APPENDIX H4

Health Risk Assessment Documentation

H4

HEALTH RISK ASSESSMENT DOCUMENTATION

1.0 INTRODUCTION

This document describes the methods and results of a health risk assessment (HRA) that evaluates potential public health effects from toxic air contaminant (TAC) emissions that would be generated by the operation of the Pacific L.A. Marine Terminal (PLAMT) Crude Oil Terminal project (the proposed Project). The methods and assumptions described also apply to the HRA for the Reduced Project and the No Federal Action/No Project Alternatives unless noted otherwise.

TACs are compounds that are known or suspected to cause adverse health effects after short-term (acute) and/or long-term (chronic) exposure. The California Air Resources Board (CARB) designates the following pollutants from the proposed Project as TACs:

- Diesel particulate matter (DPM) and other TACs from the internal combustion of fuel oils (e.g., heavy fuel oil or distillate fuels such as diesel) for propulsion and auxiliary power of ocean going vessels (OGV) and harbor craft (e.g., tugs, barges);

- Various TACs from the external combustion of fuel oils (e.g., heavy fuel oil or distillate fuels such as diesel) in boilers for the production of steam onboard OGVs;

- Various TACs in fugitive crude oil emissions released from crude oil storage tanks;

- Various TACs from the combustion of natural gas and crude oil vapors in vapor destruction units (VDUs); and

- DPM and various TACs from the internal combustion of diesel fuel in various on-road and off-road vehicles.

Most of the particulate matter emissions associated with operation of the proposed Project emission sources would result from the combustion of fuel oils. For this analysis, all particulate matter emissions from internal combustion engines were conservatively considered to be DPM. The CARB designates DPM as a TAC and considers DPM as the surrogate for the total chronic non-carcinogenic and carcinogenic health effects from the combustion of diesel fuel. An analysis performed by the South Coast Air Quality Management District (SCAQMD) determined that DPM causes the majority of the cancer risk from the inhalation of air contaminants in the Port of

Los Angeles (the Port or Los Angeles Harbor Department [LAHD]) region (SCAQMD 2000). Another recent study released by CARB indicates that, together, the San Pedro Bay Ports are one of the major contributors to the release of DPM emissions and a primary cause of elevated cancer risks in a large area of the South Coast Air Basin (CARB 2006).

This HRA was prepared in accordance with the *Health Risk Assessment Protocol for Port of Los Angeles Terminal Improvement Projects* (Protocol) (LAHD 2006) (see Appendix E.1 of the Protocol). The Protocol is a living document, developed by the LAHD in consultation with the SCAQMD and CARB. In general, the Protocol follows the methodology for preparing Tier 1 risk assessments described in the document prepared by the Office of Environmental Health Hazard Assessment (OEHHA), i.e., *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (OEHHA 2003), as well as guidance contained in *Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act (AB2588)* (SCAQMD 2005a), *Health Risk Assessment Guidance for Analyzing Cancer Risks from Mobile Source Diesel Emissions* (SCAQMD 2002), and *Risk Assessment Procedures for Rules 1401, 1402, and 212* (SCAQMD 2003). The methods in these guidance documents are incorporated into the *Hot Spots Analysis and Reporting Program* (HARP) model released by the CARB in December 2003 (CARB 2003a). While the HARP model incorporates use of the U.S. Environmental Protection Agency's (USEPA) Industrial Source Complex Short-Term model (ISCST3) for dispersion modeling (USEPA 2006a), that model was not used. Rather, the newer USEPA AERMOD model was used for dispersion modeling in conjunction with the HARP AERMOD on-ramp application.

The HRA process requires four general steps to estimate health impact results: (1) quantify proposed Project emissions; (2) identify ground-level receptor locations that may be affected by the emissions (including both a regular grid of receptors and any special sensitive receptor locations such as schools, hospitals, convalescent homes, and daycare centers); (3) perform dispersion modeling analysis to estimate ambient TAC concentrations at each receptor location; and (4) use a risk model to estimate the potential health risk at each receptor location. The following describes in detail the methods used to develop each step of the HRA.

2.0 DEVELOPMENT OF EMISSION SCENARIOS USED IN THE HRA

2.1 Emission Sources

To estimate health impacts, emission scenarios were developed for the various Project-related sources of TACs as described below.

1. **Diesel-Powered Sources**. Diesel-powered sources associated with the Project included the following:

   - Tankers traveling to and from the port in the area from the Fairway into the Precautionary Area. Each trip includes approximately 20 miles of transit in the Fairway and the Precautionary Area. Emission sources during this transit include the main propulsion engine, auxiliary engines, and boilers.

   - Tankers traveling in the area from the pilot pick-up/drop-off point (about 3 miles beyond the Port breakwater) to and from the berth. Each trip includes approximately 3 miles of transit in the Precautionary Area located outside the breakwater, transit within the harbor from the breakwater entrance gate to/from the berth, and maneuvering in/out at the near-berth area. Emission sources during this transit include the main propulsion engine, auxiliary engines, and boilers.

- Tanker hoteling while at berth. Emission sources while the vessel is at berth include the ship boilers and auxiliary generators. The main propulsion engine is turned off during hoteling.

- Tugboats used to assist the tankers between the pilot pick-up/drop-off point and the berth (an average of two tugboats per ship assist). Tugboat emission sources include the tugs' main propulsion engines and auxiliary generators.

One additional diesel-powered emission source category – marine vessels transiting the shipping lane Fairway/Precautionary Area beyond the 3-mile pilot pick-up/drop-off point – was considered but omitted from the risk assessment because sensitivity runs indicated that the relative risk contribution from these distant sources at the points of maximum impact is small compared to the risk from the sources in and near the harbor area.

- Barge emissions used to deliver OGV fuel to Berth 408. This fuel would be stored at the terminal in a 15,000 gallon tank for use in fueling the OGVs calling at the terminal.

- Construction-related emission sources, including work tugs, OGVs delivering construction materials, on-road and off-road heavy duty diesel trucks, and off-road construction equipment necessary to construct the terminal, tankage, and pipelines.

2. **Tank Farm Tank Sources (working and breathing losses).** The proposed Project would include two tank farms with a total capacity of 4.0 million barrels (bbl) of storage. Table 1 contains a breakdown of the tank farms by location and the anticipated number of turnovers at each site per month. The characteristics of the crude oil in the tanks used for modeling of emissions are: total vapor pressure (TVP) of 10 pounds per square inch absolute (psia), liquid molecular weight of 207, vapor molecular weight of 50, and liquid density of 7.1 lb/gal (USEPA TANKS 4.09d model and Pacific LA Marine Terminal, Inc. [PLAMT]).

   There would also be a 15,000 bbl fueling tank at Berth 408 that would have the same characteristics as above except it would store diesel fuel with 0.008 TVP, liquid molecular weight of 188, and vapor molecular weight of 130 (USEPA TANKS 4.09d model and PLAMT).

Table 1. Tank Farm Parameters

Tank Farm	*No. of Tanks*	*Size of Tank (bbl)*	*Diameter (ft)*	*Height (ft)*	*Turnovers (turns/month)*
Site 1	2	250k short	202	51.5	5
	1	50k surge	90	51.5	10
	1	15k fueling	52	46.5	5
Site 2	14	250k tall	185	65.5	2.5

Source: Design information from SPEC Services and PLAMT 2005.

3. **Tank Farm Vapor Destruction Unit Sources.** Tank Farm Sites 1 and 2 would have vapor destruction units (VDU) to burn any excess vapors when the tanks are being filled and when the tank roofs are resting on their legs.

SCAQMD Rule 463(d)(2) prohibits the roof of a floating roof tank from resting on the legs except when the tank is being emptied for clean up and repair. During normal operations (i.e., not cleaning or repairing tanks), crude oil storage tanks at the facility may have their roofs temporarily resting on the lower legs. To comply with Rule 463(d)(2), the tanks will be vented to the VDU while the tank roofs are resting on their legs.

The amount of crude vapor for each VDU was based on the available tank storage volume. Table 2a contains the amounts of crude vapor combustion expected per month for tank filling. The following vapor distribution was used: Tank Farm Site 1 VDU would process 12.5 percent of the total gases and Tank Farm Site 2 would process 87.5 percent. Table 2b contains the amounts of crude vapor combustion expected per year for maintenance operations. It is expected that each tank will land on its legs 6 times per year and the VDU will run for 48 hours until the headspace vapors is below 5000 parts per million (ppm).

Table 2a. VDU Assumptions for Tank Filling

Ship Type	*Crude Vapors from Tanks (standard cubic feet [scf]/call)*
Aframax	224,000
Very Large Crude Carrier (VLCC)	596,313
Suezmax	333,333
Panamax	116,667
Source: SPEC Services 2005	

Table 2b. VDU Assumptions for Tank Maintenance

Site	*No. of Tanks*	*Annual Crude Vapors from Tanks (million standard cubic square feet per year [mmscf/yr])*
Site 1	4	17.3
Site 2	14	77.8
TOTAL	**16**	**138.3**
Source: SPEC Services 2005		

4. **Fugitive Emission Sources.** Fugitive crude oil vapor emissions from various piping, valves, connections, and other crude oil transfer system components at the berth and the tank farms. It was assumed that crude oil service is considered a light liquid petroleum service. The number of valves, pumps, compressors, fittings, etc. was estimated based on preliminary design since final designs have not yet been developed. Table 3 lists the fugitive emission sources associated with the berth and tank farms.

Table 3. Fugitive Emission Parameters

New Source Unit with Best Available Control Technology (BACT)	*Service*	*Number of Sources*
Valves	Light Liquid	1,125
Pumps	Light Liquid	40
Fittings (Connectors and Flanges)	Light Liquid	1,650
Others (Compressors and others)	Light Liquid	960
Source: SPEC Services 2005.		

2.2 Emission Factor Trends

The following methods were used to develop the 70-year trends in annual emission factors for the diesel-powered emission sources evaluated in this HRA:

1. **Tankers.** Emission factors for main engines, auxiliary generators, and boilers on ocean-going marine tankers were held constant at existing levels for the entire 70-year period. This approach is consistent with the European study on vessel emissions (ENTEC 2002), as presently there are no future standards promulgated for this source category that would result in more restrictive emission factors, and fleet turnover rate is slow and uncertain. Emission factors were specified based on fuel type, and fuel type was specified based on applicable project design and/or mitigation measures.

2. **Assist Tugboats.** The emission factors for main and auxiliary generators on assist tugboats assume the use of the Port diesel fuel (average 1,900 ppm sulfur) before 2006, CARB diesel (maximum 500 ppm sulfur) in 2006, and ultra low sulfur diesel (15 ppm sulfur) after 2006. Use of lower sulfur diesel fuel results in slight reductions in DPM emissions. The fuel sulfur content requirements starting in 2006 are for California harbor craft in accordance with California Code of Regulations Title 13, Division 3, Chapter 5, Article 2, Section 2281, "Sulfur Content of Diesel Fuel".

3. **Construction Sources.** DPM Emissions from construction equipment and haul trucks, general cargo ship (for stone delivery) transit and hoteling, tugboat/barge activities associated with wharf construction, were calculated by the methods presented in section 3.2.4 of the Supplemental Environmental Impact Statement/Subsequent Environmental Impact Report (SEIS/SEIR).

2.3 Emission Estimates

The determination of health risks in this HRA required the calculation of 70-year annual average, maximum annual, and maximum 1-hour emission rates. The HRA used 70-year annual average emission rates to determine individual lifetime cancer risks. The 70-year averaging period coincided with calendar year 2010 through 2080.

Annualized emission rates for use in the HRA were estimated based on the emission factors and emission estimation methodology presented in detail in Appendix H1 and Appendix H2. Table 5 summarizes the annual unmitigated and mitigated DPM emissions expected from proposed Project sources. The mitigated emissions include incorporation of Mitigation Measures (MMs) AQ-1 through MM AQ-21, as described in Section 3.2.4 of the SEIS/SEIR.

Much of the proposed Project emission sources are diesel-powered internal combustion engines. Therefore, the analysis of long-term (chronic) health effects focused on DPM emissions, as this is the pollutant OEHHA considers in the estimation of cancer (lifetime) and chronic (annual) non-cancer effects from these sources. To estimate acute health effects, the HRA evaluated a more detailed list of pollutants, including criteria pollutants and TACs in the form of volatile organic compounds (VOCs) and particulate matter (PM). For external combustion sources such as OGV boilers, organic and particulate-based TAC emissions were quantified pursuant applicable CARB speciation profiles.

3.0 RECEPTOR LOCATIONS USED IN THE HRA

This HRA analyzes the health risks associated with TAC emissions from Project sources at a variety of locations (receptors) throughout the San Pedro Bay Ports area, including at the locations of exposure to residents, offsite workers, and sensitive members of the public. The analysis utilized a regular coarse grid of 948 receptor points spaced every 500 meters apart around the Project sites. The regular receptor grid extended 17 kilometers (km) east-west by 14 km north-south. In addition, another 203 discrete receptors were placed at sensitive receptor locations of special concern, such as schools, day care centers, convalescent homes, and hospitals in the surrounding area. Table 4 summarizes the locations of these sensitive receptors. The coordinate information and elevation of each receptor location was determined from United States Geological Survey (USGS) topographic data.

Subsequent to the initial modeling analysis and preliminary identification of maximum impact locations, the HRA was refined by modeling proposed Project emissions using new finer-spaced 1.0 km x 1.0 km receptor grids that surrounded the maximum impact locations with receptors spaced every 50 meters apart.

Maximally exposed individual (MEI) locations were selected from the modeled receptor grids for four different receptor types: residential, occupational, sensitive, and student. The selection methodology for the MEI locations was:

- The residential MEI was selected from all receptors in residential or zoned residential areas, including the public marinas (for possible live-aboards) located west of Pier 400 (in the West Channel/Watchorn Basin area) and north of the Project's Terminal Island tank farm sites (in the East Basin/Cerritos Channel area).

- The occupational MEI was selected from all non-residential receptors outside the Project property boundaries and not over open water. Receptors directly on the Project property boundaries were also considered valid for this selection (e.g., APM/Maersk Pier 400 terminal). This approach is conservative, particularly for long-term occupational exposures, because it is unlikely that an off-site worker would be located on or very near the Project property lines except on an intermittent basis.

- The sensitive MEI was selected from all identified schools, day care centers, convalescent homes, and hospitals in the surrounding area.

- The student MEI was selected from all identified schools in the surrounding area.

Table 4. Sensitive Receptors Evaluated in the HRA

Location	*Street Address*	*City*	*E UTM*	*N UTM*
DAYCARE CENTERS				
Armstrong Academy	1682 Anaheim St	Harbor City	384877	3738389
Coastline Head Start	1121 Lomita Blvd	Harbor City	379956	3740279
Der Kinder Garden School	1518 Pacific Coast Highway	Harbor City	379458	3739409
Gateway Christian School	25420 Vermont Ave	Harbor City	380509	3739569
Lilly's Babies	1647 248th St	Harbor City	379032	3740490
Normont Terrace Children's Center	25028 Petroleum Ave	Harbor City	380116	3740258
Volunteers of America- Parent Child Center	1135 257th St.	Harbor City	380165	3739532
Cabrillo Ave Children's Center	741 W. 8th Street	San Pedro	380265	3733547
Carmen's Cry Baby Care	1509 S Palos Verdes St	San Pedro	381286	3732766
Comprehensive Child Development	769 W 3rd St	San Pedro	380148	3734010
Day-Star Early Learning Center	631 W 6th St	San Pedro	380497	3733752
Federation / Port of San Pedro	202 S Beacon	San Pedro	381485	3734127
Federation / Toberman House	131 N. Grand	San Pedro	380583	3734263
First United Methodist Church	580 West 6th St	San Pedro	380574	3733740
Merry Go-round Nursery School	446 W 8th St	San Pedro	380874	3733533
Miss Shannon's Child Care	325 W 31st St.	San Pedro	380880	3731115
Park Western Place Children's	1220 Park Wester Place	San Pedro	379234	3735301
Robin's Nest Daycare	645 W 14th St	San Pedro	380380	3732882
San Pedro /Wilmington Children's Center	920 W 36th St	San Pedro	379707	3730982
San Pedro Children's Center	920 W 36th St	San Pedro	379772	3734405
Schahnin's Int Day Care		San Pedro	380133	3732170
Wee Tot Nursery School	1128 W 7th St	San Pedro	379354	3733669
World Tots LA	100 W 5th St	San Pedro	381529	3733934
YMCA of Metro LA	301 S. Bandini St	San Pedro	379750	3734044
YWCA	437 W 9th St	San Pedro	380869	3733433
YWCA Venture Park Preschool	1921 N Gaffey Street.	San Pedro	380316	3736352
Happy Harbor Preschool	1530 N Wilmington Blvd	Wilmington	382021	3739838
Munchkin Center	1348 N Marine Ave	Wilmington	383025	3739406
New Harbor Vista Child Development Center	909 W D St	Wilmington	382167	3737588
Sanchez Family Child Care	1443 Deepwater Ave	Wilmington	383559	3739727
Small World Learning Center	1749 N Avalon Blvd	Wilmington	383093	3740329
Wilmington Park Children's Center	1419 E Young St	Wilmington	384700	3738996
Yvette's Daycare	815 W Opp St	Wilmington	382230	3738553
Federation / Coastline Headstart			380017	3740136
Voa / Caesar Chavez Head Start	1269 N. Avalon St.	Wilmington	383089	3739394
A Love 4 Learning Academy	306 Elm Ave.	Long Beach	390048	3737366
Carousel Preschool	366 Cherry Ave.	Long Beach	391856	3737375
YMCA GLB Fairfield 3rd St. Preschool	607 E. 3rd St.	Long Beach	390292	3737325
Young Horizons Child Development Centers	501 Atlantic Ave.	Long Beach	390248	3737631
Coronado Head Start Child Care Center	1395 Coronado St.	Long Beach	393181	3738829
First Foursquare Church Preschool	2416 E. 11th St.	Long Beach	392312	3738428
Huntington Academy – Preschool	2935 E. Spaulding St.	Long Beach	392832	3738974
Simply Kare Child Development Center	1406 Obispo Ave.	Long Beach	393126	3738858
12th Street Head Start	1212 Long Beach Blvd.	Long Beach	389912	3738586
Atlantic Head Start	1862 Atlantic Ave.	Long Beach	390314	3739617
Comprehensive Child Development	2565 Pacific Ave.	Long Beach	389484	3741032
Elm Street Head Start	1425 & 1429 Elm Ave.	Long Beach	389991	3738889

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Table 4. Sensitive Receptors Evaluated in the HRA (continued)

Location	Street Address	City	E UTM	N UTM
Fords Family Day Care	2726 San Francisco Ave.	Long Beach	388588	3741372
Kelly's Kids Daycare Center	855 W. Willow St.	Long Beach	388761	3741139
Long Beach Blvd Head Start	2236 Long Beach Blvd.	Long Beach	389932	3740374
Long Beach Center for Child Development	622 E. Hill St.	Long Beach	390330	3740309
Long Beach Child Development Center	2222 Olive Ave.	Long Beach	390493	3740339
College Child Development – PCC	1305 E. Pacific Coast Hwy	Long Beach	391235	3739503
Long Beach Day Nursery	2801 Atlantic Ave.	Long Beach	390295	3741518
Oakwood Children's Center	2650 Pacific Ave.	Long Beach	389536	3741216
Old King Cole Day Care	3300 Oregon Ave.	Long Beach	388795	3742493
P.A.L. Family Day Care	1980 Daisy Ave.	Long Beach	388999	3739857
Pacific Head Start	2179 Pacific Ave.	Long Beach	389473	3740259
Ruiz Family Daycare	2670 Daisy Ave.	Long Beach	388990	3741078
Signal Hill Head Start	2285 Walnut Ave.	Long Beach	391535	3740444
Smart & Manageable	2054 Myrtle Ave.	Long Beach	390588	3739997
Tender Child Care	211 E. 29th St.	Long Beach	389844	3741688
Young Horizons Child Development Centers	1840 Pacific Ave.	Long Beach	389515	3739582
Young Horizons Child Development Centers	2418 Pacific Ave.	Long Beach	389526	3740732
Cabrillo Child Development Center	2205 San Gabriel Ave.	Long Beach	386680	3739773
Garfield Head Start	2240 Baltic Ave.	Long Beach	387670	3740408
Job Corp Head Start	1903 Santa Fe Ave.	Long Beach	387501	3739748
West Child Development Center	2125 Santa Fe. Ave.	Long Beach	387505	3740187
Bundle of Joy Daycare 2	1330 E. 16th St.	Long Beach	391218	3739157
Child Care Center at St. Mary Medical Center	930 Elm Ave.	Long Beach	390021	3738204
Childtime Learning Center	1 World Trade Ctr #199	Long Beach	388899	3737062
Gaviota Head Start	1131 Gaviota St.	Long Beach	391569	3738492
Jenkins Day Care	1720 Cerritos Ave.	Long Beach	390961	3739326
Kelly's Care	943 N. Washington Pl	Long Beach	390636	3738218
Little Lighthouse Educational Childcare Center	911 Pine Ave.	Long Beach	389577	3738177
Lucy's Baby Care	940 Maine Ave.	Long Beach	388828	3738211
My Three Kids Tons of Fun Day Care	1240 E. 17th St.	Long Beach	391142	3739294
N 2 Lil Folkz	1624 Chestnut Ave.	Long Beach	389217	3739222
Ole King Cole Development Center	1814 E. 7th St.	Long Beach	391695	3737831
Pine Head Start	927 Pine Ave.	Long Beach	389581	3738225
Play House, The	1301 W. 12th St.	Long Beach	388060	3738639
Progressive Steps Children Center	911 Pine Ave.	Long Beach	389621	3738176
Vincent Family Child Care	925 Walnut Ave.	Long Beach	391463	3738185
West Anaheim Child Care Center	440 W. Anaheim St.	Long Beach	389183	3738668
Young Horizons / El Jardin De La Felicidad	507 Pacific Ave.	Long Beach	389513	3738709
Bethany Preschool	2217 E. 6th St.	Long Beach	392106	3737683
Great Beginnings	3027 E. 4th St.	Long Beach	392907	3737426
Our Saviour's Lutheran Preschool	370 Junipero Ave.	Long Beach	392172	3737336
Phases – An Early Learning Comp.	404 Newport Ave.	Long Beach	393376	3737451
Ruiz Family Daycare	2670 Daisy Ave.	Long Beach	388979	3741256
SCHOOLS				
Harbor City Christian School		Harbor City	380655	3739865
Harbor City Elementary School	1508 254th St	Harbor City	379413	3739802
Learning Garden Preschool	1518 Pacific Coast Highway	Harbor City	379347	3739386
Lorenz Hillside School	1516 W. Anaheim St	Harbor City	379362	3738859
Narbonne High School	24300 Western Ave	Harbor City	379287	3740937

Table 4. Sensitive Receptors Evaluated in the HRA (continued)

Location	*Street Address*	*City*	*E UTM*	*N UTM*
Normont Elementary School	1001 253rd St	Harbor City	380360	3740007
President Avenue Elementary School	1465 243rd St	Harbor City	379451	3740991
Angel's Gate High School	3200 S Alma St	San Pedro	379582	3731350
Bandini Street Elementary School	425 N Bandini St	San Pedro	379735	3734601
Barton Hill Elementary School	423 N Pacific Ave	San Pedro	380689	3734581
Cabrillo Ave. Elementary School	732 S Cabrillo Ave	San Pedro	380082	3733567
Cooper Community Day School	2210 N Taper Ave	San Pedro	379649	3736710
Dana Middle School	1501 S Cabrillo Ave	San Pedro	380110	3732842
Fifteenth Street Elementary School	1527 S Mesa St	San Pedro	380902	3732772
Harbor OCC Center	740 N. Pacific Ave.	San Pedro	380693	3733547
Holy Trinity Elementary School	1226 W Santa Cruz St	San Pedro	379365	3734402
Holy Trinity Elementary School	1226 W Santa Cruz St	San Pedro	379337	3734320
J. F. Cooper High School	2201 N. Taper Ave	San Pedro	379791	3736724
Leland Street Elementary School	2120 S Leland St.	San Pedro	379593	3732169
Mary Star Of The Sea Elementary School	717 S Cabrillo St.	San Pedro	380082	3733583
Mary Star of the Sea High School	810 W 8th St.	San Pedro	379926	3733674
Park Western School	1214 Park Western Pl.	San Pedro	379274	3735321
Point Fermin Elementary School	3333 Kerckhoff Avenue.	San Pedro	380485	3730978
San Pedro High School	1001 W 15th St.	San Pedro	379645	3732757
Narbonne Community School	950 W Santa Cruz St.	San Pedro	379748	3734370
Taper Avenue Elementary School	1824 N Taper Ave.	San Pedro	379809	3736305
Avalon High School	1425 N Avalon Blvd	Wilmington	383045	3739524
Broad Avenue Elementary School	24815 Broad Ave	Wilmington	383151	3740602
First Baptist Christian School	1360 Broad Ave	Wilmington	383200	3739416
Fries Ave Elementary School	1301 N Fries Ave	Wilmington	382880	3739251
G Street School		Wilmington	382506	3738149
Gulf Ave Elementary School	828 W L St	Wilmington	382247	3738964
Hawaiian Avenue Elementary School	540 Hawaiian Ave	Wilmington	381913	3737808
Los Angeles Harbor College	1111 Figueroa Place	Wilmington	381309	3738644
Pacific Harbor Christian School	1530 Wilmington Blvd	Wilmington	381947	3739810
Wilmington Middle School	1700 Gulf Ave	Wilmington	382253	3740243
Wilmington Park Elementary School	1140 Mahar Ave	Wilmington	384715	3738942
Banning New Elementary School #1	500 N. Island Ave.	Wilmington	382098	3737638
Holy Family Preschool and Elementary School	1122 E. Robidoux St.	Wilmington	384268	3739363
Phineas Banning Senior High School	1527 Lakme Ave.	Wilmington	383235	3740075
Saints Peter & Paul School	706 Bay View Ave.	Wilmington	382435	3738305
Caesar Chavez Elementary	730 W. 3rd St.	Long Beach	388744	3737296
Constellation Community Charter Middle	620 Olive Ave.	Long Beach	390505	3737788
Edison Elementary	625 Maine Ave.	Long Beach	388805	3737814
Franklin Classical Middle	540 Cerritos Ave.	Long Beach	390944	3737669
Saint Anthony High School	620 Olive Ave.	Long Beach	390534	3737795
Saint Anthony Preschool / Elementary	855 E. 5th St.	Long Beach	390580	3737582
Select Community Day (Secondary)	5869 Atlantic Ave.	Long Beach	390248	3737371
Stevenson Elementary	515 Lime Ave.	Long Beach	390365	3737647
City Christian School	2209 E. 6th St.	Long Beach	392087	3737681
Birney Elementary	710 W. Spring St.	Long Beach	388875	3741876
Burnett Elementary	565 E. Hill St.	Long Beach	390228	3740326
Cambodian Christian	2474 Pacific Ave.	Long Beach	389562	3740833
Holy Innocents Elementary School	2500 Pacific Ave.	Long Beach	389544	3740927

Table 4. Sensitive Receptors Evaluated in the HRA (continued)

Location	*Street Address*	*City*	*E UTM*	*N UTM*
Jackie Robinson Academy	2750 Pine Ave.	Long Beach	389600	3741418
Lafayette Elementary School	2445 Chestnut Ave.	Long Beach	389278	3740828
Mary Butler Elementary	1400 E. 20th St.	Long Beach	391299	3739855
Oakwood Academy	2951 Long Beach Blvd.	Long Beach	389888	3741829
Signal Hill Elementary School	2285 Walnut Ave.	Long Beach	391480	3740435
Cabrillo (Juan Rodriguez) High School	2001 Santa Fe Ave.	Long Beach	387439	3739936
Hudson Development Center Daycare and Elementary School	2335 Webster Ave.	Long Beach	387067	3740604
James A Garfield Elementary	2240 Baltic Ave.	Long Beach	387710	3740410
Muir Elementary	3038 Delta Ave.	Long Beach	387933	3742038
Saint Lucy School	2320 Cota Ave.	Long Beach	387406	3740569
Stephens Middle	1830 W. Columbia St.	Long Beach	387350	3741632
Abraham Lincoln Elementary School	1175 E. 11th St.	Long Beach	390987	3738499
Artesia Well Preparatory Academy	1235 Pacific Ave.	Long Beach	389454	3738592
Creative Arts Daycare and Elementary School	1423 Walnut Ave.	Long Beach	391473	3738915
First Baptist Church School	1000 Pine Ave.	Long Beach	389638	3738317
First Lutheran Day Care, Preschool and Elementary School	946 Linden Ave.	Long Beach	390184	3738233
George Washington Middle School	1450 Cedar Ave.	Long Beach	389390	3738917
Long Beach Montessori School	525 E. 7th St.	Long Beach	390202	3737906
Polytechnic High School	1600 Atlantic Ave.	Long Beach	390337	3739143
Regency High School	490 W. 14th St.	Long Beach	389126	3738772
Renaissance High School for the Arts	235 E. 8th St.	Long Beach	389785	3738088
Roosevelt Elementary	1574 Linden Ave.	Long Beach	390166	3739112
The New City School	1230 Pine Ave.	Long Beach	389586	3738611
John G Whittier Elementary School	1761 Walnut Ave.	Long Beach	391468	3739354
Burbank Elementary	501 Junipero Ave.	Long Beach	392178	3737551
HOSPITALS				
Bay Harbor Hospital	1437 W Lomita Blvd	Harbor City	379467	3740421
Kaiser Permanente Foundation Hospital	25825 Vermont Ave	Harbor City	380073	3739356
San Pedro Peninsula Hospital	1300 W Seventh St	San Pedro	379055	3733680
Memorial Hospital of Gardena	1703 N Avalon Blvd	Wilmington	383016	3740228
Earl & Lorraine Miller Children's Hospital / Long Beach Memorial Medical Center and Hospital	2801 Atlantic Ave.	Long Beach	390174	3741498
Pacific Hospital of Long Beach	2776 Pacific Ave	Long Beach	389484	3741460
Long Beach Doctors Hospital	1725 Pacific Ave	Long Beach	389456	3739345
St. Mary Medical Center	1050 Linden Ave	Long Beach	390100	3738380
Tom Redgate Memorial Hospital	1775 Chestnut Ave	Long Beach	389227	3739447
NRS				
Bellagio Manor	1046 East 4th St.	Long Beach	390833	3737451
Breakers of Long Beach, The	210 East Ocean Blvd.	Long Beach	389739	3736892
Colonial Care Center	1913 East 5th St.	Long Beach	391786	3737576
Crofton Manor Inn	1950 East 5th St.	Long Beach	391833	3737571
Wells House	245 Cherry Ave.	Long Beach	391841	3737014
Broadway By The Sea	2725 East Broadway	Long Beach	392578	3736808
Villa Redondo Care Home	237 Redondo Ave.	Long Beach	393262	3736714
Akin's Post Acute Rehab Hospital / Atlantic Memorial Healthcare Center	2750 Atlantic Ave	Long Beach	390343	3741381
Caruthers Royale Care	2204 Lime Ave.	Long Beach	390386	3740307
Courtyard Care Center	1880 Dawson Ave.	Long Beach	392087	3739639

Table 4. Sensitive Receptors Evaluated in the HRA (continued)

Location	Street Address	City	E UTM	N UTM
Deluxe Guest Home	3260 Pine Ave.	Long Beach	389587	3740686
Deluxe Guest Home II	3266 Pine Ave.	Long Beach	389586	3740722
RMR Residential Care Facility, LLC	2900 De Forest Ave.	Long Beach	388554	3741647
Royal Care Skilled Nursing Center	2725 Pacific Ave.	Long Beach	389543	3741355
Burnett Home Care	1740 West Burnett St.	Long Beach	387440	3740697
Loram Manor	1925 Gemini St.	Long Beach	387269	3740453
Harbor View Rehabilitation Center	490 West 14th St.	Long Beach	389116	3738782
Healthview – Pine Villa Assisted Living	117 East 8th St.	Long Beach	389645	3737994
Olive Tree Home	1035 Olive St.	Long Beach	390455	3738345
Skylight Convalescent Hospital	1201 Walnut Ave.	Long Beach	391465	3738580
Villa Maria Care Center	723 East 9th St.	Long Beach	390433	3738121
Edgewater Convalescent Hospital	2625 East 4th St.	Long Beach	392530	3737465
Ruby's Guest Home	2125 East 4th St.	Long Beach	391994	3737434
OTHER				
Federal Prison	Reservation Point		382555	3732537
Cabrillo Marina – Liveaboard Housing			381489	3731926

Table 5. Proposed Project DPM Emissions from Vessels

Emission Source	*Unmitigated DPM Emissions (pounds per year [lb/yr])*	*Mitigated DPM Emissions (pounds per year [lb/yr])*
Tanker Transit [1]	79,692	67,849
Tanker Maneuvering [2]	19,081	9,332
Tanker Hoteling [3]	26,511	639
Offloading Emissions [4]	26,004	17,832
Boiler Warm-up [5]	7,387	1,294
Tugboats	11,002	11,002

Notes:

(1) These tanker main engine and auxiliary generator emissions occur in the area from Pilot pick-up to Berth 408 and back to Pilot drop-off. Per LAHD guidance, Pilot pick-up/drop-off is assumed to occur approximately 3 miles outside the breakwater.

(2) These tanker main engine and auxiliary generator emissions occur in an area approximately 250 m x 250 m in size adjacent to Berth 408.

(3) Includes emissions from 2 tanker auxiliary generators.

(4) Includes emissions from 2 tanker boilers.

(5) Includes boiler warm-up emissions while in South Coast Waters.

4.0 DISPERSION MODEL SELECTION AND INPUTS

This HRA used the HARP model to assess air quality impacts and health risks from Project operational emission sources. While HARP incorporates the Industrial Source Complex Short-Term model, Version 3 (ISCST3) for dispersion modeling, this analysis utilized the newer USEPA AERMOD dispersion model. The selection of the AERMOD model was appropriate based on: (1) the general acceptance by the modeling community and regulatory agencies of its ability to provide reasonable results for large industrial complexes with multiple emission sources, (2) the availability of annual sets of hourly meteorological data for use by AERMOD, and (3) the model's ability to handle the various physical characteristics of project emission sources, including, "point," "area," and "volume" source types. AERMOD is an USEPA-approved Gaussian-plume dispersion model that was designated as a guideline model in December 2006 and the SCAQMD approves of its use for mobile source analyses.

4.1 Model Options

The AERMOD modeling analyses used the USEPA regulatory AERMOD default options for all modeling runs. However, as recommended by the SCAQMD, the analyses used urban dispersion parameters. All sources were modeled with emissions occurring 24 hours per day.

The AERMOD model incorporated the following general options and assumptions:

- Regulatory default option.
- Single urban area was set with an area population of 535,000 and a roughness length equal to 1.0.
- All sources were defined as "urban" sources.
- No downwash effects were included.
- Meteorological data from the LAHD Berth 47, Terminal Island Treatment Plant (TITP) and St. Peter & Paul School (SPPS) monitoring stations were used for modeling. These meteorological data sets were for the September 1, 2006 through August 31, 2007 period of record and were processed using the AERMET processor in accordance with the latest applicable USEPA guidance.

4.2 Emission Source Representation

The AERMOD modeling analysis evaluated Project-related operational TAC emission sources, including ocean-going vessels (tankers) and assist tugboats; tanks; VDUs; and fugitive sources. The HRA simulated project-related emission sources as realistically as possible, taking into consideration the physical characteristics and operational location of each source. Emissions from the movement of vessels and tugboats during transit are line source emissions that were simulated and modeled as a series of separated volume sources (Figure H4-1 shows the location of vessel sources modeled). Volume source emissions are simulated by AERMOD as being released and mixed vertically and horizontally within a volume of air prior to being dispersed down wind. The actual operational characteristics of each source type in terms of area of operation and vertical stack height or source height determined the dimensions of the volume source used in the model. Stationary emissions from vessel hoteling and offloading were modeled as point (stack) sources with upward plume velocity and buoyancy. Tank emissions were modeled as an area source for each tank farm site (TFS). VDU emissions are routed to exhaust stacks and were therefore modeled as point sources. Fugitive emissions from tank farm operations were modeled as occurring from area sources associated with each tank farm site. A total of 273 emission sources were simulated in AERMOD. The specific methodology for defining the various sources is discussed below.

1. **Vessel Cruising (Precautionary Area and beyond)**. Emissions from ocean going vessels were considered from the fairway into the Precautionary Area. Emissions for this leg were simulated as a series of separated volume sources between approximately 20 miles from Pt. Fermin and the pilot pick-up/drop-off point. Total transit emissions

for these legs were calculated and divided equally among the number of transit volume sources representing each segment.

Vessel transit sources were modeled as line sources with the use of multiple volume sources and consistent with the methods found in the ISCST User's Guide, Section 1.2.2, Volume II (USEPA 1995a). The volume source width for all areas of transit was set to 100 meters. The center-to-center spacing of the fairway and precautionary area transit volume sources was 600 meters. For harbor transit sources, the center-to-center spacing of the harbor transit volume sources was 200 meters.

The HRA used the following vertical dimensions for vessel transit volume sources, based upon a series of visual observations of container ship exhaust plumes at the Port:

a. Fairway/Precautionary Area – Center of volume source equal to 50 percent above stack height (36 m), or 54 m, and a volume source depth of 25 percent of stack height, or 9 m.

These assumptions are consistent with air dispersion theory, as lower apparent wind speeds at slower ship speeds results in a higher plume rise.

The transit sources were positioned along the centerline of the vessel inbound/outbound traffic lanes through the Fairway and Precautionary Area, along a line from the edge of the Precautionary Area to Angels Gate, and then up the center of the Main Channel to Berth 408.

2. **Vessel Transit (Precautionary Area and In-Harbor Transit).** Emissions from marine vessels that transit between the pilot pick-up/drop-off point and the Project's marine terminal at Berth 408 were simulated as a series of separated volume sources beginning approximately 3 miles beyond the Port breakwater and extending to the Berth 408 wharf. Total transit emissions were calculated and divided equally among the number of transit volume sources representing each of the Precautionary Area and In-Harbor transit segments. Tug assist emissions were also calculated and represented as a series of volume sources collocated with the OGV volume sources (2 tugs per assist for an Aframax and Panamax Vessel, 3 tugs per assist for a Suezmax Vessel, and 4 tugs per assist for a VLCC).

The HRA used the following vertical dimensions for these vessel transit volume sources:

a. Harbor Transit – Center of volume source equal to 100 percent above stack height, or 72 m, and a volume source depth of 50 percent of stack height, or 18 m.

The transit volume sources were positioned approximately every 200 m along the centerline of the vessel inbound/outbound traffic lanes through the area from the pilot pick-up/drop-off point to Angels Gate, and then on to Berth 408.

3. **Vessel Near-Berth Maneuvering Area (Turning and Docking at Berth).** Approximately 20 percent of the total transit emissions from pilot pick-up/drop-off to berth would occur during vessel turning and docking activities near the berth. As a result, a dedicated near-berth volume source was created to simulate emissions from

these activities. Turning in the vicinity of Berth 408 is only required when leaving the berth to exit the harbor. Vessels docking at berth are positioned head-in, with the starboard side against the breasting dolphins. The turning/docking volume source was located in the area immediately west of Berth 408. The volume source width was set to 335 m, which is the approximate length of a typical VLCC tanker vessel. The release height and initial vertical thickness of the turning/docking volume source were as follows:

a. Near-Berth Maneuvering – Center of volume source equal to 200 percent above stack height, or 108 m, and a volume source depth of 100 percent of stack height, or 36 m.

4. **Vessel Tying up.** It takes approximately one-hour to tie the vessel to the dock and make it secure. Since the vessels are relatively stationary while this is occurring, the emissions occurring during this period were modeled as stack-type point sources. The vessel's main engine is shut off while at berth and only the boiler warm-up and auxiliary engines are working.

5. **Vessel hoteling/offloading.** Because vessels are stationary while hoteling and offloading, vessel hoteling/offloading emissions were modeled as stack-type point sources located adjacent to Berth 408. Auxiliary generator and boiler sources were modeled with separate release parameters. The release parameters (stack height, stack diameter, exhaust gas temperature, and exit velocity) for tanker hoteling/offloading emissions were obtained from Herbert Engineering Corporation (email, January 2005), and are shown in Table 6. The vessel's main engine is shut off while at berth.

Table 6. Auxiliary Generator and Boiler Stack Parameters

Source Description	*Stack Height (ft)*	*Exhaust Temp (deg F)*	*Stack Exit Velocity (ft/sec)*	*Stack Diameter (ft)*
Auxiliary Generator 1	118	800	98.4	1.53
Auxiliary Generator 2	118	800	98.4	1.53
Boiler 1	121	800	80.5	4.24
Boiler 2	121	800	80.5	4.24

Source: Herbert Engineering Corporation 2005.

6. **Tank Farm Tanks.** Fugitive emissions from crude oil tanks were modeled with the AERMOD as area sources. The emissions from each tank were first estimated by the USEPA's TANKS 4.09b model (see Appendix H.2, Attachment 8). Inputs to the model included: (1) specification of internal floating roofs for all tanks; (2) use of default values for roof fitting, tank condition, and paint; (3) assumption of crude oil with a TVP of 10 psia for all tanks; (4) assumption that crude oil vapor contains 0.38 percent by volume of benzene and 9.9 percent by volume of hexane; and (5) a maximum crude oil flow rate of 75,000 bbl/hour. Table 7 summarizes physical dimensions of the tanks.

Table 7. Crude Oil Tanks - Modeling Inputs

Tank Location	*No. of Tanks*	*Tank Size*	*Tank Diameter (ft)*	*Tank Height (ft)*	*Lateral Dimension [1] (ft)*	*Vertical Dimension [2] (ft)*
Site 1	2	250k short	202	51.5	47	24.0
	1	50k surge	90	51.5	20.9	24.0
	1	15k fueling	52	46.5	12.1	21.6
Site 2	14	250k tall	185	65.5	40.7	30.5

Notes:
(1) Lateral dimension (sigma-y) for a single volume source is equal to the diameter divided by 4.3.
(2) Vertical dimension (sigma-z) for a single volume source is equal to the height divided by 2.15.
Source: SPEC Services 2005.

7. **Vapor Destruction Units.** VDUs would be located at Tank Farm Sites 1 and 2. All VDUs were modeled as stack-type point sources with parameters as follows: stack height = 50 ft, stack exhaust temperature = 1,400 deg. F, stack exit velocity = 587 ft/min, and stack diameter = 8 ft. The amount of crude vapor that would be incinerated for each VDU was based on the available tank volume. The following distribution was used: Site 1 VDU would process 12.5 percent of the total gases, and Site 2 would process 87.5 percent. Details of the VDU emission calculations are provided in Appendix H.2.

8. **Fugitive Components.** The number and type of fugitive emission components in the current design of the tank farms was provided by SPEC Services (see Appendix H.2). The emissions from the fugitive component sources at a given tank farm site were combined and modeled as occurring from an area source. Characteristics of the area sources are shown in Table 8. Emissions were estimated based on emission factors obtained from Table IV-2b (Method 3) of Guidelines for Fugitive Emission Calculations (see Appendix H.2, Attachment 11). The emissions were estimated using the assumptions that: (1) all of the fugitive components are categorized as “light liquid service”; (2) the typical crude oil that would be transported by the Project would contain 0.38 by volume benzene and 9.9 percent by volume hexane; and (3) the maximum hourly emissions would be equal to the annual average hourly emissions.

All emission sources in the HRA were positioned by using the Universal Transverse Mercator (UTM) coordinate system (NAD-27) referenced to topographic data obtained from the USGS.

Table 8. Fugitive Components – Area Source Modeling Inputs

Tank Farm Site	*Vertical Thickness (ft)*	*Lateral x-direction (ft)*	*Lateral y-direction (ft)*
Site 1	3.7	250	450
Site 2	2.8	800	800

4.3 Meteorological Data

Due to the blocking effect of the Palos Verdes Hills, wide variations in wind conditions often occur within the Port. For example, during prevailing southwest sea breeze conditions, this geographic feature can create a relatively light wind zone in the Inner Harbor while the Outer Harbor experiences strong winds. The monthly and hourly streamlines developed for the SCAB in California South Coast Air Basin Hourly Wind Flow Patterns show that this is the case (SCAQMD 1977). Therefore, use of meteorological data collected from locations within the Port area would provide for the most accurate modeling results.

The LAHD has operated an air quality monitoring program at 4 locations within the Port area since February 2005 that includes the collection of meteorological data (LAHD 2004). This effort provided annual meteorological data sets that have been developed for purposes of dispersion modeling analyses. These data sets include hourly meteorological data (365 days × 24 hours/day = 8,760 hours) of wind speed, wind direction, temperature, stability, and mixing height.

Due to the varying wind conditions within the Port region, the most accurate way to perform the project HRA was to split the modeling domain into distinct meteorological areas. For this analysis, meteorological data from the LAHD Berth 47, Terminal Island Treatment Plant (SPPS) and St. Peter & Paul School (SPPS) monitoring stations was used. These data sets were used to represent meteorological conditions in the outer, middle, and inner harbor, respectively. All data sets were for the September 1, 2006 through August 31, 2007 period of record and were processed using the AERMET processor in accordance with the latest applicable USEPA guidance.

5.0 CALCULATION OF HEALTH RISKS

The results of the AERMOD dispersion modeling analysis represent an intermediate product in the HRA process. The HARP model was subsequently used to determine cancer risk and acute and chronic health effects from project emission sources by factoring pollutant concentrations by pollutant-specific cancer potency values and/or acute and chronic reference exposure levels (RELs) obtained from OEHHA (CARB 2005). Table 9 identifies the health risk areas of concern for each of the TACs that would be emitted by the Project.

5.1 Toxicity Factors

The inhalation unit risk factor is the pollutant-specific probability that a person will develop cancer from the continuous exposure to a concentration of 1 µg/m3 of that pollutant in the air over a period of 70 years. The unit risk factor for DPM is 300 in one million.

Long-term (chronic) exposure to low levels of DPM has also been shown to pose a hazard for chronic inflammation in the human lung. The USEPA has developed an inhalation reference concentration (RfC) of 5 µg/m3 for diesel exhaust, based on long-term data from human and animal studies. OEHHA has likewise developed a chronic REL of 5 µg/m3 for DPM. The chronic REL is an estimate of the continuous inhalation concentration to which the human population (including sensitive subgroups) can be exposed for a long period of time (generally 24 hours or greater) without appreciable risk of experiencing deleterious non-cancer effects.

In regard to short-term (acute) non-cancer effects, available health effects data show that at relatively high acute exposures, DPM can cause irritation to the eyes and upper respiratory system. However, neither the USEPA nor OEHHA has developed quantitative DPM dose-response estimates for acute non-cancer health effects (i.e., for exposures periods less than 24 hours) due to a lack of exposure-response information. Table 10 presents the cancer, chronic non-cancer, and acute non-cancer toxicity factors used to assess health risks for all TACs in this study.

Table 9. Risk Assessment Concerns for Project TAC Emissions

TAC	*Cancer Risk*	*Non-Cancer Risk (Chronic)*	*Non-Cancer Risk (Acute)*
1,3-Butadiene [1]	X	X	
Acetaldehyde [1,3]	X	X	
Acrolein [3]	X	X	X
Benzene [1,2]	X	X	X
Chlorobenzene [1]		X	
Ethylbenzene [1,3]		X	
Formaldehyde [1,3]	X	X	X
Hexane [1,2]		X	
Methyl Alcohol [1]		X	X
MEK [1]		X	X
Naphthalene [1,3]	X	X	
PAH [3]	X		
Propylene [1,3]		X	
Styrene [1]		X	X
Toluene [1,3]		X	X
Xylene [1,3]		X	X
DPM [1]	X	X	
Ammonia [1]		X	X
Antimony [1]		X	
Arsenic [1]	X	X	X
Bromine [1]		X	
Cadmium [1]	X	X	
Chromium [1]	X	X	
Copper [1]		X	X
Lead [1]	X		
Manganese [1]		X	
Mercury [1]		X	X
Nickel [1]	X	X	X
Phosphorous [1]		X	
Selenium [1]		X	
Sulfates [1]		X	X
Vanadium [1]			X
Zinc [1]		X	

Notes:

(1) Sources are diesel combustion in tanker vessel main engines, tugboat main engines, boilers, and auxiliary generators.
(2) Sources are crude oil tank vapors, crude oil fugitive components, thermal destruction of crude oil vapors in VDUs, and natural gas combustion in VDUs.
(3) Source is from natural gas combustion in VDUs.

Table 10. Toxicity Factors used in the HRA

Pollutant	*CAS Number*	*Inhalation Cancer Unit Risk Factor* $(\mu g/m^3)^{-1}$	*Chronic Inhalation REL* $(\mu g/m^3)$	*Target Organ for Chronic Exposure*	*Acute Inhalation REL* [1] $(\mu g/m^3)$	*Target Organ for Acute Exposure*
1,3-Butadiene	106-99-0	1.7×10^{-4}	20.0	Repr	n/a	n/a
Acetaldehyde	75-07-0	2.7×10^{-6}	9.0	Resp	n/a	n/a
Acrolein	107-02-8	n/a	0.06	Resp; Eyes	0.19	Eyes
Benzene	71-43-2	2.9×10^{-5}	60	Dev; CNS	1,300	Dev; Repr
Chlorobenzene	108-90-7	n/a	1,000	Al; Kid; Repr	n/a	n/a
Ethylbenzene	100-41-4	n/a	2,000	Al; Dev; Kidney; Endo	n/a	n/a
Formaldehyde	50-00-0	6.0×10^{-6}	3.0	Resp; Eyes	94	Eyes
Isomers of Xylene	1330-20-7	n/a	700	CNS; Resp	22,000	Eyes; Resp
Methyl Alcohol	67-56-1	n/a	4,000	Dev	28,000	CNS
MEK	78-93-3	n/a	1,000	Repr	13,000	Eyes; Resp
Naphthalene	91-20-3	3.4×10^{-5}	9.0	Resp	n/a	n/a
N-Hexane	110-54-3	n/a	7,000	CNS	n/a	n/a
Propylene	115-07-1	n/a	3,000	Resp	n/a	n/a
PAH	50-32-8	1.1×10^{-3}	n/a	n/a	n/a	n/a
Styrene	100-42-5	n/a	900	CNS	21,000	Eyes; Resp
Toluene	108-88-3	n/a	300	CNS; Dev; Resp	37,000	CNS; Eyes; Resp
DPM	9901	3.0×10^{-4}	5.0	Resp	n/a	n/a
Ammonia	7664-41-7	n/a	200	Resp	3,200	Eyes; Resp
Antimony	7440-36-0	n/a	0.2	Resp	n/a	n/a
Arsenic	7440-38-2	3.3×10^{-3}	0.03	Dev; CV; CNS	0.19	Dev; Repr
Bromine	7726-95-6	n/a	1.7	Resp	n/a	n/a
Cadmium	7740-43-9	4.2×10^{-3}	0.02	Kid; Resp	n/a	n/a
Chromium	18540-29-9	1.5×10^{-1}	0.2	Resp	n/a	n/a
Copper	7440-50-8	n/a	2.4	Resp	100	Resp
Lead	7439-92-1	1.2×10^{-5}	n/a	n/a	n/a	n/a
Manganese	7439-96-5	n/a	0.2	CNS	n/a	n/a
Mercury	7439-97-6	n/a	0.09	CNS	1.8	Dev; Repr
Nickel	7440-02-0	2.6×10^{-4}	0.05	Resp; Hem	6.0	Resp; Imm
Phosphorous	7723-14-0	n/a	0.07	Dev; Repr	n/a	n/a
Selenium	7782-49-2	n/a	20.0	Al; CV; CNS	n/a	n/a
Sulfates	9960	n/a	25.0	Resp	120	Resp
Vanadium	7440-62-2	n/a	n/a	n/a	30	Resp
Zinc	7440-66-6	n/a	35.0	CV; Hem; Resp	n/a	n/a

Notes:

(1) The acute exposure period is 1 hour for all compounds except arsenic (4 hours) and benzene (6 hours).

Key:

- n/a = not applicable
- AL = Alimentary System
- CNS = Central Nervous System
- CV = Cardiovascular System
- Dev = Developmental System
- Endo = Endocrine System
- Hem = Hematopoietic System
- Imm = Immune System
- Kid = Kidney
- NS = Nervous System
- Repr = Reproductive System
- Resp = Respiratory System

Source: CARB 2005.

5.2 Exposure Scenarios for Individual Lifetime Cancer Risk

For the cancer risk evaluation, the frequency and duration of exposure to TACs are assumed to be directly proportional to the risk. Therefore, this HRA used specific exposure assumptions for each receptor type, as described below.

1. **Residential and Sensitive Receptors.** The HRA estimated cancer risks for residential and sensitive receptors with the use of breathing rates described in the CARB Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk (October 2003) (CARB 2004). For risk assessments based on the inhalation pathway only (as appropriate for DPM), where a single cancer risk value is required for a risk management decision, the CARB policy recommends that the potential cancer risk be based on the breathing rate representing the 80th percentile for a 70-year exposure period. The 80th percentile lifetime breathing rate is equal to 302 liters per kilogram of body weight per day (L/kg BW-day) (CARB 2004). Therefore, the HRA determined maximum residential and sensitive receptor cancer risk impacts by using HARP's built-in 80th percentile point estimate analysis method (inhalation only) and an exposure duration of 24 hours per day, 350 days per year, and 70 years (i.e., the "Derived [Adjusted]" risk calculation method). As supplemental information, residential and sensitive receptor cancer risks were also calculated using a 65th percentile ("average") breathing rate of 271 L/kg BW-day and a 95th percentile ("high end") breathing rate of 393 L/kg BW-day.

2. **Occupational impacts.** Workers generally do not spend as much time within a project region as residents of the region. The SCAQMD therefore allows an exposure adjustment for workers (SCAQMD 2005a). Lifetime occupational exposure is based on a presence of 8 hours per day, 245 days per year (HARP uses a value of 245.7), for 40 years (as recommended by OEHHA [2003]). This exposure time produces an adjustment factor of $(8 \times 245.7 \times 40)/(24 \times 350 \times 70) = 0.134$. This factor is further modified to account for differences in the breathing rate of workers compared to the 80th percentile lifetime breathing rate. The breathing rate for workers is equal to 447 L/kg BW-day, which equates to 149 L/kg BW-day over an 8-hour work day (OEHHA 2003). Therefore, the residential risk values predicted at occupational receptors were multiplied by $(0.134 \times 447 / 302) = 0.20$ to produce the maximum occupational impacts actually expected from the project.

3. **Student impacts.** Since HARP does not directly compute risks for student receptors, risks to students were scaled from the results for residents. It is the policy of the SCAQMD to evaluate student cancer risk impacts based upon 70 years of exposure. However, students actually spend a limited time at a given school. Based upon an assumed maximum presence of 6 hours per day, 180 days per year, for 6 years, this exposure time produces an adjustment factor of $(6 \times 180 \times 6)/(24 \times 350 \times 70) = 0.011$. This factor is further modified to account for differences in the breathing rate of children compared to the 80th percentile lifetime breathing rate. The high-end breathing rate for children is equal to 581 L/kg BW-day (OEHHA 2003). Therefore, the risk values predicted at school sites were multiplied by $(0.011 \times 581 / 302) = 0.021$ to produce the maximum student impacts actually expected from the project. As supplemental information, the risk values assuming a SCAQMD-recommended full 70 years of exposure are also reported in this HRA.

4. **Recreational user impacts.** Because HARP does not directly compute risks for recreational exposure assumptions, risks for recreational receptors were scaled from the results for residents. Based upon an assumed maximum recreational presence of 2 hours per day, 350 days per year, for 70 years, an adjustment factor of (2 × 350 × 70)/(24 × 350 × 70) = 0.0833 is produced. This factor is further modified to account for differences in the breathing rate of a person engaged in recreation compared to the 80th percentile lifetime breathing rate. The breathing rate during recreation is assumed to be a "heavy activity" rate equal to 1,097 L/kg BW-day, which was obtained from the US EPA Exposure Factors Handbook (USEPA, 1997). Therefore, the risk values predicted in recreation areas were multiplied by (0.0833 × 1,097 / 302) = 0.30 to produce the maximum recreational user impacts expected from the project.

Table 11 summarizes the primary exposure assumptions used to calculate individual lifetime cancer risks by receptor type.

Table 11. Exposure Assumptions for Individual Lifetime Cancer Risk

Receptor Type	*Exposure Frequency*		*Exposure Duration (Years)*	*Breathing Rate (L/kg BW-day)*
	Hours/Day	*Days/Year*		
Residential [1]	24	350	70	302
Sensitive [1]	24	350	70	302
Occupational [2]	8	245.7	40	447
Student [3]	6	180	6	581

Notes:

(1) The residential/sensitive receptor breathing rate of 302 L/kg BW-day represents the 80th percentile breathing rate. For informational purposes, residential cancer risks were also calculated for a 65th percentile ("average") breathing rate of 271 L/kg BW-day and a 95th percentile ("high end") breathing rate of 393 L/kg BW-day (OEHHA 2003).

(2) The occupational exposure frequency of 245.7 days/year represents 5 days/week, 49 weeks/year. The occupational breathing rate of 447 L/kg BW-day equates to 149 L/kg BW-day over an 8-hour work day (OEHHA 2003).

(3) The student breathing rate of 581 L/kg BW-day represents the high end child breathing rate (OEHHA 2003).

The HARP model printouts for this HRA are too voluminous to include in an attachment; they are available in electronic format upon request.

6.0 SIGNIFICANCE CRITERIA FOR PROJECT HEALTH RISKS

For the determination of significance from a California Environmental Quality Act (CEQA) standpoint, this HRA determined the incremental increase in health effects values due to the proposed Project by estimating the net change in impacts between the proposed Project and CEQA Baseline conditions. For the determination of significance from a National Environmental Policy Act (NEPA) standpoint, this HRA determined the incremental increase in health effects values due to the proposed Project by estimating the net change in impacts between the proposed Project and NEPA Baseline. Both of these incremental health effects values (Project minus CEQA Baseline and Project minus NEPA Baseline) were compared to the significance thresholds described below.

The SCAQMD has established thresholds to determine the significance of health impacts from proposed land use development projects (SCAQMD 2005a). Based on these thresholds, a project would produce less than significant cancer risk impacts if the maximum incremental cancer risk due to the project alone were less than 10 chances in 1 million (10 × 10-6). The Port has adopted this SCAQMD threshold as being an acceptable risk level for new projects. To determine a project's significance, the HRA compared the CEQA and NEPA increments for all receptor types to the 10 in a million threshold.

For chronic and acute noncancer exposures, the HRA compared maximum predicted annual and 1-hour TAC concentrations to applicable RELs developed by OEHHA. A hazard index (defined as the summation of predicted TAC concentrations divided by their respective RELs) less than 1.0 indicates that the exposure would present an acceptable or insignificant health risk (i.e., no adverse noncancer health impact). Hazard indexes above 1.0 represent the potential for an unacceptable or significant health risk.

7.0 PREDICTED HEALTH IMPACTS

7.1 Unmitigated Project Health Impacts

Table 12 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of the Project. Because these results represent the maximum impacts predicted for each receptor type, all other impacts for similar receptor types would be less than these values.

The data in Table 12 show that the maximum Project residential cancer risk would be 12 in a million, which would occur in the Reservation Point correctional facility, which has housing. This number is greater than the 10 in a million threshold. The maximum chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential.

The maximum Project occupational cancer risk of 9.7 in a million would occur at the Maersk Inspection Building, in the APM/Maersk Pier 400 terminal. The maximum Project cancer risk for a sensitive receptor (the Federal Correctional Institution medical facilities on Terminal Island at Reservation Point) would be 12 in a million.

Figure H4-2 presents the distributions of residential and occupational cancer risks estimated for the proposed Project without mitigation. It should be noted that residential and occupational impact points are not necessarily located directly on existing homes or workplaces; rather, they are located in areas that contain these land use types.

Table 12. Maximum Health Impacts Produced by the Proposed Project without Mitigation

Health Impact	*Receptor Type*	*Maximum Impact* [1, 2]	*Significance Thresholds*	*Significant Impact*
Cancer Risk	Residential	12×10^{-6} (12 in a million)	10.0×10^{-6} (10 in a million)	Yes
	Occupational Area	9.7×10^{-6} (9.7 in a million)		No
	Sensitive Receptor	12×10^{-6} (12 in a million)		Yes
	Student	6.9×10^{-6} (6.9 in a million)		No
Non-Cancer Chronic Hazard Index	Residential	0.017	1.0	No
	Occupational Area	0.073		No
	Sensitive Receptor	0.017		No
	Student	0.012		No
Non-Cancer Acute Hazard Index	Residential	0.040	1.0	No
	Occupational Area	0.043		No
	Sensitive Receptor	0.040		No
	Student	0.028		No

Notes:

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of 10.0×10^{-6} would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (APM/Maersk); sensitive receptor, Reservation Point; student receptor, Point Fermin Elementary School.

7.2 Mitigated Project Health Impacts

The HRA evaluated the reduction of public health impacts that would occur with the implementation of feasible mitigation measures. Based upon technological feasibility, consideration of future schedules for implementation of emissions and fuel standards, and costs, the following measures were analyzed as the most feasible for adoption: (1) mandatory speed reduction for vessels within California Coastal Waters, (2) use of low-sulfur fuel in vessel auxiliary generators and boilers while at berth, and (3) use of cleaner, lower-sulfur fuel in vessel auxiliary generators and boilers while cruising and maneuvering in coastal waters. (Refer to the discussion of impact AQ-3 in Section 3.2.4.5.1 of the SEIS/SEIR for a discussion of these adopted mitigation measures and other measures that were investigated but found to be infeasible.)

Table 13 presents a summary of the maximum mitigated health impacts that would occur for each receptor type due to the operation of the Project. These data show that the Project maximum mitigated residential cancer risk would be 5.3 in a million, which would occur at Reservation Point. Therefore, operation of the mitigated Project would produce less then significant cancer risks residential receptors. The Project maximum mitigated chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential receptors.

Table 13. Maximum Health Impacts Produced by the Proposed Project with Mitigation

Health Impact	*Receptor Type*	*Maximum Impact* [1,2]	*Significance Thresholds*	*Significant Impact*
Cancer Risk	Residential	5.3×10^{-6} (5.3 in a million)	10.0×10^{-6} (10 in a million)	No
	Occupational Area	4.8×10^{-6} (4.8 in a million)		No
	Sensitive Receptor	5.3×10^{-6} (5.3 in a million)		No
	Student	2.4×10^{-6} (2.4 in a million)		No
Non-Cancer Chronic Hazard Index	Residential	0.0095	1.0	No
	Occupational Area	0.044		No
	Sensitive Receptor	0.0095		No
	Student	0.0064		No
Non-Cancer Acute Hazard Index	Residential	0.019	1.0	No
	Occupational Area	0.026		No
	Sensitive Receptor	0.019		No
	Student	0.013		No

Notes:

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of 10.0×10^{-6} would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (APM/Maersk); sensitive receptor, Reservation Point; student receptor, Point Fermin Elementary School.

Figure H4-3 presents the distributions of residential and occupational cancer risks estimated for the proposed Project with mitigation.

7.3 Unmitigated Reduced Project Health Impacts

Table 14 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of the Reduced Project Alternative. Because these results represent the maximum impacts predicted for each receptor type, all other impacts for similar receptor types would be less than these values.

The data in Table 14 show that the maximum Reduced Project residential cancer risk would be 25 in a million, which would occur in the Reservation Point correctional facility, which has housing. This number is greater than the 10 in a million threshold. The maximum chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential.

The maximum Reduced Project occupational cancer risk of 9.6 in a million would occur at the Maersk Inspection Building, in the APM/Maersk Pier 400 terminal. The maximum Reduced Project cancer risk for a sensitive receptor (the Federal Correctional Institution medical facilities on Terminal Island at Reservation Point) would be 25 in a million.

Table 14. Maximum Health Impacts Produced by the Reduced Project Alternative without Mitigation

Health Impact	*Receptor Type*	*Maximum Impact* [1, 2]	*Significance Thresholds*	*Significant Impact*
Cancer Risk	Residential	25 x 10^{-6} (25 in a million)	10.0 x 10^{-6} (10 in a million)	Yes
	Occupational Area	9.6 x 10^{-6} (9.6 in a million)		No
	Sensitive Receptor	25 x 10^{-6} (25 in a million)		Yes
	Student	11 x 10^{-6} (11 in a million)		Yes
Non-Cancer Chronic Hazard Index	Residential	0.093	1.0	No
	Occupational Area	0.059		No
	Sensitive Receptor	0.098		No
	Student	0.098		No
Non-Cancer Acute Hazard Index	Residential	0.074	1.0	No
	Occupational Area	0.042		No
	Sensitive Receptor	0.083		No
	Student	0.083		No

Notes:

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of 10.0 x 10-6 would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (APM/Maersk); sensitive receptor, Reservation Point; student receptor, Point Fermin Elementary School.

Figure H4-4 presents the distributions of residential and occupational cancer risks estimated for the Reduced Project without mitigation. It should be noted that residential and occupational impact points are not necessarily located directly on existing homes or workplaces; rather, they are located in areas that contain these land use types.

7.4 Mitigated Reduced Project Health Impacts

The HRA evaluated the reduction of public health impacts that would occur with the implementation of feasible mitigation measures under the Reduced Project Alternative. For the Berth 408 and associated PLAMT operations, the Reduced Project analysis assumed that the mitigation measures discussed under the proposed Project would be applied. Under the Reduced Project Alternative, it is assumed that several existing crude oil terminals within the San Pedro Bay Ports (SPBP) complex would receive additional crude oil due to market demand. For these terminals, it was assumed to certain measures of the SPBP Clean Air Action Plan (CAAP) would eventually be applied to those terminals under lease renewal schedules (see SEIS/SEIR Section 3.2 for a discussion of these applied measures.)

Table 15 presents a summary of the maximum mitigated health impacts that would occur for each receptor type due to the operation of the Reduced Project. These data show that the Reduced Project maximum mitigated residential cancer risk would be 18 in a million, which would occur at Reservation Point. Therefore, operation of the mitigated Project would produce significant cancer risks residential receptors. The Project maximum mitigated chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential receptors.

Figure H4-5 presents the distributions of residential and occupational cancer risks estimated for the Reduced Project with mitigation.

Table 15. Maximum Health Impacts Produced by the Reduced Project Alternative with Mitigation

Health Impact	*Receptor Type*	*Maximum Impact* [1,2]	*Significance Thresholds*	*Significant Impact*
Cancer Risk	Residential	18×10^{-6} (18 in a million)	10.0×10^{-6} (10 in a million)	Yes
	Occupational Area	5.8×10^{-6} (5.8 in a million)		No
	Sensitive Receptor	18×10^{-6} (18 in a million)		Yes
	Student	5.7×10^{-6} (5.7 in a million)		No
Non-Cancer Chronic Hazard Index	Residential	0.077	1.0	No
	Occupational Area	0.025		No
	Sensitive Receptor	0.087		No
	Student	0.087		No
Non-Cancer Acute Hazard Index	Residential	0.050	1.0	No
	Occupational Area	0.019		No
	Sensitive Receptor	0.066		No
	Student	0.066		No

Notes:

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of 10.0×10^{-6} would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (APM/Maersk); sensitive receptor, Reservation Point; student receptor, Fifteenth Street Elementary School.

7.5 No Federal Action/No Project Alternative Health Impacts

The HRA evaluated the reduction of public health impacts that would occur with the implementation of feasible mitigation measures under the No Federal Action/No Project Alternative. As with the Reduced Project Alternative, the No Federal Action/No Project Alternative assumed that several existing crude oil terminals within the SPBP complex would receive additional crude oil due to market demand. For these terminals, it was assumed to certain measures of the SPBP CAAP would eventually be applied to those terminals under lease renewal schedules (see SEIS/SEIR Section 3.2 for a discussion of these applied measures).

Table 16 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of the No Federal Action/No Project Alternative. These data show that the No Project maximum residential cancer risk would be 26 in a million, which would occur at Reservation Point. Therefore, operation of the mitigated Project would produce significant cancer risks for residential receptors. The maximum occupational impact would be 23 in a million, which is above the significant threshold. Additionally, the maximum sensitive receptor impact would be above the significance threshold. The Project maximum mitigated chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential receptors.

Table 16. Maximum Health Impacts Produced by the No Federal Action/No Project Alternative

Health Impact	*Receptor Type*	*Maximum Impact* [1,2]	*Significance Thresholds*	*Significant Impact*
Cancer Risk	Residential	26×10^{-6} (26 in a million)	10.0×10^{-6} (10 in a million)	Yes
	Occupational Area	23×10^{-6} (23 in a million)		Yes
	Sensitive Receptor	26×10^{-6} (26 in a million)		Yes
	Student	17×10^{-6} (17 in a million)		Yes
Non-Cancer Chronic Hazard Index	Residential	0.061	1.0	No
	Occupational Area	0.078		No
	Sensitive Receptor	0.073		No
	Student	0.073		No
Non-Cancer Acute Hazard Index	Residential	0.19	1.0	No
	Occupational Area	0.29		No
	Sensitive Receptor	0.23		No
	Student	0.23		No

Notes:
1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of 10.0×10^{-6} would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (south fenceline of Tank Farm Site 2); sensitive receptor, Reservation Point; student receptor, Childtime Learning Center.

Figure H4-6 presents the distributions of residential and occupational cancer risks estimated for the No Federal Action/No Project Alternative.

8.0 RISK UNCERTAINTY

OEHHA (2003) provides a discussion of risk uncertainty, which is presented here:

There is a great deal of uncertainty associated with the process of risk assessment. The uncertainty arises from lack of data in many areas necessitating the use of assumptions. The assumptions used in these guidelines are designed to err on the side of health protection in order to avoid underestimation of risk to the public. Sources of uncertainty, which may either overestimate or underestimate risk, include: 1) extrapolation of toxicity data in animals to humans, 2) uncertainty in the estimation of emissions, 3) uncertainty in the air dispersion models, and 4) uncertainty in the exposure estimates. Uncertainty may be defined as what is not known and may be reduced with further scientific studies. In addition to uncertainty, there is a natural range or variability in the human population in such properties as height, weight, and susceptibility to chemical *toxicants. Scientific studies with representative individuals and large enough sample size can characterize this variability.*

Interactive effects of exposure to more than one carcinogen or toxicant are also not necessarily quantified in the HRA. Cancer risks from all emitted carcinogens are typically added, and hazard quotients for substances impacting the same target organ system are added to determine the hazard index (HI). Many examples of additivity and synergism (interactive effects greater than additive) are known. For substances that act synergistically, the HRA could underestimate the risks. Some substances may have antagonistic effects (lessen the toxic effects produced by another substance). For substances that act antagonistically, the HRA could overestimate the risks.

Other sources of uncertainty, which may underestimate or overestimate risk, can be found in exposure estimates where little or no data are available (e.g., soil half-life and dermal penetration of some substances from a soil matrix).

The differences among species and within human populations usually cannot be easily quantified and incorporated into risk assessments. Factors including metabolism, target site sensitivity, diet, immunological responses, and genetics may influence the response to toxicants. The human population is much more diverse both genetically and culturally (e.g., lifestyle, diet) than inbred experimental animals. The intraspecies variability among humans is expected to be much greater than in laboratory animals. Adjustment for tumors at multiple sites induced by some carcinogens could result in a higher potency. Other uncertainties arise 1) in the assumptions underlying the dose-response model used, and 2) in extrapolating from large experimental doses, where, for example, other toxic effects may compromise the assessment of carcinogenic potential, to usually much smaller environmental doses. Also, only single tumor sites induced by a substance are usually considered. When epidemiological data are used to generate a carcinogenic potency, less uncertainty is involved in the extrapolation from workplace exposures to environmental exposures. However, children, a subpopulation whose hematological, nervous, endocrine, and immune systems, for example, are still developing and who may be more sensitive to the effects of carcinogens on their developing systems, are not included in the worker population and risk estimates based on occupational epidemiological data are more uncertain for children than adults. Finally, the quantification of each uncertainty applied in the estimate of cancer potency is itself uncertain.

Thus, risk estimates generated by an HRA should not be interpreted as the expected rates of disease in the exposed population but rather as estimates of potential risk, based on current knowledge and a number of assumptions. Additionally, the uncertainty factors integrated within the estimates of non-cancer RELs are meant to err on the side of public health protection in order to avoid underestimation of risk. Risk assessment is best used as a ruler to compare one source with another and to prioritize concerns. Consistent approaches to risk assessment are necessary to fulfill this function.

Additionally, please see Appendix H.3 for a brief primer on HRAs at the Port of Los Angeles.

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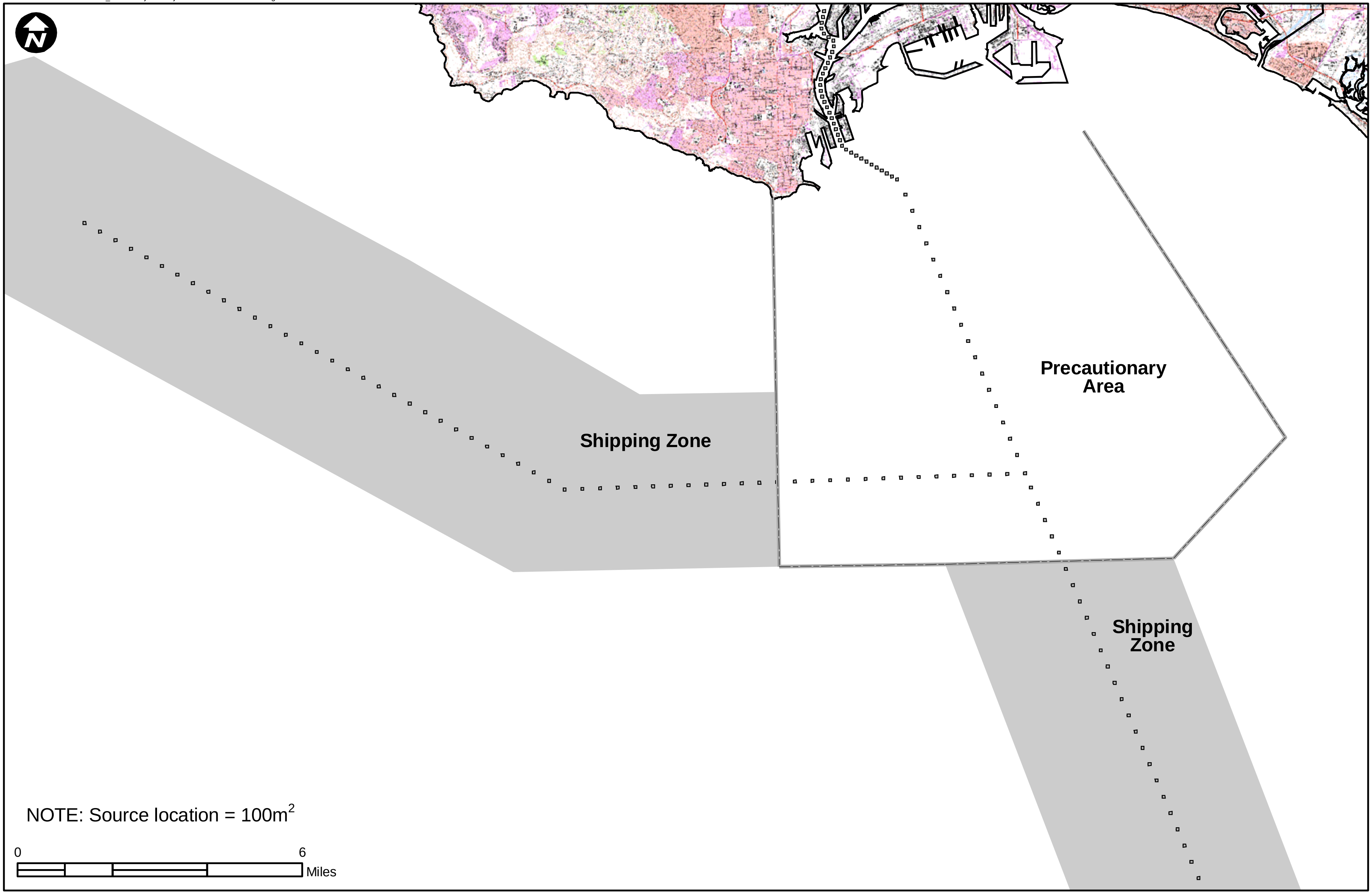

Figure H.4-1. Vessel Transit Volume Source Locations Simulated in the Dispersion Modeling Analyses

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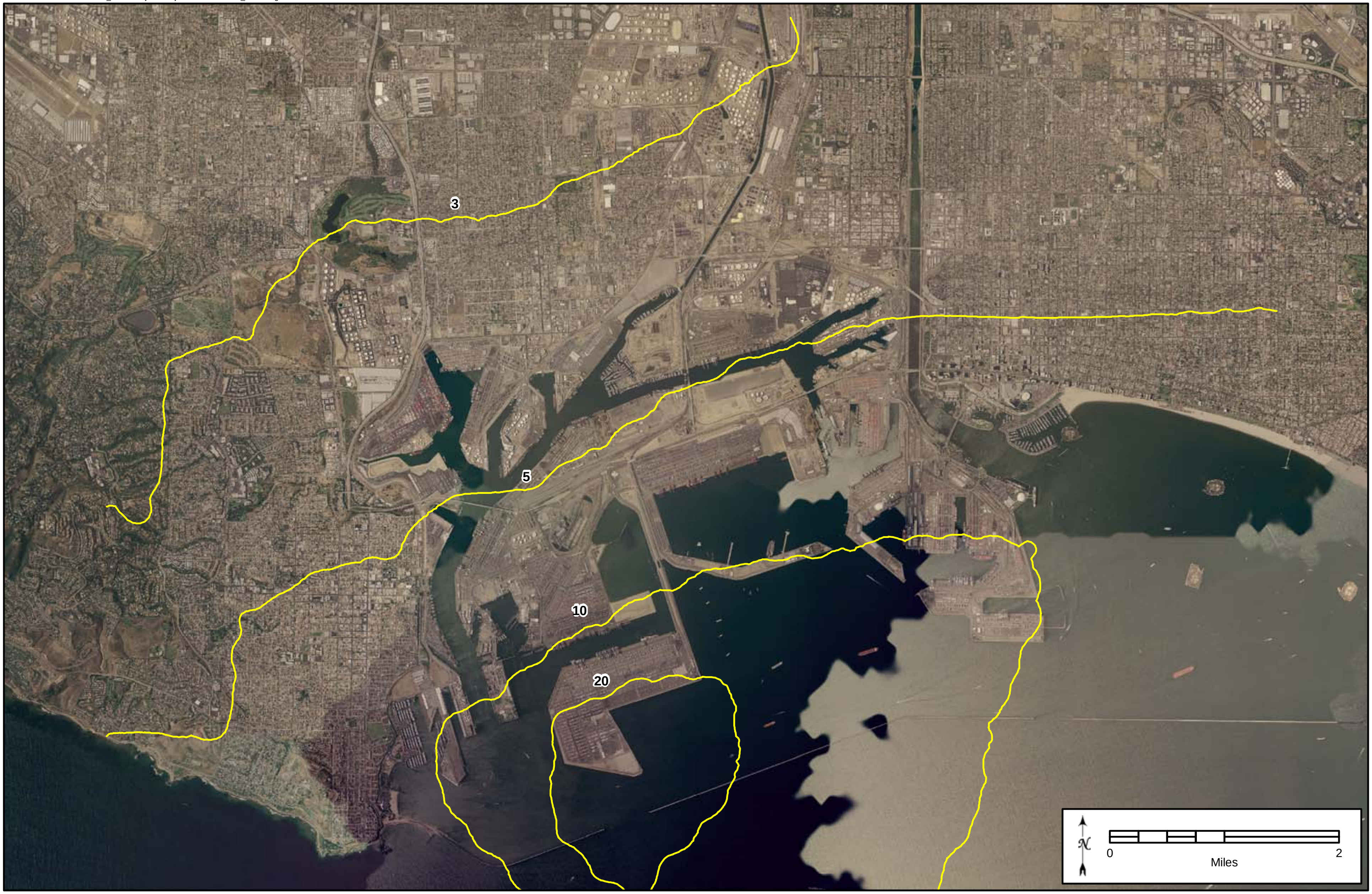

Figure H.4-2. Proposed Project without Mitigation: Residential Cancer Risk under CEQA

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Figure H.4-3. Proposed Project with Mitigation: Residential Cancer Risk under CEQA

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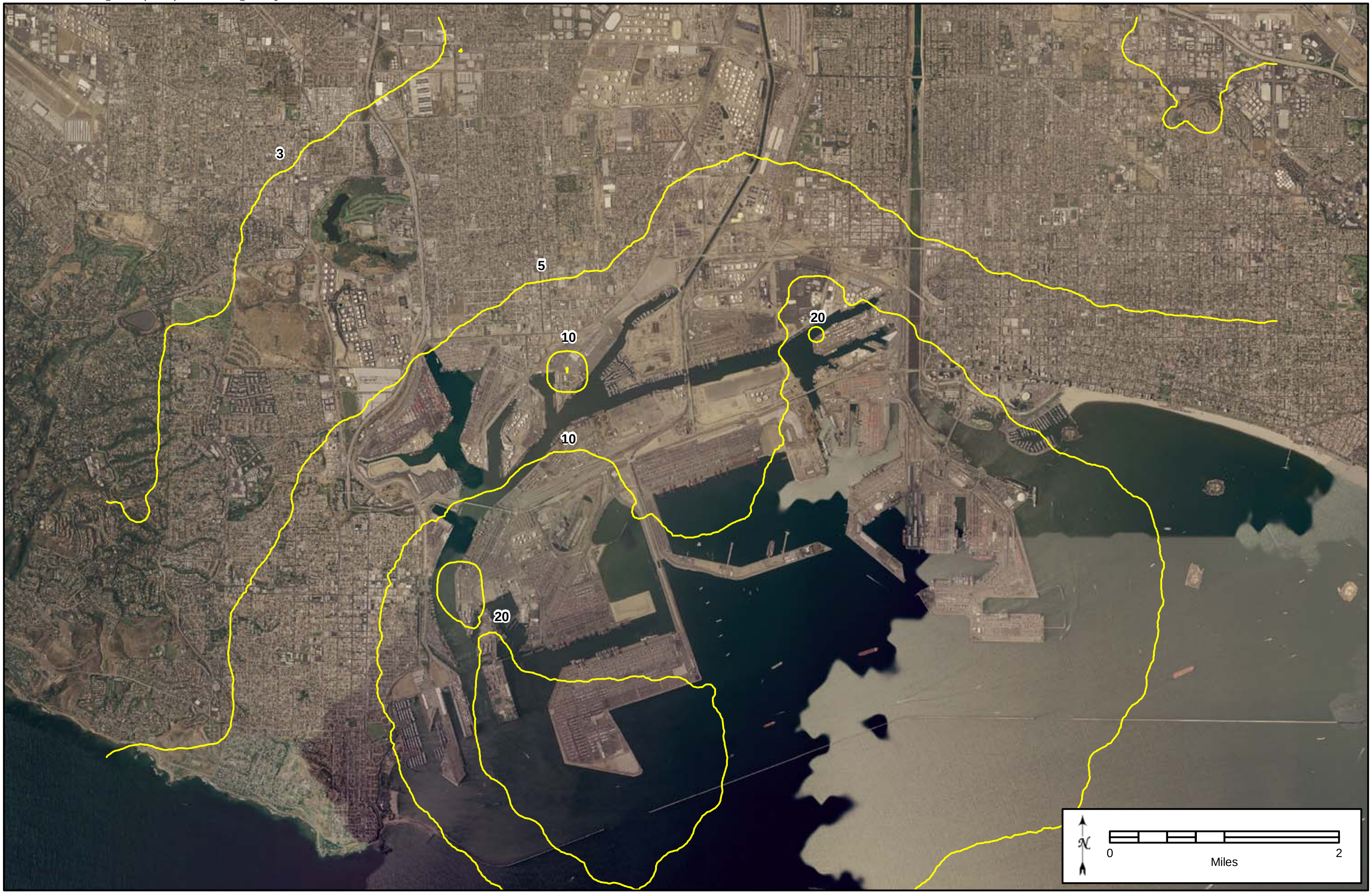

Figure H.4-4. Reduced Project Alternative without Mitigation: Residential Cancer Risk under CEQA