APPENDIX B-4

HEALTH RISK ASSESSMENT

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HEALTH RISK ASSESSMENT

FOR THE

TESORO LOS ANGELES REFINERY INTEGRATION AND COMPLIANCE PROJECT

CARSON AND WILMINGTON, CALIFORNIA

Prepared by:
Ashworth Leininger Group
601 East Daily Drive, Suite 302
Camarillo, CA 93010
(805) 764-6010

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[1] Available separately from South Coast AQMD.

1.0 EXECUTIVE SUMMARY

In June 2013, the Tesoro Refining & Marketing Company LLC (Tesoro) purchased the BP West Coast Products LLC (BP) Carson Refinery (currently termed the Tesoro Carson Operations). The current project is intended to further integrate the Carson Operations with the adjacent Tesoro Wilmington Operations to form the Tesoro Los Angeles Refinery (Refinery). A health risk assessment was conducted to support the Environmental Impact Report required by the California Environmental Quality Act (CEQA) for this project. The purpose of the analysis is to evaluate the risk associated with toxic emissions from all sources of the proposed project to determine if it has the potential to produce significant risks.

2.0 INTRODUCTION

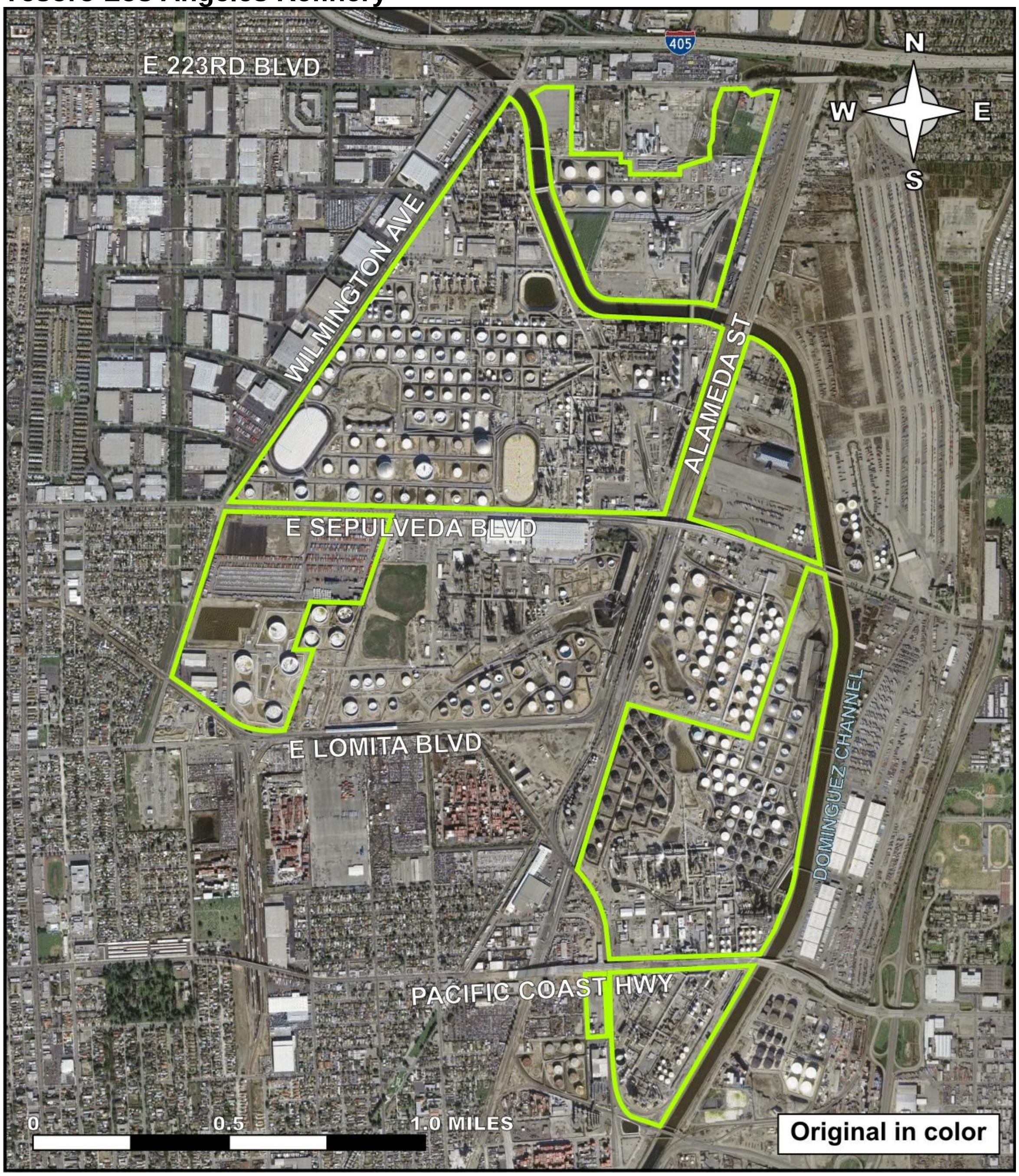
In June 2013, Tesoro purchased the BP West Coast Products LLC (BP) Carson Refinery (now named the Tesoro Los Angeles Refinery – Carson Operations) which is adjacent to the Tesoro Los Angeles Refinery – Wilmington Operations. The Los Angeles Refinery – Wilmington Operations is located at 2101 East Pacific Coast Highway, Wilmington, CA while the Los Angeles Refinery – Carson Operations is located at 2350 East 223rd Street, Carson, CA; both operations are located in the South Coast Air Basin. As these two facilities are adjacent to each other (see Figure 1), they are considered a single stationary source for air quality evaluation purposes.

Currently, the Wilmington and Carson Operations function as two separate and distinct facilities with limited operational integration. The proposed project is intended to further integrate the Los Angeles Refinery Wilmington and Carson Operations. As part of the project, the refinery will also be modified in order to comply with the federally mandated Tier 3 gasoline specifications, as well as with state and local regulations mandating emission reductions, including but not limited to, California AB32 Greenhouse Gas (GHG) Cap and Trade requirements and SCAQMD RECLAIM NOx and SOx allocation shaves. This project will include the shutdown of the Wilmington Operation's Fluid Catalytic Cracking Unit (FCCU) and reconfiguring the combined Refinery complex with flexibility to improve the gasoline to distillate production ratio in order to meet changing market demand. As part of the project, equipment efficiency and heat recovery will be optimized for new or modified units to minimize GHG and other pollutants. All new and modified sources will meet Best Available Control Technology (BACT) requirements (unless otherwise exempt). The proposed project will have a small impact on crude oil and feedstock throughput capacity. The crude oil and feedstock processing capability at the integrated Refinery will increase by approximately 2% or 6,000 BPD as a result of the proposed project. The type of crude oil and feedstocks will not change as part of the proposed project. The proposed modifications include new and modified equipment, shutdown of existing equipment, as well as piping modifications.

The above improvements and/or modifications are described further in Section 2 of the Air Quality Analysis Report.

This HRA is being conducted to support the Environmental Impact Report (EIR) for the proposed project as required by the California Environmental Quality Act (CEQA). The assessment evaluates the risk associated with toxic emissions from all sources of the proposed project to determine if it has the potential to produce significant risks. The approach used in this assessment is described later in this report and is based on written South Coast Air Quality Management District (SCAQMD) guidelines and discussions with SCAQMD staff.

Figure 1
Tesoro Los Angeles Refinery



3.0 BACKGROUND

3.1 HEALTH EFFECTS

3.1.1 Cancer Risk

Cancer risk is defined as the lifetime probability (chance) of developing cancer from exposure to a carcinogen, typically expressed as chances per million. Exposure to cancer-causing substances can be through direct inhalation or indirectly through non-inhalation pathways. Non-inhalation pathways include exposure through soil ingestion or absorption of the pollutant from soil adhered to the skin, ingestion of crops grown in soil potentially affected by deposited air pollutants, and transmittal of a dose to an infant by breast milk due to the mother's cumulative exposure. The cancer risk associated with inhalation of a carcinogen is estimated by multiplying the inhalation dose in units of milligram per kilogram-day (mg/kg-day) by an inhalation cancer potency factor [$(mg/kg/day)^{-1}$]. Non-inhalation cancer risk is calculated from cancer toxicity factors and exposure assumptions.

Cancer risks are calculated for all carcinogenic air toxics and the results are summed to estimate an overall cancer risk. This calculation procedure assumes that cancer risk is proportional to concentration at any level of exposure; that is, there is no dose that would result in a zero probability of contracting cancer. This is generally considered to be a conservative assumption at low doses, as some theories on carcinogenesis assume that certain chemicals may require a threshold level or interaction with other agents, while others say that cancer can form at any exposure level. The zero-threshold approach is consistent with the current OEHHA regulatory approach. Although the assumption of additivity of cancer risk from exposure to multiple carcinogens ignores possible antagonistic or synergistic interactions, this approach has been accepted by regulatory agencies as generally conservative.

3.1.2 Non-Cancer Risk

Non-cancer health risk refers to both acute (short-term) and chronic (long-term) adverse health effects other than cancer that may be associated with exposure to air toxics. The commonly employed regulatory metric for assessing non-cancer effects is the hazard index (HI), the ratio of the estimated exposure level of an air toxic compound to a scientifically derived reference exposure level (REL) for the same compound. RELs generally represent the highest exposure level where no adverse effect has been observed or the lowest exposure level where the onset of an adverse effect has been observed, with the inclusion of a safety factor ranging from 10 to 1000, depending on the source and quality of the scientific data. Non-cancer RELs are discussed further in Section 3.3.

If the reported concentration or dose of a given chemical is less than its REL, then the hazard index will be less than 1.0. When more than one chemical is considered, it is assumed that the effects are additive provided the associated chemicals are expected to have an adverse impact on the same target organ system (respiratory system, liver, etc). Thus, chemical-specific hazard indices are summed to arrive at a hazard index for each target organ. For any organ system, a total hazard index exceeding 1.0 indicates a potential health effect. Again, although the assumption of additivity of exposure to multiple chemicals ignores possible antagonistic or synergistic interactions, this approach has been accepted by regulatory agencies as generally conservative.

3.2 SIGNIFICANCE CRITERIA

Risks for the entire project that are less than the following regulatory thresholds are not considered to be significant and, therefore, acceptable:

- Cancer risk equal to or less than 10 in one million
- Chronic hazard index equal to or less than 1
- 8-hr chronic hazard index equal to or less than 1
- Acute hazard index equal to or less than 1
- Cancer burden equal to or less than 0.5

The cancer risk and hazard index metrics are generally applied to the maximally exposed individual (MEI). There are separate MEIs for residential exposure (i.e., residential areas) and for worker exposure (i.e., offsite work places).

4.0 RISK ASSESSMENT APPROACH

This health risk assessment was performed following the Office of Environmental Health Hazard Assessment (OEHHA), *Air Toxics Hot Spots Program Risk Assessment Guidelines*[2]. As recommended by this guideline, the California Air Resources Board (CARB) Hotspots Analysis and Reporting Program Version 2 (HARP2)[3] was used to perform a refined health risk assessment for the project's emission sources.

Consistent with SCAQMD modeling guidelines, the AMS/EPA Regulatory Model (AERMOD, v15181)[4] was used as the air dispersion model for this analysis. HARP2 includes AERMOD but also allows model runs to be performed with AERMOD outside of HARP2. For this project, AERMOD v15181 was run outside of HARP2, and the results were imported into HARP2 to complete the risk analysis. This HRA evaluates risk following SCAQMD guidelines[5]. Further discussion of AERMOD is contained in Section 4.2.1.

In general, risk assessment involves four steps:

1. Hazard identification
2. Exposure assessment
3. Dose-response assessment

[2] California Office of Environmental Health Hazard Assessment (OEHHA) 2015. Air Toxics Hot Spots Program Risk Assessment Guidelines, Guidance Manual for Preparation of Health Risk Assessments, February 2015.
[3] HARP2 (Hotspots Analysis and Reporting Program) Air Dispersion & Risk Tool, dated 16057.
[4] The latest version of the AERMOD modeling system and documentation and user's guide is available at http://www.epa.gov/scram001/dispersion_prefrec.htm.
[5] South Coast Air Quality Management District, Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act, June 5, 2015.

4. Risk characterization

Hazard identification involves identifying the toxic pollutants and whether the pollutant is a carcinogen or is associated with other types of adverse health effects. Toxic emissions from project sources are then quantified. Exposure assessment includes air dispersion modeling, identification of exposure routes, and estimation of exposure levels (dose). Dose-response requires identifying the relationship between exposure to a pollutant and the incidence of an adverse health effect in exposed populations. Finally, risk characterization combines the hazard identification, exposure assessment, dose-response assessment to estimate total cancer and non-cancer risk. The details of these four steps are presented below.

4.1 HAZARD IDENTIFICATION/ EMISSIONS ASSESSMENT

4.1.1 Project Emission Sources

The following sources from the proposed project have been identified as having toxic emissions that should be included in this HRA:

- New heaters to support the new Sulfuric Acid Regeneration Plant.
- New Propane Storage and Treatment Unit and Wet Jet Treater.
- New internal floating roof storage tanks and modifications to existing fixed and floating roof storage tanks.
- Increased utilization of several fixed and floating roof storage tanks at both Carson and Wilmington Operations.
- Modification of a Railcar LPG Loading/Unloading Rack.
- Installation of interconnect piping between the two operations.
- Modifications to existing process units and equipment resulting in the addition of equipment components and associated fugitive VOC leaks.
- Modifications to increase the permitted equipment description firing rate of the Carson 51 Vacuum Unit Heater as well as Wilmington Heaters H-100, H-300 and H-301.
- Modifications to the Carson Naphtha Hydrotreater Heater to allow the installation of ultra-low NOx burners.
- Increased utilization of the following heaters at the Carson Operations: Hydrocracker R-1, Hydrocracker R-2 and the Light Hydrotreating Unit Heater.
- Increased utilization of the FCCU Regenerator and Pre-Heater at the Carson Operations.
- Increased utilization of the Cogeneration Units 1-4 at the Carson Operations.
- Increased utilization of the following heaters at the Wilmington Operations: Delayed Coking Unit H-101, Hydrotreating Unit #3 H-30, Hydrotreating Unit #3 H-21/22, CRU H-510, CRU H-501A, H-501B, H-502 and H-503/504.
- Increased utilization of the following boilers at the Wilmington Operations: Boilers 7, 8, 9 and 10.
- Increased utilization of the following boilers at the Sulfur Recovery Plant Operations: Boilers H-1601/1602.
- Increased utilization of the following boilers at the Sulfur Recovery Plant Operations: Incinerators F-704 and H-754.

- Locomotives associated with increased railcar movement of LPG, in-transit and idling on site and just outside facility fenceline.

As a conservative approach, emission *decreases* associated with the shutdown of the Wilmington Operation's Fluid Catalytic Cracking Unit (FCCU) and associated heaters (CO Boiler, H2 Heater, H3 Heater, H4 Heater, H5 Heater and Startup Heater) were not considered in this health risk assessment.

The TACs emitted by the project, and included in the analysis[6], are:

Chemical	CAS #	Chemical	CAS #
1,2,4-Trimethylbenzene	95-63-6	Hexane	110-54-3
1,3-Butadiene	106-99-0	Hydrochloric acid	7647-01-0
2,2,4-Trimethylpentane	540-84-1	Hydrogen cyanide	74-90-8
2-Methylnaphthalene	91-57-6	Hydrogen sulfide	7783–06–4
3-Methylchloranthrene	56-49-5	Indeno(1,2,3-cd)pyrene	193-39-5
Acenaphthene	83-32-9	Isoprene	78-79-5
Acenaphthylene	208-96-8	Lead	7439-92-1
Acetaldehyde	75-07-0	Manganese	7439-96-5
Acrolein	107-02-8	Mercury	7439-97-6
Ammonia	7664-41-7	Methanol	67-56-1
Anthracene	120-12-7	Molybdenum Trioxide	1313-27-5
Antimony	7440-36-0	Naphthalene	91-20-3
Arsenic	7440-38-2	Nickel	7440-02-0
Barium	7440-39-3	PAHs, total reported	1150
Benzene	71-43-2	Perylene	198-55-0
Benzo(a)anthracene	56-55-3	Phenanthrene	85-01-8
Benzo(a)pyrene	50-32-8	Phenol	108-95-2
Benzo(b)fluoranthene	205-99-2	Phosphorus	7723-14-0
Benzo(g,h,i)perylene	191-24-2	Propylene	115-07-1
Benzo(k)fluoranthene	207-08-9	Pyrene	129-00-0
Benzo[e]pyrene	192-97-2	Selenium	7782-49-2
Beryllium	7440-41-7	Silver	7440-22-4
Cadmium	7440-43-9	Sulfuric Acid	7664-93-9
Biphenyl	92-52-4	Thallium	7440-28-0
Carbon Disulfide	75-15-0	Toluene	108-88-3
Carbonyl sulfide	463-58-1	Trimethylbenzene (mixed isomers)	25551-13-7
Chromium	7440-47-3	Vanadium	7440-62-2
Chromium (hexavalent)	18540-29-9	Xylenes (mixed)	1330-20-7
Chrysene	218-01-9	Zinc	7440-66-6
Copper	7440-50-8	Cyanide compounds	57-12-5

[6] TACs that were emitted but did not have any OEHHA/ARB approved cancer, chronic, or acute risk assessment health values are not included in this list.

Chemical	CAS #	Chemical	CAS #
Cresols (mixtures of) {cresylic acid}	1319-77-3	Cyclohexane	110-82-7
Cumene	98-82-8	Dibenz(a,h)anthracene	53-70-3
Ethylene	74-85-1	Dioxin and dioxin-like compounds	N150
Fluoranthene	206-44-0	Ethylbenzene	100-41-4
Fluorene	86-73-7	Diesel exhaust particulate matter	--
Formaldehyde	50-00-0		

4.1.2 Emission Calculation Approach

The purpose of the Health Risk Assessment was to evaluate the risk associated with changes in emissions resulting from the integration of the Wilmington and Carson operations. Emission changes are summarized below:

Modified combustion sources	Hourly emission rates were based on the 2012/2013 *daily* pre- to post-project emissions increase; annual emission rates were based on the 2012/2013 *annual* pre- to post-project emissions increase.
Non-modified combustion sources[7]	Emission rates were estimated based on the anticipated increase in operating rate of the unit.
Storage tanks	Pre-project storage tank emissions were based on 2012/2013 actual emissions; post-project storage tank emissions were based on estimated maximum emissions upon completion of the project.
Process unit pipeline component fugitives	Emission rates were estimated based on the number and type of pipeline components to be installed.
Locomotive DPM	Emissions increase in diesel particulate matter (DPM) was based on the estimated increase in locomotive activity associated with increased railcar movement of LPG, in-transit and idling on site, and just outside facility fenceline.

Details of the emission calculations for stationary sources and locomotive-related emissions are presented in the Air Quality/Global Climate Change Analysis Report.

4.2 EXPOSURE ASSESSMENT

The exposure assessment includes air dispersion modeling, identification of exposure routes, and estimation of exposure levels. In a typical exposure assessment, the air

[7] Combustion sources that won't be modified but may experience an increase in utilization.

dispersion modeling is used to estimate normalized ground level concentrations based on an emission rate of one gram per second (χ/Q or Chi over Q). Since ambient concentration is directly related to emission rate, the χ/Q is then multiplied by the emission rate for each substance to obtain a ground level concentration (GLC) resulting from each substance. Potential pathways of exposure to potential offsite receptors by each substance are identified (e.g., inhalation, dermal) and the appropriate algorithms are then used together with the χ/Q to estimate the concentration in air, soil, water, vegetation, and animals. The potential exposure levels to receptors are then estimated for each substance.

4.2.1 Air Dispersion

The air dispersion model currently required by U.S. EPA and the SCAQMD, AMS/EPA Regulatory Model (AERMOD, v15181), was used for this analysis. AERMOD simulates the atmospheric transport and dilution of emissions from project sources. This mathematical model estimates dilution of emissions by diffusion and turbulent mixing with ambient air as the emissions travel downwind from a source. AERMOD can predict the resulting cumulative concentrations from many point, area, and volume sources at numerous specified locations of interest (commonly referred to as receptors). The model is capable of predicting impacts in terrain ranging from flat to complex.

4.2.1.1 Using AERMOD with HARP2

The AERMOD program is embedded within HARP2, but the program also allows AERMOD to be run independently and the results can be imported. This approach was chosen for two reasons:

- The software used to run AERMOD allows model runs to be split up among computer processing cores, greatly reducing model run time. This is not possible when running AERMOD within HARP2.
- Running AERMOD outside of HARP2 ensures that the latest version or AERMOD is used. The latest version of HARP2 does not necessarily include the latest version of AERMOD.

When AERMOD is run outside of HARP2, the modeling results must be imported into HARP2. The general approach is as follows:

1. Create an AERMOD input file with all necessary source release parameters, receptors, and building downwash data. Each emission source is given an emission rate of 1.0 grams per second.
2. Run AERMOD using the AERMOD input file and an AERMOD-ready meteorological data file; the output files required by HARP2 are individual .GRF files that provide the impact at each receptor. Two .GRF files are created for each source – one for the maximum 1-hr average concentrations and one for the annual average concentrations.
3. Generate a comma-delimited .CSV text file containing the hourly and annual emission rates of each chemical for each emission source in the format specified by HARP2.
4. Import the files into HARP2 and run the risk analyses.

The steps above are performed for both the pre-project emissions and for the post-project emissions. Additionally, separate model runs were performed for DPM. Project total cancer risks are calculated within a spreadsheet by adding the stationary source cancer risks (post-project minus pre-project) to the mobile source cancer risks on a receptor by receptor basis. This is done separately for residential and workplace exposures.

4.2.1.2 Project Sources

The project stationary point sources identified in Section 4.1.1 were modeled using the parameters summarized in Table 1, below. Stationary combustion sources (heaters and process vents) were modeled using representative release parameters. Process unit piping component fugitive emissions were modeled as volume sources with a release height equal to 10 feet and lateral dimensions appropriate to the physical extents of the unit. For process units that were oblong in shape, the unit was divided into two or three volume sources of equal dimensions (as appropriate), and emissions were divided evenly among the sources. Piping component fugitive emissions associated with the interconnect piping were also modeled as volume sources, with the exception described below. Interconnect piping sources were modeled with a release height of 3 feet. Source parameters for the volume sources are shown in Table 2.

The interconnect piping fugitive emission source ID IC_C2 was modeled as a line source. It was modeled as a line source as this represents the most appropriate method for a long, narrow, straight fugitive emissions source near ground level. Source parameters for the line source are shown in Table 3, below.

Storage tanks were modeled as circular area (“AREACIRC”) sources with the diameter equal to the diameter of the tank and the release height equal to the height of the tank. One exception was Tank 502, which is actually a reservoir with a fixed roof. Tank 502 was modeled as an “AREAPOLY” source. The storage tanks either have fixed roofs, fixed roofs with internal floating roofs, or are fixed roof tanks connected to vapor recovery. For purposes of simplification and because these emissions are relatively small, emissions from tanks connected to vapor recovery were treated the same as the floating roof tanks (modeled as an AREACIRC source). Source parameters for the AREACIRC sources are shown in Table 4, below.

At the facility, two locomotive engines are used to move railcars carrying LPG. These locomotives were modeled as a string of evenly-spaced volume sources along the segments of track where engines are expected to travel. The engines travel a short distance outside the facility boundaries at times; this was reflected in the modeling. The locomotive source release parameters are summarized in Table 5.

Figure 2 shows the model representation of the point, volume, and area sources representing stationary and locomotive sources. The TAC emissions as input to the HARP model are included in Attachment D-4.

4.2.1.3 Terrain Characterization

AERMOD requires that each source in the analysis be categorized as being in either a rural or an urban setting. Consistent with SCAQMD guidance, all sources were designated as Urban.

Although the area is relatively flat, source and receptors were modeled with consideration of terrain elevations. The AERMOD terrain processor (AERMAP) was used to calculate terrain elevations for each source and receptor from the U.S. Geological Survey (USGS) National Elevation Dataset (NED).

Table 1
Point Source Parameters for Project Stationary Sources

Source Description	Stack ID	Stack Height		Stack Gas Exit Temperature		Stack Gas Exit Velocity		Stack Diameter		UTM Coordinates (NAD83) Easting/Northing	
		(ft)	(m)	(^{o}F)	(K)	(ft/s)	(m/s)	(ft)	(m)	(m)	(m)
Carson 51 Vacuum Unit Heater stack (D63)	51VAC	153.8	46.9	344.3	446.6	19.7	6.0	10.3	3.1	385299.8	3741864.8
Carson Cogeneration Unit 1 turbine and duct burner stack (D1226/D1227)	COGEN1	100.0	30.5	332.1	439.9	98.8	30.1	14.8	4.5	384708.0	3742507.4
Carson Cogeneration Unit 2 turbine and duct burner stack (D1233/D1234)	COGEN2	100.0	30.5	332.3	440.0	99.5	30.3	14.8	4.5	384763.4	3742505.6
Carson Cogeneration Unit 3 turbine and duct burner stack (D1236/D1237)	COGEN3	100.0	30.5	352.3	451.1	96.5	29.4	14.8	4.5	384816.3	3742503.6
Carson Cogeneration Unit 4 turbine and duct burner stack (D1239/D1240)	COGEN4	100.0	30.5	333.3	440.5	99.6	30.4	14.8	4.5	384869.4	3742502.6
Carson FCCU Regenerator	FCCUPH_C	178.8	54.5	519.9	544.2	12.0	3.7	6.5	2.0	384977.0	3742816.0
Carson FCCU Pre-Heater	FCCUR_C	171.0	52.1	604.9	591.4	60.9	18.6	11.5	3.5	385025.0	3742758.0
Carson Hydrocracker R1 Heater stack (D625)	HCU_R1	125.0	38.1	521.3	545.0	14.2	4.3	3.3	1.0	385009.7	3743159.6
Carson Hydrocracker R2 Heater stack (D627)	HCU_R2	110.3	33.6	587.0	581.5	22.3	6.8	3.6	1.1	385003.0	3743159.3
Carson Light Hydrotreating Unit Heater (D425)	LHU_HTR	84.0	25.6	618.3	598.9	15.0	4.6	3.0	0.9	384827.5	3742919.6
Carson Naphtha HDS Heater stack (D1433)	NHDS	65.1	19.8	600.1	588.8	13.4	4.1	2.4	0.7	385437.9	3741732.8
Wilmington - Sulfuric Acid Regen Plant Stk 1 - Process Air & Converter Htr	SA1_W	124.0	37.8	450.0	505.4	17.9	5.5	3.0	0.9	385559.6	3739535.2
Wilmington - Sulfuric Acid Regen Plant Stk 2 - Decomp Furnace	SA2_W	194.0	59.1	180.0	355.4	18.2	5.5	3.5	1.1	385602.5	3739519.6

Source Description	Stack ID	Stack Height		Stack Gas Exit Temperature		Stack Gas Exit Velocity		Stack Diameter		UTM Coordinates (NAD83) Easting/Northing	
		(ft)	(m)	(°F)	(K)	(ft/s)	(m/s)	(ft)	(m)	(m)	(m)
Wilmington Boilers 7 & 8 Stack	BLR78_W	65.0	19.8	500.0	533.2	6.8	2.1	7.0	2.1	385564.4	3739451.0
Wilmington Boilers 9 & 10 Stack	BLR910_W	65.0	19.8	500.0	533.2	21.6	6.6	7.0	2.1	385579.0	3739442.9
Wilmington Coker Heater H101	H101	183.0	55.8	1160.6	900.2	33.2	10.1	9.9	3.0	386023.0	3739978.7
Wilmington CRU2 Unit H-501A/B 502 503 504 Heaters Stack	H501A_ET	75.0	22.9	300.2	422.2	41.2	12.6	4.5	1.4	385783.0	3740132.0
Wilmington CRU2 Unit H-510 Heater Stack	H510	100.0	30.5	649.4	616.2	4.8	1.5	4.5	1.4	385759.0	3740106.0
Wilmington H100 Heater Stack	H100	183.0	55.8	665.6	625.2	16.2	4.9	10.0	3.0	386024.8	3739996.0
Wilmington HCU H-300 and H-301 Heaters Stack	H300_301	185.5	56.5	450.0	505.4	20.0	6.1	5.3	1.6	385652.4	3740058.5
Wilmington HTU3 Unit H-21/H-22 Heaters Stack	H21_22	116.0	35.4	640.4	611.2	1.4	0.4	5.7	1.7	385754.2	3740191.0
Wilmington HTU3 Unit H-30 Heater Stack	H30	88.0	26.8	575.6	575.2	16.9	5.1	4.0	1.2	385754.4	3740180.7
Wilmington Sulfur plant combined H-1601/1602 Stack	H1601_2	155.6	47.4	344.3	446.7	21.7	6.6	6.4	2.0	385978.8	3742153.0
Wilmington Sulfur Plant Incinerator Stack 1	F704	150.0	45.7	1064.4	846.7	45.4	13.8	6.0	1.8	386010.9	3742144.8
Wilmington Sulfur Plant Incinerator Stack 2	F754	107.0	32.6	1061.8	845.3	37.9	11.5	6.3	1.9	386002.9	3742129.3

Table 2
Piping Component Process Fugitive Volume Source Parameters

Source Description	Model ID	Release Height Above Ground		Initial Horizontal Dimension (σ_{yo})		Initial Vertical Dimension (σ_{zo})		UTM Coordinates[a] Easting/ Northing	
		(ft)	(m)	(ft)	(m)	(ft)	(m)	(m)	(m)
Carson Alkylation Unit	ALKY_C	10.0	3.0	42.0	12.8	9.3	2.8	385461.7	3741952.6
Carson FCCU	FCCU_C	10.0	3.0	57.2	17.4	9.3	2.8	385017.2	3742833.4
Carson HCU	HCU_C	10.0	3.0	28.2	8.6	9.3	2.8	385014.0	3743133.4
Carson Interconnect Piping - Pig Station	PIGST_C	3.0	0.9	19.1	5.8	2.8	0.9	385539.8	3741732.6
Carson Interconnect Piping - OSBL	IC_C1	3.0	0.9	11.6	3.5	2.8	0.9	385185.1	3741677.2
Carson Light Hydro Unit (1 of 2)	LHU_C1	10.0	3.0	35.1	10.7	9.3	2.8	384842.3	3742895.3
Carson Light Hydro Unit (2 of 2)	LHU_C2	10.0	3.0	35.1	10.7	9.3	2.8	384865.1	3742895.8
Carson LPG Rail Car Loading/Unloading	LPG_C	10.0	3.0	11.5	3.5	9.3	2.8	385819.4	3742730.7
Carson Mid Barrel Distillate Treater (1 of 2)	MID_C1	10.0	3.0	35.1	10.7	9.3	2.8	384842.3	3742895.3
Carson Mid Barrel Distillate Treater (2 of 2)	MID_C2	10.0	3.0	35.1	10.7	9.3	2.8	384865.1	3742895.8
Carson Naphtha HDS	NAPHDS_C	10.0	3.0	11.5	3.5	9.3	2.8	385478.6	3741892.9
Carson Naphtha Isom Unit (1 of 2)	NISOM_C1	10.0	3.0	91.5	27.9	9.3	2.8	385390.8	3741751.8
Carson Naphtha Isom Unit (2 of 2)	NISOM_C2	10.0	3.0	91.5	27.9	9.3	2.8	385449.1	3741750.8
Carson No. 51 Vacuum Unit	51VAC_C	10.0	3.0	76.3	23.3	9.3	2.8	385264.1	3741831.4
Carson Wet Jet Treater (New)	WETJET_C	10.0	3.0	15.3	4.7	9.3	2.8	385168.8	3741885.9
Crude Tank Farm - Pipeline Component Fugitives	CCT_FUG	3.0	0.9	164.8	50.2	2.8	0.9	384291.4	3741414.0
Wilmington - New Piping for Tanks 300035-300036	NWPIPE_W	3.0	0.9	6.0	1.8	2.8	0.9	385510.8	3740479.0
Wilmington CRU (1 of 2)	CRU_W1	10.0	3.0	61.0	18.6	9.3	2.8	385695.0	3740150.0
Wilmington CRU (2 of 2)	CRU_W2	10.0	3.0	61.0	18.6	9.3	2.8	385696.4	3740106.0
Wilmington Hydrocracker Unit (1 of 3)	HCU_W1	10.0	3.0	65.6	20.0	9.3	2.8	385645.9	3740144.1
Wilmington Hydrocracker Unit (2 of 3)	HCU_W2	10.0	3.0	65.6	20.0	9.3	2.8	385647.7	3740107.6

Source Description	Model ID	Release Height Above Ground		Initial Horizontal Dimension (σ_{yo})		Initial Vertical Dimension (σ_{zo})		UTM Coordinates[a] Easting/ Northing	
		(ft)	(m)	(ft)	(m)	(ft)	(m)	(m)	(m)
Wilmington Hydrocracker Unit (3 of 3)	HCU_W3	10.0	3.0	65.6	20.0	9.3	2.8	385650.3	3740072.8
Wilmington Hydrotreater Unit No. 1	HTU1_W	10.0	3.0	22.9	7.0	9.3	2.8	385814.4	3740039.1
Wilmington Hydrotreater Unit No. 2	HTU2_W	10.0	3.0	64.9	19.8	9.3	2.8	385789.8	3740149.7
Wilmington Hydrotreater Unit No. 4	HTU4_W	10.0	3.0	53.4	16.3	9.3	2.8	385463.3	3740135.8
Wilmington side Pig Station - Piping Interconnect (1 of 2)	PIGST_W1	3.0	0.9	19.5	5.9	2.8	0.9	386187.1	3741129.1
Wilmington side Pig Station - Piping Interconnect (2 of 2)	PIGST_W2	3.0	0.9	19.5	5.9	2.8	0.9	386182.9	3741116.5
Wilmington Interconnect Piping (Location 1 of 3) - OSBL	IC_W1	3.0	0.9	34.9	10.6	2.8	0.9	385839.8	3740251.6
Wilmington Interconnect Piping (Location 2 of 3) - OSBL	IC_W2	3.0	0.9	93.0	28.4	2.8	0.9	385544.7	3739633.8
Wilmington Interconnect Piping (Location 3 of 3) - PSTU	IC_W3	3.0	0.9	81.4	24.8	2.8	0.9	385535.2	3739865.7
Wilmington Propane Sales Treating Unit	PSTU_W	10.0	3.0	13.0	4.0	9.3	2.8	385505.5	3740163.2

[a] Center of volume source

Table 3
Project Line Source Parameters

Source ID	Source Description	Start UTM Coordinates Easting/ Northing		End UTM Coordinates Easting/ Northing		Line Width		Vertical Dimension (σ_{zo})	
		(m)	(m)	(m)	(m)	(ft)	(m)	(ft)	(m)
IC_C2	Carson Interconnect Piping - OSBL	384435.89	3742374.48	384660.62	3742369.67	32.8	10.0	2.79	0.85

Table 4
Project Circular Area Source Parameters

Source Description	Model ID	Release Height Above Ground		Radius of Circle		UTM Coordinates[a] Easting/ Northing	
		(ft)	(m)	(ft)	(m)	(m)	(m)
Carson new 500 MBBL Crude Tank (1 of 6)	CRDTK1_C	56.0	17.1	120.0	36.6	384266.0	3741526.0
Carson new 500 MBBL Crude Tank (2 of 6)	CRDTK2_C	56.0	17.1	120.0	36.6	384373.0	3741526.0
Carson new 500 MBBL Crude Tank (3 of 6)	CRDTK3_C	56.0	17.1	120.0	36.6	384238.0	3741414.0
Carson new 500 MBBL Crude Tank (4 of 6)	CRDTK4_C	56.0	17.1	120.0	36.6	384344.0	3741414.0
Carson new 500 MBBL Crude Tank (5 of 6)	CRDTK5_C	56.0	17.1	120.0	36.6	384209.0	3741303.0
Carson new 500 MBBL Crude Tank (6 of 6)	CRDTK6_C	56.0	17.1	120.0	36.6	384314.0	3741303.0
Carson Tank 14	TK14	64.0	19.5	100.0	30.5	384497.0	3741772.1
Carson Tank 31	TK31	42.0	12.8	58.5	17.8	384911.9	3742071.6
Carson Tank 502	TK502	0.0	0.0	-- [b]	-- [b]	384042.4	3741877.9
Carson Tank 62	TK62	42.0	12.4	58.5	20.7	385139.2	3742309.5
Carson Tank 63	TK63	42.0	12.4	58.5	20.7	385058.5	3742311.1
Carson Tank 64	TK64	41.0	12.4	58.5	20.5	384977.2	3742314.3
Carson Tank 959	TK959	41.0	15.8	58.5	22.9	385249.7	3742903.0
Wilmington Tank 300035 (replaces 80035)	300035	72.0	21.9	90.0	27.4	385495.1	3740432.7
Wilmington Tank 300036 (replaces 80036)	300036	72.0	21.9	90.0	27.4	385527.4	3740529.9
Wilmington Tank 80035	80035	41.0	12.5	58.5	17.8	385495.1	3740432.7
Wilmington Tank 80036	80036	41.0	12.5	58.5	17.8	385527.4	3740529.9
Wilmington Tank 80038	80038	42.0	12.8	58.5	17.8	385442.3	3740498.3
Wilmington Tank 80044	80044	42.0	12.8	58.5	17.8	385928.8	3740567.9
Wilmington Tank 80060	80060	42.0	12.8	58.5	17.8	386044.2	3740333.8
Wilmington Tank 80067	80067	41.0	12.5	58.5	17.8	385969.0	3740298.0
Wilmington Tank 80074	80074	42.0	12.8	58.5	17.8	385498.1	3740685.5

Source Description	Model ID	Release Height Above Ground		Radius of Circle		UTM Coordinates[a] Easting/ Northing	
		(ft)	(m)	(ft)	(m)	(m)	(m)
Wilmington Tank 80079	80079	42.0	12.8	58.5	17.8	386092.7	3740128.4
Wilmington Tank 80211	80211	42.0	12.8	58.5	17.8	386017.5	3740558.8
Wilmington Tank 80215	80215	40.0	12.2	60.0	18.3	386111.5	3740528.6
Wilmington Tank 80217	80217	40.0	12.2	60.0	18.3	386162.3	3740684.2

[a] Center of source

[b] Tank 502 modeled as an AREAPOLY source due to its oval shape. Area of source is 34,639 m^2.

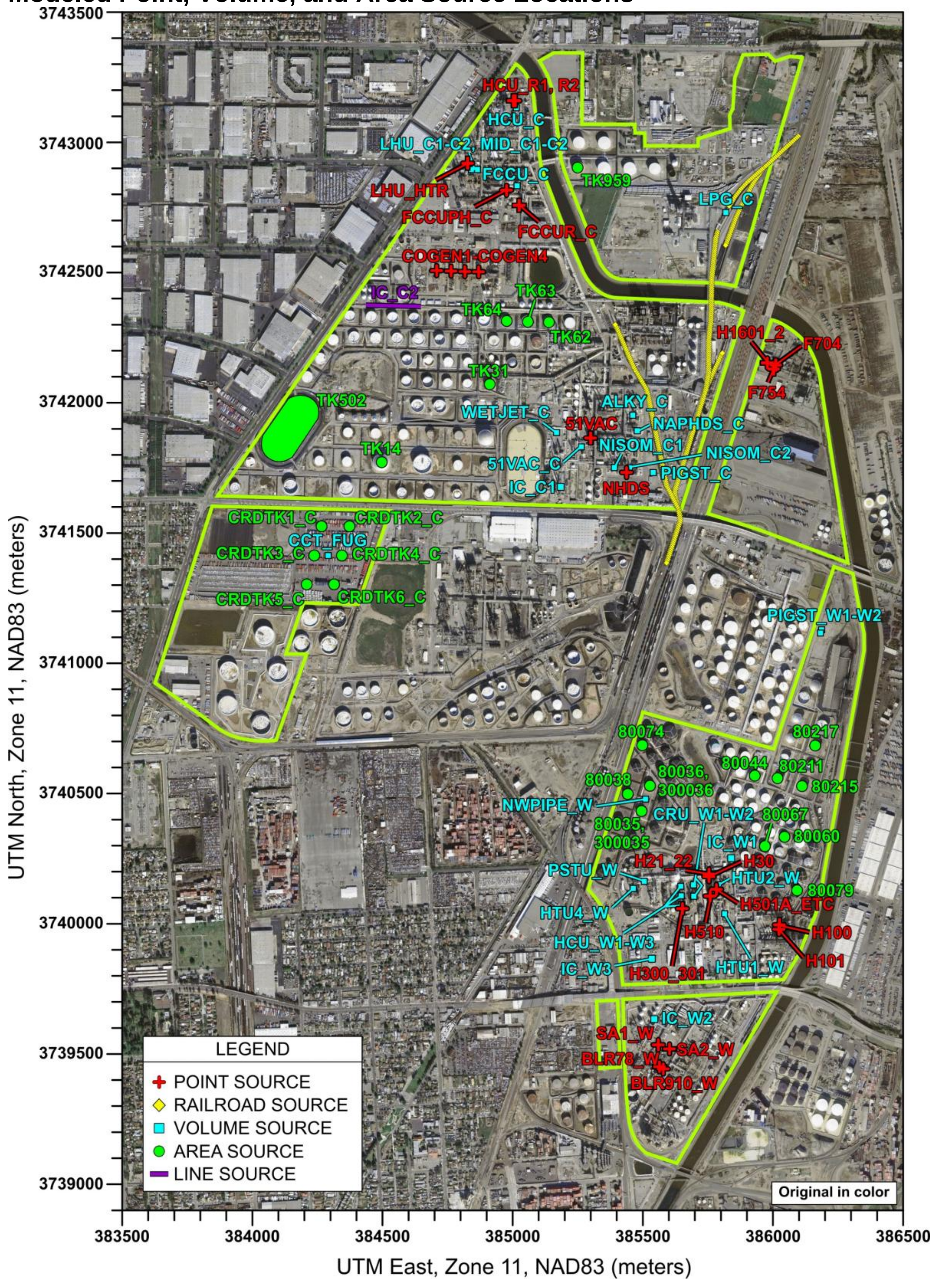
Table 5
Release Parameters for Volume Sources Representing Locomotives

Source Description	Release Height		Spacing Between Sources		Horizontal Dimension (σ_{yo})		Vertical Dimension (σ_{zo})	
	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)
Locomotives	18.4	5.6	24	7.32	11.16	3.4	8.53	2.6

Note: Locomotive volume source parameters based on values used for daytime traveling locomotives in Commerce Rail Yard modeling study[8] (Table 41). Source locations are included in Attachment D-1.

[8] Sierra Research, Inc., Toxic Air Contaminant Emissions Inventory and Dispersion Modeling Report for the Commerce Rail Yard, Los Angeles, California, prepared for Union Pacific Railroad Company, January 2007.

Figure 2
Modeled Point, Volume, and Area Source Locations



4.2.1.4 Building Downwash

When point sources are located near or on buildings or structures, the dispersion of the plume can be influenced. The wake produced on the lee side of the structure can cause the plume to be pulled toward the ground near the structure resulting in higher concentrations. This is called building downwash. Stack heights that minimize downwash effects are designated good engineering practice (GEP) stack heights.

The effects of building downwash have been examined in this modeling analysis. AERMOD uses the EPA-approved Building Profile Input Program with Plume Rise Model Enhancements (BPIP-PRIME) to provide input for the downwash analysis. This program calculates the GEP formula stack heights and direction-specific building dimensions for input to the dispersion calculations. BPIP-PRIME requires the input of building coordinates and heights, and stack coordinates. The heaters and process vents are project stationary point sources. The building downwash effects for these stacks are based on structures in the vicinity that were judged to have downwash potential.

4.2.1.5 Meteorological Data

The AERMOD-ready meteorological data sets for years 2006, 2007, 2008, 2009, and 2011 for the Long Beach, CA monitoring station were used for the analysis. These data sets were developed by SCAQMD using AERMET version 14134, the AERMOD meteorological data preprocessor, and provided for use in this analysis. The Long Beach meteorological station is located less than 3 miles east of the refinery. A windrose showing a graphical distribution of wind speed and wind direction for the time period modeled is shown in Attachment D-2.

4.2.1.6 Receptors

Health effect indices such as cancer risk, chronic hazard index, and acute hazard index were calculated for a variety of receptor locations. Receptors of primary interest are those at residential locations, at sensitive population locations, and at offsite worker locations. However, in order to get a more complete picture of the patterns of exposure, concentrations and risk are also calculated at regularly spaced grid points throughout the modeling domain.

The receptors used to analyze project impacts include:

- 25-m spaced receptors along the outer facility boundary
- 100-m spaced receptors within the facility boundary and out to 1,000+ meters from the facility boundary
- 250-m spaced receptors beyond 1,000 m out to 3,500 m or more from the facility boundary
- Sensitive receptors within a radius of approximately 6 kilometers of a central refinery location

Receptor spacing was based on SCAQMD modeling guidance[9], which requires a fenceline spacing of 100 meters or less for facility areas greater than or equal to 100 acres. One

[9] South Coast Air Quality Management District, Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act, June 5, 2015, Table 9.

receptor along the facility boundary fell within the exclusion zone[10] of one of the volume sources representing the locomotive emissions. Per discussions with AQMD staff, this receptor was removed as the pollutant concentrations calculated for this receptor cannot be considered accurate. Since the receptor spacing requirement was 100 meters, and the actual spacing used was 25 meters, the spacing along the boundary where the receptor was removed remained within SCAQMD requirements. Receptor heights above ground were set to 0.0 meters, consistent with SCAQMD modeling guidance. This network is composed of Cartesian (X,Y) receptors with Universal Transverse Mercator (UTM) coordinates. The modeling was conducted using the North American Datum of 1983 (NAD83).

Sensitive receptor locations (schools, day care facilities, hospitals, and convalescent homes) were obtained via an internet search and the Google Maps database. The sensitive receptors used in the project analysis are listed in Table 6.

Figure 3 shows the model representation of grid and fenceline receptors, and Figure 4 plots the sensitive receptor locations. A total of 5,738 fenceline and grid receptors were included in the analysis, plus an additional 76 sensitive receptors. Since some of the sensitive receptors were located beyond the extents of the grid, the sensitive receptors were modeled separately in AERMOD and HARP2. Fenceline, grid, and sensitive receptors are included in Attachment D-4. Onsite receptors (receptors within facility boundaries) are used solely for creating risk contours (see Section 5) and are not considered when assessing off-site impacts. Onsite receptors are listed in Attachment D-3.

4.2.2 Exposure Pathways

A receptor can be hypothetically exposed to a substance through several different pathways. Typically, the primary environmental exposure pathway in a health risk assessment is direct inhalation of gaseous and particulate air pollutants. However, there is the potential for exposure via non-inhalation pathways due to the deposition of particulate pollutants in the environment. In general, potential non-inhalation exposure pathways include:

- Dermal (skin) absorption
- Soil ingestion
- Mother’s milk
- Fish ingestion
- Home grown produce ingestion
- Pasture ingestion (including beef and dairy)
- Drinking water ingestion
- Pigs, chickens, and/or eggs ingestion

[10] Concentrations are not calculated by AERMOD in a source exclusion zone. For volume sources, the exclusion zone is the region [(2.15 x Sigma Y) + 1 meter)] from the center of the volume. See 12/6/2011 Memorandum entitled “Haul Road Workgroup Final Report” from Randy Robinson, EPA Region 5 and Mick Daye, EPA Region 7, to Tyler Fox, Leader, Air Quality Modeling Group and George Bridgers, Clearinghouse Coordinator, Air Quality Modeling Group.

For this analysis, per SCAQMD guidance[11] only the dermal absorption, soil ingestion, mother's milk, and home grown produce ingestion pathways were considered to be viable non-inhalation exposure pathways for the area of impact. Exposure to DPM is evaluated for the inhalation pathway only, consistent with OEHHA guidelines. Moreover, acute impacts of DPM are not calculated as there is no acute inhalation risk assessment health value for DPM.

[11] South Coast Air Quality Management District, Supplemental Guidelines for Preparing Risk Assessment for the Air Toxics "Hot Spots" Information and Assessment Act, June 5, 2015, Table 11.

Table 6
Description and Coordinates of Sensitive Receptors

Description	UTM Coordinates (NAD83) Easting/Northing	
	(m)	(m)
Andrew Carnegie Middle School	383558	3744007
Annalee Elementary School	384218	3746693
Avalon High School	383044	3739793
Banning Elementary School	382774	3737978
Banning High School	383286	3740026
Banning-Marine Avenue Adult Center	382948	3739923
Bethune Mary School	386721	3739987
Bonita Street Elementary School	383370	3743858
Broad Avenue Elementary School	383158	3740800
Broadacres Elementary School	385396	3746688
Cabrillo High School	387473	3739922
Carson Elementary School	382022	3744352
Carson High School	382047	3743274
Carson Montessori Academy	383307	3744170
Catskill Elementary School	382435	3742047
Cesar Chavez Elementary School	388750	3737361
Child Time Learning Center	388951	3737098
Curtiss Middle School	384293	3746322
Del Amo Elementary School	385247	3744738
Edison Elementary School	388774	3737826
Elizabeth Hudson Elementary School	387091	3740595
First Baptist Church	383243	3739694
Fries Avenue Elementary School	382836	3739449
Garfield Head Start Elementary School	387692	3740405
Golden Wings Academy Inc	383115	3745483
Gulf Avenue Elementary School	382164	3739057
Harbor-UCLA Medical Center	380471	3744060
Hawaiian Avenue Children’s Center	381811	3737926
Hawaiian Avenue Elementary	381812	3737989
Hillcrest Care Center	389343	3742818
Holy Family Grammar School	384401	3739366
John Muir Elementary School	387914	3742030
Jonathan Jaques Children's Center Hospital	390345	3741550
Kaiser Permanente South Bay	381895	3741791
Li’l Cowpoke Pre-School	383104	3737974
Long Beach Brethren Elementary School	390143	3743190
Long Beach Day Nursery	389275	3739143
Long Beach Head Start School	391125	3741695

Description	UTM Coordinates (NAD83) Easting/Northing	
	(m)	(m)
Long Beach Japanese School	387304	3739447
Long Beach Job Corp Dynamic Educational	387472	3739724
Long Beach School for Adult	389368	3739487
Long Beach Child Development	387287	3740345
Mary Bethune School	389232	3738849
Memorial Heart Institute Hospital	390121	3741522
Miller Children's Hospital	390121	3741522
Normont Elementary School	380300	3740328
Oakwood Academy School	389995	3743777
Old King Cole Day Care	388848	3742528
Pacific Harbor Elementary School	381903	3740040
Pacific Hospital of Long Beach	389587	3741419
Phineas Banning Senior High School	383288	3740032
Rancho Dominguez Preparatory School	387538	3744360
Regency High School	389116	3738789
Robinson (Jackie) School	389694	3741418
Royal Care Skilled Nursing Care Center	389480	3741357
Santa Fe Convalescent Hospital	387542	3742485
St Philomena School	382031	3743958
St. Lucy’s School	387437	3740571
Sts. Peter & Paul School	382456	3738335
The Palmcrest Grand Care Center, Inc	389279	3742980
Thomas A. Edison State Pre-School	388900	3737881
Vermont Christian School	381588	3738582
Volunteers of America - Head Start Preschool	379911	3739748
Washington Middle School	389361	3738974
Webster Elementary School	387380	3742512
West Child Development Center	387474	3740168
White Middle School	381089	3743544
Will J. Reid High School	387037	3740324
William Logan Stephens Junior High	387367	3741657
Wilmington Boys and Girls Club	381354	3740025
Wilmington Christian School	383005	3740658
Wilmington Junior High School	382039	3740361
Wilmington Park Children’s Center	384655	3739221
Wilmington Park Elementary School	384618	3739222
Wilmington YMCA	383050	3739071
Wyo Tech National Institute of Tech	387041	3739640

Figure 3
Fenceline and Grid Receptor Locations

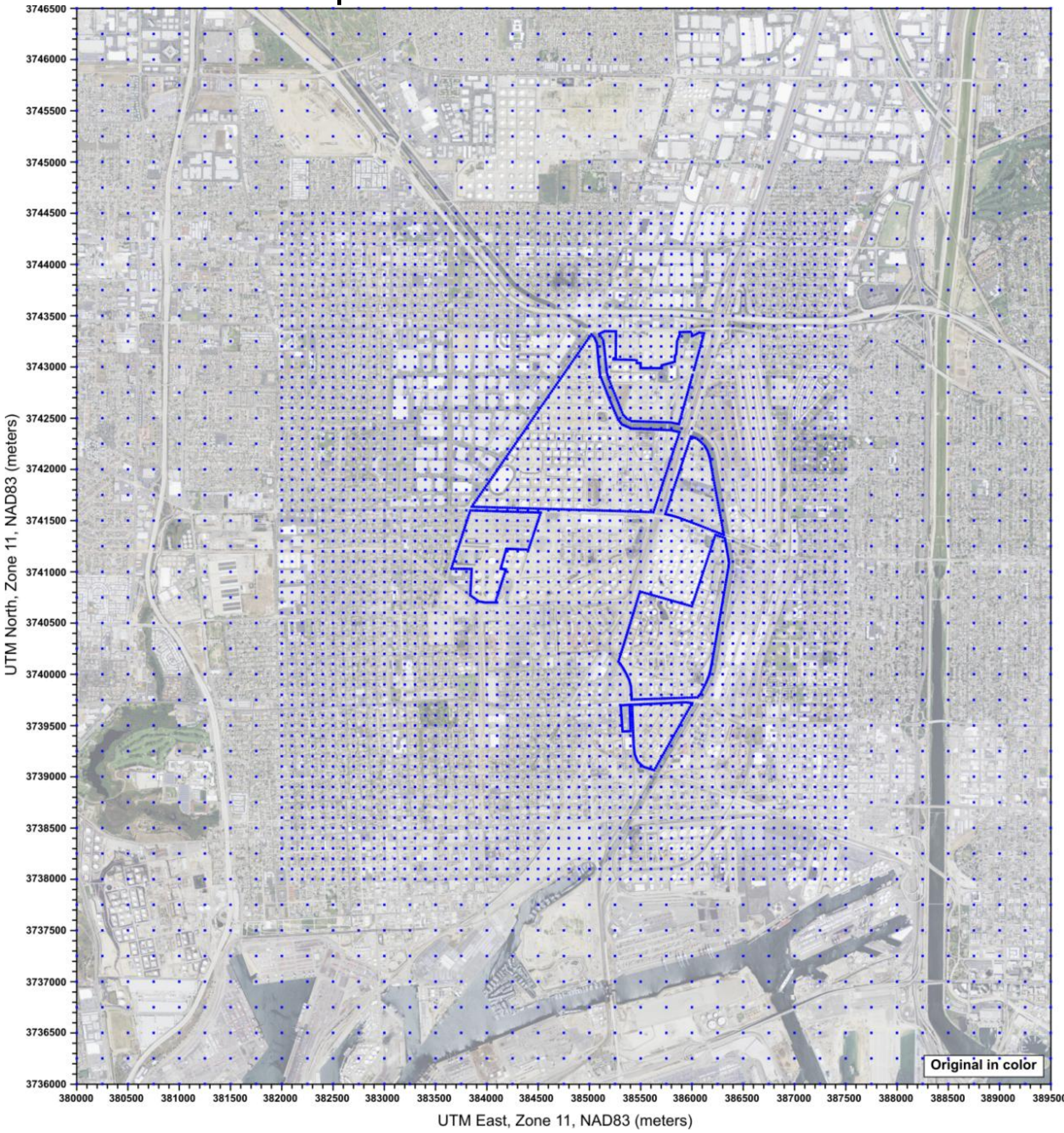
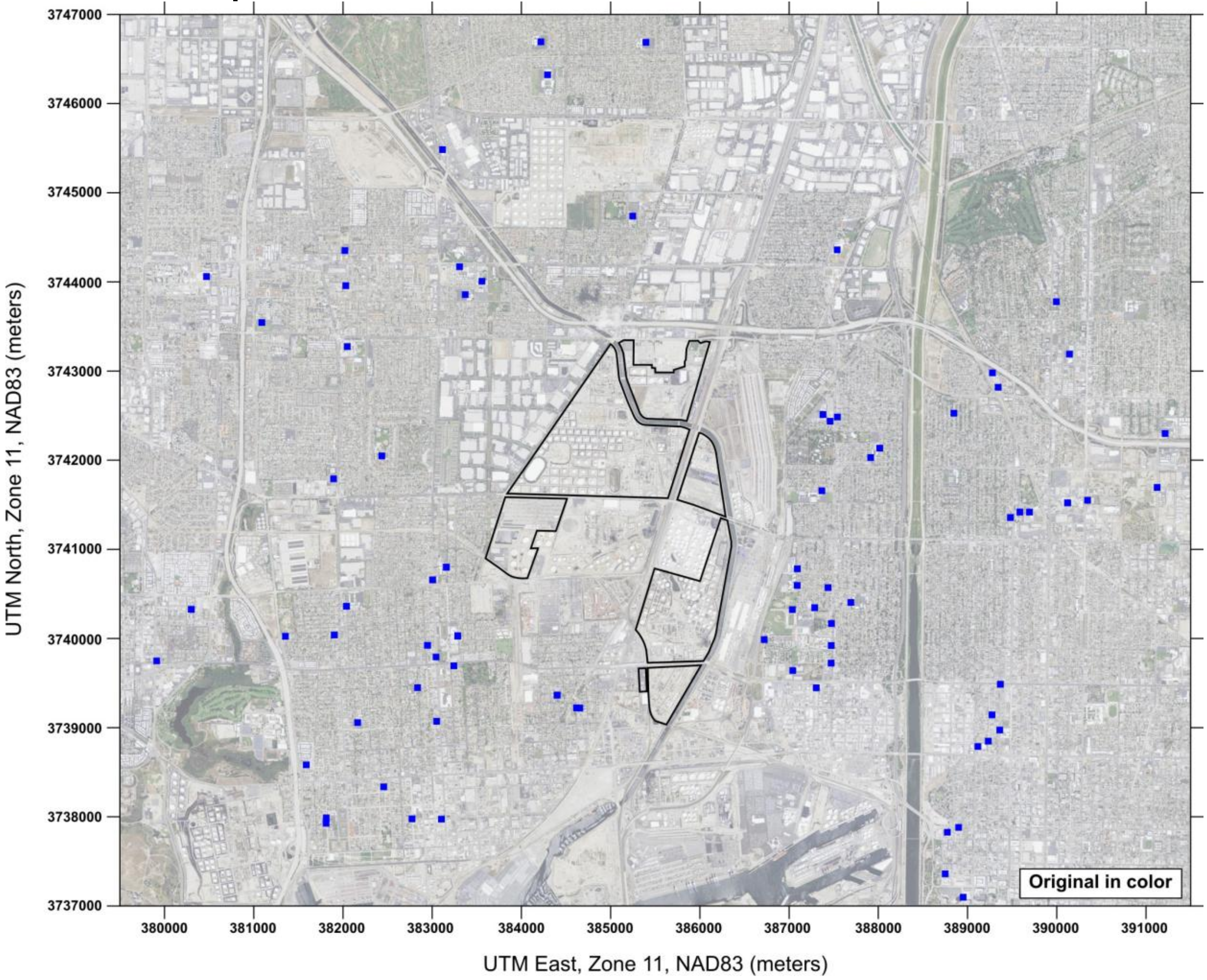


Figure 4
Sensitive Receptor Locations



4.3 EXPOSURE DOSE

Based on the estimated concentrations in the air, soil, and plants, the HARP2 software program calculated potential exposure levels to people through the various applicable pathways. The program used the algorithms identified in the OEHHA risk assessment guidelines[12].

4.4 DOSE-RESPONSE

As described in the OEHHA risk assessment guidelines, the dose-response assessment describes the quantitative relationship between the amount of exposure of a person to a substance (the dose) and the incidence or occurrence of an adverse health impact (the response). For carcinogens, this information is quantified as a cancer potency slope. For non-carcinogens, dose-response information is characterized as a reference exposure level.

4.4.1 Carcinogens

OEHHA has developed cancer potency factors for inhalation and non-inhalation pathways. The cancer potency factors represent an upper bound probability of developing cancer based on a continuous lifetime exposure to one milligram per kilogram of body weight of a substance. The cancer potency factor does not represent a threshold under which a person would not develop cancer but instead is used to estimate the probability of developing cancer. OEHHA regularly updates cancer potency factors as new information becomes available. This assessment is based on the latest health tables made available by OEHHA.

4.4.2 Non-carcinogens

OEHHA has developed RELs for acute and chronic non-carcinogenic impacts. Unlike cancer potency factors, these RELs represent concentration thresholds at which no adverse non-cancer health effects are anticipated. Since a substance may affect multiple organs or endpoints, each substance may have multiple RELs to represent each toxicological endpoint. However, the REL for the most sensitive endpoint is used to ensure the REL considers the most adverse potential impacts. The chronic RELs are based on a long term exposure of 8 years while the acute RELs are typically based on a one hour exposure. Chronic RELs have been developed for inhalation and non-inhalation pathways while 8-hr chronic and acute RELs have been developed only for the inhalation pathway. OEHHA regularly updates the RELs and this health risk assessment is based on the latest HARP health tables made available by OEHHA.

5.0 RISK CHARACTERIZATION

By combining the results from the exposure assessment and dose response assessment, the HARP2 software program estimated potential cancer risk and non-cancer risks. More specifically, the calculated doses and exposure pathway information are used with the RELs and cancer potency factors to quantify cancer and non-cancer health impacts.

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[12] California Office of Environmental Health Hazard Assessment (OEHHA) 2015. Air Toxics Hot Spots Program Risk Assessment Guidelines. February 2015.

5.1 CARCINOGENS

The cancer health impacts are characterized as a cancer risk that represents the chances per million people of developing cancer. The cancer risk from each substance is added together to arrive at a total cancer risk. The exposure durations modeled in HARP2 followed OEHHA and SCAQMD guidance and are shown in Table 7 below.

Table 7
Exposure Durations Used in Risk Modeling

Risk type	Exposure Duration
Residential and sensitive receptor cancer risk	24 hr/day, 350 day/yr, 30 years
Cancer burden	24 hr/day, 350 day/yr, 70 years
Worker cancer risk	8 hr/day, 250 day/yr, 25 years

5.2 NON-CARCINOGENS

The non-cancer health impacts are characterized through a hazard index (HI). The HI for each toxicological endpoint or target organ system is calculated for each applicable substance. The total HI for each target organ system is equal to the sum of the HI from each substance. As a conservative measure, pre-project impacts were not subtracted from post-project impacts in the non-carcinogen risk calculations. An HI of one or less indicates that adverse non-cancer health impacts are not anticipated.

5.2.1 Chronic HI

The chronic HI calculations are based on annual average concentrations and the chronic REL. Separate HARP2 analyses were run for DPM and for all other toxic chemicals. The results from the two HARP2 runs were then summed together to determine the total HI.

5.2.2 8-Hr Chronic HI

8-hr chronic calculations were made in HARP2 based on the annual average concentrations and 8-hr chronic RELs. Since no 8-hr chronic RELs exist for DPM, the 8-hr chronic calculations were based only on the stationary source modeling. As these sources emit continuously, no adjustment factors were applied.

HARP2 contains an option to calculate the 8-hr chronic HI based on hour-by-hour model results for a specific 8-hr period (e.g., 8:00 AM to 4:00 PM to represent typical worker schedule). As this option requires long model times and can generate extremely large computer files, ARB guidance[13] suggests a screening calculation prior to performing this refined analysis. An extremely conservative screening calculation was made by multiplying the maximum chronic HI values by three. Multiplying by three provides the absolute worst-

[13] California Office of Environmental Health Hazard Assessment (OEHHA) 2015. Air Toxics Hot Spots Program Risk Assessment Guidelines. February 2015, p. 4-46.
California Air Resources Board, User Manual for the Hotspots Analysis and Reporting Program Air Dispersion Modeling and Risk Assessment Tool Version 2. March 17, 2015, p. 46.

case value, as this assumes that all exposure occurs in the same 8-hr period each day. This approach also assumes that the 8-hr chronic REL is equal to the chronic REL, which is not the case for most chemicals[14]. Using this conservative screening approach, neither the maximum residential, worker, nor sensitive receptor chronic HI multiplied by three exceeded one.

5.2.3 Acute HI

The acute HI calculations are based on maximum 1-hr average concentrations and the acute REL. Since no acute RELs exist for DPM, the acute calculations were based only on the stationary source modeling.

5.3 HARP2 ANALYSIS METHOD

The HARP2 analysis methods followed SCAQMD guidance[15] and are shown in Table 8 below. These options affect the way the cancer risk and chronic HI are calculated at each receptor.

Table 8
Analysis Methods Used in Risk Modeling

Risk	Method
Residential cancer risk	RMP Using the Derived Method
Worker cancer risk	OEHHA Derived Method
Residential chronic and 8-hr chronic risk	OEHHA Derived Method
Worker chronic and 8-hr chronic risk	OEHHA Derived Method
Acute risk	Default/NA

6.0 HEALTH RISK RESULTS

6.1 CANCER RISK

The predicted increase in health risks at maximally exposed offsite receptors are summarized by category in Table 10. As shown, the highest calculated cancer risks at residential, sensitive, and worker receptors are below 10 in one million.

The highest cancer risk at a residential receptor is a cancer risk value of 3.6 in one million. The receptor is located just west of the western boundary of the refinery nearest to the proposed new crude tanks – see Figure 5. Contours showing the aerial distribution of calculated cancer risks for worst-case residential exposure are shown on Figure 6. The highest calculated cancer risk at a sensitive receptor was 2.1 in one million, at Bethune Mary School located about 500 meters east of the eastern boundary of the Wilmington

[14] 8-hr chronic RELs are either equal to or greater than the chronic REL for the respective chemical. Notably, there are many chemicals for which an 8-hr chronic REL does not exist, including DPM.
[15] HARP2: South Coast Air Quality Management District, Supplemental Guidelines for Preparing Risk Assessment for the Air Toxics "Hot Spots" Information and Assessment Act, June 5, 2015, Table 11.

Operations area. Table 11 provides a list of the highest sensitive receptors in terms of cancer risk.

The receptor with the highest calculated worker exposure cancer risk was located near the railroad tracks at the northeastern boundary of the refinery – see Figure 5. The receptor is in the immediate vicinity of the location where a locomotive engine enters and exits the facility boundary when moving LPG railcars. The worst case worker cancer risk at this receptor is 9.2 in one million. This receptor is located along the fenceline[16] where long-term (multi-decade) 40 hour/week exposure is highly unlikely to occur. Contours showing the areal distribution of calculated cancer risks for worst-case worker exposure are shown on Figure 7.

Table 12 provides the contributions of DPM to the total cancer risks shown in Table 10. DPM is the primary source of cancer risk for the maximum offsite worker receptor, but only a small contributor to cancer risk for the maximum residential and sensitive receptors.

6.2 CHRONIC AND ACUTE RISK

The maximum chronic hazard index (worker or residential) of 0.127 was predicted at a receptor just east of the southern portion of the facility. The maximum 8-hr chronic hazard index (worker or residential) of 0.108 was predicted at a receptor just west of the Wilmington operations refinery interconnect system. The maximum increase in the acute hazard index value was predicted to be 0.052 at a fenceline receptor[17] along the Dominguez Channel. The maximum chronic HI and acute HI receptors are shown in Figure 5. All maximum chronic and acute HI receptors were in close proximity to or along facility boundaries with the exception of the maximum residential chronic HI receptor, which was approximately 3 km east of the southern portion of the facility. This was due primarily to the risk associated with the Wilmington Sulfuric Acid Decomposition Furnace stack (SA2_W) – a very tall stack (194 feet) with significant sulfuric acid emissions.

6.3 CANCER BURDEN

Rule 1401 Risk Assessment Procedures[18] require that cancer burden (increase in cancer cases in the population) be calculated whenever the maximum individual cancer risk (MICR) exceeds one in a million. Since both the maximum residential receptor and maximum worker receptor exceeded one in a million, a calculation was performed to determine if cancer burden could exceed 0.5. A conservative approach was used as a screening calculation. Using the default population density of 4,000 persons per square kilometer, the cumulative area (in square kilometers) of all residential areas within the one in a million isopleth line, and the highest calculated cancer risk between the residential and worker receptors, cancer burden is estimated as shown in Table 9 below:

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[16] Per discussions with AQMD staff, fenceline receptors in the vicinity of the rail-line could be included as worker receptors as a conservative measure.
[17] As a conservative assumption, all fenceline receptors were considered when determining the maximum acute HI.
[18] South Coast Air Quality Management District, Risk Assessment Procedures for Rules 1401, 1401.1 and 212, Version 8.0, June 5, 2015.

Table 9
Cancer Burden Calculation

Parameter	Value
Residential area within 1 in million cancer risk isopleth line (km2)	12.5
Population density (persons/km2)	4,000
Cancer risk	9.2E-06
Cancer burden (total cancer cases)	0.46

Since the cancer burden is less than 0.5, no further analysis is necessary.

Table 10
Summary of Maximum Project Offsite Cancer and Non-cancer Risks

Location[a]	Cancer Risk			Chronic Risk			8-Hr Chronic Risk			Acute Risk[d]		
	Increase Cases in-one-million	UTM Coordinates (NAD83)		Hazard Index	UTM Coordinates (NAD83)		Hazard Index	UTM Coordinates (NAD83)		Hazard Index	UTM Coordinates (NAD83)	
		Easting (m)	Northing (m)		Easting (m)	Northing (m)		Easting (m)	Northing (m)		Easting (m)	Northing (m)
Residential receptor [b]	3.6	383700	3741400	0.049	387500	3739600	0.006	383700	3741400	0.052	385305	3742454
Offsite workplace receptor	9.2	386006	3742921	0.127	386000	3739500	0.108	386153	3741128	0.052	385305	3742454
Sensitive Receptor [b]	2.1	386721	3739987	0.054	387304	3739447	0.005	386721	3739987	0.010	386721	3739987

[a] Excluding onsite grid receptors
[b] Worst-case residential exposure
[c] Maximum sensitive receptors:
Cancer Risk: Bethune Mary School
Chronic Risk: Long Beach Japanese School
8-Hr Chronic Risk: Bethune Mary School
Acute Risk: Bethune Mary School
[d] Fenceline receptors were conservatively included as potential residential and worker receptors for determination of maximum acute risk.

Figure 5
Location of Maximum Calculated Health Risks

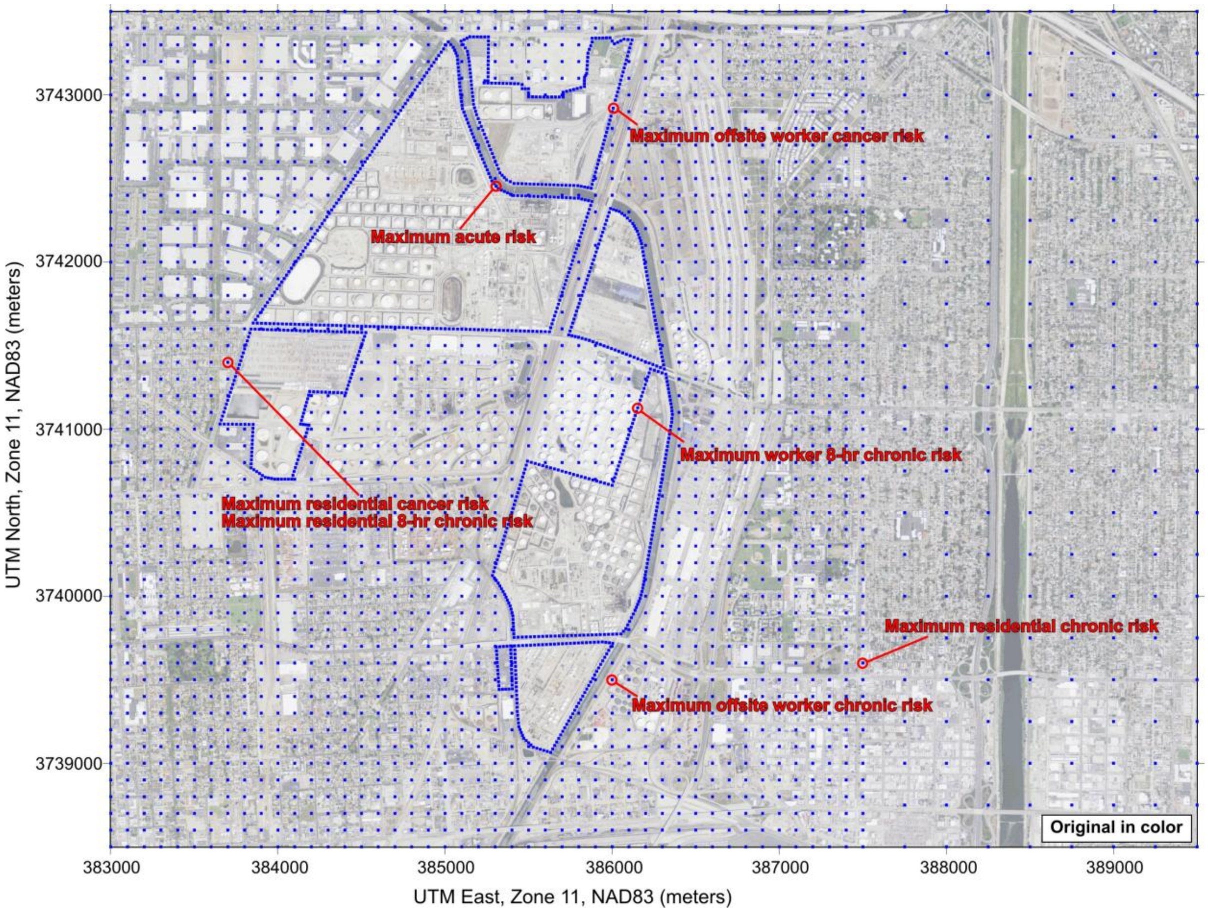
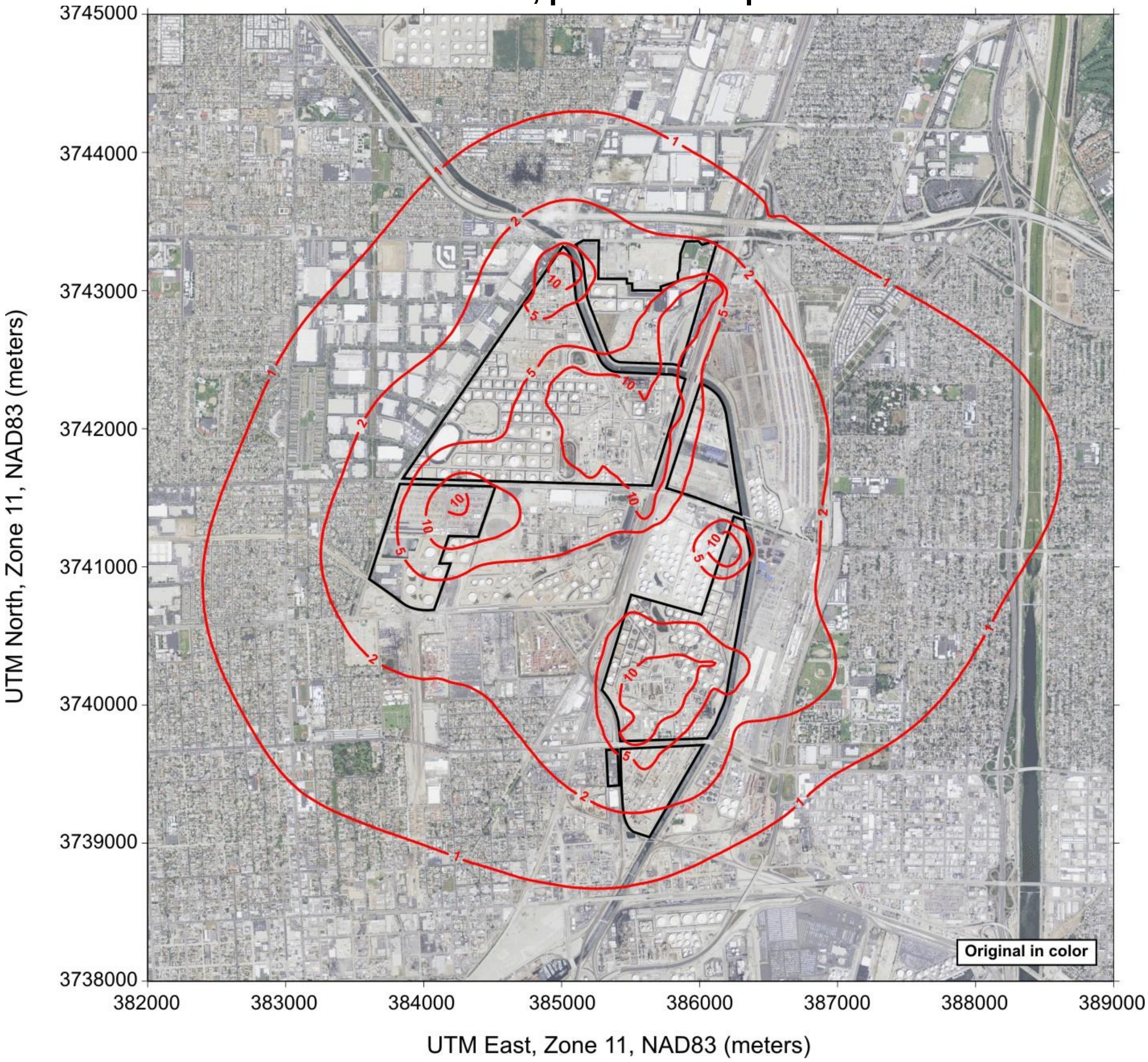
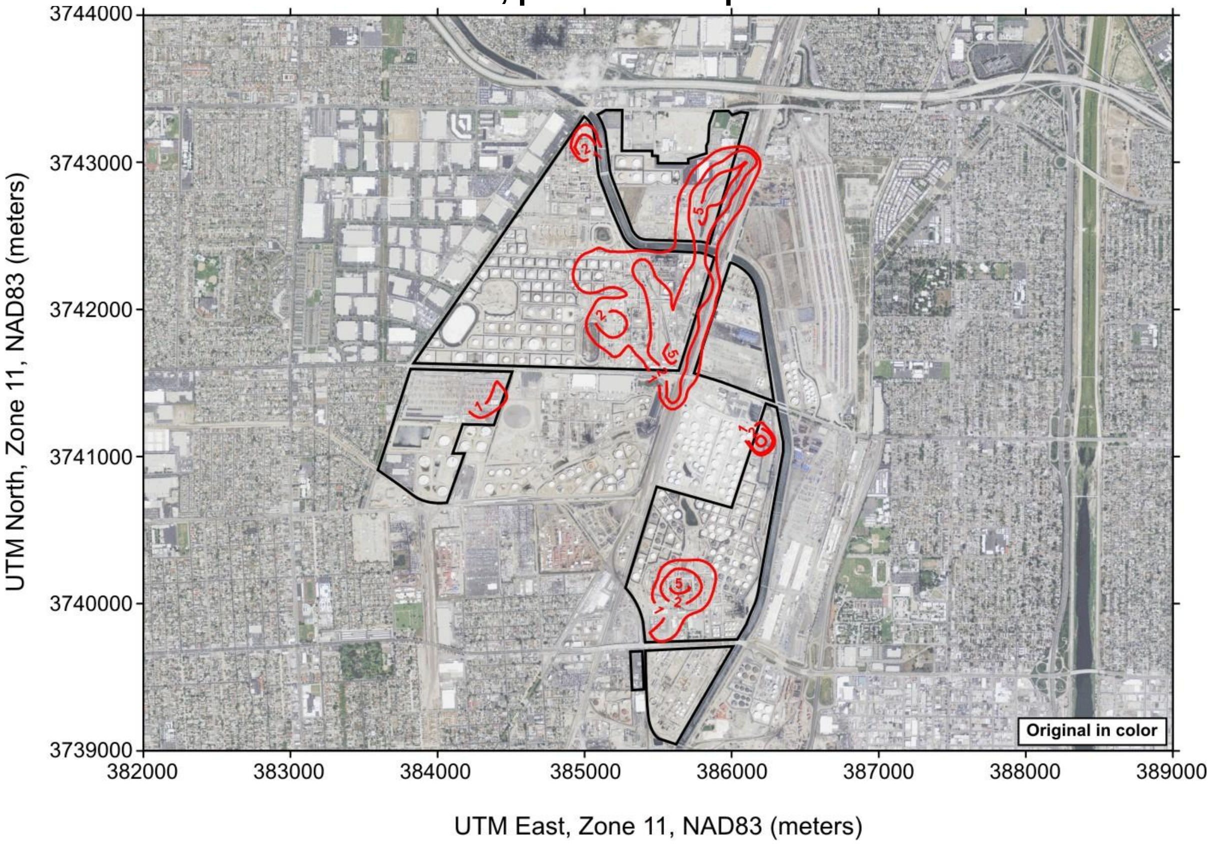


Figure 6
Contours of Residential Cancer Risk, per million exposed



Note: The contours shown above represent worst-case hypothetical residential exposure.

Figure 7
Contours of Worker Cancer Risk, per million exposed



Note: The contours shown above represent worst-case hypothetical worker exposure.

Table 11
Summary of Project Cancer Risks
at the Most Exposed Sensitive Receptors

Sensitive Receptor Name	UTM Coordinates (NAD83)		Increased Cancer Cases (in-one-million)
	Easting (m)	Northing (m)	
Bethune Mary School	386721	3739987	2.09
Will J. Reid High School	387037	3740324	1.91
Elizabeth Hudson Elementary School	387091	3740595	1.74
Broad Avenue Elementary School	383158	3740800	1.73
William Logan Stephens Junior High	387367	3741657	1.58
Long Beach Child Development	387287	3740345	1.55
Wilmington Christian School	383005	3740658	1.47
Phineas Banning Senior High School	383288	3740032	1.42
Banning High School	383286	3740026	1.41
St. Lucy’s School	387437	3740571	1.40
Wilmington Park Children’s Center	384655	3739221	1.38
Webster Elementary School	387380	3742512	1.38
Holy Family Grammar School	384401	3739366	1.37
Wilmington Park Elementary School	384618	3739222	1.36
Santa Fe Convalescent Hospital	387542	3742485	1.30
West Child Development Center	387474	3740168	1.29
John Muir Elementary School	387914	3742030	1.25
First Baptist Church	383243	3739694	1.20
Garfield Head Start Elementary School	387692	3740405	1.19
Avalon High School	383044	3739793	1.14
Banning-Marine Avenue Adult Center	382948	3739923	1.14
Cabrillo High School	387473	3739922	1.12
Wyo Tech National Institute of Tech	387041	3739640	1.10

Table 12
Contribution of Diesel Particulate Matter to Calculated Cancer Risks

Chemical	Contribution (Increase Cases in-one-million)		
	Residential Receptor	Offsite Workplace Receptor	Sensitive Receptor
DPM	0.11	9.05	0.08
Other TACs [a]	3.53	0.15	2.02
Total	3.64	9.19	2.09

[a] The TACs primarily responsible for cancer risk are chrysene, benzo(a)pyrene, benzene, and naphthalene.

Attachment D-4 contains the AERMOD input and output files. The attachment also has the HARP Risk module outputs with the calculated stationary source risks at each receptor, and the spreadsheet outputs of calculated mobile DPM risks and total (stationary plus mobile) risks for each receptor.

ATTACHMENT D-1 LOCOMOTIVE VOLUME SOURCE LOCATIONS

Source ID	UTM (X)	UTM (Y)
RRB_0001	386097.2	3743023.1
RRB_0002	386091.8	3743018.2
RRB_0003	386086.4	3743013.2
RRB_0004	386081.0	3743008.3
RRB_0005	386075.6	3743003.3
RRB_0006	386070.2	3742998.4
RRB_0007	386064.8	3742993.4
RRB_0008	386059.5	3742988.5
RRB_0009	386054.1	3742983.5
RRB_0010	386048.7	3742978.6
RRB_0011	386043.3	3742973.6
RRB_0012	386037.9	3742968.7
RRB_0013	386032.5	3742963.7
RRB_0014	386027.1	3742958.8
RRB_0015	386021.7	3742953.9
RRB_0016	386016.3	3742948.9
RRB_0017	386010.9	3742944.0
RRB_0018	386005.5	3742939.0
RRB_0019	386000.2	3742934.1
RRB_0020	385994.8	3742929.1
RRB_0021	385989.4	3742924.2
RRB_0022	385984.0	3742919.3
RRB_0023	385978.6	3742914.3
RRB_0024	385973.2	3742909.4
RRB_0025	385967.8	3742904.4
RRB_0026	385962.6	3742899.3
RRB_0027	385958.4	3742893.3
RRB_0028	385954.2	3742887.4
RRB_0029	385949.9	3742881.4
RRB_0030	385945.7	3742875.4
RRB_0031	385941.5	3742869.5
RRB_0032	385937.2	3742863.5
RRB_0033	385933.0	3742857.5
RRB_0034	385928.8	3742851.6
RRB_0035	385924.8	3742845.4
RRB_0036	385921.2	3742839.0
RRB_0037	385917.7	3742832.6
RRB_0038	385914.2	3742826.2
RRB_0039	385910.6	3742819.8
RRB_0040	385907.1	3742813.4
RRB_0041	385903.6	3742807.0
RRB_0042	385900.0	3742800.6
RRB_0043	385896.5	3742794.2
RRB_0044	385893.0	3742787.8
RRB_0045	385889.4	3742781.4
RRB_0046	385886.4	3742774.8
RRB_0047	385883.3	3742768.1
RRB_0049	385877.2	3742754.8
RRB_0050	385874.2	3742748.1
RRB_0051	385871.2	3742741.5
RRB_0052	385868.1	3742734.8
RRB_0053	385865.1	3742728.2
RRB_0054	385862.1	3742721.5
RRB_0055	385859.0	3742714.9
RRB_0056	385856.2	3742708.1
RRB_0057	385853.7	3742701.3
RRB_0058	385851.2	3742694.4
RRB_0059	385848.6	3742687.5
RRB_0060	385846.1	3742680.6
RRB_0061	385843.6	3742673.8
RRB_0062	385841.1	3742666.9
RRB_0063	385838.6	3742660.0
RRB_0064	385836.1	3742653.2
RRB_0065	385833.6	3742646.3
RRB_0066	385831.1	3742639.4
RRB_0067	385828.6	3742632.6
RRB_0068	385826.0	3742625.7
RRB_0069	385823.5	3742618.8
RRB_0070	385821.0	3742611.9
RRB_0071	385818.5	3742605.1
RRB_0072	385957.8	3742896.2
RRB_0073	385952.3	3742891.4
RRB_0074	385946.8	3742886.6
RRB_0075	385941.3	3742881.7
RRB_0076	385935.9	3742876.9
RRB_0077	385930.4	3742872.1
RRB_0078	385924.9	3742867.2
RRB_0079	385919.4	3742862.4
RRB_0080	385913.9	3742857.6
RRB_0081	385908.4	3742852.7
RRB_0082	385902.9	3742847.9
RRB_0083	385897.5	3742843.0
RRB_0084	385892.5	3742837.6
RRB_0085	385887.6	3742832.3
RRB_0086	385882.6	3742826.9
RRB_0087	385877.6	3742821.5
RRB_0088	385872.7	3742816.1
RRB_0089	385868.3	3742810.3
RRB_0090	385864.0	3742804.4
RRB_0091	385859.6	3742798.5
RRB_0092	385855.3	3742792.6
RRB_0093	385850.9	3742786.7
RRB_0094	385847.1	3742780.5
RRB_0095	385843.3	3742774.3

ATTACHMENT D-1 LOCOMOTIVE VOLUME SOURCE LOCATIONS

Source ID	UTM (X)	UTM (Y)	Source ID	UTM (X)	UTM (Y)
RRB_0048	385880.3	3742761.4	RRB_0096	385839.4	3742768.0
RRB_0097	385835.6	3742761.8	RRG_0047	385764.7	3742475.4
RRB_0098	385831.8	3742755.5	RRG_0048	385764.6	3742468.1
RRG_0001	385746.3	3742060.3	RRG_0049	385764.5	3742460.7
RRG_0002	385749.3	3742066.9	RRG_0050	385764.4	3742453.4
RRG_0003	385752.3	3742073.6	RRG_0051	385764.3	3742446.1
RRG_0004	385755.4	3742080.2	RRG_0052	385764.2	3742438.8
RRG_0005	385758.4	3742086.9	RRG_0053	385764.1	3742431.5
RRG_0006	385761.4	3742093.6	RRG_0054	385764.0	3742424.2
RRG_0007	385764.5	3742100.2	RRG_0055	385764.0	3742416.9
RRG_0008	385767.5	3742106.9	RRG_0056	385763.9	3742409.5
RRG_0009	385770.5	3742113.5	RRG_0057	385763.8	3742402.2
RRG_0010	385773.6	3742120.2	RRG_0058	385763.7	3742394.9
RRG_0011	385776.6	3742126.8	RRG_0059	385763.6	3742387.6
RRG_0012	385779.6	3742133.5	RRG_0060	385763.5	3742380.3
RRG_0013	385782.7	3742140.2	RRG_0061	385763.4	3742373.0
RRG_0014	385785.7	3742146.8	RRG_0062	385763.3	3742365.7
RRG_0015	385788.7	3742153.5	RRG_0063	385763.2	3742358.3
RRG_0016	385791.8	3742160.1	RRG_0064	385762.9	3742351.0
RRG_0017	385794.8	3742166.8	RRG_0065	385762.6	3742343.7
RRG_0018	385797.8	3742173.4	RRG_0066	385762.2	3742336.4
RRG_0019	385800.9	3742180.1	RRG_0067	385761.9	3742329.1
RRG_0020	385803.9	3742186.8	RRG_0068	385761.6	3742321.8
RRG_0021	385805.8	3742190.8	RRG_0069	385761.3	3742314.5
RRG_0022	385786.9	3742656.6	RRG_0070	385760.8	3742307.2
RRG_0023	385785.0	3742649.5	RRG_0071	385759.9	3742299.9
RRG_0024	385783.1	3742642.5	RRG_0072	385759.1	3742292.7
RRG_0025	385781.3	3742635.4	RRG_0073	385758.2	3742285.4
RRG_0026	385779.9	3742628.2	RRG_0074	385757.4	3742278.1
RRG_0027	385779.2	3742620.9	RRG_0075	385756.7	3742270.8
RRG_0028	385778.4	3742613.7	RRG_0076	385755.9	3742263.6
RRG_0029	385777.7	3742606.4	RRG_0077	385755.2	3742256.3
RRG_0030	385777.0	3742599.1	RRG_0078	385754.4	3742249.0
RRG_0031	385776.2	3742591.8	RRG_0079	385753.7	3742241.7
RRG_0032	385775.5	3742584.6	RRG_0080	385753.6	3742234.4
RRG_0033	385774.8	3742577.3	RRG_0081	385753.5	3742227.1
RRG_0034	385774.0	3742570.0	RRG_0082	385753.5	3742219.8
RRG_0035	385773.3	3742562.7	RRG_0083	385753.4	3742212.5
RRG_0036	385772.6	3742555.4	RRG_0084	385753.4	3742205.2
RRG_0037	385771.8	3742548.2	RRG_0085	385753.4	3742197.9
RRG_0038	385771.1	3742540.9	RRG_0086	385753.3	3742190.5
RRG_0039	385770.4	3742533.6	RRG_0087	385753.3	3742183.2
RRG_0040	385769.6	3742526.3	RRG_0088	385753.2	3742175.9
RRG_0041	385768.9	3742519.1	RRG_0089	385753.2	3742168.6
RRG_0042	385768.1	3742511.8	RRG_0090	385753.1	3742161.3
RRG_0043	385767.4	3742504.5	RRG_0091	385753.1	3742154.0
RRG_0044	385766.7	3742497.2	RRG_0092	385753.1	3742146.7

ATTACHMENT D-1 LOCOMOTIVE VOLUME SOURCE LOCATIONS

Source ID	UTM (X)	UTM (Y)
RRG_0045	385765.9	3742489.9
RRG_0046	385765.2	3742482.7
RRG_0095	385752.9	3742124.7
RRG_0096	385752.9	3742117.4
RRG_0097	385751.8	3742110.2
RRG_0098	385750.7	3742102.9
RRG_0099	385749.5	3742095.7
RRG_0100	385748.4	3742088.5
RRG_0101	385747.2	3742081.3
RRG_0102	385746.1	3742074.0
RRG_0103	385744.9	3742066.8
RRG_0104	385743.8	3742059.6
RRG_0105	385742.1	3742052.5
RRG_0106	385739.9	3742045.5
RRG_0107	385737.8	3742038.5
RRG_0108	385735.7	3742031.5
RRG_0109	385733.5	3742024.5
RRG_0110	385731.4	3742017.5
RRG_0111	385729.3	3742010.5
RRG_0112	385727.1	3742003.5
RRG_0113	385725.0	3741996.5
RRG_0114	385722.9	3741989.5
RRG_0115	385720.7	3741982.5
RRG_0116	385718.6	3741975.5
RRG_0117	385716.5	3741968.5
RRG_0118	385714.4	3741961.5
RRG_0119	385712.2	3741954.5
RRG_0120	385710.1	3741947.5
RRG_0121	385708.0	3741940.5
RRG_0122	385705.8	3741933.5
RRG_0123	385703.7	3741926.5
RRG_0124	385701.6	3741919.5
RRG_0125	385699.4	3741912.5
RRG_0126	385697.3	3741905.5
RRG_0127	385695.2	3741898.5
RRG_0128	385693.0	3741891.6
RRG_0129	385690.9	3741884.6
RRG_0130	385688.8	3741877.6
RRG_0131	385686.6	3741870.6
RRG_0132	385684.5	3741863.6
RRG_0133	385682.4	3741856.6
RRG_0134	385680.2	3741849.6
RRG_0135	385678.1	3741842.6
RRG_0136	385676.0	3741835.6
RRG_0137	385673.8	3741828.6
RRG_0138	385671.7	3741821.6
RRG_0139	385669.6	3741814.6

Source ID	UTM (X)	UTM (Y)
RRG_0093	385753.0	3742139.3
RRG_0094	385753.0	3742132.0
RRG_0143	385661.0	3741786.6
RRG_0144	385658.9	3741779.6
RRG_0145	385656.8	3741772.6
RRG_0146	385654.6	3741765.6
RRG_0147	385652.5	3741758.6
RRG_0148	385650.4	3741751.6
RRG_0149	385648.2	3741744.6
RRG_0150	385646.1	3741737.6
RRG_0151	385644.0	3741730.6
RRG_0152	385641.8	3741723.6
RRG_0153	385639.7	3741716.6
RRG_0154	385637.6	3741709.6
RRG_0155	385635.4	3741702.6
RRG_0156	385633.3	3741695.6
RRG_0157	385631.2	3741688.6
RRG_0158	385629.1	3741681.6
RRG_0159	385626.9	3741674.6
RRG_0160	385624.9	3741667.6
RRG_0161	385624.0	3741660.3
RRG_0162	385623.1	3741653.1
RRG_0163	385623.8	3741645.9
RRG_0164	385625.5	3741638.8
RRG_0165	385627.2	3741631.7
RRG_0166	385628.9	3741624.6
RRG_0167	385630.5	3741617.4
RRG_0168	385632.2	3741610.3
RRG_0169	385633.9	3741603.2
RRG_0170	385635.6	3741596.1
RRG_0171	385637.2	3741589.0
RRG_0172	385638.9	3741581.8
RRG_0173	385640.6	3741574.7
RRG_0174	385642.3	3741567.6
RRG_0175	385642.9	3741560.3
RRG_0176	385643.2	3741553.0
RRG_0177	385643.0	3741545.8
RRG_0178	385640.8	3741538.8
RRG_0179	385638.5	3741531.9
RRG_0180	385636.3	3741524.9
RRG_0181	385634.0	3741517.9
RRG_0182	385631.8	3741511.0
RRG_0183	385629.5	3741504.0
RRG_0184	385627.3	3741497.1
RRG_0185	385625.0	3741490.1
RRG_0186	385622.8	3741483.1
RRG_0187	385620.5	3741476.2

ATTACHMENT D-1 LOCOMOTIVE VOLUME SOURCE LOCATIONS

Source ID	UTM (X)	UTM (Y)	Source ID	UTM (X)	UTM (Y)
RRG_0140	385667.4	3741807.6	RRG_0188	385618.3	3741469.2
RRG_0141	385665.3	3741800.6	RRG_0189	385616.1	3741462.2
RRG_0142	385663.2	3741793.6	RRG_0190	385613.8	3741455.3
RRG_0191	385611.6	3741448.3	RRG_0239	385554.1	3741863.5
RRG_0192	385609.3	3741441.4	RRG_0240	385552.6	3741870.7
RRG_0193	385607.1	3741434.4	RRG_0241	385551.2	3741877.9
RRG_0194	385604.8	3741427.4	RRG_0242	385549.7	3741885.0
RRG_0195	385602.6	3741420.5	RRG_0243	385548.2	3741892.2
RRG_0196	385600.3	3741413.5	RRG_0244	385546.7	3741899.4
RRG_0197	385598.1	3741406.6	RRG_0245	385545.3	3741906.5
RRG_0198	385595.8	3741399.6	RRG_0246	385543.8	3741913.7
RRG_0199	385593.6	3741392.6	RRG_0247	385542.3	3741920.8
RRG_0200	385591.3	3741385.7	RRG_0248	385540.8	3741928.0
RRG_0201	385632.4	3741598.9	RRG_0249	385539.4	3741935.2
RRG_0202	385629.1	3741605.5	RRG_0250	385537.9	3741942.3
RRG_0203	385625.9	3741612.0	RRG_0251	385536.4	3741949.5
RRG_0204	385622.6	3741618.6	RRG_0252	385534.9	3741956.7
RRG_0205	385619.4	3741625.1	RRG_0253	385533.5	3741963.8
RRG_0206	385616.1	3741631.7	RRG_0254	385532.0	3741971.0
RRG_0207	385612.9	3741638.2	RRG_0255	385530.5	3741978.2
RRG_0208	385609.6	3741644.8	RRG_0256	385529.0	3741985.3
RRG_0209	385606.4	3741651.3	RRG_0257	385527.6	3741992.5
RRG_0210	385603.1	3741657.9	RRG_0258	385526.1	3741999.7
RRG_0211	385599.9	3741664.4	RRG_0259	385524.6	3742006.8
RRG_0212	385596.6	3741671.0	RRG_0260	385523.1	3742014.0
RRG_0213	385593.4	3741677.6	RRG_0261	385521.7	3742021.2
RRG_0214	385591.0	3741684.4	RRG_0262	385520.2	3742028.3
RRG_0215	385589.5	3741691.6	RRG_0263	385518.4	3742035.4
RRG_0216	385588.1	3741698.7	RRG_0264	385516.1	3742042.3
RRG_0217	385586.6	3741705.9	RRG_0265	385513.8	3742049.3
RRG_0218	385585.1	3741713.1	RRG_0266	385511.2	3742056.1
RRG_0219	385583.6	3741720.2	RRG_0267	385507.6	3742062.4
RRG_0220	385582.1	3741727.4	RRG_0268	385503.9	3742068.8
RRG_0221	385580.7	3741734.6	RRG_0269	385500.2	3742075.1
RRG_0222	385579.2	3741741.7	RRG_0270	385496.5	3742081.4
RRG_0223	385577.7	3741748.9	RRG_0271	385492.8	3742087.7
RRG_0224	385576.2	3741756.1	RRG_0272	385489.1	3742094.0
RRG_0225	385574.8	3741763.2	RRG_0273	385485.4	3742100.3
RRG_0226	385573.3	3741770.4	RRG_0274	385481.8	3742106.7
RRG_0227	385571.8	3741777.5	RRG_0275	385478.1	3742113.0
RRG_0228	385570.3	3741784.7	RRG_0276	385474.4	3742119.3
RRG_0229	385568.9	3741791.9	RRG_0277	385470.7	3742125.6
RRG_0230	385567.4	3741799.0	RRG_0278	385467.0	3742131.9
RRG_0231	385565.9	3741806.2	RRG_0279	385463.9	3742138.6
RRG_0232	385564.4	3741813.4	RRG_0280	385461.0	3742145.3
RRG_0233	385563.0	3741820.5	RRG_0281	385458.1	3742152.0
RRG_0234	385561.5	3741827.7	RRG_0282	385455.2	3742158.7

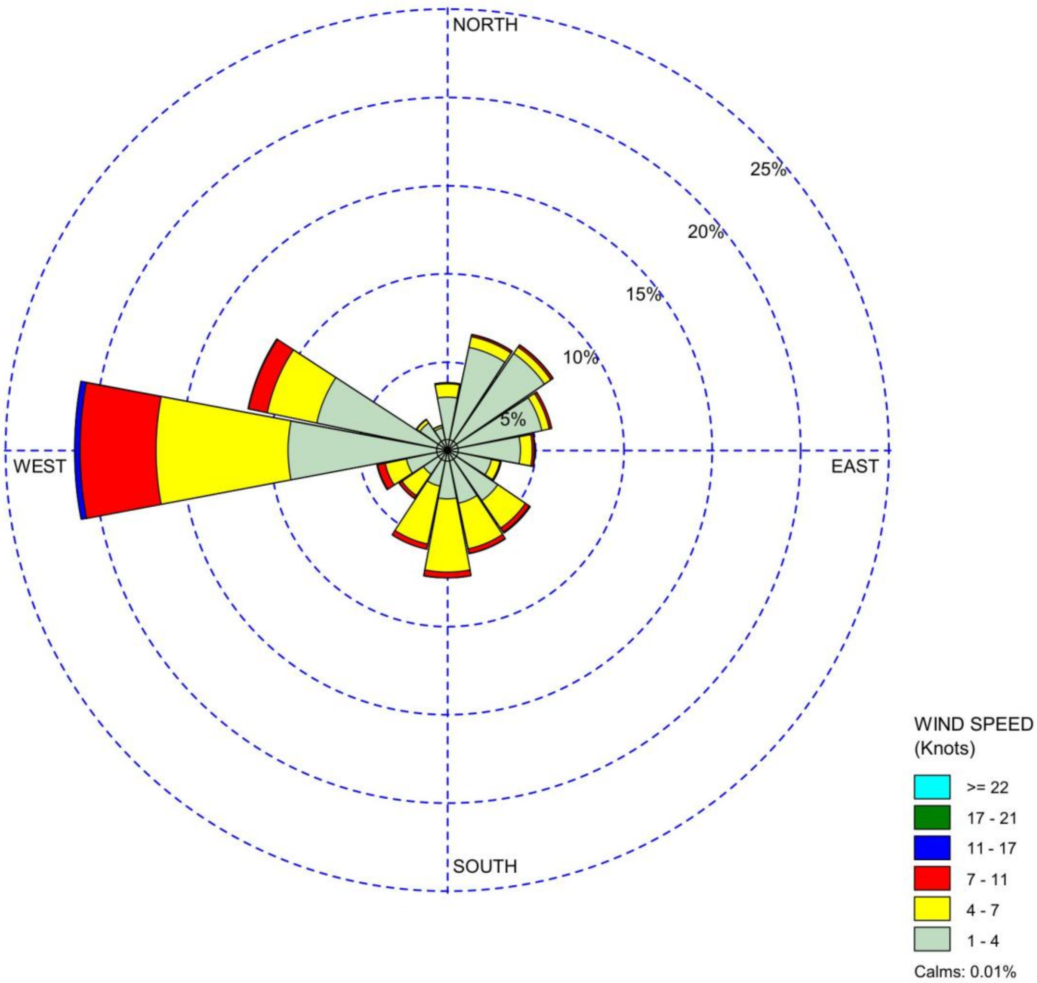
ATTACHMENT D-1 LOCOMOTIVE VOLUME SOURCE LOCATIONS

Source ID	UTM (X)	UTM (Y)
RRG_0235	385560.0	3741834.9
RRG_0236	385558.5	3741842.0
RRG_0237	385557.1	3741849.2
RRG_0238	385555.6	3741856.4
RRG_0287	385440.7	3742192.3
RRG_0288	385437.8	3742199.0
RRG_0289	385434.9	3742205.7
RRG_0290	385432.0	3742212.4
RRG_0291	385429.1	3742219.2
RRG_0292	385426.3	3742225.9
RRG_0293	385423.4	3742232.6
RRG_0294	385420.5	3742239.3
RRG_0295	385417.6	3742246.0
RRG_0296	385414.7	3742252.8
RRG_0297	385411.8	3742259.5
RRG_0298	385408.9	3742266.2
RRG_0299	385406.0	3742272.9
RRG_0300	385403.1	3742279.6
RRG_0301	385400.2	3742286.3
RRG_0302	385397.3	3742293.1
RRG_0303	385394.4	3742299.8

Source ID	UTM (X)	UTM (Y)
RRG_0283	385452.3	3742165.4
RRG_0284	385449.4	3742172.1
RRG_0285	385446.5	3742178.9
RRG_0286	385443.6	3742185.6

ATTACHMENT D-2 WINDROSE

WIND ROSE PLOT: Long Beach, CA	DISPLAY: Wind Speed Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Met years: 2006, 2007, 2008, 2009, 2011	**Start Date: 1/1/2006 - 00:00** **End Date: 12/31/2011 - 23:00**		
		MODELER:	
	CALM WINDS: **0.01%**	TOTAL COUNT: **43378 hrs.**	
	AVG. WIND SPEED: **3.66 Knots**	DATE: **5/19/2014**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

ATTACHMENT D-3 LIST OF ONSITE RECEPTORS

UTM (X)	UTM (Y)	Elev. (m)	UTM (X)	UTM (Y)	Elev. (m)	UTM (X)	UTM (Y)	Elev. (m)
385600	3739100	3.8	385600	3740100	3.8	386100	3740600	13.0
385500	3739200	3.6	385700	3740100	4.2	386200	3740600	14.4
385600	3739200	3.8	385800	3740100	4.9	385500	3740700	10.7
385700	3739200	3.0	385900	3740100	5.3	385600	3740700	9.0
385500	3739300	3.5	386000	3740100	6.7	385700	3740700	8.5
385600	3739300	3.2	386100	3740100	6.7	385800	3740700	9.0
385700	3739300	3.5	385400	3740200	10.2	386100	3740700	11.0
385500	3739400	3.7	385500	3740200	4.3	386200	3740700	13.5
385600	3739400	3.5	385600	3740200	4.6	383900	3740800	13.0
385700	3739400	3.5	385700	3740200	6.0	384000	3740800	13.0
385800	3739400	3.2	385800	3740200	6.6	384100	3740800	13.0
385500	3739500	7.5	385900	3740200	6.7	385500	3740800	11.5
385600	3739500	5.1	386000	3740200	7.9	386100	3740800	9.5
385700	3739500	3.6	386100	3740200	9.3	386200	3740800	11.8
385800	3739500	3.3	386200	3740200	5.6	386300	3740800	10.7
385500	3739600	8.7	385400	3740300	10.9	383900	3740900	13.0
385600	3739600	7.7	385500	3740300	9.9	384000	3740900	13.0
385700	3739600	3.5	385600	3740300	8.6	384100	3740900	13.0
385800	3739600	3.5	385700	3740300	6.6	386100	3740900	9.4
385900	3739600	3.3	385800	3740300	7.2	386200	3740900	11.4
385500	3739700	9.9	385900	3740300	7.3	386300	3740900	12.8
385600	3739700	8.4	386000	3740300	8.8	383900	3741000	13.0
385700	3739700	8.5	386100	3740300	11.1	384000	3741000	12.8
385800	3739700	6.9	386200	3740300	9.0	384100	3741000	13.0
385900	3739700	4.6	385400	3740400	11.8	386200	3741000	8.9
385500	3739800	10.8	385500	3740400	10.3	386300	3741000	11.3
385600	3739800	10.2	385600	3740400	9.0	383700	3741100	13.7
385700	3739800	10.2	385700	3740400	6.9	383800	3741100	13.0
385800	3739800	9.9	385800	3740400	8.1	383900	3741100	13.0
385900	3739800	8.0	385900	3740400	8.6	384000	3741100	12.9
386000	3739800	7.6	386000	3740400	10.3	384100	3741100	12.7
385500	3739900	11.4	386100	3740400	11.9	386200	3741100	9.8
385600	3739900	10.8	386200	3740400	14.2	386300	3741100	13.0
385700	3739900	11.0	385400	3740500	12.3	383800	3741200	13.1
385800	3739900	9.3	385500	3740500	10.8	383900	3741200	12.5
385900	3739900	6.8	385600	3740500	9.4	384000	3741200	12.3
386000	3739900	7.2	385700	3740500	7.1	384100	3741200	12.7
386100	3739900	5.4	385800	3740500	8.4	386200	3741200	10.5
385400	3740000	11.7	385900	3740500	9.3	386300	3741200	13.7
385500	3740000	10.9	386000	3740500	11.2	383800	3741300	12.2
385600	3740000	9.7	386100	3740500	13.3	383900	3741300	11.9
385700	3740000	3.3	386200	3740500	14.3	384000	3741300	12.3
385800	3740000	4.7	385500	3740600	10.8	384100	3741300	12.3
385900	3740000	6.0	385600	3740600	9.0	384200	3741300	12.4
386000	3740000	6.2	385700	3740600	8.1	384300	3741300	12.1
386100	3740000	5.6	385800	3740600	8.7	384400	3741300	11.5
385400	3740100	11.5	385900	3740600	9.7	386300	3741300	13.1
385500	3740100	9.0	386000	3740600	11.0	383800	3741400	11.7

ATTACHMENT D-3 LIST OF ONSITE RECEPTORS

UTM (X)	UTM (Y)	Elev. (m)	UTM (X)	UTM (Y)	Elev. (m)	UTM (X)	UTM (Y)	Elev. (m)
383900	3741400	11.8	386200	3741700	5.3	384700	3742000	10.8
384000	3741400	12.4	384000	3741800	11.2	384800	3742000	8.4
384100	3741400	12.4	384100	3741800	11.7	384900	3742000	7.2
384200	3741400	12.3	384200	3741800	12.1	385000	3742000	6.9
384300	3741400	12.1	384300	3741800	11.5	385100	3742000	8.7
384400	3741400	11.3	384400	3741800	10.9	385200	3742000	9.1
386300	3741400	5.7	384500	3741800	11.1	385300	3742000	9.0
383900	3741500	11.7	384600	3741800	11.1	385400	3742000	9.0
384000	3741500	11.8	384700	3741800	9.9	385500	3742000	8.7
384100	3741500	12.1	384800	3741800	10.2	385600	3742000	6.0
384200	3741500	12.3	384900	3741800	8.4	385700	3742000	6.6
384300	3741500	12.1	385000	3741800	8.7	385900	3742000	6.6
384400	3741500	11.2	385100	3741800	9.7	386000	3742000	6.6
386000	3741500	6.0	385200	3741800	9.9	386100	3742000	6.9
386100	3741500	5.4	385300	3741800	9.5	384200	3742100	11.6
386200	3741500	8.2	385400	3741800	9.0	384300	3742100	11.2
385100	3741600	9.6	385500	3741800	8.4	384400	3742100	10.6
385200	3741600	9.5	385600	3741800	6.9	384500	3742100	11.1
385300	3741600	8.7	385900	3741800	6.5	384600	3742100	10.8
385400	3741600	8.7	386000	3741800	6.3	384700	3742100	10.8
385500	3741600	9.0	386100	3741800	6.0	384800	3742100	8.1
385600	3741600	9.0	386200	3741800	6.3	384900	3742100	8.2
385800	3741600	6.6	384100	3741900	11.6	385000	3742100	7.2
385900	3741600	6.3	384200	3741900	11.8	385100	3742100	7.2
386000	3741600	6.0	384300	3741900	11.5	385200	3742100	6.8
386100	3741600	5.7	384400	3741900	10.7	385300	3742100	6.7
386200	3741600	5.3	384500	3741900	11.1	385400	3742100	6.5
384000	3741700	11.4	384600	3741900	11.1	385500	3742100	6.7
384100	3741700	11.7	384700	3741900	10.8	385600	3742100	6.9
384200	3741700	11.8	384800	3741900	8.6	385700	3742100	6.9
384300	3741700	11.5	384900	3741900	7.9	386000	3742100	6.6
384400	3741700	11.0	385000	3741900	7.2	386100	3742100	6.9
384500	3741700	11.4	385100	3741900	9.6	384300	3742200	10.9
384600	3741700	11.6	385200	3741900	9.6	384400	3742200	10.6
384700	3741700	11.4	385300	3741900	9.3	384500	3742200	10.8
384800	3741700	9.6	385400	3741900	9.0	384600	3742200	10.5
384900	3741700	10.1	385500	3741900	8.7	384700	3742200	10.8
385000	3741700	10.2	385600	3741900	6.6	384800	3742200	8.9
385100	3741700	10.0	385700	3741900	6.9	384900	3742200	8.1
385200	3741700	9.9	385900	3741900	6.6	385000	3742200	7.8
385300	3741700	9.6	386000	3741900	6.3	385100	3742200	7.5
385400	3741700	9.0	386100	3741900	6.3	385200	3742200	6.9
385500	3741700	8.7	386200	3741900	6.6	385300	3742200	6.2
385600	3741700	7.3	384200	3742000	11.8	385400	3742200	5.7
385800	3741700	6.6	384300	3742000	11.2	385500	3742200	6.2
385900	3741700	6.3	384400	3742000	10.6	385600	3742200	7.3
386000	3741700	6.0	384500	3742000	10.8	385700	3742200	7.1
386100	3741700	5.7	384600	3742000	10.8	385800	3742200	6.9

ATTACHMENT D-3 LIST OF ONSITE RECEPTORS

UTM (X)	UTM (Y)	Elev. (m)
386000	3742200	6.9
386100	3742200	6.9
384400	3742300	10.3
384500	3742300	10.8
384600	3742300	10.6
384700	3742300	10.6
384800	3742300	8.4
384900	3742300	8.6
385000	3742300	8.1
385100	3742300	7.5
385200	3742300	7.6
385300	3742300	6.6
385400	3742300	6.6
385500	3742300	7.2
385600	3742300	7.2
385700	3742300	7.0
385800	3742300	7.2
386000	3742300	6.7
384400	3742400	10.3
384500	3742400	10.5
384600	3742400	10.5
384700	3742400	9.9
384800	3742400	8.5
384900	3742400	9.3
385000	3742400	8.4
385100	3742400	8.4
385200	3742400	9.9
385300	3742400	8.2
384500	3742500	10.5
384600	3742500	9.9
384700	3742500	9.8
384800	3742500	9.0
384900	3742500	9.3
385000	3742500	9.0
385100	3742500	9.0
385200	3742500	8.7
385400	3742500	7.2
385500	3742500	7.2
385600	3742500	7.2
385700	3742500	7.0
385800	3742500	7.1
384600	3742600	9.8
384700	3742600	9.6
384800	3742600	9.6
384900	3742600	9.6
385000	3742600	9.3
385100	3742600	10.0
385200	3742600	8.7
385400	3742600	7.5
385500	3742600	7.2
385600	3742600	7.5
385700	3742600	7.1
385800	3742600	6.9
385900	3742600	6.9
384600	3742700	9.9
384700	3742700	10.2
384800	3742700	9.6
384900	3742700	9.9
385000	3742700	9.6
385100	3742700	10.2
385300	3742700	8.1
385400	3742700	7.8
385500	3742700	7.4
385600	3742700	7.2
385700	3742700	6.9
385800	3742700	6.9
385900	3742700	7.2
384700	3742800	9.3
384800	3742800	8.4
384900	3742800	9.4
385000	3742800	9.9
385100	3742800	9.9
385300	3742800	8.1
385400	3742800	7.8
385500	3742800	7.6
385600	3742800	7.2
385700	3742800	7.1
385800	3742800	7.0
385900	3742800	7.5
384800	3742900	7.4
384900	3742900	9.0
385000	3742900	9.3
385100	3742900	8.0
385200	3742900	8.4
385300	3742900	8.1
385400	3742900	7.6
385500	3742900	7.2
385600	3742900	7.2
385700	3742900	6.9
385800	3742900	6.9
385900	3742900	7.5
384900	3743000	8.4
385000	3743000	8.7
385200	3743000	8.1
385300	3743000	7.8
385400	3743000	7.5
385800	3743000	6.9
385900	3743000	7.2
386000	3743000	8.0
384900	3743100	7.2
385000	3743100	8.4
385200	3743100	7.8
385900	3743100	7.2
386000	3743100	7.8
385000	3743200	8.4
385200	3743200	7.5
385900	3743200	7.4
386000	3743200	7.8
385200	3743300	6.9
385900	3743300	7.2
386000	3743300	7.5
386100	3743300	8.1

ATTACHMENT D-4 AIR DISPERSION MODELING FILES

The AERMOD and HARP2 input and output files are available upon request from the SCAQMD.