A Preliminary Risk-Based Screening Approach for Air Toxics Monitoring Data Sets

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PART I: BACKGROUND

The purpose of this document is to provide a risk-based methodology for performing an *initial* screen of air toxics monitoring data sets in outdoor air. This methodology is necessary because:

1. Many Region 4 State, local, and tribal (R4 SLT) air agencies have been collecting air toxics data for a number of years;

2. These Agencies want to evaluate the data sets to determine what the results indicate with regard to the potential for exposures of potential public health concern;

3. The risk-based approaches for evaluating air toxics have made significant strides in recent years; however, many R4 SLTs are still in the process of developing their expertise in this area. This maturing expertise, as well as resource issues, have had the effect of hindering many R4 SLTs in their efforts to develop a detailed risk evaluation of their monitoring data sets;

4. As they work to develop their risk assessment expertise [e.g., by becoming more familiar with the full details of the EPA's Air Toxics Risk Assessment (ATRA) Reference Library[1]], R4 SLTs need a concise methodology that they can use to efficiently screen existing monitoring data sets to identify whether any chemicals are potentially posing exposures of public health concern in specific geographic areas;

What This Preliminary Screening-Level Methodology Is Not

This preliminary screening-level methodology is not a substitute for a thorough risk assessment. Instead, the application of this process will commonly result in a "short list" of chemicals and geographic locations that should be the focus of more rigorous risk evaluation. This short list of chemicals are characterized in this document as posing *exposures of potential public health concern* and is only meant to imply that the chemicals failed the screening analysis. To clarify the actual level of concern posed by any given chemical that fails the screen will necessarily require a more in-depth risk analysis and may even require the collection of additional data.

(Analysts may decide to carry all detected chemicals through a subsequent risk assessment, whether they fail the screen or not. While this is somewhat more work, the availability of computer tools such as spreadsheets and databases make this a relatively trivial exercise. Carrying all chemicals through the risk assessment process also has the benefit of further clarifying for stakeholders which chemicals are the likely risk drivers and which are likely not.)

Ultimately, this methodology is not an end in itself. Instead, it should be viewed as a tool that can help narrow the focus of SLTs to important chemicals and locations as they work to strengthen their risk assessment skills.

5. There is a need to standardize the procedures used by R4 SLTs to produce uniform risk-based screening results. This document presents a step in that direction.

It is expected that the application of this screening-level methodology by R4 SLTs will allow them to better address air toxics issues by focusing their limited resources for further analysis only on those geographic areas and chemicals for which the available data indicate a potential for exposures of public health concern. The method may also provide a risk basis for a decision to

continue (or not continue) a given monitoring effort. For example, monitoring sites that consistently indicate a low potential for exposures of public health concern, by application of this screening methodology, might reasonably be discontinued and the monitoring resources shifted to other locations. This methodology will also help R4 SLTs better understand the data quality objectives (DQOs) that monitoring studies should meet for the results to be used in a risk-based decision making framework.

It should be noted that performing this screening-level methodology in an adequate fashion necessarily requires the analyst to have already learned some of the fundamentals of risk assessment (e.g., understanding data quality requirements for air toxics monitoring data sets used in a risk-based decision making framework). To that end, this document attempts to point analysts to key references that they should be familiar with as they apply the methodology.

A. Overview of the Screening-Level Methodology

The basic concept behind this risk-based initial screening level methodology is to evaluate air monitoring data sets using a framework that is, by design, relatively simple to perform yet conservative (i.e., health protective) in nature. This initial screening methodology is designed, through the use of conservative decisions, to identify pollutants for which risks are unlikely to be of concern. Accordingly, if all of the monitoring data "pass the screen" using this approach, the analyst may be able to conclude that the monitoring results are indicative of acceptably low risk and that a more robust analysis (were one to be done) would come to the same conclusion. Any chemicals that do not pass the screening criteria would become the primary focus for any number of follow-up activities.

For example, decision makers might choose, based on the screening level results, to perform a more extensive analysis of these failing chemicals to help confirm or deny the outcome of the screening level assessment. Specifically, a likely next step an analyst will generally recommend for chemicals failing the screen is to develop more rigorous estimates of potential exposure, such as 95% upper confidence limits (95% UCL) of the arithmetic mean using the full set of monitoring data, as described in the ATRA Reference Library, Volume 1, Appendix I. The analyst may also recommend the application of an exposure model (see www.epa.gov/ttn/fera), and may also indicate a need for additional air quality monitoring or air dispersion modeling to help clarify potential exposures and risks.

In some circumstances, decision makers may choose “action oriented” alternatives to respond to the screening results. For example, consider a screening level assessment that identifies a chemical of potential public health concern that can readily be linked to a specific source. If there are inexpensive and available risk reduction options for the emission source, the decision makers may simply choose to take actions to reduce potential exposures to that chemical rather than perform further analysis.

The basic steps of the screening process are outlined below. The details of each of these steps are discussed in detail in the sections that follow.

1. Identify the monitoring data sets to be screened and the geographic areas and time frames that the monitoring data in question represent.

2. Assess the data to determine if they are of sufficient quantity and quality to perform the screen.

3. For each chemical detected at least once in the data set, create a statistical summary of the monitoring results for that chemical. The statistical summary will commonly include the following: Number of valid samples collected and frequency of detection, the method detection limits (MDLs), and range of detected values.

4. For each detected chemical in the data set, compare the maximum monitored value to the suggested chronic screening level value provided in Appendix A and the acute values provided in Appendix B (the basis for using the maximum value found as a surrogate for exposure is provided in Part I, Section D below). Summarize the results of the comparison process in a table. Highlight chemicals whose maximum monitored values exceed their respective screening values (chronic and acute). For each chemical whose maximum monitored value exceeds a screening value, review the full data set and determine the percentage of detections that are at or above the screening value.

5. Augment the results described in Step 4 with ancillary information about chemicals that fail the screen (e.g., possible sources, applicable regulations, estimated background concentrations, NATA national scale assessment results for the geographic area, etc.).

6. Describe areas of uncertainty in the analysis.

7. Based on the screening results provided in Step 4, the ancillary data developed in Step 5, and the uncertainty analysis developed in Step 6, develop a written description of the analysis, including a discussion about the possibility that a public health threat exists that requires further analysis. Include in this discussion an overall statement of the confidence in the results.

Systematic Planning

Systematic Planning is necessary to define the type, quantity, and quality of data a decision maker needs to make a decision and is performed *before* collecting or generating environmental data. The **Data Quality Objectives (DQO) Process** is an example of a systematic planning process that assessors would use to translate a decision maker's aversion to decision error into a quantitative statement of data quality needed to support a decision. EPA requires that a systematic planning process such as the DQO process be used for all EPA environmental data collection activities.

For more information on EPA's quality program, see www.epa.gov/quality.

These steps are shown pictorially in Exhibit 1. An example is provided in Appendix D to illustrate how to apply this methodology to an air toxics monitoring data set.

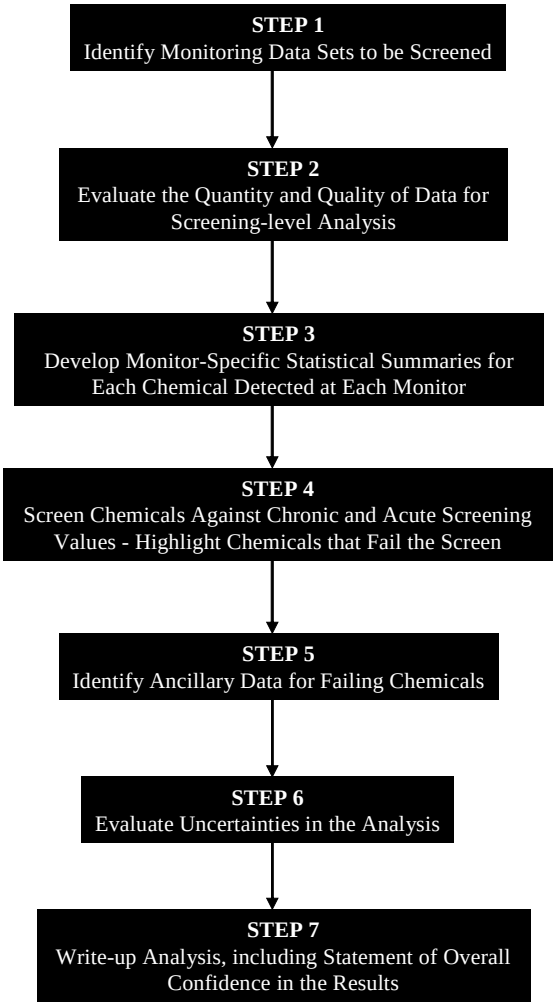
At the end of the screening process, the analyst will generally have sorted the detected chemicals at each monitor into two groups. The first group consists of chemicals that "pass the screen." These chemicals are below screening level concentrations for both chronic and acute exposures. Decision makers may decide to pursue evaluation of these chemicals no further.

The second group consists of chemicals that "fail the screen." These chemicals are at or above screening level concentrations for chronic and/or acute exposures. These chemicals, at a minimum, will commonly require a more in-depth analysis (e.g., a more detailed risk assessment) to clarify the potential risks associated with the monitored concentrations.

As noted previously, all detected chemicals can easily be carried forward to the full risk assessment given the available computer tools to automate the process and the analysts may choose to do so. The benefit of carrying all detected chemicals forward is to further clarify which chemicals are the likely risk drivers and which are likely not. This will also help avoid a potential misperception by some stakeholders that analysts are trying to "hide important data."

EXHIBIT 1

Flow Diagram for Preliminary Risk-Based Screening of Air Toxics Monitoring Data



B. Derivation of Chronic Screening Values

In this methodology, a *chronic screening value* is used to indicate a concentration of a chemical in the air to which a person could be continually exposed for a lifetime (assumed to be 70 years) and which would be unlikely to result in a deleterious effect (either cancer or noncancer health effects).

The suggested chronic screening values used in this methodology are presented in Appendix A. The starting point for the

derivation of these screening values is the Office of Air Quality Planning and Standards' (OAQPS) list of recommended chronic inhalation toxicity values for the Hazardous Air Pollutants (HAPs).[2] Specifically, the methodology uses the OAQPS recommended inhalation unit risk (IUR) value for cancer causing agents and inhalation reference concentration (RfC) for noncancer health effects[a] as a starting point and performs the following manipulations to derive a final chronic screening value:

i. Chronic screening value for "noncancer" (and in some cases, cancer) health endpoints. For the "noncancer" screening value (which in some cases, is also a cancer screening value), the chronic RfCs were used as a starting point since chronic RfCs are, by definition, an estimate of the concentration of a chemical in the air to which continuous exposure over a lifetime is expected to result in little appreciable deleterious effects to the human population, including sensitive subgroups. However, most ambient air contains a mixture of chemicals which may result in a cumulative hazard that is not accounted for by assessing chemicals on an individual basis. To account for possible exposure to multiple contaminants, the noncancer chronic screening value for each chemical was selected to be one tenth of its chronic RfC [i.e., (0.1) x (RfC) x (1000)]. Noncancer screening values are presented in Appendix A as an air concentration in ug/m^3. (Since RfCs are reported as mg/m^3 in the OAQPS table, multiplication by 1000 is necessary to convert mg to ug).

Calculating the noncancer screening values in this fashion is conservative since it is unlikely that a person would be continuously exposed over a lifetime to 10 chemicals that behave in a toxicologically similar manner.[b]

ii. Chronic screening value for cancer health endpoints. For cancer, the IUR for a chemical is used as a starting point to derive an air

Chronic vs. Acute
What's the Difference?

Chronic exposure is continuous or multiple exposures that occur over an extended period of time or a significant fraction of an animal's or person's lifetime.

Chronic health effects are effects that occur as a result of repeated or long term (chronic) exposures (IRIS definition).

Acute exposure is one or multiple exposures occurring within a short time frame relative to the lifetime of an animal or person (e.g., approximately 24 hours or less for humans).

An ***acute health effect*** may occur within a short period of time following an acute exposure, for example, minutes to a few days. (Some acute exposures may also lead to chronic health effects.)

The ATRA Library, Volume 1, Chapter 12 provides details on chronic vs acute toxicity data.

[a]Note that some RfCs are developed to be protective of both cancer and noncancer health endpoints.

[b]This rationale has been previously employed by Region III Superfund program in their table of risk based concentrations - http://www.epa.gov/reg3hwmd/risk/human/index.htm.

concenration corresponding to a specific individual cancer risk level. In this methodology, the cancer screening risk level was selected as one in one million (written 1E-06 or $1x10^{-6}$) which is the lower end of the cancer risk range cited in the 1989 Benzene NESHAP (approximately 1E-04 to approximately 1E-06) as the range of risk used for regulatory decision making for the air toxics program.[3] The 1E-06 level of risk was also selected to take into account the potential for simultaneous exposure to multiple carcinogens. Specifically, one would have to experience the unlikely scenario of continuous lifetime exposure to 100 cancer causing agents (all at a concentration corresponding to a risk level of 1E-06) to approach the upper end of the above noted risk range (approximately 1E-04). The chronic screening value for cancer is calculated by simply dividing the IUR into a risk of one in a million [(1E-6)/(IUR)]. Cancer screening values are presented in Appendix A as air concentrations in ug/m^3.

iii. Final chronic screening value for both cancer and noncancer effects. The final chronic screening value for a chemical is simply the lower of the concentration values calculated in Steps i and ii above. The final chronic screening values are presented as an air concentration in ug/m^3. A quick review of Appendix A shows that a number of chemicals have no final chronic screening value, indicating no data in the toxicological references upon which OAQPS relies for toxicity values. Chapter 12 (Section 12.7) of Volume 1 of the ATRA Reference Library discusses various approaches to dealing with chemicals that have no toxicity information.

The suggested screening levels in this methodology were selected for the reasons stated above and because this approach has precedent in other risk-based environmental programs (see footnote b). If a SLT decides to use different screening levels, it is encouraged to document why it chose an alternate value and why the alternate value is in line with the screening level concept (i.e., a simple approach counterbalanced with conservative inputs and decision criteria).

[NOTE: The OAQPS Toxicity Values tables are not static and changes are made from time to time which may not be reflected in the current version of this screening level methodology. Analysts are encouraged to routinely review the OAQPS Toxicity Values tables for changes and to adjust the screening levels presented here, as necessary. This applies to both chronic and acute values presented in Appendices A and B.]

C. Derivation of Acute Screening Values

Many air pollutants can cause adverse health effects after short-term (acute) exposure to relatively high concentrations that last from a few minutes to days. Depending on the exposure circumstances and the chemicals involved, acute exposures may be of greater concern than chronic exposures. Appendix B provides a discussion of how to perform an acute risk-based screening level evaluation along with a selection of available acute toxicity values.

D. Issues Regarding Risk-based Analysis Using Monitoring Data

In this preliminary risk-based screening approach, monitoring data are used to represent exposure. The screening values presented in Appendix A apply to **continuous lifetime exposures** to the general population, including sensitive subpopulations (even though these values are commonly derived from studies involving discontinuous exposures). As such, it would be most useful to have monitoring data that are also representative of *the same time frame* (i.e., continuous lifetime exposure). This follows from the general risk assessment principle that the time frames associated with exposure data and toxicity data should match in order for the two types of data to be computationally combined in a risk-based analysis.

That being said, monitoring samples are, as noted above, most often collected *discontinuously over relatively short periods of time* (e.g., a 24 hour, 1 hour, or 15 minute sample collected every 6 or 12 days for a year). In a full scale risk assessment, the analyst would usually perform a series of mathematical computations to convert a year-long set of monitoring data into a more rigorous estimate of long term exposure. Most commonly, the analyst would calculate a 95% UCL of the arithmetic mean of the monitoring data set (see ATRA Reference Library, Volume 1, Appendix I). In some cases, higher levels of analysis would rely on air dispersion modeling (and perhaps exposure modeling) to evaluate exposure, while relying on monitoring data to evaluate modeling results, look for gaps in the emissions inventory, and confirm hotspots. The various ways in which one can approach a risk based analysis are provided in the ATRA reference library. The text box on the next page describes several common approaches for evaluating exposures.

To avoid having to perform such calculations for each chemical detected at a monitor in a preliminary risk-based screen of the type described here, a less onerous, yet conservative alternate approach is necessary to help identify the chemicals and locations that are likely responsible for most of the risk. The analyst could then focus any subsequent refined analysis (i.e., in the full risk assessment) on this subset of chemicals and locations.

In this screening approach, the maximum monitored sample result is used as a ***conservative surrogate*** for long-term exposure in the preliminary screening level process. This is suggested since, in a full scale risk assessment, one would usually not use a higher value (i.e., the mathematical development of more robust estimates of chronic exposure using a full set of monitoring data will generally lead to estimated exposure concentrations at or below the maximum monitored value found).

In short, using the maximum detected concentration of a chemical as a surrogate for long term exposure is a simple and straightforward way to screen a large monitoring data set and is expected to result in a lessened chance that chemicals posing exposures of potential public health concern will be removed from further consideration. (To more fully understand the utility of a screening approach as a preliminary step in a full risk analysis, it is important that analysts become familiar with the process of developing more robust long term inhalation exposure concentrations and risk estimates. Analysts are referred to the ATRA Reference

Library, Volume 1, Part II and Appendix I to learn more about this subject.)

Finally, it should be noted that the analysis of acute concerns using air monitoring data is the same for both screening level evaluations and more robust risk assessments; namely, the analyst compares *individual monitoring sample results* to acute toxicity values to evaluate the potential for acute exposures of potential public health concern. This is discussed in detail in the following sections.

Approaches to Evaluating Exposure

For air toxics impact analysis, a variety of measures may be used to evaluate the potential exposures of a person to a chemical in the air. Some measures are fairly crude and some are more refined. The most common measures used to estimate exposure are listed below (generally, from most crude to most refined):

Pounds Released	A very crude indicator of potential exposure because there is no information on either fate and transport in the environment or on how people interact with the contaminated air.
Ambient Concentration	A better indicator of potential exposure (fate and transport are included) but still lacks information on how people interact with the contaminated air. The quality of the concentration estimate depends on the methods used to develop it (i.e., the various types of monitoring or modeling used).
Exposure Model Refined Ambient Concentration	An even better indicator of potential exposure because it does include information on how people interact with the contaminated air. The quality of the information depends on both the methods used to estimate ambient concentration as well as those used to evaluate demographics and activity patterns.
Personal Exposure	An even higher level of understanding of exposure, usually developed by personal exposure monitoring.

The term *exposure concentration* is used to describe the concentration of a chemical in its transport or carrier medium (i.e., an environmental medium or contaminated food) at the point of contact. This concentration can be either a monitored or modeled value and may or may not have been refined by the application of an exposure model.

PART II: DETAILED SCREENING METHODOLOGY

This Part provides the detailed method for performing a risk-based screening of an air toxics monitoring data set (see Part I, Section A, Steps 1-7). Information is provided on how to identify the monitoring data set to screen, how to perform the actual screen, and how to begin to interpret and communicate the results. For brevity, the reader is referred to the relevant sections of the ATRA library for detailed information, where necessary.

STEP 1: Identify the monitoring data sets to be screened and the geographic areas and time frames that the monitoring data in question represent.

Gather together the monitoring data sets that are to be evaluated in the screening assessment. This will commonly be comprised of the data collected at one, two, or some small number of monitors placed in and around a specific neighborhood or some other relatively small geographic area (e.g. monitors set up around a small town). At a minimum, monitors to be included should all be within the same airshed.[c] The geographic area the monitor was established to evaluate (e.g., neighborhood scale, urban scale, etc.) should be noted along with the analytes sampled by the monitor, the analytical method used to evaluate the samples, and the time frame of monitoring (i.e., frequency of sample collection and length of time the monitoring occurred). For chronic exposure analysis, monitoring data sets should contain a minimum of one year's data to allow for a consideration of seasonal and source variation. Only full year data sets should be used for year-to-year comparisons (or at least data sets that are comparable in terms of the time frame monitored each year).

Note that some air toxics may have a strong concentration gradient across a study area. Concentration gradients depend on a number of factors, including specific characteristics of the sources in the area, area-specific physical considerations such as terrain effects and local meteorology, and atmospheric chemistry. As such, it may be helpful to develop a separate screening level analysis for different groupings of monitors in the same airshed if they are separated by a reasonably large distance. For example, a large urban area may have one group of monitors located in a highly industrialized mixed-use residential area and another group of monitors located miles away in a non-industrial residential area. From the standpoint of assessing and communicating what the monitoring results may indicate from a risk perspective, it may be helpful to perform separate screening analyses for the different groups of monitors for these two neighborhoods.

An additional consideration is the similarity across the different areas with regard to sources of the chemicals of interest and their influence on the monitors. For example, if two areas are similar in terms of land use, types of sources, and chemicals emitted, the analyst may wish to evaluate both groups of

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[c]For this screening level methodology, an airshed means a geographic area that, due to topography, meteorology, and climate, shares the same air. The segregation of monitors by airshed is used here as a way to distinguish (on a coarse geographic scale) potential exposure scenarios from one another.

monitors within the same screening level analysis. Ultimately, the analyst must take into consideration the unique circumstances of any given geographic area when deciding what monitors to consider together in a particular screening level analysis.

Once a set of monitors to be evaluated has been identified, the data from all these monitors could be combined into one large data set. The advantage to this approach is that only one screen needs to be performed for each chemical. The drawback is that if any chemical fails the screen (a likely event for at least some ubiquitous chemicals), the combined data set will have to be disaggregated to identify the failing monitor(s). On balance, it is recommended that the screening process be performed on a monitor-by-monitor basis.

STEP 2: Assess the data to determine if they are of sufficient quantity and quality to perform the screen.

The basis of this screening process is to use monitoring data to assess *potential exposures* to people in the vicinity of the monitor and, thereby, the potential risk posed by the exposures. As such, enough high quality data that were developed specifically for the purpose of *assessing exposures* are needed to allow a meaningful risk-based screen to be performed. In other words, to perform a *risk-based* screen, the data should meet *risk-based* DQOs.

If an existing monitoring data set was developed without risk-based DQOs in mind, the data should be evaluated to assess their utility for risk-based decision making. If the analyst identifies any significant data quantity or quality issues, the issues should be articulated in the final report. In some instances the analyst may recommend that the risk screening not be performed at all.

[NOTE: The details of performing a data quality assessment are significant and analysts are encouraged to familiarize themselves with the ATRA Reference Library Volume 1, Chapters 6, 10, and Appendix H, EPA's Quality System documents[4], and EPA's *Guidance for Data Useability in Risk Assessment*[5] before evaluating monitoring data quality for a risk-based screening analysis.]

As an example, consider an existing neighborhood scale monitoring data set for volatile organic compounds (VOCs) in which samples were collected once every 12 days for 4 months. Several data quality issues should be considered.

- **Issue 1 - Sample Frequency.** The Lake Michigan Air Directors' Consortium (LADCO) and Midwest Regional Planning Organization recently completed a series of analyses on existing air toxics monitoring data to evaluate, among other things, the minimum sampling frequency needed to develop annual averages within a specified level of precision. The results of this work helped inform the development of DQOs for the new National Air Toxics Trends Stations (NATTS).

  The LADCO studies indicate, for example, that the sampling frequency to develop an annual average for benzene should be a minimum of 1 in 6 days.[6]

- **Issue 2 - Length of Sampling.** The 4 month sampling regime will not have captured the long-term variability in air concentrations that results from source emission changes over time and meteorological influences which can change dramatically from season to season.

- **Issue 3 - Spatial Representativeness of Samples.** The monitor was established to be representative of the neighborhood scale. But just how far beyond the monitor are the sample results accurate? Are the results accurate out to one block away from the monitor? Two blocks away? One kilometer away? Does the representativeness of a monitor vary with distance by chemical type (e.g., volatile organic compounds versus particulates)?

These are just a few of the issues that need to be considered when deciding whether there are limitations in the data set that should be communicated to the risk manager in the screening level write-up or whether the screen should be performed at all. Analysts are encouraged to become familiar with the LADCO studies and other relevant

Is My Method Sensitive Enough?

When evaluating the quality of data for screening purposes, an important question to ask is "is my sampling and analytical procedure sensitive enough?" For example, if the Appendix A screening level for Chemical X is 0.5 ug/m^3 but the method detection limit (MDL) for the compound (as reported by the lab) was only 1.0 ug/m^3, samples that are reported at "not detected" at the MDL may actually have Chemical X present above the screening level (i.e., above 0.5 ug/m^3), but below 1.0 ug/m^3. In some cases, there may be no easy remedy to this problem (e.g., there is no readily available method with sufficient sensitivity). In other cases, poor planning may have led to using a method with inadequate sensitivity when a more sensitive method was available.

A related issue is how to treat "J-flagged data." A J-flagged value is a detection that occurs between the MDL and the limit of quantitation for a given sample (the "sample quantitation limit" or SQL). For screening purposes, J-flagged data are generally used "as is." That is to say, they are considered to be positive detections that are present at the concentrations reported by the lab.

More information on MDLs, SQLs, and dealing with flagged data is provided in ATRA Volume 1, Appendices H and I.

monitoring and data quality literature in order to better understand the evolving state of the science and the data quality needs of the end-users.

In summary, there is usually little (if anything) to be done to enhance the quality of existing monitoring data sets. If historical data sets are used, the analyst should be careful to fully explain the inherent limitations associated with the data. New monitoring efforts to evaluate risk should identify and establish the relevant risk-based DQOs *before monitoring commences*. This will help ensure that sufficient high-quality data are collected to allow the assessment questions to be evaluated at a level that is acceptable to the end users of the analysis.

STEP 3: For each chemical detected at least once in the data set, create a statistical summary of the monitoring results for that chemical. The statistical summary will commonly include the following: Number of valid samples collected and frequency of detection, the method detection limits (MDLs), and range of detected values.

Once a set of monitors has been identified for the screening effort, the analyst should develop statistical summaries for each chemical detected at least once at each monitor. A separate statistical summary should be developed for each monitor (i.e., if there are three monitors being screened, there will be three statistical summary tables providing information for each of the detected chemicals at each monitor). A suggested table format for statistical summaries follows (see an example of how to fill in this table in Appendix D):

Statistical Summary of Detected Chemicals
Monitor Number 101

Detected Chemical (CAS Number)	Frequency of Detection	Laboratory-Specific Method Detection Limit (ug/m^3)*	Range of Detected Values (ug/m^3)

*Analysts may also choose to include a column listing the range of SQLs found across samples for a given analyte since the SQLs (not the MDLs) are typically used in the full risk assessment to evaluate long-term chronic exposures. ATRA Volume 1, Appendix I discusses this issue in detail.

Where:

- **Detected Chemical and CAS Number** is the name of the analyte reported by the laboratory. The Chemical Abstracts Service (CAS) registry number reported by the lab should also be included because it can help sort out chemical nomenclature differences that occur between different laboratories and between labs and regulatory chemical lists.

- **Frequency of Detection** is the number of times a chemical is detected in *valid samples* at a monitor (including "J-flagged" values[d]) compared to the number of valid samples collected. For example, consider a data set in which 30 volatile organic chemical (VOC) samples were collected but only 25 were determined to be valid (i.e., the data validation process rejected 5 samples). In the 25 valid samples, benzene was detected in only 20 of the samples (15 detects above the quantitation limit and 5 J-flagged values below the quantitation limit). In this example, the frequency of detection would be reported as 20/25.

Automating the Process
ProUCL

Evaluating large air toxics monitoring data sets by hand can be cumbersome and time consuming (and may lead to mistakes). Fortunately, any number of computer software packages are available to help automate the process.

One such EPA software program, ProUCL, was specifically designed to help evaluate environmental data sets as part of the risk assessment process. For example, ProUCL can calculate some of the summary statistics useful for a risk-based screening level assessment. ProUCL can also develop the higher level statistics (e.g., 95% upper confidence limits) needed to perform a refined risk assessment.

ProUCL is available from EPA's Technical Support Center for Monitoring and Site Characterization (http://www.epa.gov/nerlesd1/tsc/software.htm).

One use of the frequency of detection is to quickly help determine whether a chemical is routinely found in the air. This information, in conjunction with ancillary data such as the presence of potential sources, can help inform the next steps (if any) that decision makers select. For example, if a detected chemical exceeds its chronic screening value, but was infrequently detected (e.g., <10% of the time; see ATRA Reference Library, Volume 1, Appendix I) and further investigation identifies no likely sources, the decision makers may opt to pursue this chemical no further.

- **Laboratory-Specific Method Detection Limits**. The MDL is reported by the laboratory for each detected chemical in the data set. Providg the MDLs allows the analyst

[d]"J" is a laboratory qualifier denoting that there is a positive identification but that the associated numerical concentration value is an estimated quantity. These values are used "as is" in the screening process (i.e., by removing the J qualifier and using the reported value as a detection at the reported concentration).

to quickly determine the ability of the laboratory to detect a given chemical above the screening level.

- **Range of Detected Values** is the range, for each chemical detected, of concentrations actually detected and reported by the laboratory. The range should include the highest (maximum) detection found and the lowest detection found. J-values are included. For example, in a data set for benzene, if the maximum detected value found was 2.3 ug/m^3 and the lowest detected value found was 0.05J ug/m^3, the range would be reported as "0.05J - 2.3".[e]

STEP 4: For each detected chemical in the data set, compare the maximum monitored value to the suggested chronic screening level value provided in Appendix A and the acute values provided in Appendix B. Summarize the results of the comparison process in a table. Highlight chemicals whose maximum monitored values exceed their respective screening values (chronic and acute).

For each chemical whose maximum monitored value exceeds a screening value, review the full data set and determine the percentage of detections that are at or above the screening value.

For this step, prepare a new table for each monitor that shows the name and CAS number of each detected chemical, the maximum concentration detected, the chronic and acute screening values, and an indication of whether the maximum value is greater than or equal to the screening values (yes or no). An example table is provided below. An example of how to fill in this table is provided in Appendix D.

The chemicals that fail the screen become the focus of the remaining steps of the screening level assessment and may be the focus of any subsequent analyses (e.g., a more refined risk analysis). As noted previously, the fact that a chemical fails the screen only indicates that there is a ***potential*** for exposures of concern. A more refined analysis will usually be required to clarify the likelihood that these chemicals are presenting exposures of concern.

STEP 5: Augment the results described in Step 4 with ancillary information about chemicals that fail the screen (e.g., possible sources, applicable regulations, estimated background concentrations, NATA national scale assessment results for the geographic area, etc.).

For each of the chemicals that fails the screen in Step 4, collect and present ancillary information that will help decision makers put the results in context. This can be done in narrative style or in a table. For example, provide information on possible sources that

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[e]Note that while some laboratories do not routinely report detections between the quantitation limit and the detection limit (i.e., some labs do not report J-flagged values), the J-flagged data are generally considered necessary to perform this screening approach (a data set would generally be considered insufficient quality for risk-based screening purposes if J-flagged data have been purposefully excluded).

Summary of Screening Analysis for Detected Chemicals
Monitor Number 101

Detected Chemical (CAS Number)	Maximum Concentration detected (ug/m^3)	Final Chronic Screening Value from Appendix A (ug/m^3)	Acute Screening Value from Appendix B (ug/m^3)	Maximum Concentration is ≥ Chronic Screening Value (Yes/No)? (% Detections Exceeding)[1]	Maximum Concentration is ≥ Acute Screening Value (Yes/No)? (% Detections Exceeding)[1]

1. If the maximum value found exceeds a screening value (chronic or acute), the full data set of valid samples for the chemical is reviewed to determine the percentage of detections that, individually, are at or above the screening value. The *% Detections Exceeding* is equal to the number of detections at or above the screening value divided by the total number of detections, multiplied by 100.

may be responsible for these concentrations, how these concentrations compare to other similar geographic areas, and what (if anything) is currently being done regarding air concentrations of this chemical. Other important issues are whether the local community has articulated concerns about air toxics in the past and whether any relevant health studies have been performed in the area (e.g., cancer statistics studies performed by the Agency for Toxic Substances and Disease Registry - ATSDR). Some key information sources include:

- The National Emissions Inventory (or more locally developed inventories)[7];
- The Toxics Release Inventory[8];
- Permit files, including compliance and enforcement information;
- The National Air Toxics Assessment (NATA) national-scale assessment estimates of HAP concentration by geographic area;[9]
- Existing rules and future rulemaking activities affecting sources;
- Community complaints; and
- ATSDR[10] and local health departments and universities.

(See the ATRA Reference Library, Volume 1, Chapters 2 and 4 for helpful information on emissions inventories and air toxics rules and regulations.)

STEP 6: Describe areas of uncertainty in the analysis.

Reliable information may or may not always be available for some aspects of the risk screening process (indeed, scientific uncertainty is an inherent part of any risk based analysis). As such, risk managers almost always have to make decisions using assessments that are not as definitive in all key areas as would be desirable. To try and compensate for some of this uncertainty, the risk screening process described here is structured to be overtly conservative.

That being said, it is imperative that the analyst encourage the end users (not only

risk managers, but any other stakeholder, including the media and the public) to not only "look at the numerical answers" but also to put them into context by clearly describing the uncertainties associated with the analysis and the impact the uncertainties may have on the results. A description of uncertainty in risk-based analysis is provided in the ATRA Reference Library, Volume 1, Chapters 3 and 13 (Chapter 3 also discusses another important concept in risk based analysis - variability). Given the central role of uncertainty and variability in risk-based analysis and decision making, the analyst is encouraged to become familiar with these concepts and to keep them in mind throughout both the development and communication of the screening level analysis results.

Some of the important questions to cover in the uncertainty analysis include:

- What geographic areas do the monitoring results represent?
- Are "hotspots" possibly present that are not captured by the monitoring results?
- Are there important chemicals possibly present that were not sampled?
- Were sample frequency, sampling duration, detection limits, and other risk-based DQOs sufficient to allow a scientifically sound screening of the monitoring data set?
- Were any chemicals detected for which screening values were not available?
- Were any conservative assumptions made which may have overstated an apparent problem (e.g., assuming all chromium is hexavalent when the local emissions inventory indicates otherwise?)
- Were any assumptions made which may have understated an apparent problem (e.g., having too few monitors to provide a representative evaluation of exposures across a geographically large study area)?
- If the monitoring data sets are historical in nature, have local conditions changed to such an extent that the older data do not represent current exposures?
- Are there chemicals released from nearby sources or detected in monitoring samples which have the potential to partition to other media and present significant exposures through pathways other than inhalation (e.g., dioxin, mercury)?

STEP 7: Based on the screening results provided in Step 4, the ancillary data developed in Step 5, and the uncertainty analysis developed in Step 6, develop a written description of the analysis, including a discussion about the possibility that a public health threat exists that requires further analysis. Include in this discussion an overall statement of the confidence in the results.

Once the screening assessment has been performed, the chemicals that fail the screen identified, relevant ancillary information collected, and an analysis of uncertainties developed, the analyst should describe the process and results in writing. The analyst should be careful to provide enough information so that any reader can follow the logical progression the analyst took, including how the evaluated data set was identified, how the analysis was performed, and how the conclusions were developed.

The analyst should make sure to include important assumptions and decisions made throughout the process. A suggested report outline is provided in Appendix C. Useful background information on presenting risk-based information is included in the ATRA Reference Library, Volume 1, Chapter 13. Analysts should also be familiar with the EPA Science Policy Council's risk characterization program documents which discuss important aspects of writing and communicating about risk (e.g., transparency and clarity in discussions of potential risk).[11]

At the end of the written evaluation, the analyst is encouraged to make statements about their overall confidence in the conclusions, including statements regarding the air toxics that fail the screen and which may require further evaluation (and, conversely, whether chemicals that "pass the screen" can reasonably be removed from further consideration). These statements, along with the full discussion of uncertainty developed in Step 6 are key elements needed by subsequent users of the analysis to critically judge whether and how to use the screening results in the decision making process.

It is important to re-emphasize that the resulting report from a preliminary screening level analysis of this type **is not** a substitute for a full risk characterization. The purpose of developing a report that includes ancillary data, an uncertainty discussion, and statements about the analysts' confidence in the conclusions is only to help decision makers better understand the problem and decide on next steps. Those next steps will almost always include a more rigorous risk evaluation of chemicals that, at a minimum, failed the screen (e.g., developing 95% UCL values from the full monitoring data set, performing air dispersion and exposure modeling, etc.) and may also include the collection of additional data.

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APPENDIX A

CHRONIC SCREENING VALUES

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As described in the main body of this document, Appendix A provides chronic inhalation screening values that are, for a given entry, the lesser of screening values for cancer and chronic noncancer health effects. In order to make the process even more straightforward for the screening process (and at the same time remain conservative), several additional simplifying assumptions were made and incorporated into this chronic screening value Appendix.

Specifically, several of the entries in OAQPS's Toxicity Values Table 1 (see http://www.epa.gov/ttn/atw/toxsource/summary.html) were combined into one entry in this Appendix for screening level purposes. The simplifications are as follows:

1. The OAQPS toxicity Table 1 entries *Antimony Compounds, Antimony Pentoxide, Antimony Potassium Tartrate, Antimony Tetroxide,* and *Antimony Trioxide* were condensed into one entry (Antimony Compounds) in this screening level Appendix A. The toxicity data utilized for this entry is that of antimony trioxide, the only data available for antimony or one of its compounds in the OAQPS table.

2. The OAQPS toxicity Table 1 entries *Chromium (III) Compounds* and *Chromium (VI) Compounds* were condensed into one entry (Chromium Compounds) in this screening level Appendix A. The toxicity data for this entry is that of "Chromium (VI) Compounds."

3. The OAQPS toxicity Table 1 entries for *Cyanide Compounds, Calcium Cyanide, Copper Cyanide, Hydrogen Cyanide, Potassium Cyanide, Potassium Silver Cyanide, Silver Cyanide, Sodium Cyanide*, and *Zinc Cyanide* were condensed into one entry (Cyanide Compounds) in this screening level Appendix A. The toxicity value utilized for this entry is that of hydrogen cyanide, the only data available for cyanide or one of its compounds in the OAQPS table.

4. The OAQPS toxicity Table 1 entries for *Mercuric Chloride, Mercury (Elemental), Methyl Mercury,* and *Phenylmercuric Acetate* were condensed into one entry (Mercury Compounds) in this screening level Appendix A. The toxicity data for this entry is that of elemental mercury. (Note that this screening level methodology is focused on *inhalation only*. As such, issues associated with methyl mercury ingestion are not incorporated into this screening level Appendix A.)

5. The OAQPS toxicity Table 1 entries for *Nickel Compounds, Nickel Oxide, Nickel Refinery Dust*, and *Nickel Subsulfide* were condensed into one entry (Nickel Compounds) in this screening level Appendix A. The toxicity data for this entry is that of "Nickel Compounds" for the noncancer RfC and "Nickel Subsulfide" for the cancer IUR.

6. The OAQPS toxicity Table 1 entries for *Selenium Compounds, Selenious Acid*, and *Selenourea* were condensed into one entry (Selenium Compounds) in this screening level Appendix A. The toxicity data for

this entry is that of Selenium Compounds.

7. The OAQPS toxicity Table 1 entries for *Lindane (gamma-HCH), alpha-Hexachlorocyclohexane (a-HCH), beta-Hexachlorocyclohexane (b-HCH)*, and *technical Hexachlorocyclohexane (HCH)* were condensed into one entry [Hexachlorocyclohexane (HCH)] in this screening level Appendix A. The toxicity data for this entry is that of lindane (gamma-HCH) for the noncancer RfC and alpha-Hexachlorocyclohexane (a-HCH) for the cancer IUR.

Several other toxicity surrogates were used for chemicals having no toxicity data, as follows:

1. The toxicity value for "Cresols (mixed)" was used as a surrogate for each of the isomers o-, m-, and p-cresol.

2. The toxicity value for "Xylenes (mixed)" was used as a surrogate for o- and m-xylenes.

3. The noncancer RfC for naphthalene was used as a surrogate for the noncancer toxicity of each of the chemicals listed in the PAH grouping (since none of these entries has a unique RfC). Note that several of the chemicals in the PAH grouping are substituted.

It should be noted that ethylene glycol monobutyl ether was delisted from the list of hazardous air pollutants (HAPs) on November 29, 2004 (see *Federal Register* Volume 69, Number 228, pp. 69320-69325). Toxicity data for this chemical is presented for informational purposes only.

Finally, it should also be noted that the number of significant figures shown is reflective of the number of significant figures shown in the OAQPS toxicity table from which these screening numbers were drawn.

Appendix A Chronic Inhalation Screening Values Based on OAQPS Toxicity Table 1 www.epa.gov/ttn/atw/toxsource/table1.xls (4/27/2010)		Noncancer at HQ = 0.1	Cancer at 1 x 10^{-6} Risk Level	FINAL SCREENING VALUE
		ug/m^3	ug/m^3	ug/m^3
Acetaldehyde	75-07-0	9.E-01	4.5E-01	**4.5E-01**
Acetamide	60-35-5		5.E-02	**5.E-02**
Acetonitrile	75-05-8	6.E+00		**6.E+00**
Acetophenone	98-86-2			**No Value**
Acrolein	107-02-8	2.E-03		**2.E-03**
Acrylamide	79-06-1	6.E-01	1.E-02	**1.E-02**
Acrylic acid	79-10-7	1.E-01		**1.E-01**
Acrylonitrile	107-13-1	2.E-01	1.5E-02	**1.5E-02**
Allyl chloride	107-05-1	1.E-01	2.E-01	**1.E-01**
Aniline	62-53-3	1.E-01	6.3E-01	**1.E-01**
Antimony compounds (1)	Various	2.E-02		**2.E-02**
Arsenic compounds	7440-38-2	1.5E-03	2.3E-04	**2.3E-04**
Arsine	7784-42-1	5.E-03		**5.E-03**
Benzene	71-43-2	3.E+00	1.3E-01	**1.3E-01**
Benzidine	92-87-5	1.E+00	1.5E-05	**1.5E-05**
Benzotrichloride	98-07-7		2.7E-04	**2.7E-04**
Benzyl chloride	100-44-7		2.0E-02	**2.0E-02**
Beryllium compounds	7440-41-7	2.E-03	4.2E-04	**4.2E-04**
Biphenyl	92-52-4			**No Value**
Bis(2-ethylhexyl)phthalate	117-81-7	1.E+00	4.2E-01	**4.2E-01**
Bis(chloromethyl)ether	542-88-1		1.6E-05	**1.6E-05**
Bromoform	75-25-2		9.1E-01	**9.1E-01**
1,3-Butadiene	106-99-0	2.E-01	3.E-02	**3.E-02**
Cadmium compounds	7440-43-9	1.E-03	5.6E-04	**5.6E-04**
Captan	133-06-2		1.E+00	**1.E+00**
Carbaryl	63-25-2			**No Value**
Carbon disulfide	75-15-0	7.E+01		**7.E+01**
Carbon tetrachloride	56-23-5	1.0E+01	1.7E-01	**1.7E-01**
Chloramben	133-90-4			**No Value**
Chlordane	57-74-9	7.E-02	1.E-02	**1.E-02**
Chlorine	7782-50-5	1.5E-02		**1.5E-02**
Chloroacetic acid	79-11-8			**No Value**
2-Chloroacetophenone	532-27-4	3.E-03		**3.E-03**
Chlorobenzene	108-90-7	1.E+02		**1.E+02**
Chlorobenzilate	510-15-6		1.3E-02	**1.3E-02**
Chloroform	67-66-3	9.8E+00		**9.8E+00**

Appendix A Chronic Inhalation Screening Values Based on OAQPS Toxicity Table 1 www.epa.gov/ttn/atw/toxsource/table1.xls (4/27/2010)		Noncancer at HQ = 0.1	Cancer at 1 x 10^{-6} Risk Level	FINAL SCREENING VALUE
		ug/m^3	ug/m^3	ug/m^3
Chloroprene	126-99-8	7.E-01		**7.E-01**
Chromium Compounds (2)	Various	1.E-02	8.3E-05	**8.3E-05**
Chromium (VI) trioxide, chromic acid mist	11115-74-5	8.E-04		**8.E-04**
Cobalt compounds	7440-48-4	1.E-02		**1.E-02**
Coke Oven Emissions	8007-45-2		1.6E-03	**1.6E-03**
m-Cresol (3)	108-39-4	6.E+01		**6.E+01**
o-Cresol (3)	95-48-7	6.E+01		**6.E+01**
p-Cresol (3)	106-44-5	6.E+01		**6.E+01**
Cresols (mixed)	1319-77-3	6.E+01		**6.E+01**
Cumene	98-82-8	4.E+01		**4.E+01**
Cyanazine	21725-46-2		4.2E-03	**4.2E-03**
Cyanide Compounds (4)	Various	3.E-01		**3.E-01**
Acetone cyanohydrin	75-86-5	1.E+00		**1.E+00**
Cyanogen	460-19-5			**No Value**
Cyanogen bromide	506-68-3			**No Value**
Cyanogen chloride	506-77-4			**No Value**
Ethylene cyanohydrin	109-78-4			**No Value**
Thiocyanic acid, 2-(benzothiazolylthio) methyl est	21564-17-0			**No Value**
2,4-D, salts and esters	94-75-7			**No Value**
DDE	72-55-9		1.0E-02	**1.0E-02**
1,2-Dibromo-3-chloropropane	96-12-8	2.E-02	5.E-04	**5.E-04**
Dibutylphthalate	84-74-2			**No Value**
p-Dichlorobenzene	106-46-7	8.E+01	9.1E-02	**9.1E-02**
3,3'-Dichlorobenzidine	91-94-1		2.9E-03	**2.9E-03**
Dichloroethyl ether	111-44-4		3.0E-03	**3.0E-03**
1,3-dichloropropene	542-75-6	2.E+00	3.E-01	**3.E-01**
Dichlorvos	62-73-7	5.E-02	1.2E-02	**1.2E-02**
Diesel engine emissions	DIESEL EMIS.	5.E-01		**5.E-01**
Diethanolamine	111-42-2	3.E-01		**3.E-01**
3,3'-Dimethoxybenzidine	119-90-4		3.E-01	**3.E-01**
p-Dimethylaminoazobenzene	60-11-7		7.7E-04	**7.7E-04**

Appendix A Chronic Inhalation Screening Values Based on OAQPS Toxicity Table 1 www.epa.gov/ttn/atw/toxsource/table1.xls (4/27/2010)		Noncancer at HQ = 0.1	Cancer at 1 x 10^{-6} Risk Level	FINAL SCREENING VALUE
		ug/m³	ug/m³	ug/m^3
3,3'-Dimethylbenzidine	119-93-7		3.8E-04	**3.8E-04**
Dimethyl formamide	68-12-2	3.E+00		**3.E+00**
N,N-dimethylaniline	121-69-7			**No Value**
1,1-Dimethylhydrazine	57-14-7			**No Value**
2,4-dinitrophenol	51-28-5			**No Value**
2,4-Dinitrotoluene	121-14-2	7.E-01	1.1E-02	**1.1E-02**
2,4/2,6-Dinitrotoluene (mixture)	25321-14-6		5.3E-03	**5.3E-03**
1,4-Dioxane	123-91-1	3.6E+02	1.3E-01	**1.3E-01**
1,2-Diphenylhydrazine	122-66-7		4.5E-03	**4.5E-03**
Epichlorohydrin	106-89-8	1.E-01	8.3E-01	**1.E-01**
1,2-Epoxybutane	106-88-7	2.E+00		**2.E+00**
Ethyl acrylate	140-88-5			
Ethyl benzene	100-41-4	1.E+02	4.E-01	**4.E-01**
Ethyl carbamate	51-79-6		3.4E-03	**3.4E-03**
Ethyl chloride	75-00-3	1.E+03		**1.E+03**
Ethylene dibromide	106-93-4	9.E-01	2.E-03	**2.E-03**
Ethylene dichloride	107-06-2	2.4E+02	3.8E-02	**3.8E-02**
Ethylene glycol	107-21-1	4.E+01		**4.E+01**
Ethylene oxide	75-21-8	3.E+00	1.1E-02	**1.1E-02**
Ethylene thiourea	96-45-7	3.E-01	7.7E-02	**7.7E-02**
Ethylidene dichloride (1,1-Dichloroethane)	75-34-3	5.E+01	6.3E-01	**6.3E-01**
Formaldehyde	50-00-0	9.8E-01	7.7E-02	**7.7E-02**
Diethylene glycol monobutyl ether	112-34-5	2.E+00		**2.E+00**
Diethylene glycol monoethyl ether	111-90-0			**No Value**
Ethylene glycol butyl ether (5)	111-76-2	1.3E+03		**1.3E+03**
Ethylene glycol ethyl ether	110-80-5	2.E+01		**2.E+01**
Ethylene glycol ethyl ether acetate	111-15-9	3.E+01		**3.E+01**
Ethylene glycol methyl ether	109-86-4	2.E+00		**2.E+00**
Ethylene glycol methyl ether acetate	110-49-6	9.E+00		**9.E+00**
Heptachlor	76-44-8		7.7E-04	**7.7E-04**
Hexachlorobenzene	118-74-1	3.E-01	2.2E-03	**2.2E-03**
Hexachlorobutadiene	87-68-3	9.E+00	4.5E-02	**4.5E-02**

Appendix A Chronic Inhalation Screening Values Based on OAQPS Toxicity Table 1 www.epa.gov/ttn/atw/toxsource/table1.xls (4/27/2010)		Noncancer at HQ = 0.1	Cancer at 1 x 10^{-6} Risk Level	FINAL SCREENING VALUE
		ug/m³	ug/m³	ug/m^3
Hexachlorocyclohexane (HCH) (6)	Various	3.E-02	5.6E-04	**5.6E-04**
Hexachlorocyclopentadiene	77-47-4	2.E-02		**2.E-02**
Hexachlorodibenzo-p-dioxin, mixture	19408-74-3		7.7E-07	**7.7E-07**
Hexachloroethane	67-72-1	8.E+00	3.E-01	**3.E-01**
Hexamethylene-1,6-diisocyanate	822-06-0	1.E-03		**1.E-03**
n-Hexane	110-54-3	7.E+01		**7.E+01**
Hydrazine	302-01-2	2.E-02	2.0E-04	**2.0E-04**
Hydrochloric acid	7647-01-0	2.E+00		**2.E+00**
Hydrofluoric acid	7664-39-3	1.4E+00		**1.4E+00**
Hydrogen sulfide	7783-06-4	2.E-01		**2.E-01**
Hydroquinone	123-31-9			**No Value**
Isophorone	78-59-1	2.E+02	3.7E+00	**3.7E+00**
Lead compounds (7)	7439-92-1	1.5E-02		**1.5E-02**
Tetraethyl lead	78-00-2			**No Value**
Maleic anhydride	108-31-6	7.E-02		**7.E-02**
Manganese compounds	7439-96-5	5.E-03		**5.E-03**
Mercury compounds (8)	Various	3.E-02		**3.E-02**
Methanol	67-56-1	4.E+02		**4.E+02**
Methoxychlor	72-43-5			**No Value**
Methyl bromide	74-83-9	5.E-01		**5.E-01**
Methyl chloride	74-87-3	9.E+00		**9.E+00**
Methyl chloroform (1,1,1-Trichloroethane)	71-55-6	5.E+02		**5.E+02**
Methyl ethyl ketone	78-93-3	5.E+02		**5.E+02**
Methyl isobutyl ketone	108-10-1	3.E+02		**3.E+02**
Methyl isocyanate	624-83-9	1.E-01		**1.E-01**
Methyl methacrylate	80-62-6	7.E+01		**7.E+01**
Methyl tert-butyl ether	1634-04-4	3.E+02	3.8E+00	**3.8E+00**
4,4'-Methylene bis(2-chloroaniline)	101-14-4		2.3E-03	**2.3E-03**
Methylene chloride	75-09-2	1.E+02	2.1E+00	**2.1E+00**
Methylene diphenyl diisocyanate	101-68-8	6.E-02		**6.E-02**
4,4'-Methylenedianiline	101-77-9	2.E+00	2.2E-03	**2.2E-03**
Nickel compounds (9)	Various	9.E-03	2.1E-03	**2.1E-03**
Nitrobenzene	98-95-3	9.E-01	2.5E-02	**2.5E-02**

Appendix A Chronic Inhalation Screening Values Based on OAQPS Toxicity Table 1 www.epa.gov/ttn/atw/toxsource/table1.xls (4/27/2010)		Noncancer at HQ = 0.1	Cancer at 1 x 10^{-6} Risk Level	FINAL SCREENING VALUE
		ug/m³	ug/m³	ug/m³
2-Nitropropane	79-46-9	2.E+00	1.8E-01	**1.8E-01**
Nitrosodimethylamine	62-75-9		7.1E-05	**7.1E-05**
N-Nitrosomorpholine	59-89-2		5.3E-04	**5.3E-04**
Parathion	56-38-2			**No Value**
Polychlorinated biphenyls	1336-36-3		1.E-02	**1.E-02**
Aroclor 1016	12674-11-2			**No Value**
Aroclor 1254	11097-69-1			**No Value**
Pentachloronitrobenzene	82-68-8		1.4E-02	**1.4E-02**
Pentachlorophenol	87-86-5	1.E+01	2.0E-01	**2.0E-01**
Phenol	108-95-2	2.E+01		**2.E+01**
p-Phenylenediamine	106-50-3			**No Value**
Phosgene	75-44-5	3.E-02		**3.E-02**
Phosphine	7803-51-2	3.E-02		**3.E-02**
Phosphorus, white	7723-14-0	7.E-03		**7.E-03**
Phthalic anhydride	85-44-9	2.E+00		**2.E+00**
Begin Polycyclic Aromatic Hydrocarbons (PAHs) (10)				
Acenaphthene	83-32-9	3.E-01		**3.E-01**
Acenaphthylene	206-96-8	3.E-01		**3.E-01**
Anthracene	120-12-7	3.E-01		**3.E-01**
Benzo(a)anthracene	56-55-3	3.E-01	9.1E-03	**9.1E-03**
Benzo(b)fluoranthene	205-99-2	3.E-01	9.1E-03	**9.1E-03**
Benzo[j]fluoranthene	205-82-3	3.E-01	9.1E-03	**9.1E-03**
Benzo(k)fluoranthene	207-08-9	3.E-01	9.1E-03	**9.1E-03**
Benzo(g,h,i)perylene	191-24-2	3.E-01		**3.E-01**
Benzo(a)pyrene	50-32-8	3.E-01	9.1E-04	**9.1E-04**
Benzo(e)pyrene	192-97-2	3.E-01		**3.E-01**
Carbazole	86-74-8	3.E-01	1.8E-01	**1.8E-01**
beta-Chloronaphthalene	91-58-7	3.E-01		**3.E-01**
Chrysene	218-01-9	3.E-01	9.1E-02	**9.1E-02**
Dibenz[a,h]acridine	226-36-8	3.E-01	9.1E-03	**9.1E-03**
Dibenz[a,j]acridine	224-42-0	3.E-01	9.1E-03	**9.1E-03**
Dibenz(a,h)anthracene	53-70-3	3.E-01	8.3E-04	**8.3E-04**
7H-Dibenzo[c,g]carbazole	194-59-2	3.E-01	9.1E-04	**9.1E-04**

Appendix A Chronic Inhalation Screening Values Based on OAQPS Toxicity Table 1 www.epa.gov/ttn/atw/toxsource/table1xls (4/27/2010)		Noncancer at HQ = 0.1	Cancer at 1 x 10^{-6} Risk Level	FINAL SCREENING VALUE
		ug/m³	ug/m³	ug/m^3
Dibenzo[a,e]pyrene	192-65-4	3.E-01	9.1E-04	**9.1E-04**
Dibenzo[a,h]pyrene	189-64-0	3.E-01	9.1E-05	**9.1E-05**
Dibenzo[a,i]pyrene	189-55-9	3.E-01	9.1E-05	**9.1E-05**
Dibenzo[a,l]pyrene	191-30-0	3.E-01	9.1E-05	**9.1E-05**
7,12-Dimethylbenz(a)anthracene	57-97-6	3.E-01	1.4E-05	**1.4E-05**
1,6-Dinitropyrene	42397-64-8	3.E-01	9.1E-05	**9.1E-05**
1,8-Dinitropyrene	42397-65-9	3.E-01	9.1E-04	**9.1E-04**
Fluoranthene	206-44-0	3.E-01		**3.E-01**
Fluorene	86-73-7	3.E-01		**3.E-01**
Indeno(1,2,3-cd)pyrene	193-39-5	3.E-01	9.1E-03	**9.1E-03**
3-Methylcholanthrene	56-49-5	3.E-01	1.6E-04	**1.6E-04**
5-Methylchrysene	3697-24-3	3.E-01	9.1E-04	**9.1E-04**
1-Methylnaphthalene	90-12-0	3.E-01		**3.E-01**
2-Methylnaphthalene	91-57-6	3.E-01		**3.E-01**
Naphthalene	91-20-3	3.E-01	2.9E-02	**2.9E-02**
5-Nitroacenaphthene	602-87-9	3.E-01	2.7E-02	**2.7E-02**
6-Nitrochrysene	7496-02-8	3.E-01	9.1E-05	**9.1E-05**
2-Nitrofluorene	607-57-8	3.E-01	9.1E-02	**9.1E-02**
1-Nitropyrene	5522-43-0	3.E-01	9.1E-03	**9.1E-03**
4-Nitropyrene	57835-92-4	3.E-01	9.1E-03	**9.1E-03**
Phenanthrene	85-01-8	3.E-01		**3.E-01**
Pyrene	129-00-0	3.E-01		**3.E-01**
End PAH Listings				
1,3-Propane sultone	1120-71-4		1.4E-03	**1.4E-03**
Propionaldehyde	123-38-6	8.E-01		**8.E-01**
Propoxur	114-26-1			**No Value**
Propylene dichloride	78-87-5	4.E-01	5.3E-02	**5.3E-02**
Propylene oxide	75-56-9	3.E+00	2.7E-01	**2.7E-01**
Quinoline	91-22-5			**No Value**
Selenium compounds (11)	Various	2.E+00		**2.E+00**
Hydrogen selenide	7783-07-5	8.E-03		**8.E-03**
Styrene	100-42-5	1.E+02		**1.E+02**
Styrene oxide	96-09-3	6.E-01		**6.E-01**
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	4.E-06	3.0E-08	**3.0E-08**
1,1,2,2-Tetrachloroethane	79-34-5		1.7E-02	**1.7E-02**
Tetrachloroethene	127-18-4	2.7E+01	1.7E-01	**1.7E-01**
Titanium tetrachloride	7550-45-0	1.E-02		**1.E-02**
Toluene	108-88-3	4.E+01		**4.E+01**

Appendix A Chronic Inhalation Screening Values Based on OAQPS Toxicity Table 1 www.epa.gov/ttn/atw/toxsource/table1.xls (4/27/2010)		Noncancer at HQ = 0.1	Cancer at 1 x 10^{-6} Risk Level	FINAL SCREENING VALUE
		ug/m^3	ug/m^3	ug/m^3
2,4-Toluene diamine	95-80-7		9.1E-04	**9.1E-04**
2,4/2,6-Toluene diisocyanate mixture (TDI)	26471-62-5	7.E-03	9.1E-02	**7.E-03**
o-Toluidine	95-53-4		2.0E-02	**2.0E-02**
Toxaphene	8001-35-2		3.1E-03	**3.1E-03**
1,2,4-Trichlorobenzene	120-82-1	2.E+01		**2.E+01**
1,1,2-Trichloroethane	79-00-5	4.E+01	6.3E-02	**6.3E-02**
Trichloroethylene	79-01-6	6.E+01	5.E-01	**5.E-01**
2,4,5-Trichlorophenol	95-95-4			**No Value**
2,4,6-Trichlorophenol	88-06-2		3.2E-01	**3.2E-01**
Triethylamine	121-44-8	7.E-01		**7.E-01**
Trifluralin	1582-09-8		4.5E-01	**4.5E-01**
Uranium compounds	7440-61-1	3.E-02		**3.E-02**
Uranium, soluble salts	URANSOLS			**No Value**
Vinyl acetate	108-05-4	2.E+01		**2.E+01**
Vinyl bromide	593-60-2	3.E-01	3.1E-02	**3.1E-02**
Vinyl chloride	75-01-4	1.E+01	1.1E-01	**1.1E-01**
Vinylidene chloride	75-35-4	2.E+01		**2.E+01**
m-Xylene (12)	108-38-3	1.E+01		**1.E+01**
o-Xylene (12)	95-47-6	1.E+01		**1.E+01**
Xylenes (mixed)	1330-20-7	1.E+01		**1.E+01**

Table Notes

See the discussion at the beginning of this Appendix for a more full discussion of the following endnotes.

(1) The toxicity data for this entry is that of antimony trioxide in the OAQPS chronic toxicity values Table 1, the only data available for antimony or one of its compounds.
(2) The toxicity data for this entry is that of "chromium (VI) compounds" in the OAQPS chronic toxicity values Table 1.
(3) The toxicity value for "cresols (mixed)" was used as a surrogate for o-, m-, and p-cresol.
(4) The toxicity value for this entry is that of hydrogen cyanide in the OAQPS chronic toxicity values Table 1.
(5) Ethylene glycol butyl ether was delisted from the list of hazardous air pollutants (HAPs) on November 29, 2004 (see Federal Register Volume 69, Number 228, pp. 69320-69325). Toxicity data for this chemical is presented for informational purposes.
(6) The toxicity data for this entry is that of "lindane (gamma-HCH) for the noncancer RfC and "alpha-hexachlorocyclohexane (a-HCH)" for the cancer IUR in the OAQPS chronic toxicity values Table 1.
(7) Note that the National Ambient Air Quality Standard (NAAQS) for lead is 1.5 ug/m^3 (quarterly average). See http://www.epa.gov/air/criteria.html.
(8) The toxicity data for this entry is that of elemental mercury in the OAQPS chronic toxicity values Table 1.
(9) The toxicity data for this entry is that of "nickel compounds" for the noncancer RfC and "nickel subsulfide" for the cancer IUR in the OAQPS chronic toxicity values Table 1.
(10) The noncancer RfC for naphthalene in the OAQPS chronic toxicity values Table 1 was used as a surrogate for the noncancer toxicity of each of the chemicals listed in the PAH grouping (since none of the entries has a unique RfC). Note that several of the chemicals in the PAH grouping are substituted.
(11) The toxicity data for this entry is that of selenium compounds in the OAQPS chronic toxicity values Table 1.
(12) The toxicity value for "Xylenes (mixed)" was used as a surrogate for o- and m-xylenes.

APPENDIX B

ACUTE SCREENING ANALYSIS

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The basic process for screening a monitoring data set for potential acute exposure issues is similar to the way the same data set is evaluated for chronic issues (i.e., simply comparing the maximum value found in the data set to an identified screening value). However, there are several key differences between chronic and acute analysis of which the analyst must be aware.

One difference is that in the chronic screen, the screening value is the lower of values for both cancer and noncancer health effects. In acute analysis, only noncancer effects are considered (OAQPS does not currently recommend an evaluation of cancer outcomes resulting from acute exposures). Another key difference is that while there is only one final screening value for chronic analysis in Appendix A, there are multiple possible acute screening values in Appendix B against which to compare the monitoring results. [Note that Appendix B only presents the selection of available acute values currently provided by OAQPS (see endnote 2 and the descriptions provided on that webpage). If analysts use additional acute values in their evaluation, they are encouraged to document why they were selected and how they were used.]

There are a number of issues that have led OAQPS to simply identify a variety of acute toxicity values for the HAPs, rather than recommend one value for risk-based acute analysis, including:

- Acute toxicity values have been developed for purposes that vary more widely than chronic values. Some types of acute values are designed to be estimates of exposures at or below which there is little risk of adverse effects, while others are intended to predict exposures at or above which adverse effects could occur.

- Some acute values are expressed as concentration-time matrices (i.e., different allowable concentrations for different exposure times), while others are expressed as single concentrations for a set exposure duration.

- Some acute values may specifically consider multiple exposures, whereas others consider exposure as a one-time event.

- Some sources of acute values are intended to regulate workplace exposures, assuming a population of healthy workers exposed for a limited period of time each day (i.e., children, seniors, or other sensitive individuals are not considered). Such occupational values may also consider cost and feasibility, factors that would be inappropriate for the type of screening approach described here. [See Chapters 12 and 13 of Volume 1 of the ATRA Reference Library for more detail on the subject of acute toxicity value development and acute risk characterization, respectively. Analysts are encouraged to read and become familiar with this material and the descriptive material associated with the OAQPS acute toxicity values table before proceeding.]

For this risk-based screening approach, a toxicologist with experience in this area should generally evaluate acute noncancer hazard by comparing the maximum monitored value to the variety of acute values presented in this appendix and other

relevant acute values, and then discussing the comparisons by considering the characteristics of the acute screening values, such as their purpose, averaging time, and health endpoints.

EPA is just beginning to develop acute reference exposure values for some pollutants [see, for example, U.S. EPA. 2004. *Integrated Risk Information System (IRIS); Announcement of 2004 Program; Request for Information.* FR 69(26)5971-5976] which will lead to improvements in acute risk assessment for air toxics.

In order to assist analysts understand and apply the acute toxicity values appropriately, a short explanation of each of the types of values presented in Appendix B is provided below. A more lengthy discussion of each is provided in the ATRA Reference Library, Volume 1, Chapter 12.

Sources of Acute Dose-Response Information In Appendix B

Hazard identification and dose-response assessment information for acute exposure in Appendix B was obtained from the following sources:

1. **US Agency for Toxic Substances and Disease Registry (ATSDR).** In addition to its chronic minimum risk levels (MRLs), ATSDR also develops MRLs for acute exposure. As with chronic values, acute MRLs are estimates of human exposure to a substance that is likely to be without an appreciable risk of adverse effects (other than cancer) over a specified duration of exposure, and can be derived for acute exposures by the inhalation and oral routes. Acute MRLs are published as part of pollutant-specific toxicological profile documents, and also in a table that ATSDR regularly updates and distributes (available on-line at http://www.atsdr.cdc.gov/mrls.html). Unlike the one-hour focus of many of the other values listed here, acute MRLs are derived for exposures of 1 to 14 days.

2. **California Environmental Protection Agency (CalEPA)**. CalEPA has developed acute dose-response assessments for many substances, expressing the results as acute inhalation Reference Exposure Levels (RELs). As with its chronic RELs, CalEPA defines the acute REL as a concentration level at (or below) which no health effects are anticipated. Most, but not all, of the acute RELs are derived for exposures of one hour. CalEPA's acute RELs are available on-line at: http://www.oehha.ca.gov/air/acute_rels/index.html.

3. **National Advisory Committee for Acute Exposure Guideline Levels (NAC)**. EPA's Office of Prevention, Pesticides and Toxic Substances established the NAC in 1995 to develop Acute Exposure Guideline Levels (AEGLs) and supplementary information on hazardous substances for federal, state, and local agencies and organizations in the private sector concerned with emergency

planning, prevention, and response. The NAC/AEGL Committee is a discretionary Federal advisory committee that combines the efforts of stakeholders from the public and private sectors to promote efficiency and utilize sound science.

The NAC published an initial priority list of 85 chemicals for AEGL development in May 1997 and has since proposed AEGLs for additional substances. The AEGLs for a substance take the form of a matrix, with separate ambient levels for mild (AEGL-1), moderate (AEGL-2), and severe (AEGL-3) effects. Each of the effect levels are provided for as many as four different exposure periods, typically 0.5, 1, 4, and 8 hours. Appendix B provides only the 1-hour and 8-hour values for AEGLs 1 and 2 effect levels, and includes a superscript that identifies whether the value is final, interim, or proposed. For more information on the AEGL program, see http://www.epa.gov/opptintr/aegl/index.htm. (In the Appendix B table for AEGLs: f = final i = interim p = proposed.)

4. **American Industrial Hygiene Association (AIHA).** AIHA has developed emergency response planning guidelines (ERPGs) for acute exposures at three different levels of severity of health effects. These guidelines (available on-line through the US Department of Energy at http://www.orau.gov/emi/scapa/teels.htm) represent concentrations for exposure of the general population for up to 1 hour associated with effects expected to be mild or transient (ERGP-1), irreversible or serious (ERPG-2), and potentially life-threatening or lethal (ERPG-3). Appendix B includes ERPG values for ERPG 1 and 2 effect levels.

5. **National Institute for Occupational Safety and Health (NIOSH)**. As part of its mission to study and protect worker health, NIOSH determines concentrations of substances that are Immediately Dangerous to Life or Health (IDLHs). IDLHs were originally determined for 387 substances in the mid-1970's as part of the Standards Completion Program (SCP), a joint project by NIOSH and the Occupational Safety and Health Administration (OSHA), for use in assigning respiratory protection equipment. NIOSH is currently evaluating the scientific adequacy of the criteria and procedures used during the SCP for establishing IDLHs. In the interim, the IDLHs have been reviewed and revised. NIOSH maintains an on-line database (http://www.cdc.gov/niosh/idlh/idlh-1.html) of IDLHs, including the basis and references for both the current and original IDLH values (as paraphrased from the SCP draft technical standards). Appendix B provides IDLH values divided by 10 to more closely match the mild-effect levels developed by other sources, consistent with methodology used to develop levels of concern under Title III of the Superfund Amendments and Reauthorization Act, and their

use in the accidental release prevention requirements under section 112(r) of the Clean Air Act. The IDLH/10 values have commonly been used as “levels of concern” in emergency planning programs such as Clean Air Act 112(r).[12] The averaging time for the IDLH/10 values is one hour.

6. **U.S. Department of Energy (DOE).** DOE has defined Temporary Emergency Exposure Limits (TEELs), which are temporary levels of concern (LOCs) derived according to a tiered, formula-like methodology (described at http://www.orau.gov/emi/scapa/Method_for_deriving_TEELs.pdf and available on-line at http://www.atlintl.com/DOE/teels/teel/teel_pdf.html). DOE has developed TEELs with the intention of providing a reference when no other LOC is available. DOE describes TEELs as "approximations of potential values" and "subject to change." The EPA's emergency planning program (section 112(r)) does not generally rely on them, and they are provided in the OAQPS Table 2 (and in this Appendix) purely to inform situations in which no other acute values are available. For example, a finding of an acute exposure near a TEEL may indicate the need for a more in-depth investigation into the health effects literature. TEELs are not recommended as the basis of regulatory decision-making. Like ERPGs, TEELs are multiple-tiered, representing concentrations associated with no effects (TEEL-0), mild, transient effects (TEEL-1), irreversible or serious effects (TEEL-2), and potentially life-threatening (TEEL-3). Consistent with DOE's intent, Appendix B provides the TEEL-0 and -1 concentrations for substances that lack acute values from other sources. The averaging time for TEELs is 15 minutes.

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	CAS NO.	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
Acetaldehyde	75-07-0	81 [i]	81 [i]	490 [i]	200 [i]	81	490		***0.47***	360		
Acetamide	60-35-5										25	75
Acetonitrile	75-05-8	22 [i]	22 [i]	540 [i]	140 [i]					84		
Acetophenone	98-86-2										10	30
2-Acetylaminofluorene	53-96-3										0.25	0.75
Acrolein	107-02-8	0.069 [i]	0.069 [i]	0.23 [i]	0.23 [i]	0.069	0.23	0.0069	***0.0025***	0.46		
Acrylamide	79-06-1									6		
Acrylic acid	79-10-7	4.4 [i]	4.4 [i]	140 [i]	41 [i]	4.4	140		6			
Acrylonitrile	107-13-1	10 [p]	10 [p]	130 [p]	19 [p]	22	77	0.22		19		
Allyl chloride	107-05-1	***8.8*** [i]	***8.8*** [i]	***170*** [i]	***69*** [i]	9.4	130			78		
4-Aminobiphenyl	92-67-1										0.5	1.5
Aniline	62-53-3	30 [f]	3.8 [f]	46 [f]	5.7 [f]					38		
Anisidine	90-04-0									5		
Antimony compounds	7440-36-0									5		
Antimony pentafluoride	7783-70-2										0.75	0.75
Antimony potassium tartrate	304-61-0										1.2	4
Antimony trihydride	7803-52-3		[i]	***7.7*** [i]	***0.92*** [i]							
Antimony trioxide	1309-64-4										0.6	1.5
Arsenic chloride	7784-34-1										0.19	0.56
Arsenic compounds	7440-38-2								***0.0002***	0.5		
Arsenic oxide	1327-53-3		[i]	3 [i]	1.2 [i]							
Arsenic pentoxide	1303-28-2								0.00019			
Arsine	7784-42-1		[f]	0.54 [f]	0.064 [f]		0.54		0.16	0.96		
Asbestos	1332-21-4										0.005	0.5
Benzene	71-43-2	170 [i]	29 [i]	2600 [i]	640 [i]	170	2600	0.029	1.3	160		
Benzidine	92-87-5										0.15	0.5
Benzotrichloride	98-07-7										0.1	0.1
Benzyl chloride	100-44-7					5.2	52		0.24	5.2		
Beryllium chloride	7787-47-5										0.015	0.04
Beryllium compounds	7440-41-7						0.025			0.4		
Beryllium fluoride	7787-49-7										0.01	0.025
Beryllium nitrate	13597-99-4										0.03	0.075
Beryllium oxide	1304-56-9										0.005	
Biphenyl	92-52-4		[i]	61 [i]	28 [i]							
Bis(2-ethylhexyl)phthalate	117-81-7										5	10
Bis(chloromethyl)ether	542-88-1		[i]	0.21 [i]	0.094 [i]		0.47					
Bromoform	75-25-2									880		
1,3-Butadiene	106-99-0	1500 [i]	1500 [i]	12000 [i]	6000 [i]	1500	12000			440		
Cadmium compounds	7440-43-9							***0.00003***		0.9		

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	CAS NO.	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
Cadmium stearate	2223-93-0										0.03	0.15
Calcium cyanamide	156-62-7										0.5	1.5
Captan	133-06-2										5	15
Carbaryl	63-25-2									10		
Carbon disulfide	75-15-0	40 [f]	21 [f]	500 [f]	160 [f]	40	500		6.2	160		
Carbon tetrachloride	56-23-5	280 [i]	120 [i]	1200 [i]	510 [i]	280	1200		1.9	130		
Carbonyl sulfide	463-58-1		[i]	***140*** [i]	***57*** [i]							
Catechol	120-80-9										23	68
Chloramben	133-90-4										35	100
Chlordane	57-74-9									10		
Chlorine	7782-50-5	1.5 [f]	1.5 [f]	5.8 [f]	2.1 [f]	1.5	5.8	***0.2***	0.21	2.9		
Chloroacetic acid	79-11-8		[f]	26 [f]	3.2 [f]							
2-Chloroacetophenone	532-27-4											
Chlorobenzene	108-90-7	46 [i]	46 [i]	690 [i]	690 [i]					460		
Chlorobenzilate	510-15-6										0.075	0.25
Chloroform	67-66-3		[i]	310 [i]	140 [i]		310	0.49	0.15	240		
Chloromethyl methyl ether	107-30-2		[i]	1.6 [i]	0.73 [i]		1.6					
Chloroprene	126-99-8									110		
Chromium (III) compounds	16065-83-1											
Chromium (VI) compounds	18540-29-9									1.5		
Chromium (VI) trioxide, chromic acid mist	11115-74-5									1.5		
Chromium chloride	10025-73-7										1.5	4
Chromium compounds	7440-47-3										1	1.5
Cobalt bromide	7789-43-7										0.2	0.2
Cobalt carbonate	513-79-1										0.12	0.12
Cobalt carbonyl	10210-68-1										0.27	0.27
Cobalt chloride	7646-79-9										0.12	0.12
Cobalt compounds	7440-48-4									2		
Cobalt hydrocarbonyl	16842-03-8					0.13	0.13					
Cobalt nitrate	Co Nitrate										0.15	0.15
Cobalt oxides (mixed)	COBOXIDES										0.075	0.075
Coke Oven Emissions	8007-45-2										0.1	1.2
m-Cresol	108-39-4									110		
o-Cresol	95-48-7									110		
p-Cresol	106-44-5									110		
Cresols (mixed)	1319-77-3									110		
Cumene	98-82-8	250 [i]	250 [i]	1500 [i]	640 [i]					440		
Cyanophos	2636-26-2										1.2	3.5

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	CAS NO.	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
Cyanide compounds	57-12-5									2.5		
Acetone cyanohydrin	75-86-5	7 [r]	3.5 [r]	25 [r]	8.7 [r]							
Barium cyanide	542-62-1										0.6	2
Calcium cyanide	592-01-8	***3.8*** [p]	***1.9*** [p]	***13*** [p]	***4.7*** [p]							
Copper cyanide	544-92-3										1.2	4
Cyanogen	460-19-5	***4.3*** [p]	***2.1*** [p]	***18*** [p]	***9.2*** [p]							
Cyanogen bromide	506-68-3										20	44
Cyanogen chloride	506-77-4						1					
Cyanogen iodide	506-78-5										35	100
Hydrogen cyanide	74-90-8	2.2 [f]	1.1 [f]	7.8 [f]	2.8 [f]		7.8		0.34	5.5		
Potassium cyanide	151-50-8										5	5
Potassium silver cyanide	506-61-6										1	3
Potassium thiocyanate	333-20-0										10	35
Silver cyanide	506-64-9										25	25
Sodium cyanide	143-33-9										5	5
Zinc cyanide	557-21-1										20	20
2,4-D, salts and esters	94-75-7									10		
DDE	72-55-9										10	30
Diazomethane	334-88-3										0.34	1
Dibenzofuran	132-64-9										10	30
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4										3E-05	8E-05
1,2-Dibromo-3-chloropropane	96-12-8										0.0097	0.029
Dibutylphthalate	84-74-2									400		
p-Dichlorobenzene	106-46-7							12		90		
3,3'-Dichlorobenzidine	91-94-1										2.1	6.2
Dichloroethyl ether	111-44-4									58		
1,3-Dichloropropene	542-75-6										4.5	14
Dichlorvos	62-73-7	***0.99*** [p]	***0.99*** [p]	***5.1*** [p]	***5.1*** [p]			0.018		10		
Diesel engine emissions	EMIS.										35	100
Diethanolamine	111-42-2										2	6
Diethyl sulfate	64-67-5										1.9	4.7
N,N-diethyl/dimethylaniline	Dialks											

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	**CAS NO.**	**mg/m3**	**mg/m3**	**mg/m3**	**mg/m3**	**mg/m3**	**mg/m3**	**mg/m3**	**mg/m3**	**mg/m3**	**mg/m3**	**mg/m3**
p-Dimethylaminoazobenzene	60-11-7										15	50
3,3'-Dimethylbenzidine	119-93-7										0.1	0.3
Dimethyl carbamoyl chloride	79-44-7										0.88	2.6
Dimethyl formamide	68-12-2		[i]	270 [i]	110 [i]	6	270			150		
Dimethyl phthalate	131-11-3									200		
Dimethyl sulfate	77-78-1	0.12 [i]	0.045 [i]	0.62 [i]	0.22 [i]					3.6		
N,N-dimethylaniline	121-69-7									50		
1,1-Dimethylhydrazine	57-14-7		[f]	7.4 [f]	0.93 [f]					3.7		
4,6-Dinitro-o-cresol	534-52-1									0.5		
2,4-dinitrophenol	51-28-5										3	7.5
2,4-Dinitrotoluene	121-14-2									5		
2,4/2,6-Dinitrotoluene (mixture)	25321-14-6										0.2	0.6
1,4-Dioxane	123-91-1	61 [i]	61 [i]	1200 [i]	360 [i]			7.2	3	180		
1,2-Diphenylhydrazine	122-66-7										10	30
Epichlorohydrin	106-89-8	22 [i]	22 [i]	91 [i]	38 [i]	22	91		1.3	28		
1,2-Epoxybutane	106-88-7	***210*** [p]	***210*** [p]	***410*** [p]	***410*** [p]							
Ethyl acrylate	140-88-5	34 [i]	34 [i]	150 [i]	38 [i]	34	150			120		
Ethyl benzene	100-41-4	***140*** [p]	***140*** [p]	***4800*** [p]	***2500*** [p]			***43***		350		
Ethyl carbamate	51-79-6										500	500
Ethyl chloride	75-00-3							40		1000		
Ethylene dibromide	106-93-4	130 [i]	35 [i]	180 [i]	50 [i]					77		
Ethylene dichloride	107-06-2					200	810			20		
Ethylene glycol	107-21-1							***2***				
Ethylene imine (Aziridine)	151-56-4		[i]	8.1 [i]	0.83 [i]							
Ethylene oxide	75-21-8		[i]	81 [i]	14 [i]		81			140		
Ethylene thiourea	96-45-7										3.5	10
Ethylidene dichloride (1,1-Dichloroethane)	75-34-3									1200		
Formaldehyde	50-00-0	1.1 [f]	1.1 [f]	17 [f]	17 [f]	1.1	17	0.049	***0.055***	2.5		
Diethylene glycol monobutyl ether	112-34-5										100	150
Diethylene glycol monoethyl ether	111-90-0										140	410
Ethylene glycol ethyl ether	110-80-5								0.37	180		
Ethylene glycol ethyl ether acetate	111-15-9								0.14			

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	CAS NO.	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
Ethylene glycol methyl ether acetate	110-49-6											
Heptachlor	76-44-8									3.5		
Hexachlorobenzene	118-74-1										0.002	0.006
Hexachlorobutadiene	87-68-3					11	32					
Hexachlorocyclopentadiene	77-47-4										0.11	0.2
Hexachlorodibenzo-p-dioxin, mixture	19408-74-3										0.005	0.015
Hexachloroethane	67-72-1							58				
Hexamethylene-1,6-diisocyanate	822-06-0										0.034	0.1
Hexamethylphosphoramide	680-31-9										0.29	0.92
n-Hexane	110-54-3		[i]	12000 [i]	12000 [i]					390		
Hydrazine	302-01-2	0.13 [i]	0.13 [i]	17 [i]	2.1 [i]	0.13	17			6.5		
Hydrofluoric acid	7664-39-3	0.82 [f]	0.82 [f]	20 [f]	9.8 [f]	0.82	20	0.016	0.24	2.5		
Hydrogen sulfide	7783-06-4	0.71 [i]	0.46 [i]	38 [i]	24 [i]	0.71	38	0.098	0.042			
Hydroquinone	123-31-9									5		
Isophorone	78-59-1										28	28
Lead acetate	301-04-2										0.075	0.2
Lead chloride	7758-95-4										0.06	0.2
Lead compounds	7439-92-1									10		
Lead nitrate	10099-74-8										0.075	0.22
Lead subacetate	1335-32-6										0.06	0.2
Tetraethyl lead	78-00-2									4		
Tetramethyl lead	75-74-1									4		
Lindane (gamma-HCH)	58-89-9									5		
alpha-Hexachlorocyclohexane (a-HCH)	319-84-6										0.5	1.5
beta-Hexachlorocyclohexane (b-HCH)	319-85-7										0.5	1.5
technical Hexachlorocyclohexane (HCH)	608-73-1										0.15	0.5
Maleic anhydride	108-31-6					0.8	8			1		
Manganese chloride	7773-01-5										0.4	6

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	CAS NO.	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
Manganese dioxide	1313-13-9										0.3	4
Manganese oxide	1317-35-7										0.25	0.75
Manganese sulfate	7785-87-7										0.5	7.5
methylcyclopentadienyl	12108-13-3										0.6	0.6
Mercuric acetate	1600-27-7										0.01	0.03
Mercuric chloride	7487-94-7										0.035	0.12
Mercuric nitrate	10045-94-0										0.04	0.15
Mercuric oxide	21908-53-2										0.025	0.1
Mercury (elemental)	7439-97-6		[p]	1.7 [p]	0.33 [p]		2		*6E-04*			
Methylmercuric dicyanamide	502-39-6										0.015	0.04
Mercury compounds	HG_CMPDS									1		
Methoxyethylmercuric acetate	151-38-2										0.015	0.05
Methyl mercury	22967-92-6									0.2		
Phenylmercuric acetate	62-38-4										0.1	0.1
Methanol	67-56-1	690 [i]	350 [i]	2700 [i]	680 [i]	690	2700		28	790		
Methoxychlor	72-43-5									500		
Methyl bromide	74-83-9		[i]	820 [i]	260 [i]		820	0.19	3.9	97		
Methyl chloride	74-87-3		[i]	1900 [i]	780 [i]		1900	1		410		
Methyl chloroform (1,1,1-Trichloroethane)	71-55-6	1300 [i]	1300 [i]	3300 [i]	1700 [i]	1300	3300	11	68	380		
Methyl hydrazine	60-34-4		[f]	3.2 [f]	0.39 [f]					7.2		
Methyl iodide	74-88-4					150	290			58		
Methyl isobutyl ketone	108-10-1										310	310
Methyl isocyanate	624-83-9		[f]	0.16 [f]	0.019 [f]	0.058	0.16			0.7		
Methyl methacrylate	80-62-6	70 [i]	70 [i]	490 [i]	200 [i]					410		
Methyl tert-butyl ether	1634-04-4	180 [i]	180 [i]	2100 [i]	1400 [i]			7.2				
4,4'-Methylene bis(2-chloroaniline)	101-14-4										0.11	0.33
Methylene chloride	75-09-2	690 [i]	[i]	1900 [i]	210 [i]	690	1900	2.1	14	800		
Methylene diphenyl diisocyanate	101-68-8					0.2	2			7.5		
4,4'-Methylenedianiline	101-77-9										0.081	0.81
Naphthalene	91-20-3									130		
Nickel acetate	373-02-4											
Nickel carbonyl	13463-39-3		[f]	0.25 [f]	0.031 [f]					1.4		

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	CAS NO.	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
Nickel compounds	7440-02-0								0.006	1		
Nickel nitrate	13138-45-9										3	3
Nickel oxide	1313-99-1										0.75	0.75
Nickel refinery dust	NI_DUST											
Nickel subsulfide	12035-72-2											
Nickel sulfate	7786-81-4										2.5	2.5
Nitrobenzene	98-95-3									100		
4-Nitrobiphenyl	92-93-3										0.25	0.75
4-Nitrophenol	100-02-7										0.75	2.5
2-Nitropropane	79-46-9									36		
Nitrosodimethylamine	62-75-9										3.5	10
N-Nitrosomorpholine	59-89-2										12	30
N-Nitroso-N-methylurea	684-93-5										0.015	0.05
Parathion	56-38-2		[p]	***1.5*** [p]	***0.48*** [p]					1		
Polychlorinated biphenyls	1336-36-3										1	3
Aroclor 1016	12674-11-2										0.2	0.6
Aroclor 1221	11104-28-2										0.2	0.6
Aroclor 1242	53469-21-9										1	3
Aroclor 1248	12672-29-6										0.2	0.6
Aroclor 1254	11097-69-1										0.5	1.5
Aroclor 1260	11096-82-5										0.3	0.75
Pentachloronitrobenzene	82-68-8										0.5	1.5
Pentachlorophenol	87-86-5									0.25		
Phenol	108-95-2	58 [f]	24 [f]	89 [f]	46 [f]	58	89		5.8	96		
p-Phenylenediamine	106-50-3										0.1	0.3
Phosgene	75-44-5		[f]	1.2 [f]	0.16 [f]		1.2		0.004	0.81		
Phosphine	7803-51-2		[f]	2.8 [f]	0.35 [f]		2.8					
Phosphorus, white	7723-14-0							0.02				
Phthalic anhydride	85-44-9									6		
Acenaphthene	83-32-9										0.4	1.2
Anthracene	120-12-7										2	6
Benzo(a)anthracene	56-55-3										0.1	0.3
Benzo(b)fluoranthene	205-99-2										0.2	0.6
Benzo(k)fluoranthene	207-08-9										0.2	0.6
Benzo(g,h,i)perylene	191-24-2										10	30
Benzo(a)pyrene	50-32-8										0.2	0.6
Carbazole	86-74-8										0.75	2.5
beta-Chloronaphthalene	91-58-7										0.2	0.6

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	CAS NO.	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
Dibenz(a,h)anthracene	53-70-3										10	30
Dibenzo[a,e]pyrene	192-65-4										0.035	0.1
Fluoranthene	206-44-0										0.005	0.015
Fluorene	86-73-7										7.5	25
Indeno(1,2,3-cd)pyrene	193-39-5										0.15	0.5
3-Methylcholanthrene	56-49-5										0.2	0.6
1-Methylnaphthalene	90-12-0										6	20
2-Methylnaphthalene	91-57-6										6	20
2-Naphthylamine	91-59-8										2.5	7.5
1-Nitropyrene	5522-43-0										0.1	0.3
Phenanthrene	85-01-8										0.4	1
Pyrene	129-00-0										15	15
1,3-Propane sultone	1120-71-4										0.4	1.2
beta-Propiolactone	57-57-8										1.5	1.5
Propionaldehyde	123-38-6	110 [i]	110 [i]	620 [i]	260 [i]							
Propoxur	114-26-1										0.5	1.5
Propylene dichloride	78-87-5							0.23		180		
Propylene oxide	75-56-9	170 [i]	170 [i]	690 [i]	200 [i]	170	690		3.1	95		
1,2-Propyleneimine	75-55-8		[i]	28 [i]	2.8 [i]							
Quinoline	91-22-5										1.1	3.2
Quinone	106-51-4									10		
Selenium compounds	7782-49-2									0.1		
Hydrogen selenide	7783-07-5		[i]	2.4 [i]	0.86 [i]		2.4		0.005	0.33		
Potassium selenate	7790-59-2										0.5	1.5
Selenious acid	7783-00-8										0.3	1
Selenium dioxide	7446-08-4										0.25	0.75
Selenium disulfide	7488-56-4										0.35	1
Selenium oxychloride	7791-23-3										0.4	1.2
Selenium sulfide	7446-34-6										0.25	0.75
Sodium selenate	13410-01-0										0.5	1.5
Sodium selenite	10102-18-8										0.4	1.2
Styrene	100-42-5	85 [i]	85 [i]	550 [i]	550 [i]	85	550	***8.5***	21	300		
Styrene oxide	96-09-3										20	61
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6										0.0006	0.0015
1,1,2,2-Tetrachloroethane	79-34-5									69		
Tetrachloroethene	127-18-4	240 [i]	240 [i]	1600 [i]	550 [i]	240	1600	1.4	20	100		
Titanium tetrachloride	7550-45-0	0.54 [i]	0.54 [i]	7.8 [i]	0.73 [i]	5.1	7.8					
Toluene	108-88-3	750 [i]	750 [i]	4500 [i]	2400 [i]	750	1900	3.8	37	190		

Acute Dose-Response Values for Screening Risk Assessments (Based on OAQPS Toxicity Table 2; 4/27/2010)		AEGL-1 (1-h)	AEGL-1 (8-h)	AEGL-2 (1-h)	AEGL-2 (8-h)	ERPG-1	ERPG-2	MRL	REL	IDLH/10	TEEL-0	TEEL-1
CHEMICAL NAME	CAS NO.	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
2,4/2,6-Toluene diisocyanate mixture (TDI)	26471-62-5										1.8	5.3
2,4-Toluene diisocyanate	584-84-9	0.14 [f]	0.071 [f]	0.59 [f]	0.15 [f]	0.14	1.1			1.8		
o-Toluidine	95-53-4									22		
Toxaphene	8001-35-2										0.5	1
1,2,4-Trichlorobenzene	120-82-1										37	37
1,1,2-Trichloroethane	79-00-5									55		
Trichloroethylene	79-01-6	700 [i]	410 [i]	2400 [i]	1300 [i]	700	2400	11				
2,4,5-Trichlorophenol	95-95-4										10	30
2,4,6-Trichlorophenol	88-06-2										10	30
Triethylamine	121-44-8								2.8			
Trifluralin	1582-09-8										0.025	0.075
2,2,4-trimethylpentane	540-84-1										350	350
Uranium compounds	7440-61-1									1		
Uranium (IV) dioxide	1344-57-6						30					
Uranium hexafluoride	7783-81-5	3.6 [f]	[f]	9.6 [f]	1.2 [f]	3.6	9.6					
Uranium oxide	1344-59-8						10					
Uranium, soluble salts	URANSOLS										0.05	0.6
Uranyl acetate dihydrate	541-09-3										0.075	1
Uranyl nitrate hexahydrate	13520-83-7										0.1	1.2
Vinyl acetate	108-05-4	24 [i]	24 [i]	630 [i]	260 [i]	18	260					
Vinyl bromide	593-60-2										22	66
Vinyl chloride	75-01-4	640 [i]	180 [i]	3100 [i]	2100 [i]	640	3100	1.3	180			
Vinylidene chloride	75-35-4										20	79
m-Xylene	108-38-3								22	390		
o-Xylene	95-47-6									390		
p-Xylene	106-42-3								22	390		
Xylenes (mixed)	1330-20-7	560 [i]	560 [i]	4000 [i]	1700 [i]			8.7	22	390		
Xylenes (mixed)	1330-20-7	560 [i]	560 [i]	4000 [i]	1700 [i]			8.7	22	390		

APPENDIX C

SUGGESTED SCREENING REPORT OUTLINE

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The following is a suggested report outline for a risk-based air toxics screening level analysis. Analysts should feel free to modify this as necessary to meet the specific circumstances of their analysis. However, analysts are encouraged to keep in mind that the types of information highlighted in this outline are the minimum elements usually considered necessary to document any basic air toxics risk-based screening level analysis.

Title Page

Authors, disclaimers, preface, etc.

1. Executive Summary

2. [Corresponding to Step 1] Background discussion (what is being done in the analysis, why is it being done, description of monitoring data to be evaluated, including maps showing location of monitors and nearby populations, sources, etc.)

3. [Corresponding to Step 2] Assessment of data quality

4. [Corresponding to Step 3] Statistical summaries, by monitor, of detected chemicals

5. [Corresponding to Step 4] Comparison of detected values to chronic/acute screening values; identification of chemicals failing the screen

6. [Corresponding to Step 5] Collection and description of relevant ancillary data

7. [Corresponding to Step 6] Analysis and description of uncertainties

8. [Corresponding to Step 7] Conclusions

9. References

10. Appendices, as needed

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APPENDIX D

ABBREVIATED SCREENING EXAMPLE

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Abbreviated Screening Example

Note to reader - this example is not exhaustive in its explanation of how a full screening level analysis should be performed and documented. Rather, it provides enough information to illustrate for the reader the general logic behind a screening level analysis, including how to fill in the various data tables.

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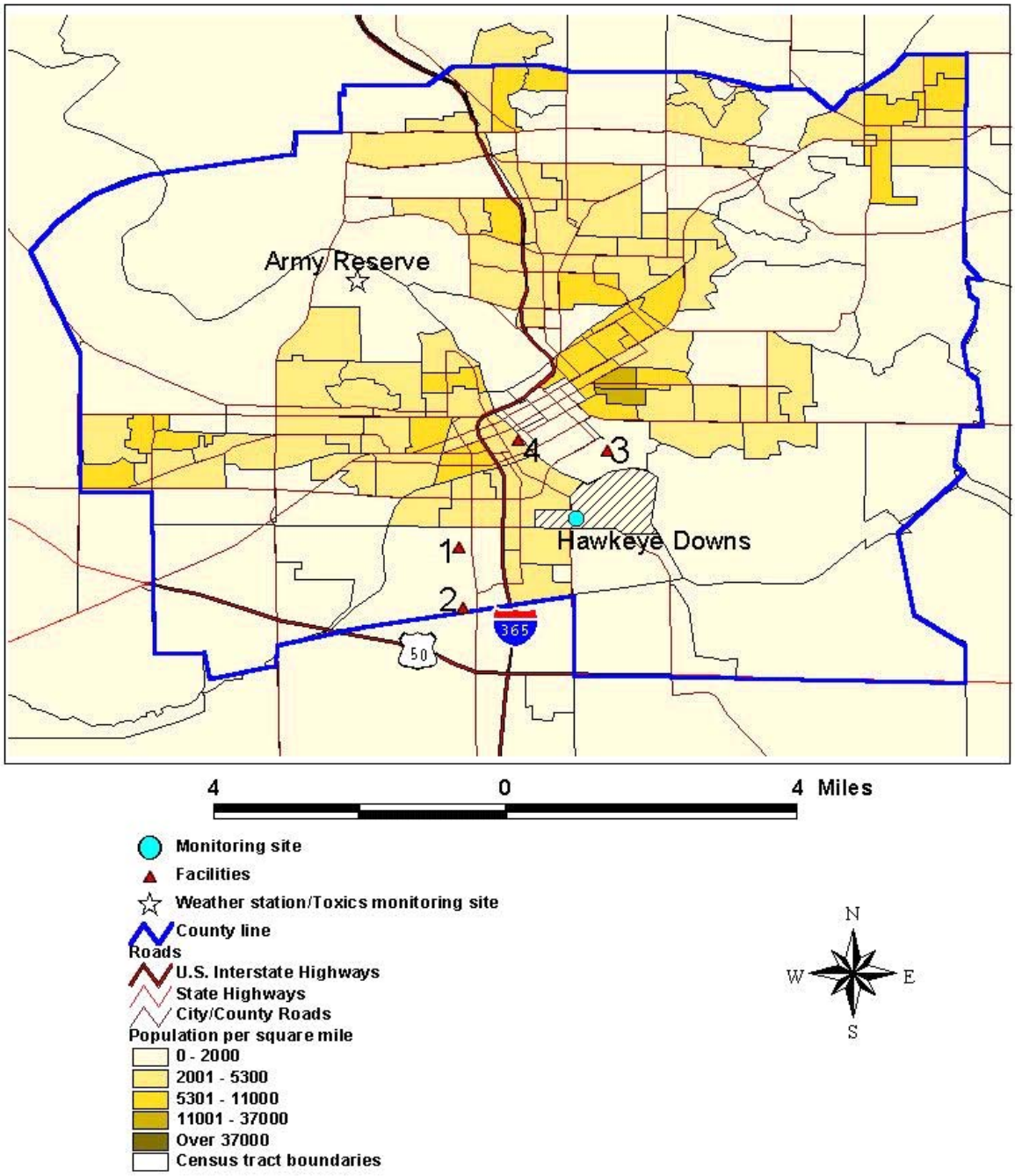
1. Background

After several years of intermittent complaints from the Hawkeye Downs neighborhood of Ag County, a coalition of county government, private community organizations, and local industry representatives has been formed to investigate health risks from air pollution. Specifically, residents of Hawkeye Downs are concerned that a number of people in the neighborhood may be sick because of the emissions from four industrial sources in the immediate vicinity of Hawkeye Downs. Complaints include respiratory irritation and cough. Cancer incidence in the county is above the state and national average.

The Ag County Air Pollution Control Agency (ACAPCA) began collecting air toxics monitoring samples earlier this year at a monitoring site within Hawkeye Downs (see map, next page). The same air toxics are also monitored by ACAPCA at an Army Reserve site which is located in a rural area far from any industrial or large mobile sources. Meteorological data which are representative of the county are also collected at the Army Reserve monitor location. At both monitoring sites, volatile organic compound (VOC) and carbonyl samples are collected as 24-hour composite samples on the same 1-in-6 day sampling schedule. The sampling commenced in January 2004, with the most recent samples collected in early July 2004. A total of 30 samples has been collected during this period at each of the monitoring sites. ACAPCA's lab performs the analytical evaluation of the samples, validates the results, and reports the data to EPA. The lab has provided the first six months of validated data to a subgroup (the "risk assessment team") of the larger community stakeholder group.

The community stakeholder group's ultimate goal is to perform a risk assessment using <u>one full year's worth of monitoring data</u> (once it is available). In the meantime, the risk assessment team would like to perform a ***preliminary screen*** of the currently available 6-month's worth of monitoring data to develop a ***preliminary picture*** of the potential for exposure of the Hawkeye Downs community to air toxics concentrations of concern, according to the procedures described in this screening-level methodology.

Population Density for Ag County, USA
(US Census - 2000)



Note that, at a minimum, one full year's worth of monitoring data is commonly considered necessary to evaluate chronic exposures. In this example, the stakeholders are planning to collect and evaluate one full year's worth of data using the risk assessment procedures outlined in ATRA, Volume 1, Part II; however, while the data collection process is occurring, they have decided to go ahead and screen the first 6-months of data to help identify any potential risk drivers as early in the process as possible. They might find, for example, that a chemical of known origin frequently exceeds both an acute and chronic level during the first 6-months of the monitoring study and that this is sufficient justification for the risk managers to act. Conversely, if the first 6-months of data show infrequent detections that are near or below the chronic screening levels, the partial data set may provide no strong basis for action (i.e., decision making would need to wait until the completion of the full-year monitoring study). Ultimately, analysts may chose to perform exploratory analyses using only a partial data set; however, they must be careful to both understand and communicate the associated limitations to the end users.

STEP 1: Identify the monitoring data sets to be screened and the geographic areas and time frames that the monitoring data in question represent.

The geographic areas to be evaluated in this screening level analysis consist of two neighborhoods separated by approximately 4 miles. One monitor (the Hawkeye Downs monitor) was established to be a neighborhood-scale monitor. The other monitor (the Army Reserve monitor) is in the same airshed as the Hawkeye Downs Monitor and was also established as a neighborhood-scale monitor. Meteorological data collected at the Army Reserve monitor is considered to be representative of the larger geographic region, including the Hawkeye Downs neighborhood.

The risk assessment team, after reviewing the purpose and placement of the monitors, as well as the locations of known air toxics emissions sources and meteorological information, has decided to do the following with regard to Step 1:

- Include both monitoring locations in the screening level assessment since they are within the same airshed and are in reasonably close proximity to one another.
- The meteorological data collected at the Army Reserve site will be used to evaluate meteorological conditions at both sites.

- Keep the analytical data sets developed at the two monitoring sites separate since the two monitors likely represent two distinct exposure scenarios. (Combining data that represent different exposure scenarios would obscure the overall analysis.)

Ultimately, the team believes that evaluating and communication information from both sites as part of one screening level analysis will provide clues to the nature and impact of air toxics emissions sources in the geographic area as a whole.

STEP 2: Assess the data to determine if they are of sufficient quantity and quality to perform the screen.

The data needs for this monitoring study were established by a rigorous systematic planning process that identified the purpose of the monitoring study, the questions the study will attempt to answer, and the quantity and quality of data needed to answer those questions within limits acceptable to the decision makers. Based on the specific data quality needs for the assessment, a Quality Assurance Project Plan (QAPP) was developed that establishes the details of sample collection, transport, analysis, data validation, and data reporting. The QAPP also describes an established QA/QC program for the project, documentation requirements, and roles and responsibilities of the people performing the work. For the first 6 months of data collection, the samples have been collected, analyzed, validated, and reported in general accordance with the QAPP. The risk assessment team noted the following exceptions:

- At the Hawkeye Downs monitor, one of the 30 VOC samples was not collected due to an instrument malfunction.

- At the Army Reserve monitor, two of the 30 VOC samples were invalidated during the data validation process due to laboratory contamination.

The QAPP states that a valid sample collection rate of 90% is sufficient to perform the risk assessment on a full year's worth of data. As such, the risk assessment workgroup judges the 6-month monitoring data set to be of acceptable quantity and quality for performing the risk-based screening level analysis (the sampling effort is on track to meet the goals of the QAPP, including a 90% valid sample collection rate).

STEP 3: For each chemical detected at least once in the data set, create a statistical summary of the monitoring results for that chemical. The statistical summary will commonly include the following: Number of valid samples collected and frequency of detection, the method detection limits (MDLs), and range of detected values.

In the Ag County study, only 4 chemicals were detected at the Hawkeye Downs monitor. The 4 chemicals are acetaldehyde, methylene chloride, benzene, and vinyl chloride. Three of these same 4 chemicals were also the only chemicals to be detected at the Army Reserve monitoring site. (Vinyl chloride was not detected at the Army Reserve site.)

The risk assessment workgroup reviewed the validated analytical data for the samples collected at the Hawkeye Downs monitor (30 carbonyl and 29 VOC samples) and at the Army Reserve monitor (30 carbonyl and 28 VOC samples) and developed the following statistical summaries for the two monitoring sites:

Statistical Summary of Detected Chemicals
Hawkeye Downs Monitoring Site

Detected Chemical (CAS Number)	Frequency of Detection	Laboratory-Specific Method Detection Limit (ug/m^3)	Range of Detected Values (ug/m^3)
Acetaldehyde (75-07-0)	15/30	0.016	0.04J - 0.35
Methylene Chloride (75-09-2)	25/29	0.045	0.9 - 4.5
Benzene (71-43-2)	29/29	0.014	0.2 - 2.2
Vinyl Chloride (75-01-4)	20/29	0.024	0.03J-0.08

Statistical Summary of Detected Chemicals
Army Reserve Monitoring Site

Detected Chemical (CAS Number)	Frequency of Detection	Laboratory-Specific Method Detection Limit (ug/m^3)	Range of Detected Values (ug/m^3)
Acetaldehyde (75-07-0)	4/30	0.016	0.02J - 0.09
Methylene Chloride (75-09-2)	2/28	0.045	0.1J - 0.7
Benzene (71-43-2)	19/28	0.014	0.05 - 1.2

Note that acetaldehyde and methylene dichloride were infrequently detected at the Army Reserve monitoring site. From the lab reports, it is also noted that several detected concentrations at both monitoring sites were below sample quantitation limits and flagged as J values.

STEP 4: For each detected chemical in the data set, compare the maximum monitored value to the suggested chronic screening level value provided in Appendix A and the acute values provided in Appendix B. Summarize the results of the comparison process in a table. Highlight chemicals whose maximum monitored values exceed their respective screening values (chronic and acute). For each chemical whose maximum monitored value exceeds a screening value, review the full data set and determine the percentage of detections that are at or above the screening value.

For the Hawkeye Downs monitoring site, the risk assessment workgroup identified the maximum value found for each chemical detected from the statistical summary of the data provided in Step 3 as well as the chronic and acute screening values for each chemical from Appendices A and B. They then compared the maximum value found to the chronic and acute screening values and presented the results in a table (see below). [Note that the group decided to use the suggested screening levels provided in Appendices A and B; however, they could have chosen both different toxicity values and screening risk levels (e.g., a chronic noncancer screening level other than an HQ = 0.1). In either event, risk assessment teams are encouraged to document their rationale for the selection of both toxicity values and risk screening levels.] From this table, the toxicologist on the stakeholder team drew the following conclusions:

- **Acetaldehyde.** The maximum concentration of acetaldehyde is below the final chronic screening value from Appendix A, indicating no apparent concern for chronic exposure for this chemical. Since the maximum value found for this chemical is below its chronic screening value, an acute analysis was not performed. (Since chronic values are usually not greater than acute values and the maximum measurement is below the chronic screening value, it is assumed that acute exposures are not a concern.) Therefore, the acute column is marked "N/A" or "not applicable".

- **Vinyl Chloride.** The maximum concentration of vinyl chloride is below the final chronic screening value from Appendix A, indicating no apparent concern for chronic exposure for this chemical. Since the maximum value found for this chemical is below its chronic screening value, an acute analysis was not performed. Therefore, the acute column is marked "N/A" or "not applicable".

- **Methylene Chloride.** The maximum concentration of methylene chloride is above its chronic screening value. Only some of the methylene chloride detections at the monitor are above the chronic screening value while others are below. An evaluation of the 25 methylene chloride detections at the Hawkeye Downs monitor shows that 10 of the samples are below the chronic screening value and 15 are above. The frequency of monitored values exceeding the chronic screening value is, therefore: [(15 ÷ 25) x 100 = 60%]. Depending on the amount by which the measurements exceed the chronic value and the magnitude of the measurements that are lower than the screening value, this may be indicative of a potential chronic concern for this chemical.

Summary of Screening Analysis for Detected Chemicals
Hawkeye Downs Monitor

Detected Chemical (CAS Number)	Maximum Concentration detected (ug/m^3)	Final Chronic Screening Value from Appendix A (ug/m^3)	Acute Screening Value from Appendix B (ug/m^3)	Maximum Concentration is ≥ Chronic Screening Value (Yes/No)? (% Detections Exceeding)[1]	Maximum Concentration is ≥ Acute Screening Value (Yes/No)? (% Detections Exceeding)[1]
Acetaldehyde (75-07-0)	0.35	0.45	N/A	NO	N/A
Methylene Chloride (75-09-2)	**4.5**	**2.1**	**Various (See discussion below)**	**YES (60% of detections exceed the chronic screening value)**	**NO (See discussion below)**
Benzene (71-43-2)	**2.2**	**0.13**	**Various (See discussion below)**	**YES (100% of detections exceed the chronic screening value)**	**NO (See discussion below)**
Vinyl Chloride (75-01-4)	0.08	0.11	N/A	NO	N/A

1. If the maximum value found exceeds screening value (chronic or acute), the full data set of valid samples for the chemical was reviewed to determine the percentage of detections that, individually, are at or above the screening value. The *% Detections Exceeding* is equal to the number of detections at or above the screening value divided by the total number of detections multiplied by 100.

With regard to the potential for acute exposures to this compound, the team reviewed the acute screening values for this chemical in Appendix B and found five values (EPRG-1 and ERPG-2 values, an acute MRL, an acute REL, and an IDLH/10). The team's toxicologist noted that the 24-hour sampling time for the monitor falls within the acute MRL duration (24 hours to two weeks) and that acute MRLs were developed to evaluate exposures to the general public (see http://www.atsdr.cdc.gov/mrls.html). The toxicologist recommends, after consideration of the characteristics of the other acute toxicity values, such as their purpose, duration, and health endpoints, that evaluation of acute exposures should be performed using only the acute MRL. Since the maximum value found for methylene chloride (4.5 ug/m^3) is almost two orders of magnitude smaller than the acute MRL for this compound (2,100 ug/m^3), the team concludes that acute exposures do not appear to be an issue.

- **Benzene.** Benzene's maximum concentration also exceeded its chronic screening value. Since benzene was detected in all samples (frequency of detection = 29/29) and since the range of detected values exceeds the chronic screening value, it can be concluded that 100% of the detections are above the

chronic screening value [percentage of samples above the chronic screening value = (29 ÷29) x 100 = 100%].

With regard to the potential for acute exposures, the team reviewed the acute screening values for this chemical in Appendix B and found that there are many available acute values. The team's toxicologist noted that the 24-hour sampling time for the monitor falls within the acute MRL duration (24 hours to two weeks) and that acute MRLs were developed to evaluate exposures to the general public (see http://www.atsdr.cdc.gov/mrls.html). The toxicologist recommends, after consideration of the characteristics of the other acute toxicity values, such as their purpose, duration, and health endpoints, that evaluation of acute exposures should be performed using only the acute MRL.

Since the maximum value found for benzene (2.2 ug/m^3) is almost two orders of magnitude lower than the acute MRL for this compound (160 ug/m^3), the team concludes that there appears to be no evidence of acute exposures of concern for this chemical.

The chemicals failing the screen at the Hawkeye Down monitoring site are, therefore, ***benzene and methylene chloride for chronic concerns***.

The risk assessment workgroup prepared a similar table for the Army Reserve monitoring site (see below).

The Army Reserve monitoring results for acetaldehyde and methylene chloride are below their chronic screening values and no acute exposure evaluation was performed. The maximum concentration for benzene is above the chronic screening level but not above the acute MRL. Only some of the benzene detections at the Army Reserve are above the chronic screening value while others are below. An evaluation of the 19 benzene detections at the Army Reserve monitor shows that 10 of the samples are below the chronic screening value and 9 are above. The frequency of exceedance of the chronic screening value is, therefore: [(9 ÷ 19) x 100 = 47%].

The chemical failing the screen at the Army Reserve monitoring site is, therefore, ***benzene for chronic concerns.***

Summary of Screening Analysis for Detected Chemicals
Army Reserve Monitor

Detected Chemical (CAS Number)	Maximum Concentration detected (ug/m^3)	Final Chronic Screening Value from Appendix A (ug/m^3)	Acute Screening Value from Appendix B (ug/m^3)	Maximum Concentration is $\geq$ Chronic Screening Value (Yes/No)? (% Detections Exceeding)[1]	Maximum Concentration is $\geq$ Acute Screening Value (Yes/No)? (% Detections Exceeding)[1]
Acetaldehyde (75-07-0)	0.09	0.45	N/A	NO	N/A
Methylene Chloride (75-09-2)	0.7	2.1	N/A	NO	N/A
Benzene (71-43-2)	**1.2**	**0.13**	**Various (See discussion for the Hawkeye Downs monitor)**	**YES (47% of detections exceed the chronic screening value)**	**NO (See discussion for the Hawkeye Downs monitor)**

1. If the maximum value found exceeds screening value (chronic or acute), the full data set of valid samples for the chemical was reviewed to determine the percentage of detections that, individually, are at or above the screening value. The *% Detections Exceeding* is equal to the number of detections at or above the screening value divided by the total number of detections multiplied by 100.

STEP 5: Augment the results described in Step 4 with ancillary information about chemicals that fail the screen (e.g., possible sources, applicable regulations, estimated background concentrations, NATA national scale assessment results for the geographic area, etc.).

This section of the analysis would focus on only two chemicals – benzene and methylene chloride (the two chemicals that fail the screen). The risk assessment team would develop information about the likely sources of air emissions of these two chemicals, the location of the sources, and the regulatory status of the sources. They would also gather information about estimated concentrations/risks from the NATA national scale assessment for comparison, the locations and characteristics of local populations in the area (noting especially sensitive subpopulations and environmental justice areas), and the possibility of upwind sources outside the study area. Information on citizen complaints and any medical, epidemiological, or modeling studies would also be important to note.

STEP 6: Describe areas of uncertainty in the analysis.

The risk assessment workgroup is careful to identify and describe the important areas of uncertainty in their risk screening analysis.

Some of the various questions they have decided to cover in their uncertainty evaluation include the following:

- Do the monitors provide a representative estimate of exposure across the neighborhoods which they are meant to represent?
- Are there important chemicals possibly present in air that were not sampled?
- The samples only cover 6 months of the year and do not take into account seasonal variation in meteorology or changing source characteristics over time. How might this impact the way in which the screening results should be viewed?
- Are there chemicals released from nearby sources which have the potential to partition to other media and present significant exposures through pathways other than inhalation (e.g., dioxin, mercury)?
- What are the uncertainties associated with the underlying toxicological database of the selected screening levels?
- Is there a potential for additive acute effects (see ATRA Volume 1, Section 13.2.2.3)?

STEP 7: Based on the screening results provided in Step 4, the ancillary data developed in Step 5, and the uncertainty analysis developed in Step 6, develop a written description of the analysis, including a discussion about the possibility that a public health threat exists that requires further analysis. Include in this discussion an overall statement of the confidence in the results.

The risk assessment team collects all the information it has developed together and sits down to write its screening assessment report. It decides to use the suggested outline provided in Appendix C of this screening level methodology. The group is careful to provide only factual information and not to make any judgements about risk mitigation actions that should be taken to respond to the screening level analysis (that is the realm of the risk manager). However, they appropriately make conclusions about the potential for exposures of public health concern, the populations that may be affected and, if possible, the sources primarily responsible for the potential exposures. They also make sure to clearly and thoroughly provide important details about the strengths, weakness, and other details of the analysis and to provide statements about their confidence in their conclusions. For example, in discussing the screening values for the detected chemicals, the analyst would discuss issues such as the carcinogenic weight of evidence for detected compounds and uncertainty factors used in the derivation of reference concentrations.

They should also make recommendations about further analyses that should be done to clarify or reduce uncertainties in the screen. It is particularly important for the analyst to clarify that chemicals that fail the screen pose exposures of *potential* concern and that more robust and thorough analysis will likely be required to clarify the nature of the risk. Ultimately, the risk assessment team makes sure their report is thorough, logical, clear, and transparent so that the risk managers and any other stakeholder interested in following their analysis can understand what they did, how they did it, why they did it the way they did, and what they concluded.

References

1. U.S. EPA. 2004. *Air Toxics Risk Assessment Reference Library, Volume 1, Technical Resource Manual*. Office of Air Quality Planning and Standards (EPA-453-K-04-001A). April (http://www.epa.gov/ttn/fera/risk_atra_main.html).

2. OAQPS Toxicity Values Table - http://www.epa.gov/ttn/atw/toxsource/summary.html (note that these values are updated from time to time and changes in the OAQPS toxicity tables may not be reflected in the current version of this screening level methodology).

3. U.S. EPA. 1989a. National Emission Standards for Hazardous Air Pollutants; Benzene. *Federal Register* 54(177):38044-38072, Rule and Proposed Rule. September 14.

4. EPA's Quality System for Environmental Data and Technology website - http://www.epa.gov/quality/

5. U.S. EPA. 1992. *EPA's Guidance for Data Useability in Risk Assessment, Part A.* Office of Emergency and Remedial Response (9285.7-09A). April. http://www.epa.gov/oswer/riskassessment/superfund_misc.htm

6. The Lake Michigan Air Directors Consortium, in conjunction with EPA has, over the past few years been evaluating the historical air toxics monitoring data set (as well as newer data sets) to clarify how best to perform air toxics monitoring. Their reports, which can be viewed at http://www.ladco.org/toxics.html, have helped inform the sampling protocols that have been established for EPA's new National Air Toxics Trends Sites (NATTS) monitoring network.

7. National Emissions Inventory website - http://www.epa.gov/ttn/chief/eiinformation.html

8. Toxics Release Inventory website - http://www.epa.gov/tri/

9. National Air Toxics Assessment website - http://www.epa.gov/ttn/atw/nata/

10. Agency for Toxic Substances and Disease Registry website - http://www.atsdr.cdc.gov/

11. EPA's Risk Characterization Program website - http://epa.gov/osa/spc/htm/2riskchr.htm

12. USEPA 1987. *Technical Guidance for Hazards Analysis, Emergency Planning for Extremely Hazardous Substances*. EPA-OSWER-99-0001. USEPA, FEMA USDOT.