

Appendix B Overview of Screening-level Approaches

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1.0 Introduction

Community-scale assessments can be expensive, time-consuming, and complex. As such, many planning teams will apply a variety of *screening techniques* to try and limit the analysis to only those chemicals and sources that are likely to contribute significantly to the overall risk.

Conversely, some analysts will purposefully not perform any screening in order to keep the overall analysis as true to the notion of a *cumulative* assessment as possible. The approach ultimately selected for any given project will depend on the stated goals of the assessment, the needs of the analysts and decision makers, the established data quality objectives, and the resources available to perform the analysis.

The screening-level approaches used by analysts commonly incorporate a variety of simplifying, yet conservative assumptions that allow the assessment team to hone in on the chemicals and sources that are most likely to “drive” the risk in the study area. Likewise, if the screening-level analysis indicates that the potential risk of a specific emission is relatively low, it might be appropriate to remove it from further analysis (see Exhibit B-1 for an illustration of how screening can be used in the overall analytical approach to focus in on the most likely significant contributors to area risks).

This Appendix describes several screening-level approaches that may be useful for community-scale assessments. Note that each community assessment will be different and that the screening techniques actually used may closely match the examples provided here, they may be a modification of one of these approaches, or analysts may select and implement a different approach entirely (i.e., there is no “one size fits all” approach to selecting and applying screening techniques in a community-scale multisource analysis). Under all circumstances, analysts should be careful to fully describe why they selected a screening technique, how they performed the analysis, and why the removal of chemicals or sources from further consideration was appropriate and justifiable.

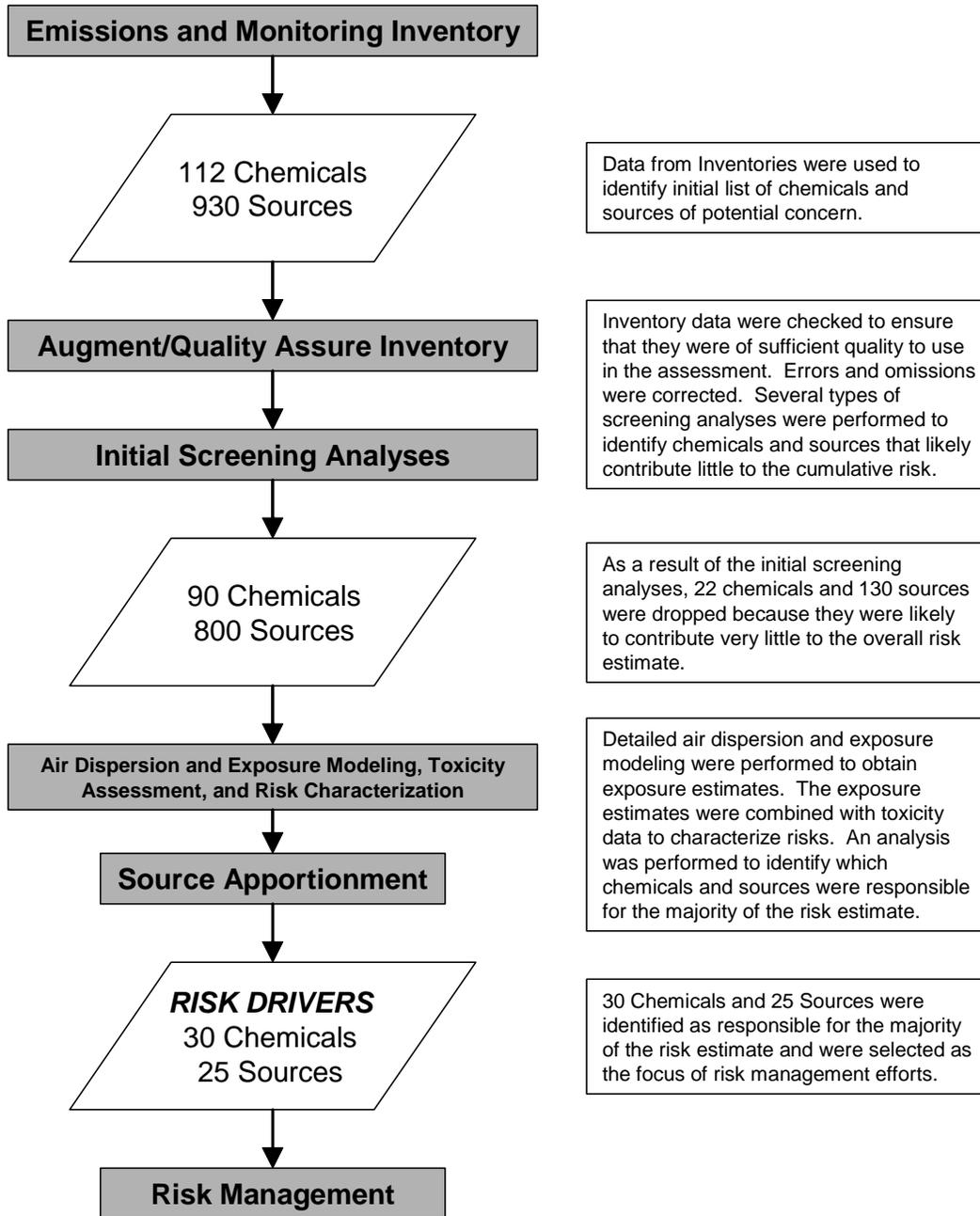
Screening-Level Approaches - Use the Right Approach for the Situation

The screening-level approaches described in this appendix are generalized examples of techniques that may be applicable for a given community-scale assessment. However, depending on the needs, goals, and data quality objectives of an assessment, the approaches described here may not be feasible, appropriate, or even necessary. Analysts should consider the circumstances of their particular assessment and employ the approaches (or modifications) appropriate for the assessment.

What About PBT Chemicals?

Analysts should use caution when screening out persistent chemicals that bioaccumulate and biomagnify since relatively small emissions may lead to high levels in non-air media such as biota over time. (See ATRA Volume 1, Parts III and IV for a discussion of PBT chemicals.)

Exhibit B-1. Example of the Use of a Screen to Reduce the Scope of an Assessment.



This graphic illustrates each step of a sample cumulative multisource assessment and describes the role each plays in developing the ultimate result – identifying the chemicals and sources responsible for the majority of the risk estimate. This sample assessment also illustrates a tiered or phased approach in which the risk assessment begins with a large set of chemicals and sources of potential concern and narrows the focus (by screening out insignificant contributors) for the more refined tier of analysis.

2.0 Overview of Screening-Level Approaches

As introduced in Chapter 3, **screening** is a process by which analysts apply a series of criteria to a group of chemicals and sources to determine which of the chemicals and sources may be of sufficient concern to be considered for additional action. For example, in a community impacted by a large number and variety of emission sources and chemicals (a common scenario), analysts will often apply one or more techniques to try and “narrow the field” to those chemicals and sources that are probably the most important in terms of study-area cumulative risk. This “short list” of sources and chemicals would then become the focus of a more robust analysis. (In some cases, the screening results may provide sufficient information for risk management to begin - see 3.3.1.) The benefit of screening is that it can help reduce unnecessary work, it can speed up the analysis, and it can help to clarify the important issues for a community. One drawback is that, if not done properly, important information can be lost. Another drawback is the community members are sometimes suspicious of screening as a way to “hide” important information. The amount of time it takes to develop, explain, and obtain buy-in to a screening level analysis may negate any benefits of performing the screening in the first place.

There are any number of “screening techniques” that could theoretically be employed to limit the number of sources and chemicals in a community multisource analysis with the possibilities ranging from fairly arbitrary in nature (and, thus, questionable) to more scientifically objective. From a practical standpoint, the screening process usually takes shape in the form of an analysis that is performed in a “tiered” or “phased” approach (discussed in Chapter 3) that generally progresses from simple approaches that rely on reasonably conservative inputs and assumptions to more complex approaches that attempt to provide both more realistic estimates of risk and a

What Are Some Screening-Level Approaches Other People Have Developed?

There are several existing air toxics-specific documents that provide insight into the concept of screening and possible approaches to screening level analysis. Analysts are encouraged to familiarize themselves with these documents prior to implementing screening assessments in a community-level multisource assessment.

- U.S. EPA. 1992. *A Tiered Modeling Approach for Assessing the Risks Due to Sources of Hazardous Air Pollutants*. Office of Air Quality Planning and Standards (EPA-450/4-92-001). March. (<http://www.epa.gov/reg3artd/airquality/mod.htm>)
- U.S. EPA. 2004. *Air Toxics Risk Assessment Reference Library, Volume 2, Facility-Specific Assessment*. Office of Air Quality Planning and Standards (EPA-453-K-04-001B). April. (http://www.epa.gov/ttn/fera/risk_atra_vol2.html)
- U.S. EPA Region 6. 2003. *Regional Air Impact Modeling Initiative (RAIMI) Pilot Study in Port Neches, TX*. May. (http://www.epa.gov/earth1r6/6pd/rcra_c/raimi/raimi.htm)
- U.S. EPA. *Draft Community Assistance Technical Team Air Screening How To Manual*. Office of Pollution Prevention and Toxics, Washington, D.C. (<http://www.epa.gov/opptintr/cahp/howto.html>)
- U.S. EPA. 2006. *A Preliminary Risk-Based Screening Approach for Air Toxics Monitoring Data Sets*. Region 4 Air, Pesticides, and Toxics Management Division (EPA-904-B-06-001). February. (<http://www.epa.gov/region4/air/airtoxic/Screening-020607-KM.pdf>)

(Note that these screening techniques address inhalation-only exposures. EPA is working to develop better screening techniques for multi-media impacts of pollutants that deposit out of the atmosphere.)

better understanding of community variability and risk estimate uncertainties. Within each tier of analysis, any one or more screening techniques may be employed to further reduce the number of chemicals and sources evaluated in that tier. (Note that the tiered risk assessment approach provided in Exhibit 3-10 is not meant to imply that there is a clear distinction between tiers of analysis. For example, a series of refinements in a lower tier analysis might be indistinguishable from a higher tier analysis. Instead, these tiers of analysis are best thought of as points along a spectrum of increasing complexity and detail. The important focus is the specific ways in which a given assessment is refined in successive iterations, including the application of screening level approaches, rather than whether or not it would be considered a lower or higher tier of analysis.)

Analysts that are developing and/or using screening approaches should keep in mind that a good technique will usually need to meet three criteria:

- (1) The screening technique will be a relatively simple, straightforward approach;**
- (2) The inherent simplicity of the screening approach will be counterbalanced with reasonably conservative inputs and assumptions; and**
- (3) The decision criteria used to evaluate the screening results (i.e., to either “screen out” or “retain” a chemical or source) will also be reasonably conservative.**

If the analyst is not reasonably confident that the technique will not lose or “screen out” important information, the technique may not justify removing sources or chemicals from further consideration. Analysts should be particularly cautious about screening techniques that are based on arbitrary decisions about what to keep in and what to leave out (e.g., “we will keep in only major stationary sources and leave out all area sources”). Unless such techniques can be shown to reliably remove only insignificant sources and chemicals, their use may not be justifiable.^(a)

The following sections illustrate some common screening techniques for air toxics assessments. As noted previously, the needs, goals, and data quality objectives of a specific study will drive the selection, use, and timing of a screening technique.

2.1 Toxicity Weighted Screening Approach (TWSA)

The TWSA approach is referred to as *hazard-based approach* because it is intended to be entirely emissions- and toxicity-based, without considering dispersion, fate, receptor locations, and other exposure parameters. This type of approach is usually employed as a “first cut” screen during the early exploratory phase of an assessment to quickly get a sense of emissions that are

This example TWSA approach uses a cutoff of 99 percent of total toxicity-weighted emissions. ***This is not intended as a suggested value***, as others (e.g., 90 or 95 percent) may be appropriate for focusing a given risk assessment on the subset of air toxics that are likely to drive the risk management decision.

^a One example of where this type of technique would be justifiable is when the planning and scoping team decides on a scope that purposefully omits specific sources and chemicals (e.g., their stated purpose is to evaluate “only major stationary sources,” “only mobile sources,” etc.). However, when such is the case, the analysis is no longer a “multisource assessment” and the stated purpose and goals of the assessment should acknowledge this fact.

potentially important (and can also be used to quickly get a sense of potential risk reduction strategies). The benefit of this type of approach is that it is quick, easy, and cheap to perform. The drawback is that it does not provide any information about exposure and risk. Another important drawback is that any clues about the importance of a given source or chemical emission to local impacts that it does provide may be subject to substantial uncertainty.

Toxicity weighting of emissions or ambient concentrations is a process whereby air toxics emissions data (and, less frequently monitored air toxics concentrations) are combined with *weighting factors* developed from toxicity values such as carcinogenic potency estimates (e.g., inhalation unit risk factors) and reference concentrations (RfCs) to account for differences in relative toxicity among air toxics (see ATRA Volume 1, Section 6.3.2.1). Other weighting factors could also potentially be developed and included to account for differences in dispersion characteristics or variations in population density or behavior.

One way to perform the toxicity weighting (using emissions data as an example) is to place all emissions amounts for different chemicals on the same scale of relative hazard potential. For example, the IUR for acrylamide indicates that it is approximately 160 times more potent a carcinogen than benzene. Knowing only this, the analyst could consider one ton of acrylamide emissions equivalent to 160 tons of benzene for purposes of potential to cause cancer. In other words, the TWSA essentially normalizes the emissions rates of each toxic air pollutant to a hypothetical substance with an inhalation unit risk value of 1 per $\mu\text{g}/\text{m}^3$ for carcinogenic effects and/or a reference concentration (RfC) of 1 mg/m^3 for noncancer (and in some cases, cancer) effects. It requires emissions information as well as the applicable dose-response values (see ATRA Volume 1, Chapter 12). This technique is especially helpful when the number of HAPs and/or the number of emission points is large.

Risk-Screening Environmental Indicators (RSEI)

RSEI is a fast and effective toxicity-weighting screening tool for evaluating releases from industrial facilities reporting to the TRI. RSEI considers the amount of chemical released (using TRI data), the location of that release, the toxicity of the chemical, its fate and transport through the environment, the route of human exposure, and the number of people affected. This information is used to create numerical values that can be added and compared in a variety of ways to assess the relative risk of chemicals, facilities, regions, industries, etc. (see <http://www.epa.gov/opptintr/rsei/>).

Following this logic, emissions of each toxic air pollutant would be weighted according to their relative potencies to allow for direct comparison of potential risk across air toxics (with IUR and RfC estimates evaluated separately). For example, this type of analysis permits comparisons of the relative risk posed by pollutants with large mass emissions and low toxicity against pollutants with small mass emissions but high toxicity. Once the toxicity weighted values have been determined, they can be parsed a number of ways to identify chemicals and sources for more in-depth evaluation.

The steps for emissions-based toxicity weighted screening would include the following steps (see Exhibit B-2 for an example calculation):

1. Identify all the inhalation unit risks (IURs) and RfCs for the air toxics in all facility/source emissions.

2. Determine the total tons/year of each toxic air pollutant emitted from facility/source emissions.
3. Multiply the emission rate of each toxic air pollutant by its IUR to obtain a toxicity-emissions product.
4. Rank-order the toxicity-emissions products and obtain the sum of all products.
5. Starting with the highest ranking product, proceed down the list until the cumulative sum of the products reaches a large proportion (e.g., 99 percent) of the total of the products for all the air toxics. Include in the assessment all the air toxics that contributed to this proportion of the total.
6. Repeat steps 3 through 5, but instead divide the emissions rate by the RfCs to obtain “hazard equivalent tons”/year (see Exhibit B-3).

Keep in mind that the TWSA does not provide a quantitative estimate of risk. All it provides is a screening level perspective of potential hazard posed by emissions or ambient concentrations. Nevertheless, emissions and ambient concentrations clearly have a strong influence over exposure and risk, and therefore the toxicity-weighting approach, while a crude yardstick, could help inform a risk management decision if a more refined assessment is not feasible.

Some Notes of Caution When Using the TWSA Approach

The TWSA approach should generally be used to rank pollutants within sources, but not between sources. That is, TWSA should generally not be used to remove a source from the multisource assessment at the screening level. Proceeding in this manner will insure that each source goes into the multisource assessment with at least its potentially most risky pollutants. Other issues that should be considered when performing a TWSA include:

- **Stack vs. Fugitive Emissions:** Impacts to receptors exposed to releases from tall stacks versus impacts to receptors exposed to fugitive releases from very localized, poorly dispersed emission sources could be very different. As such, if the TWSA approach is to be used for sources in a community, they should, at a minimum, be segregated into stack emissions and fugitive emissions and the TWSA performed separately for each type.
- **Emissions Characterization Quality:** The TWSA will typically be based on existing, not refined, emissions data. Some of these data may be fairly crude for some sources and chemicals, while more accurate information may be available for others (e.g., stack test data), resulting in a variable mix of emission estimates with different levels of accuracy. Unless a concerted effort is made to use only emissions of the same caliber and accuracy level, mixing the level of certainty around emissions could lead to artificially ranked chemicals. Specifically, pollutants could be retained because emissions were estimated high in order to be conservative (in light of uncertainties in the existing emissions inventory), while other pollutants with more robust emissions characterization may be eliminated because the estimates were more accurate.
- **Multipathway Exposures.** If persistent, bioaccumulative toxics (the PB-HAPs, see Chapter 9) are to be included in the assessment, they should be the subject of a separate TWSA based on ingestion dose-response values and bioconcentration factors to avoid the problem of eliminating ingestion hazards with an inhalation TWSA.

Exhibit B-2. Example TWSA Calculation for Cancer Effects

Air Toxic (all Facility/Source Emissions)	Emissions (tons/year)	IUR	Cancer Equivalent Tons/year	Percent of Total	Cumulative Percent
1,3-butadiene	8.2×10^1	3.0×10^{-5}	2.5×10^{-3}	23.8%	23.8%
carbon tetrachloride	1.5×10^2	1.5×10^{-5}	2.2×10^{-3}	21.3%	45.1%
beryllium compounds	8.6×10^{-1}	2.4×10^{-3}	2.1×10^{-3}	19.8%	64.9%
arsenic compounds	4.2×10^{-1}	4.3×10^{-3}	1.8×10^{-3}	17.5%	82.4%
2,3,7,8-TCDD	2.0×10^{-5}	3.3×10^1	6.6×10^{-4}	6.4%	88.8%
chromium (VI) compounds	3.7×10^{-2}	1.2×10^{-2}	4.4×10^{-4}	4.3%	93.1%
polycyclic organic matter ^(a)	6.7	5.5×10^{-5}	3.7×10^{-4}	3.6%	96.7%
cadmium compounds	1.0×10^{-1}	1.8×10^{-3}	1.8×10^{-4}	1.8%	98.4%
formaldehyde	2.2×10^4	5.5×10^{-9}	1.2×10^{-4}	1.1%	99.5%
1,3-dichloropropene	5.2	4.0×10^{-6}	2.1×10^{-5}	0.2%	99.7%
allyl chloride	2.8	6.0×10^{-6}	1.7×10^{-5}	0.2%	99.9%
methylene chloride	1.9×10^1	4.7×10^{-7}	8.7×10^{-6}	0.1%	100.0%
benzene	9.3×10^{-2}	7.8×10^{-6}	7.3×10^{-7}	0.0%	100.0%
Total			1.0×10^{-2}	100.0%	

Heavy line denotes 99% cutoff. In this example, 1,3-dichloropropene, allyl chloride, methylene chloride, and benzene might be dropped from the cancer analysis.

^(a) Cancer equivalent tons/year and IUR are based on the assumption that benzo(a)pyrene represents 5% of emissions.

Exhibit B-3. Example TWSA Calculation for Noncancer (and Some Cancer) Effects					
Air Toxic	Emissions (tons/year)	RfC	Noncancer Equivalent Tons/year	Percent of Total	Cumulative Percent
beryllium compounds	8.6×10^{-1}	2.0×10^{-5}	4.3×10^4	38.3%	38.3%
1,3-butadiene	8.2×10^1	2.0×10^{-3}	4.1×10^4	36.7%	75.0%
arsenic compounds	4.2×10^{-1}	3.0×10^{-5}	1.4×10^4	12.6%	87.6%
cadmium compounds	1.0×10^{-1}	2.0×10^{-5}	5.1×10^3	4.6%	92.1%
carbon tetrachloride	7.0×10^2	1.9×10^{-1}	3.7×10^3	3.3%	95.4%
allyl chloride	2.8	1.0×10^{-3}	2.8×10^3	2.5%	97.9%
formaldehyde	8.9	9.8×10^{-3}	9.1×10^2	0.8%	98.7%
2,3,7,8-TCDD	2.0×10^{-5}	4.0×10^{-8}	5.0×10^2	0.4%	99.1%
chromium (VI) compounds	3.7×10^{-2}	1.0×10^{-4}	3.7×10^2	0.3%	99.5%
toluene	1.3×10^2	4.0×10^{-1}	3.2×10^2	0.3%	99.8%
1,3-dichloropropene	5.2	2.0×10^{-2}	2.6×10^2	0.2%	100.0%
methylene chloride	1.9×10^1	1	1.9×10^1	0.0%	100.0%
benzene	4.8×10^{-2}	3.0×10^{-2}	1.6	0.0%	100.0%
Total			1.1×10^5	100.0%	
Heavy line denotes 99% cutoff. In this example, chromium (VI) compounds, toluene, 1,3-dichloropropene, methylene chloride, and benzene might be dropped from the analysis.					

2.2 Comparisons Between Ambient Concentrations and Risk-Based Concentrations (RBCs)

A second type of hazard-based screening approach is the comparison of ambient air toxics concentrations to risk-based concentrations (RBCs). RBCs for cancer effects (developed from IURs) are ambient concentrations associated with specific levels of cancer risk and usually assume 70 years of continuous exposure. RBCs based on RfCs are ambient concentrations that pose no appreciable hazard to humans (also assuming continuous lifetime exposure). An example of this type of methodology has recently been developed by EPA for screening air toxics monitoring data sets (see <http://www.epa.gov/region4/air/airtoxic/Screening-020607-KM.pdf>).

Comparisons of estimated concentrations to RBCs can provide indicators of potential public health impacts but should not be considered a characterization of actual health risks.

What If I Had Better Data?

In a higher level of analysis where actual exposure and risk data have been developed, an analysis of this type can be used to further focus the assessment on the significant air toxics of concern. This approach would be similar to the TWSA, except that the analyst would use the estimates of individual cancer risk and hazard instead of toxicity-weighted emissions. An example of this type of risk-based approach would commonly include the following steps:

1. Using applicable input data, run a simple dispersion and/or exposure model (with conservative assumptions) and calculate cancer risk at a selected point (e.g., maximum exposed individual location).
2. Rank-order the individual risk estimates for each emitted toxic air pollutant and obtain the sum of the cancer risk.
3. Starting with the highest ranking cancer risk, proceed down the list until the individual air toxics contributing a large proportion (e.g., 99 percent) of the total risk estimate are included. Include those air toxics in subsequent tiers of analysis.
4. Repeat steps 1 through 3 for hazard.

2.2.1 Example Derivation of Chronic RBCs

In this example, the starting point for the derivation of RBC values for chronic exposures is the Office of Air Quality Planning and Standards' (OAQPS) list of recommended chronic inhalation toxicity values for the Hazardous Air Pollutants (HAPs).⁽¹⁾ Specifically, the methodology uses the OAQPS recommended cancer IUR values and chronic inhalation reference concentrations (RfCs) as starting points and performs the following manipulations to derive a final chronic screening value:

- **Chronic RBC for “noncancer” (and in some cases, cancer) health endpoints.** For the “noncancer” RBC value [which in some cases (e.g., chloroform), is also a cancer screening value], the chronic RfCs are 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 simultaneous exposure to multiple contaminants, the noncancer chronic RBC value for each chemical is lowered by a preselected amount. In this example, the amount by which the RfC is lowered is selected to be a ten-fold reduction of the RfC [i.e., $(0.1) \times (\text{RfC})$].

Calculating the “noncancer” RBC 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.

- **Chronic RBC value for cancer health endpoints.** The IUR for a carcinogenic chemical is used as a starting point to derive an air concentration corresponding to a specific individual cancer risk level. Commonly, the cancer RBC risk level is selected as one in one million (written $1\text{E-}06$ or 1×10^{-6}) which is the lower end of the cancer risk range cited in the 1989

Benzene NESHAP (1E-04 to 1E-06) as an acceptable range of risk for the air toxics program.⁽²⁾ The 1E-06 level of risk also takes 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 limit of the acceptable risk range (1E-04). The chronic RBC value for cancer is calculated by simply dividing a risk of one in a million by the IUR [(1E-6)/(IUR)].

- **Final chronic RBC value for both cancer and noncancer (and in some cases, cancer) effects.** The final chronic RBC value for a chemical is simply the lower of the concentration values calculated above.

The example methodology for the development of chronic RBCs has precedent in other risk-based environmental programs (e.g., Superfund risk assessors have commonly used similar screening levels to narrow the focus of hazardous site investigations).^(b) If analysts decide to use different RBC levels, they are encouraged to document why they chose an alternate value and why the alternate value is in line with the screening level concept (i.e., a simple approach counterbalanced with highly conservative inputs and decision criteria).

2.2.2 Examples of the RBC Approach

Example applications of this approach include the following:

- Suppose a single VOC monitor is placed in the center of a neighborhood that is surrounded by heavy industry and major highways. Twenty-four-hour composite samples are collected every six days for a year (approximately 60 samples). Analysts compile all of the data and then compare the maximum value found for each chemical detected to its final chronic RBC value. Those chemicals that are above their respective RBC values (i.e., the chemicals that “fail the screen”) are selected for a follow-on air modeling risk assessment study.

In this example, the analysts have used the screening technique to weed out chemicals that are unlikely to be present at levels that pose significant chronic risk. The benefit of this approach is that the effort needed in the ensuing detailed modeling assessment may be dramatically reduced. For example, the emissions inventory needed for the modeling study could focus only on sources known to emit “failing” chemicals.

A potential drawback to this approach relates to whether or not the single monitoring site provides data adequate to meet the necessary risk-based data quality objectives. For example, if the monitoring data are not representative of community exposures (e.g., if there are “hotspots” not captured by the single monitor), important chemicals could be erroneously removed from further consideration. Another potential pitfall is inadequate detection limits. Specifically, if the RBC is lower than the analytical detection limit, ambient concentrations could be higher than the RBC, but not be detected due to an inadequate monitoring procedure.

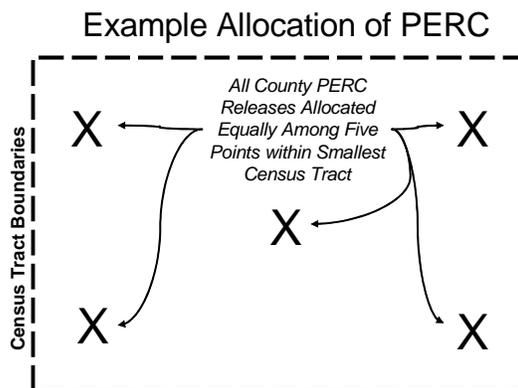
^b This rationale has been previously employed by Region III Superfund program in their table of risk based concentrations (see <http://www.epa.gov/reg3hwmd/risk/human/index.htm>).

- Suppose the question is whether or not to include a particular set of diffuse sources in the analysis (e.g., nonpoint sources which have been aggregated up to one total emission amount in the emissions inventory for the county in which the study area is located). Performing a thorough analysis of such sources can require significant resources to determine their precise spatial location. It can also take significant computational time to predict their impact if there are many individual emission points.

In order to evaluate whether or how to include these diffuse nonpoint sources, the analysts decide to perform an air dispersion modeling run on these sources using the conservative assumption that all the sources are located at five “pseudo-points” evenly distributed within the smallest populated census tract in the modeling domain (refer to Appendix A for a description of the use of pseudo-points). The analyst would perform the air dispersion modeling and compare the resulting ambient concentrations to the chemical-specific RBCs. If the analysis indicates that the potential for risk is sufficiently low (all annual average values are below their respective RBCs), this source type might reasonably be removed from further analysis. If some of the chemicals “fail the screen” (i.e., exceed their respective RBC) and others “pass the screen” (i.e., are below their respective RBC), the analyst may be able to reasonably remove the passing chemicals from further analysis.

For example, consider a study area (a metropolitan county) with an unknown number of dry cleaners which release perchloroethylene or PERC. The NEI for the county provides only one single total annual amount of PERC released from all dry cleaners in the county. The analysts decide that it would be too resource intensive to locate and map all the dry cleaners; in addition, allocating the emissions around the county (e.g., according to population at the census block level) is not acceptable to the planning and scoping team. How might they resolve this dilemma?

The analysts decide to perform an exploratory screening analysis of potential PERC risks to determine whether the dry cleaning emissions are a significant issue in the first place. To do this, they make the simplifying, yet conservative assumption that all dry cleaning emission are released from five points within the smallest census tract in the county (see figure) in order to simulate a likely high-end estimate of possible exposures in the study area. They decide to then use the dispersion model



ISCST3 to estimate the point of maximum annual average PERC concentration using conservative modeling options [to meet screening criteria (1) and (2) above]. The estimated concentration is then used, as is, as an estimate of lifetime exposure concentration (no exposure model is employed which is, again, simple and, usually, conservative) and the results compared against RBC values. In this analysis, the analysts select the RBC to be concentrations representative of a cancer risk level of one in one million and a hazard quotient = 0.1 [to meet screening criterion (3) above]. If the maximum concentration is below both the cancer RBC and the hazard RBC, the analysts might consider it justifiable to

remove this source type and its PERC releases from further consideration in the multisource analysis.

While the RBC approach is more complex than emissions-weighting, it brings two significant advantages to the overall evaluation. First, it may allow analysts to more confidently identify air toxics that are likely to pose insignificant risk for which further reductions may not carry significant health benefits. Depending on whether an air dispersion model is used, one may also be able to account for variation in exposure (and potential risk) across an exposed population.

That having been said, this approach does not take into account other factors that can influence exposure (and risk), such as the activities that people engage in (e.g., working, jogging) and where these activities occur (e.g., at home, school, and work) since an exposure model was not employed, making it subject to greater uncertainty than an approach that does include an estimate of exposure through application of an exposure model.^(c) Nevertheless, ambient concentrations are important determinants of exposure and risk, making the concentration/RBC approach a possible basis for risk management decisions if a more refined assessment is not feasible. (Also keep in mind that issues such as secondary formation and other fate and transport phenomena may have a strong influence on exposure and risk. As such, any gains in conservativeness from using a restrictive RBC may be offset by not having fully evaluated all important fate and transport issues.)

2.3 Comparisons Between Estimated Exposures and RBCs that May Yield Quantitative Estimates of Risk

This approach is similar to described in Section 2.2 with the exception that the ambient concentrations predicted through air dispersion modeling are further refined by the application of an exposure model (see ATRA Volume 1, Chapter 11). These refined estimates of exposure are then compared to RBCs in the same way as previously described. The benefit of taking the time to apply the exposure model is that the analyst can usually be more certain that a chemical which is removed from further consideration poses insignificant risk (or that a chemical that is above the RBC may pose significant risk).

^c As discussed in Exhibit 5-2, long term average estimates of ambient air concentrations (from either dispersion modeling or air quality monitoring) are sometimes used as a surrogate for the chronic exposures people in a study area actually experience. This approach is considered to provide only a screening level estimate of chronic “risk” since it does not take into account either the actual locations of people in the study area or how those people move around during the course of the day. Risk analysts frequently use this approach to assess risk and risk managers commonly base their decisions on such results. That having been said, there are obvious pros and cons to this approach. Avoiding the development of more detailed information on exposures experienced by people in the study area (e.g., via use of an exposure model that takes into account the activity patterns of the people in the study area) is generally faster, easier and requires less knowledge regarding exposure assessment. On the other hand, using ambient concentration as a surrogate for exposure to outdoor air toxics provides answers that are likely to overestimate risk. This can result in taking action when the risks are actually acceptably low. Ultimately, the planning and scoping team will need to evaluate the level of detail that will be needed in the assessment results in order for the risk managers to be able to do their job. Commonly, this will result in the planning and scoping team designing an iterative approach to the risk assessment wherein a screening assessment is done first. If the results of the screening approach are sufficient for the risk managers, the assessment is complete. In contrast, the screening results may be insufficient for decision making and a reassessment of part or all of the risk analysis using more advanced techniques may be undertaken. For more information on planning and scoping, see Chapter 4.

2.4 Quantitative Estimates of Hazards and Carcinogenic Risk for Individuals and Populations

In a higher tier of analysis, in which predicted concentrations of air toxics are refined by the application of an exposure model and then combined with dose-response values (IURs) to develop quantitative estimates of cancer risk,^(d) all or some of the previous screening methods described above may have been used to identify the exact chemicals and sources that are carried forward to this more formal risk assessment process. However, even within this level of analysis, additional layers of screening may be employed to further refine a specific aspect of the analysis. Consider the following example:

A risk assessment being performed in a community that is simultaneously impacted by multiple chemicals and sources. The analysts perform a variety of conservative screening techniques to arrive at a set of chemicals and sources that will be the subject of a rigorous emissions inventory development, air dispersion modeling, and exposure modeling study to derive deterministic (i.e., single value or “point”) estimates of chronic risk and hazards at specific points throughout the study area.

At the end of this phase of the study, the analysts have identified a subset of chemicals and sources which appear to be responsible for most of the risk based on the deterministic results. However, the level of analysis provided by the deterministic risk characterization is still insufficient for risk management decision making. In particular, the risk managers indicate that they need to have a more full accounting of variability of exposure and risk as well as better understanding of the uncertainties surrounding these estimates for those chemicals and sources responsible for 95% of the risk (as determined by the deterministic analysis). They need this information in order to better judge whether the estimated risks should be mitigated given the costs associated with the available risk reduction options or whether additional data needs to be developed to reduce uncertainty to acceptably low levels. In response, the analysts develop a probabilistic characterization of risk for this subset of chemicals and sources (see ATRA Volume 1, Chapter 31). They also use probabilistic techniques to quantitatively assess uncertainty.

This example illustrates a process by which simplistic, yet conservative screening techniques were used to narrow the focus of a deterministic analysis down to a short list of chemicals and sources that are likely to contribute most to cumulative risk estimates. The results of the deterministic risk assessment are then used to identify chemicals and sources that are carried forward to an even higher level of analysis (probabilistic analysis of risk and uncertainties).

In summary, there are any number of screening techniques that can be used to limit the scope of an analysis and only a few of the more common approaches have been highlighted in this Appendix. Analysts are cautioned to remember that the more screening out of chemicals and sources that takes place, the more the analysis necessarily moves away from being “cumulative” in nature. When weighed against the need to describe to stakeholders why screening was done and why it is “ok,” it may be ultimately be time well spent to simply include as many sources

^d There are not readily available approaches for quantitatively predicting *risks* of effects other than cancer. A hazard quotient approach (which is not a quantitative prediction of the statistical probability of disease outcome) is commonly used for these “other effects.”

and chemicals as possible in the analysis. Depending on the scope of the analysis, this may be feasible; in some communities, the sheer number and types of sources and chemicals may make screening a necessity. If screening steps are used to narrow the focus of an analysis, the screening steps should be conservative in nature so as to avoid removing chemicals and sources that may significantly contribute to risk. In all cases, the description of the screening process must be carefully detailed in the risk assessment documentation to clarify why the screening was done, how it was done, and why the analysts are reasonably confident that no important information was lost in the process.

References

1. 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).
2. U.S. EPA. 1989a. National Emission Standards for Hazardous Air Pollutants; Benzene. *Federal Register* 54(177):38044-38072, Rule and Proposed Rule. September 14.