial vertical plume as indicated in Table 6, based on default vehicle heights and formulas provided by EPA (EPA 2015b, 2019).

Table 6. Characterizations of Source and Plume Height for On-Road Sources

Source Type	Vehicle Height (VH; meters)	Release Height (meters) = (VH × 1.7)/2	Initial Vertical Plume Parameter (SigmaZ; meters) = (VH*1.7)/2.15
On-road light duty (including exhaust, brake, dust)	1.53	1.3005	1.2098
On-road heavy-duty (including exhaust, brake, dust)	4	3.4	3.1628

Sources: VH = EPA 2015b. RH = EPA 2015b, EPA 2019, SigmaZ = EPA 2019.

ICF modeled two of each rail polygon—one polygon for daytime activity and another for nighttime activity. ICF defined daytime as 6 a.m. through 5:59 p.m. ICF set the source release heights and the parameter for the initial vertical plume as indicated in Table 7 (ENVIRON International, Corporation 2008: Table 4-1). ENVIRON used these height and vertical-plume values for arriving-departing line haul, while they used much higher values for switcher activities.

Table 7. Characterizations of Source and Plume Height for Rail Sources

Source Type	Release Height (meters)		Initial Vertical Plume Parameter (SigmaZ; meters)	
	Daytime	Nighttime	Daytime	Nighttime
Switcher (rail yard)[1]	37.76	37.3	8.78	8.67
All Other Rail[2]	4.76	11.25	1.11	2.62

[1] Activity Subcategory D (Switching) (ENVIRON International, Corporation, 2008: Table 4-1).

[2] Activity Subcategory E (Arriving-Departing Line Haul) (ENVIRON International, Corporation, 2008: Table 4-1).

ICF did not directly model dispersion of stationary-source emissions. ICF based concentrations on EPA's RSEI modeling (see Section 3.3, *Stationary and Other Sources*).

4.5 RECEPTORS

Receptors are specific locations where air pollutant concentrations are simulated in the dispersion model. Our analysis had two types of receptors: those used for the HRA and those used for PM evaluation. Those for the HRA evaluation are referred to here and in the body of the EIR as *sensitive receptors*; they represent sensitive land uses such as residences, schools, and parks. The second type, *ambient receptors,* are used to determine the ambient air quality impacts of the Plan, specifically the incremental changes PM concentrations across the modeled areas. In practice in the dispersion modeling the locations of both types of receptors were at the same place for both HRA and PM assessment. In the ambient air quality analysis these locations are referred to as ambient receptors. In the HRA (Section 5) these represent different types of sensitive receptors based on the land use in which they occur (e.g., schools, parks, or residential).

ICF first created a regular grid of receptors across the assessment domain, which was consistent across analysis years and spaced at 50 meters, consistent with CARB and South Coast Air Quality Management District (SCAQMD) recommendations (CARB 2005, SCAQMD n.d.). The consistency of the receptor grid across analysis years was to support incremental-risk calculations, except where changes in land use caused receptors to be in or out of a given year of modeling (e.g., a residential area projected to exist in 2050 where none existed in 2016, or vice versa) or where AADT or construction plans changed source locations or designations (e.g., a new major link is built in 2035, or AADT projections cause a link to go from minor to major status). ICF created the grid of receptors for a given analysis year to extend 500 feet (approximately 152 meters) from major links and rail lines, also including a 10-foot (approximately 3-meter) right-of-way buffer adjacent to a major link to account for the shoulder. No receptors were placed within a source. This approach ensured that receptor definitions were consistent with both available land-use definitions and specific sources defined in the proposed Plan. The 10-foot road edge buffer forming the inside boundary of receptors defined the road shoulder, setting the closest area of public access to the major link, and representing the "fenceline" of the project area, consistent with Caltrans road cross-sections provided by SANDAG (Uchitel pers. comm.); ICF assumed no shoulder for rail. The 500-foot outer boundary of receptors was a distance judged to provide adequate representation of the near-road or near-rail concentration gradient, consistent with CARB guidance (2005) for siting new sensitive land uses within 500 feet of a freeway, or urban road with more than 100,000 vehicles/day. Table 8 indicates the number of receptors for each modeling subdomain and analysis year.

In determining health risk, the subset of the gridded receptors that were sensitive receptors represented residential, school, and recreational land uses, based on SANDAG's land-use models. The land-use models had codes facilitating identification of schools and recreational areas; for residential areas there were data on all four analysis years, and ICF required a land-use polygon to have at least one dwelling unit to be considered residential.[30] Recreational and school land uses do not change in this analysis.[31] Some land-use polygons could have multiple land uses.

Table 8. Number of Modeling Receptors, by Modeling Subdomain and Analysis Year

	Analysis Year			
Modeling Subdomain	**2016**	**2025**	**2035**	**2050**
Chula Vista	2,093	2,179	2,950	3,083
Downtown	3,004	3,499	4,418	5,711
El Cajon	1,645	1,953	1,906	2,522
Escondido	2,046	2,155	2,138	2,391
Kearny	2,253	2,331	3,156	3,733
Oceanside	2,909	3,068	3,151	3,153
Total	**13,950**	**15,185**	**17,719**	**20,593**

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[30] Please note residential sensitive-receptor zones here represent residential land uses, not specific houses. These were used to characterize incremental health risk in residential locations. This is independent of the population in these areas, which could change, for example, if more residents move into the area due to denser housing stock.

[31] Note that there can still be "new" recreational or school receptors that are "turned on" by a new source. For example, a new rail that comes near an existing school that was not previously near enough to a source to be included in the modeling would be a "new" receptor for the modeling even though the land use is unchanged. This is explained further in Section 7.3.

ICF placed all ambient receptors for PM analysis at ground level (i.e., flagpole receptors at 0-meter height), consistent with SCAQMD guidelines (SDAPCD guidelines do not include guidance on receptor heights). ICF placed all sensitive receptors for HRA analysis a standard breathing height of 1.2 meters, consistent with HARP modeling default (CARB 2015b). These are heights above ground level, with terrain included.

Note that these sensitive receptors represent land use, not necessarily the "density" of a land use. That is, a residential sensitive receptor indicates that the land around that sensitive receptor is used for residential purposes (possibly among others); however, it does not indicate how many people live at that residence. This is explained further with the scope of the HRA in Chapter 5, *Estimating Health Risks*.

All receptors were modeled considering the underlying terrain elevation. ICF included terrain modeling in the analysis for all modeling subdomains, utilizing EPA's current version (version 18081) of AERMOD's terrain processor, AERMAP.

4.6 OTHER MODEL SPECIFICATIONS

Other model specifications were consistent with regulatory applications of AERMOD.

ICF used the version of AERMOD current at the time of modeling (19191) to conduct all dispersion analyses. ICF included only model regulatory default (DFAULT) options except for use of the FASTALL computation method, which optimizes model runtime for area sources through a hybrid approach. As mentioned in Section 4.3, the meteorological data obtained from SDACPD were processed with 1-minute-averaged wind data where available (via EPA's AERMINUTE preprocessor), the sigma-theta AERMET option coupled with onsite measurements of turbulence, and typically with substitutions of missing temperature and cloud-cover values.

SDAPCD guidance for HRAs recommends rural dispersion throughout the San Diego region except on a case-by-case basis (SDAPCD 2019). ICF used urban dispersion for modeling subdomains containing more than 50% of their land area designated as Census Urban Areas (i.e., for all modeling subdomains except Escondido). For the Escondido modeling subdomain (the only modeling subdomain with 50% or less of its land area designated as Census Urban Area), urban dispersion settings were on a source-by-source basis: if more than 50% of a major link segment, rail segment, or partial tract was in a Census Urban Area, then ICF modeled that source segment with urban dispersion. ICF used an urban population of 3,337,685 (U.S. Census Bureau 2017), for the San Diego-Carlsbad Major Statistical Area, consistent with the relatively isolated nature of San Diego's urban area (EPA 2018), for the urban dispersion setting.

This analysis excluded impacts of any trees or other mitigating barriers such as sound walls that could affect dispersion between sources and receptors.

4.7 BACKGROUND CONCENTRATIONS DATA

ICF did not include background concentrations in any AERMOD simulation. Background is important for establishment of cumulative risk, but not incremental risk (Chapter 5). It is also relevant for the PM thresholds (Section 6.1). Both are discussed below.

San Diego currently is in nonattainment for both the PM2.5 CAAQS (for which there is an annual standard) and the PM10 CAAQS (for which there are 24-hour and annual standards; both must not be exceeded for a region to be considered in attainment for PM10 CAAQS; CARB 2019).[32,33] The monitor DVs based on 2016 data (CARB, n.d.-) show exceedances of the 24-hour PM10 CAAQS and the 24-hour and annual PM2.5 CAAQS at the Otay Mesa-Donovan monitor in the Chula Vista area, which ICF excluded from this analysis. (Because of this, none of the modeled subdomains are treated as nonattainment for PM2.5 for modeling purposes, although the county is thus designated. See discussion further below). The monitor DVs also show exceedances of the 24-hour PM10 CAAQS at the monitor ICF selected for the Downtown modeling subdomain, as well as the annual PM10 CAAQS at the Downtown monitor and the monitor ICF selected for the Chula Vista modeling subdomain. All other modeling subdomains and standards show exceedances of the applicable standards based on the 2016 monitor DVs.

For computation of PM thresholds, ICF assigned to each model subdomain a single background concentration (2016 DV [CARB n.d.]) for each pollutant and averaging period. There are relatively few available monitors to calculate PM DVs and other information related to AAQS for the modeling subdomains for the baseline project year of 2016. Therefore, ICF used a limited number of monitors to describe the baseline air quality across the assessment domain.

Table 9 presents the assignment of PM monitors and 2016 DVs to each modeling subdomain. Table 10 provides the metadata for each of the PM monitors chosen.

Table 9. Assignments of Monitors and Design Values (in micrograms per cubic meter) for Particulate Matter for each Modeling Subdomain

Modeling Subdomain	National Standards[1]						California Standards[2]					
	PM2.5				PM10		PM2.5		PM10			
	Annual (12.0)[3]		24 Hour (35)[4]		24 Hour (150)[5]		Annual (12)[6]		Annual (20)[g]		24 Hour (50)[7]	
	Monitor	DV	Monitor	DV	Monitor	DV	Monitor	DV	Monitor	DV	Monitor	DV
Oceanside	KVR	7.6	KVR	15	KVR	39	KVR	8	KVR	20	KVR	35
Escondido	KVR	7.6	KVR	15	KVR	39	KVR	8	KVR	20	KVR	35
Kearny	KVR	7.6	KVR	15	KVR	39	KVR	8	KVR	20	KVR	35
El Cajon	KVR	7.6	KVR	15	KVR	39	KVR	8	KVR	20	FSD/LES	44[i]
Downtown	CVA	8.8	CVA	19	DTN	53	DTN	10	**DTN**	**24**	**DTN**	**51**
Chula Vista	CVA	8.8	CVA	19	CVA	48	CVA	9[j]	**CVA**	**23**	CVA	48

[1] NAAQS available in Title 40, Part 50 of the Code of Federal Regulations: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr50_main_02.tpl

[2] CAAQS available in Section 70200 of Title 17 of California Code of Regulations: https://ww3.arb.ca.gov/regs/title17/70200.pdf, and summarized along with NAAQS by CARB: https://ww2.arb.ca.gov/sites/default/files/2020-07/aaqs2.pdf.

[3] The PM2.5 National Annual DV is calculated as the average of three consecutive national averages (shown here: average of 2014–2016).

[4] The PM2.5 National 24-hour DV is calculated as the average of three consecutive annual 98th percentile values (shown here: average of 2014–2016).

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[32] CARB Area Designations for State PM2.5 Ambient Air Quality Standards: https://www.arb.ca.gov/desig/adm/2019/state_pm25.pdf?_ga=2.133211788.342428628.1625676234-2022182663.1612965600.

[33] CARB Area Designations for State PM10 Ambient Air Quality Standards: https://www.arb.ca.gov/desig/adm/2019/state_pm10.pdf?_ga=2.226854559.342428628.1625676234-2022182663.1612965600.

[5] The PM10 National 24-hour NAAQS standard is violated when the sum of exceedances over 3 years is greater than three. The DV given is the maximum 24-hour average concentration of PM10 over 2014–2016, which is a conservative overestimate of air quality with regard to 24-hour PM10.

[6] The PM2.5 State Annual DV is the maximum of three consecutive annual averages (shown here: maximum of 2014–2016).

[7] The PM10 State Annual DV is the maximum of three consecutive annual averages (shown here: maximum of 2014–2016).

[8] The PM10 State 24-hour DV is calculated as the maximum 24-hour PM10 average observed within the year (shown here: maximum in 2016).

[9] During 2016, the FSD monitor was moved to its current LES location. Considering the FSD and LES datasets together, the 2016 record of PM10 data is 95% complete, and the highest 24-hour PM10 value from that superset (actually from the LES location) is larger than at the KVR monitor.

[10] The Otay Mesa-Donovan monitor has a DV of 13 for 2016 (for the annual PM2.5 CAAQS), but ICF did not utilize it because it is non-FEM, and ICF was aware of some technical issues with the monitor that caused reporting problems.

Notes:

PM = particulate matter; PM10 = PM with aerodynamic diameter less than or equal to 10 micrometers; PM2.5 = PM with aerodynamic diameter less than or equal to 2.5 micrometers; DV = design value; KVR = Kearny Villa Road; CVA = Chula Vista; DTN = 1110 Beardsley Street; LES = Lexington Elementary School; FSD = Floyd Smith Drive.

Bold underline indicates an exceedance or violation of the standard. Parenthetical values in the third header row indicate the standard-level concentrations.

Table 10. Metadata on Monitoring Stations for Particulate Matter

Name	Latitude	Longitude	Elevation (meters)	Agency	Notes
Chula Vista (CVR)	32.63	-117.06	55	SDAPCD	Not available
Beardsley Street (DTN)	32.70	-117.15	141	SDAPCD	Not available
Kearny Villa Road (KVR)	32.85	-117.12	134	SDAPCD	Not available
Floyd Smith Drive (FSD)	32.82	-116.97	119	SDAPCD	FSD was moved back to its original site, LES, in late 2016.
Lexington Elementary School (LES)	32.79	-116.94	144	SDAPCD	Data from FSD and LES are combined in 2016 to create a complete record.

All the selected sites are either Federal Reference (FRM) or Federal Equivalent Method (FEM) for the pollutant they are supporting (SDAPCD 2017). This ensures that the DVs extracted are commensurate with their purpose here.

ICF chose PM monitors according to the amount of data completeness required to calculate 2016 DVs for all AAQS. When a modeling subdomain contained more than one PM monitor with DVs available for a given AAQS, ICF selected the monitor with the higher DV to be conservative.

- With one exception, ICF used KVR in the Escondido, El Cajon, and Oceanside modeling subdomains because it is the closest monitor to these modeling subdomains with the data completeness necessary to calculate DVs for 2016.
- The exception is for the 24-hour PM10 CAAQS specifically for the El Cajon modeling subdomain. During 2016, SDAPCD’s FSD monitor was moved to its current LES location. Considering the FSD and LES datasets together, the 2016 record of PM10 data is 95% complete, and the highest 24-hour PM10 value from that superset (actually from the LES location) is larger than at the KVR monitor. To be conservative, ICF utilized the LES station for the 24-hour PM10 CAAQS.

- ICF used CVA DVs in the Downtown modeling subdomain for the PM2.5 24-hour and annual NAAQS, instead of DTN DVs due to data-completeness issues.

ICF considered the Pala Airpad Tribal monitor to the northeast of the overall assessment domain, but rejected it due to the lack of certified data along with low DVs for the data that were available. ICF considered the Otay Mesa-Donovan monitor but ultimately rejected it as the particulate monitors are not operated according to FEM/FRM standards, and ICF was made aware of some technical issues with the monitor that caused reporting problems during this period.

Figure 3 shows the locations of the PM monitors described in Table 9. Table 10 summarizes the monitoring station assignments by modeling subdomain.

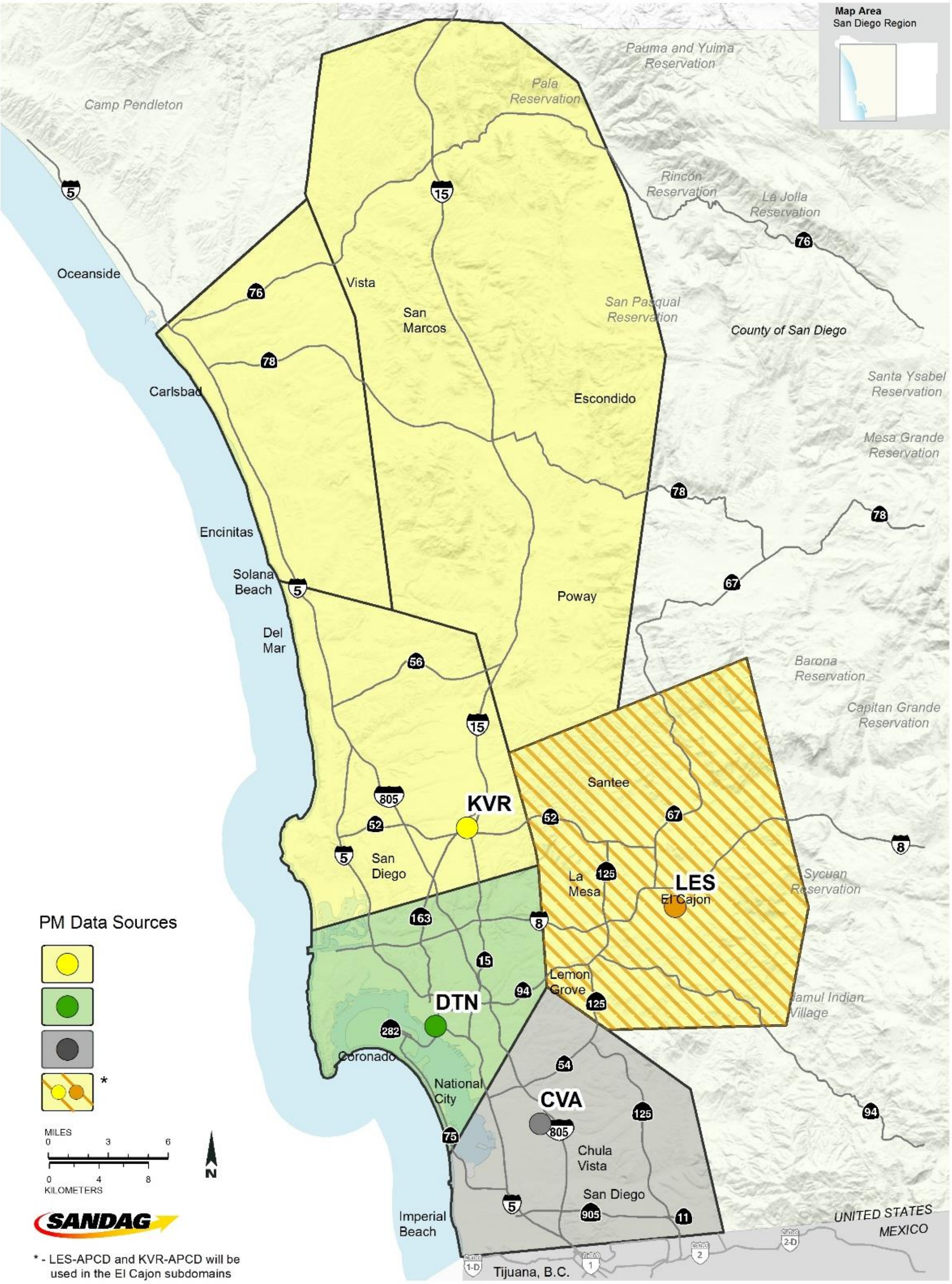

Figure 3. Sources of 2016 Design Values for Particulate Matter

Notes: Labels in the map indicate the monitor abbreviation (see Table 9 and Table 10). All monitors are managed by SDAPCD.

4.8 OUTPUTS

4.8.1 PARTICULATE MATTER

For PM2.5 modeling, ICF used AERMOD to determine the 24-hour-average NAAQS DVs, specifically the highest multi-year average of the 98th percentile 24-hour PM2.5 concentrations, which equates to the multi-year average of the annual eighth-highest 24-hour values. In AERMOD, ICF achieved this by setting the AERMOD keyword POLLID to PM2.5 and the output rank to 8TH, which outputs the multi-year average of the annual eight-highest 24-hour values at each ambient receptor. For PM2.5 annual standards, ICF modeled each year of meteorological data separately with annual-average outputs, so that ICF could identify the maximum annual concentration at each ambient receptor for the CAAQS DV and the multi-year-average annual concentration at each ambient receptor for the NAAQS DV.

For PM10 modeling, ICF used AERMOD to determine the 24-hour-average NAAQS DVs. The 24-hour NAAQS is violated when the 24-hour-average concentration exceeds the standard more than once per year on average over 3 years, such that the DV equates the High-N+1-High value of 24-hour-average concentrations over N years. In AERMOD, ICF arrived at this DV by setting the POLLID to PM10 and the output rank to 4TH, because N is 3 here. For the 24-hour CAAQS, ICF used AERMOD to determine the highest 24-hour-average concentration in the 3-year modeling period, which ICF used as the CAAQS DV though it is a conservative estimate because the CAAQS form refers to 1 year of analysis rather than 3 years (i.e., the highest 24-hour-average in 1 year rather than across 3 years). For the PM10 annual CAAQS, ICF modeled each year of meteorological data separately with annual-average outputs, so that ICF could identify the maximum annual concentration at each ambient receptor for the CAAQS DV.

ICF compared these DVs against PM thresholds, as described in Section 6.1.

4.8.2 HEALTH RISK ASSESSMENT

HRA dispersion modeling produces only interim results. ICF used AERMOD to output toxicity-weighted TAC concentrations as maximum 1-hour-average concentrations (for acute assessment) and period-average concentrations (for chronic non-cancer and cancer assessment) at each sensitive receptor for the 3-year modeling period. These concentrations were benzene-equivalents based on relative toxicity for a given health endpoint as discussed in Section 4.4, *Source Representation*. ICF used these AERMOD outputs in the HARP model to estimate cancer and acute and chronic non-cancer health risks for each sensitive-receptor type and modeling subdomain (Chapter 5).

5 ESTIMATING HEALTH RISKS

The health risks associated with pollutant exposure were estimated by translating the toxicity weighed TAC concentrations from Chapter 4 into exposure risks. ICF evaluated both incremental and cumulative health impacts from the proposed Plan. Incremental risks are evaluated for cancer, acute non-cancer, and chronic non-cancer endpoints. Only cancer health impacts were evaluated for cumulative risks. The exposure parameters used in HARP2 to estimate excess lifetime cancer risks and non-cancer Hazard Indices (HI) for all potentially exposed populations are consistent with updated risk assessment guidelines from OEHHA. This section summarizes the methods and tools used to estimate health risks from exposures to TACs associated with the proposed Plan.

5.1 POLLUTANTS ASSESSED

As discussed in Section 2.2, health risks associated with the proposed Plan were estimated for the following nine priority MSATs: 1,3-butadiene acetaldehyde, acrolein, benzene, DPM, ethylbenzene, formaldehyde, naphthalene, and POM. Only exhaust emissions were speciated, consistent with FHWA's approach for priority MSATs.

TACs can result in a variety of health impacts. For this assessment, cancer and short (acute) and long-term (chronic) non-carcinogenic impacts were assessed. The severity of adverse health impacts from TACs are dependent on the toxicity of the compound and the level of exposure. These priority MSAT pollutants do not have substantial multi-pathway exposure mechanisms.[34] Accordingly, this analysis considers the inhalation pathway only. All analyses were performed using OEHHA's HARP2 model.

As discussed in Section 4.4, ICF used toxicity weighting to expedite the air quality modeling and risk assessment. TAC emissions were scaled based on toxicity weighting to benzene, utilizing OEHHA reference values for a given endpoint. Because of the relative differences in the health benchmark values used to assess cancer, non-cancer acute, and non-cancer chronic health effects, different toxicity weightings were used for each of the endpoints. This approach allows a single AERMOD simulation to represent the compound effects of all considered TACs, because although HARP can consider multi-pollutant impacts, AERMOD is a single pollutant model. However, this approach requires modeling the three health effects endpoints separately in HARP to accommodate the different weighting factors by different endpoint. See Section 4.4 and Table 5 for more information on this approach.

5.2 HEALTH EFFECTS ENDPOINTS

As noted, ICF used a benzene toxicity-weighting approach to estimate health effects from exposure to TAC emissions under the proposed Plan of the nine MSATs. Sections 5.2.1 and 5.2.2 provide more detail on carcinogenic and non-carcinogenic health evaluations, respectively.

5.2.1 CARCINOGENIC EFFECTS

Excess lifetime cancer risks are estimated as the increased likelihood that an individual will develop cancer over a lifetime as a direct result of exposure to potential carcinogens. The estimated risk is expressed as a unitless probability. The cancer risk attributed to a chemical is calculated by multiplying the chemical intake or dose at the human exchange boundaries (e.g., lungs) by the chemical-specific cancer potency factor (CPF). Cancer-risk age sensitivity factors (ASFs) are included to account for an anticipated special sensitivity to carcinogens of infants and children. The use of CPFs and ASFs is recommended by OEHHA in its 2015 Health Risk Guidelines and included in HARP.

Consistent with both OEHHA and SDAPCD recommendations for a 30-year exposure duration for estimating cancer risk for residential sensitive receptors, ICF determined cancer increments using a 30-year continuous exposure to the level of emissions associated with the proposed Plan in a given year. This is true for each of the three modeled Plan years and the baseline (2016) at a given location. For example, the cancer risk associated with year 2025 is estimated as 30 years of exposure to the 2025 level of emissions. The incremental risk for 2025 is based on 30-years of exposure at 2025 levels minus the risk from 30 years of exposure at the existing

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[34] See Table 5.1 of OEHHA's Hot Spot Guidance, https://oehha.ca.gov/media/downloads/crnr/2015guidancemanual.pdf.

(2016) levels of emissions. These incremental risks are then compared to the incremental cancer risk thresholds (Section 6.2). The 30-year exposure applies only to the residential and recreational exposure scenarios. For the school scenario, an exposure duration of 13 years was used, although the same mathematical construct applies. See Section 5.3 for more detail on exposure settings.

Section 7.3, *HRA,* provides results for incremental changes in cancer risk and cumulative cancer risk for each Plan year.

5.2.2 NON-CARCINOGENIC EFFECTS

The potential for exposure to result in chronic non-cancer effects is evaluated by comparing the estimated annual-average air concentration to the chemical-specific non-cancer chronic RELs, using HARP. Acute non-cancer effects utilize the peak 1-hour air concentration in comparison with the acute RELs. When calculated for a single chemical, the comparisons yield a ratio termed a hazard quotient (HQ). Consistent with OEHHA guidance, to assess the potential for adverse non-cancer health effects from simultaneous exposure to multiple chemicals, the chronic or acute HQs for all chemicals are summed for each target organ system, yielding an HI. Conservatively, HIs were reported for the most impacted organ system. Non-cancer chronic HIs utilized the period average concentrations from AERMOD. Non-cancer risks relied on the same sources and pollutants identified earlier.

ICF reports incremental changes in chronic and acute HI, similar to that discussed for cancer end points. Note that there is no quantitative evaluation of cumulative non-cancer impacts due to lack of data on background non-cancer risks.[35]

5.3 EXPOSURE SCENARIOS ASSESSED

For a given ambient concentration of pollutant, the potential for adverse health effects is a function of the types of persons exposed (e.g., adults, children, pregnant women) and the duration and extent of exposure. Based on guidance from the most recent version of the *Air Toxic Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* dated February 2015 (OEHHA 2015), health impacts were assessed for Residential, School, and Recreational exposure scenarios.

Residential

For residential sensitive receptors, lifetime cancer risks were conservatively based on an assumed 30-year exposure duration (ED) to TAC air concentrations with exposure beginning in the third trimester.[36] All HRA modeling was performed with HARP and included OEHHA's ASFs, as appropriate, and OEHHA-derived inhalation rates (i.e., 95th percentile inhalation rate).

OEHHA guidance suggests that the fraction of time at home (FAH) for residential sensitive receptors be set to 1 for ages less than 16 years for cases where a school lies within a 1 per million cancer isopleth of the site. For

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[35] As discussed in Section 5.4.4, cumulative cancer risks rely on EPA's National Air Toxics Assessment (NATA), which reports cumulative cancer risks only. No attempt to calculate cumulative non-cancer risks was made given the lack of data.

[36] Note that ICF did not assess occupational cancer risk or 8-hour chronic HI.

the current assessment, ICF conservatively used an FAH of 1 for ages less than 16 for all residential sensitive receptors, regardless of school location. All other inputs were HARP default values for inhalation exposure.[37]

Non-cancer risks for the resident scenario were based on the relevant exposure parameters described above.

School

To assess health effects on sensitive receptors, a K-12 student scenario was evaluated. To assess cancer risks for the school scenario an ED of 13 years was used, with exposure beginning at age 5.[38] For school sensitive receptors, the fraction of time exposed was set to 12% (6 hours per day, 180 days per year) for all exposed ages starting at age 5. Preschools were not assessed.

Non-cancer risks for the school scenario were based on the relevant exposure parameters described above.

Recreational

To assess cancer risks for recreational sensitive receptors, the ED was set to 30 years and the fraction of time exposed was set to 4% (2 hours per day, 180 days per year), assuming the average amount of time spent daily in such locations.

Non-cancer risks for the recreational scenario were based on the relevant exposure parameters described above.

5.4 RISK ESTIMATION METHODS

The current version of CARB's HARP model[39] (version 21081) was used to estimate the short- and long-term health impacts from exposure to the pollutants emitted from operation of the road network and selected additional sources influenced by or expected to have compounding effects on the road emissions from the proposed Plan.

Estimated ground-level concentrations (GLC) (discussed below) were used as inputs to HARP to calculate cancer, non-cancer acute, and non-cancer chronic health endpoints, for each modeled sensitive receptor in each modeled subdomain, for each assessed year, and for residential, school, and recreational sensitive receptors.

5.4.1 GROUND-LEVEL CONCENTRATIONS

GLCs for all TACs were based on the output of the air dispersion modeling, conducted with AERMOD, as described in Chapter 4. As noted in Section 2.2.2, the full universe of TACs evaluated was: 1,3-butadiene, acetaldehyde, acrolein, benzene, DPM, ethylbenzene, formaldehyde, naphthalene, and POM/PAH. POM/PAH comprised benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene,

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[37] Note that HARP was also used to translate TAC concentrations for stationary sources from the RSEI model to California-relevant risks. In that case, residential parameters were also used as described here. However, those did not include the conservative FAH approximation included for Plan sources. This is a small inconsistency that subtracts out in incremental risk calculation for most sensitive receptors. See Section 5.4.2.

[38] The 13-year exposure duration represents K–12 schools and is consistent with the approach OEHHA recommends. This is a conservative overestimate for other school types, such as K–5, as it assumes exposure will occur at the same location even if the student is at a different location for grades 5–12.

[39] Available at: https://www.arb.ca.gov/toxics/harp/admrt.htm.

dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene, all expressed as benzo[a]pyrene-equivalents based on their OEHHA cancer PEFs. As indicated in Section 4.4, ICF did not include some TACs for some exposure scenarios due to absence of a promulgated toxicity reference value—assessments of acute non-cancer risks did not include exposures to DPM, ethylbenzene, naphthalene, and POM/PAH (benzo[a]pyrene), while assessments of chronic non-cancer risks also did not include exposures to POM/PAH. Cancer assessments did not include exposures to acrolein. ICF also did not include emissions of acenaphthene, acenaphthylene, anthracene, benzo[g,h,i]perylene, fluoranthene, fluorene, phenanthrene, and pyrene in the expression of POM/PAH emissions as benzo[a]pyrene-equivalents for the same reason. Finally, ICF expressed all TAC emissions as benzene-equivalents (toxicity-weighted).

The AERMOD modeling resulted in GLCs for benzene (actually, the sum of all TACs represented as benzene-risk-equivalent concentrations). The AERMOD output PLOTFILE files expressed the largest hourly concentration at each sensitive receptor in the multi-year modeling (for use in acute risk assessment) and the multi-year-average concentration at each sensitive receptor (for use in chronic non-cancer and cancer risk assessment) of this pseudo-pollutant, which is input to the HARP model.

5.4.2 STATIONARY SOURCES

The proposed Plan has the potential to place new sensitive receptors at locations that previously were uninhabited and potentially in areas with high levels of pollutants due to nearby stationary sources. ICF assessed risks from both the mobile sources directly affected by the proposed Plan, and indirectly from nearby stationary sources for all sensitive receptors.

Data from EPA's RSEI model was used to estimate chronic non-cancer and cancer risks for stationary sources within the modeling subdomains. Chemical-specific GLCs were taken from the RSEI model for stationary sources in San Diego county, then modeled using HARP to determine the risks in a manner consistent with OEHHA's approach. These risks were calculated using chemical-specific GLCs at centroid points of an 810- by 810-meter grid across San Diego County. Cancer and chronic non-cancer risks were assessed assuming a 30-year ED with exposure starting in the 3rd trimester. As stationary source impacts are not the primary concern, ICF approximated this step by conservatively modeling only with a residential exposure scenario but tempered the approach by using the default FAH values for children under the age of 16. The resulting risk on the 810-meter grid was then interpolated using a (12-point, power of 2) inverse distance weighting approach in ArcGIS to interpolate stationary risks to each sensitive-receptor point in each modeling subdomain. This interpolated value is that used in the increment calculation. As noted above, the same stationary source risk is used for all years as there is no projection of 2016 stationary source concentrations to future years.

Finally, as the stationary sources concentrations from RSEI reflect only long-term exposure concentrations and are not appropriate for short-term, acute assessments, we did not include them in calculations of acute incremental risks from the proposed Plan.

5.4.3 INCREMENTAL HEALTH RISK ESTIMATION

Incremental risk is computed as the difference in risk values between the assessed plan year and the existing year for each sensitive receptor. For mobile source risks (i.e., risks associated directly with Plan emissions), incremental risks are calculated as:

$$Mobile\ incremental\ risk = Plan\ year\ risk - 2016\ risk$$

This is the form used for estimating acute exposures because the stationary source data does not include short-term concentrations. For chronic and cancer risk, however, ICF accounts for the potential for the Plan to result in new sensitive receptors relocated to areas of high concentrations of stationary source pollutants by adding stationary source risks to those mobile source risks to estimate a "total" incremental risk at a given sensitive receptor location:

$$Total\ incremental\ risk = (Plan\ year\ risk + stationary\ risk) - (2016\ risk + stationary\ risk)$$

In cases where a sensitive receptor exists in both the Plan year and the existing year (i.e., 2016), stationary risks, which are constant across the years assessed, cancel out as can be seen in the total incremental risk formula above. Stationary risks, therefore, only affect the total incremental risk in cases where a sensitive receptor "turns off" (receptor exists in 2016, but not in the Plan year) or "turns on" (receptor does not exist in 2016 but does exist in the Plan year). In the first case where a sensitive receptor "turns off," a sensitive receptor exists in 2016, which is not there in the assessed Plan year, resulting in a negative incremental risk. However, when a sensitive receptor "turns on," the total risk from the baseline 2016 year is zero, leaving the sum of the Plan year risk and stationary risk as total incremental risk. In this situation, the incremental risk is equal to the "total" risk (Plan plus stationary).

The summary results distinguish between risks that arise from existing sensitive receptors (receptors that exists in 2016) and risks that arise from new sensitive receptors (receptors that do not exist in 2016 but exist in the subsequent Plan years).

5.4.4 CUMULATIVE HEALTH RISK ESTIMATION

SDAPCD does not define a cumulative heath risk threshold and does not provide existing or expected cumulative risk values across the San Diego region to use in assessing cumulative health risk for the proposed Plan. ICF estimated cumulative health risk impacts by combining the health risk increment from the proposed Plan with the EPA's most recent assessment of risks in the modeled areas based on the 2014 National Air Toxics Assessment (NATA).[40] The 2014 NATA assessment includes emissions, ambient concentrations, and exposure estimates for about 180 air toxics plus DPM. NATA also provides estimates of cancer risk based on those chemicals for which there are carcinogenic health benchmarks for inhalation exposures. Because EPA does not have a carcinogenic health benchmark for DPM, DPM is not included in the risk estimates under NATA. However, DPM concentrations are provided under NATA. ICF used these DPM concentrations in HARP to calculate DPM cancer risks, then added those risks to the NATA cancer risk data to develop a total cancer risk, inclusive of DPM. ICF believes the NATA to be the most complete dataset to provide background risk levels for the modeled areas (i.e., risks to residents before the implementation of the Plan). NATA results were used because the data were easily accessible, efficient to use, and sufficiently timely (i.e., based on 2014 emissions). NATA data is reported at the Census Tract level. The sensitive receptors were given the NATA plus DPM risk value of the Census Tract in which they lie.

ICF computed cumulative risk at each modeled location in each year as:

$$cumulative\ cancer\ risk = cancer\ risk_{NATA} + cancer\ risk\ _{NATA\ DPM} +\ mobile\ incremental\ risk$$

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[40] https://www.epa.gov/national-air-toxics-assessment/2014-nata-assessment-results.

The first term was taken directly from NATA risk results and includes the risk for all carcinogenic pollutants and sources; however, as noted previously, it does not include risks from exposures to DPM. The second term was computed using residential exposure and cancer unit risk factors for DPM from OEHHA with the HARP tool for each sensitive receptor, following the same approach used for the other TACs described above, but based on total DPM concentrations from NATA, by census tract. It should be noted that these include all sources. This allows for the inclusion of DPM background risk values, using OEHHA methods, because NATA does not include DPM in their carcinogenic risk assessment. The third term is the mobile source cancer risk increment from the proposed Plan (project year minus existing), as discussed in Section 5.4.3, *Incremental Health Risk Estimation*. This term corrects the NATA values for the difference in mobile sources expected under the proposed Plan between project and existing years.

Note that the cumulative assessment is not an incremental evaluation. It is an estimate of the total risk from all sources in each modeling subdomain, from long-term exposure to the level of emissions associated with the proposed Plan and other sources that are included in NATA. Cumulative risks are reported for each of the proposed Plan years in Section 7.3. Note also that the mobile increment is essential to the cumulative risk calculation. Thus, cumulative risks are calculated only for sensitive receptors that exist in both the baseline and future years. (i.e., those receptors that are neither "turned on" or "turned off"). Finally, because NATA uses daily time-activity patterns to estimate long-term exposures, the NATA results were only used to estimate cumulative risks for residential sensitive receptors. School and recreational sensitive receptors would be inconsistent with the NATA characterization of risk given the small fraction of time spent in those environments.

6 THRESHOLDS

This section discusses the thresholds by which pollutant concentrations and risk are evaluated for significance.

6.1 PARTICULATE MATTER THRESHOLDS

As noted in Section 4.7, *Background Concentrations Data,* the San Diego region is currently in attainment of the PM10 and PM2.5 NAAQS and nonattainment of both PM10 and PM2.5 CAAQS.

The proposed Plan would have a significant local PM air-quality impact if it causes a new violation of the PM standards or contributes substantially to an existing or projected violation of the PM standards. Impacts were based on incremental concentration changes, similar to that used in the previous EIR (Section 4.3 of the EIR for the 2015 Regional Plan [SANDAG 2015]). These thresholds must be based on incremental concentration to avoid double counting that would occur if project concentrations were added to background and compared to the NAAQS or CAAQS. Any ambient receptor in a proposed Plan analysis year but not in the baseline year (e.g., a receptor modeled for 2050 but not for 2016, such as from a change in land use or new or expanded sources) could not be included in calculations of PM increments. That is, Plan increments cannot be calculated at ambient receptors that do not have modeled PM concentrations for the baseline year, and air-quality impacts cannot be determined at locations without Plan increments because the existing sources are already included in the monitored (background) concentrations.

For modeling subdomains where the monitored DVs were below the applicable standard(s), ICF established subdomain-, pollutant-, and averaging-period–specific thresholds of incremental concentration. This threshold was the difference between the applicable NAAQS or CAAQS level for PM concentrations and the monitored DV for the subdomain. ICF then computed the incremental change in modeled PM DV between the Plan and existing (2016) conditions. Where the maximum of these modeled increments across the modeling subdomain was at or below the PM threshold, implementation of the proposed Plan would not cause a new exceedance of the applicable standard(s).

For the remaining areas (those where the monitored DVs are above the PM standard[s]; i.e., nonattainment modeling subdomains), ICF determined if the proposed Plan would significantly contribute to existing violations by comparing the maximum incremental concentrations to a significant change threshold. Because SANDAG does not have its own incremental thresholds, ICF used thresholds from relevant agencies based on substantial evidence, discussed in part here. The most relevant thresholds are those recommended by SDAPCD. The SDAPCD has not published formal guidance regarding California Environmental Quality Act (CEQA) compliance, but air-district rulemaking often is the source for CEQA thresholds (SDAPCD 1998).[41] SDAPCD Rule 20.2 (New Source Review for non-major stationary sources) defines an incremental increase as 5.0 μg/m^3 for 24-hour PM10 and 3.0 μg/m^3 for annual PM10 (SDAPCD 1998). The County of San Diego suggests the 5.0 μg/m^3 24-hour PM10 threshold in its CEQA guidance (County of San Diego 2007). Neither SDAPCD nor the County provide recommendations for analyzing ambient PM2.5. The federal significant impact levels (SILs), intended to define when changes are not meaningful and do not contribute to a violation of the NAAQS under the Prevention of Significant Deterioration (PSD) program, would imply less-than-significant impacts in all Class I, II, or III areas. The federal annual SILs are 1.0 and 0.2 μg/m^3, and the federal 24-hour SILs are 5.0 and 1.2 μg/m^3 for PM10 and PM2.5, respectively.

Based on this review of relevant thresholds, ICF used the incremental thresholds presented in Table 11 (the source for each is summarized in parentheses).

Table 11. Significant Impact Levels Utilized when Monitor Design Values Were Above the Threshold Concentration for Particulate Matter

Time Scale	PM10	PM2.5
Annual	3.0 (SDAPCD, San Diego County)	0.2 (EPA)
24-hour	5.0 (SDAPCD, San Diego County, EPA)	1.2 (EPA)

As mentioned, SDAPCD Rule 20.2 defines an incremental increase of both 24-hour and annual PM10 (5.0 μg/m^3 and 3.0 μg/m^3, respectively). The County of San Diego, in its CEQA guidance, defines a significant impact on ambient air as an exceedance of the SDAPCD's 24-hour PM10 standard (defined as 5.0 μg/m^3). As noted, neither the SDAPCD nor County has provided recommendations for analyzing ambient PM2.5 concentrations. For PM2.5, ICF believes the SCAQMD PM2.5 Significant Change Thresholds are the most appropriate for use in the San Diego region over the more conservative federal SILs given the logic above about air quality in the South Coast region being much worse than the San Diego region and the fact that the use of SCAQMD Significant Change Thresholds are already conservative and health-protective. Note that the PM2.5 thresholds shown in Table 11 are more conservative than those used in the previous EIR (SANDAG 2015);). The PM10 thresholds also differ for the reasons discussed.

ICF shows each subdomain-, pollutant-, and averaging-period–specific threshold of incremental concentration in Section 7.2, *Particulate Matter,* alongside the results of the PM assessment.

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[41] For example, SCAQMD's *Significant Change Threshold* is based on rulemaking for New Source Review, and County of San Diego Screening Level Thresholds for mass emissions are based on permit levels for New Source Review.

6.2 HRA THRESHOLDS

The HRA considered incremental changes in cancer, chronic, and acute risks at residential, school, and recreational sensitive receptor locations. Each is defined in terms of an incremental change (increase) in risk from the proposed Plan relative to existing conditions.

- Carcinogenic health impacts are represented as the estimated excess 30-year cancer risk increment. A significant cancer health impact is defined as an excess cancer risk increment (net new) of 10 in a million or greater under the proposed Plan relative to baseline conditions anywhere in the modeling subdomain.
- A significant chronic non-cancer health impact is defined as an incremental chronic HI of 1.0 or greater anywhere in the modeling subdomain.
- A significant acute health impact is also defined as an incremental acute HI of 1.0 or greater anywhere in the modeling subdomain.

These criteria are consistent with SDAPCD levels of significance for public notification.[42]

ICF also considered cumulative health risks in each modeled subdomain under the proposed Plan. As above, these only apply for residential sensitive receptor types and only for cancer health risks. A significant cumulative health impact is determined by exceedance of the following cumulative threshold:

- A cancer risk of 100 per million or greater for residential sensitive receptors.

Note that a cumulative cancer risk of 100 per million was also used in the previous EIR (SANDAG 2015).

7 RESULTS

ICF first developed an inventory of the pollutant emissions associated with the Plan. This included link-based emissions for on-road mobile sources and source-based emissions for passenger and freight rail and other major stationary sources. ICF then conducted dispersion modeling to estimate localized PM10, PM2.5, and TAC concentrations under baseline (2016) conditions and three future-year (2025, 2035, and 2050) conditions with implementation of the proposed Plan. ICF then assessed incremental carcinogenic, acute non-cancer, and chronic non-cancer risks based on the modeled concentrations of TACs from the Plan and supplemented with additional risk values for potentially exposed populations. The methodology and details of these analyses are described in Chapters 2, 3 and 4, above. Here we summarize the results of each analysis step.

7.1 MASS EMISSIONS

ICF started with link- and time-resolved ABM outputs for 2016, 2025, 2035, and 2050. Vehicle speeds are time resolved, congested speeds from the ABM. Those activity data were coupled with EMFAC-based, speed resolved emission factors for San Diego County for the same years from EMFAC. ICF also incorporated road dust emissions into the air quality modeling determined with the CARB method and used MOVES-based speciation values to compute MSAT emissions; however, the summary Table 12 does not show MSAT or road dust emissions. Table 12 represents total road emissions in the assessment domain, although these were split among major and minor links based on an AADT threshold, vehicle type, and time period as described above for dispersion modeling. These emissions levels were compared against both SANDAG-provided conformity results and EMFAC model defaults to quality assure results, as described in Section 3.1. Figure 4 summarizes

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[42] https://www.sdapcd.org/content/dam/sdc/apcd/PDF/Misc/APCD_HRA_Guidelines.pdf.

emissions of all pollutants in each year. Figure 5 summarizes the PM emissions by component and year. Although exhaust PM is dramatically reduced over this time period compared to the 2016 baseline (82% reduction by 2050 for both PM2.5 and PM10), total PM (exhaust plus brake and tire wear plus road dust) is reduced, then steadily increases over time due to increased vehicle miles traveled, so the net change by 2050 is only slightly different from the 2016 baseline. Specifically, total road emissions of PM2.5 show a 9% decrease by 2050, while PM10 shows a 2% increase in region-wide emissions.

Table 12. Average Daily On-Road Emissions (tons) and Vehicle Miles Traveled (millions of miles) Modeled for the Plan and Baseline Conditions[1]

Year	PM2.5	PM10	TOG	ROG	NO_X	SO_X	CO	VMT
2016	3.6	14.	9.0	6.4	33.	0.36	145	85.
2025	3.2	13.	3.8	2.4	11.	0.28	67.	85.
2035	3.2	13.	3.2	1.8	8.0	0.24	53.	87.
2050	3.3	14.	3.1	1.6	7.5	0.23	51.	90.

Year	Butadiene[1,3]	Acetaldehyde	Acrolein	Benzene	Ethyl-Benzene	Formaldehyde	Naphthalene	PAH[2]	DPM
2016	0.023	0.11	0.012	0.26	0.12	0.22	0.023	7.5E-05	0.53
2025	0.0020	0.032	0.0029	0.10	0.041	0.079	0.0065	4.4E-05	0.093
2035	7.2E-05	0.025	0.0020	0.075	0.028	0.055	0.0046	2.4E-05	0.078
2050	5.7E-05	0.024	0.0018	0.068	0.025	0.052	0.0042	1.8E-05	0.071

[1] Top table shows criteria pollutants and precursors; bottom table shows air toxics.

[2] PAH values are the sum of the individual components, toxicity-weighted.

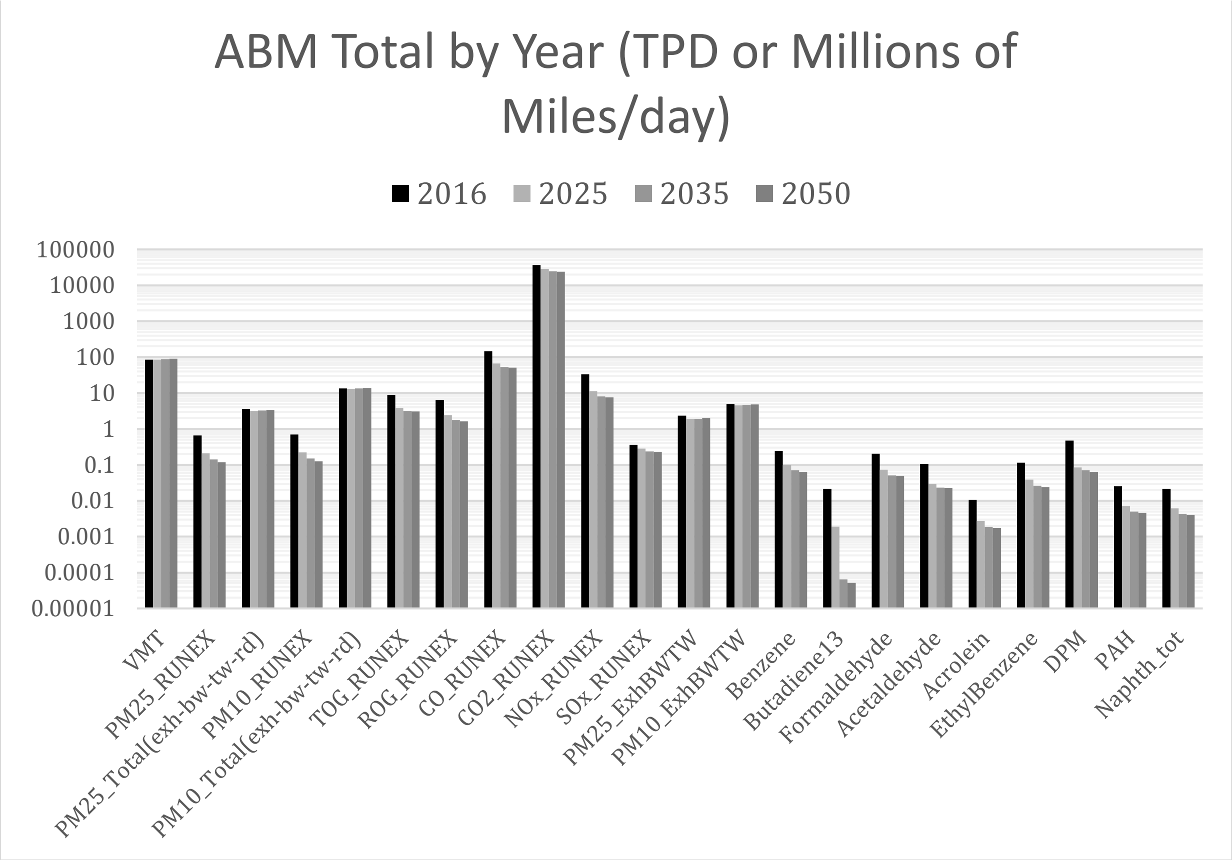

Figure 4. Summary of all Pollutant Emissions by Year

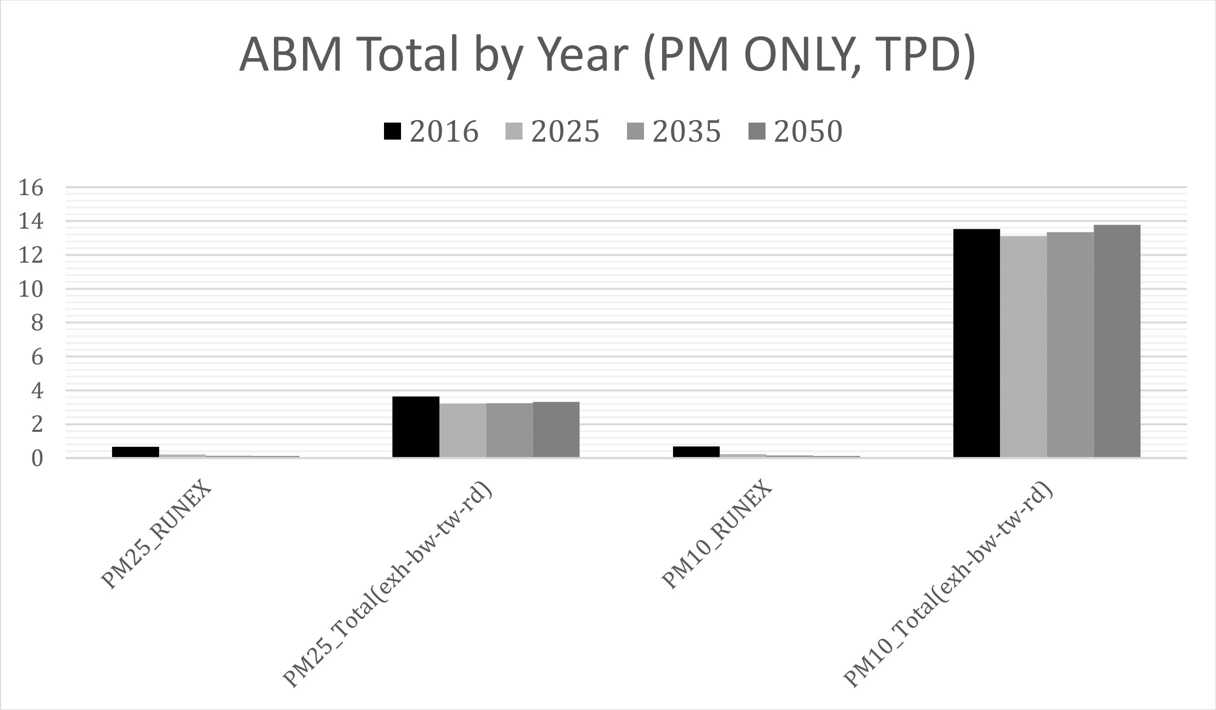

Figure 5. ABM-Based Calculation of PM2.5 and PM10 Emissions by Year

Note: exh=exhaust; bw=brake wear; tw=tire wear; rd=road dust; RUNEX=running exhaust.

Table 13 and Table 14 show the Rail emissions under the Plan by year. Table 13 shows the criteria pollutants and precursors, while Table 14 shows the mobile source air toxic pollutants calculated for rail countywide.

Table 13. Average Daily Emissions of Criteria Pollutants and Precursors (tons) for Rail Activity Under the Plan and Baseline Conditions

Year	PM10	PM25	VOC	NO_X	SO_X	NH_3
2016	0.067	0.064	0.13	2.3	0.029	0.0013
2025	0.016	0.015	0.039	0.82	0.051	0.0017
2035	0.016	0.015	0.041	0.84	0.12	0.0031
2050	0.033	0.031	0.078	1.7	0.28	0.0066

Table 14. Average Daily Emissions of Air Toxics (tons) for Rail Activity Under the Plan and Baseline Conditions

Year	1,3-Butadiene	Acetaldehyde	Acrolein	Benzene	Ethyl-Benzene	Formaldehyde	Naphthalene	PAH[1]	DPM
2016	2.4E-04	0.011	0.0032	0.0041	9.4E-04	0.031	7.3E-04	2.3E-07	0.067
2025	5.0E-05	0.0032	5.7E-04	0.0011	2.3E-04	0.010	3.8E-04	1.3E-07	0.016
2035	3.8E-05	0.0029	4.9E-04	0.0007	2.6E-04	0.009	4.5E-04	9.3E-08	0.016
2050	6.9E-05	0.006	8.7E-04	0.0012	4.9E-04	0.017	1.2E-03	1.7E-07	0.033

[1] PAH values are the sum of the individual components, toxicity-weighted.

7.2 PARTICULATE MATTER

As discussed above, ICF modeled both pollutants (PM2.5 and PM10) at each ambient receptor and year for all applicable DVs. ICF then differenced the modeled concentrations between the Plan year and the 2016 baseline year to show whether the increment is positive—that is, whether the Plan would lead to an increased concentration of the pollutant at any ambient receptor in any future year relative to current conditions. Note that ICF calculated this increment only at ambient receptors that existed in both the baseline and Plan years (i.e., existing ambient receptors. See Section 6.1.) A positive increment alone does not necessarily indicate that a significant air quality impact would result—that is determined by comparing this increment to the thresholds applicable to each modeling subdomain discussed in Section 6.1.

Table 15 shows the results of this analysis. The first column shows the modeling subdomain (or whole assessment domain) to which the results apply. The second column shows which of the six air quality standards is being evaluated (NAAQS or CAAQS; 24-hour or annual averaging period). The third column shows the applicable threshold, which varies by air quality standard, averaging period, and modeling subdomain (described further in Section 6.1). The rest of the columns show the resulting data, grouped by modeled year (2025, 2035, and 2050). In each case there are two datasets. The first is the approximate land area with ambient receptors (a) exceeding the applicable ambient air quality threshold, or (b) showing a positive increment (i.e., an increase in concentrations) but less than the applicable threshold. As ambient receptors are placed on a regular grid, this area is estimated from the number of receptors observed beyond each metric. The number is indicative of the total land area matching each of these categories, which was thus estimated.[43] If at least one ambient receptor's incremental concentration exceeds the applicable threshold (see red shading in Table 15), a significant air quality impact is observed. However, the number of ambient receptors or total land area is not itself indicative of any standard. The second dataset for each year is shown by the third column—the maximum incremental concentration increase in a modeling subdomain for a given standard and year, where values of 0 indicate no change in concentration and all other values quantify the increase in concentration relative to 2016. Because these are incremental concentrations relative to 2016, Table 15 does not show results for the 2016 baseline year.

Across the entire modeled area, a small number of ambient receptors showed incremental concentrations that exceeded either or both PM10 CAAQS thresholds (i.e., that exhibited significant PM10 ambient concentration impacts), particularly for the annual standard. For the PM10 annual CAAQS, the Kearny, El Cajon, and Escondido modeling subdomains all showed exceedances in at least 1 year, with incremental concentrations up to 4 µg/m^3 in Escondido in 2050, which is compared to a threshold of 0 (the monitored DV was equal to the standard, such that any incremental concentration above 0 would trigger an exceedance in this case). For the PM10 24-hour CAAQS, all exceedances occurred in the Chula Vista modeling subdomain, where the maximum exceedance was at most a factor of 2 above the threshold. At many other ambient receptors, the modeled incremental concentrations were above 0, up to a value of 15 µg/m^3, meaning the Plan was causing higher concentrations than the 2016 baseline conditions, but those increments did not exceed the thresholds. No locations in the entire modeling domain showed an increase in PM10 above the NAAQS level.

No locations in the entire assessment domain showed an increase in PM2.5 that exceeded any of the relevant thresholds. Thus, there are no significant air quality impacts for PM2.5 anywhere in the assessment domain. This is important as PM2.5 is the pollutant most associated with adverse health impacts.

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[43] Each receptor is determined from a regularly spaced, 50-m grid. See Section 4.5. Thus, the total land area represented by a single receptor is approximately 2,500 m2 (0.62 acres). This is approximate as it simplifies receptors at the edges of a source.

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Table 15. Summary of Results for Incremental Concentrations of Particulate Matter for Plan by Year, Relative to the 2016 Baseline

			2025			2035			2050		
			Approximate Land Area (acres)		Maximum Incremental Concentration	Approximate Land Area (acres)		Maximum Incremental Concentration	Approximate Land Area (acres)		Maximum Incremental Concentration
Modeling Sub-domain	Standard	Threshold ($\mu g/m^3$)	Above Threshold	With Positive Increment but Not Above Threshold	Value ($\mu g/m^3$)	Above Threshold	With Positive Increment but Not Above Threshold	Value ($\mu g/m^3$)	Above Threshold	With Positive Increment but Not Above Threshold	Value ($\mu g/m^3$)
Whole Assessment Domain	PM2.5 Annual NAAQS	Varies	0	18	0.6	0	117	0.6	0	232	0.7
	PM2.5 24 Hour NAAQS		0	1	1	0	34	1	0	30	2
	PM10 24 Hour NAAQS		0	168	4	0	376	10	0	687	10
	PM2.5 Annual CAAQS		0	1	1	0	1	1	0	5	1
	PM10 Annual CAAQS		33	33	2	113	19	3	273	16	4
	PM10 24 Hour CAAQS		1	179	6	6	475	14	2	716	15
Kearny	PM2.5 Annual NAAQS	4.4	0	0	0	0	0	0	0	13	0.1
	PM2.5 24 Hour NAAQS	20	0	0	0	0	0	0	0	0	0
	PM10 24 Hour NAAQS	111	0	0	0	0	0	0	0	38	1
	PM2.5 Annual CAAQS	4	0	0	0	0	0	0	0	0	0
	PM10 Annual CAAQS	0	0	0	0	0	0	0	6	0	1
	PM10 24 Hour CAAQS	15	0	0	0	0	0	0	0	12	1
Downtown	PM2.5 Annual NAAQS	3.2	0	0	0	0	0	0	0	0	0
	PM2.5 24 Hour NAAQS	16	0	0	0	0	0	0	0	0	0
	PM10 24 Hour NAAQS	97	0	31	1	0	30	1	0	27	1
	PM2.5 Annual CAAQS	2	0	0	0	0	0	0	0	0	0
	PM10 Annual CAAQS	3 (SIL)	0	22	1	0	7	1	0	12	1
	PM10 24 Hour CAAQS	5 (SIL)	0	32	1	0	25	1	0	25	1
Chula Vista	PM2.5 Annual NAAQS	3.2	0	13	0.6	0	12	0.3	0	17	0.2
	PM2.5 24 Hour NAAQS	16	0	1	1	0	6	1	0	0	0
	PM10 24 Hour NAAQS	102	0	20	4	0	12	3	0	20	2
	PM2.5 Annual CAAQS	3	0	1	1	0	0	0	0	0	0
	PM10 Annual CAAQS	3 (SIL)	0	11	2	0	12	1	0	4	1
	PM10 24 Hour CAAQS	2	1	23	4	6	18	3	2	30	3
El Cajon	PM2.5 Annual NAAQS	4.4	0	0	0	0	2	0.1	0	14	0.6
	PM2.5 24 Hour NAAQS	20	0	0	0	0	0	0	0	3	1
	PM10 24 Hour NAAQS	111	0	0	0	0	0	0	0	24	6
	PM2.5 Annual CAAQS	4	0	0	0	0	0	0	0	1	1
	PM10 Annual CAAQS	0	0	0	0	1	0	1	25	0	3
	PM10 24 Hour CAAQS	6	0	0	0	0	0	0	0	25	6
Escondido	PM2.5 Annual NAAQS	4.4	0	5	0.1	0	103	0.6	0	188	0.7
	PM2.5 24 Hour NAAQS	20	0	0	0	0	28	1	0	27	2

Modeling Sub-domain	Standard	Threshold (µg/m^3)	2025			2035			2050		
			Approximate Land Area (acres)		Maximum Incremental Concentration	Approximate Land Area (acres)		Maximum Incremental Concentration	Approximate Land Area (acres)		Maximum Incremental Concentration
			Above Threshold	With Positive Increment but Not Above Threshold	Value (µg/m^3)	Above Threshold	With Positive Increment but Not Above Threshold	Value (µg/m^3)	Above Threshold	With Positive Increment but Not Above Threshold	Value (µg/m^3)
	PM10 24 Hour NAAQS	111	0	117	4	0	334	10	0	551	10
	PM2.5 Annual CAAQS	4	0	0	0	0	1	1	0	4	1
	PM10 Annual CAAQS	0	33	0	1	112	0	3	242	0	4
	PM10 24 Hour CAAQS	15	0	124	6	0	431	14	0	609	15
Oceanside	PM2.5 Annual NAAQS	4.4	0	0	0	0	0	0	0	0	0
	PM2.5 24 Hour NAAQS	20	0	0	0	0	0	0	0	0	0
	PM10 24 Hour NAAQS	111	0	0	0	0	0	0	0	27	1
	PM2.5 Annual CAAQS	4	0	0	0	0	0	0	0	0	0
	PM10 Annual CAAQS	0	0	0	0	0	0	0	0	0	0
	PM10 24 Hour CAAQS	15	0	0	0	0	1	1	0	15	1

Notes:

PM = particulate matter; PM10 = PM with aerodynamic diameter less than or equal to 10 micrometers; PM2.5 = PM with aerodynamic diameter less than or equal to 2.5 micrometers; NAAQS = National Ambient Air Quality Standard; CAAQS = California Ambient Air Quality Standard; µg/m^3 = micrograms per cubic meter; SIL = significant impact threshold.

Thresholds: All values were derived from monitored design values and the standard concentration, except where "(SIL)" indicates usage of a significant impact level due to the monitored design-value concentration being above the standard concentration (see Sections 4.7 and 6.1).

Shading: "Above Threshold" column = red shading indicates one or more ambient receptors had maximum incremental concentration values above the given threshold; "With Positive Increment but Not Above Threshold" column = orange shading indicates one or more ambient receptors had an incremental concentration above 0 but below the threshold; "Value (µg/m^3)" = orange shading indicates a value above 0, while red shading indicates a value above the threshold.

7.3 HRA

Table 16 through Table 19 summarize the results of the HRA described in Chapter 5 and Section 6.2.

Table 16, Table 18, and Table 19 show results by modeling subdomain, by receptor type, by year, and by health endpoint. All tables show both risks and corresponding areas. Table 16 shows 2016 risk values and 2025, 2035, and 2050 incremental changes in HI or cancer risk per million relative to 2016. Cancer risks are shown first for each modeling subdomain and receptor type. For 2016, maximum risks and area exceeding the 10 per million risk threshold are shown. For the projected years, incremental risk and incremental area are shown. These are followed by acute risks and chronic risks, with the same layout. Table 16 presents the analysis for “sensitive receptors near existing emission sources”—that is, those that are exposed to existing rail and/or roadway buffers, not those driven by new sources “turning on” new receptors.

Table 18 and Table 19 have a similar layout. They also show results by subdomain and year with results grouped first for cancer, then acute, and finally chronic risks. Table 18 and Table 19 are both for cases where new receptors are “turned on” due to two types of changes in the proposed Plan. Thus, these tables do not show values for 2016 and list the total value in future years. Those changes are new emission sources, such as new rail lines (Table 18) or new land uses, such as new residential development (Table 19). In each case, the maximum value is shown (cancer risks per million or HI) followed by the land area (in acreage)—based on number of sensitive receptors—exceeding the threshold. Cancer impacts are shown first, then acute, then chronic. As in Section 7.2, the impacted area is estimated from the number of sensitive receptors exceeding thresholds. This does not indicate number of units (see footnote 43).

Table 17 shows the cumulative cancer risk impacts by year under the Plan for residential land uses.

Table 16. Results Summary of the Maximum Health Impacts at Existing Sensitive Receptors

Cancer		2016		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Cancer Risk	Area (acres) Exceeding 10 per Million	Maximum Incremental Cancer Risk	Incremental Area (acres) Exceeding 10 per Million	Maximum Incremental Cancer Risk	Incremental Area (acres) Exceeding 10 per Million	Maximum Incremental Cancer Risk	Incremental Area (acres) Exceeding 10 per Million
Chula Vista	Residential	265	1,201	-5	0	-6	0	-6	0
Chula Vista	Recreational	11	2	-1	0	-1	0	-1	0
Chula Vista	School	0	0	0	0	0	0	0	0
Downtown	Residential	447	1,423	-26	0	-31	0	-32	0
Downtown	Recreational	13	22	-1	0	-2	0	-2	0
Downtown	School	8	0	-4	0	-5	0	-5	0
El Cajon	Residential	314	995	-12	0	-14	0	-14	0
El Cajon	Recreational	7	0	-2	0	-2	0	-2	0
El Cajon	School	0	0	0	0	0	0	0	0
Escondido	Residential	416	1,229	-5	0	-6	0	-5	0
Escondido	Recreational	8	0	-2	0	-3	0	-3	0
Escondido	School	5	0	-3	0	-4	0	-4	0
Kearny	Residential	401	1,025	-10	0	-11	0	-11	0
Kearny	Recreational	7	0	0	0	0	0	0	0
Kearny	School	11	2	-3	0	-3	0	-3	0
Oceanside	Residential	255	1,690	-10	0	-12	0	-12	0
Oceanside	Recreational	8	0	-1	0	-1	0	-1	0
Oceanside	School	8	0	-1	0	-1	0	-1	0
Regional Maximum and Sum of Area		447	7,590	0	0	0	0	0	0

Acute		2016		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Acute Risk	Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Acute Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Acute Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Acute Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index
Chula Vista	Residential	1.8	49	-0.1	0	0	0	0.5	0
Chula Vista	Recreational	1.2	10	-0.1	0	-0.1	0	0.2	0
Chula Vista	School	0	0	0	0	0	0	0	0
Downtown	Residential	2.1	314	-0.3	0	-0.2	0	-0.2	0
Downtown	Recreational	2.3	131	-0.3	0	-0.3	0	-0.3	0
Downtown	School	1	1	-0.6	0	-0.6	0	-0.6	0
El Cajon	Residential	1.7	70	-0.2	0	-0.2	0	0.2	0
El Cajon	Recreational	1.1	2	-0.2	0	-0.2	0	-0.2	0
El Cajon	School	0	0	0	0	0	0	0	0
Escondido	Residential	6.9	751	-0.3	0	-0.3	0	-0.3	0
Escondido	Recreational	2.3	17	-0.4	0	-0.5	0	-0.5	0
Escondido	School	1	1	-0.6	0	-0.7	0	-0.7	0
Kearny	Residential	2	153	-0.2	0	-0.2	0	-0.2	0
Kearny	Recreational	1.5	7	-0.2	0	-0.3	0	-0.3	0
Kearny	School	1.5	4	-0.4	0	-0.4	0	-0.4	0
Oceanside	Residential	2.3	261	-0.1	0	-0.2	0	-0.2	0
Oceanside	Recreational	1.8	43	-0.2	0	-0.2	0	-0.2	0
Oceanside	School	1.5	2	-0.4	0	-0.4	0	-0.4	0
Regional Maximum and Sum of Area		6.9	1,815	0	0	0.0	0	0.5	0

Chronic		2016		2025		2035		2050	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Incremental Chronic Risk**	**Incremental Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Incremental Chronic Risk**	**Incremental Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Incremental Chronic Risk**	**Incremental Area (acres) Exceeding 1.0 Hazard Index**
Chula Vista	Residential	31.6	1,205	-0.6	0	-0.8	0	-0.8	0
Chula Vista	Recreational	31.3	88	-1.8	0	-2.1	0	-2.2	0
Chula Vista	School	0	0	0	0	0	0	0	0
Downtown	Residential	52.9	1,423	-3.3	0	-3.8	0	-4	0
Downtown	Recreational	37	431	-4.1	0	-4.8	0	-4.9	0
Downtown	School	17.3	7	-9.7	0	-11.2	0	-11.6	0
El Cajon	Residential	37.2	995	-1.5	0	-1.7	0	-1.8	0
El Cajon	Recreational	20.2	22	-5.3	0	-6	0	-6.1	0
El Cajon	School	0	0	0	0	0	0	0	0
Escondido	Residential	49.2	1,232	-0.6	0	-0.8	0	-0.6	0
Escondido	Recreational	23.6	32	-6.8	0	-7.9	0	-8	0
Escondido	School	12.3	4	-7.2	0	-8.3	0	-8.4	0
Kearny	Residential	47.6	1,025	-1.2	0	-1.4	0	-1.4	0
Kearny	Recreational	20.1	368	-0.8	0	-0.9	0	-0.9	0
Kearny	School	24.9	36	-6.4	0	-7.3	0	-7.5	0
Oceanside	Residential	30.2	1,690	-1.2	0	-1.4	0	-1.5	0
Oceanside	Recreational	22.4	102	-1.7	0	-2	0	-2	0
Oceanside	School	18.8	7	-2.4	0	-2.7	0	-2.8	0
Regional Maximum and Sum of Area		52.9	8,666	0	0	0	0	0	0

Notes:

HI = Hazard Index; Risk = cancer risk values in risks per million; Mobile increment = HI/risk increment from 2016 baseline year, without stationary risks (acute has no stationary HI); Total increment = HI/risk increment from 2016 baseline year, including stationary risks; Cumulative = sum of mobile increment cancer risk, NATA 2014 cancer risk, and NATA 2014 DPM cancer risk (only for the cancer scenario and for residential sensitive receptors that exist in both the plan year and in the 2016 baseline year)

Thresholds: Non-cancer (acute and chronic) HI threshold of 1; incremental cancer threshold of 10; cumulative cancer threshold of 100.

Rounding: Non-cancer HIs were rounded to one decimal place; cancer risks were rounded to a whole number.

Table 17. Results Summary of the Maximum Cumulative Health Impacts at Existing Sensitive Receptors

Modeling Subdomain	Type of Sensitive Receptor	Maximum Cumulative Cancer Risk (per million)				Area (Acres) Exceeding 100 per million			
		2016	2025	2035	2050	2016	2025	2035	2050
Chula Vista	Residential	619	544	559	558	1,205	1,166	1,133	1,126
Downtown	Residential	1,015	946	928	922	1,423	1,405	1,373	1,371
El Cajon	Residential	479	453	449	449	995	977	896	954
Escondido	Residential	392	346	339	339	1,232	1,226	1,200	1,183
Kearny	Residential	476	422	413	412	1,025	1,013	1,001	994
Oceanside	Residential	378	361	358	357	1,690	1,653	1,611	1,604
Regional Maximum and Sum of Area	Residential	1,015	946	928	922	7,570	7,439	7,214	7,232

Table 18. Results Summary of the Maximum Health Impacts from New Emission Sources[1]

Cancer		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Cancer Risk	Area (acres) Exceeding 10 per million	Maximum Cancer Risk	Area (acres) Exceeding 10 per million	Maximum Cancer Risk	Area (acres) Exceeding 10 per million
Chula Vista	Residential	26	5	59	418	24	408
Chula Vista	Recreational	1	0	2	0	2	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	54	2	123	527	110	1,236
Downtown	Recreational	3	0	2	0	3	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	0	0	132	2	131	324
El Cajon	Recreational	0	0	0	0	1	0
El Cajon	School	0	0	0	0	1	0
Escondido	Residential	0	0	0	0	24	150
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	0	0	33	309	30	359
Kearny	Recreational	0	0	1	0	1	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	8	0	12	5	46	4
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		54	7	132	1,261	131	2,480

Acute		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Acute Risk	Area (acres) Exceeding 1.0 Hazard Index	Maximum Acute Risk	Area (acres) Exceeding 1.0 Hazard Index	Maximum Acute Risk	Area (acres) Exceeding 1.0 Hazard Index
Chula Vista	Residential	0.1	0	0.3	0	0.8	0
Chula Vista	Recreational	0.1	0	0.2	0	0.6	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	0.2	0	0.5	0	0.9	0
Downtown	Recreational	0.3	0	0.2	0	0.3	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	0	0	0.8	0	0.8	0
El Cajon	Recreational	0	0	0	0	0.3	0
El Cajon	School	0	0	0	0	0.2	0
Escondido	Residential	0	0	0	0	0.3	0
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	0	0	0.3	0	0.5	0
Kearny	Recreational	0	0	0.2	0	0.3	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	0.1	0	0.1	0	0.3	0
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		0.3	0	0.8	0	0.9	0

Chronic		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Chronic Risk	Area (acres) Exceeding 1.0 Hazard Index	Maximum Chronic Risk	Area (acres) Exceeding 1.0 Hazard Index	Maximum Chronic Risk	Area (acres) Exceeding 1.0 Hazard Index
Chula Vista	Residential	2.7	5	6.1	418	2	401
Chula Vista	Recreational	1.5	4	3	74	3.1	158
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	5.4	2	13.2	527	11.6	1,236
Downtown	Recreational	6.8	1	4.7	24	4.3	43
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	0	0	14.2	2	13.8	324
El Cajon	Recreational	0	0	0	0	2.5	2
El Cajon	School	0	0	0	0	2.2	1
Escondido	Residential	0	0	0	0	2.5	150
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	0	0	3	313	2.7	362
Kearny	Recreational	0	0	2.3	25	2.5	96
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	0.9	0	1.3	6	4.8	4
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		6.8	12	14.2	1,389	13.8	2,777

[1] Results show maximum health values and number of sensitive receptors above threshold by Year, Subdomain, and Receptor. Cancer Impacts are Shown First, then Acute, then Chronic.

Notes: HI = Hazard Index; Risk = cancer risk values in risks per million; Mobile increment = HI/risk increment from 2016 baseline year, without stationary risks (acute has no stationary HI); Total increment = HI/risk increment from 2016 baseline year, including stationary risks; Cumulative = sum of mobile increment cancer risk, NATA 2014 cancer risk, and NATA 2014 DPM cancer risk (only for the cancer scenario and for residential sensitive receptors that exist in both the plan year and in the 2016 baseline year)

Thresholds: Non-cancer (acute and chronic) HI threshold of 1; incremental cancer threshold of 10; cumulative cancer threshold of 100.

Rounding: Non-cancer HIs were rounded to one decimal place; cancer risks were rounded to a whole number.

Table 19. Results Summary of the Maximum Health Impacts at New Land Use Sensitive Receptors[1]

Cancer		**2025**		**2035**		**2050**	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Cancer Risk**	**Area (acres) Exceeding 10 per million**	**Maximum Cancer Risk**	**Area (acres) Exceeding 10 per million**	**Maximum Cancer Risk**	**Area (acres) Exceeding 10 per million**
Chula Vista	Residential	53	83	34	86	29	86
Chula Vista	Recreational	0	0	0	0	0	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	149	381	137	436	133	472
Downtown	Recreational	0	0	0	0	0	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	138	209	122	259	106	262
El Cajon	Recreational	0	0	0	0	0	0
El Cajon	School	0	0	0	0	0	0
Escondido	Residential	120	69	57	68	77	93
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	58	69	40	140	37	147
Kearny	Recreational	0	0	0	0	0	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	57	137	38	166	33	163
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		149	948	137	1,156	133	1,224

Acute		2025		2035		2050	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**
Chula Vista	Residential	0.3	0	0.2	0	0.5	0
Chula Vista	Recreational	0	0	0	0	0	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	0.6	0	0.4	0	0.6	0
Downtown	Recreational	0	0	0	0	0	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	0.5	0	0.7	0	0.7	0
El Cajon	Recreational	0	0	0	0	0	0
El Cajon	School	0	0	0	0	0	0
Escondido	Residential	2.1	5	1.4	2	1.5	2
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	0.3	0	0.2	0	0.3	0
Kearny	Recreational	0	0	0	0	0	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	0.4	0	0.3	0	0.3	0
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		2.1	5	1.4	2	1.5	2

Chronic		2025		2035		2050	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**
Chula Vista	Residential	5.4	83	3.4	88	2.8	82
Chula Vista	Recreational	0	0	0	0	0	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	13.2	381	8	436	7.1	472
Downtown	Recreational	0	0	0	0	0	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	14.9	210	13.2	259	11.2	262
El Cajon	Recreational	0	0	0	0	0	0
El Cajon	School	0	0	0	0	0	0
Escondido	Residential	12.9	69	5.9	70	7.9	93
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	6.3	69	4.2	141	3.8	148
Kearny	Recreational	0	0	0	0	0	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	6.1	138	4	167	3.4	161
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		14.9	950	13.2	1,162	11.2	1,218

[1] Results show maximum health values and number of sensitive receptors above threshold by Year, Subdomain, and Receptor. Cancer Impacts are Shown First, then Acute, then Chronic.

Notes: HI = Hazard Index; Risk = cancer risk values in risks per million; Mobile increment = HI/risk increment from 2016 baseline year, without stationary risks (acute has no stationary HI); Total increment = HI/risk increment from 2016 baseline year, including stationary risks; Cumulative = sum of mobile increment cancer risk, NATA 2014 cancer risk, and NATA 2014 DPM cancer risk (only for the cancer scenario and for residential sensitive receptors that exist in both the plan year and in the 2016 baseline year)

Thresholds: Non-cancer (acute and chronic) HI threshold of 1; incremental cancer threshold of 10; cumulative cancer threshold of 100.

Rounding: Non-cancer HIs were rounded to one decimal place; cancer risks were rounded to a whole number.

Table 16 shows that the increment in cancer risk is less than or equal to zero for all receptor types for all modeling subdomains for all three projected years. That is, the proposed Plan does not increase cancer risk for existing sensitive receptors in any year. For acute health risk, the maximum incremental risk does increase for any type of receptor until 2050. In 2050 there is a maximum increase in incremental acute risk for residential and recreational receptors in in the Chula Vista subdomain and residential receptors in the El Cajon subdomain. However, none of these increases are above the significance threshold of 1.0 incremental HI. As for cancer, incremental chronic risks are less than or equal to zero in all subdomains and all projected years.

Table 17 shows that cumulative risks exceed the 100 per million cancer risk threshold in all domains and all years. However, the increment compared to 2016 is always negative. That is, total cancer risk to which residents are exposed is being reduced in every year under the proposed Plan.

For sensitive receptors that are "turned on" in future years (Table 18 and Table 19), the cancer and non-cancer risks can be significant, because there is no 2016 risk from which to increment. That is, these are new receptors for the modeling, with no recorded value in 2016. Without a 2016 modeled value from which to calculate a difference, the reported values for a future year are the value alone in that future year (there is no baseline value to subtract from the projected year to compute an increment). Note that this does not mean there is no risk in these locations in 2016, just that it was not modeled. Note also that the cancer and chronic risks presented here include both mobile (rail and on-road) and stationary risks, while acute considers only mobile sources under the proposed Plan. For new receptors activated by new emissions sources (Table 18), the cancer risk exceeds 10 per million only for residential receptors, but in all three modeled years. The chronic risk HI exceeds 1.0 for residential and recreational receptors in multiple subdomains for all three years. The acute risk HI does not exceed 1.0 in any subdomain or year for these "new" receptors.

For new sensitive receptors "turned on" by new land uses (Table 19), the cancer risk exceeds 10 per million only for residential receptors, but in all three modeled years and every modeling subdomain. Similarly, the chronic risk HI exceeds 1.0 only for new residential receptors in all subdomains for all years. The acute risk HI also exceeds 1.0 only in the Escondido subdomain, but for all years for these "new" receptors.

Also, note that all rail emissions in this analysis are conservatively modeled as if all trains are diesel fueled and at- or above-grade. The proposed Plan considers tunneling or other approaches to move these sources underground and locating portals, adits, windows and other venting features away from sensitive receptors, which would reduce or eliminate the passenger rail impacts on public health. The engineering to support such a reduction would be conducted at the individual project level and is not included in this analysis but is included as a mitigation measure in the EIR. Similarly, it is anticipated that locomotives in the proposed Plan would eventually move to zero emissions technology, such as zero-emission multiple units (ZMU), hydrogen fuel cell, or hybridization of locomotives. This would eliminate or reduce PM and MSAT emissions from the vehicles, and thus the health impacts, because there would be no exhaust emissions. SANDAG anticipates that the cost assumptions already in the proposed Plan for rail equipment are adequate to introduce ZMU trains by 2035. (Veeh pers. comm.) This is discussed further in the body of the EIR (Section 4.3, *Air Quality*).

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