Risk and Technology Review -

Analysis of Socio-Economic Factors for Populations Living Near Marine Vessel Loading Facilities

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EPA Contract No. EP-D-06-119
Work Assignment No. 3-14

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August 6, 2010

Disclaimer

Although the analysis described in this document has been funded wholly or in part by the United States Environmental Protection Agency contract EP-D-06-119 to EC/R Incorporated, it has not been subject to the Agency's review and therefore does not necessarily reflect the views of the Agency, and no official endorsement should be inferred.

Contents

1. Introduction

This document describes the approach used to evaluate the potential cancer risks that may affect different social, demographic, and economic groups within the populations living near marine vessel loading facilities associated with inhalation exposures to hazardous air pollutants (HAP) emitted by these facilities. This work was carried out in support of the U.S. Environmental Protection Agency's Residual Risk and Technology Review (RTR) for marine vessel loading emissions subject to Maximum Available Control Technology (MACT) requirements under 40 CFR 63 Subpart Y.

In the RTR analysis, risks due to the inhalation of HAP were modeled for the populations residing within 50 kilometers of each marine vessel loading facility using the Human Exposure Model, Version 3 (HEM3).[1,2] HEM3 estimates cancer and noncancer risks at the level of census blocks using the AERMOD state-of-the-art air dispersion model developed under the direction of the American Meteorological Society (AMS) / EPA Regulatory Model Improvement Committee (AERMIC). Each census block typically includes about 50 people. Additional information on the risk analysis is available in the docket for the proposed **National Emission Standards for Hazardous Air Pollutant Emissions: Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks; Group I Polymers and Resins; Marine Tank Vessel Loading Operations; Pharmaceuticals Production; The Printing and Publishing Industry; and Steel Pickling--HCl Process Facilities and Hydrochloric Acid Regeneration Plants** rulemaking where a memo to the docket is provided, covering the inputs and specific assumptions, and addressing uncertainties specific to each category.

In the current analysis, cancer risk predictions from the marine vessel loading HEM3 modeling effort were linked to detailed census data in order to evaluate the distribution of risks for different social, demographic and economic groups. The following population categories were studied:

- Total population
- White
- Minority
- African American (or Black)
- Native Americans
- Other races and multiracial
- Hispanic or Latino

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1. EC/R. 2006. Modeling for the Residual Risk and Technology Review Using the Human Exposure Model 3 – AERMOD Version. Prepared by EC/R Incorporated for the U.S. Environmental Protection Agency, Research Triangle Park, NC.

2. EC/R. 2008. HEM-3 User's Guide. Prepared by EC/R Incorporated for the U.S. Environmental Protection Agency, Research Triangle Park, NC. http://www.epa.gov/ttn/fera/human_hem.html#guide

- Children 18 years of age and under
- Adults 19 to 64 years of age
- Adults 65 years of age and over
- Adults without a high school diploma
- Households earning under the national median income
- People living below the poverty line

The HEM3 results for a particular census block reflect the level of risk that would be experienced by an individual residing in the block for 70 years. In addition, the HEM3 risk estimates are not adjusted for commuting patterns or for the difference between indoor and outdoor pollutant concentrations.

The distributions of source category risks across the various demographic groups were compared to: 1) those associated with HAP sources at the facilities containing the source category (i.e., "facility-wide"); and 2) nationwide distributions of each of the demographics groups. The "facility-wide" and nationwide inhalation risks were obtained from the final National-scale Air Toxics Assessment (NATA) for 2005, which estimates the risks associated with HAP emissions from all stationary sources, onroad and nonroad mobile sources, dispersed area sources, and the background due to long-range transport and natural emissions.[3] Two separate analyses of the risk distributions were performed. One focused on the demographics of those individuals projected to experience a risk of 1 in a million or greater. The other focused on the demographics of those individuals living within 5 kilometers of a marine vessel loading facility, regardless of the projected risk.

The census data used in this analysis is described in Section 2. The algorithms used to compute the distributions of risk and exposure are presented in Section 3. The results of this analysis are presented in Section 4.

2. Census Data

Table 1 summarizes the census data used in this analysis, showing the source of each dataset and the level of geographic resolution. All of the data are from the 2000 Decennial census. Race and ethnicity data were obtained at the census block level. Age distributions, data on educational status, and economic data were obtained at the block group level. A census block contains about 50 people on average; and a block group contains about 26 blocks on average, or about 1,350 people. (For comparison, a census tract is larger than a block group, with each tract containing an average of 3 block groups, or about 4,300 people.)

3. EPA. 2009. National Air Toxics Assessments. U.S. Environmental Protection Agency, Research Triangle Park, NC. http://www.epa.gov/ttn/atw/natamain/

Table 1. Summary of Census Data used to Analyze Risks for Different Socio-economic Groups

Type of population category	Source of data	Level of geographic resolution
Racial and ethnic categories	Landview®	Census block
Age groups	SF3 Table P8	Block group
Level of education - adults without a high school diploma	SF3 Table 37	Block group
Households earning below the national median income	SF3 Table 52	Block group
People living below the poverty line	SF3 Table P87	Block group

Data on race and ethnicity were obtained primarily from the Landview® database compiled by the Census Department.[4] Landview® gives a breakdown for the population of each census block among different racial classifications, including: White, African American or Black, American Indian or Native Alaskan, Asian, Native Hawaiian or other South Pacific Islander, other race, and two or more races. In the current analysis, the Asian, Native Hawaiian or other South Pacific Islander, and other race categories were combined into a single category. The Landview® database also indicates the number of people in each tract that are of Hispanic or Latino ethnicity. Landview® covers the 50 states, the District of Columbia, and Puerto Rico, but does not cover the Virgin Islands. Race and ethnicity data on the Virgin Islands were obtained from the Virgin Islands Summary File.[5]

Data on age distributions, poverty status, household incomes, and education level in the U.S. and Puerto Rico were obtained from the 2000 Census of Population and Housing Summary File 3 (SF3) Long Form. For the U.S. this file was accessed on a DVD version prepared by GeoLytics.[6] SF3 data for Puerto Rico were obtained from the Census Department website,[7] and data for the Virgin Islands were retrieved from similar tables in the Virgin Islands Summary File.[5]

The SF3 data set consists of over 800 separate tables, each providing information on a different subject. For the current analysis, data were obtained from Tables P8, P37, P52, and P87. Table P8 gives the estimated numbers of men and women in different age categories for

4. Census. 2002. LandView 5 on DVD [electronic resource] : a viewer for EPA, Census and USGS data and maps. U.S. Census Bureau, Washington, D.C.

5. Census. 2008. Virgin Islands Summary File. U.S. Census Bureau, Washington, D.C. www.factfinder.census.gov

6. Census. 2004. Census DVD 2000 Long Form SF3, Release 2.2. Geolytics, Inc., East Brunswick, NJ. www.geolytics.com

7. Census. 2008. SF3 Data for Puerto Rico. U.S. Census Bureau, Washington, D.C. www.factfinder.census.gov

each census block group. Table P37 analyzes the level of education attained by men and women over 25 years of age (e.g. some high school but no high school diploma, high school graduate, some college, etc.). Table P52 gives information on household income in 1999, and Table P87 estimates the number of people living below the poverty line in each block group.

3. Calculation Methods

The HEM3 models the cancer risk at a point near the geographic center of each census block.[8] For the current analysis, this risk estimate was assumed to apply to all individuals residing in the block. We used block identification codes to link the HEM3 modeling results for each block to the appropriate census statistics. This allowed us to estimate the numbers of people falling into different population subcategories within each block. We then analyzed the distribution of estimated inhalation risks within each population subcategory, giving the numbers of people within the subcategory that are exposed to different risk levels. Each distribution involved a tabulation of all the census blocks modeled for the marine vessel loading source category. We also computed the average risk for all individuals in each population subcategory.

Distributions of risk and average risks were computed for the raw HEM3 model results for marine vessel loading. For comparison, distributions of risk and average risks were also computed for all emission sources at the facility (including marine vessel loading) (e.g., "facility-wide"), and in the country as a whole.

Section 3.1 describes the calculation method used for categories where block-level data were available -- racial and ethnic categories and the total population. Sections 3.2 through 3.5 describe calculation methods for age categories, education status, household income, and poverty status, respectively.

3.1 Racial and Ethnic Categories and the Total Population

Since race and ethnicity data were available at the census block level, the calculation of risk distributions for these categories involved a simple block-by-block accumulation of the people in each subcategory. We began by identifying a set of bins reflecting the level of risk. The population of each block was then assigned to the appropriate risk bin based on the modeled risk level in the block. The numbers of people in each risk bin were then added together for all of the blocks modeled for the marine vessel loading source category:

$$H(R_{ab},s) = \sum_i^{(Ra \le Ri < Rb)} [N(s,i)] \qquad (1)$$

where:

$H(R_{ab},s)$ = the population count for risk bin R_{ab}, which is between R_a and R_b for population subgroup "s"

8. HEM3 generally uses the coordinates given by the census for the internal point, or "centroid" of each block. However, when the footprint of an industrial facility includes the block centroid, the model is designed to identify the highest-risk point outside of the facility's footprint.

R_i = the modeled risk level in block "i" (estimated lifetime cases of cancer per million population)

$\sum_i^{(Ra \le Ri < Rb)}$ refers to the summation over all blocks i where R_i falls in bin R_{ab}, between R_a and R_b

N(s,i) = the number of people within population subcategory s, in block i

The same approach was used for the total population. The average risk for a given population subcategory or for the total population was calculated using the following equation:

$$A(S) = \sum_i [N(s,i) \times R_i] / \sum_i [N(s,i)] \quad (2)$$

where:

A(s) = the average risk for population subgroup "s" (estimated lifetime cases of cancer per million population)

$\sum_i$ refers to the summation over all blocks "i" modeled for the emission source category

N(s,i) and R_i were defined above

It must be noted that in the overall NATA risk analysis, only stationary sources were modeled at the census block level. Risks due to onroad and nonroad mobile emissions sources, dispersed area sources, and ambient background levels of HAP were analyzed at the census tract level instead of the block level. EPA chose this larger scale of analysis for these categories for two reasons. First, the locations of these sources are not known definitively. Rather, the geographic distribution of emissions for these categories has been estimated from county level emissions data. Second, emissions from these categories are believed to be more uniformly distributed within a given county or census tract. Therefore, in the current analysis, we have assumed that the NATA risks for mobile sources, area sources, and background pollutant levels are the same for all blocks within a given census tract. As noted above, stationary source risk estimates were available at the census block level.

3.2 Age Categories

Age data were retrieved from the Table P8 of the census SF3 Table, which contains data on the numbers of males and females of different ages in each census block group. In processing the age data, we began by aggregating the categories in the census to the broader age groups studied in this analysis. For instance, the total number of children 18 years of age and under was calculated by adding together the number of girls under 1 year, the number of boys under 1 year, the number of 1-year-old girls, the number of 1-year-old boys, and so on up to and including 18-year-old girls and boys. In this way, we calculated the number of children age 18 and under, the number of adults from 18 to 64, and the number of adults 65 and older in each census block group.

The next step was to estimate the numbers of people in each age group at the block level. To make this calculation, we assumed that the fraction of people in each age group was the same for all blocks in a given block group. Thus, the number of people in a particular age group and within a particular census block was estimated as follows:

$$N(a,b/bg) = N(t,b/bg) \times N(a,bg)/N(t,bg) \quad (3)$$

where:

N(a,b/bg) = number of people within age group "a", in block "b" of block group "bg"
N(t,b/bg) = total number of people in block "b" of block group "bg"
N(a,bg) = number of people within age group "a" in block group "bg"
N(t,bg) = total number of people in block group "bg"

Equation 1 was then applied to the block-level population estimates to generate risk distributions for different age groups, and Equation 2 was used to compute the average risk for each age group.

3.3 Level of Education

Table P37 of the SF3 dataset specifies the education status for men and women age 25 and older for each census block group, based on the last grade completed. To obtain the total number of adults without a high school degree, we added together the numbers who had completed grades below a high school senior. Thus, the number of people without a high school degree equals the sum of the number of males with no schooling, the number of females with no schooling, the numbers of males and females who have completed nursery school through 4th grade, up to the numbers of males and females who have completed some high school but not received a high school degree.

The number of adults without a high school degree as a fraction of the total population was assumed to be the same for each block in the block group. Thus, the number of adults without a high school degree in each block was computed as follows:

$$N(nhs,b/bg) = N(t,b/bg) \times N(nhs,bg)/N(t,bg) \quad (4)$$

where:

N(nhs,b/bg) = number of adults without a high school diploma, in block "b" of block group "bg"
N(t,b/bg) = total number of people in block "b" of block group "bg"
N(nhs,bg) = number of adults without a high school diploma in block group "bg"
N(t,bg) = total number of people in block group "bg"

Equation 1 was then used to generate risk distributions based on the block-level results, and Equation 2 was used to compute the average risk for adults without a high school diploma.

3.4 Household Income

Table P52 of the SF3 dataset estimates the numbers of households in each block group with income for the year 1999 in various ranges, generally divided into $5000 increments (e.g. $10,000 to $14,999, $15,000 to $19,999, etc.). The median national income for 1999 was about $42,000 per year. Therefore, in order to determine the number of households with incomes under the median income, we added the estimates for the ranges below that level. We assumed that the household incomes in the $40,000 to $44,999 increment were evenly distributed over this range. Therefore, 40% of the households in the $40,000 to $49,000 income range were assumed to be below the national median income of about $42,000. The following equation was used to estimate the fraction of households below the national median income within each census block group:

$$F(sm,bg) = [C_{<10} + C_{10\text{-}15} + \ldots. + C_{35\text{-}40} + (0.4 \times C_{40\text{-}45})] / C_T \quad (5)$$

where:

$F(sm,bg)$ = fraction of households in block group "bg" with incomes below the median national income
$C_{<10}$ = number of households with incomes under $10,000
$C_{10\text{-}15}$ = number of households with incomes from $10,000 to $14,999
$C_{35\text{-}40}$ = number of households with incomes from $35,000 to $39,999
$C_{40\text{-}45}$ = number of households with incomes from $40,000 to $44,999
C_T = total number of households in block group "bg"

The fraction of people living in households below the median income for each block within the block group was assumed to the same as the fraction of households below the median income for the block group.

$$N(sm,b/bg) = F(sm,bg) \times N(t,b/bg) \quad (6)$$

where:

$N(sm,b/bg)$ = number of people in block "b" of block group "bg" living in households below the national median income
$F(sm,bg)$ = fraction of households in block group "bg" below the national median income
$N(t,b/bg)$ = total number of people in block "b" of block group "bg"

Equation 1 was then used to generate risk distributions based on the block-level results, and Equation 2 was used to compute the average risk for adults without a high school diploma. It must be noted that this approach neglects any potential relationship between household size and income level within a particular block group. However, it is expected to provide a reasonable indication of the risk level of people living below the national median income, relative to the population as a whole.

3.5 Poverty Level

Table P87 of the SF3 dataset estimates the total number people in each block group living below the poverty level, as well as the numbers of people below the poverty level in different age groups. The current study did not include an analysis of poverty status by age group, only of the total population below the poverty line. The fraction of people below the poverty line was assumed to be the same for each block in the block group. Thus, the population below the poverty line in each block was computed as follows:

$$N(p,b/bg) = N(T,b/bg) \times N(p,bg)/N(T,bg) \quad (7)$$

where:

N(p,b/bg) = number of people below the poverty line in block "b" of block group "bg"
N(T,b/bg) = total number of people in block "b" of block group "bg"
N(p,bg) = number of people below the poverty line in block group "bg"
N(T,bg) = total number of people in block group "bg"

Equation 1 was then used to generate risk distributions based on the block-level results, and Equation 2 was used to compute the average risk for adults without a high school diploma.

4. Results

The distribution of estimated lifetime inhalation cancer risks above 1 in a million for different racial and ethnic groups among the population living near marine vessel loading facilities is shown in Table 2. For comparison, Table 2 provides the distributions of inhalation risks for the population exposed to emissions from all source categories at the marine vessel loading facility (i.e., facility-wide) and for the nationwide demographic breakdown (i.e., nationwide). The facility-wide and nationwide risks were obtained from the final NATA for 2005, which estimates the risks associated with HAP emissions from all stationary sources, onroad and nonroad mobile sources, dispersed area sources, and the background due to long-range transport and natural emissions. For the detailed demographic analysis used to create Table 2, see Appendix A of this document.

The results of the demographic analysis presented in Table 2 show that for those with cancer risk greater than one in a million due to the marine vessel loading source category, risks may be significantly higher for the "Hispanic or Latino" demographic group and somewhat higher for the "Other and Multiracial" demographic group than we would normally expect, based on the typical distribution of those demographic groups across the U.S. The cancer risk for the remaining demographic groups is very close to or slightly lower than the typical U.S. distribution. The results of the demographic analysis for the facility-wide emissions show that with the exception of the "Minority" and "African American demographic groups, which are somewhat higher than the source category and the typical U.S. distribution, the remaining demographic groups are similar to the results of the source category.

Table 2. Summary of Demographic Assessment Results for the Marine Vessel Loading Source Category

Emissions Basis	Maximum Risk (in 1 million)	Population With Risk Greater Than 1 in 1 million										
		Total	Minority	African American	Other and Multiracial	Hispanic or Latino	Native American	Ages 0 to 18	Ages 19 to 64	Ages 65 and up	Below the Poverty Level	Over 25 Without a HS Diploma
Source Category	20	64,579	29%	7%	21%	38%	0.6%	31%	57%	11%	15%	19%
Facility-wide	200	814,872	38%	18%	19%	34%	0.5%	32%	59%	10%	18%	18%
Nationwide Demographic Breakdown	n/a	285,339,128	25%	12%	12%	14%	0.9%	27%	60%	12%	13%	13%

Notes:

Source Category, Facility-wide, and Nationwide emissions are based on the 2005 NATA, dated May 2010.

Minority population is the total population minus the white population.

Population figures are for the population residing within 5 km of these facilities.

5. Uncertainty Discussion

Our analysis of the distribution of risks across various demographic groups is subject to the typical uncertainties associated with census data (e.g., errors in filling out and transcribing census forms), which are generally thought to be small, as well as the additional uncertainties associated with the extrapolation of census-block group data (e.g., income level and education level) down to the census block level.

The uncertainties in these risk estimates include the same uncertainties in emissions data sets, in air dispersion modeling, in inhalation exposure and in dose response relationships that are associated with our source category risk estimates. The degree of uncertainty associated with facility-wide risk estimates, based on the 2005 NATA, dated May 2010, is generally greater than for source categories because emissions data for source categories not currently undergoing an RTR review may be incomplete.

The methodology for our demographic analyses is still evolving. While this is our best attempt to provide useful information now, our thinking is continuously advancing. EPA is in the process of developing technical guidance for environmental justice analyses. We present these analyses, with their associated uncertainties, to EPA decision makers and the public as additional analyses to inform RTR decisions.

Appendix A

Table A-1. Distribution of Inhalation Cancer Risk for Racial and Ethnic Groups

Range of lifetime individual cancer risk (chance in one million)[a]	Numbers of people in different ranges for lifetime cancer risk[b]					
	Total population	White	African American	Native American	Other and multiracial	Hispanic or Latino[c]
Modeled risk from the marine vessel loading category						
0 to 1	6,164,710	3,367,081	1,365,464	43,625	1,388,540	1,335,970
1 to 5	59,920	42,237	4,636	342	12,705	22,213
5 to 10	3,661	2,855	29	36	741	1,863
10 to 20	604	390	13	5	196	420
20 to 30	394	242	13	4	135	275
Total number	6,229,289	3,412,805	1,370,155	44,012	1,402,317	1,360,741
Average risk (chances in one million)	0.06	0.06	0.03	0.05	0.06	0.12
Modeled risk from facilities containing marine vessel loading source category						
0 to 1	5,414,417	2,908,577	1,221,126	39,861	1,244,853	1,085,927
1 to 5	364,024	234,800	90,681	1,490	37,053	57,776
5 to 10	267,026	165,434	40,118	1,503	59,971	109,304
10 to 20	129,137	73,786	13,700	794	40,857	72,244
20 to 30	31,391	16,548	3,443	247	11,153	20,602
30 to 40	10,743	5,742	542	52	4,407	6,370
40 to 50	5,122	3,405	165	27	1,525	3,432
50 to 100	5,594	3,435	361	27	1,771	3,551
100 to 150	1,147	666	11	7	463	967
150 to 200	682	406	8	4	264	562
200 to 250	6	6	0	0	0	6
Total number	6,229,289	3,412,805	1,370,155	44,012	1,402,317	1,360,741
Average risk (chances in one million)	1.1	1.1	0.6	0.9	1.3	2.4

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors.

[b]Distributions by race are based on demographic information at the census block level. Risks from marine vessel loading emissions were modeled at the block level, as were other NATA stationary source emissions. Mobile sources, area sources, and background risks were analyzed at the census block level in NATA.

[c]The Hispanic or Latino population is double-counted in this analysis, since different individuals within the category may classify themselves as White, African American, Native American, or other.

Table A-2. Distribution of Risk for Different Age Groups

Range of lifetime individual cancer risk (chance in one million)[a]	Numbers of people in different ranges for lifetime cancer risk[b]			
	Total population	Ages 0 thru 18	Ages 19 thru 64	Ages 65 and up
Modeled risk from the marine vessel loading category				
0 to 1	6,164,710	1,652,374	3,759,411	752,925
1 to 5	59,920	18,798	34,184	6,938
5 to 10	3,661	1,212	2,073	376
10 to 20	604	202	364	38
20 to 30	394	124	249	21
Total number	6,229,289	1,672,710	3,796,281	760,298
Average risk (chances in one million)	0.06	0.07	0.054	0.045
Modeled risk from facilities containing marine vessel loading source category				
0 to 1	5,414,417	1,415,641	3,316,785	681,991
1 to 5	364,024	109,719	216,731	37,574
5 to 10	267,026	85,347	157,282	24,397
10 to 20	129,137	42,542	74,904	11,691
20 to 30	31,391	11,132	17,713	2,546
30 to 40	10,743	3,787	5,912	1,044
40 to 50	5,122	1,868	2,839	415
50 to 100	5,594	2,016	3,026	552
100 to 150	1,147	418	675	54
150 to 200	682	237	410	35
200 to 250	6	2	4	0
Total number	6,229,289	1,672,710	3,796,281	760,298
Average risk (chances in one million)	1.1	1.3	1.0	0.8

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not

[b]Distributions by age and education level are based on modeling data at the Census block level, and age and education data at the block group level. All blocks in a block group are assumed to have the same age and income distribution.

Table A-3. Distribution of Risk for Adults with and without a High School Diploma

Range of lifetime individual cancer risk (chance in one million)[a]	Numbers of people in different ranges for lifetime cancer risk[b]		
	Total population	Total number 25 and older	Number 25 and older without a high school diploma
Modeled risk from the marine vessel loading category			
0 to 1	6,164,710	3,974,795	1,075,242
1 to 5	59,920	35,930	11,208
5 to 10	3,661	2,082	822
10 to 20	604	331	175
20 to 30	394	214	105
Total number	6,229,289	4,013,352	1,087,552
Average risk (chances in one million)	0.06	0.05	0.07
Modeled risk from facilities containing marine vessel loading source category			
0 to 1	5,414,417	3,530,843	937,318
1 to 5	364,024	224,415	52,655
5 to 10	267,026	155,047	52,347
10 to 20	129,137	73,276	30,600
20 to 30	31,391	17,019	8,338
30 to 40	10,743	5,928	2,912
40 to 50	5,122	2,774	1,378
50 to 100	5,594	3,113	1,460
100 to 150	1,147	582	343
150 to 200	682	352	198
200 to 250	6	3	2
Total number	6,229,289	4,013,352	1,087,552
Average risk (chances in one million)	1.1	0.9	1.4

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors.

[b]Distributions by age and education level are based on modeling data at the Census block level, and age and education data at the block group level. All blocks in a block group are assumed to have the same age and income distribution.

Table A-4. Distribution of Risk for People Living in Households below the National Median Income and Below the Poverty Line

Range of lifetime individual cancer risk (chance in one million)[a]	Numbers of people in different ranges for lifetime cancer risk[b]		
	Total population	People living in households below the national median income[c]	People living below the poverty line
Modeled risk from the marine vessel loading category			
0 to 1	6,164,710	3,504,463	1,273,411
1 to 5	59,920	33,741	8,990
5 to 10	3,661	2,217	708
10 to 20	604	407	154
20 to 30	394	225	62
Total number	6,229,289	3,541,053	1,283,325
Average risk (chances in one million)	0.06	0.06	0.05
Modeled risk from facilities containing marine vessel loading source category			
0 to 1	5,414,417	3,073,530	1,138,839
1 to 5	364,024	196,004	59,290
5 to 10	267,026	154,541	47,617
10 to 20	129,137	81,400	25,516
20 to 30	31,391	20,874	6,978
30 to 40	10,743	6,696	2,146
40 to 50	5,122	3,267	1,225
50 to 100	5,594	3,516	1,240
100 to 150	1,147	805	333
150 to 200	682	415	138
200 to 250	6	4	2
Total number	6,229,289	3,541,053	1,283,325
Average risk (chances in one million)	1.1	1.1	1.0

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors.

[b]Distributions by income are based on modeling data at the Census block level, and income data at the block group level. All blocks in a block group are assumed to have the same age and income distribution.

[c]The median income is the national median household income in 1999, about $41,000.

Table A-5. Distribution of Inhalation Cancer Risk[a] for Racial and Ethnic Groups, Age Groups, Adults without a High School Diploma, and People Living in Households Below the Poverty Line

	Total population	Minority[c]	African American	Native American	Other and multiracial	Hispanic or Latino[d]	Ages 0 thru 18	Ages 19 thru 64	Ages 65 and up	Number 25 and older without a high school diploma	People living below the poverty line
Modeled risk from the marine vessel loading category											
Total population within 5 km of facilities[b]	6,229,289	2,816,484	1,370,155	44,012	1,402,317	1,360,741	1,672,710	3,796,281	760,298	1,087,552	1,283,325
Percentage of total		45%	22%	0.7%	23%	22%	27%	61%	12%	17%	21%
Average risk (in one million)	0.06	0.05	0.03	0.05	0.06	0.12	0.07	0.05	0.05	0.07	0.05
Modeled risk from facilities containing marine vessel loading source category											
Total population within 5 km of facilities[b]	6,229,289	2,816,484	1,370,155	44,012	1,402,317	1,360,741	1,672,710	3,796,281	760,298	1,087,552	1,283,325
Percentage of total		45%	22%	0.7%	23%	22%	27%	61%	12%	17%	21%
Average risk (in one million)	1.1	1.0	0.6	0.9	1.3	2.4	1.3	1.0	0.8	1.4	1.0
Nationwide demographic breakdown											
Total population[b]	285,339,128	70,799,422	35,043,873	2,489,515	33,265,937	39,083,760	77,245,364	172,602,490	35,491,274	36,660,464	37,181,029
Percentage of total		25%	12%	0.9%	12%	14%	27%	60%	12%	13%	13%

Notes:

a Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors.

b Distributions by race are based on demographic information at the census block level. Distribution of other demographic groups are based on the extrapolation of census block group level data to the census block level. Risks from marine vessel loading emissions were modeled at the block level.

c The minority population is the total population minus the white population.

d The Hispanic or Latino population is double-counted in this analysis, since different individuals within the category may classify themselves as White, African American, Native American, or other.