

# **New Boston Air Quality Study 1999**



Division of Air Pollution Control  
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## EXECUTIVE SUMMARY

In June 1999, at the request of Ohio EPA and the Portsmouth Local Air Agency, New Boston Coke Corporation tested the coke oven gas being emitted from its coke facility in New Boston, Ohio. Ohio EPA and the Portsmouth Local Air Agency requested this test because large emissions of volatile organic compounds from a specific source at the facility had been disclosed by the company in 1998. Prior to 1998, Ohio EPA was unaware of the quantity of emissions from the plant, as reports submitted by New Boston Coke failed to include the emissions from a particular stack. Based on the results of the 1999 stack test, Ohio EPA expedited completion of this air quality study using ambient (outdoor) air data collected in the vicinity of New Boston Coke facility.

The data used for this report was collected from 1993-1999 at an ambient air monitor located on the roof of the Portsmouth Water Treatment Plant, which is located just downwind of the New Boston Coke facility. This study includes ambient air toxics monitoring results for volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs). This monitor was one of several Ohio EPA placed in the vicinity of known or suspected large individual sources of air pollutants. Detailed listing of all ambient air concentrations measured in this study are provided in **Appendix A** of this report. Monitors were installed and operated in Cleveland, Middletown, and New Boston as part of this effort.

From the New Boston ambient air data, a risk assessment from exposure to the chemicals of potential concern was conducted in order to translate the air monitoring data into a quantitative risk perspective. **Table A** summarizes the calculation of excess cancer risk for each group of measured chemicals. The calculations for non-carcinogenic risks are summarized in **Table B**. Details of both the carcinogenic and non-carcinogenic calculations are provided in the body of the report.

The agency has conducted preliminary air dispersion modeling of the emissions from the “bleeder” stack at the New Boston Coke facility. The results of the modeling indicate that the concentrations measured at the Portsmouth Water Treatment Plant would be representative of air quality within approximately one kilometer of the plant. The concentrations of pollutants drop off with increased distance from the plant. A detailed description of the modeling information used is provided in **Appendix B** of this report.

For the purpose of the risk assessment, it is assumed that a hypothetical individual is exposed constantly for 24 hours per day and 365 days per year to the average measured airborne concentrations of the air pollutants. The route of exposure for this assessment is through the inhalation pathway. Assumptions made during a risk assessment tend to be conservative, in order to ensure that the actual risks will be no greater than the estimated risk. In fact, the actual risks will likely be less than those

estimated in this study.

For an accurate interpretation of the predicted risks, these risks must be placed in perspective with common daily activities. A range of "acceptable" health risk values for carcinogens has historically ranged from one in one million ( $1 \times 10^{-6}$ ) for regulation of certain individual source categories, to some sources routinely operating in the one in 10,000 ( $1 \times 10^{-4}$ ) range. For non-carcinogenic estimation of Hazard Indexes (HI), a calculated HI below 100% is generally regarded as a "safe" level of exposure.

**Table A: Summary of Excess Cancer Risks for New Boston, Ohio, 1999**

Sources of Risk	Carcinogenic Risk (totaled for each class)
Volatile Organic Compounds	2.17 E-03 (2.17 excess cases in 1,000)
Polycyclic Aromatic Hydrocarbons	4.20 E-05 (4.20 excess cases in 100,000)
<b>Total Carcinogenic Risk</b>	<b>2.22 E-03 (2.22 excess cases in 1,000)</b>

The total carcinogenic risk for the area within approximately one kilometer of the New Boston monitoring site is in the range of  $10^{-3}$  (1 in 1,000 range). VOCs appear to be contributing the most significant portion of the total carcinogenic risk (approximately 95%). This study did not measure other classes of air toxic compounds that also contribute to aggregate air pollution risk. Most large urban industrial areas in the United States exhibit aggregate or total carcinogenic risks in the  $10^{-4}$  to  $10^{-5}$  range. Risks in the range Ohio EPA found present in the ambient air sampled at the Portsmouth Water Treatment Plant are unusually high. While the topography of the Ohio River Valley adds to the transport of toxics in the valley, there is a large single source of VOCs in the area contributing directly to this assessment. Areas of higher risk characteristically may also contain large volumes of automobile traffic, although this may not be a significant factor in this area.

**Table B: Summary of Non-carcinogenic Risks for New Boston, Ohio, 1999**

Sources of Risk	Health Effects Reference Dose (Hazard Index Percentage)
Volatile Organic Compounds	47.8
Polycyclic Aromatic Hydrocarbons	21.53

Total Hazard Index	69.33
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The total Hazard Index (HI) is below 100%. If the HI is above 100%, there may be concern for cause of potential adverse health effects due to exposure to these chemicals. The HI is the summary of individually-calculated Hazard Quotients (HQs) for each compound measured. For individual non-carcinogenic estimation of risks, a calculated HQ below 100% is generally regarded as a “safe” level of exposure. Currently, no guidance exists for determining acceptable levels of aggregate non-carcinogenic risks beyond the simple estimation of creating a HI from summed HQs. A detailed explanation is included in the text.

Based on the data collected during the 1999 stack test, New Boston Coke is a large source for VOCs in the area, and a correspondingly high cancer risk number may be a result of emissions from this source. Based on the results of the study, it is recommended that immediate efforts be taken to reduce the VOC concentrations in this community.

## Introduction

The Ohio EPA, Division of Air Pollution Control (DAPC), has completed an urban air toxic monitoring study for the New Boston area. This ongoing study is the responsibility of the Air Toxics Unit (ATU) and Air Monitoring Section (AMS). The creation of this report is part of Ohio EPA's Urban Air Toxic Monitoring Program, initiated to address the potential concerns for high cancer risks from multi-pollutant interactions in urban and industrial areas. Ohio EPA has also completed Urban Air Toxic monitoring at other locations. Results of other ambient air quality studies conducted in Ohio are listed in **Table 1**. This information is supplied in order to compare the ambient air concentrations measured in this study to others measured in the State.

Scioto County had seven reporting facilities for the Toxic Release Inventory for 1998. The Village of New Boston is a smaller, Ohio River Valley community with a major source of air toxic pollutants located in the immediate vicinity. New Boston Coke Corporation is a major source of VOC compound releases into the ambient air. New Boston Coke operates a coke facility near the Village of New Boston. At a coke plant, powdered coal is charged into large ovens to drive off the more volatile compounds in the coal. The remaining product, coke, is used in the steel industry to fuel blast furnaces to make iron. During the coking process, while the coal is being heated, gasses are produced that contain large numbers of volatile compounds (coke oven gas). The coke oven gas is cleaned and used to heat the coke battery itself, and other equipment at the plant. The remaining amount of coke oven gas is sent to a "by-products plant" where certain chemicals are recovered (distilled) from the coke oven gas, including light oils and benzene. The recovered products are sold to other markets.

This area was chosen for monitoring because of the close proximity of a significant pollution source to a population of approximately 25,000 people (1990 census records list a population of 22,680 for Portsmouth and 2,565 for the Village of New Boston). For this study, Ohio EPA in conjunction with the Portsmouth City Health Department, conducted ambient air toxics monitoring for volatile organic compounds (VOCs) and semi-volatile organic compounds, specifically polycyclic aromatic hydrocarbons (PAHs).

Sampling at the Portsmouth Water Treatment Plant, 4862 Gallia Rd., Portsmouth, Ohio has been in effect intermittently from 1993 through 1999. The VOC sampling device is located on the roof of the water treatment plant, in the same area as other Ohio EPA air pollution samplers (such as the PM<sub>10</sub> particulate samplers). The water plant is located along Route 52 on the east side of New Boston. The monitoring site faces the New Boston Coke facility, which is a few hundred meters away, located on the eastern edge of the Village along the Ohio River.

**Table 1: Representative Summary Comparison of Ohio Ambient Air Data**

COMPOUNDS	New Boston 1993-1999 µg/m <sup>3</sup>	Middletown 1996 µg/m <sup>3</sup>	Cincinnati 1996 µg/m <sup>3</sup>	Cleveland 1996 µg/m <sup>3</sup>
Benzene	128.00	2.27	28.01	3.04
Methyl Chloride	1.14	1.05	1.67	0.97
Dichlorodifluoromethane	2.30	2.77	2.81	2.67
Ethylbenzene	0.5	0.97	0.82	0.82
4-Ethyltoluene	ND	ND	ND	0.63
Dichloromethane	0.38	0.87	1.47	1.17
Tetrachloroethylene	0.46	4.65	1.65	2.22
Toluene	18.56	4.77	7.47	6.33
1,1,1-Trichloroethane	1.18	1.22	0.77	0.82
Trichlorofluoromethane	57.95	2.54	1.15	3.64
1,2,4-Trimethylbenzene	0.83	1.67	1.56	1.15
1,3,5-Trimethylbenzene	ND	0.82	0.90	0.52
o-Xylene	1.13	1.14	1.22	0.95
m+p-Xylene	5.61	6.74	6.14	6.57

## Methods

### Part 1 - Volatile Organic Compound Sampling and Analysis

The primary component of this study consists of ambient sampling for volatile organic compounds (VOCs). These are defined as compounds that are generally found in the vapor state at normal temperatures. These compounds can be chlorinated or simple hydrocarbons. During this study, VOC samples were collected using a whole-air sampling system that pumps ambient air into an evacuated stainless steel canister. The canister acts as a storage container which allows the air sample to be maintained virtually unchanged until it is analyzed. Initially the samples were collected sporadically; however, as the sampling program became more routine, an effort was made to collect samples twice a month (once every 13<sup>th</sup> day). Each sample was collected over a 24 hour period, from midnight to midnight.

During analysis, the volatile tendency of VOC compounds allows them to be vaporized when heated (if not already in vapor state), and then injected into an analytical device called a gas chromatograph (GC). The typical analytical system used for this study utilized a GC with a special detector called a mass spectrometer (MS). As a sample passes through a GC column, the various compounds separate out of the sample mixture. The compounds exit the column individually and the concentration of each is detected by the mass spectrometer. These concentrations are illustrated as peaks on a chromatogram. Each peak represents the concentration of each compound in the sample. Compound identification is accomplished by comparing the retention time of the peaks on the chromatogram with those from a chromatogram of a known mixture of compounds. Retention time is the time it takes for a particular compound to reach the detector. As long as the analytical conditions remain the same, a compound from one analysis to the next will have the same retention time.

During the analysis, each sample is analyzed against an analytical standard containing a number of VOCs of known concentration. Using this standard, any target compound detected can be accurately identified and quantified. In the early years of this study the analytical standard contained 42 individual compounds. In 1998, the analytical method was modified by Ohio EPA to include an enhanced standard that now contains 68 compounds. Beyond this comparative analysis method, the GC/MS can tentatively identify non-target compounds of significant quantity that maybe present in a sample. The GC/MS combination works by taking an unidentified component of a sample and isolating that individual peak. Once isolated, that peak can be broken down into mass fragments forming a fingerprint by which a compound can be identified by comparing that fingerprint to a library of thousands of known compounds built into the analytical system. **Tables 2 and 3** list the VOCs that were capable of being measured (target compounds) during the sampling periods identified by year.



**Table 2. (1993-1997) Compound List of 42 Compounds for Canister Analysis**

benzene	trans-1,3-dichloropropene
benzyl chloride	1,2-dichloro-1,1,2,2-tetrafluoroethane
1,3-butadiene	ethylbenzene
carbon tetrachloride	4-ethyltoluene
chlorobenzene	hexachlorobutadiene
chlorodifluoromethane	methyl bromide
chlorethane / ethyl chloride	styrene
chloroform / trichloromethane	1,1,2,2-tetrachloroethane
chloromethane / methyl chloride	tetrachloroethene
3-chloropropene	toluene
1,2-dibromomethane	1,2,4-trichlorobenzene
dichloromethane	1,1,1-trichloroethane
1,2-dichlorobenzene (ortho)	1,1,2-trichloroethane
1,3-dichlorobenzene (meta)	trichloroethene
1,4-dichlorobenzene (para)	trichlorofluoromethane
dichlorodifluoromethane	1,1,2-trichloro-1,2,2-trifluoroethane
1,2-dichloroethane	1,2,4-trimethylbenzene
1,1-dichloroethane	1,3,5-trimethylbenzene
cis-1,2-dichloroethene	vinyl chloride
1,2-dichloropropane	o-xylene
cis-1,3-dichloropropene	total m+p-xylene

**Table 3. (1998-1999) Compound List of 68 Compounds for Canister Analysis**

acetone	trans-1,3-dichloropropene
benzene	1,2-dichloro-1,1,2,2-tetrafluoroethane
benzyl chloride	n-dodecane
bromodichloromethane	ethylbenzene
bromoform	4-ethyltoluene
bromomethane / 1,2-dibromoethane	n-heptane
1,3-butadiene	hexachlorobutadiene
-butane	hexane
2-butanone	methyl-butyl ether
carbon disulfide	methylene chloride / dichloromethane
carbon tetrachloride	4-methyl-2-pentanone
chlorobenzene	a-methylstyrene
chlorodifluoromethane	napthalene
chlorethane / ethyl chloride	n-nonane
chloroform / trichloromethane	n-octane
chloromethane / methyl chloride	n-pentane
3-chloropropene	n-propyl benzene
cumene	styrene
cyclohexane	1,1,2,2-tetrachloroethane
decane	tetrachloroethylene
dibromomethane	toluene
1,2-dibromoethane	1,1,2-trichlorobenzene
dibromomethane	1,1,1-trichloroethane
1,2-dichlorobenzene (ortho)	1,1,2-trichloroethane
1,3-dichlorobenzene (meta)	trichloroethene
1,4-dichlorobenzene (para)	trichlorofluoromethane
dichlorodifluoromethane	1,1,2-trichloro-1,2,2-trifluoroethane
1,1-dichloroethane	1,2,4-trimethylbenzene
1,2-dichloroethane	1,3,5-trimethylbenzene
1,1-dichlorethene	n-undecane
cis-1,2-dichlorethene	vinyl acetate
trans-1,2-dichloroethene	vinyl chloride
1,2-dichloropropane	o-xylene
cis-1,3-dichloropropene	total m+xylene

## Part 2 - Semi-Volatile Organic Compound Sampling and Analysis

While Part 1 of this study focused on VOCs, during 1991 and 1993 some additional sampling was conducted that focused on semi-volatile organic compounds (SVOCs). SVOCs are not as volatile as VOCs. These compounds are found in either the vapor state, or attached to particulate matter at normal atmospheric temperatures. Sampling for these types of compounds requires a device that collects both the vapor phase and the particulate phase of a compound simultaneously in the sampled air stream. This is accomplished in a modified Total Suspended Particulate (TSP) sampler operating at a lower flow rate. The particulate matter is trapped on a quartz fiber filter, while the vapor portion is captured on an adsorbent cartridge made up of a sandwich of poly-urethane foam (PUF) and a chemical resin. During this study, all of the samples were collected over a 48-hour sampling period to obtain an adequate sample concentration and to improve the minimum detection limits. The specific operation procedure is found in the U.S. EPA document, *Compendium of the Methods for the Determination of Toxic Organic Compound in Ambient Air* (Section TO-4).

During analysis the sample returned from the field is extracted and then concentrated, followed by silica gel clean-up, using column chromatography to remove potential interferences prior to analysis. The analysis is performed by GC/MS, described in detail above. For SVOCs, there are three separate groups of measured pollutants: polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides. From the samples collected during this study, only PAH compounds were detected.

## Results

**Tables 4 - 10**, located in **Appendix A** of this report, summarize the VOC results of all types of samples collected in each year from 1993-1999 at the Portsmouth Water Treatment Plant site. Individual yearly results for this monitor have been included in Ohio EPA ambient air quality reports and national databases. The detailed results for each sample collected are available by request from the Division of Air Pollution Control.

Each table lists the compound name, the arithmetic mean (average) for the year's data, the maximum and minimum detected sample values during the year, and the number of samples in which each compound was detected. The total possible number of samples collected each year is stated below each table. All units are micrograms per cubic meter air volume ( $\mu\text{g}/\text{m}^3$ ).

In the case where a compound on the target list for VOC analysis was not detected above the analysis detection limit during any sampling event during a specific year, the

compound is not listed in the table for that year. For the compound that was not detected during the year, no arithmetic mean value is included in the assessment.

The detection limit is the lowest measurement the procedure can accurately quantify as a true measurement of the ambient air concentration. If a compound was detected once or more during a year's sampling period, the arithmetic mean (average) contains a value for any non-detect measurement(s) as half the detection limit. Other options for handling values below the detection limit are available, such as using the detection limit itself, or using a value of zero for the measurement result. Using values of half the detection limit is common practice because values of zero may underestimate the true air concentration, while values of the detection limit itself may likewise over-estimate the true air concentration.

Compounds that were not detected during the entire study period are not included in **Tables 4** through **10**. Two additional tables (**Tables 11** and **12**) were generated to represent the new compounds from the enhanced 68 compound list (**Table 3** above) that were detected in the 1998-1999 samples. In each table, the common compound name with the arithmetic mean (average) is listed. The maximum and minimum observed values are also included to demonstrate the upper and lower range of the measured values. The number of samples detected each year are listed.

The SVOC results collected during years 1991 and 1993 are listed in **Table 13**, also located in the Appendix. From the samples collected in 1991 and 1993, only PAH compounds were detected. Because the number of samples collected during this part of the study were small, all results are listed in **Table 13**, in  $\mu\text{g}/\text{m}^3$ .

## Discussion

The data generated by this study's sampling program present the measured concentrations for VOC and SVOC compounds on the roof of the Portsmouth Water Treatment Plant, located near the Village of New Boston, Ohio. To evaluate the potential for adverse health effects as a result of breathing these compounds at concentrations measured in this study, the results were evaluated by a risk assessment. Risk assessment is a process which uses current available toxicological information as a basis for estimating the health effects that individuals or populations may experience as a result of prolonged exposure to hazardous substances. For this study Ohio EPA followed the risk assessment guidelines provided by the National Academy of Science (NAS) and the U.S. EPA. The result of a risk assessment produces a numerical prediction of the probability of an adverse health effect, such as carcinogenicity and/or systematic toxicity, that may occur as a result of exposure to a single, or multiple toxic compounds.

For the purpose of this study, it is assumed that a hypothetical individual is exposed constantly for 24 hours per day and 365 days per year to the average measured airborne concentrations of the air pollutants. The route of exposure for this assessment is through the inhalation pathway. Assumptions made during a risk assessment tend to be conservative, in order to ensure that the actual risks will be no greater than the estimated risk. In fact, the actual risks will most likely be less than those estimated in this study.

VOC and SVOC (PAH) data from the Portsmouth Water Treatment Plant were used for the risk evaluation. This site yields a representation of the ambient air quality in the New Boston, Ohio area. Some VOCs, such as benzene, carbon tetrachloride, and trichloromethane, are classified as hazardous because they have been implicated as potential carcinogens. Others, such as toluene and 1,1,1-trichloroethane, are believed to cause non-carcinogenic adverse health effects such as developmental, reproductive, neurobehavioral, or cardiovascular health implications. Polycyclic aromatic hydrocarbons (PAHs) are products of incomplete organic matter combustion and are typically found adsorbed to airborne particles such as soot and smoke. PAHs include benzo(a)pyrene, pyrene, chrysene, fluoranthene, etc. U.S. EPA has classified benzo(a)pyrene as a probable human carcinogen. The carcinogenic potential of other PAHs are estimated by using the toxic equivalent factor (TEQ) method. This method uses benzo(a)pyrene as the reference compound for assigning ranked toxicity to other compounds in the same class.

The toxicity of non-carcinogenic chemicals detected and measured in this study was determined by Ohio EPA using reference dose/reference concentrations (RfDs/RfCs) and unit risk factors (URFs) for carcinogenic compound data. Toxicity information was obtained from the U.S. EPA's Integrated Risk Information System database (IRIS). Chronic RfDs/RfCs are estimates of daily exposure levels for which the human population, including sensitive subpopulations, may be exposed constantly for long periods, that is likely to be without an appreciable risk of adverse health effects. Chronic RfDs/RfCs are especially developed to be protective for long-term exposures to the compounds. The RfDs/RfCs are used for non-carcinogenic chemicals only. Non-carcinogenic risks are individually evaluated by the use of a Hazard Quotient (HQ), which is the ratio of the average ambient air concentrations compared to the RfC for each compound (measured concentration divided by the RfC). If the HQ exceeds 1.0 (100% of the RfC) for a compound, there may be concern for cause of potential health effects as a result of exposure to the compound. This is the method included in the *U.S. EPA Risk Assessment Guidelines of 1986*.

To evaluate combined (total) non-carcinogenic adverse health effects, the total risk is evaluated by the use of the Hazard Index (HI). The HI is the summation of the individual HQs for each compound in the mixture. If the HI exceeds 100% for the mixture of compounds, there may be concern for cause of potential health effects as a result of exposure to the group of compound.

The URFs are used to assess health risks from carcinogenic compounds. The URF is a toxicity value that defines quantitatively the relationship between dose and response. Multiplying the URF by the long-term average daily dose will produce the probability of developing a cancer as a result of exposure (defined as the excess lifetime cancer risk).

The current method of estimating the total health effects risk from exposure to mixtures of carcinogenic compounds consists of adding individual risk numbers to approximate the total risk. This summation is based upon the principle that the addition of each risk produces a combined total risk estimate. This is the method currently recommended by the *U.S. EPA Risk Assessment Guidelines of 1986*, in the absence of additional information. It has been suggested in scientific literature that exposure to combinations of pollutants may cause greater or lesser risk than can be explained by merely the summation of the individual exposure risks.

For the calculation of excess cancer risk the Unit Risk Factors (URFs) from the IRIS database as of November 1999 were used in the calculations. For chemicals for which carcinogenicity is currently under review by U.S. EPA, values provided in the Health Effect Assessment Summary Table (HEAST) were used. For PAH risk calculation, benzo(a)pyrene is used as the reference compound, and the toxicity equivalent factors (TEFs) suggested by Clement International Corporation are used. Similarly, for non-carcinogenic VOCs, RfCs available in IRIS as of November 1999 were used in the calculations. Presently IRIS has many RfCs that are under review. Therefore, for chemicals which do not have RfCs in IRIS, values provided in the HEAST are used. Route to route extrapolation was conducted to estimate RfCs from RfDs, where no RfC were available. More advanced risk estimates will be made in the future as new and updated study results are available.

**Table C** indicates the total carcinogenic risk within approximately one kilometer of the monitoring site located at the Portsmouth Water Treatment Plant appears to be in the range of  $10^{-3}$ . The table includes columns for the compound name, the numerical URF, literature source for the URF, the average concentration of the compound measured during the entire study (average being determined as outlined above regarding values below detection limits), and the resultant carcinogenic risk. SVOC (PAH) values for 1991 and 1993 are included in the total risk calculation. Although measurements for SVOC compounds were available for limited years, the relative contribution to the total risk contribution from these compounds is not large.

**Table D** depicts the calculations for non-carcinogenic effects (both the individual HQs and the total HI are listed). The table includes columns for the compound name, the RfC, literature source for the RfC, the average concentration of the compound measured during the entire study (average being determined as outlined above regarding values below detection limits), and the resultant HQ. The HI (summed HQ

percentage) is below the recommended 100% ceiling, indicating that adverse non-cancer human health effects are not expected to occur due to inhalation exposure at these concentrations.

**Table C: Summary of Carcinogenic Health Effects Risk for New Boston 1999**

COMPOUNDS	CARCINOGENIC UNIT RISK ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	SOURCE	AVERAGE CONCENTRATION ( $\mu\text{g}/\text{m}^3$ )	CARCINOGENIC RISK
<b>VOCs</b>				
Methyl Chloride	1.8 E-06	HEAST	1.14	2.05 E-6
Dichloromethane	4.7 E-07	IRIS	0.38	1.79 E-07
Trichloromethane	2.3 E-05	IRIS	0.38	6.67 E-06
1,1-Dichloroethene	5.0 E-05	IRIS	0.64	3.20 E-05
Benzene	7.8 E-06	IRIS	128.00	9.98 E-04
1,3-Butadiene	2.8 E-04	IRIS	3.86	1.08 E-03
Carbon tetrachloride	1.5 E-05	IRIS	0.60	9.00 E-06
Trichloroethene	1.7 E-06	HEAST	0.30	6.29 E-07
Tetrachloroethene	9.5 E-07	HEAST	0.46	4.37 E-07
Styrene	5.7 E-07	HEAST	1.55	8.84 E-07
Benzyl Chloride**	4.86 E-05	IRIS	0.87	4.23 E-05
<b>SUM</b>				<b>2.17E-03</b>
<b>PAHs</b>				
Benzo(a)pyrene**	2.10 E-03	1	0.01	1.09 E-05
Benzo(a)anthracene	2.10 E-04	0.1	0.01	2.46 E-06
Benzo(b)fluoranthene	2.10 E-04	0.1	0.01	2.54 E-06
Benzo(k)fluoranthene	2.10 E-04	0.1	0.00	8.19 E-07
Chrysene	2.10 E-05	0.01	0.01	3.11 E-07
Dibenz(a,h)anthracene	2.10 E-03	1	0.01	2.27 E-05
Indeno[1,2,3-cd]pyrene	2.10 E-04	0.1	0.01	2.25 E-06
<b>SUM</b>				<b>4.20 E-05</b>
<b>TOTAL CARCINOGENIC RISK</b>				<b>2.22 E-03</b>

\*\* Estimation based on slope factor of oral route.



Table D: Summary of Non-carcinogenic Health Effect Risk for New Boston

COMPOUNDS	REFERENCE CONC. ( $\mu\text{g}/\text{m}^3$ )	SOURCE	AVERAGE CONC. ( $\mu\text{g}/\text{m}^3$ )	HAZARD PERCENT INDEX (HQ)
<b>VOCs</b>				
Acetone	3.50 E+02	IRIS**	14.88	4.30
N-Butane	4.50 E+04	TLV/42	10.13	0.00
2-Butanone	1.00 E+03	IRIS	1.67	0.20
Dichlorodifluoromethane	7.00 E+02	IRIS**	2.30	0.30
Trichlorofluoromethane	1.05 E+03	IRIS**	57.95	5.30
Dichloromethane	2.10 E+02	IRIS**	0.38	0.20
1,1,2-trichloro-1,2,2-trifluoroethane	1.05 E+05	IRIS**	0.59	0.00
Trichloromethane	3.50 E+01	IRIS**	0.29	0.80
1,1,1-trichloroethane	1.00 E+03	HEAST	1.18	0.10
Chlorodifluoromethane	5.00 E+04	IRIS	1.05	0.00
Carbon tetrachloride	2.45 E+00	IRIS**	0.60	24.50
Carbon disulfide	7.00 E+02	IRIS	10.47	1.50
Hexane	2.00 E+02	IRIS	3.07	1.50
Toluene	4.00 E+02	IRIS(RfC)	18.56	4.60
Tetrachloroethene	3.50 E+01	IRIS**	0.46	1.30
Ethylbenzene	1.00 E+03	IRIS(RfC)	0.50	0.10
m+p-Xylene	7.00 E+02	HEAST	5.61	0.20
Styrene	1.00 E+03	IRIS(RfC)	1.55	0.20
o-Xylene	7.00 E+02	HEAST	1.13	0.80
1,2,4-trichlorobenzene	3.50 E+01	IRIS**	0.59	1.70
1,2,4-trimethylbenzene	7.90 E+03	TLV/42	0.83	0.00
p-dichlorobenzene	8.00 E+02	IRIS(RfC)	0.40	0.10
Vinyl acetate	2.00 E+02	IRIS	0.49	0.20
<b>SUM</b>				<b>47.8</b>
<b>PAHs</b>				
Naphthalene	1.40 E+01	HEAST	2.962	21.16
Acenaphthene	2.10 E+02	IRIS**	0.114	0.05
Fluorene	1.40 E+02	IRIS**	0.285	0.20
Anthracene	1.05 E+03	IRIS**	0.049	0.00
Fluoranthene	1.40 E+02	IRIS**	0.083	0.06
Pyrene	1.05 E+02	IRIS**	0.054	0.05
<b>SUM</b>				<b>21.53</b>
<b>TOTAL HEALTH EFFECTS PERCENTAGE</b>				<b>69.33</b>

\*\* Estimation based on route to route extrapolation from RfD

For an accurate interpretation of the predicted risks, these risks must be placed in perspective with common daily activities. A range of "acceptable" health risk values for carcinogens has been proposed by U.S. EPA. Historically, acceptability ranges from one in one million ( $1 \times 10^{-6}$ ) for regulation of certain source categories of individual toxic air pollutants, to some source categories routinely operating in the one in ten thousand ( $1 \times 10^{-4}$ ) range. For non-carcinogenic estimation of Hazard Indexes, an individual calculated index below one (100%) is generally regarded as a "safe" level of exposure.

Most large urban areas in the United States exhibit aggregate or total carcinogenic risks in the  $10^{-4}$  to  $10^{-5}$  range. Ambient air concentrations of pollutants measured in other Ohio cities are listed in **Table 1** (above). While it is common for industrial or light industrial areas to have risks greater than those, some smaller suburban and rural areas have combined carcinogenic risks in the  $10^{-6}$  to  $10^{-8}$  range. Areas of higher risk characteristically may also contain large volumes of congested automobile traffic. Workers in such areas routinely are exposed only during working hours, and return to residential areas of decreased exposure concentrations during non-working hours. While it is certainly desirable to have these aggregate risks minimized to the lowest possible level, a no-risk scenario would be impossible to achieve in an industrial area.

Within the above framework describing acceptable risk, the total risk number for the ambient air sampled at the Water Treatment Plant in New Boston, Ohio of  $2.22 \times 10^{-3}$  is uncommonly high. Both the risk for 1,3-Butadiene at  $1.08 \times 10^{-3}$  and the benzene component at  $9.98 \times 10^{-4}$  are unacceptably high values. The 1999 stack test data from this facility document large releases of benzene and other VOC compounds from New Boston Coke Corporation. Other pollutants potentially emitted from this facility, such as particulate matter and metals, were not included in this risk assessment. The addition of this information could raise the cancer risk estimation accordingly. Based on the combined risk, it is recommended that immediate efforts be taken to reduce benzene and other VOC emissions in the vicinity of the Portsmouth Water Treatment Plant. Continued monitoring efforts will enable Ohio EPA to further evaluate the carcinogenic risks and non-carcinogenic adverse health effects associated with air toxics concentrations measured in the New Boston, Ohio area.

For further information concerning the risk assessment portions of this report, contact Paul Koval of the Air Toxics Unit. For questions concerning the ambient air monitoring portion of this assessment, contact Phil Downey of the Air Monitoring Section. The address is: Ohio EPA, Division of Air Pollution Control, P.O. Box 1049, Columbus, Ohio 43216-1049. The phone number for the Division is 614-644-2270.

# **New Boston Air Quality Study 1999**

## **- Appendix A-**

Table 4: 1993 VOC Sampling Results Summary for New Boston\*

**1993**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX. OBS.	MIN. OBS.	SAMPLES DETECTED
dichlorodifluoromethane	2.25	2.82	1.71	6
methyl chloride	3.92	19.50	0.30	5
trichlorofluoromethane	131.19	261.00	3.14	6
1,1-dichloroethene	0.64	2.82	2.82	1
dichloromethane	0.39	0.68	0.52	3
1,1,2-trichloro-1,2,2-trifluoroethane	1.04	1.92	0.77	4
trichloromethane	0.38	1.00	1.00	1
1,1,1-trichloroethane	2.96	12.39	0.90	6
benzene	175.30	627.00	4.50	6
carbon tetrachloride	0.65	0.96	0.78	4
trichloroethene	0.68	2.72	2.72	1
toluene	27.97	86.20	3.84	6
tetrachloroethene	0.53	1.46	1.46	1
ethylbenzene	1.09	1.37	0.85	6
m+p-xylene	5.63	12.50	1.33	6
styrene	3.03	10.20	0.54	5
o-xylene	1.74	3.32	0.55	6
4-ethyl toluene	0.29	0.50	0.50	1
1,3,5-trimethylbenzene	0.31	0.63	0.63	1
1,2,4-trimethylbenzene	1.01	1.73	0.91	5
p-dichlorobenzene	0.41	0.65	0.58	2

\* The sampling frequency in 1993 was 6 (the total number of detections possible was 6).

\*\* Compounds where samples detected are listed as 0, the  $\frac{1}{2}$  detection limit value is used in the arithmetic mean calculation.

Table 5: 1994 VOC Sampling Results Summary for New Boston\*

**1994**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX OBS.	MIN OBS.	SAMPLES DETECTED
dichlorodifluoromethane	1.83	3.75	0.72	18
methyl chloride	0.48	0.79	0.21	17
trichlorofluoromethane	29.89	206.00	1.91	18
dichloromethane	0.37	2.47	0.32	5
1,1,2-trichloro-1,2,2-trifluoroethane	0.44	0.75	0.68	3
trichloromethane	0.27	0.57	0.57	1
1,1,1-trichloroethane	0.80	2.66	0.52	17
benzene	105.63	348.00	0.87	18
carbon tetrachloride	0.72	1.45	0.53	14
toluene	12.82	49.10	0.89	18
tetrachloroethene	0.40	0.99	0.84	2
ethylbenzene	0.47	1.60	0.41	7
m+p-xylene	2.22	8.27	0.50	18
styrene	0.87	3.86	0.39	10
o-xylene	0.65	2.09	0.42	10
4-ethyl toluene	0.27	0.56	0.56	1
1,3,5-trimethylbenzene	0.27	0.56	0.47	2
1,2,4-trimethylbenzene	0.54	1.92	0.47	8

\* The sampling frequency in 1994 was 18 (the total number of detections possible was 18).

\*\* Compounds where samples detected are listed as 0, the half detection limit value is listed as the arithmetic mean.

Table 6: 1995 VOC Sampling Results Summary for New Boston\*

**1995**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX OBS.	MIN OBS.	SAMPLES DETECTED
dichlorodifluoromethane	1.70	2.62	0.56	15
methyl chloride	0.52	0.76	0.39	15
trichlorofluoromethane	40.35	200.00	1.74	15
dichloromethane	0.26	0.81	0.39	3
1,1,1-trichloroethane	0.52	0.82	0.52	11
benzene	142.99	823.00	11.70	15
carbon tetrachloride	0.45	0.72	0.59	6
trichloroethene	0.29	0.61	0.61	1
toluene	18.87	100.00	2.91	15
tetrachloroethene	0.44	1.88	1.88	1
ethylbenzene	0.55	3.33	0.40	6
m+p-xylene	3.17	14.40	0.96	15
styrene	1.15	7.46	0.41	7
o-xylene	1.57	7.99	0.40	14
1,3,5-trimethylbenzene	0.44	2.03	0.70	3
1,2,4-trimethylbenzene	0.71	2.22	0.47	9
benzyl chloride	0.30	0.83	0.83	1
p-dichlorobenzene	0.40	1.09	0.81	2

\* The sampling frequency in 1995 was 15 (the total number of detections possible was 15).

\*\* Compounds where samples detected are listed as 0, the  $\frac{1}{2}$  detection limit value is used in the arithmetic mean calculation.

Table 7: 1996 VOC Sampling Results Summary for New Boston\*

**1996**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX OBS.	MIN OBS.	SAMPLES DETECTED
dichlorodifluoromethane	1.51	2.00	0.60	7
methyl chloride	1.71	4.10	1.10	7
ethyl chloride	0.24	0.90	0.90	1
trichlorofluoromethane	28.00	92.00	1.70	7
dichloromethane	0.59	2.40	0.90	2
1,1,1-trichloroethane	0.35	0.60	0.10	3
benzene	147.00	560.90	17.80	7
toluene	20.01	40.60	2.60	7
tetrachloroethene	0.55	1.80	1.80	1
ethylbenzene	0.26	0.50	0.50	1
m+p-xylene	11.43	21.60	3.80	7
styrene	1.41	3.10	0.80	4
o-xylene	0.93	1.70	0.70	5
1,3,5-trimethylbenzene	0.31	0.70	0.70	1
1,2,4-trimethylbenzene	0.72	1.90	0.80	4

\* The sampling frequency in 1996 was 7 (the total number of detections possible was 7).

\*\* Compounds where samples detected are listed as 0, the  $\frac{1}{2}$  detection limit value is used in the arithmetic mean calculation.

Table 8: 1997 VOC Sampling Results Summary for New Boston\*

**1997**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX OBS.	MIN OBS.	SAMPLES DETECTED
dichlorodifluoromethane	2.07	3.40	1.40	3
methyl chloride	0.47	1.20	1.20	1
trichlorofluoromethane	3.83	5.00	3.00	3
1,1,1-trichloroethane	2.26	4.00	2.50	2
benzene	12.47	26.30	2.60	3
trichloroethene	0.45	0.80	0.80	1
toluene	2.70	3.50	2.00	3
ethylbenzene	0.35	0.60	0.60	1
m+p-xylene	2.37	3.10	1.30	3
o-xylene	0.41	0.50	0.50	2
1,2,4-trimethylbenzene	0.48	0.60	0.60	2

\* The sampling frequency in 1997 was 3 (the total number of detections possible was 3).

\*\* Compounds where samples detected are listed as 0, the  $\frac{1}{2}$  detection limit value is used in the arithmetic mean calculation.



Table 9: 1998 VOC Sampling Results Summary for New Boston\*

**1998**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX OBS.	MIN OBS.	SAMPLES DETECTED
dichlorodifluoromethane	4.23	6.04	2.01	4
methyl chloride	1.62	2.10	1.07	4
trichlorofluoromethane	167.15	563.44	5.66	4
1,1,1-trichloroethane	6.88	23.86	0.55	2
benzene	150.14	159.70	19.49	4
toluene	13.99	21.81	4.98	4
ethylbenzene	0.27	0.44	0.44	1
m+p-xylene	6.14	4.45	2.03	4
styrene	1.02	1.99	0.69	3
o-xylene	0.88	1.10	0.62	4
1,2,4-trimethylbenzene	0.75	1.05	0.50	4

\* The sampling frequency in 1998 was 4 (the total number of detections possible was 4).

\*\* Compounds where samples detected are listed as 0, the  $\frac{1}{2}$  detection limit value is used in the arithmetic mean calculation.

Table 10: 1999 VOC Sampling Results Summary for New Boston\*

**1999**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX OBS.	MIN OBS.	SAMPLES DETECTED
dichlorodifluoromethane	3.20	5.49	1.95	17
methyl chloride	1.16	1.83	0.86	16
trichlorofluoromethane	74.60	349.00	3.37	16
dichloromethane	0.26	1.38	1.38	1
benzene	139.20	552.34	9.10	16
toluene	24.67	96.00	2.80	16
ethylbenzene	0.49	0.93	0.49	10
m+p-xylene	11.00	30.02	1.68	10
styrene	2.38	7.80	0.61	15
o-xylene	1.51	3.71	0.80	15
1,2,4-trimethylbenzene	1.34	2.50	0.80	15
benzyl chloride	1.40	4.66	1.05	10

\* The sampling frequency in 1999 was 16 (the total number of detections possible was 16).

\*\* Compounds where samples detected are listed as 0, the  $\frac{1}{2}$  detection limit value is used in the arithmetic mean calculation.

**Table 11: 1998 VOC Sampling Results Summary for New Boston; additional compounds detected only during 1998-1999\*****1998**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX OBS.	MIN OBS.	SAMPLES DETECTED
acetone	9.30	14.72	6.51	4
1,3-butadiene	3.14	5.39	0.90	4
n-butane	12.12	23.16	6.03	4
2-butanone	1.24	1.74	0.90	4
carbon disulfide	4.88	9.17	1.64	3
chlorodifluoromethane	0.85	1.43	0.61	3
hexane	2.41	3.47	1.43	4
naphthalene	7.61	19.17	1.60	4
n-pentane	0.70	0.90	0.54	4
vinyl acetate	0.96	1.47	0.72	3

\* The sampling frequency in 1998 was 4 (the total number of detections possible was 4).

**Table 12: 1999 VOC Sampling Results Summary for New Boston; additional compounds detected only during 1998-1999\*****1999**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	ARITHMETIC MEAN	MAX OBS.	MIN OBS.	SAMPLES DETECTED
acetone	16.28	38.60	3.38	16
1,3-butadiene	4.04	11.23	0.40	16
n-butane	9.64	60.31	1.91	16
2-butanone	1.86	3.89	0.87	16
carbon disulfide	11.90	28.80	1.64	16
chlorodifluoromethane	1.10	4.29	0.50	12
cumene	0.40	1.65	1.65	1
hexane	3.23	8.94	0.75	16
naphthalene	16.47	47.39	4.53	14
n-pentane	7.55	111.80	0.30	14
vinyl acetate	0.41	3.33	0.72	2

\* The sampling frequency in 1999 was 16 (the total number of detections possible was 16).

Table 13: 1991 and 1993 SVOC Sampling Results Summary for New Boston

**1991 and 1993**units  $\mu\text{g}/\text{m}^3$ 

COMPOUNDS	10-21-91	10-23-91	06-28-93	07-06-93	09-07-93	09-28-93
Naphthalene	1.0390	.2080	3.6690	9.7551	2.9088	.1939
Acenaphthylene	.2020		.3434	.9915	.1374	.1156
Acenaphthene	.1160	.0390	.1063	.2648	.1027	.0559
Fluorene			.3953	1.0385	.2563	.0105
Phenanthrene	.2260	.0200	.5120	1.3266	.3436	.0270
Anthracene	.0270	.0230	.0562	.1580	.0301	.0021
Fluoranthene	.0550		.1098	.2177	.0605	.0480
Pyrene	.0240		.0889	.1638	.0385	.0063
Chrysene			.0282	.0335	.0117	.0063
Dibenz(a,h) anthracene			.0460	.0003	.0056	.0039
Indeno[1,2,3cd] pyrene			.0220	.0251	.0053	.0029
Benzo-						
(a)anthracene			.0207	.0258	.0100	.0048
(a)pyrene			.0120	.0004	.0062	.0035
(b)fluoranthene			.0246	.0279	.0100	.0007
(k)fluoranthene			.0085	.0001	.0036	.0020
(g,h,i)perylene			.0248	.0421	.0117	.0091

# **New Boston Air Quality Study 1999**

## **- Appendix B-**

### Air Modeling Analysis

Results of a 1999 stack test of the New Boston Coke bleeder stack were used to evaluate the potential short term and long term ambient air impacts due to the emissions of benzene from this source. Information contained in the stack test report was used to characterize the release parameters from this source (emission rate, stack height, stack diameter, volume flow and stack temperature). Additional information was obtained from USGS topographical maps to approximate the location of the stack and the location and size of the major facility structures. Additional information concerning building heights was obtained from the Portsmouth Local Air Agency.

The ISCST3 model (version 99155) was used to estimate the peak one hour and annual benzene impacts from the bleeder stack. The ISCST3 model is a U.S. EPA approved model (Appendix W to 40 CFR Part 51, Guideline on Air Quality Models) applicable to point sources such as stacks and vents in simple and complex terrain. The peak one hour benzene emission rate of 30.87 grams per second, obtained from the stack test data, was assumed in the modeling.

One year of National Weather Service (NWS) meteorological data (1991 Huntington surface and upper air) was used in the computer model. In general, one year of on-site or 5 years of NWS are recommended for a complete modeling evaluation.

Terrain elevation information obtained from digitized USGS topographical map files was used to develop a receptor array in the vicinity of the plant. Receptors are the locations at which the model is directed to calculate ambient concentrations due to a source, or set of sources. Over 2500 receptors with 100 meter spacing were placed around the facility and discrete fence-line receptors were placed at the approximate property line of the facility. It is anticipated that a facility plot plan that contains the exact boundaries, once obtained, will indicate that the actual plant property is smaller than the area that was assumed in the modeling.

Results of this modeling indicate a peak one-hour concentration of 7864 ug/m<sup>3</sup> and a peak annual concentration of 211 ug/m<sup>3</sup>. These peaks occur approximately 300-400 meters northeast of the assumed location of the bleeder stack. Concentrations due to the source are predicted to drop off rapidly from the modeled peak. Concentrations are generally higher in the elevated terrain near the plume height of the bleeder stack. Peak annual concentrations drop off to 100 ug/m<sup>3</sup> at distance of 0.8 kilometers from the source. Peak 1-hour concentrations drop off to 1000 ug/m<sup>3</sup> at a distance of 3.2 kilometers from the source.