# Appendix H

Comparison of Air Toxics Data Collected –
St. Louis Community Air Project
and the
National Air Toxics Trends Station

## Appendix H

## Comparison and Contrast of Air Toxics Data Collected: St. Louis Community Air Project and the National Air Toxics Trends Station

Air Quality Analysis Section staff examined the ambient air quality, with respect to air toxics, of ambient air data collected at two different monitoring sites in St. Louis, Missouri. Specifically, staff compared and contrasted the annual arithmetic means of the chemicals of concern and the associated cancer risks identified in the St. Louis Community Air Project to the annual arithmetic means and the associated cancer risks of the chemicals of concern based on the ambient data collected at the National Air Toxics Trends Station from 2005 through 2010. The purpose of this examination was to describe the similarities and differences between the ambient air quality of northern and southern St. Louis City.

St. Louis Community Air Project (CAP)

The St. Louis CAP was a broad-based collaborative effort that aimed to improve St. Louis City inhabitants' health through the identification and eventual reduction of air pollution in the greater St. Louis City metropolitan area. The CAP monitoring effort began in May 2001 and ended in December 2003. It consisted of one-in-six day measurements of ambient air quality at three monitoring sites in St. Louis City, one of which was located at 3026 Minnesota Avenue (Figure 1). At this monitoring site, a single collection system collected both volatile organic compounds (VOCs) via SUMMA canister and carbonyls via DNPH (2,4-dinitrophenylhydrazine) sorbent cartridges. A PUF (polyurethane foam) sampler collected ambient samples for polycyclic aromatic hydrocarbon (PAH) and dioxin analysis. High-volume samplers collected $PM_{10}$ (particulate matter having an aerodynamic diameter smaller than 10 microns) and collocated metals, and an aethalometer collected black carbon as a surrogate for diesel particulate matter. Additionally, the nearby $PM_{2.5}$ (particulate matter having an aerodynamic diameter smaller than 2.5 microns) Speciation Trends network located at this monitoring site collected $PM_{2.5}$ samples on a one-in-three-day schedule.

Eastern Research Group (ERG) staff used U.S. Environmental Protection Agency (EPA) methods to qualitatively and quantitatively analyze the ambient air samples for VOCs, $PM_{10}$ metals, $PM_{2.5}$ metals, and PAHs. Additionally, ERG staff used the National Institute for Occupational Safety and Health 5040 Thermal Optical Analysis, also referred to as Thermal Optical Transmittance (TOT), to analyze the elemental and organic carbon fractions of $PM_{2.5}$. ERG staff's analyses yielded the annual arithmetic means of the air toxics detected in the ambient air samples.

To identify the chemicals of concern among the VOCs, $PM_{10}$ metals, $PM_{2.5}$ metals, carbonyls, dioxins/furans, and PAHs detected in the ambient air samples, staff identified the chemicals of concern as those air toxics that had a higher ranking in the confidence of the reported detection; that is, in comparison to the minimum detection level, and annual arithmetic means greater than or equal to the respective human health-based cancer or non-cancer benchmarks. Based on the annual arithmetic means and the associated cancer risk level of 1-in-100,000 and a continuous exposure period of 70 years, the data analysis identified the following air toxics as chemicals of concern: acetaldehyde, a product of secondary formation; arsenic compounds, products of oil and coal combustion; benzene, a component of petroleum products and mobile source exhaust; chromium compounds, products of electroplating; and formaldehyde, a product of secondary formation (Table I). Of these chemicals of concern, formaldehyde was the driver of the cancer risk. The data analysis did not identify any chemicals of concern associated with a non-cancer risk.

National Air Toxics Trends Station (NATTS)

The current NATTS network consists of 27 sites across the nation, of which 20 are urban sites and seven are rural sites, which typically collect at each site ambient air quality data on more than 100 air toxics. The primary objective of the NATTS network is to provide long-term air toxics monitoring data that is of consistent high quality. These data can then find such uses as assessing trends and emission reduction program efficacy, verifying air quality models, and serving as direct input to source-receptor models. The monitoring site (AIRS ID 29-510-0085) located at 3247 Blair Street in St. Louis, Missouri is part of the NATTS network, collecting ambient air quality data on a neighborhood scale for research purposes (Figure 1).

At this monitoring site, a single collection system collects both VOCs via SUMMA canister and carbonyls via DNPH sorbent cartridges on a one-in-six-day schedule. A PUF sampler collects ambient samples for PAH analysis. High-volume samplers collect $PM_{10}$ and collocated metals; whereas, a separate collection system collects hexavalent chromium. An aethalometer collects black carbon. Additionally, the nearby $PM_{2.5}$ Speciation Trends network located at this monitoring site collects $PM_{2.5}$ samples on a one-in-three-day schedule.

Similar to the analyses performed for the St. Louis CAP, ERG staff again use U.S. EPA methods to qualitatively and quantitatively analyze the ambient air samples for VOCs, $PM_{10}$ metals, $PM_{2.5}$ metals, and PAHs. ERG staff's analyses yields the annual arithmetic means of the air toxics detected in the ambient air samples.

To identify the chemicals of concern among the VOCs, $PM_{10}$ metals, $PM_{2.5}$ metals, and PAHs detected in the ambient air samples, staff identified the chemicals of concern as those air toxics that had a higher ranking in the confidence of the reported detection; that is, in comparison to the minimum detection level, and annual arithmetic means greater than or equal to the respective human health-based cancer or non-cancer benchmarks. Based on the annual arithmetic means and the associated cancer risk level of 1-in-1,000,000 and a continuous exposure period of 70 years, the data analyses for the years 2005 to 2010 identified two $PM_{10}$ metals and between six and 10 VOCs as chemicals of concern (Table II). For all six years, these data analyses identified acetylaldehyde, arsenic $PM_{10}$, benzene, cadmium $PM_{10}$, carbon tetrachloride, chloromethane, and formaldehyde as chemicals of concern associated with a cancer risk. During this time, formaldehyde was the driver of the cancer risk. For five consecutive years, from 2006 through 2010, data analyses also identified acrolein as a chemical of concern associated with a non-cancer risk, and as the driver of this risk.

Comparison and Contrast

To compare and contrast the air toxics quantified in the St. Louis CAP data analysis (Table I) to the air toxics quantified in the 2005 through 2010 NATTS data analyses (Table II) reveals the similarities and differences between the number and identity of the air toxics appearing in the two data analyses. A comparison of the data analyses showed that four air toxics, which were acetaldehyde, arsenic $PM_{10}$, benzene, and formaldehyde, appeared in both data analyses. In contrast however, though chromium compounds appeared in the St. Louis CAP data analysis, chromium compounds did not appear in any of the NATTS data analyses. Furthermore, the contrast between the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses revealed that a greater number of air toxics appeared in the NATTS data analyses than in the St. Louis CAP data analysis. For example, though these air toxics appeared in any one of the NATTS data analysis, none appeared in the St. Louis CAP data analysis:

- Cadmium $PM_{10}$, carbon tetrachloride, and chloromethane appeared in each and every NATTS data analysis.
- Acrolein, 1,3-butadiene, and chloroform, appeared in the 2006 through 2010 NATTS data analyses.
- 1,4-dichlorobenzene and tetrachloroethylene appeared in four of the NATTS data analyses.
- Ethylbenzene appeared in three NATTS data analyses.
- Acetonitrile appeared in the 2010 NATTS data analysis.

With respect to the number and identity of air toxics appearing in the data analyses, the contrast revealed that more differences existed between the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses than the similarities that the comparison between these two data analyses revealed.

The comparison and contrast of the cancer and non-cancer risk estimates based on the St. Louis CAP data analysis (Table I) to the cancer and non-cancer risk estimates based on the 2005 through 2010 NATTS data analyses (Table II) also revealed similarities and differences between the two data analyses. A comparison of the data analyses showed that the cancer risk estimate based on the St. Louis CAP data analysis, 9.9 additional cases of cancer per an exposed population of 100,000, fell into the range of cancer risks based on the 2005 through 2010 NATTS data analyses, 7.3 to 10 additional cases of cancer per an exposed population of 100,000. Additionally, both the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses identified exposure to formaldehyde as the driver for this cancer risk. In contrast however to the cancer risk based on the St. Louis CAP data analysis, the cancer risks based on the NATTS data analyses decreased from a high of 100 additional cases of cancer per an exposed population of 1,000,000 in 2007, to 79, 73, and 76 additional cases of cancer per an exposed population of 1,000,000 in 2008, 2009, and 2010, respectively. Furthermore, with respect to a non-cancer risk, the St. Louis CAP data analysis did not estimate a non-cancer risk was associated with exposure to any air toxic. The 2006 through 2010 NATTS data analyses however estimated that a non-cancer risk was associated with exposure to acrolein, and the 2010 NATTS data analysis estimated a non-cancer risk was also associated with exposure to acetonitrile.

Table III compares and contrasts the annual arithmetic means of the chemicals of concern and the associated cancer risks estimated in the St. Louis CAP data analysis to these same chemicals of concern and associated cancer risks estimated in the 2005 through 2010 NATTS data analyses. Overall, the annual arithmetic means of arsenic $PM_{10}$, acetaldehyde, benzene, and formaldehyde quantified in the St. Louis CAP data analysis were greater than the annual arithmetic means for these chemicals of concern quantified in any of the NATTS data analyses. The exceptions were the annual arithmetic mean for arsenic $PM_{10}$ quantified in the 2005 NATTS data analysis and the annual arithmetic mean for formaldehyde quantified in the 2007 NATTS data analysis.

The greater annual arithmetic means quantified in the St. Louis CAP however did not always translate into greater associated cancer risks. Set at risk level of 1-in-100,000 and a continuous exposure period of 70 years, the comparison of the cancer risks associated with arsenic $PM_{10}$, acetaldehyde, and benzene estimated in the St. Louis CAP data analysis showed these risks were equal to those cancer risks estimated for these chemicals of concern in the 2005 through 2010 NATTS data analyses, except for acetaldehyde quantified in the 2008 NATTS data analysis. In contrast, formaldehyde's associated cancer risk estimated in the St. Louis CAP data analysis was greater than or equal to the risks estimated in the 2005 through 2010 NATTS data analyses, as these risks estimated in the 2007 through 2010 NATTS data analyses decreased from six additional cases of cancer per an exposed population of 100,000 to three additional cases of cancer per an exposed population of 100,000.

To compare and contrast the additivities of the excess cancer risks estimated in the St. Louis CAP data analysis to the additivities of the excess cancer risks estimated in the 2005 through 2010 NATTS data analyses reveals more about the similarities and differences between the two data analyses (Table IV). For those chemicals of concern that are of the *carcinogenic to humans* (Group A) classification, the additivities of the excess cancer risks in both the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses were equal to each other. For a continuous 70-year exposure in a population of 100,000, the chemicals of concern of the *carcinogenic to humans (Group A)* classification were associated with two excess cases of cancer. Exposure to both benzene and arsenic $PM_{10}$ contributed equally to this excess cancer risk

The St. Louis CAP data analysis and the 2005 through 2010 NATTS analyses estimated that the largest number of excess cancers was associated with exposures to chemicals of concern of the *likely to be carcinogenic to humans* (Group B) classification. Both the St. Louis CAP data analysis and the NATTS data analyses identified exposure to formaldehyde as the driver of this excess cancer risk. In contrast however, differences existed between the additivities of the cancer risks estimated in the St. Louis CAP data analysis and those estimated in the 2005 through 2010 NATTS data analyses for this classification of chemicals of concern. For example, overall, the additivities of the excess cancer risks associated with exposure to this classification of chemicals of concern estimated in the St. Louis CAP data analysis were greater than the additivities of the excess cancer risks associated with exposure to this classification of chemicals of concern estimated in the 2005 through 2010 NATTS data analyses. A possible cause of this disparity is the St. Louis CAP data analysis' estimation of an excess cancer risk associated with exposure to formaldehyde that was always greater than or equal to this same risk estimated in the 2005 through 2010 NATTS data analyses.

Yet the 2005 NATTS data analysis estimated an excess cancer risk associated with exposure to chemicals of concern of the *likely to be carcinogenic to humans* (Group B) classification that was equal to that same risk estimated in the St. Louis CAP data analysis, and the 2007 NATTS data analysis estimated such an excess cancer risk that was greater than this same risk estimated in the St. Louis CAP data analysis. In both the 2005 and 2007 NATTS data analyses, the excess cancer risks associated with exposure to carbon tetrachloride contributed to the additivity of the excess cancer risks. In fact in every NATTS data analysis, the excess cancer risks associated with chlorinated hydrocarbons, namely carbon tetrachloride and chloroform, contributed to the additivity of the excess cancer risks associated with exposure to chemicals of concern of the *likely to be carcinogenic to humans* (Group B) classification. No such hydrocarbon contribution was present in the St. Louis CAP data analysis' estimation of the excess cancer risk associated with exposure to the chemicals of concern of the *likely to be carcinogenic to humans* (Group B) classification.

Likewise, chlorinated hydrocarbons also contributed to the additivity of the excess cancer risk associated with exposure to chemicals of concern of the *inadequate information to assess carcinogenic potential* (Group D) classification. In a contrast to the St. Louis CAP data analysis, this contribution was visible in the 2006, 2008, and 2010 NATTS data analyses as chlorinated hydrocarbons contributed to excess cancer risks that were greater than the excess cancer risk associated with exposure to chemicals of concern of the *inadequate information to assess carcinogenic potential* (Group D) classification estimated in the St. Louis CAP data analysis. This contribution to the additivity of the excess cancer risks was mainly due to exposure to 1,4-dichlorobenzene, chloromethane, ethylbenzene, and tetrachloroethylene. No such hydrocarbon contribution was present in the St. Louis CAP data analysis' estimation of the excess cancer risk associated with exposure to the chemicals of concern of the *inadequate information to assess carcinogenic potential* (Group D) classification.

## Conclusions

The comparison and contrast of the St. Louis CAP data analysis to the 2005 through 2010 NATTS data analyses revealed the similarities and differences between the ambient air quality of northern and southern St. Louis City. The comparison revealed three major similarities between the two data analyses. First of all, acetaldehyde, arsenic $PM_{10}$, benzene, and formaldehyde were chemicals of concern in both the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses. For exposure to acetaldehyde, arsenic $PM_{10}$, and benzene, both the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses estimated equal cancer risks of one additional case of cancer per an exposed population of 100,000. Secondly, the cancer risk estimate based on the St. Louis CAP data analysis, 9.9 additional cases of cancer per an exposed population of 100,000, fell into the range of cancer risks based on the 2005 through 2010 NATTS data analyses, 7.3 to 10 additional cases of cancer per an exposed population of 100,000. Additionally, both the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses identified exposure to formaldehyde as the driver for this cancer risk. Finally, the additivity of the excess cancer risk was the subject of the third major similarity. For those chemicals of concern that are of the *carcinogenic to humans* (Group A) classification, the additivities of the excess cancer risks in both the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses were equal to two excess cases of cancer. Exposure to both benzene and arsenic $PM_{10}$ contributed equally to this excess cancer risk. Additionally, the St. Louis CAP data analysis and the 2005 through 2010 NATTS analyses estimated that the largest number of excess cancers was associated with exposures to chemicals of concern of the *likely to be carcinogenic to humans* (Group B) classification.

The contrast between the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses revealed that more differences than similarities existed between these two data analyses. Regarding the chemicals of concern, overall, the annual arithmetic means of arsenic $PM_{10}$, acetaldehyde, benzene, and formaldehyde quantified in the St. Louis CAP data analysis were greater than the annual arithmetic means for these chemicals of concern quantified in any of the NATTS data analyses. Furthermore, though chromium compounds appeared in the St. Louis CAP data analysis, chromium compounds did not appear in any of the NATTS data analyses. Rather, the contrast revealed that a greater number of air toxics, among them being acrolein, acetonitrile, 1,3-butadiene, cadmium $PM_{10}$, ethylbenzene, and five chlorinated hydrocarbons, appeared in the 2005 through 2010 NATTS data analyses than in the St. Louis CAP data analysis. Due to the appearance of acrolein and acetonitrile, the NATTS data analyses estimated that a non-cancer risk associated with exposure to the ambient air was present; whereas, the St. Louis CAP data analysis did not estimate such a non-cancer risk was present.

More differences existed between the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses with respect to cancer risk. For example, formaldehyde's associated cancer risk estimated in the St. Louis CAP data analysis was greater than or equal to the risks estimated in the 2005 through 2010 NATTS data analyses, as these cancer risks based on the 2008 through 2010 NATTS data analyses decreased in contrast to the cancer risk based on the St. Louis CAP data analysis. As a possible consequence of formaldehyde's associated cancer risk, the overall additivities of the excess cancer risks associated with exposure to chemicals of concern of the *likely to be carcinogenic to humans* (Group B) classification estimated in the St. Louis CAP data analysis were greater than the additivities of the excess cancer risks associated with exposure to this classification of chemicals of concern estimated in the 2005 through 2010 NATTS data analysis. Yet unlike the St. Louis CAP data analysis, the excess cancer risks associated with chlorinated hydrocarbons, namely carbon tetrachloride and chloroform, contributed to the additivity of the excess cancer risks associated with exposure to chemicals of concern of the *likely to be carcinogenic to humans* (Group B) classification in the 2005 through 2010 NATTS data analyses. Chlorinated hydrocarbons also contributed to excess cancer risks associated with exposure to chemicals of concern of the *inadequate information to assess carcinogenic potential* (Group D) classification in the 2006, 2008, and 2010 NATTS data analyses. No such hydrocarbon contribution was present in the St. Louis CAP data analysis' estimation of the excess cancer risk associated with exposures to the chemicals of concern of the *likely to be carcinogenic to humans* (Group B) and the *inadequate information to assess carcinogenic potential* (Group D) classifications.

Overall, the comparison and contrast of the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses indicated that with respect to air toxics, the ambient air quality measured at the St. Louis CAP monitoring site was similar to that measured at the NATTS monitoring site. Monitors at each site detected acetaldehyde, arsenic $PM_{10}$, benzene, and formaldehyde at ambient concentrations associated with excess cancer risks between one and six additional cases of cancer per an exposed population of 100,000. The largest number of excess cancers was associated with exposures to chemicals of concern of the *likely to be carcinogenic to* *humans* (Group B) classification. Of these chemicals of concern, exposure to formaldehyde was the driver of this excess cancer risk. Though differences existed between the two data analyses due to the detection of chlorinated hydrocarbons; especially carbon tetrachloride and chloroform, acrolein, and acetonitrile, this difference may however be more of a reflection of the monitoring site's surroundings. The surroundings of the St. Louis CAP monitoring site were residential whereas those of the NATTS monitoring site are industrial.

This comparison and contrast therefore indicates that the spatial difference between the two monitoring sites, the current NATTS monitoring site is 4.2 miles to the northeast of the former St. Louis CAP monitoring site, has little effect on the ambient air quality with respect to air toxics within this narrow north-south corridor of the St. Louis City air-shed. Instead it is the combustion of coal and oil, the presence of petroleum products and the exhaust of mobile sources, and the occurrence of secondary formation that have a greater influence on making the ambient air quality of northern St. Louis City remarkably like that of southern St. Louis City.

**TABLE I — Chemicals of Concern for the St. Louis CAP**

| Air Toxic | Annual Arithmetic Mean (ppbv) | Annual Arithmetic Mean (µg/m³) | Cancer Risk Associated With 70-Year Exposure Risk = 1E-05 |
|---|---|---|---|
| *Cancer Risk* | | | |
| Formaldehyde | 3.72 | | 5.9 |
| Acetaldehyde | 2.668 | | 1.0 |
| Benzene | 0.444 | | 1.0 |
| Arsenic Compounds | | 0.002 | 1.0 |
| Chromium Compounds | | 0.002 | 1.0 |
| **Total** | | | **9.9** |

| Air Toxic | Annual Arithmetic Mean (ppbv) | Annual Arithmetic Mean (µg/m³) | Hazard Quotient |
|---|---|---|---|
| *Non-cancer Risk* | | | |
| None | | | |

CAP = Community Air Project; ppbv = parts per billion by volume; µg/m³ = micrograms per cubic meter

| Year | Air Toxic | Annual Arithmetic Mean (ppbv) | Annual Arithmetic Mean (µg/m$^3$) | Cancer Risk Associated With 70-Year Exposure Risk = 1E-06 |
|---|---|---|---|---|
| *Cancer Risk* | | | | |
| 2010 | Formaldehyde | 2.2305 | | 34 |
| | Benzene | 0.322415 | | 8 |
| | Acetaldehyde | 2.272315 | | 8 |
| | Arsenic $PM_{10}$ | | 0.00102 | 5 |
| | Chloroform | 0.03951 | | 5 |
| | 1,3-Butadiene | 0.0560375 | | 4 |
| | 1,4-Dichlorobenzene | 0.057861667 | | 4 |
| | Carbon tetrachloride | 0.09177 | | 3 |
| | Chloromethane | 0.61474 | | 2 |
| | Cadmium $PM_{10}$ | | 0.00062 | 1 |
| | Ethylbenzene | 0.1008675 | | 1 |
| | Tetrachloroethylene | 0.03429 | | 1 |
| | **Total** | | | **76** |
| 2009 | Formaldehyde | 1.9999 | | 31 |
| | Carbon tetrachloride | 0.10877 | | 10 |
| | Arsenic $PM_{10}$ | | 0.00155 | 8 |
| | Benzene | 0.261016667 | | 6 |
| | Acetylaldehyde | 1.30951 | | 5 |
| | Chloroform | 0.04342 | | 5 |
| | 1,3-Butadiene | 0.028725 | | 2 |
| | 1,4-Dichlorobenzene | 0.023266667 | | 2 |
| | Cadmium $PM_{10}$ | | 0.00099 | 2 |
| | Chloromethane | 0.66793 | | 2 |
| | **Total** | | | **73** |
| 2008 | Formaldehyde | 2.3 | | 35 |
| | Carbon tetrachloride | 0.116066 | | 11 |
| | Benzene | 0.312705 | | 8 |
| | Chloroform | 0.045918 | | 6 |
| | Arsenic $PM_{10}$ | | 0.000959 | 5 |
| | Acetaldehyde | 1.132524 | | 4 |
| | 1,4-Dichlorobenzene | 0.052197 | | 3 |
| | 1,3-Butadiene | 0.040615 | | 3 |
| | Chloromethane | 0.661951 | | 2 |
| | Cadmium $PM_{10}$ | | 0.000748 | 1 |
| | Tetrachloroethylene | 0.026345 | | 1 |
| | **Total** | | | **79** |

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| Year | Air Toxic | Annual Arithmetic Mean (ppbv) | Annual Arithmetic Mean (µg/m$^3$) | Cancer Risk Associated With 70-Year Exposure Risk = 1E-06 |
|---|---|---|---|---|
| 2007 | Formaldehyde | 3.719317 | | 57 |
| | Arsenic $PM_{10}$ | | 0.00183 | 9 |
| | Acetylaldehyde | 2.254167 | | 8 |
| | Carbon tetrachloride | 0.090787 | | 8 |
| | Benzene | 0.259016 | | 6 |
| | Chloroform | 0.044180 | | 5 |
| | 1,3-Butadiene | 0.041402 | | 3 |
| | Chloromethane | 0.536885 | | 2 |
| | Cadmium $PM_{10}$ | | 0.000724 | 1 |
| | Tetrachloroethylene | 0.029361 | | 1 |
| | **Total** | | | **100** |
| 2006 | Formaldehyde | 2.592918 | | 40 |
| | Carbon tetrachloride | 0.100339 | | 9 |
| | Benzene | 0.285254 | | 7 |
| | Acetylaldehyde | 1.637885 | | 6 |
| | Arsenic $PM_{10}$ | | 0.001055 | 5 |
| | Chloroform | 0.036407 | | 4 |
| | 1,3-Butadiene | 0.043288 | | 3 |
| | Chloromethane | 0.564068 | | 2 |
| | 1,4-Dichlorobenzene | 0.037492 | | 2 |
| | Cadmium $PM_{10}$ | | 0.000662 | 1 |
| | Ethylbenzene | 0.098475 | | 1 |
| | Tetrachloroethylene | 0.025314 | | 1 |
| | **Total** | | | **81** |
| 2005 | Formaldehyde | 2.979683 | | 46 |
| | Arsenic $PM_{10}$ | | 0.002328 | 12 |
| | Benzene | 0.360273 | | 9 |
| | Carbon tetrachloride | 0.094262 | | 9 |
| | Acetylaldehyde | 1.476784 | | 5 |
| | Chloromethane | 0.652459 | | 2 |
| | Cadmium $PM_{10}$ | | 0.00094 | 2 |
| | Ethylbenzene | 0.124918 | | 1 |
| | **Total** | | | **86** |

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| Year | Air Toxic | Annual Arithmetic Mean (ppbv) | Annual Arithmetic Mean (µg/m$^3$) | Hazard Quotient |
|---|---|---|---|---|
| *Non-cancer Risk* | | | | |
| 2010 | Acrolein | 0.961236667 | | 110 |
| | Acetonitrile | 55.13981 | | 2 |
| 2009 | Acrolein | 0.3159 | | 36 |
| 2008 | Acrolein | 0.355082 | | 41 |
| 2007 | Acrolein | 0.326746 | | 38 |
| 2006 | Acrolein | 0.245712 | | 28 |
| 2005 | None | | | |

NATTS = National Air Toxics Trends Station; ppbv = parts per billion by volume; µg/m$^3$ = micrograms per cubic meter

**TABLE III — The Annual Arithmetic Means and Associated Cancer Risks of the Chemicals of Concern Identified in the St. Louis CAP Data Analysis to the 2005 Through 2010 NATTS Data Analyses**

| Air Toxic | St. Louis Community Air Project | | | National Air Toxics Trends Station | | | |
|---|---|---|---|---|---|---|---|
| | Annual Arithmetic Mean (ppbv) | Annual Arithmetic Mean (µg/m$^3$) | Cancer Risk Associated With 70-Year Exposure Risk = 1E-05 | Year | Annual Arithmetic Mean (ppbv) | Annual Arithmetic Mean (µg/m$^3$) | Cancer Risk Associated With 70-Year Exposure Risk = 1E-05 |
| Arsenic $PM_{10}$ | | 0.002 | 1 | 2005 | | 0.002328 | 1 |
| | | | | 2006 | | 0.001055 | 1 |
| | | | | 2007 | | 0.00183 | 1 |
| | | | | 2008 | | 0.000959 | 1 |
| | | | | 2009 | | 0.00155 | 1 |
| | | | | 2010 | | 0.00102 | 1 |
| Acetylaldehyde | 2.668 | | 1 | 2005 | 1.476784 | | 1 |
| | | | | 2006 | 1.637885 | | 1 |
| | | | | 2007 | 2.254167 | | 1 |
| | | | | 2008 | 1.132524 | | <1 |
| | | | | 2009 | 1.30951 | | 1 |
| | | | | 2010 | 2.272315 | | 1 |
| Benzene | 0.448 | | 1 | 2005 | 0.360273 | | 1 |
| | | | | 2006 | 0.285254 | | 1 |
| | | | | 2007 | 0.259016 | | 1 |
| | | | | 2008 | 0.312705 | | 1 |
| | | | | 2009 | 0.26101666 | | 1 |
| | | | | 2010 | 0.322415 | | 1 |
| Formaldehyde | 3.65 | | 6 | 2005 | 2.979683 | | 5 |
| | | | | 2006 | 2.592918 | | 4 |
| | | | | 2007 | 3.719317 | | 6 |
| | | | | 2008 | 2.3 | | 4 |
| | | | | 2009 | 1.9999 | | 3 |
| | | | | 2010 | 2.2305 | | 3 |

ppbv = parts per billion by volume: µg/m$^3$ = micrograms per cubic meter

**TABLE IV — Comparison of Additivity of Cancer Risks Estimated for the St. Louis CAP Data Analysis to That for the 2005 Through 2010 NATTS Data Analyses**

| Year | Air Toxic | U.S. EPA's Weight-of-Evidence Classification | Cancer Risk Associated With 70-Year Exposure Risk = 1E-05 | |
|---|---|---|---|---|
| | | | St. Louis CAP | NATTS |
| 2010 | Benzene | Known Human Carcinogen | 1 | 1 |
| | Arsenic $PM_{10}$ | A | 1 | 1 |
| | 1,3-Butadiene | Carcinogenic | 0 | <1 |
| | **Total** | | **2** | **2** |
| | Formaldehyde | B1 | 6 | 3 |
| | Acetaldehyde | B2 | 1 | 1 |
| | Chloroform | Likely Carcinogenic | 0 | 1 |
| | Carbon Tetrachloride | Likely Carcinogenic | 0 | <1 |
| | Tetrachloroethylene | Likely Carcinogenic | 0 | <1 |
| | Cadmium $PM_{10}$ | B1 | 0 | <1 |
| | **Total** | | **7** | **5** |
| | 1,4-Dichlorobenzene | | 0 | <1 |
| | Chloromethane | Can't Be Determined | 0 | <1 |
| | Ethylbenzene | D | 0 | <1 |
| | **Total** | | **0** | **1** |
| 2009 | Arsenic $PM_{10}$ | A | 1 | 1 |
| | Benzene | A | 1 | 1 |
| | 1,3-Butadiene | Known Carcinogen | 0 | <1 |
| | **Total** | | **2** | **2** |
| | Formaldehyde | B1 | 6 | 3 |
| | Carbon Tetrachloride | B2 | 0 | 1 |
| | Acetaldehyde | B2 | 1 | 1 |
| | Chloroform | Likely Carcinogenic | 0 | 1 |
| | Cadmium $PM_{10}$ | B1 | 0 | <1 |
| | **Total** | | **7** | **6** |
| | 1,4-Dichlorobenzene | Not Defined | 0 | <1 |
| | Chloromethane | Can't Be Determined | 0 | <1 |
| | **Total** | | **0** | **<1** |
| 2008 | Benzene | A | 1 | 1 |
| | Arsenic $PM_{10}$ | A | 1 | 1 |
| | 1,3-Butadiene | Known Carcinogen | 0 | <1 |
| | **Total** | | **2** | **2** |
| | Formaldehyde | B1 | 6 | 4 |
| | Carbon Tetrachloride | B2 | 0 | 1 |
| | Chloroform | Likely Carcinogenic | 0 | 1 |
| | Acetaldehyde | B2 | 1 | <1 |
| | Cadmium $PM_{10}$ | B1 | 0 | <1 |
| | **Total** | | **7** | **6** |
| | 1,4-Dichlorobenzene | Not Defined | 0 | <1 |
| | Chloromethane | Can't Be Determined | 0 | <1 |
| | Tetrachloroethylene | Not Defined | 0 | <1 |
| | **Total** | | **0** | **1** |

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| Year | Air Toxic | U.S. EPA's Weight-of-Evidence Classification | Cancer Risk Associated With 70-Year Exposure Risk = 1E-05 | |
|---|---|---|---|---|
| | | | **St. Louis CAP** | **NATTS** |
| 2007 | Arsenic $PM_{10}$ | A | 1 | 1 |
| | Benzene | A | 1 | 1 |
| | 1,3-Butadiene | Known Carcinogen | 0 | <1 |
| | **Total** | | **2** | **2** |
| | Formaldehyde | B1 | 6 | 6 |
| | Carbon Tetrachloride | B2 | 0 | 1 |
| | Acetaldehyde | B2 | 1 | 1 |
| | Chloroform | Likely Carcinogenic | 0 | 1 |
| | Cadmium $PM_{10}$ | B1 | 0 | <1 |
| | **Total** | | **7** | **9** |
| | Chloromethane | Can't Be Determined | 0 | <1 |
| | Tetrachloroethylene | Not Defined | 0 | <1 |
| | **Total** | | **0** | **<1** |
| 2006 | Benzene | A | 1 | 1 |
| | Arsenic $PM_{10}$ | A | 1 | 1 |
| | 1,3-Butadiene | Known Carcinogen | 0 | <1 |
| | **Total** | | **2** | **2** |
| | Formaldehyde | B1 | 6 | 4 |
| | Carbon Tetrachloride | B2 | 0 | 1 |
| | Acetaldehyde | B2 | 1 | 1 |
| | Chloroform | Likely Carcinogenic | 0 | <1 |
| | Cadmium $PM_{10}$ | B1 | 0 | <1 |
| | **Total** | | **7** | **6** |
| | Chloromethane | Can't Be Determined | 0 | <1 |
| | 1,4-Dichlorobenzene | Not Defined | 0 | <1 |
| | Ethylbenzene | D | 0 | <1 |
| | Tetrachloroethylene | D | 0 | <1 |
| | **Total** | | **0** | **1** |
| 2005 | Arsenic $PM_{10}$ | A | 1 | 1 |
| | Benzene | A | 1 | 1 |
| | **Total** | | **2** | **2** |
| | Formaldehyde | B1 | 6 | 5 |
| | Carbon Tetrachloride | B2 | 0 | 1 |
| | Acetaldehyde | B2 | 1 | 1 |
| | Cadmium $PM_{10}$ | B1 | 0 | <1 |
| | **Total** | | **7** | **7** |
| | Chloromethane | Can't Be Determined | 0 | <1 |
| | Ethylbenzene | D | 0 | <1 |
| | **Total** | | **0** | **<1** |

NATTS = National Air Toxics Trends Station; U.S. EPA = U.S. Environmental Protection Agency.
Classifications: A = carcinogenic to humans; B = likely to be carcinogenic to humans; D = inadequate information to assess carcinogenic potential.

**FIGURE 1 — Locations of the St. Louis Community Air Project (CAP) and the National Air Toxics Trends Station (NATTS) Monitoring Sites**