Appendix K - Residual Risk Assessment (§112(f)) performed for the Coke Oven National Emission Standards for Hazardous Air Pollutant (NESHAP)

Evaluation of the Residual Risk Assessment (§112(f)) performed for the National Emission Standards for Coke Oven Batteries (USEPA 2005b)

1.0 Introduction

The 1990 CAA requires the USEPA to conduct a residual risk review of every technology based NESHAP standard developed under section 112(d) of the Act. Section 112(f) Standard to Protect Public Health and the Environment, requires the USEPA to promulgate additional standards for a specific NESHAP if such standards are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect. This process is referred to as a residual risk assessment. The residual risk assessment is conducted to determine if the cancer and non-cancer risk to the neighboring communities are within "acceptable" limits after a NESHAP standard is implemented. The target non-cancer risk level is the determination of a Hazard Index less the 1.0. The target cancer risk level is to reduce the lifetime excess cancer risk, to the individual most exposed to emissions of pollutants classified as known, probable or possible carcinogens, to less than one-in-one-million. These desired risk levels have not been achieved in all post-NESHAP residual risk evaluations.

In April of 2005, the USEPA promulgated the National Emission Standards for Coke Oven Batteries final rule[1] and determined that the risks from the Tonawanda Coke Corporation coke oven batteries were acceptable when the additional lowest achievable emission rate (LAER) controls are implemented as required in the final rule. However, the determination did not include any monitoring data in the vicinity of Tonawanda Coke or the three other coke ovens included in the residual risk assessment.

As part of the Study grant, the results from the monitored data collected in the vicinity of Tonawanda Coke will be used to evaluate if the modeled results reported by the USEPA in their March 2005 Risk Assessment Document for Coke Oven MACT Residual Risk was reasonably correct. USEPA's 2005 Residual Risk Assessment determination is based on an evaluation of inhalation cancer risk posed by emissions from the Tonawanda coke oven battery operation. There was a determination that the risk from the coke oven batteries was acceptable. The hazard index was less than one and a maximum individual cancer risk of 50 in one million was determined using air dispersion modeling. However, the USEPA also conducted a facility wide risk assessment of emissions from all operations at the Tonawanda Coke facility and determined a maximum individual cancer risk of 100 in-one-million. The USEPA identified a limitation - the lack of monitoring data in the vicinity of the coke oven facilities - that could be used to evaluate the modeled ambient concentrations. The USEPA noted that monitoring data may be useful

[1] USEPA, NESHAP for Coke Oven Batteries, FR Vol. 70, Number 72 page 1992

for evaluating the modeling approaches used in the residual risk assessment if the monitoring network had the following characteristics:

(1) the monitor was designed to measure at least one of the HAPs known to be emitted from the facility;
(2) the monitoring method should be sensitive enough to measure the anticipated ambient concentration of HAP from the facility;
(3) the monitoring area should be encompassed by the modeling study area (usually within 50 kilometers);
(4) the monitoring data should, ideally, be contemporaneous or as close as possible with the emission estimates which drive the modeling. For short-term emission events, site specific meteorological data are needed to interpret the monitoring results;
(5) The monitored data should be identified or linked to the facility modeled. This may be accomplished by knowing that the monitor was intentionally placed to capture specific facility emissions, or that the HAP being monitored is unique to the facility that was modeled. This determination should also consider the degree to which the other HAP sources in the vicinity might contribute to background levels of the HAP. Ideally, for the most utility in evaluating the modeling approach, the monitoring data should be dominated by contributions from the source or facility being assessed.

Characteristics of the Tonawanda Community Study ("Study") monitoring network in response to the items above:

(1) The monitoring network was capable of measuring HAPs known to be emitted from the Tonawanda Coke facility (1,3-butadiene, benzene, carbon disulfide, toluene, and all isomers of xylene);
(2) The monitoring methods were sensitive enough to measure ambient concentrations of these HAPs. All of the above compounds were either classified as Category B or Category C pollutants (see Section 7.0 of the Study report);
(3) All four monitors were located within the residual risk study area and capable of capturing the modeled receptors at the distance predicted for maximum impact from all coke oven processes
(4) The emissions data from the facility is contemporaneous with the network, but the emission rates from the facility were adjusted in some cases as described in this Appendix. A meteorological station was established in the study area to collect local meteorological data;
(5) The monitoring network was developed to measure the dispersion of HAPs from the Tonawanda Coke facility and other industrial sources, as well as, motor vehicle emissions within the study area. One monitor at the Grand Island Boulevard Industrial (GIBI) site was located in the predominant wind direction near the property line of Tonawanda Coke. The study also accounted for other sources of these HAPs within the study area.

The cancer risk calculation performed by NYSDEC used a greater emission rate for these two compounds than found in the Residual Risk document. The benzene emission rates

modeled by NYSDEC which are different than those modeled for the Residual Risk assessment are due to the following changes. First, the battery emissions represent data submitted to the Department in July of 2003. Second, the increase in emissions from the by-products operation is based upon sampling conducted at the ammonia still in the Fall of 2008 and lastly, the equipment leaks represent the combined emissions of leaks, loading and wastewater reported in the Residual Risk assessment to consolidate the modeling runs.

USEPA and NYSDEC modeled benzene emissions from the Tonawanda Coke facility of 15.5 and 20.6 tons per year respectively and the reported emissions from Tonawanda Coke for the year of 2008 were 5.2 tons year as shown in Table K-1.

Table K-1. Emission Comparisons (emission in tons per year)

		Battery	Pushing	Quenching	Combustion	By-Products	Equipment Leaks	**Totals**
USEPA's Residual Risk	**Benzene**	0.88	0.00	0.00	9.05	2.30	3.25	**15.5**
	BSO	1.73	2.00	1.00	0.00	0.00	0.00	**4.7**
NYSDEC	**Benzene**	1.23	0.00	0.00	9.05	6.28	4.0	**20.6**
	BSO	1.73	2.00	1.23	0.00	0.00	0.00	**4.9**

2.0 Inhalation Cancer Risk Calculations - Facility Wide

USEPA's maximum annual cancer risk from the Tonawanda Coke facility is predicted to occur directly offsite from the facility, between 200 meters southwest and to 500 meters northeast from the plant in non-residential locations. These maximum impact areas are still frequented by individuals working at several near-by manufacturing facilities. The greatest annual cancer risk occurs on plant property but not always in the same location when using different models and different meteorological data sets.

The USEPA did not characterize facility-wide risk other than to indicate that the maximum risk occurs on plant property, so NYSDEC's monitor data will only be utilized to compare the maximum individual risk from the coke oven battery. NYSDEC evaluated two models in this Study, HEM3 and RAIMI (see Appendix I for more details). Using RAIMI, HEM3, an independent version of AerMod[2] and data from the USEPA modeling runs for the Coke Oven Residual Risk[3], the calculated cancer risk is presented for the facility-wide emissions of the Tonawanda Coke facility. The risk associated with the coke battery alone (MACT1) will be addressed in the next section.

In the coke manufacturing process, the cancer risk drivers are benzene and benzene soluble organics (BSO). Coke manufacturing has a unique emission profile as shown in the emissions table above. Where by the by-product processes and combustion processes

[2] BEEST for Windows, Version 9.77a, Bee-line Software
[3] USEPA, output files for modeling run, communication with Ted Palma, OAQPS

emit the risk driver benzene, the coking process emits BSO and benzene. For a complete description of coke oven gas and its surrogate BSO, see section 7.3 of the Study report.

The first step is to determine if the modeling performed by the USEPA can be considered reasonably correct in comparison to the monitoring data. This will be accomplished by predicting ambient concentrations for benzene and BSO at the monitoring site. The USEPA does not state in the Residual Risk document the exact locations where the final population cancer risks were calculated. The cancer risks presented for the MACT1 portion of the analysis indicates an inhalation cancer risk of 44 in-one-million for emissions associated with LAER controls. To characterize a receptor location representing a population based receptor, the Brookside Terrace Residential Site (BTRS) monitor was chosen.

The BTRS represents a residential location downwind of the Tonawanda Coke Plant. Using the RAIMI model output, NYSDEC calculated a model-to-monitor ratio of 1.0 after accounting for all sources of benzene in the Study areas. Initially, the GIBI monitor, located approximately 800 meters north-northeast of the coke oven battery, was not selected for the residual risk evaluation because the HEM3 and RAIMI models calculated a model-to-monitor ratio for benzene of 0.3 and less. The annual benzene concentration measured at the GIBI site of 9.8 $\mu g/m^3$could not be replicated with either Tonawanda Coke's emission statements or the revised emission inventory as shown in the above table.

To calculate the cancer risk at the BTRS monitor, the predicted concentrations of benzene and BSO were multiplied by their respective cancer unit risk concentration. When the benzene and BSO risks are combined, the total risk is 32 in-one-million. The contribution from other suspected cancer compounds emitted from the facility such as total polycyclic organic compounds, and 1,3-butadiene were calculated to contribute an additional inhalation risk of 1.1 in-one-million excess cancer risk.

Predicted Facility-wide Risk at the BTRS Monitor Location

RAIMI - ISCST3	Break down of risk, BSO 3.1E-5 (concentration - 0.05 $\mu g/m^3$) Break down of risk, Benzene 7.6E-7 (concentration - 0.10 $\mu g/m^3$) **Total Risk** = 3.2E-5 or 32 in-one-million excess cancer risk
HEM3 - AerMod	Break down of risk, BSO 9.8E-5 (concentration - 0.157 $\mu g/m^3$) Break down of risk, Benzene 4.4E-6 (concentration - 0.57 $\mu g/m^3$) **Total Risk** = 1.02E-4 or 102 in-one-million excess cancer risk
BEEST - AerMod	Break down of risk, BSO 9.8E-5 (concentration - 0.157 $\mu g/m^3$) Break down of risk, Benzene 3.5E-6 (concentration - 0.45 $\mu g/m^3$) **Total Risk** = 1.01 E-4 or 101 in-one-million excess cancer risk

USEPA - ISC/BLP Break down of risk, BSO 1.7E-5 (concentration - 0.027 μg/m^3)
Break down of risk, Benzene 1.2E-6 (concentration - 0.15 μg/m^3)
Total Risk = 1.8 E-5 or 18 in-one-million excess cancer risk

As can be seen from the USEPA model, the combined risk of the two cancer risk drivers are below the 44 in-one-million for emissions associated with LAER controls for the battery alone. The USEPA must have identified a receptor location closer to the Coke Oven facility than the Brookside Terrace monitor. Nonetheless, USEPA's predicted concentration for benzene at this location is 0.15 μg/m^3. The AerMod runs predicted higher concentrations in the range of 0.45 to 0.57 μg/m^3.

The predicted concentration impact from the coke ovens is dependent on how the model input described the emission source, within the model. The RAIMI software could only accept the coke oven battery emission input as separate virtual stacks and the other two models were treated two ways, the coke oven as an area source and as virtual stacks. When treating the coke oven as virtual stacks, the outcome from the HEM3 model was to decrease the overall concentration predicted at the Brookside Terrace monitor. The difference in benzene was 0.52 μg/m^3 compared to the 0.57 μg/m^3 shown above. The difference in BSO was 0.085 μg/m^3 compared to the 0.157 μg/m^3 shown above. This difference accounted for a reduction of overall inhalation cancer risk of 57 in-one-million versus the 102 shown above. Treating the emissions from the coke oven as virtual stacks has the effect of lowering the overall concentration. Overall, the RAIMI software model when compared to the HEM3 model for the Tonawanda Coke facility, predicted ambient concentrations three times less for the main risk driver BSO. Some of this calculated difference in concentration is the two models use different meteorological data sets but in total the RAIMI software is less conservative. Also, USEPA also used virtual stacks with an enhanced buoyancy calculation which be discussed in a section below.

In the Table D-2 , Appendix D of USEPA's Residual Risk document, the location of the maximum concentration for the coke oven, by-product plant, combustion stack and quench tower were presented based upon a unitized gram per second concentration. Multiplying the gram per second emission rate by the unitized value calculates a concentration for any emission rate input. Using the formula in the Residual Risk document, the maximum benzene concentration for the coke oven battery is 0.043 μg/m^3 at 500 meters. The other models show maximum benzene concentration much higher at 100 to 500 meters from the plant, 1.5 and 2.5 μg/m^3, RAIMI and HEM3 respectively. This difference could potentially be explained by USEPA's use of the enhanced buoyancy calculation.

The unitized concentration listed in the Residual Risk document for the by-product plant states a maximum predicted benzene concentration of 6.3 μg/m^3 at 300 meters from the plant. The GIBI monitored data, representing all source sectors, shows an annual impact of 9.8 μg/m^3 for benzene at approximately 800 and 900 meters from the coke oven and by-product plant, respectively. It is possible that the high readings for benzene can be attributed to the by-product plant even though it would be expected that the maximum

concentration calculated by USEPA of 6.3 μg/m^3 at 300 meters would be considerably lower at the GIBI monitor at 900 meters away.

3.0 Predicted MACT 1 Risk at Brookside Terrace Monitor Location

MACT 1 refers to the emissions from the coking process at the coke oven battery and not the emissions associated with the pushing or quenching process. The coking process emits benzene and BSO. The pushing and quenching process accounts for almost half of the BSO emissions assigned to the facility and no appreciable benzene emissions. The maximum risk reported in the Residual Risk document based upon actual emissions from the coke oven for populated receptors is 33 in-one-million excess inhalation cancer risk. The excess cancer risk increases to 50 in-one-million based upon MACT allowable emissions and 44 in-one-million for LAER allowable. The risk reported in the Residual Risk document does not state which populated receptor location or locations were chosen. Also, it is not stated if the populated receptor was chosen to be a census tract centroid similar to NATA, or if the populated receptor is a census block centroid. The nearest census block centroid is located directly across from the coke battery and is on top of the Huntley landfill. Obviously this is not an appropriate location to make population based risk decisions, so NYSDEC choose the BTRS monitor to make risk based comparisons betweens models and monitored data. If a census tract centroid was chosen, the census tract centroid with the greatest predicted concentration is 36029-007800 located 800 meters northeast from the BTRS monitor.

The emissions from the coke oven battery are benzene soluble organic (BSO) emissions and other volatile compounds which are predominantly benzene. The contribution from other suspected cancer compounds emitted from the facility such as total polycyclic organic compounds, and 1,3-butadiene were calculated to contribute an additional inhalation risk of 1.1 in-one-million excess cancer risk. The risk from the coke oven battery for the cancer risk drivers, benzene and BSO, are presented below:

RAIMI - ISCST3	Break down of risk, BSO 1.1E-5 (concentration - 0.018 μg/m^3) Break down of risk, Benzene 6.9E-8 (concentration - 0.009 μg/m^3) **Total Risk** = 1.1 E-5 or 11 in-one-million excess cancer risk
HEM3 - AerMod (As Area Source)	Break down of risk, BSO 9.8E-5 (concentration - 0.157 μg/m^3 Break down of risk, Benzene 0.8E-6 (concentration 0.11 μg/m^3) **Total Risk** = 9.9 E-5 or 99 in–one-million excess cancer risk
HEM3 - AerMod (As Point Source)	Break down of risk, for BSO is 7.3E-5 in a million (0.116 μg/m^3) Break down of risk, for Benzene 0.4E-6 in a million (0.058 μg/m^3) **Total Risk** = 7.3E-5 or 73 inone-million excess cancer risk

USEPA - ISC/BLP* Break down of risk, BSO 8.1E-6 (concentration - 0.013 $\mu g/m^3$)
Break down of risk, Benzene 5.3E-8 (concentration - 0.007 $\mu g/m^3$)
Total Risk = 8.1 E-6 or 8 in-one-million excess cancer risk

* Emissions modeled from the USEPA are lower than NYSDEC model, see table above.

Discussion of Modeling Parameters Assumptions

The USEPA used the Buoyant Line Plume model and ISCST3 model to calculate ambient concentrations resulting from the dispersion of contaminants from the Tonawanda Coke facility. Unique to the coking process is the high temperatures attained in the coke oven battery. These high temperatures add to the dispersion of emissions from the coking process and subsequently the pushing process. Appendix E of the Residual Risk document details the enhanced plume calculation completed by USEPA.

As stated in Appendix E of the Residual Risk document, "coke ovens facilities produce significant heat from large, parallel oven batteries, which behave as low-level buoyant line sources. Because of the parallel-line source configuration, plume rise is enhanced as ambient air is not fully entrained into the plume." The buoyant line plume model (BLP), which was used in the Residual Risk Assessment, was specifically developed to stimulate the plume rise from multiple line sources subject to downwash.

According to Appendix D of the Residual Risk document, the location of the maximum concentration predicted by the BLP model from the coke oven was 500 meters northeast from the facility. The HEM3 model and an independent AerMod model predicted the maximum impact for a vapor or particle to be 85 and 130 meters respectively. In either case, BLP or AerMod the maximum impact is occurring on plant property or within the Huntley Landfill boundary.

The models used by NYSDEC did not employ enhanced buoyancy calculations since this Study was not intended to make multiple model-to-model comparisons. One objective of the Tonawanda Community Air Quality Study grant was to compare the residual risk modeling results completed by the USEPA to monitored concentrations conducted by NYSDEC and to note the limitations of our approach.

4.0 MACT 1 Predicted Risk vs. the Monitored Data at Brookside Terrace Monitor

The predicted concentrations for benzene from the facility-wide emissions and the coke oven battery have been estimated using various models and modeling approaches as seen above. This is needed to give the reader an understanding of the various predictions that can be calculated using different modeling assumptions and meteorological data.

As stated in the initial objectives in Section 1.0, "the degree to which the other HAP sources in the vicinity might contribute to background levels of the HAP" need to be

included when comparing model to monitor data so the other sources contributing to the total benzene concentration were identified. The use of ambient concentration predictions from NATA were used to assess the contributions from non-road and background sources. The on-road and area source data as described in the inventory chapter (section 6.0) of the Study document were modeled. Tonawanda Coke is the only source of BSO and the largest source of benzene in the area, as identified from the inventory. Combing the predicted benzene concentrations from the other source categories with the predicted benzene concentration contribution from the MACT 1 source will provide a complete model prediction at the location of the BTRS monitor for the MACT 1 contribution, see Table K-2. This same procedure is presented for the GIBI monitor as seen in Table K-3. even though the initial RAIMI model to monitor results showed significant underestimation at that monitoring location.

Table K-2 Model-to-Monitor Concentrations of Benzene in $\mu g/m^3$ at the BTRS Monitor

Model	**Location**	**Major**	**Area**	**On-road**	**Non-road**	**Background**	**Total**
RAIMI All sources	Monitor Location	0.17	0.27	0.508	0.083	0.703	1.73
RAIMI Tonawanda Coke	Monitor Location	0.10	0.27	0.508	0.083	0.703	1.66
RAIMI Coke oven battery	Monitor Location	**0.009**	0.27	0.508	0.083	0.703	1.57
HEM3 Coke oven battery	Monitor Location	**0.058**	0.27	0.508	0.083	0.703	1.62
USEPA Coke oven battery	Nearest Receptor to Monitor	**0.007**	0.27	0.508	0.083	0.703	1.57
Monitor	**Concentration**						1.95

As seen in Table K-2, the MACT 1 point source (coke oven battery) contributes a small amount to the overall predicted benzene concentration at the BTRS monitor.
The USEPA's predicted concentration at the BTRS monitor is 0.007 $\mu g/m^3$. This represents less than 0.5 % of the total concentration measured at the monitor. The HEM3 prediction is 3.5% of the total concentration measured at the monitor. The RAIMI software predicts the benzene concentration from the Tonawanda Coke facility to be 0.10 $\mu g/m^3$ or 6% of total.

With or without the point source contribution, the predicted modeled concentration would be within the target range of 0.5 to 2 model-to-monitor ratio. Because the emissions from other source categories dominant the monitor's measured results, it is not possible to definitively state that the risks projected in Table 3-15 of the Residual Risk assessment are in agreement with the monitored data found in the year long monitoring study.

4.1 MACT 1 and Facility-wide Predicted Risk vs. the Monitored Data at the GIBI Site

A second approach is to use the GIBI site to make a comparison between monitored emissions and predicted model emissions, see Table K-3. At this monitoring site, the contributing factors are less of an influence. It is important to note that the modeled emission input for benzene is four times higher than what is reported to NYSDEC's emission inventory and the USEPA's National Emissions Inventory and Toxics Release Inventory. In the USEPA's Residual Risk document, the USEPA used NESHAP allowable emissions to estimate Tonawanda Coke's benzene emissions impact. This emission rate is three times higher than the actual benzene emissions reported to NYSDEC's emission inventory.

Table K-3 Model to Monitor Concentrations of Benzene in $\mu g/m^3$ at GIBI Monitor.

Model	Location	Major	Area	On-road	Non-road	Background	Total
RAIMI	Monitor Location	1.35	0.089	0.716	0.131	0.703	2.99
HEM3	Monitor Location	3.75	0.089	0.716	0.131	0.703	5.39
HEM3 Coke oven facility	Monitor Location	3.42	0.089	0.716	0.131	0.703	5.06
HEM3 battery	Monitor Location	0.496	0.089	0.716	0.131	0.703	2.14
USEPA Coke oven facility	Monitor Location	1.18	0.089	0.716	0.131	0.703	2.82
USEPA battery	Monitor Location	0.02	0.089	0.716	0.131	0.703	1.66
USEPA Coke oven facility	Monitor Location Adjusted emissions*	3.21	0.089	0.716	0.131	0.703	4.83
USEPA Coke oven battery	Monitor Location Adjusted emissions*	0.028	0.089	0.716	0.131	0.703	1.67
USEPA Coke oven facility	Maximum Impact (300 meters)	**6.3**	0.089	0.716	0.131	0.703	7.93
Monitor	**Concentration**						9.8

- Adjusted emissions to replicate the emissions used by NYSDEC
- HEM3 represents all benzene major benzene sources in the inventory

A benzene concentration of 2.82 $\mu g/m^3$ is predicted for the GIBI monitoring site when the USEPA facility wide prediction of 1.18 $\mu g/m^3$ is combined with the benzene contributions from other source sectors. The model-to-monitor ratio is less 0.5 and not in the target range of 0.5 to 2.0. The predicted concentration is dominated by the emissions from the by-product plant and not the coke oven battery. If the emissions are increased to represent the adjusted NYSDEC emission inventory, the facility-wide concentration is 4.83 $\mu g/m^3$ which just meets the 0.5 of the target range of 0.5 to 2.0 for modeling to monitor. Adding the predicted concentrations of the other major sources in the area would increase the adjusted USEPA concentration to 5.16 $\mu g/m^3$, This calculation is not shown above but is based upon the difference between HEM3 and HEM3-coke oven facility.

Using the data presented in Table K-3, it is evident that the USEPA modeled concentrations for the Tonawanda Coke Corporation could not be replicated without adjusting the emissions upward an additional 25%. Even with this increase, the model was on the lower range of acceptability with the model to monitor ratio goal of 0.5 to 2.0. The benzene emissions and predicted ambient impacts appear to be dominated by emissions from the by-products plant and this source appears to be where benzene reduction efforts should be focused.

5.0 Residual Risk Assessment for Coke Ovens: Comparing the Residual Risk Report Cancer Risk isopleths with Benzene and Benzene Soluble Organic (BSO) Modeled Data.

The Residual Risk document contains isopleths maps of potential excess cancer risk around the Tonawanda Coke facility modeled out to a distance of fifty kilometers. The isopleth map shows that within ten kilometers of the facility, the risks range from 1 in-one-million excess cancer risk to greater than 100 in-one-million excess cancer risk near the Tonawanda Coke facility. The study area of nine census tracts encompasses a radius of three kilometers around Tonawanda Coke and Figure 3.3 indicates risks between 10 in-one-million and in excess of 100 in-one-million.

Air dispersion modeling completed using the RAIMI software shows excess cancer risk in the nine census tract area also ranging between 10 in-one-million and in excess of 100 in-one-million. The USEPA's isopleth map in the residual risk assessment is not an effective tool for the public or State air pollution personnel to interpret and it should have been presented with a maximum distance of ten kilometers with major roadways included.

Figure K-1 presents the potential inhalation cancer risk with the use of GIS for the modeled benzene emissions from the Tonawanda Coke facility. Figure K-2 shows the

potential inhalation cancer risk using the emissions reported to NYSDEC from the Tonawanda Coke Corporation. The reported emissions data are considerably lower than the modeled benzene emission. Figure K-3 shows the potential inhalation cancer risk for all carcinogens monitored and estimated from the Tonawanda Coke Corporation. The cancer risk estimates are based upon the upper-bound excess lifetime cancer risk resulting from continuous exposure to an air contaminant. The USEPA defines the upper bound as "a plausible upper limit to the true value of a quantity. This is usually not a true statistical confidence limit." The use of an "upper limit" means that the true risk of developing cancer from exposure is not likely to be higher and may be lower than the estimates provided in this study. The risk drivers from the Tonawanda Coke Corporation were established to be benzene and benzene soluble organics. The benzene is a measured concentration while the benzene soluble organics represents a modeled estimate based upon specific modeling assumptions. As discussed above, the modeled cancer risk for these two HAPs range from 18 to 102 in-one-million excess cancer risk at BTRS.

6.0 Cancer Incidence

This discussion was included because the Residual Risk document presented population facility wide risk as a cancer incidence value. Residual risk assessments have presented increased cancer risk incidence values for the entire receptor population within the area of analysis or entire modeling domain. NYSDEC does not believe cancer incidence is a good metric to present cancer risk information to the public, elected officials or non-technical risk managers. Nonetheless, in order to analyze the results of the USEPA residual risk report, NYSDEC performed air dispersion modeling with the Human Exposure Model (HEM3) to calculate a cancer incidence for the surrounding nine census tracts in the Study area. The cancer risk drivers (benzene and BSO) for the Tonawanda Coke facility as identified in the residual risk assessment were modeled.

Using the HEM3 model, the facility wide cancer incidence, based upon the emissions modeled above, is 0.044 new cancer annual cases versus 0.023 found in the Residual Risk Report. Adjusting for the increased in emissions used in the HEM3 model would only account for an increase of 1.32 (20.6/15.5, using benzene as an example) and not the factor of 1.9 calculated by the HEM3 model. Also, the 0.044 calculated cancer incidence represents the nine census tract Study area, approximately a six kilometer radius. This radius is significantly smaller than the radius used by USEPA of 50 km. HEM3 would calculate a cancer incidence of 0.13 for this larger area because of the greater population exposed. A 6 km ring represents about 85,000 people and a 50 km ring represents over one million people. Using HEM3 to measure cancer incidence resulted in a more conservative outcome at the 50 km radius. This difference could not be explained by substituting a different meteorological dataset alone. The HEM3 air dispersion modeling was conducted with the 5 year meteorological dataset and the one year local meteorological dataset assembled by NYSDEC.

The USEPA reports the lifetime cancer cases associated with residents living in the exposure area for 70 years to be 1.6 cases (0.023 * 70). The HEM3 model for the nine

census tract Study area resulted in 3 lifetime cancer cases associated with residents living in the exposure area for 70 years.

NYSDEC believes the use of 50 km to portray risk from a single facility emitting hazardous air pollutants is not appropriate and the use of cancer incidence values is not the best approach to portray risk to the general public because the risk calculation will change when describing a larger population size. The overall cancer incidence which is influenced by the population size and geographical locations affects the final calculation does not offer the transparency needed for effective risk communication. The 1990 CAA requires the presentation of maximum individual risk. The presentation of maximum individual risk provides the public and risk managers with an understandable and transparent metric to make risk management decisions.

7.0 Comparison of Benzene Ambient Air Measurements Near Coke Plants

There are other studies that have measured ambient levels of benzene near Coke Plants. The Indiana Department of Environmental Management (IDEM) sited a monitoring station near the property line of the Citizens Gas and Coke Utility in Indianapolis. The monitor was located at Indianapolis Public School #21 (IPS21) and measured benzene and other air pollutants (IDEM, 2006). Four years of data was collected and the average benzene concentration over the four year period was 5.7$\mu g/m^3$. During the course of the study the average annual benzene concentrations at IPS21 decreased from 8.7 $\mu g/m^3$ to 2.3 $\mu g/m^3$. Much of this decline was attributed to emission reduction activities that occurred at the Citizens Gas and Coke Utility during this time period.

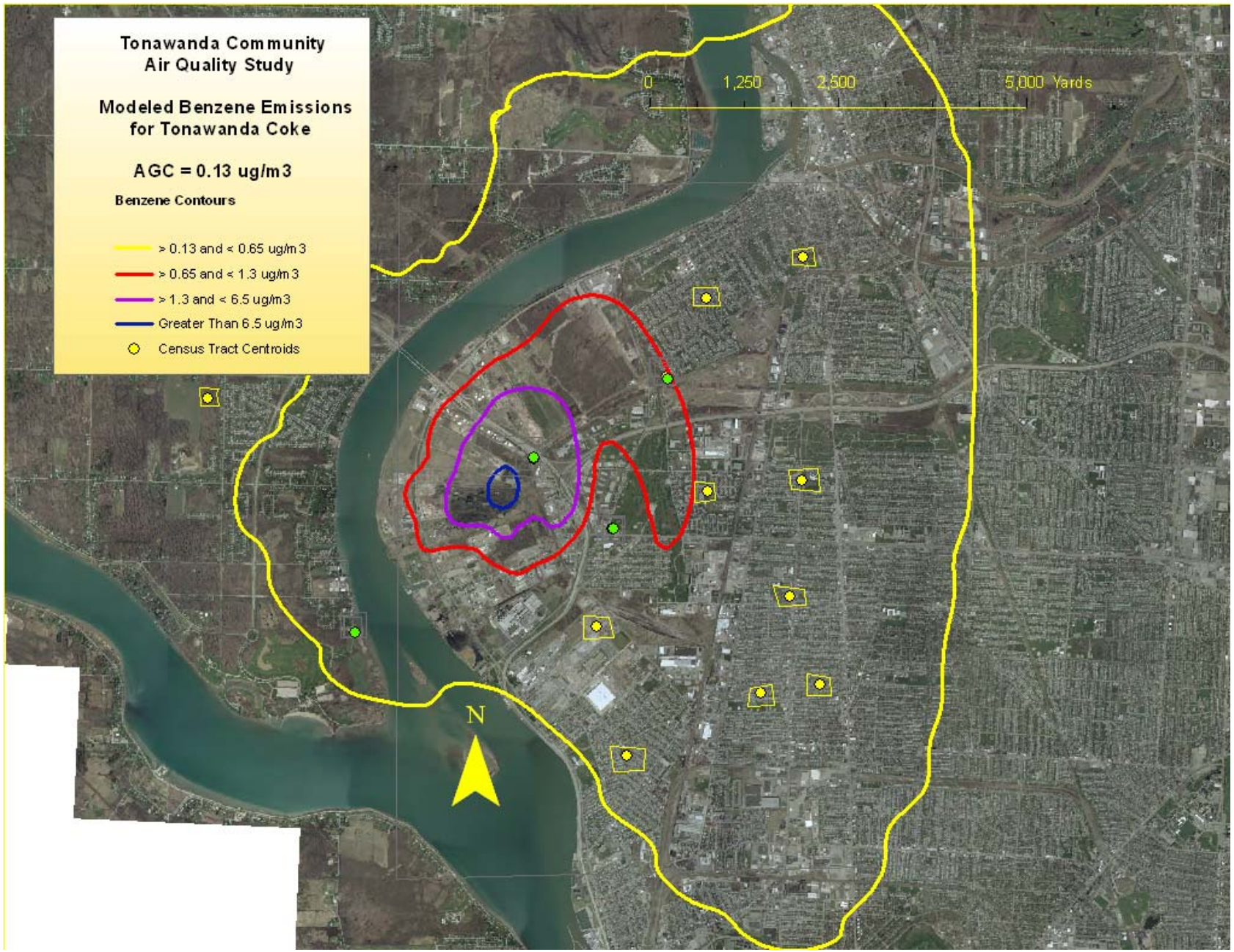
Similar to the NYSDEC study, the IDEM study conducted modeling to monitor analysis to evaluate how well the model predicted the measured concentrations of benzene at IPS21. When all sources of benzene in the study area including background concentrations were accounted for the modeling results accounted for 45.4% of the monitored value (2.54 versus 5.59 $\mu g/m^3$). IDEM noted many difficulties in modeling the benzene releases which may have lead to the discrepancy between the modeling and monitor comparison. Some of the reasons stated were selection of general modeling assumptions, receptor location variability in benzene modeled concentrations, uncertainty in the location of the leaking benzene sources, and default modeling assumptions used in place of actual emission point information.

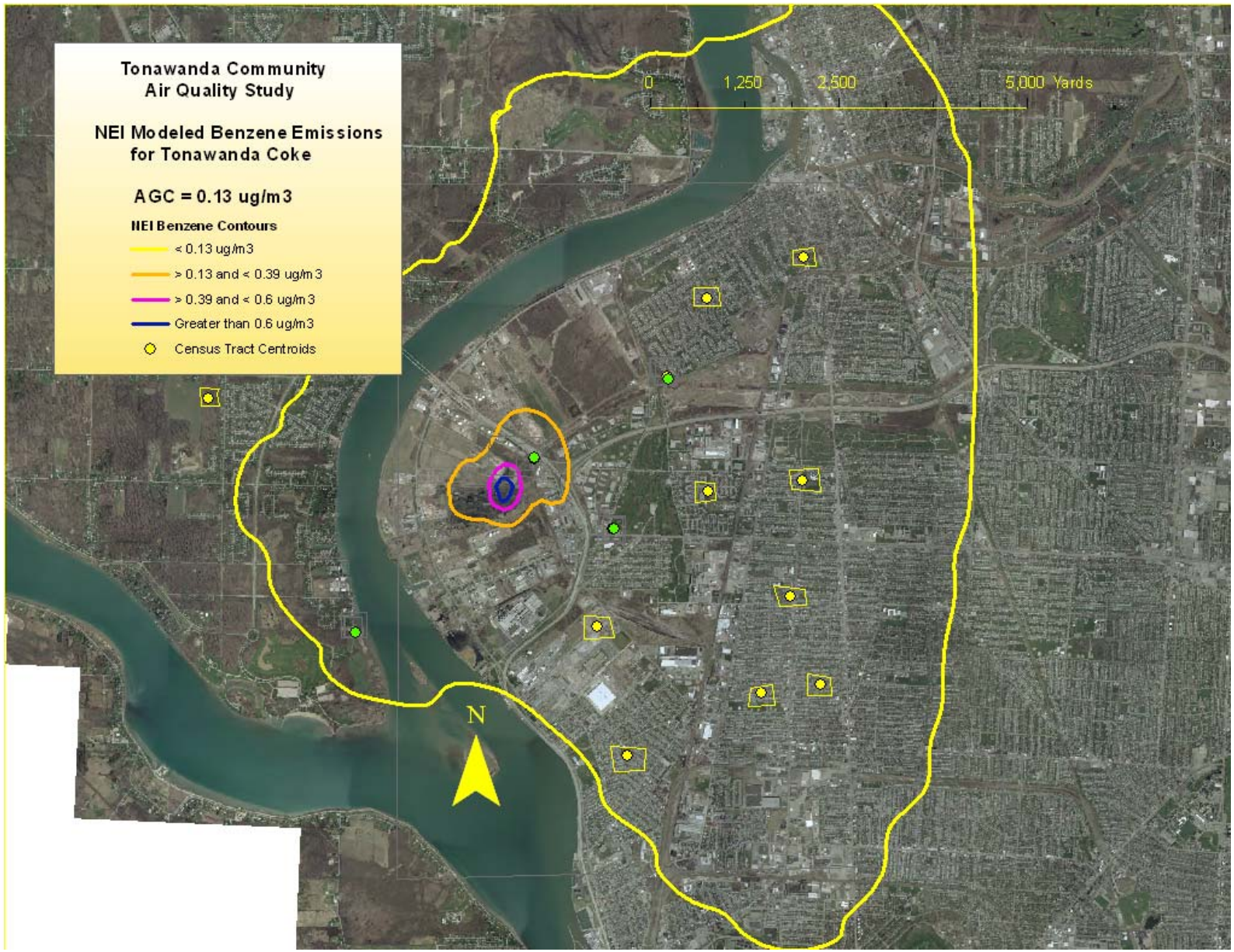
The modeling to monitor analysis conducted in the Tonawanda Community Air Quality Study as described in Appendix K also accounted for all known sources and background concentrations of benzene. Our modeling results only accounted for 28% of the benzene monitored value at the GIBI site. A number of the same factors cited by the IDEM are possible reasons for the disagreement, but there also may be an issue with the emission factors currently used to estimate benzene emissions from coke operations. The modeling conducted by IDEM and NYSDEC used the NESHAP allowable emission rates that are dependent on benzene emissions factors developed for the various processes at a Coke facility (USEPA, 2008). The confidence ranking in these benzene emission factors ranges

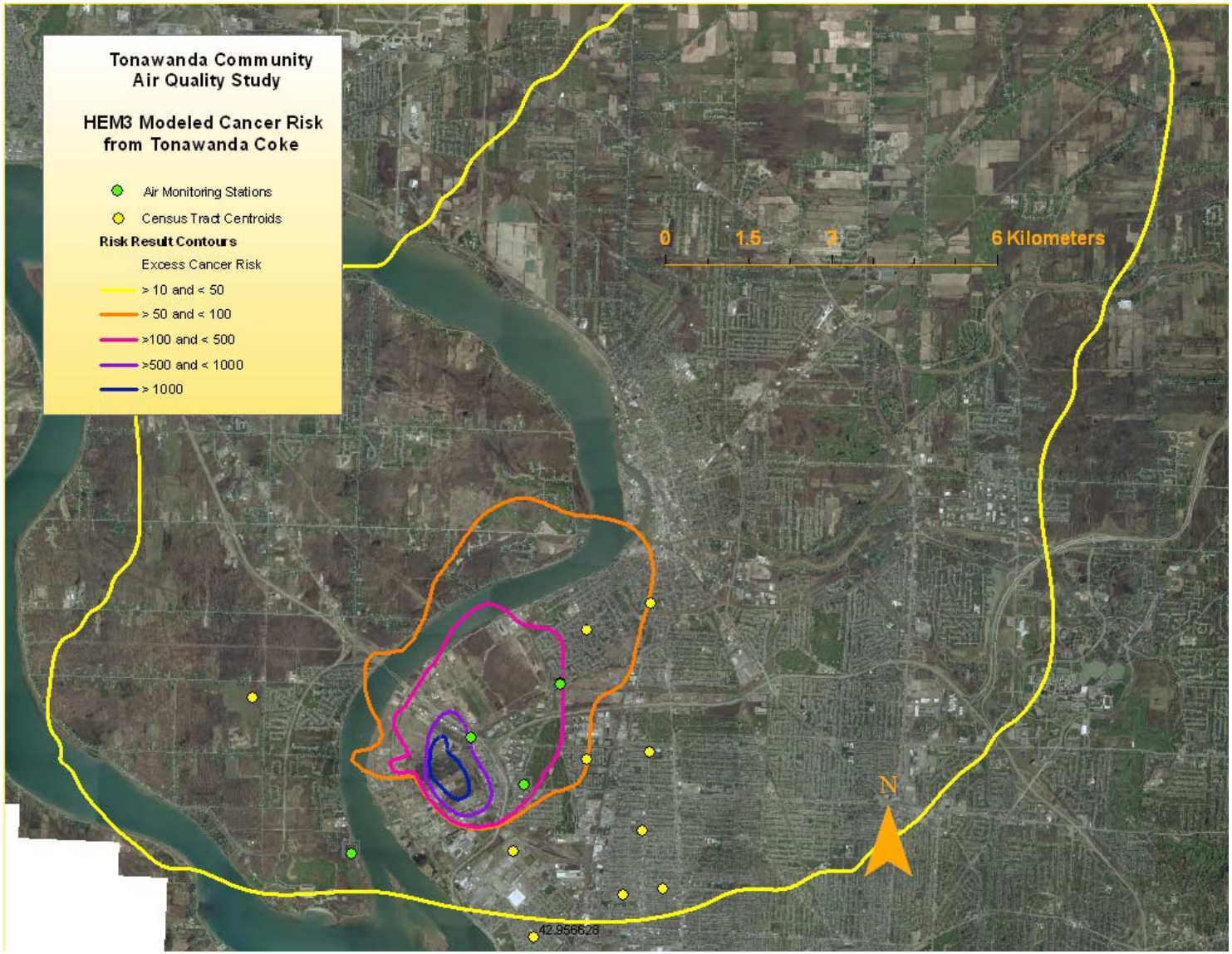
from A (high reliability in the estimate) to E (low reliability in the estimate) (USEPA, 1997).

A recent study conducted by Carnegie Mellon University in Allegheny County, Pennsylvania also measured elevated concentrations of benzene that were attributed to Coke plants (Carnegie Mellon University, 2009). The report concludes that new programs are needed to control the benzene emissions from the local major sources.

Figures K-1 through K-3 on Landscape pages


Tonawanda Community
Air Quality Study
Modeled Benzene Emissions
for Tonawanda Coke
AGC = 0.13 ug/m3
Benzene Contours
> 0.13 and < 0.65 ug/m3
> 0.65 and < 1.3 ug/m3
> 1.3 and < 6.5 ug/m3
Greater Than 6.5 ug/m3
Census Tract Centroids
0
1,250
2,500
5,000 Yards
N


Tonawanda Community
Air Quality Study
NEI Modeled Benzene Emissions
for Tonawanda Coke
AGC = 0.13 ug/m3
NEI Benzene Contours
< 0.13 ug/m3
> 0.13 and < 0.39 ug/m3
> 0.39 and < 0.6 ug/m3
Greater than 0.6 ug/m3
Census Tract Centroids
0
1,250
2,500
5,000 Yards
N


Tonawanda Community
Air Quality Study
HEM3 Modeled Cancer Risk
from Tonawanda Coke
Air Monitoring Stations
Census Tract Centroids
Risk Result Contours
Excess Cancer Risk
> 10 and < 50
> 50 and < 100
>100 and < 500
>500 and < 1000
> 1000
0
1.5
3
6 Kilometers
N
42.956626