

**Assessment of**  
**“The Smokestack Effect - Toxic Air and America’s Schools”**  
**USA Today, December 8, 2008**

**NC Division of Air Quality**  
**December 15, 2008**

## Introduction

The USA Today Newspaper published a special report article titled “*The Smokestack Effect - Toxic Air and America’s Schools*” on December 8, 2008. The article attempts to compare health risks from exposure to toxic air pollutants outside schools across the country. The [Political Economy Research Institute](#) at the University of Massachusetts Amherst provided analytical help by using the Risk Screening Environmental Indicators (RSEI) computer model developed by the U.S. Environmental Protection Agency (EPA).

The RSEI model was used to relatively rank 127,800 schools nationwide from predicted exposure to chemicals likely to be in the air based on 2005 emission data from more than 20,000 industrial facilities. RSEI generates results through values known as “Indicator Elements” which are unitless and can be compared one to another. RSEI output is not a quantitative risk assessment; the indicator elements do not represent a quantitative assessment of risk. RSEI can evaluate in a comparative manner environmental and human-health aspects associated with industrial releases of chemicals and supports environmental program ranking and prioritization activities, strategic planning, and targeting and trend analysis.

Because RSEI uses input information developed for other regulatory purposes, its output must be interpreted understanding the original purposes for which those information sources were developed. RSEI makes certain assumptions that affects the output and requires expert interpretation. Environmental release information not included in the model inputs must also be considered in understanding overall results.

The USA Today article presents output from RSEI using the 2005 Toxics Release Inventory (TRI) Data, the year 2000 census data, and toxicity data from the EPA Integrated Risk Information System (IRIS) database and other information sources. See Appendix A for more information.

RSEI is not designed as a substitute for more comprehensive, site-specific risk assessments. Information presented in the USA Today article should be viewed only as a first step in assessing a variety of available information about environmental releases.

## Schools

The USA Today report lists seven North Carolina schools in the 1<sup>st</sup> percentile of schools in areas of highest modeled levels of toxic chemicals. Two schools in Canton, three schools in Gastonia, one school in Maxton and one school in Raleigh are identified as being impacted by acetaldehyde, ammonia, aniline, chlorine dioxide, chromium and chromium compounds, cobalt, formaldehyde, glycol ethers, diisocyanates including toluene diisocyanate, hydrochloric acid, manganese and manganese compounds, nitrobenzene, polycyclic aromatic compounds, sulfuric acid, and lead and lead compounds. Of these, chlorine dioxide, and cobalt are not regulated under the State air toxics program and lead is regulated under the overall air pollution control program. Corresponding industrial facilities that emit the chemicals are also listed. DAQ is

thoroughly reviewing the information in the USA Today report regarding these areas, and as of today has determined the following:

**Canton area<sup>1</sup>** – The facility whose emissions appear to most significantly impact the area, formerly Blue Ridge Paper Products, Inc., submitted an air dispersion modeling report in 2007 demonstrating compliance with NC Air Toxics regulations. In particular, the level of sulfuric acid, the pollutant listed by USA Today as having the 55%-56% of the overall toxicity at the two Canton area schools, was modeled to be only 17% of the acceptable ambient level (AAL) at the facility property boundary.

**Gastonia area<sup>2</sup>** – For two of the three Gastonia area schools mentioned, diisocyanates and toluene diisocyanate (mixed isomers) are reported to contribute 91%-95% of the overall toxicity. DAQ has determined that the facility emitting these compounds, RadiciSpandex Corporation, no longer operates manufacturing processes that emit these pollutants as of 2006. For the other area school, manganese and manganese compounds were listed as responsible for 80% of the air toxicity outside the school. However, a review of current DAQ emissions inventory records revealed no significant source of these compounds in or around Gastonia.

**Maxton area<sup>3</sup>** – One school in Maxton was listed in the 1<sup>st</sup> percentile, with 81% of toxicity attributed to sulfuric acid. The facility whose emissions appeared to most significantly impact the area, Pilkington North America, Inc., submitted an air dispersion modeling report in 2006 demonstrating compliance with NC Air Toxics regulations, including sulfuric acid.

**Raleigh area<sup>4</sup>** – One school was listed in the 1<sup>st</sup> percentile, with 99% of toxicity attributed to aniline (63%) and nitrobenzene (36%). The only nearby source of these chemicals, Mallinckrodt Inc., submitted an air dispersion modeling report in 2008 demonstrating compliance with NC Air Toxics regulations for aniline emissions, with a maximum modeled aniline concentration of 4% of the AAL at the property boundary. For nitrobenzene, a modeling report submitted in 2005 demonstrated compliance for this compound, with a maximum modeled concentration of 54% of the AAL at the property boundary.

## State Air Toxics Program

The State of North Carolina established its own state air toxics program in 1990 prior to the inception of the US Environmental Protection Agency (EPA) federal air toxics program. The NC toxics program is a "risk-based" air pollution control program designed to protect the public health by limiting emissions of regulated toxic air pollutants. The NC Air Toxics Program regulates ninety-seven toxic air pollutants or pollutant groups. Twenty-one of these are not regulated under EPA federal air toxics rules.

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<sup>1</sup> Bethel Christian Academy and North Canton Elementary

<sup>2</sup> Rhyne Elementary, Webb Street Special Education, and Highland School of Technology

<sup>3</sup> Townsend Middle School

<sup>4</sup> Neuse Baptist Christian School

The toxics rule at its core has a set of health-based guidelines establishing airborne concentration levels at facility property lines below which no adverse health effects are observed, even in sensitive subgroups of the general population including children. The guidelines for known carcinogens represent "one in a million" cancer risk. Regulated facilities in NC are expected to reduce their emissions below those guidelines at their property line. Other examples of how the NC program addresses toxic pollutant issues include:

- Assessing emissions through:
  - Monitoring and measuring air quality for toxic air pollutants
  - Compliance activities such as intensive inspections and investigations
  - Air dispersion modeling and
  - Special studies
- Performing risk assessments and program planning activities to focus efforts toward the reduction of exposures and emissions
- Developing and implementing air pollution control strategies for toxic or hazardous air pollutants
- Performing education and outreach activities
- Conducting emergency air monitoring to promptly bring air toxics expertise to communities during potentially toxic events, including the explosion in Apex in 2006 and the huge forest fire in eastern NC in 2008

As a part of the air quality permitting process, most NC industrial facilities are required to conduct dispersion modeling to demonstrate that the facility wide emissions of all regulated pollutants expected to increase as a result of adding or modifying emission sources do not result in off property concentrations that would cause an adverse health impact. This demonstration is made using air quality computer dispersion models that are able to simulate the release, transport, and dispersion of the pollutants as they move away from the facility and to predict the pollutant ground level concentrations at hundreds or thousands of locations at and beyond the facility property boundary. The maximum predicted concentration of each pollutant is then compared to the applicable air quality standard or for NC air toxics, Acceptable Ambient Level (AAL), to establish compliance. Most of these modeling demonstrations are made using refined level models (e.g., AERMOD), that use detailed site specific or representative data (e.g., meteorology, individual source emissions and emission data, source locations, etc.) which is considered more accurate and representative than screen level models which generally assume worst case meteorology and single source emission data and locations.

## **Air Monitoring**

NC DAQ in cooperation with local governments, tribal councils and industries operate over 75 air monitoring sites across the state for a variety of pollutants. These sites have been established based on a number of regulations, risk factors and siting criteria. Of these sites, seven specifically compose an Urban Air Toxics (UAT) network and are located in six urban areas across the state, Asheville, Winston-Salem, Charlotte, Raleigh (2), and Wilmington. The seventh site is located in a rural area in Candor, as a reference site. Composite samples taken over a 24-hour period are collected weekly. Three of these sites are located on or very near school property located in Mecklenburg, Wake and

Forsyth counties.<sup>5</sup> These sites monitor for a large suite of chemicals. The table below lists the schools (percentile ranking) and the compounds USA Today identifies as having impacts.

<b>School Name (Percentile Ranking)</b>	<b>City, County</b>	<b>Modeled Compounds</b>
East Millbrook Middle School (46 <sup>th</sup> percentile)	Raleigh, Wake	aniline, nitrobenzene, chromium and chromium compounds, hydrochloric acid, and ammonia
Garinger High School (24 <sup>th</sup> percentile)	Charlotte, Mecklenburg	sulfuric acid, hydrochloric acid, manganese and manganese compounds, antimony and antimony compounds, polycyclic aromatic compounds
East Winston Primary School Winston-Salem Preparatory Academy Ephesus Jr. Academy (all 28 <sup>th</sup> percentile)	Hattie Ave., Winston-Salem, Forsyth	hydrochloric acid, manganese and manganese compounds, sulfuric acid, glycol ethers, hydrogen fluoride

Of the compounds listed above the DAQ routinely analyzes for nitrobenzene at two sites (Candor and Millbrook), and the metals as constituents of fine particulate samples.

Nitrobenzene was not detected at Candor and Millbrook for 2007. Through April 18, 2008, only six of ten samples from the Candor site and three of eight samples from the Millbrook site were above the detection limit. The highest values at both of these sites were less than 0.01% of the AAL.

Metals measured are derived by analyzing fine particulate matter filters and obtaining a total metal concentration. According to the USA Today article, the RSEI model assumes all reported chromium is chromium VI. Since total chromium measurements are treated as chromium VI equivalent, a very toxic form of chromium, the risk associated with exposure to total chromium may be grossly overestimated. The average total chromium concentration measured at the Millbrook site for 2007 was 3.8 ng/m<sup>3</sup>.

The average manganese concentration measured at the Garinger site for 2007 was 1.4 ng/m<sup>3</sup>. The average manganese concentration measured at the Hattie Ave. site for 2007 was 1.1 ng/m<sup>3</sup>. These measurements represent less than 0.01% of the current AAL.

The average antimony concentration measured at the Garinger site for 2007 was 17.9 ng/m<sup>3</sup>. The majority of sources reporting antimony in NC reported annual emissions of less than one pound. Although there is no current AAL for antimony, it is regulated as a federal hazardous air pollutant. Antimony is regulated by NC as a particulate emission.

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<sup>5</sup> East Millbrook Middle School, Raleigh. Garinger High School, Charlotte. Hattie Avenue, Winston-Salem in proximity to three schools - East Winston Primary School, Winston-Salem Preparatory Academy and Ephesus Jr. Academy

## Case Study—Canton

### *Canton Study Summary*

In response to odor complaints in Canton, NC, the NC Division of Air Quality's Toxics Protection Branch conducted a 21-day monitoring study in May 2006. The study was performed to coincide with a scheduled maintenance "outage" at the Blue Ridge Paper Products (BRPP) facility; when it was surmised that the potential for emission of odorous compounds would be greatest. The goals of the study were to: 1) identify and quantitate air contaminants having the potential to contribute to the level of odor in Canton, 2) identify and quantitate air contaminants believed to cause adverse human health effects, and 3) estimate the potential levels of risk of exposure to these air contaminants. The complete report can be found at the following website: [NCDENR - Division of Air Quality - Investigations and Area Studies](http://daq.state.nc.us/toxics/studies/) (<http://daq.state.nc.us/toxics/studies/>).

The monitored compounds or compound classes were ammonia, carbonyl compounds, volatile organic compounds, mercury, and reduced sulfur compounds. These were the compounds that were believed to potentially be present in the ambient air in the community. Primary consideration was for compounds that could potentially produce odors, notably, the reduced sulfur compounds.

Three sites were selected in the area. Two sites (B&C) were located in Canton and represented the best available sites in terms of predominant wind directions, proximity to BRPP, and proximity to the home and business of the primary complainant. A third site (A) was located in Asheville to represent a "non-impacted" site.

The ammonia sampling showed that no data exceeded the lower detection limit (LDL) of 2.6 ppm (1820  $\mu\text{g}/\text{m}^3$ ). These data indicate that there was no risk from acute exposure to ammonia (NC acceptable ambient level (AAL) = 2700  $\mu\text{g}/\text{m}^3$ ) at any of the sites. Additionally, while there is no chronic NC AAL for ammonia, but there is an EPA Reference Concentration (RfC) (100  $\mu\text{g}/\text{m}^3$ ). Because of the relatively high sampling method LDL, it cannot be concluded that there is no risk resulting from chronic exposure. Ammonia is not carcinogenic; there is no cancer risk.

Carbonyl compound sampling was conducted for a suite of 15 compounds of which two were of primary concern as it relates to the NC Toxics program, formaldehyde and acetaldehyde. These two compounds had the highest average concentration of carbonyl compounds monitored in the study. However, comparing this data to data collected in May 2002-2005 at a rural Candor, NC site shows that carbonyl data collected at the three sites are comparable to levels found in the rural air of Candor. In addition to this comparison, based on information provide to DAQ from BRPP in a July 2007 air quality modeling study, the maximum formaldehyde concentration of 11.1  $\mu\text{g}/\text{m}^3$  occurred at 266 meters from the center of the facility at an angle of 42 degrees east of north which represents approximately 10% of the acceptable ambient level (based on a 1 hour acute exposure). It is possible to conclude from these data that the modeled formaldehyde concentration expected to occur at Site B would be less than or equal to 11.1  $\mu\text{g}/\text{m}^3$ , however formaldehyde concentrations were observed to be 27  $\mu\text{g}/\text{m}^3$  at Site B. This implies that there are additional sources of formaldehyde and it seems likely that due to Site B's location in a BRPP parking lot (between BRPP and a complainant's house) that automobile emissions are a likely additional source. Comparison of carbonyl data at

sites B and C, before, during, and after the outage showed no discernible trend indicating a connection between plant operations and the carbonyl concentrations. This would also tend to support the supposition that vehicles are the source of the formaldehyde and acetaldehyde seen at Site B.

Volatile organic compound (VOC) sampling was also conducted for a suite of 45 compounds. Comparison of data from each of the three sites indicates that average VOC concentrations across sites are similar. Additionally, the comparison of each of the three sites to the rural Candor UAT site (data for May in both 2005 and 2006) indicates that VOC concentrations are elevated in those VOCs such as benzene, toluene, and xylenes, but this is attributable primarily to greater mobile source emissions in urban areas.

Mercury monitoring was conducted at Asheville (Site A) and Canton (Site C). The average elemental mercury concentration at Site A was 1.3 ng/m<sup>3</sup> and at site C was 1.6 ng/m<sup>3</sup> (one billionth of a gram per cubic meter). The generally accepted average background elemental mercury concentration is between 1 and 2 ng/m<sup>3</sup>, therefore the data from the two sampling sites are not considered to be different from background. For comparison purposes, the most stringent NC AAL for mercury or compounds of mercury is 600 ng/m<sup>3</sup>.

Reduced sulfur compound monitoring was conducted for a suite of 20 reduced sulfur compounds (RSC). RSCs as a class of compounds are generally malodorous, however they are not the only chemicals that are. Only 4 samples (one at Site A, one at Site B, and two at Site C) of the 38 RSC samples collected produced detectable results. RSCs generally have low odor threshold concentrations (the human sense of smell is very sensitive); these compounds can be detected by their odor even when their airborne concentrations are so low that they cannot be analytically detected. Only carbonyl sulfide, carbon disulfide, ethyl methyl sulfide, and diethyl sulfide have olfactory thresholds greater than the detection limits for the monitoring method. Otherwise unidentified TRS compounds can produce an unpleasant olfactory response, but RSCs are not the only compounds that produce such a response. Additionally, of the samples with detectable levels of RSCs, 1 sample from Site A contained one quantifiable compound, diethyl disulfide, at 11.0 ppbv (parts per billion by volume). The other three samples contained nonspecific total reduced sulfur (TRS, defined as any reduced sulfur compound(s) not specifically identified and quantified relative to hydrogen sulfide response) at Site A of 220 ppbv, at Site B of 58 ppbv, and Site C of 12 ppbv and 16 ppbv.

The following section will provide a brief description of the risk assessment performed for this study.

## **Canton Air Monitoring Risk Assessment**

An assessment of risk was performed using the air monitoring study data. It is important to note that this assessment was performed on a 21-day set of air monitoring data, and assumptions had to be made in order to determine risks arising from acute exposure, chronic exposure, and cancer risk.

All monitoring, except for ammonia and mercury, was conducted on a 24-hour basis; that is, sampling for VOCs, carbonyls, and RSCs was conducted over a 24-hour sampling

period during each of the 21-day study period. Ammonia and mercury monitoring utilized continuous monitoring over that same period. Two monitoring sites were established in Canton, NC and one background site was established in Asheville, NC.

Assumptions that were made in order to process the monitoring included:

- Acute risk (for those air toxics having an acute reference level) was determined by assuming that the mass of pollutant sampled was accumulated in a 1-hour period.
- Chronic risk (for those air toxics having a chronic reference level) was determined assuming that the mean airborne concentration sampled over the 21-day study period was the same as the annualized exposure concentration.
- Cancer risk (for those air toxics having a cancer Inhalation Unit Risk) was determined over an assumed lifetime of 70 years at the average 21-day exposure concentration.
- For the purposes of this summary, the population of Canton, NC is assumed to be 5,000.

A Hazard Quotient (HQ) is a number derived by dividing an average measured concentration by a health-based standard. HQs less than 1 are considered to be of minimal risk of adverse health effects arising from exposure. The higher the HQ is from a value of 1, the greater the risk. A Hazard Index (HI) is the sum of the HQs from toxic air pollutants that affect the same organ systems. HQs only apply to acute and chronic health effects with non-cancer endpoints.

Risks arising from exposure to toxic air pollutants having cancer endpoints are estimated by multiplying the exposure concentration by a unit risk value.

For **Site A** (Asheville, reference site):

Carbonyl Compounds

The largest contributor to acute risk for the carbonyl compounds sampled (aldehydes and ketones) is FORMALDEHYDE. The Hazard Quotient determined (as described above, total mass of air toxic collected assumed to be collected in a 1-hour period/acute reference level) was 42.6.

<b>Air Toxic</b>	<b>Hazard Quotient</b>
Formaldehyde	42.6
Benzaldehyde	7.5
Butyraldehyde	6.9
Propionaldehyde	4.6
Acetaldehyde	4.5

If it is assumed that the equivalent 1-hour concentration is the same as the 24-hour concentration, the largest contributor to acute risk is FORMALDEHYDE (HQ = 1.8). The HQs for all other carbonyls sampled are less than 1 (risk is minimal).

Analysis of the 24-hour sampling data shows that there are no large contributors to chronic risk (sum of HQs for all sampled carbonyls is less than 1).

Insofar as cancer risk is concerned, only two carbonyls were determined to exhibit elevated cancer risk (risk greater than 1 in a million population):

Air Toxic	Excess Cancer Cases Resulting in Canton, NC
Formaldehyde	< 1
Acetaldehyde	<< 1

Volatile Organic Compounds

The data indicate that there is no excess acute or chronic risk from exposure to VOCs.

Insofar as cancer risk is concerned, only one VOC was determined to exhibit elevated cancer risk (risk greater than 1 in a million population):

Air Toxic	Excess Cancer Cases Resulting in Canton, NC
Benzene	<< 1

Reduced Sulfur Compounds (RSCs)

The largest contributor to acute risk for the RSCs sampled is METHYL MERCAPTAN. The Hazard Quotient determined (as described above, total mass of air toxic collected assumed to be collected in a 1-hour period/acute reference level) was 2.

If it is assumed that the equivalent 1-hour concentration is the same as the 24-hour concentration, there is no large contributor to acute risk. The HQs for all RSCs sampled are less than 1 (risk is minimal).

Analysis of the 24-hour sampling data shows that the sole large contributor to chronic risk is hydrogen sulfide (HQ = 1.7). There appears to be elevated chronic risk from exposure to hydrogen sulfide.

There is no cancer risk resulting from exposure to RSCs.

For **Site B**, Canton:

Carbonyl Compounds

The largest contributor to acute risk for the carbonyl compounds sampled (aldehydes and ketones) is FORMALDEHYDE. The Hazard Quotient determined (as described above, total mass of air toxic collected assumed to be collected in a 1-hour period/acute reference level) was 215.

Air Toxic	Hazard Quotient
Formaldehyde	215
Benzaldehyde	12.9
Butyraldehyde	12.6
Acetaldehyde	11.3
Propionaldehyde	6.8
Valeraldehyde	1.8

If it is assumed that the equivalent 1-hour concentration is the same as the 24-hour concentration, the largest contributor to acute risk is FORMALDEHYDE (HQ = 8.9). The HQs for all other carbonyls sampled are less than 1 (risk is minimal).

Analysis of the 24-hour sampling data shows FORMALDEHYDE is the largest contributor to chronic risk (HQ = 2.7).

Insofar as cancer risk is concerned, formaldehyde was determined to exhibit elevated cancer risk (risk greater than 1 in a million population):

Air Toxic	Excess Cancer Cases Resulting in Canton, NC
Formaldehyde	2

Volatile Organic Compounds

The data indicate that there is no excess acute or chronic risk from exposure to VOCs.

Insofar as cancer risk is concerned, two VOCs were determined to exhibit elevated cancer risk (risk greater than 1 in a million population):

Air Toxic	Excess Cancer Cases Resulting in Canton, NC
Chloroform	<< 1
Benzene	<< 1

Reduced Sulfur Compounds (RSCs)

The largest contributor to acute risk for the RSCs sampled is METHYL MERCAPTAN. The Hazard Quotient determined (as described above, total mass of air toxic collected assumed to be collected in a 1-hour period/acute reference level) was 2.2.

If it is assumed that the equivalent 1-hour concentration is the same as the 24-hour concentration, there is no large contributor to acute risk. The HQs for all RSCs sampled are less than 1 (risk is minimal).

Analysis of the 24-hour sampling data shows that the sole large contributor to chronic risk is hydrogen sulfide (HQ = 2). There appears to be elevated chronic risk from exposure to hydrogen sulfide.

There is no cancer risk resulting from exposure to RSCs.

For **Site C**, Canton:

Carbonyl Compounds

The largest contributor to acute risk for the carbonyl compounds sampled (aldehydes and ketones) is FORMALDEHYDE. The Hazard Quotient determined (as described above, total mass of air toxic collected assumed to be collected in a 1-hour period/acute reference level) was 215.

Air Toxic	Hazard Quotient
Formaldehyde	28
Butyraldehyde	5
Acetaldehyde	4
Propionaldehyde	3
Benzaldehyde	2

If it is assumed that the equivalent 1-hour concentration is the same as the 24-hour concentration, the largest contributor to acute risk is FORMALDEHYDE (HQ = 1.2). The HQs for all other carbonyls sampled are less than 1 (risk is minimal).

Analysis of the 24-hour sampling data shows that there are no large contributors to chronic risk (sum of HQs for all sampled carbonyls is less than 1).

Insofar as cancer risk is concerned, formaldehyde was determined to exhibit elevated cancer risk (risk greater than 1 in a million population):

Air Toxic	Excess Cancer Cases Resulting in Canton, NC
Formaldehyde	< 1
Acetaldehyde	<< 1

Volatiles Organic Compounds

The data indicate that there is no excess acute or chronic risk from exposure to VOCs.

Insofar as cancer risk is concerned, only one VOC was determined to exhibit elevated cancer risk (risk greater than 1 in a million population):

Air Toxic	Excess Cancer Cases Resulting in Canton, NC
Benzene	<< 1

Reduced Sulfur Compounds (RSCs)

The largest contributor to acute risk for the RSCs sampled is METHYL MERCAPTAN. The Hazard Quotient determined (as described above, total mass of air toxic collected assumed to be collected in a 1-hour period/acute reference level) was 1.8.

If it is assumed that the equivalent 1-hour concentration is the same as the 24-hour concentration, there is no large contributor to acute risk. The HQs for all RSCs sampled are less than 1 (risk is minimal).

Analysis of the 24-hour sampling data shows that the sole large contributor to chronic risk is hydrogen sulfide (HQ = 2). There appears to be elevated chronic risk from exposure to hydrogen sulfide.

There is no cancer risk resulting from exposure to RSCs.

**Canton Modeling**

The most recent modeling demonstration completed by the former Blue Ridge Paper Products facility was conducted in September, 2008, to evaluate facility wide emissions of all NC air toxics associated with combustion source (e.g., boilers) emissions; these emissions included sulfuric acid and acetaldehyde. The modeling was conducted using the latest generation EPA approved AERMOD model with onsite meteorology to determine the highest predicted impacts for each air toxic at each of hundreds of locations at and beyond the facility property boundary out to a distance of 7 kilometers.

The maximum impacts were predicted to occur at the facility property boundary and were less than 28% of the applicable AAL for all the pollutants evaluated.

## Areas for Further Investigation

The USA Today article raises questions about exposure of school children (and by implication, associated communities) to toxic air pollutants. The discussion above is a summary response to that article. A more refined analysis of the results indicated by this article will provide a better assessment of the risk resulting from exposure to air pollutants. What follows is a list of some of those things that could be included in that analysis.

### RSEI Model

The USA Today article presents results from using RSEI, 2005 Toxics Release Inventory (TRI) Data, 2000 census data, and toxicity data from the EPA’s IRIS database. DAQ would rerun the RSEI model using AAL concentrations, as well as more up to date emission inventory and census data.

### HEM-3 (AERMOD)

The USA Today article uses output from the RSEI model to imply exposure risk, a task that RSEI is not designed to perform. A more appropriate model to use would be the Human Exposure Model (HEM, version 3) that directly estimates exposure risk, incorporating NC AALs.

### Sulfuric Acid

The Division of Air Quality obtains air emission inventories from facilities with air permits. Facilities are required to report annually or every five years depending upon their classification. The table below list the latest two years of information for sulfuric acid in descending order of size of facilities from largest to smallest.

	<b>Number of Facilities</b>	<b>2005</b>	<b>Number of Facilities</b>	<b>2006</b>
Title V	49	4,360,900	51	4,689,000
Synthetic Minor	6	13,230	4	11,900
Small	8	23,500	8	23,500
Non-reporting	0	10,800	0	17,500

The submissions to TRI, data subsequently used in the RSEI model, are self-reported and unverified data. Errors in these data are known to exist and are acknowledged by USA Today. For priority setting, this is not a major problem with the TRI data set. However, it becomes one if those data are used to estimate risk, however broadly one wishes to define that term. The toxicity weighting used in RSEI for sulfuric acid is very conservative and is derived from an analysis by the California EPA. If the NC AAL was substituted for the Cal EPA value, the toxicity weighting would be an order of magnitude lower resulting in a lower toxicity rating as used in the USA Today article.

### *Chromium*

Metals measured are derived by analyzing fine particulate matter filters and obtaining a total metal concentration. According to the USA Today article, the RSEI model assumes all reported chromium is chromium VI. Since total chromium measurements are treated as chromium VI equivalent, a very toxic form of chromium, the risk associated with exposure to total chromium may be grossly overestimated. The average total chromium concentration measured at the Millbrook site for 2007 was 3.8 ng/m<sup>3</sup>. Statewide measurements in 2007 at other sites averaged 3.5 ng/m<sup>3</sup> at Garinger and 1.6 ng/m<sup>3</sup> at Hattie Avenue in Winston Salem. It is recommended that sources of chromium VI be investigated and risks assessed as resources allow.

***Appendix A***  
***Technical Information for RSEI Model, Toxics  
Release Inventory, and the Integrated Risk  
Information System***

### RSEI Model

The [Risk-Screening Environmental Indicators](#) (RSEI) Model is a screening-level tool developed by the EPA. RSEI:

- is a screening model that can process large datasets quickly.
- combines exposure estimates with population data and toxicity weights to provide a risk-screening result.
- estimates general trends based upon relative risk-related impacts of toxic chemical releases.
- uses input industry chemical release data from EPA's Toxics Release Inventory (TRI) in combination with toxicity data from the Integrated Risk Information System (IRIS).

### RSEI limitations

- Only models point sources required to report in TRI
- If there is more than one release point at a facility, a single median height stack centered in the facility is used as the release point
- Uses generic release point assumptions regarding median stack height, median stack diameter and median exit gas velocity based on SIC codes (when data is absent in TRI).
- Only models one year at a time
- Does not differentiate between indoor and outdoor air concentrations
- Does not account for population activity patterns
- Assumes populations are continuously exposed
- Does not include acute health effects
- Does not model individual risk
- Does not model incidence of risk (i.e. increased cases of cancer)
- Assumes total metal toxicity is based on the most toxic form of the metal
- Census data are projected based on linear interpolations not on actual numbers except for decennial census years.

### TRI Data

The [Toxics Release Inventory](#) (TRI) is a database containing chemical data from select industries reporting annually. These industries are required by law to report releases and transfers of certain toxic chemicals. The data contains nearly 650 chemicals and chemical categories from industries including manufacturing, metal and coal mining, electric utilities, and commercial hazardous waste treatment, among others. The data contained in the inventory are collected under the Emergency Planning and Community Right-to-Know Act (EPCRA) enacted in 1986.

### TRI limitations

- Does not account for all toxic chemicals
- Not all facilities report actual releases, some only report estimates
- Facilities required to report are those that meet these specifications:
  - Listed SIC codes AND
  - Must employ 10 full-time employees AND

- Must manufacture or process more than 25,000 pounds or use more than 10,000 pounds of a listed chemical during the calendar year
- Does not include releases from other emission sources such as:
  - Mobile (on and off road)
  - non-industrial VOC emissions, fertilizer application, or pesticide applications
  - Fires (forest, agricultural, prescribed)
  - Area sources (small)
  - Other non-industrial sources

### *IRIS*

The [Integrated Risk Information System](#) (IRIS) is a database of exposure levels for hazardous air pollutants exposure to which can result in adverse health effects. Over 500 chemical records are contained in IRIS. It is a tool that provides hazard identification and dose-response assessment information. The data contained within IRIS may be used in risk assessments.

IRIS limitations include:

- Assessments are outdated for many chemicals
- Does not contain assessments for newer chemicals
- Most assessments contain extrapolated animal to human data
- Many assessments contain extrapolated high to low dose data

### **Monitoring**

The USA Today article conducted specific monitoring studies after running the RSEI model. Air quality was monitored at 95 schools across the country using three monitoring strategies. Most monitors were placed within 100 yards of a school. The reported results do not indicate whether monitoring was performed at any of the schools in NC.

Diffusion badge monitors were used for up to one week at 95 schools in 30 states to sample for VOCs and ethylene oxide.

Particulate samplers were used to collect filter samples for no more than 96 hours. Those samples were analyzed for metals (17 schools) and polycyclic aromatic compounds (PAHs) (23 schools).

Semi-continuous monitoring for gases such as ammonia, hydrogen sulfide, benzene, toluene, xylene, naphthalene, butadiene and other HAPs was performed near eight schools in Ohio, Pennsylvania and Texas.

### Monitoring Limitations

- Short monitoring periods don't account for naturally variable meteorology
- Monitoring results potentially include sources of air pollution not included in the TRI database.
- Seasonal variations are not addressed
- Study plan or quality assurance methodologies were not discussed