The St. Louis Community Air Project (CAP)

Ambient air toxics monitoring in the St. Louis area was focused for the past two years on the St. Louis Community Air Project (CAP). This was a community-based effort to identify and reduce air pollutants in St. Louis urban areas in response to residents' health conceerns. As part of this effort the St. Louis CAP identified and prioritized toxic air pollutants in St. Louis using human health-based cancer and noncancer benchmarks. Subsequently, measurement of ambient concentrations of approximately 250 analytes at three sites in an initial study area in south St. Louis was conducted on a one-in-six day schedule for one year (see site map attached). This included sampling of volatile organic compounds, semi-volatiles, $PM_{2.5}$ metals, $PM_{2.5}$ elemental carbon as a surrogate for diesel particulate matter, and carbonyls. Dioxin sampling was conducted for one month. Comparisons of the ambient concentrations of 113 analytes (104 HAPs) to the respective human health-based benchmarks were made.

Chemicals found to be of concern, at annual average ambient concentrations greater than the respective human health-based cancer benchmarks included formaldehyde, chromium compounds, arsenic compounds, and benzene and acetaldehyde. For arsenic compounds, chromium compounds, acetaldehyde, and benzene, a cancer risk of one additional case of cancer in a human population of 100,000 was associated only with a 70-year exposure to the annual average ambient concentrations quantified in the CAP study. For the annual average ambient formaldehyde concentration quantified in the CAP study, cancer risks of 5.8, 2.5, and 1.2 additional cases of cancer in a human population of 100,000 were associated with exposures of 70, 30, and 15 years, respectively.

Table 1 provides specifics on associated risks.

Table 1. Excess Cancer Risk Characterization for St. Louis CAP1

Analyte	Annual Average Ambient Concentration	Cancer Benchmarks Associated With Duration of Exposure (1 in 100,000)		
		70-Year	30-Year	15-Year
Arsenic Compounds	0.002 µg/m^3	0.002 µg/m^3		
Risk in 100,000		1		
Chromium Compounds	0.002 µg/m^3	0.002 µg/m^3		
Risk in 100,000		1		
Acetaldehyde	2.668 ppbv	2.5 ppbv		
Risk in 100,000		1		
Benzene	0.448 ppbv	0.41 ppbv		
Risk in 100,000		1		
Formaldehyde*	3.72 ppbv	0.627 ppbv	1.46	2.93
Risk in 100,000		5.8	2.5	1.2

* Second monitoring year

Table 2 shows additivity of excess cancer risk for residents of St. Louis for year 1, based on weight-of-evidence classifications of analytes and assumption of 70-year exposures.

Table 2. Additivity of Cancer Risk for the St. Louis Community Air Project.

Analyte	Weight-of-Evidence Classification	Cancer Risk Associated With 70-Year Exposure (1 in 100,000)
Arsenic Compounds	A	1
Benzene	A	1
Chromium Compounds	A	1
Total		3
Acetaldehyde	B2	1
Formaldehyde	B1	5.8
Total		6.8

* Weight-of-evidence classifications derived from EPA IRIS. Cancer risks associated with 70-year exposures are taken from Table 1.

Table 2 shows that a 70-year exposure to *known* human cancer causing analytes in the A group may pose a total cancer risk of 3 additional cancer cases in a human population of 100,000. This risk is evenly divided among the three analytes.

A 70-year exposure to the *probable* human cancer causing analytes in the B group poses a total cancer risk of 6.8 additional cases of cancer in a human population of 100,000—roughly 2 times greater than that of exposure to the known human cancer-causing analytes. Formaldehyde is the primary driver of cancer risk from exposure to the probable human cancer-causing analytes.

Thus, for a 70-year exposure at these annual average ambient concentrations, all analytes may pose a total cancer risk of 9.8 additional cases of cancer in a human population of 100,000. Formaldehyde, representing the higher risk, is the primary driver of the cancer risk.

The monitoring network was revised for a second year of sampling, to better determine spatial and temporal variation of pollutants, and provide additional data for risk evaluation. This included a location north of downtown St. Louis City, Blair St. (a National Air Toxics Trends Station), a continuous monitoring site at Washington University in St. Louis County, and a rural site 25 miles south of St. Louis City near Bonne Terre, MO.

In evaluating spatial variation with the second year of monitoring, all of the chemicals of concern were found to have urban scales of impact. In the case of formaldehyde, a regional impact of some magnitude was found. Levels of formaldehyde were significantly lower in the second year of monitoring than the first, which may relate to changes in sampler design. Tables 3. and 4. provide annual averages for specific pollutants at the 24-hour time-resolved monitoring sites in the second year of CAP.

Table 3. CAP2 Organics, Detected More than Half the Time, with Averages Greater than Half of the 70-Year Human Health-Based Benchmark (70-Bench).
(ND's replaced with half of MDL in calculation of averages)
(highlighted values greater than 70-Bench)

	average ppbv	**70-Bench** ppbv
Benzene		
Grant School SNMOC	0.438	0.410
Blair St. SNMOC	0.481	0.410
Blair St. VOC	0.479	0.410
Bonne Terre SNMOC	0.219	0.410
1,3-Butadiene		
Grant School SNMOC	0.081	0.150
Blair St. SNMOC	0.085	0.150
Carbon Tetrachloride		
Blair St. VOC	0.080	0.110
Formaldehyde		
Grant School	3.724	0.627
Blair St.	4.080	0.627
Bonne Terre	3.396	0.627
Acetaldehyde		
Grant School	2.551	2.500
Blair St.	2.014	2.500

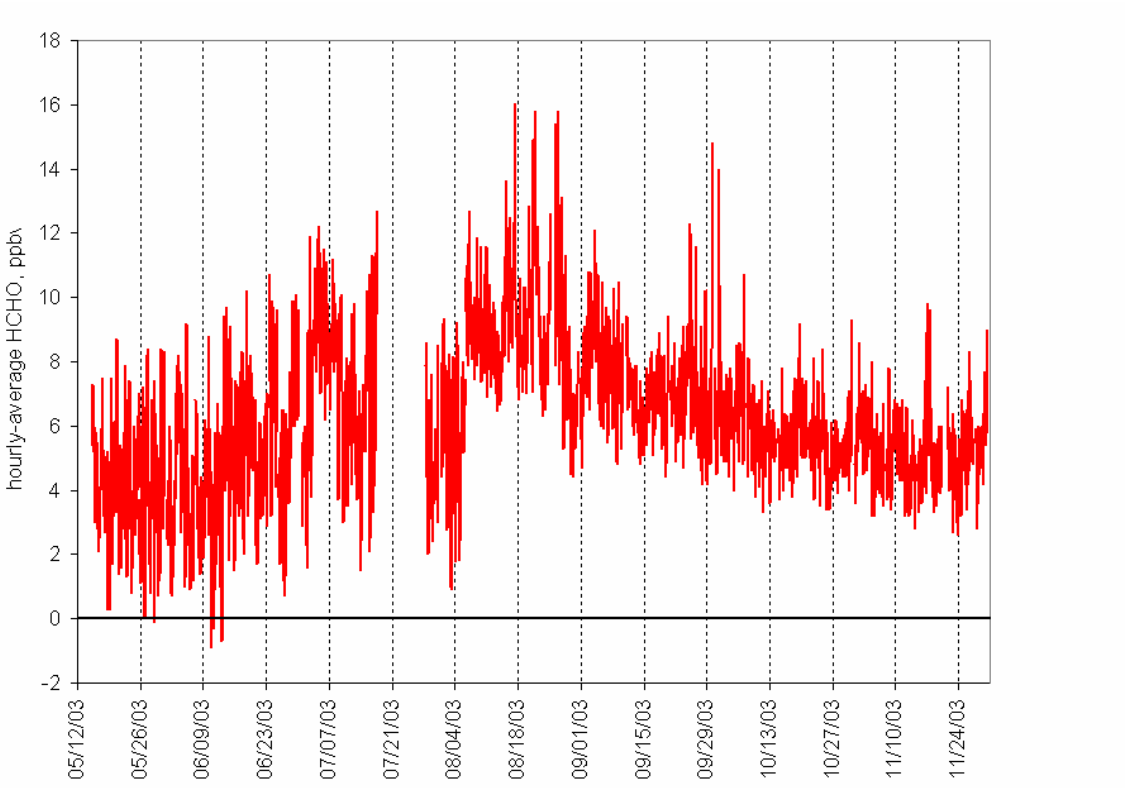
Table 4. CAP2 Metals, Detected More than Half the Time, with Averages Greater than Half of the 70-Year Human Health-Based Benchmark (70-Bench).
(ND's replaced with half of MDL in calculation of average for PM2.5 samples)
(highlighted values greater than 70-Bench)

	average	**70-Bench**
	ug/m3	ug/m3
Arsenic		
Blair St. PM2.5 (1/3-12/11)	0.00252	0.002
Blair St. PM10 (7/8-12/29)	0.00253	
Arnold PM2.5 (1/3-12/11)	0.00202	0.002
Bonne Terre PM2.5 (3/22-12/14)	0.00108	0.002
Chromium		
Blair St. PM2.5 (1/3-12/11)	0.00209	0.002
Blair St. PM10 (7/8-12/29)*	0.00273	
Arnold PM2.5 (1/3-12/11)	0.00214	0.002

*PM10 chromium blank averages about 70% of sample result, so result is suspect

Continuous formaldehyde data at the Washington University site has yet to be fully validated for the entire monitoring period, however, it provides confirmation of the second year levels sampled at the 24-hour carbonyl sampling sites. (See Figure 1.) Further analysis of this data will be forthcoming to determine its relationship to other pollutants and evaluate diurnal trends.

Figure 1. St. Louis CAP Hourly Formaldehyde Time-Series



With the end of the St. Louis CAP, sampling and monitoring activities will continue at the Blair St. NATTS on an every-sixth-day schedule, including:

- Carbonyl sampling and analysis using DNPH-coated sorbent cartridges (Method TO-11A),
- VOC (Method TO-15) sampling and analysis using SUMMA polished stainless steel canisters,
- PM_{10} sampling and metals analysis using a hi-vol sampler,
- Continuous monitoring and recording of hourly average values of airborne black carbon (an indicator for diesel exhaust particulate matter) using the aethalometer.

Three additional tasks have been preliminarily approved by U.S. Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards. A fourth task is under discussion for funding with Region VII. They include:

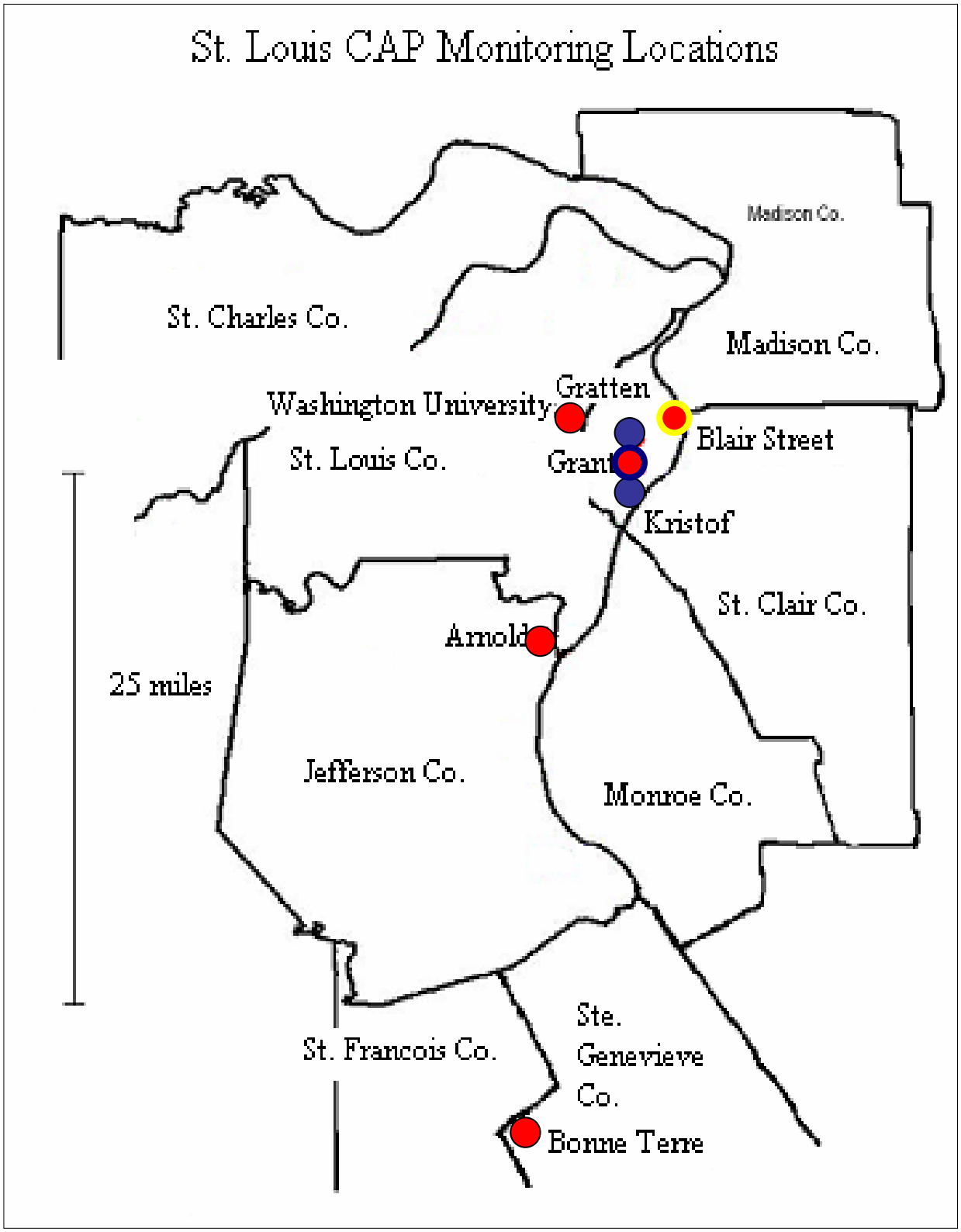
- Trace level carbon monoxide (CO) monitoring at the Blair St. Station. Blair St. is one of four NATTS sites chosen to provide evaluation of a trace level CO analyzer from

one of two instrument vendors and evaluation of the suitability of trace level CO as an indicator of the source of organic air toxics. Operation will begin in 2004.

- Continuous formaldehyde (HCHO) monitoring at a site near the Blair St. Station. This site is one of three NATTS sites chosen to provide evaluation of a continuous formaldehyde analyzer. Operation will begin in approximately July 2004 and continue for one year. An OPSIS UV DOAS will be relocated to the same site and operated for intercomparison of results from the two continuous analyzers. Following completion of one year of monitoring, the continuous formaldehyde analyzer will be relocated to the Blair St. Station.

- Hexavalent chromium sampling at the Blair Street Station. This task is planned for all NATTS sites beginning in January 2005, given that hexavalent chromium is a better indicator of risk than total chromium.

- PM10 metals sampling at the Arnold, MO Station. This task has been discussed with EPA Region 7, and funding has been requested. Arsenic concentrations at Arnold measured with the $PM_{2.5}$ sampler have been episodically higher than at other speciation sites in the area. This monitoring will provide information on airborne concentrations of arsenic and other metallic species with greater sensitivity than that of the $PM_{2.5}$ speciation sampler there.



NATTS

CAP I

CAP II