Minnesota Pollution Control Agency

http://www.pca.state.mn.us/

Air Emissions Risk Analysis (AERA) — Guidance Updates: What's New Archives

A limited list of chemical toxicity value changes are found on the "Chemical Information" page. A complete list can be found in the "IHB Updates" worksheet in the Risk Assessment Screening Spreadsheet (RASS) or Q/CHI spreadsheet.

March 2012

In order to use the most up to date toxicity information, the toxicity values in the RASS from EPA's Health Effects Assessment Summary Tables (HEAST) have been eliminated and Provisional Peer Reviewed Toxicity Values derived by EPA's Superfund Health Risk Technical Support Center are now being used. This was done in consultation with the Minnesota Department of Health.

June 2011

The AERA Forms were updated to reflect procedural changes that will allow the MPCA to determine if an air permit application is complete within 30 business days, with the goal of issuing the air permit in 150 calendar days. It is highly recommended that AERA materials be submitted for MPCA review prior to submitting an air permit so that site specific suggestions from the MPCA can be incorporated into the AERA. An AERA with a refined analysis based on EPA's Human Health Risk Assessment Protocol (e.g. IRAP) will require approval of a protocol (the new AERA-26 form) prior to submitting an air permit application. Proposers and consultants working on projects that may require an AERA should discuss their project with an MPCA supervisor or manager before beginning work on an AERA.

September 2009

Multi-pathway Risk Analysis

Information describing additional exposure assumptions was added to the Multi-pathway Risk Analysis Web page. This additional set of assumptions describes the use of central tendency estimates for human exposure. The risk estimates using central tendency assumptions for human exposure should be presented with, and not replace, risk estimates based on reasonable maximum exposure assumptions that follow MPCA's AERA guidance.

July 2009

Change in AERA guidance: Who needs to complete an AERA?

Change in Default Thresholds for AERAs: The MPCA program managers have changed the default thresholds for conducting AERAs to coincide with environmental review thresholds. Proposals going through the environmental review process because a project meets thresholds identified in Minn. R. 4410.4300.subp.15 or Minn. R. 4410.4400 and the project increases air emissions of a single criteria pollutant by 250 tons per year or more need to conduct an AERA. However, the MPCA will continue to use its discretion in requesting proposers conduct an AERA for projects outside of this default - these cases generally encompass existing air emission sources that are the source of significant public interest or the specifics of a new facility or existing facility expansion indicate a need for further analysis prior to public notice. Some of the factors that may be considered in evaluating the need for an AERA include the location of the facility, the types of receptors nearby and their distance from the facility, the type of facility and/or change, and the amount and types of emissions from the facility.

March 2009

Cumulative Air Emissions Risk Analysis

Cumulative Air Emissions Risk Analysis Guidance is now available on the Cumulative Air Emissions Risk Analysis Web page. A cumulative air emissions risk analysis evaluates risks from multiple sources, on-site and off-site. On-site sources include point, area, and mobile sources associated with the existing facility and the proposed project. Off-site sources include nearby point, area, mobile sources and regional background. The air concentrations associated with these emissions are either generated from air dispersion modeling and/or ambient monitoring data. The degree to which air emissions are assessed for each source is dependent on the availability of modeling and monitoring data.

Updated Mercury Guidance

The January 2009 version of the MPCA's Mercury Risk Estimation Model (MMREM) has been updated to reflect comments from independent reviewers. The fraction of the terrestrial watershed reaching the water body increased from 10% to 26%.

Please see the Mercury Guidance Web page for the latest version of the spreadsheet.

Multi-Pathway Screening Factors For Assessing Risks From Non-Inhalation Exposures To Air Pollutants

The RASS and Q/CHI spreadsheet have been updated with the new multimedia factors. An explanation of the development of these new multimedia factors (multi-pathway screening factors) can be found in the paper Multi-Pathway Screening Factors For Assessing Risks From Non-Inhalation Exposures To Air Pollutants completed by Dr. Gregory Pratt and Mary Dymond of the MPCA. This study was published in the Journal of the Air and Waste Management Association (April 2009), which is available on the Multi-pathway Risk Analysis Web page.

Updating Guidance For Estimating Emissions From Natural Gas Boilers

The following pollutants with E rated emission factors based on detection limits from AP-42 do not need to be included in quantitative emission estimates from natural gas fueled boilers because of the uncertainty associated with them. Instead, they should be discussed qualitatively. All other pollutants with AP-42 values should be included quantitatively.

- 56-49-5 3-Methylchloranthrene
- 57-97-6 7,12-Dimethylbenz(a)anthracene
- 83-32-9 Acenaphthene
- 203-96-8 Acenaphthylene
- 120-12-7 Anthracene
- 56-55-3 Benz(a)anthracene
- 50-32-8 Benzo(a)pyrene
- 205-99-2 Benzo(b)fluoranthene
- 191-24-2 Benzo(g,h,i)perylene
- 205-82-3 Benzo(k)fluoranthene
- 218-01-9 Chrysene
- 53-70-3 Dibenzo(a,h)anthracene
- 193-39-5 Indeno(1,2,3-cd)pyrene
- 7440-41-7 Beryllium
- 7782-49-2 Selenium

September 2007

Updated AERA Guide

The AERA Guide was updated in version 1.1 of the document to reflect policy changes and modifications to the AERA process that occurred since the original document was developed in 2004. This update did not present new information or require different methodologies but rather incorporated the updates that were posted on this website since the beginning of the AERA process and were not previously in the guide.

June 2007

Emissions from Utilizing Natural Gas as an Onsite Fuel Source

MPCA staff reviewed past practices of the onsite sources that should be included in the Risk Analysis Screening Spreadsheet (RASS) and concluded that emissions from utilizing natural gas as a fuel should also be quantified. If your facility utilizes natural gas as a fuel in boilers or other devices and you are completing an AERA, the combustion products and their emissions from natural gas need to be included in the RASS.

Several developments prompted a review of the exclusion of emissions when utilizing natural gas. These developments include the availability of information, improved tools for assessing health impacts, and the need to address the health impacts of natural gas combustion in a facility's evaluation. Over the past year, several facilities have quantified these emissions and included them in their analysis and submittals to ensure a more complete quantification of estimated impacts. MPCA staff is also developing explicit guidance when assessing cumulative potential effects for the environmental review process.

A reminder regarding when to prepare an AERA

Recent changes to the EAW threshold from 100 tpy to 250 tpy for individual criteria pollutants won't eliminate the need for an AERA. Proposers should still plan to complete an AERA if their facility's potential to emit is >100 tpy for any individual pollutant.

January 2007

MPCA's Mercury Risk Estimation Model now available

- The MPCA Mercury Risk Estimation Method (MMREM) is now available for assessing the incremental mercury risk associated with eating fish from water bodies near permitted or potentially permitted sources. MMREM can be used to estimate the noncancer oral hazard quotients associated with fish tissue consumption based on increases in mercury deposition.

Alteration in Guidance for Estimating $PM_{2.5}$ Emission from AERAs

- As of March 31, 2006, US EPA no longer supports the PM Calculator Software. The PM Calculator is referenced in MPCA's Estimating $PM_{2.5}$ Emissions for AERAs (aq9-12) guidance for calculating filterable $PM_{2.5}$ emissions. $PM_{2.5}$ emission factors are still available in EPA's WebFIRE database and AP-42 emission factor compilations.

August 2006

Ethanol Facilities: Determination of Need for an Air Emissions Risk Analysis

- The Determination of Need for an Air Emissions Risk Analysis offers a checklist for an ethanol facility proposer to determine if this type of analysis is necessary in the planning and permitting process for an ethanol production facility.
- For additional information contact Heather Magee-Hill.

March 2006

Estimating $PM_{2.5}$ Emissions for AERAs

- The Estimating $PM_{2.5}$ Emissions for AERAs (aq9-12) amends the MPCA's Air Emissions Risk Analysis (AERA) Guidance Version 1.0 dated March 2004 related to estimating $PM_{2.5}$ emissions and predicting ambient air impacts. Specifically, section 2.6.1 "Criteria pollutants" and section 3.4.8 "$PM_{2.5}$" were revised as described in this guidance.
- For additional information see the AERA Emissions Web page.

Updated Guidance and Forms

- AERAs submitted after April 15, 2006 should incorporate the Emissions Estimating Guidance and updated forms. A six month grace period will apply for forms and emissions guidance submitted after April 15, 2006. However, using the updated MPCA materials may expedite the AERA process.

February 2006

Emissions Estimating Guidance For Use in an AERA

- MPCA Emissions Estimating Guidance For Use in an AERA (aq9-06) provides general guidance for preparing emission estimates for input into the risk analysis screening spreadsheet (RASS) of an Air Emissions Risk Analysis (AERA), and is to be viewed as a supplement to the MPCA's AERA Guidance. It is the goal of the MPCA that emission estimates used in an AERA should be the most accurate estimate of emissions over the appropriate timeframe with a reasonable certainty that chemical emission rates are not underestimated, irrespective of the data source from which they are derived.
- For additional information see the AERA Emissions Web page.

January 2006

Buffer Distance

- MPCA altered buffer distances previously used in providing data in the Qualitative Analysis section of the AERA.

October 28, 2005

Ethanol Sector Specific Interim Exposure Values Guidance

- The Minnesota Department of Health (MDH) developed acute and chronic Ethanol Sector Specific Interim Exposure Values (ESSIEVs) for thirteen chemicals. MDH considers the ESSIEVs sector specific for ethanol production facilities and cannot endorse the routine use of ESSIEVs for other types of facilities.

RASS

- The RASS was revised to incorporate the Ethanol Sector Specific values. The updated RASS requires that an SIC code be entered on the Emissions worksheet.
- An unlocked version of the RASS will no longer be available on the website. Facilities seeking to use an unlocked version will need to contact MPCA risk assessment staff listed at the bottom of this page.

July 2005

AERA Guidance Revision

- Effective July 2005: For proposed expansions to existing facilities requiring AERAs, project proposers will need to submit current facility emissions and total facility emissions after the proposed modification. At a minimum this will result in two RASS and the supporting documentation.
- For additional information and guidance on this policy please contact risk assessment staff listed below.

Risk Assessment staff

- Shelley Burman, Supervisor, 651-757-2255
- Mary Dymond, 651-757-2327
- Kristie Ellickson, 651-757-2336
- Heather Magee-Hill, 651-757-2545

Last modified on February 25, 2013 14:09

Air Emissions Risk Analysis (AERA) Guidance

Version 1.1

September 2007

Minnesota Pollution
Control Agency

Environmental Analysis & Outcomes Division
Industrial Division

aq9-18

Interim Final Draft. This document, its appendices and other materials related to the Air Emissions Risk Analysis (AERA) process are interim final drafts, meaning that, while these documents are considered final as of the version date, the Minnesota Pollution Control Agency (MPCA) will complete future revisions as necessary to improve the risk analysis process. The MPCA will update the chemical list and other AERA documents periodically in an effort to incorporate new scientific information. All updates will be dated and posted on the MPCA website. The latest version of the AERA tools should be used at the beginning of each new project. If submittals for a proposed project are not made using this version within a six month period, the MPCA website should be consulted for updates and incorporated at that time. The latest version of the AERA tools can be found online at: http://www.pca.state.mn.us/air/atguide.html.

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APPENDICES

Acronyms and Definitions

Acronyms:

AERA:	Air Emission Risk Analysis
AERMOD:	AMS/EPA Regulatory Model
Agency:	Minnesota Pollution Control Agency
BACT:	Best Available Control Technology
BIDs:	Background Information Documents
CAPTAPS:	Criteria Air Pollutant, Toxic Air Pollutant Screening
CAPTAPS-A:	Criteria Air Pollutant, Toxic Air Pollutant Screening with AERMOD
CAS#:	Chemical Abstract Service number
COPI:	Chemicals of Potential Interest
DISPERSE:	Dispersion Information Screening Procedures for Emission Risk Screening Evaluations
EAW:	Environmental Assessment Worksheet
EIS:	Environmental Impact Statement
EPA:	United States Environmental Protection Agency
EPA AP-42:	EPA's air pollutant emissions factor database.
EPRI:	Electric Power Research Institute
FIRE:	EPA's Factor Information Retrieval Data System
GEP:	Good Engineering Practice
HAPs:	Hazardous Air Pollutants (http://www.epa.gov/ttn/atw/orig189.html)
HBV:	Health Based Value
HI:	Hazard Index
HEAST:	Health Effects Assessment Summary Tables
HRV:	Health Risk Value
HQ:	Hazard Quotient
IHB:	Inhalation Health Benchmark
IRAP:	Industrial Risk Assessment Program
IRIS:	Integrated Risk Information System
LAER:	Lowest Achievable Emission Rates
MACT:	Maximum Achievable Control Technology
MAAQS:	Minnesota Ambient Air Quality Standards
MDH:	Minnesota Department of Health
MSDS:	Material Safety Data Sheets
MPCA:	Minnesota Pollution Control Agency
NAAQS:	National Ambient Air Quality Standards
NESHAP:	National Emissions Standard for Hazardous Air Pollutants
OAQPS	Office of Air Quality Planning & Standards (EPA)
OEHHA:	Office of Environmental Health Hazard Assessment (California EPA)
OSW:	Office of Solid Waste (EPA)
PAHs:	Polycyclic Aromatic Hydrocarbons
PBTs:	Persistent Bioaccumulative Toxic chemical
PCB:	Polychlorinated Biphenyls
POM:	Polycyclic Organic Matter
PTE:	Potential to Emit
RASS:	Risk Assessment Screening Spreadsheet

REL: Reference Exposure Level (OEHHA)
TLVs Threshold Limit Values
VOCs: Volatile Organic Compounds

Definitions:

As used in this Guidance, the following terms have the meaning provided.

Accidental Release: non-routine release to air due to various process upsets such as: start-ups, shutdowns, malfunctions of emission units or air pollution control systems

Acute Exposure: Exposure to one or more doses of a contaminant within a short period of time. Acute exposure is evaluated using the maximum ambient air concentration of a contaminant that occurs during one hour.

Air Toxics: A category of substances in the air that are known or suspected of causing cancer or other health problems.

AP-42: Air pollutant emission factors from "Compilation of Air Pollutant Emission Factors." Online at http://www.epa.gov/ttn/chief/ap42/index.html.

Background: Background air quality is the general concentration of pollutants in the air, not including the pollutants contributed by the source or sources under review.

Carcinogen: An agent capable of inducing a cancer response. Carcinogenic chemicals may act by initiation, promotion, and conversion.

CAS number: Chemical Abstracts Service registry number. Each chemical has a CAS registry number in order to ensure unique identification.

Ceiling Value: Acute HRVs and California Reference Exposure Levels with developmental endpoints should be considered ceiling values not to be exceeded. Adverse developmental effects could occur upon short term exposure to these chemicals at concentrations above inhalation health benchmarks.

Chemicals of Potential Interest (COPI): The chemicals known or reasonably expected to be emitted by a facility.

Chronic Exposure: Multiple exposures occurring over an extended period of time or a significant fraction of an individual's lifetime. For the purpose of AERA, chronic exposure is evaluated using an annual averaged ambient air concentration of a contaminant.

Criteria Pollutants: The pollutants for which EPA has established national ambient air quality standards. The criteria pollutants are: particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameters ($PM_{2.5}$), sulfur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), ozone, and lead (Pb).

Developmental Toxicants: Chemicals with acute Health Risk Values (HRVs) and acute Reference Exposure Levels (RELs) with "reproductive/developmental" listed as endpoint of concern (or toxicologic endoint). Exposure of a developing fetus or newborn to these chemicals for short periods of time during a critical period of development can result in severe adverse effects.

Dispersion Factor: a numerical value that represents the proportional relationship between an emissions rate from a stack or vent and the resulting ambient air concentration of the emittant.

Estimated Future Actual Emissions: The mass of pollutants emitted under an operating scenario that is reflected by some future business case that is not the "potential to emit" for the emissions source or facility.

Hazard Index: The sum of more than one hazard quotient for multiple substances with the same or similar toxic endpoints. For AERA purposes, at the screening level it is assumed all noncarcinogens have the same or similar toxic endpoint.

Hazard Quotient: The ratio of a single substance exposure level to an inhalation health benchmark (IHB) for that substance derived from a similar exposure period (e.g., Conc/IHB, where Conc is the air concentration for a particular contaminant, and the IHB is the inhalation health benchmark (RfC, HRV, etc.).

Hazardous Air Pollutants (HAPs): The 188 chemicals identified in the Clean Air Act. The specific list can be found at: http://www.epa.gov/ttn/atw/188polls.html.

Hierarchy of Toxicity Data Sources: MPCA and MDH guidance for the preferred order for the selection of toxicity data sources. Specific MDH guidance > MDH HRVs > EPA IRIS > CalEPA (OEHHA) > EPA HEAST.

Incremental Cancer Risk: Excess risk to an individual, over background risk of cancer, attributed to lifetime exposure to a cancer-causing chemical.

Inhalation Health Benchmark (IHB): A chronic IHB is a concentration in ambient air at or below which a chemical is unlikely to cause an adverse health effect to the general public when exposure occurs daily throughout a person's lifetime. An acute IHB is a concentration in ambient air at or below which a chemical is unlikely to cause an adverse health effect to the general public when exposure occurs over a prescribed period of time. For implementation purposes, acute IHBs are compared to one-hour averaged concentrations. A subchronic IHB is the concentration in ambient air at or below which the chemical is unlikely to cause an adverse health effect to the general public when exposure occurs on a continuous basis over a less than lifetime exposure. For implementation purposes, subchronic IHBs are compared to a monthly averaged concentration.

Modification: The definition for "modification" is provided in Minn. R. 7007.0100, subp. 14.

MPCA air pollutant identification numbers: MPCA has developed a system of applying identifying numbers to groups of chemicals that do not have CAS numbers.

Potential to Emit: The maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restriction on hours of operation or on the type and amount of fuel combusted, stored, or processed, shall be treated as part of its design if the limit or the effect it would have on emissions is federally enforceable. (Minn. R. 7055.0100, subp. 35a)

Qualitative Analysis: Refers to any pertinent information not represented by the estimated "risk" values generated by the RASS. The AERA qualitative analysis may include qualitative, semi-qualitative, and quantitative components.

Quantitative Analysis: The estimation of cancer risks and hazard indices using the RASS.

Risk: Characterizes estimated cancer risks and non cancer health endpoints.

Speciation: Chemicals are often a part of a larger group or class, such as polyaromatic hydrocarbons (PAHs). Speciation is a process in which individual chemicals emitted at a facility are identified and removed from the larger group or class for individual assessment.

Surrogate: In AERA, IHBs for specific chemicals have been applied to compounds, groups, or mixtures containing a fraction of that specific chemical. When a value that was developed for one specific chemical is a applied to other chemicals, that value is known as a surrogate value.

Toxic Endpoint: The endpoint of cancer for carcinogens or the organ or physiological system(s) affected by exposure to non-carcinogens. For carcinogenic chemicals, the organ or physiological systems are not differentiated, but all treated as a single endpoint.

Unit Risk: The upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 $\mu g/m^3$ in air.

Volatile Organic Chemicals (VOCs): Chemicals identified as participating in atmospheric reactions that contribute to the concentration of ozone in the ambient air. VOC is defined by EPA definition 40 CFR 51.100(s).

Introduction

This guide describes the MPCA's methodology for conducting a screening-level Air Emissions Risk Analysis (AERA). Permit applicants who use this guide and its associated forms will achieve reliable data, which MPCA staff can process efficiently. Because it is a guideline however, permit applicants may modify the methodology where appropriate, or choose not to use it. If applicants choose to modify or not use the methodology in this guide, they should inform MPCA staff early in the AERA process.

The AERA process described in this guidance document is designed to estimate potential public health effects from air emission sources, source groups, chemicals and associated exposure pathways. The MPCA uses the results from the AERA process (along with other factors) during the environmental review and permitting processes to make risk management decisions. Factors considered in the management decisions include which of the sources, chemicals and pathways (at least those over which the MPCA has some influence) clearly do not pose unacceptable risks or hazards to the public as a result of their emissions.

In this document, the term "risk" generally refers to estimated cancer risks and the potential for noncancer health effects. Noncancer health effects are described using a hazard quotient (for a single chemical) or a hazard index (the sum of hazard quotients for all noncancer chemical exposures). In the AERA process, "quantitative analysis" specifically refers to the estimation of cancer risks and hazard indices using the Risk Assessment Screening Spreadsheet (RASS). The AERA process additionally includes a "qualitative analysis," which identifies issues for which public health impacts cannot be easily quantified.

The quantitative portion of the AERA screening process can be iterative, starting with a conservative evaluation (i.e., considers a worst-case scenario) that identifies chemicals and issues that may require more refined analysis. The AERA process provides tools for several levels of refinement. Chemicals can be dropped from further analysis at any point through the refinement process if documentation is provided demonstrating that individual chemical cancer risks are less than 10^{-6} and noncancer hazard quotients are less than 0.1. Additionally, if the sum of the individual chemical screening level cancer risks is less than 1E-05 *and* the sum of the individual chemical screening level hazard quotients (i.e., screening hazard index) is less than 1, only the qualitative portion of the AERA need be considered in risk management decisions.

For the purposes of the AERA process described here, incremental cancer risks and hazard indices are those associated with emissions from a proposed modification to an existing facility, from a proposed new facility, or from the sum of a proposed modification and the existing facility, depending on the goal of the project. While the quantitative evaluation of emissions in the RASS is limited to the facility under review; quantitative or semi-quantitative information about nearby facilities and ambient air monitoring data may be considered in the qualitative analysis.

Odors are presently considered in an Environmental Review Worksheet (EAW) process and not within the AERA. For those facilities that complete an AERA outside the environmental review process, the MPCA will consider on a case-specific basis the need and the process for evaluating potential odor impacts. All facility AERAs assess chemicals that are associated with odors for potential health effects in the same manner as other chemicals (i.e., using readily available toxicity information).

The AERA process may be updated periodically to incorporate new information or to adjust the process in order to put forward the best possible information. These updates are likely to occur more frequently than this guide can be updated. The latest updates to the AERA process can be found at http://www.pca.state.mn.us/air/aera-archive.html. Project proposers should check this website prior to submitting an AERA.

Organization of this Guide

This guide describes both how an Air Emissions Risk Analysis (AERA) is conducted, and the process involved in reviewing and using the AERA results.

Section 1 – The AERA Process. This section describes when an AERA should be conducted, the process a project proposer should expect for contacting and involving the MPCA, how the MPCA will conduct reviews and other issues related to the process of conducting an AERA.

Section 2 - Preparing for and conducting the quantitative portion of the screening process. This section provides guidance on generating the list of chemicals emitted from a facility, estimating emissions for chemicals having an inhalation health benchmark value (IHB) in the risk analysis screening spreadsheet (RASS), selecting dispersion factors for generating air concentrations, and applying IHBs and multimedia factors to chemical concentrations to estimate risks (cancer risks and noncancer hazard indices). Additional guidance is provided on how to treat specific chemicals as well.

Section 3 – Preparing for and conducting the qualitative portion of the screening process. In addition to generating a quantitative estimate of potential risks, a more qualitative analysis is conducted. This portion of the analysis is designed to allow a project proposer and the MPCA to consider those factors that do not easily lend themselves to numerical risk estimates, or where generating a risk estimate could be done but with greater time and expense to a project proposer and the MPCA (e.g., developing IHBs for chemicals not quantitatively assessed). In some cases, issues identified in the qualitative section may be further assessed in a focused risk analysis.

Section 4 - Using the AERA results.
An MPCA technical team will be formed for a project and may be comprised of staff with expertise in engineering and permit writing, environmental review, risk assessment and dispersion modeling. The MPCA risk assessment, engineering, and modeling staff review a project proposer's emissions estimates, dispersion factor selection methodology, and output from the RASS along with a project's qualitative material. The Minnesota Department of Health's (MDH) guidance is also incorporated when appropriate. The MPCA staff generates a summary memorandum of the AERA—the quantitative results and key qualitative considerations—to support any recommendations made to MPCA managers for further action. Information

regarding a project's estimated risks and potential public health impacts is incorporated into the environmental review or air emissions permit for public comment.

The AERA Process

1.1 Overview of AERA

An overview of the AERA is provided in Figure 1. The beginning of the AERA can be viewed as screening, i.e., the initial examination of an emissions source or facility and its chemical emissions is broad in scope. Risk screening methodologies are intended to be high-end estimates to determine a "plausible worst case" situation among all of the individual risks in the population. This estimate is meant to describe individuals who, as a result of where they may live and what they do, experience the highest level of exposure within some reasonable bounds. The term *conservative* will be used in this guidance document to describe this level of analysis. The initially broad scope is narrowed through the application of risk estimating tools to screen out insignificant chemicals and sources while considering more qualitative (non-quantitative) factors. MPCA staff will consult with the Minnesota Department of Health (MDH) as needed throughout the process.

Issues may be identified through the screening portion of the analysis that indicate a more refined and less conservative analysis may be appropriate. In such cases, MPCA staff can provide further guidance on a course of action. In cases where further guidance from MPCA staff is warranted, staff with relevant expertise and MPCA program managers will participate in providing that guidance. Four possible courses of action that could result from the screening process might be:

(1) a more refined, but very focused, risk assessment of the issues identified through the screening process;
(2) no further analysis, and a project proposer can complete the environmental review and/or permitting process;
(3) implementing additional pollution prevention and/or mitigative measures to reduce or better disperse emissions may be considered; or
(4) if the AERA is part of an EAW, the recommendation may be made that risks be evaluated within an environmental impact statement or in a full risk assessment.

The scope of a focused risk analysis will depend on the specific issues identified in the screening analysis. Generic guidance for conducting focused risk assessments is therefore not included in this document.

Figure 1 provides an overview of the MPCA's AERA process described in this document.

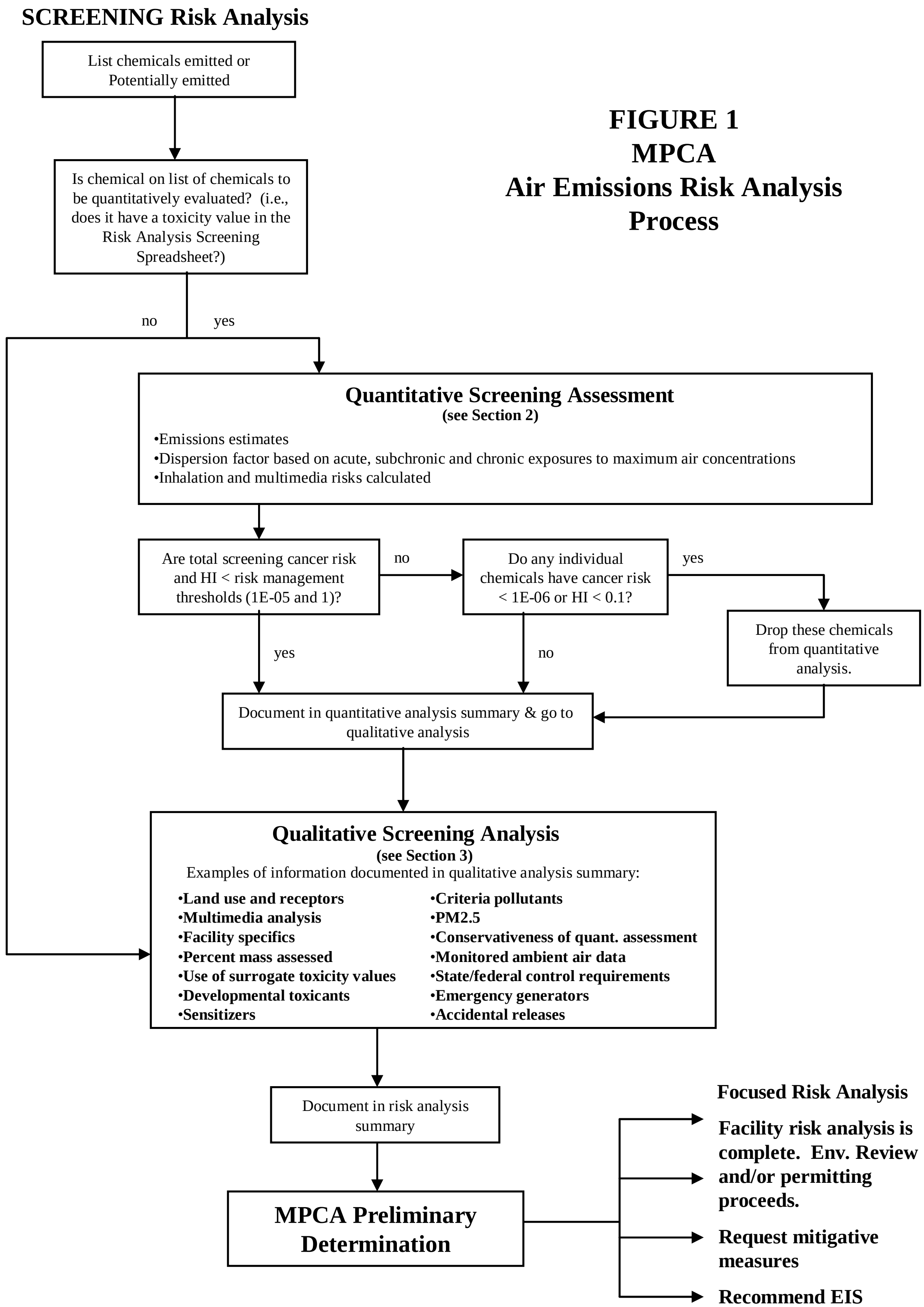

FIGURE 1
MPCA
Air Emissions Risk Analysis Process

1.2 Who needs an AERA?

An analysis of the impacts from air emissions is necessary when an Environmental Assessment Worksheet (EAW) or Environmental Impact Statement (EIS) is being conducted because the proposed project was identified as being one of the mandatory categories in Minn. R. 4410.4300, subp. 15. (A). or Minn. R. 4410.4400, or when air emissions of a single criteria pollutant are expected to be greater than 100 tons per year after the use of control equipment. The AERA process in this document has been designed for project proposers to use in conducting an analysis of impacts.

Environmental reviews of proposed electric production facilities greater than or equal to 25 MW are conducted by the Environmental Quality Board[1]. While the MPCA is not the responsible governmental unit for this environmental review, the MPCA will require the submittal of an AERA in accordance with this guidance in order to prepare an air emissions permit. To ensure smooth and timely consideration of all environmental factors, the project proposer should submit the AERA prior to the project's environmental review public notice period to allow the MPCA time to complete its review.

Feedlots requiring EAWs have a separate assessment process, described in Guidelines for Alternative EAW Form for Animal Feedlots and are not intended to be assessed under the process described in this document.

The MPCA may also direct a project proposer or facility owner to conduct an AERA when:

1) Substantive comments are received during a public comment period for an air emissions facility permit that might be resolved through the AERA process. In this instance, the permit can be issued containing the requirement to conduct the analysis, rather than delaying permit issuance until an AERA is completed;
2) The permittee is applying for a "flexible air permit" where a facility owner is seeking pre-authorized changes to a facility such that toxic emissions may be allowed to be changed without additional permitting;
3) At the MPCA's discretion: an existing air emission source is the source of significant public interest, or a new or existing facility is suspected of being an emitter of toxic substances that potentially represent a significant public health or environmental risk, regardless of environmental review or permit status.

Before an analysis is required in these three instances, MPCA permitting project staff will prepare a summary of issues that might be addressed through an analysis. MPCA staff and managers will then determine whether an AERA will be required of a facility.

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[1] The EQB has the responsibility for issuing siting permits for power plants equal to or greater than 50 MW, after it has completed its review. New power plants under 50 megawatts but over 25 megawatts do not require a site permit from the EQB, but do require an Environmental Assessment Worksheet under the Minnesota Environmental Policy Act (Minn. Stat. ch. 116D) and Minn. Rules, part 4410.4300. New power plants under five megawatts are exempt from any state environmental review, and plants between five and 25 megawatts are subject to discretionary review. Further information can be found at http://www.eqb.state.mn.us/EnergyFacilities/powerplants.html

1.3 MPCA's authority to regulate sources emitting Air Toxics.

The Minnesota Pollution Control Agency has authority to gather information that is relevant to pollution or to MPCA rules or statutes. Representatives of the MPCA may also examine records of all kinds and may have access to property to obtain information or conduct surveys or investigations. Minn. Stat. § 116.091. For air permits, a permit applicant is required to provide all information required by the rules and must supplement the application if all relevant facts have not been supplied.

The MPCA also has authority to craft permit conditions to prevent pollution and to protect human health and the environment, even though the requirements do not specifically exist in rule (Minn. Stat.§ 116.07, subd. 4a and Minn. R. 7007.0800, subp. 2). The general permitting rule also authorizes the MPCA to craft permit conditions that protect human health and the environment (Minn. R. 7001.0150, subp. 2). At this time, the AERA process evaluates only the potential for human health impacts, and does not include analysis of potential ecological impacts.

Minn. R. 7007.1000, subp.2 also provides the MPCA the authority to deny a permit if there is a potential for adverse effects to human health or the environment.

The MPCA uses its general authorities often in the development of permits and in enforcement actions. Staff requires information, records, data, testing, monitoring, reports and similar submittals to ensure that staff has complete information before making recommendations. Many permits contain facility-specific conditions based on the MPCA's general authority to prevent pollution and to protect human health and the environment. The MPCA's general authorities are important tools to insure that MPCA staff has the flexibility to respond to individual situations.

1.4 What is the process to review an AERA?

The MPCA assigns team members to projects undergoing the AERA process, and makes assignments as early as feasible. Team members may be assigned before a project's Environmental Assessment Worksheet or permit application is submitted if the MPCA is alerted about a pending project proposal. Team members include a manager, an engineer, a dispersion modeler, and a risk assessor. One of the team members will be assigned the role of project lead, whose role is described below.

The AERA review process begins with a project proposer's submittal of a completed RASS and supporting material. The MPCA and MDH both have roles and responsibilities in the review of the AERA. A flowchart showing the roles and responsibilities of staff within MPCA and MDH is depicted in Appendix A.

An initial completeness check of the AERA submittal is conducted before a formal review begins. A completeness check includes a review to ensure that forms, maps, electronic submittals, RASS worksheets and supporting information recommended in the guidance have been provided. If no further data are needed, review continues. If additional data appear necessary, the project proposer is notified, and further review ceases until those data are provided. When the data are provided, they are shared with the team members for review.

Each staff person conducts a review of portions of the AERA assigned to them using internal forms and checklists. Internal forms are the basis for determining the completeness and accuracy of the analysis. The information on the forms is summarized in an impact analysis summary memorandum.

1.4.1 Impact Analysis Summary

The impact analysis summary provides a concise memorandum of the AERA results, and highlights information that may affect the MPCA's recommendation regarding a project's future course of action. The memorandum describes the project in terms of risk, providing any qualitative information to describe what a risk estimate might mean. The memorandum may also contain recommendations for air emission permit limitations, and also provides general information regarding the facility that could be relevant and useful in communicating the results of the AERA and the MPCA's recommendations to the public.

1.5 How will the MPCA facilitate the AERA preparation and review process?

In order to ensure the best use of MPCA staff resources, the MPCA does not expect to conduct routine meetings with proposers regarding the AERA other than a project review kickoff meeting. After an initial screening of the AERA submittals is completed, meetings between the MPCA and project proposer may be necessary, but because the entire AERA will be understood by the MPCA staff as well as the project proposer, meetings and discussions will focus directly on specific issues because they will have been well-defined by the project proposer.

1.5.1 Project review "kick-off" meeting

The project review kickoff meeting is hosted by the MPCA to introduce to the project proposer, the project lead, staff and section manager assigned to review the AERA and subsequent permit applications. At this meeting, both the project proposer and MPCA staff raise potential issues surrounding the project, including the likely level of community interest and concern. The project proposer should also identify for staff the proposer's contacts for responding to comments from the MPCA's review of the AERA.

This AERA guidance does not require interim meetings and deliverables. However, the project proposer and MPCA may agree at a project kickoff meeting that based on project specific issues, meetings and interim deliverables are desirable.

1.5.2 Roles and Responsibilities

Within an AERA, the project proposer and MPCA have certain roles and responsibilities.

Project Proposer

A project proposer is responsible for collecting information related to the proposed project described in this guide, generating both the quantitative and qualitative analysis of risk from the project. A project proposer has a responsibility to provide complete and accurate information that is current as of the date of submittal and with best reasonable efforts. The project proposer will certify the accuracy and completeness of information provided as explained in section 1.7. The MPCA creates a staff team to conduct a review and generate project recommendations. Typical team members and their roles are as follows:

Permit Writer/Engineer

A permit writer assigned to the project is responsible for reviewing air emissions data related to the facility. Permit writers perform a number of tasks during the engineering review:

- determine completeness and quality of the emissions estimation information;
- confirm emission rate calculations, including reviewing existing and proposed control requirements and related permit requirements;
- determine whether additional information should be submitted by the project proposer, including whether additional refinements in emissions and/or improvements in air pollution control are necessary, and communicate that to the project proposer;
- assist in the drafting of the project's risk analysis summary by providing a description of the results of the engineering review and recommending permit limitations if necessary.

The engineer fills out an internal review form to document results of the engineering review of the emissions inventory and the emission rates. The permit engineer may request additional information from the project proposer prior to completing the engineering review, and consult with the dispersion modeler, risk assessor, and manager as needed. Results from the engineering review are relied upon by the risk assessor in summarizing the AERA process and results.

Dispersion Modeler

An internal form for modelers streamlines the review of dispersion factors (in terms of $\mu g/m^3$ per g/s) selected for use in the RASS. The internal review form documents any modeling staff recommendations. The dispersion modeler also consults with the permit engineer, risk assessor, and manager as needed.

Risk Assessors

A risk assessor conducts a completeness check of the AERA to determine completeness of the submittal and to preliminarily identify any issues that might influence the conditions in an air emissions permit or findings of an EAW. The risk assessor reviews both the quantitative and qualitative analysis contained in the AERA submittal, and will be responsible for preparing the impact analysis summary. The risk assessor also consults with the permit engineer, project proposer, dispersion modeler, MDH, and manager as needed.

Environmental Review Staff

An AERA is sometimes necessary as part of the environmental review process (see section 1.2). An MPCA staff person in the Environmental Review Unit is assigned for each project undergoing review. This person is responsible for the preparation of documents required of the MPCA by environmental review rules. In order to complete this work for proposed projects, the Environmental Review staff rely on the permit writer, risk assessor, dispersion modeler and others to provide information for the environmental review products.

Project Lead

One of the team members will be assigned the role of "project lead" during the project kickoff meeting. This person's role will be to track the progress of the preparation of an environmental review document, AERA and/or permit.. This person will also serve as a common contact person between the MPCA and the project proposer. The project lead most typically is the permit writer; however, environmental review staff has also been given this role.

Assigned Section Manager

The assigned section manager is one of the MPCA managers responsible for ongoing administration of the MPCA's air quality permitting programs. Section managers consider staff recommendations to create the MPCA's preliminary determination of the results of an AERA.

1.5.3 Assign the MPCA Section Manager at the start

The assigned section manager will typically be one manager with day-to-day permit management duties, but other managers may be assigned on a case by case basis. The project kick-off meeting will include assigning the section manager.

1.5.4 Resolve issues early (Dispute Resolution)

An AERA requires the expertise and judgement of many different experts. When faced with having to make choices in the AERA, each area of expertise uses significant professional judgement. Thus, there is often opportunity for legitimate differences of professional opinion that require resolution. The MPCA believes that most of these disagreements should be resolved as soon as the disagreement surfaces, at the level closest to the disagreement as possible (staff, supervisor, manager) and as quickly as possible. MPCA staff and supervisors work with the project proposer to resolve disagreements in as practicable a manner as possible. Most disagreements can be addressed in this manner. If a project proposer is not satisfied with the opinion of staff, they may contact the assigned section manager to discuss the issue and its resolution.

1.5.5 Involve Minnesota Department of Health as a team member

The Minnesota Department of Health supports the MPCA's toxics assessment process in many areas. Key to the success of an AERA and its review process is including the MDH as a team member during AERA production and review. The MPCA notifies the MDH when a proposed project is known and an AERA is likely to be conducted. The MPCA's request for a team member is made informally to MDH via phone or email.

The MPCA may also request assistance from MDH to review specific chemicals, to then advise the MPCA whether a health benchmark value can or should be developed. Both the MPCA and MDH recognize that developing these values requires effort and time. It remains the MPCA's policy that such requests will not stop AERA review or permitting work at the MPCA. Permitting will continue, and when an inhalation health benchmark for a particular chemical is developed, the chemical will be incorporated into the RASS for future analyses.

When the MPCA requests specific MDH guidance on a chemical, the MPCA will post a copy of its request on the AERA website. MDH's guidance will also be posted when received by the MPCA.

1.5.6 Standardized forms

To improve the time it takes to complete and review an AERA, the MPCA has developed forms. These forms are to minimise the amount of effort required to document each step of the risk analysis. Forms are also intended to standardize the location and reporting of common information. Forms are available on the MPCA's AERA website.

1.6 Community Involvement

The MPCA's goal is to involve communities early in the permitting process, learn of citizens concerns before a draft permit is placed on public notice, and engage people in a more constructive and positive exchange of information. In this process, "community" means any group or person that has an interest in the outcome of a MPCA permit. For example, groups could include neighbors, special interest groups, local governments, other businesses, groups within a project proposer's own company, and can even extend to other state and federal agencies interested in how a project affects their own missions and responsibilities.

Project proposers are responsible for conducting activities to involve the community early. Project proposers should not rely on press releases or the MPCA's public comment period to effectively communicate their projects' benefits or to learn the community concerns about potential impacts. Project proposers should actively engage community groups and local governments in conversation well before a project is submitted for environmental review or permitting.

At times, project proposers may benefit from mentoring by other businesses who have dealt with the MPCA and public concerns with regard to their own project. The Minnesota Chamber of Commerce represents project proposers who are successful community involvement practitioners and, if contacted, may be able to provide references. Other trade associations, business groups or local economic development agencies could also be contacted for assistance in locating mentors.

Local governments also need support and assistance in understanding impacts and consequences of new or expanding commercial and industrial facilities. The League of Minnesota Cities can offer support and direct local officials to expertise other cities have found useful.

Citizens are, of course, always able to provide comments during the public notice period of environmental review and permits. However, concerned citizens might find early contact with a project proposer more beneficial in terms of learning about a proposal and sharing concerns than waiting to express concerns during a public notice period. To this end, the MPCA is developing means of automatically notifying interested parties via electronic mail when the MPCA receives an air emissions permit application. A person can sign up at the MPCA's air emissions permitting website to be on the notification list.

1.7 Certification of Information Provided

An analysis of toxic air emissions prepared by a project proposer, using this guidance or a project proposer's alternative method, is a component of an air emissions permit application process, and like any other permit application, report or compliance certification, must be certified as to its truth, accuracy and completeness. This certification language is found in Minn. R. 7007.0500 Subp. 3, as follows:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for

gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete."

Preparing for and Conducting a Quantitative Air Emissions Risk Analysis

The purpose of this section is to provide guidance on preparing a quantitative analysis of facility emissions. This involves:

- generating the list of chemicals emitted at a facility,
- estimating emissions for the chemicals emitted with an inhalation health benchmark value (IHBs),
- selecting dispersion factors for estimating air concentrations,
- using the IHBs and multimedia factors in the Risk Assessment Screening Spreadsheet (RASS) to estimate potential risks, and
- documenting the results.

Risk estimates are limited by the types and amounts of chemicals that are included in the quantitative portion of the AERA process. The reliability of these estimates depends on the availability of health information and the quality and completeness of information put into the RASS. Properly identifying chemical emission rates and air dispersion parameters for the facility and applying appropriate health benchmarks are critical activities that significantly affect the quality of the quantitative risk analysis.

2.1 Overview of the AERA quantitative process

The quantitative analysis process is designed to use available toxicity information to estimate risks from facility emissions. The RASS was designed to estimate risks from inhalation of chemical emissions and from ingestion of any persistent, bioaccumulative, and toxic chemicals (PBTs) via selected exposure scenarios. In the RASS, facility air emission risk estimates are derived using the following three sets of information:

1) Chemical emission rate estimates for the operating scenario selected for assessment;
2) Air dispersion factors for acute, subchronic, and chronic exposure time periods; and
3) Toxicity information (IHBs and multimedia factors)

The risk estimates derived can range from general (screening) to more accurate (refined), depending on the level of effort and specificity used in producing emission estimates and dispersion factors.

The RASS incorporates dispersion factors (in terms of $\mu g/m^3$ per g/s) generated using a modeling program called DISPERSE (Dispersion Information Screening Procedures for Emission Risk Screening Evaluation) with facility-specific chemical emissions data to predict air concentrations. These concentrations are then used in combination with IHBs to generate inhalation risk estimates. For PBTs, the RASS multiplies inhalation risks by multimedia factors to estimate risks to residents from consuming home-grown vegetables and to farmers from consuming home-grown vegetables, meat and dairy products.

The RASS is intended to function as a screening tool, the purpose of which is to evaluate a fairly broad selection of chemicals initially. The screening process identifies and eliminates chemicals or their emission source(s) if cancer risks and hazard quotients do not present a level of risk that warrants further study (see Figure 1). When compiling the information needed to complete the quantitative analysis, the project-proposer may use relatively more conservative assumptions (which would result in higher screening level risk estimates) or may use more accurate (refined) information, which should result in more accurate risk estimates. It may be most convenient to begin by using more conservative assumptions for data that are more time consuming to collect, and refine the information as needed. In any event, the assumptions used should not underestimate risks for chemicals included in the RASS. If using conservative emission estimates or dispersion factors results in total facility screening level risk estimates above the risk management thresholds of 1E-05 cancer risk and hazard index of 1 (see Figure 1), it is highly recommended that project-proposers continue to refine the information to the extent possible using the AERA modeling tools.

The three primary components of the quantitative analysis are described in more detail in Section 2.3, Section 2.4, and Section 2.5, respectively.

2.2 Assessing Modifications at Existing Facilities

In addition to using AERA for new facilities, an AERA will be conducted at existing facilities when modifications or facility expansions are required to undergo environmental review.

Because modifications at existing facilities often include changes to existing emission units in addition to expansions, an AERA should be conducted for the entire facility based on conditions after modifications are made. If the estimated risks are below the MPCA's risk threshold goals, no additional quantitative risk analysis is necessary, and the project proposer need only complete the qualitative analysis. For proposed expansions to existing facilities requiring AERAs, project proposers should submit current facility emissions and total facility emissions after the proposed modification. This may result in two RASS and the supporting documentation

2.3 Identifying Chemicals Emitted and Estimating Emission Rates

This section describes the air emission sources to be assessed, the process for identifying emitted chemicals, chemicals that need to be assessed quantitatively, and emission estimation methods.

2.3.1 Identify and Define Emission Sources

Emissions from all units or sources subject to air emissions permitting are subject to assessment in an AERA, except for the units or sources identified below. An emissions unit is any piece of equipment or any process that emits pollutants into the air, including stacks and vents. Operations that do not have a specific stack or vent, but will exhaust into the atmosphere through building ventilation or escape through doors or windows (e.g. parts washers) are considered emission sources and will need to be included in the assessment.

Air emissions not emitted through stacks or vents are considered fugitive emissions and will need to be accounted for in the AERA. Examples of fugitive emission sources include volatile organic compound emissions from outdoor leaking valves, hydrogen sulfide from uncovered wastewater treatment plants, and particulates blowing from outdoor stockpiles. "Fugitives" released within a building should be assumed to be released to the outdoor air—most commonly assumed to discharge through the building's heating and ventilating system.

The RASS evaluates emissions impacts based on releases through “stacks”. Thus the characteristics of emission sources or points that are not stacks (windows and doors or fugitive emission sources) must be modified in some way to allow the RASS to predict dispersion and risk. Options for modification might include entering fugitive emissions in the RASS as though they would be emitted through a one-meter stack, using SCREEN3 or a more refined dispersion model to estimate ambient air concentrations.

2.3.2 Emission Sources that do not have to be quantified

Certain types of emission sources do not need to be included in the quantitative assessment, as described below.

- Exclude an “insignificant activity” as defined in Minn. R. 7007.1300 (and its associated emissions) from the quantitative risk analysis if:
  a) the activity emits a chemical that does not have an IHB listed in the RASS, or
  b) the activity emits a chemical that is also emitted by sources/units already included in the emission inventory, <u>and</u> the contribution of the individual activity is less than 1% of the total emission inventory for a chemical (hourly for acute and annual for chronic).

If an emissions source does not meet one of these two tests, then it must be included in the RASS. Some types of insignificant activities can emit substantial amounts of air toxics or small amounts of highly toxic chemicals; they should not be automatically excluded from the AERA process.

- Internal combustion engines associated with emergency generators and fire pumps are not quantitatively assessed. Further discussion of these sources is required in the qualitative portion of the AERA. See section 3.3.2 for the definition of “emergency generator” and additional guidance related to describing these emission units.

2.3.3 Identifying Available Sources of Emissions Information

The table below (Table 2-1) describes common sources of emissions information and the MPCA’s view of the quality of data each source provides. Often industry trade groups will maintain datasets for their members’ use which can be used to estimate source emissions. Additionally, simple Internet searches can identify similar facilities, especially those that have been permitted in other states. Other states’ analyses often can reveal additional emissions data points or sets that may be available for consideration.

The project proposer must also recognize that few data sources will contain emissions from emerging or novel air emission processes, that is, processes that are not common or have not had stack testing will likely not be included in databases. Reasonable effort is expected to identify toxic air emissions associated with these types of sources by examining the professional literature or interviewing expert authorities. Characterizing emissions from similar sources (e.g. by fuel type, process etc.) might be appropriate in these instances, while recognizing the attendant limitations as well.

Project proposers are expected to describe the process and effort expended in identifying chemicals of potential interest. At a minimum, project proposers are expected to identify the references consulted, the chemicals identified by the reference and whether a facility under review is expected to release the chemical. The MPCA may request copies of these reference materials as part of their quality assurance process.

Table 2-1 Types of Sources of Data for Air Toxics Assessments

Data Source Type	Comments on data quality
U.S. Environmental Protection Agency's (EPA) AP-42	Emissions data made available to or developed by EPA that EPA categorizes according to quality. Provides criteria pollutant emission factors and for most emission sources, toxics emissions factors. Also will often include emissions summaries for source types for which a MACT standard has been developed. See additional comments in section 2.3.1 of this guide. Easily accessible on the web.
EPA's Factor Information Retrieval (FIRE) Data System	EPA's "staging area" for toxics emissions factors. Somewhat complete information for combustion sources, but incomplete for emissions from manufacturing units.
Material Safety Data Sheets	Very reliable source of toxics content information for painting and other coating or evaporative uses. MSDS sheets are not reliable data sources for estimating the reaction products of emission sources where chemical reactions are involved.
• Air emission test data from a project proposer's own facility or similar facilities elsewhere • Chemical analyses of feedstocks and products	They are very useful for developing the list of chemicals emitted from a facility, along with an emissions rate. Cannot be used to exclude chemicals not tested.
• Peer-Reviewed technical literature • Conference proceedings • Trade organizations that maintain emissions databases or information • Industry publications • Trade group reports	Best engineering judgment and consideration of the following factors should be used when developing emission factors: (a) the precision and accuracy of the data (b) the design and operational similarity between the emission units (c) the size of the data set (d) the availability of data of equal or greater quality (e) operating conditions of the emissions unit when data was collected (f) the data analysis procedures
Document for the 2002 Electric Generating Unit (EGU) National Emissions Inventory (NEI) ftp://ftp.epa.gov/EmisInventory/draftnei2002/egu2002nei_final.pdf	Data are obtained using the Energy Information Administration (EIA) – 767 electric power survey. These are EPA derived emission factors.
California Air Toxics Emission Factors Search http://www.arb.ca.gov/app/emsinv/catef_form.html	California database of emission factors. May provide emission factors for chemicals not in other sources.

2.3.4 Identifying the Chemicals of Potential Interest

Once all relevant emission sources are identified, an inventory of chemicals emitted or potentially emitted should be provided. These chemicals are called Chemicals of Potential Interest (COPI). Emission rates should be estimated for the subset of chemicals on the COPI list with readily available IHBs, (i.e., those listed in the *ToxValue* worksheet of the RASS). A COPI list can be generated in the RASS by completing the *Chem wo IHB* worksheet. This worksheet includes HAPs without IHBs, respiratory sensitizers without IHBs, and then asks the project proposer to list additional chemicals emitted at the facility. This worksheet along with the chemicals quantified for risk estimates are the chemicals of potential interest.

Chemicals emitted but lacking IHBs are identified and described separately in a qualitative analysis (discussed in Section 3 of this guide). No chemical-specific quantitative analysis of these chemicals is necessary. However, as described in Section 3, a semi-quantitative analysis may be performed to inform the process. To determine the robustness of the toxics assessment, several comparisons of the types and amounts of chemicals are made (percent HAPs assessed, percent VOCs assessed).

2.3.5 Estimating Emissions of Air Toxics and Criteria Pollutants

The RASS is designed to assess inhalation health risks from short-term (acute), mid-term (subchronic) and long-term (chronic) exposures. Acute exposure is defined in this process as one hour of exposure to a chemical in the ambient air. Chronic exposure is defined as exposure to the average ambient air concentration during a year. Subchronic exposure for this analysis is defined as exposure over a one-month period. Multimedia exposures are also assessed for PBTs based on annual average concentrations. Annual and hourly emission rates for each chemical therefore must be determined to conduct the assessment. Air dispersion modeling output provides dispersion factors appropriate to convert the emission rates to average concentrations for the following time periods: 1-hour, 3-hour, 8-hour, 24-hour, monthly and annual. Using the appropriate dispersion factors, criteria pollutant air concentrations are estimated from the hourly and annual emission rates inputted into the RASS for the averaging times associated with their various state and federal ambient air quality standards. Monthly air concentrations for air toxics are estimated from annual emission rates.

The MPCA has developed guidance for estimating emissions to be used in an AERA, particularly when stack test data is used to develop a site-specific emission factor. This guidance includes the Agency's database hierarchy as well as the preferred statistical treatment of datasets with variation based on the exposure scenario(s) being assessed. The document is titled *The Emission Estimating Guidance for Use in an AERA* and can be found at http://www.pca.state.mn.us/air/aera-emissions.html#guidance.

One method of assessing emissions is to use emission estimates that reasonably represent an emissions unit, and are as precise as a project proposer initially chooses to make them. A project proposer uses these estimates in the RASS to generate a risk estimate. If the total estimated risks are greater than the risk management thresholds, a project proposer may choose to put efforts into a more refined analysis of specific chemicals or emission source conditions that represent the larger fractions of the risks. For example, the composition estimate of a coating might be further refined, or a stack test might be performed to better describe control efficiency or variability. In this way, an iterative method of estimating emissions based on the results of screening is used, focusing on chemicals and sources that drive potential risks.

Regardless, a project proposer must document the data sources used to generate emission estimates and the treatment of those data sources in producing the emissions estimate.

2.3.6 Choosing the operating scenario for assessment

Project proposers may choose to assess one or both of two facility operating scenarios:

- the proposed "potential to emit" as defined by permit conditions; and/or
- an emissions scenario that is not the PTE, but describes another level of emissions. The scenario could be "actual" or current emissions, "estimated future actual" emissions, that is, emissions of a future business case, or some other condition described by the project proposer.

The emission rates selected for assessment may become the basis for state-only enforceable limits within the facility's construction and operating permit. Limits within a permit include emission limits, operating or production limits, monitoring, recordkeeping and periodic reporting to the MPCA.

Existing and proposed permit limits and any other enforceable limits should be taken into account when determining emission rates. The operation of control equipment can only be taken into account if its operation is required by a permit or rule. Generally, the extent to which it is credited is dictated by the permit or rule requirements. For example, if the permit specifies a control efficiency limit, this value would be used to generate the emission rate in the risk calculations.

The effect of the emission limit should be carefully considered, however. If the limit results in limiting emissions during a calendar year, the limit can likely be used to lower the annual emission rate (that is, the emission rate used to calculate chronic exposure), but not the hourly emission rates. It is not appropriate to simply divide annual pollutant releases by operating hours without considering whether the emissions unit actually operates in this manner. This situation often arises with painting or coating operations. Often a permit will limit total chemical use during a month or year and complement the limit with recordkeeping; however, there is infrequently a limit on the rate of use within an hour. In this case, the hourly emissions rate would be the maximum process rate, regardless of annual emissions limits. The same situation applies to batch processes that last more than an hour and where emission rates fluctuate throughout the batch. The peak hourly rate for the batch must be considered for acute impacts.

2.3.7 Considerations when estimating "future actual emissions"

The derivation of emission rates should be documented in the submittal of AERA emissions data, regardless of the operating scenario selected for assessment. Assessment of some future expected emissions level is expected to reflect a business case, and not just an emissions scenario prepared for the purpose of conducting an AERA. Examples describing a future case might be a shareholder prospectus, a letter to a parent company, applications for business loans, internal capital equipment requisition requests, or other internal planning documents.

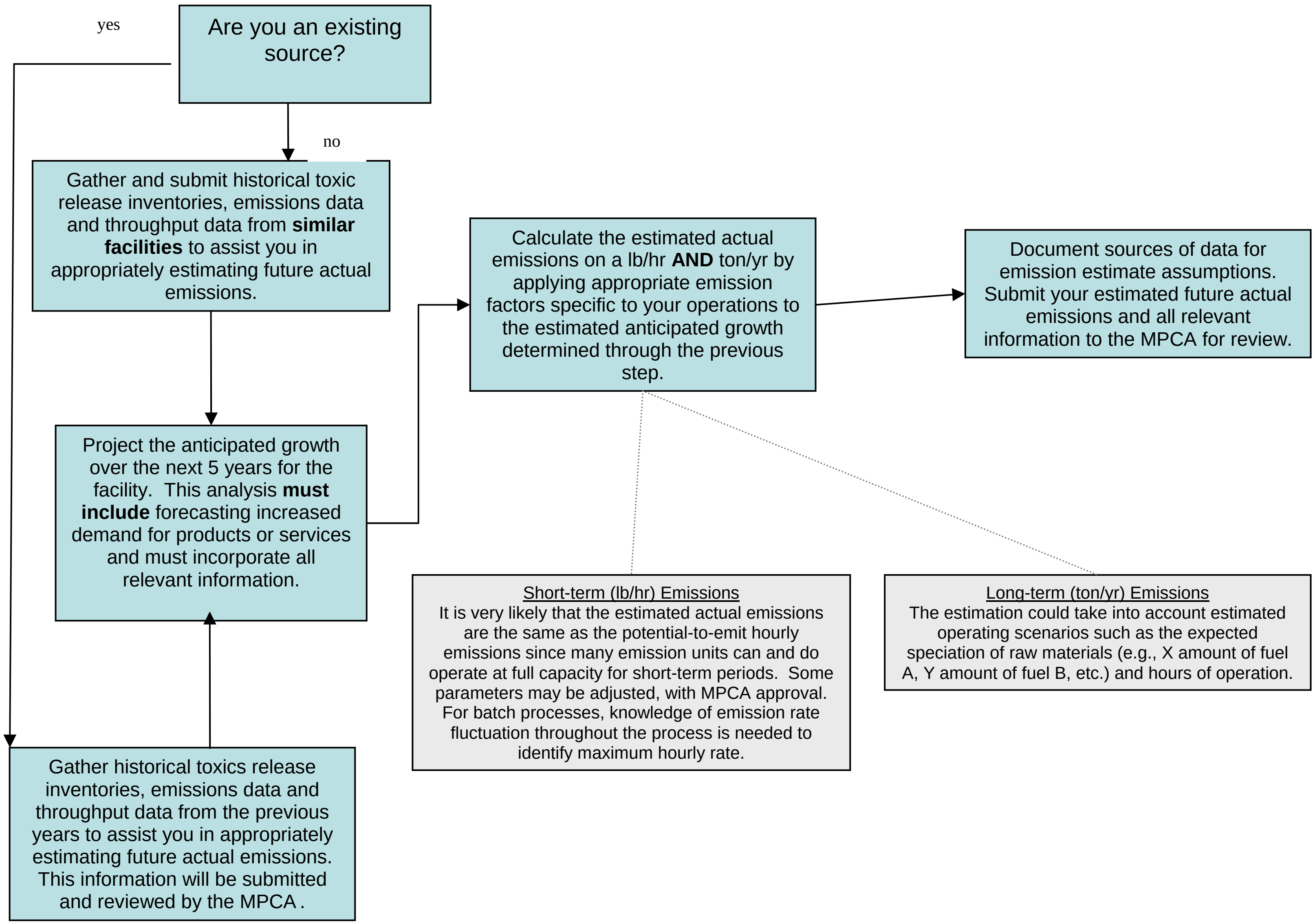
If the estimated future actual emissions are assessed, the emissions should be estimated looking forward for 5 years using all relevant data, including but not limited to historical operations and expected future utilization. In projecting future operations, it is recommended that a project proposer consider the highest projection of business activity that could be expected to be achieved, including any future increases in activity from increased demand for products or services produced at a facility. This definition of future actual emissions is not identical to its definition of “projected actuals” in the 2002 New Source Review rule changes in that in AERAs, the MPCA expect the project proposers to include business expansions, and not eliminate historical or baseline emissions.

If the AERA is being conducted for an existing facility, the MPCA requests that a project proposer include Toxic Release Inventories (TRI) within the AERA to provide a general confirmation of recent actual emission levels. TRI’s for three years should normally be sufficient, unless the project proposer believes that recent business cycles do not adequately reflect past actual business. In that case, the project proposer may choose to submit additional information.

Project proposers need to calculate a facility’s estimated actual emissions on both a short-term (lb/hr) and long-term basis (ton/yr). For short-term emissions, it is very likely that the estimated actual emissions are the same as the potential hourly emissions since many emissions units can and do operate at full capacity for short-term periods. However, certain parameters could be adjusted even on a short-term basis. For example, if an emissions factor is given as a range based on moisture content, for PTE the highest number should be used. For estimated future actual emissions, it may be possible to justify using a lower number based on the expected moisture content. If a project proposer has conducted performance testing and the MPCA has approved an emissions rate, factor, or control efficiency through the testing rules, this data could be used in estimating future emissions if it is relevant.

Figure 2 below provides an overview of the process for estimating future actual emissions.

Figure 2
Estimating Future Actual Emissions



2.3.8 Accounting for variability and uncertainty in air emissions estimates

Estimating emissions of air toxics can at times be more problematic than estimating criteria pollutants. The available dataset is often comparatively smaller meaning the variability of the emissions rates may or may not be well understood. The MPCA expects emission estimates to account for variability. Normal process, material and operating conditions can combine to affect emission rate estimates, estimates of risk, and if not considered, might make any subsequent permit limit difficult to comply with.

Next, recognize that in the quantitative evaluation, the MPCA seeks emission estimates that will not underestimate toxic exposures. Many emission factors are arithmetic averages of a data set, and should not automatically be assumed to be maximum emission rates for a source type on either a short or long term basis.

A key first step to characterizing a dataset and its variability is to assess the data quality. This includes making judgments about whether available data is relevant and that it is a reasonably representative sample of the population of interest and that the data is free of significant errors. Statistical tools can then be used to predict confidence intervals or estimates to present upper-bound emission estimates.

Before using EPA's AP-42 factors directly for estimating toxics emissions, MPCA suggests considering their derivation and applicability. AP-42 factors can be assumed to represent *long-term* emissions for a source, but care should be exercised when using them.[2] To further understand the nature of AP-42 factors, the user of this toxics screening procedure is directed to read the Introduction portion of AP-42, found on the Internet at http://www.epa.gov/ttn/chief/ap42/c00s00.pdf. AP-42 guidance directs users to review the literature and technology to be aware of circumstances that might cause sources to have emissions characteristics that are different from other typical existing sources.

Project proposers may be requested to provide a description of how these issues were considered in the derivation of emission factors for the project under review.

2.4 Dispersing emissions to generate ambient air impacts

After emissions have been characterized, the ambient air impacts from a project must be predicted. Air concentrations are generated in the RASS when chemical emission rates are multiplied by dispersion factors ($\mu g/m^3$ per g/s) obtained using one of the various methods described below. The RASS computes screening level acute, subchronic and chronic inhalation risks and multimedia risks for each chemical and computes the total risk for the mixture of chemicals assessed.

There are three categories of dispersion factors:

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[2] As an example, the analysis conducted on AP-42 factors for NOx from engines shows that their application must be well-considered. Frey, H.C. and Song, Li "Methods for Quantifying Variability and Uncertainty in AP-42 Emission Factors; Case Studies for Natural Gas-Fueled Engines" *J. Air and Waste Management Association.* 53:1436-1447, December 2003.

1. **Default.** EPA's new AERMOD dispersion model was pre-run by MPCA staff to generate dispersion factor tables based on default dispersion assumptions for use in the RASS lookup tables. These default dispersion factors are automatically selected from the RASS *DispTable* worksheet when the user enters stack height and the receptor distance of interest (e.g., fence line, nearest resident, nearest farm, nearest lake, etc.).

2. **DISPERSE batch program.** Rather than, or in addition to, using the default DISPERSE lookup table in the RASS, the user can use dispersion factors generated from the DISPERSE Batch Program, which also uses EPA's AERMOD dispersion model. The user must provide additional stack parameters and specific data to use the DISPERSE Batch Program. Appendix B provides an overview of how to do this. Detailed technical information on using the Batch program can be found in the AERA Guidance companion document, *"Dispersion Information Screening Procedures for Emission Risk Screening Evaluations (DISPERSE) with emphasis on DISPERSE Look-up Table and DISPERSE Batch Programs"*.

3. **Other.** Project proposers may also use dispersion factors from other site-specific modeling (e.g., PSD modeling or Title V modeling) if available. If using other site-specific modeling, users must set up the model to report the highest ambient value, not 2nd high or other lesser value as done in criteria pollutant assessments for comparison to NAAQS or PSD increments. Additionally, the model must be set up to report the highest monthly average in order to properly account for risks from pollutants that have "subchronic" health effects.

2.4.1 Combining Stacks with Similar Dispersion Characteristics

To accommodate multiple stacks more efficiently, it may be helpful to group stacks with similar dispersion characteristics such as stack height, stack diameter, exit velocity, exit temperature, and proximity to similarly sized buildings. "Similar" means stacks are located within approximately 100 meters of each other near similar sized buildings and stack parameters vary less than 20 percent[3].

2.4.2 Combining Stacks for use with Look-Up Table

Create different groups of stacks by combining those with similar heights in each group. Within each group, select the shortest stack height in the group. The look-up table reflects generally worst-case conditions for other parameters (i.e., stack diameter, stack exit velocity, stack exit temperature, and stack-to-building geometry).

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[3] See EPA document titled "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised". Pages 2-2 and 2-3 offer a more complex method for combining similar stacks. However, it must be repeated for each pollutant – this can be tedious if there are many pollutants (i.e., it uses individual stack emission rates and stack parameters). It may be useful for refined follow-up reviews (e.g., risk driver pollutants), but not the initial screening.

2.4.3 *Combining Stacks for Use with Batch Process*

Combining stacks for use with the batch process allows for grouping stacks with similar diameters, exit velocities and temperatures, and proximity to buildings. Additional instructions and guidance for combining stacks for the batch process are provided in the DISPERSE Guidance found in Appendix B of the AERA Guidance.

2.4.4 *Determining the Exposure Scenario for Selecting Dispersion Factors*

For an AERA screening process, the MPCA evaluates risks for receptors that could be located at area(s) of maximum facility-related chemical air concentrations. Concentrations are estimated at ground level receptors only; receptors at elevated levels are not considered in the AERA process at this time. For facilities with physical restraints limiting public access to their property, acute risks should be estimated for persons who could be located at the maximum hourly air concentration at or beyond their "fence line". "Fence line" is determined in a manner similar to the New Source Review analysis, and is determined by whether the public generally has routine access to a facility's property.

If physical access to a facility's property is not restricted, acute impacts should be assessed at the location of maximum hourly air concentration predicted anywhere (unless it falls over a building, in which case it need only be considered if there is public rooftop access). Chronic risks should be computed for potential receptors located at the maximum annual air concentration at or beyond the property "fence line".

Project proposers should include maps in the AERA material submitted to the MPCA to show property boundaries and fence lines. Clearly indicate whether a fence actually exists. Property boundaries alone are not sufficient to identify fence lines.

2.5 Applying Toxicity Information

MPCA intends to use the best readily available toxicity information to assess chemical emissions. Toxicity data sources that have undergone broad peer review were considered by the MPCA and MDH to be acceptable sources from which to compile IHBs. The MPCA and MDH view the hierarchy of toxicity data sources in the following manner:

Specific MDH guidance (e.g., HBVs[4] or an IHB developed for use on a similar facility) → MDH HRVs → U.S. EPA IRIS → California EPA (OEHHA) → U.S. EPA HEAST

Values undergoing review by these groups are not included in the RASS, but will be added to the RASS when finalized by the group.

Some chemicals persist in the environment, are bioaccumulative, and are toxic (PBTs). For these chemicals, toxicity information characterizing risks from ingestion exposures were used in conjunction with US EPA's Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities to derive default multimedia factors. These factors are approximations of the ratios of the maximum risk from indirect exposure pathways to the maximum risk from the

[4] In certain instances where there is new toxicological information or where no toxicity value exists, MDH may develop a Health-Based Value (HBV). HBVs are not promulgated, and therefore, should not be considered equivalent to HRVs. HBVs are similar to other non-promulgated MDH guidance and recommendations.

inhalation exposure pathway. The derivation of these factors is described in Appendix C. The factors can be viewed in the RASS in the *MMFactor* worksheet.

Some chemicals may be considered PBTs for which toxicity information is available with which to assess the ingestion pathways, but inhalation toxicity information is not available with which to assess the inhalation pathway. Because the RASS computes indirect pathway risks from inhalation risks, indirect risks for chemicals of this nature will not be computed. MPCA staff will, however, note these chemicals in the risk analysis summary. A list of chemicals considered to be PBTs is provided in the RASS in the *Chem wo IHB* and the *RiskCalcs* worksheets.

2.5.1 Health Benchmark Uncertainties

Section 3 discusses many of the qualitative pieces of information that will be considered when evaluating a facility's emissions. However, it does not include a review of the level of certainty surrounding the health benchmarks used in the risk calculations. For most facilities, only a fraction of the total 'toxics' emissions will be assessed in the RASS; the following discussion relates to that fraction only.

Inhalation health-benchmarks are generally derived as air concentrations likely to be without appreciable risk of harmful effects on humans. IHBs are derived by extrapolation from higher concentrations that have been shown in animals or humans to cause adverse effects. Standardized methods are used to determine the appropriate extrapolation methods.

With respect to carcinogenic effects, the IHBs are chosen so the additional lifetime cancer risk of an individual exposed for a lifetime to the IHB concentration is expected to be equal to or less than 1 chance in 100,000 (or 10^{-5}) of developing cancer.

For many chemicals, there remains uncertainty as to whether they can cause cancer in humans. National and international organizations publish scientific judgments regarding the strength of evidence linking the chemical (in any amount) to human cancer. This weight of evidence approach is one way to describe the uncertainty (or certainty) about cancer risks.

Exposures to air concentrations somewhat higher than the IHBs may also be without appreciable risk of harmful effects, but there is not enough information to know how much higher, if any, would be considered safe.

For chemicals with an extensive database of human toxicity information covering a broad range of concentrations, there is less uncertainty in setting the non-cancer IHBs, hence uncertainty factors may be relatively small. For other chemicals with more limited information, larger uncertainty factors are used in developing the IHBs. IHBs do not indicate at what higher concentrations detectable health impacts would likely occur.

In all cases, IHBs are set based on available knowledge demonstrating adverse effects. Some effects may be unknown and therefore not addressed by the IHB. For example, the toxicity information for any single chemical listed in the *ToxValues* worksheet of the RASS does not necessarily address all exposure periods (i.e., may cover chronic but not short-term exposures) or all health endpoints (i.e., may cover cancer but not noncancer endpoints, or vice versa). Some health benchmark values are developed lacking information about cancer or noncancer health endpoints (e.g., diesel HRV developed in absence of adequate cancer data and therefore may not be protective from cancer effects; many chronic noncancer IHBs were developed lacking developmental, neurotoxicity data). These data gaps must be recognized in the assessment of these chemicals. This situation, which is inherent in regulatory toxicology assessments, may or may not result in an underestimate of the potential for cancer or noncancer health effects for a given chemical.

2.6 Chemicals with additional considerations

The MPCA has found that several pollutants require careful treatment in emissions estimating and in determining their related IHB. Guidance for many of these chemicals is provided here. The MPCA's website should be consulted from time to time to identify additional policy decisions made after the release date of this manual related to special treatment of certain chemicals.

2.6.1 Criteria Pollutants

The ratio of the criteria pollutant concentrations to their respective ambient air quality standards (AAQS) may be an important consideration. An example would be when there are a number of irritant 'toxics' emitted at relatively high levels. Hourly and annual emissions should be entered for the listed criteria pollutants in the *Emissions* page of the RASS. Dispersion factors developed for the 1-hour, 3-hour, 8-hour, 24-hour, monthly and annual averaging times will be automatically extracted from the lookup tables in the RASS (*DispTables* worksheet) to predict air concentrations for the pollutants' various AAQS averaging time. Discussion of other methods for deriving dispersion factors can be found in Section 2.4.

While the RASS can be used to compare maximum estimated ambient air concentrations of criteria pollutants with AAQS, it cannot be used to document non-compliance with an AAQS. The modeling in the RASS reports the "high first-high" to predict ambient concentrations, while AAQS compliance documentation relies on the "high sixth-high".

2.6.2 Volatile Organic Compounds and Hazardous Air Pollutants

A project proposer should be aware of total HAPs and VOCs expected to be emitted at a facility. The RASS asks a project proposer to enter those totals for in the *Emissions* page. HAPs and VOCs are labeled for each chemical in the *Emissions* page and these are summed for each stack. The fraction of total VOCs and total HAPs assessed in the RASS is then displayed in the *Summary* page. This information is useful to the permit engineer and is also used by the risk assessor in the qualitative assessment, discussed in Section 3.

2.6.3 Nitrogen Oxides

While short-term (acute) exposure to nitrogen dioxide can result in adverse respiratory effects, there is not currently a national AAQS to protect against this exposure. An acute nitrogen dioxide IHB value developed by the California Office of Environmental Health Hazard Assessment and approved by the Minnesota Department of Health has therefore been included in the IHB database for NOx emissions screening. The user should input the hourly emission rate of NOx from a stack directly into the toxics assessment portion of the worksheet under nitrogen oxide (NO_2).

2.6.4 Lead

Lead emissions could result in exposure levels of concern at environmental concentrations less than the ambient air quality standard for lead. For that reason, an IHB value is included in the IHB database. In addition to entering lead emissions into the criteria pollutant portion, the user should also input lead emission rates directly into the toxics assessment portion of the RASS, where it will be screened using the California Reference Exposure Level (REL). The user should enter lead emissions under one or more of the following lead categories, as appropriate: lead, lead compounds or lead chromate.

2.6.5 Diesel Particulates

The Minnesota Department of Health has promulgated a chronic health risk value (HRV) for the pollutant "diesel particulates". This IHB was developed based on available information regarding noncancer health effects. For diesel-fired combustion sources, particulate emission rates of PM_{10} should be input into the risk estimation worksheet as "diesel particulate". This is an analysis of diesel emissions that is separate from analyses to predict impacts on the NAAQS.

2.6.6 Mercury

The RASS does not quantify the risks from consuming fish – the primary pathway of concern when mercury is emitted. There is a separate model developed by MPCA staff entitled Mercury Risk Estimating Method for this purpose that is available at http://www.pca.state.mn.us/air/aera-mercury.html. However, mercury can also be toxic when inhaled, and IHB values are included in the RASS to evaluate inhalation risks. See Section 3.4.6 for further discussion.

2.6.7 Chemical Groups and Mixtures

This section provides specific guidance for entering emissions of various chemical groups and mixtures into the RASS. If the facility emits chemical mixtures or groups other than those described below, a similar approach may be appropriate, but this will be reviewed by MPCA.

2.6.8 Air Pollutant Identification Numbers

If chemical-specific emissions information is available (and the Chemical Abstract Service [CAS] number of the emitted chemical matches a CAS number on the spreadsheet), then enter it directly. In some cases, emission estimates will be for a mixture or chemical group which may not have a CAS number. For example, many chemical groups listed as federal hazardous air pollutants (HAPs) do not have official CAS numbers. MPCA air pollutant identification numbers were developed to facilitate the tracking and analysis of chemicals and mixtures in the spreadsheet. A list of the MPCA air pollutant identification numbers for air emission mixtures is provided in Appendix D. MPCA may expand this list in the future

2.6.9 Surrogate IHBs for Chemical Mixtures and Groups

The intent of the AERA process is to quantitatively assess all emitted chemicals with readily available toxicity information. Toxicity information is not typically available for entire mixtures or groups of many chemicals, such as aldehydes, but an IHB may be available for one or more of the individual chemicals contained in the mixture, for instance formaldehyde. In general, as a rough screening measure, the entire mass of the mixture can be entered in the generic mixture row of the spreadsheet (e.g., aldehydes). Surrogate values are defined for AERA purposes as mixture IHBs derived from the most toxic chemical with an available IHB contained in the mixture.

Where surrogates were used to represent chemical groups or mixtures, they are identified on the *ToxValues* page to the right of the toxic endpoint column for the acute, cancer, and chronic and subchronic noncancer IHBs.

2.6.10 Assessing Chemical Mixtures or Groups in RASS

Specific examples for entering emissions of chemical groups and mixtures are described below. At the screening level, the emissions may initially be entered as chemical mixtures and groups, or may be more specifically characterized into chemical-specific emissions (speciation).
If the use of surrogate IHBs identifies the mixture or group as a potential risk driver, it should undergo additional evaluation with readily available emissions speciation information. A potential risk driver would be any chemical with a hazard quotient greater than 0.1 or a cancer risk greater than 1×10^{-6}. If speciation of the chemical group or mixture does not drop the total facility estimated hazard index or cancer risk below the risk management threshold, a project proposer may need to complete a more refined, focused, analysis.

2.6.11 Aldehydes

Specific IHBs are currently available for acetaldehyde, formaldehyde and glutaraldehyde. In some cases emissions may be reported more generally, for example, as "aldehydes". The screening spreadsheet is designed to assess undefined mixtures of aldehydes using the most stringent IHB. Mixtures of aldehydes should be entered in the aldehydes row, but if the emissions are reported in a speciated form (i.e., the emissions mass of the individual aldehydes are known), then the specific emissions of acetaldehyde, formaldehyde and glutaraldehyde can be entered into the spreadsheet and the "aldehydes" row can be left blank. The remainder of the mass should be included in the VOCs and total HAPs reported in the *Emissions* page of the RASS. Assessing total aldehydes using the more stringent IHB is generally more conservative.

2.6.12 Petroleum Hydrocarbons—Aliphatic (C7 – C11)

A health based IHB for the $C_7 - C_{11}$ aliphatic fraction of Total Petroleum Hydrocarbons was derived based on inhalation studies on de-aromatized petroleum streams in: *Development of Fraction Specific Reference Doses and Reference Concentrations from Total Petroleum Hydrocarbons*, Volume 4, Total Petroleum Hydrocarbon Working Group Series[5]. The value was based on aliphatic petroleum mixtures containing primarily $C_7 - C_{11}$ and minimal aromatics. Facility emissions of mixtures or individual chemicals that include primarily aliphatic hydrocarbons (in the $C_7 - C_{11}$ range) and with less than 1.5 % aromatics should be assessed with a chronic noncancer IHB of 5,000 $\mu g/m^3$, which is listed in the *ToxValues* page under "petroleum hydrocarbons, aliphatic ($C_7 - C_{11}$)". Consistent with the general approach described above for the treatment of mixtures, the mass of all aromatics with available IHBs (e.g., benzene) should be subtracted from the mixture to be assessed separately. If a petroleum hydrocarbon mixture

[5] http://www.aehs.com/publications/catalog/contents/Volume4.pdf

contains a higher fraction of aromatics than 1.5% and subtracting the mass of aromatics with IHBs reduces the fraction to less than 1.5%, the remaining mixture should be assessed using the recommended IHB of 5,000 µg/m^3. Information documenting the composition of the mixtures assessed with this IHB should be provided in the assessment.

2.6.13 Chromium compounds

IHBs for chromium VI (CAS# 18540-29-9) Cr(VI)) are presented two ways depending on the physical form (particulate matter or chromic acid mists and dissolved Cr(VI) aerosols. The noncancer chronic and subchronic IHBs are more stringent for the chromic acid mists and dissolved Cr (VI) aerosols. Similarly, lead chromate, strontium chromate and zinc chromate are chemicals containing Cr(VI) which can dissolve and form mists. The general group "chromium compounds" may also contain Cr(VI) in the dissolved form, so these are assigned the more restrictive values. Given specific knowledge that a facility's chromium emissions are not in a chromic acid mist or dissolved state, the emissions may be assessed using the Cr(VI) particulate IHBs. Similarly, to the extent that the chromium is known not to be in the Cr(VI) oxidation state, then those emissions are not quantitatively assessed using this spreadsheet. Instead these should be included in the qualitative analysis.

2.6.14 Glycol Ethers

If emissions estimates are reported generally as glycol ethers, these emissions should be entered as "glycol ethers", and will be assessed using the surrogate approach, which means the lowest (most toxic) individual glycol ether IHB will be applied to the entire mixture. Alternatively, IHBs for specific glycol ethers are included on the spreadsheet, and if speciated emissions information is available for all glycol ethers specifically listed in the RASS, it is not necessary to enter emissions in the general category "glycol ethers." Instead, the remainder of the mass should be included in the total VOCs and HAPs reported in the RASS *Emissions* page.
If speciated emissions information is available for some but not all of the glycol ethers, then the chemical-specific emissions should be entered in the CAS-specific row for these chemicals, and the rest of the glycol ethers mass should be entered under the general category "glycol ethers", MPCA Air Identification Number 0-01-2.

2.6.15 Polycyclic Aromatic Hydrocarbons (PAH)

Benzo(a)pyrene may be used as a surrogate for other polycyclic aromatic hydrocarbons (PAHs) if an appropriate IHB is not available. California EPA Potency Equivalency Factors (PEFs) also may be used to estimate their potency relative to benzo(a)pyrene (see Methods for Estimating Health Risks from Carcinogenic Polycyclic Aromatic Hydrocarbons, Minnesota Department of Health, May 29, 2001). If speciated emissions information is available for all the PAHs specifically listed in the RASS, it is not necessary to enter emissions in the general category "PAHs". The remainder of the mass should be included in the total HAPs reported in the RASS *Emissions* page. Screening emissions of all PAHs using the benzo(a)pyrene surrogate will generally be more conservative than using speciated information.

2.6.16 Polycyclic Organic Matter (POM)

Polycyclic organic matter (POM) is HAPs and is defined as organic chemicals with greater than one benzene ring which have a boiling point of at least 100.5 degrees Centigrade. The general category POM includes PAHs, dioxins, furans and many other chemicals. The screening spreadsheet uses benzo(a)pyrene as a surrogate for POM. This may not be a conservative assumption (e.g., if the POM were dioxins/furans). If dioxins or furans are present in the emissions, these should be specifically assessed on the spreadsheet and subtracted from the POM. If the POM emissions are speciated to identify the mass of all individual POM chemicals specifically included on the spreadsheet, then it may be unnecessary to include any other POM emissions on the row labeled POM in the spreadsheet. The remainder of the mass would be included in the total HAPs reported in the *Emissions* page of the RASS.

2.6.17 Dioxins/Furans

Dioxin and furan emissions should be entered into the spreadsheet in the most specific and appropriate category. The exceptions are dioxins/furans lacking a World Health Organization Toxicity Equivalency Factor (TEF). If a project proposer has converted the individual dioxin/furan congener emission rates to 2,3,7,8-TCDD equivalents, these emissions can be summed and entered into the RASS *Emissions* page on the line for 2,3,7,8-TCDD equivalents (Air Pollutant Identification Number 00-09-1).

2.7 Generating a Risk Estimate

2.7.1 RASS Inputs

Several pieces of information need to be entered into the RASS:

- Hourly and annual chemical emissions rates (Section 2.3)
- Information to select dispersion factors:
    - Stack height and receptor/fence line distance to use RASS default dispersion factors
    - DISPERSE batch program output for manual input
    - Alternative dispersion factors generated from site-specific modeling (Section 2.4)
- Mass of VOCs emitted (from permit application)
- Mass of HAPs emitted (from permit application)

2.7.2 Computing Acute, Subchronic and Chronic Risks

Current inhalation and ingestion health benchmarks are incorporated into the RASS, so once the project proposer has entered the hourly and annual chemical emission rates and the dispersion factor data into the RASS, risk estimates are calculated. If the facility is accessible to the public (per NSR “fence line” definition; see also Section 2.4), the receptor/fence line distance for the acute exposure scenario may be different from the receptor/fence line distance considered for subchronic and chronic exposures. If this is the case the spreadsheet should be used twice, once to assess the acute (1-hour) concentration and once to assess the maximum monthly and maximum annual concentrations. If the facility is not accessible to the public per the NSR definition, the RASS need only be run one time for the acute, subchronic and chronic exposure scenarios.

2.7.3 Eliminating chemicals or emission sources based on risk

As illustrated in Figure 1, the RASS can be used to focus the risk analysis at the screening level by identifying chemicals or emission sources associated with relatively low risk estimates, documenting this information, and excluding them from further assessment. Chemicals assessed using relevant exposure scenarios and found to meet the risk management criteria for relatively low risks can be dropped from further assessment at any point during the screening process, regardless of the summed cancer or non-cancer risk. The chemicals and sources must be maintained in the RASS, however; elimination of chemicals from further evaluation does not imply no risk. It means the contribution from these chemicals to the total facility risk is insignificant relative to the risks potentially posed by the chemicals retained for further analysis

The risk management criteria for relatively low risks are, for AERA purposes:

- chemical-specific hazard quotients of less than 0.1 (without rounding and including the sum across all exposure routes) and
- chemical-specific cancer risks less than 10^{-6} (without rounding and including the sum of risks across all exposure routes).

Chemicals at concentrations above the criteria are color-coded in the *RiskCalc* page of the RASS. The relevant exposure scenarios for most facilities include all estimated exposure times (chronic, subchronic and acute) and all relevant exposure routes (inhalation and ingestion) for a resident and farmer. In some cases where adequate land use documentation is provided, consideration of the farmer may not be necessary. As described elsewhere in this guide, the ingestion exposure route is only assessed for PBT chemicals.

The MPCA believes that the emission source and chemical elimination process will work most effectively by choosing to use default dispersion factors first, so that chemical emissions, sources, or source groups emissions sources are appropriately identified as not being significant contributors to a facility's air emission risk, and need no longer be considered in the assessment. Once the scope has been narrowed using the lookup table dispersion factors, the user may choose to run the DISPERSE Batch program to generate more site-specific dispersion factors, which can then be manually input into the RASS to overwrite the (usually) more conservative RASS lookup values. There are likely other ways as well of using the RASS to narrow the scope of the assessment to focus on risk drivers. Regardless, *documentation must be provided to demonstrate the rationale for excluding a chemical or emissions source from further analysis.* No forms are provided for this documentation. It is expected that the project proposer most frequently will simply submit multiple copies of the RASS for this documentation. Other methods are also possible. Regardless, the documentation must be clear about how the exclusion process was conducted.

2.8 Risk Characterization

The National Research Council (Science and Judgment in Risk Assessment, 1994) states that the risk characterization step "combines the assessments of exposure and response under various exposure conditions to estimate the probability of specific harm to an exposed individual or population." The risk characterization process integrates information from the hazard identification (chemical identification and emissions estimation), dose-response assessment (toxicity assessment), and exposure assessment (determination of who might be exposed and to how much) steps and 'translates' it to a form usable by risk managers, decision makers or the public. The hazard identification, dose-response, and exposure to how much steps are included in the quantitative portion of the AERA process, and are described in this section.

Who might be exposed beyond the default receptors evaluated in the quantitative portion is considered as part of the qualitative evaluation, as described in Section 3. When characterizing risk, key issues should also be identified (e.g., were estimated emissions or measured emissions data used, was a surrogate IHB used to represent a chemical mixture, was a small fraction of the mass emitted evaluated), and summarize overall strengths and major uncertainties. The type of qualitative information gathered (Section 3) is essential so that conclusions considering facility emissions in their proper context can be drawn.

The integration of the hazard identification and dose-response steps into risk estimates and their application in the AERA process are further described below.

Risks are calculated in the RASS tool using available IHBs. Chemical-specific risks are calculated and displayed in the *RiskCalcs* worksheet; total risks are summarized in the *Summary* worksheet.

2.8.1 Inhalation Risk Calculation

Noncancer IHBs for chronic, subchronic and acute exposure periods are listed in the *ToxValues* worksheet of the RASS. Unit risk factors are also listed for carcinogens. For each exposure scenario, the chemical-specific hazard quotients (i.e., ratios of the estimated air concentrations to their respective IHBs) are calculated and shown in the *RiskCalcs* worksheet. Air concentrations are multiplied by the available inhalation unit risk factors to estimate the chemical-specific inhalation cancer risks shown in the *RiskCalcs* worksheet. The *Summary* worksheet provides the summed risks (cancer risks and hazard indices).

2.8.2 Ingestion Risk Calculation

Multimedia factors for selected persistent, bioaccumulative, and toxic chemicals are used to estimate noncancer and cancer risks from ingestion exposures for resident and farmer scenarios. These multimedia factors are chemical-specific ratios of the maximum estimated risk from the ingestion exposure route to the maximum estimated risk from the inhalation exposure route. Multimedia factors are more fully described in Appendix C.

Multimedia factors for a farmer and a resident are multiplied by the chronic screening inhalation hazard quotients and the screening inhalation cancer risks to obtain screening level risks from ingestion exposure routes. The combined cancer risks and hazard quotients for the multimedia (inhalation and ingestion) exposure routes are then computed for individual chemicals (see the *RiskCalcs* worksheet). The risks summed across all chemicals (cancer risks and hazard indices) are shown in the *Summary* worksheet.

Preparing for and Conducting Qualitative Analysis of Risk

3.1 Introduction

The qualitative analysis is designed to provide supplementary information to the quantitative Risk Assessment Screening Spreadsheet (RASS) results for MPCA staff to consider in making preliminary determinations and recommendations regarding a facility. This section describes the supplemental information being sought, who will generate the information, how it might be developed and included within a project proposer's Air Emissions Risk Analysis (AERA), and how the MPCA will use qualitative information. A complete AERA includes *both* the quantitative and qualitative analysis of a project, regardless of the quantitative estimate or risk.

While the quantitative portion of the AERA using the RASS provides an estimate of risks for some of the chemicals emitted or potentially emitted from a facility, many potential issues cannot be easily quantified. Those impacts must therefore be treated in a more qualitative fashion.

Some of the information requested for qualitative consideration is directly related to emissions, but information related to a facility's location is also sought. Qualitative information is used to help describe a facility from the project start in the environmental review process, through preparation of an air permit and public comment periods, to the final deliberation and issuance of a construction permit.

Some of the information described below may have been compiled by a project proposer for other permits or reviews, in particular Environmental Assessment Worksheets. When information requested for an AERA process has already been generated, copies of that material may be substituted for or supplement the suggested submittals in this guidance.

It should be recognized that the MPCA cannot anticipate every potential project scenario or environmental impact; hence the analysis described herein may miss some potentially relevant information. If questions regarding any of the qualitative factors discussed in this section or other potentially relevant information arise during the preparation of an AERA and prior to submitting information for an AERA review, contact the project lead at the MPCA to discuss what information might be necessary.

Table 3.1 at the end of this section provides a summary of the issues to be considered qualitatively, the rationale for their consideration, and who will obtain and report the information.

3.2 Land Use and Receptor Information

Land use information is useful to identify relevant exposure scenarios (resident, farmer, fish consumption) and the probability of the presence of sensitive individuals. The following features related to land use and receptor information are expected to be discussed in the qualitative analysis. Project proposers are encouraged to provide maps whenever possible to help provide accurate descriptions and understanding of sites, neighborhoods, land use, proximity to water bodies, etc. The Minnesota Department of Natural Resources maintains a large set of maps on their website, as well as an internet-based spatial data acquisition site that allows users to download raw computer-readable data for use in their Geographic Information System (GIS), image processing system, or traditional database environment. Appendix F provides internet addresses for this website and other mapping resources.

3.2.1 General Neighborhood Information

The qualitative analysis should include a description of the general locale of the project proposal. The description should identify the neighborhood and areas of industry and other air emission sources of significance in the area. Specific interest in a project locale may include:

- Population within appropriate census tracts surrounding a facility
- Air Emission Point Sources identified by MPCA's air toxics emissions inventory
- Other air emission sources, industrial facilities, or environmentally sensitive areas

The MPCA will use existing internal databases to identify these features. If this material becomes available on the Internet, the project proposer may be asked to produce this information. The MPCA will use this information to describe the characteristics of the locale, and if it appears will help further describe a facility's impact, calculate a population risk.

The following summarizes the distances or radii from the source that should be considered when evaluating multimedia issues:

Stack height less than 50 meters: 1.5 kilometers (approximately one mile)
Stack height between 50 and 100 meters: 3 kilometers (approximately two miles)
Stack height greater than 100 meters: 10 kilometers (approximately six miles)

Zoning and land use maps should be based on a 10 kilometer radius, regardless of stack height. If zoning information only exists for a city, township, or county - that may be provided instead of 10 kilometer radius information. MPCA recognizes that some areas of the state do not have zoning information available.

3.2.2 Sensitive Receptors

For purposes of an AERA, sensitive populations are groups of people who, due to their age or health status, are sensitive to the presence of air emissions. Sensitive populations may include infants, children, pregnant women, elderly, asthmatics, athletes and sick or immuno-compromised people.

To provide information about the location of sensitive populations surrounding the facility, the project proposer's submittals should include maps identifying schools, daycare facilities, hospitals, nursing homes, recreational areas (including tennis courts and swimming pools), senior centers, and other public or private facilities at which sensitive populations may be congregated. The maps may be a sketch with distances and receptor locations identified. If a map is not readily available or feasible, these types of potential receptors should be described in writing and identified in the area around the facility. The maps or descriptions of sensitive receptor locations should include the area within a radius of at least 1.5 kilometers from the facility.

3.2.3 Multimedia Receptors

Another type of "sensitive receptor" is the population surrounding a facility that could be exposed to the persistent, bioaccumulative and toxic chemicals (PBTs) in a facility's emissions via the food chain. The PBTs emitted at a proposed facility may need some consideration beyond the indirect risks calculated in the RASS. If a facility does not emit the PBTs identified in the RASS, only the inhalation exposure route need be evaluated, and a project proposer need not submit the information below.

3.2.4 Farmers and Residents

While the RASS always computes inhalation risks to receptors located at the area of highest concentration (typically within a 2 mile radius for stacks less than 100 meters), the AERA process assumes the same receptor ingests any PBT pollutants a facility might emit via the food pathway. Using maximum estimated air concentrations, indirect risks are computed for two receptor types: a nearby resident who consumes vegetables grown in his or her own garden, and a farmer who, in addition to consuming homegrown vegetables, regularly eats home-grown meat and dairy products. Because of the large distance between farms, the likelihood of a farmstead currently existing at the location of maximum concentration is small, and the farmer risk may be greatly over-predicted. The project proposer may therefore choose to also evaluate risks to the farmers currently living nearest to the location of maximum concentration. AERA submittal forms ask whether this additional risk estimate was generated.

If no information is provided in the AERA submittal regarding land use, the default assumption will be that a farmer could be impacted by facility emissions, and the farmer's risks will be used as a basis for decisions. If land use information is provided to the MPCA indicating that the area within a 2-mile radius (6 miles for stack heights greater than 100 meters) is entirely residential (or that it is not and will not be agricultural), only the indirect risks for the resident (which will be lower than the risks to the farmer) will be considered in any risk-based determinations to be made regarding a facility.

3.2.5 Fishers

The RASS does not assess deposition to water bodies with subsequent accumulation in fish and humans consuming the fish. This is because of the very large variability surrounding water bodies such as watershed size, water body turnover rate, flow rate, etc. makes it difficult to describe appropriate assessment at this time. The MPCA has developed a model for estimating mercury concentrations in fish tissue based on air emissions attributable to a proposed source. This model also estimates a hazard quotient for mercury from fish consumption which may be added to the total non-cancer risk calculated for the residential receptor. This model is separate from the RASS and may be requested of a project proposer if the facility will be located in an area close to a fishable waterbody or if there are general concerns about exposure through fish consumption in the area. The model and guidance are available from the MPCA website.

The absence of a quantitative analysis for non-mercury PBTs is not because this pathway is considered to be of less concern than the other indirect pathways. In some cases, fish consumption could result in the highest risks related to the project being proposed. Polychlorinated biphenyls (PCBs) concentrations are already measured at levels of concern in fish in Minnesota lakes, and the Minnesota Department of Health (MDH) issues fish consumption advisories. Therefore, the information submitted regarding water bodies will be weighed to decide whether a focused risk assessment should be conducted to assess the risks from consuming fish. Some factors considered will likely be location of the water body relative to the emissions source, location of the water body relative to the area of maximum impact, the nature of the PBTs, and whether the water body can be considered “fishable”.

A water body may be considered “fishable” if it typically contains water year-round in a year that receives at least 75 percent of the normal annual precipitation for that area. For facilities with stack heights less than 100 meters, a map should be provided showing lakes, rivers and streams within a 3 km radius (approx. 2 miles). For facilities with stack heights greater than 100 meters, show lakes, rivers and streams for the area within a 10 km radius (6 miles). Also show water bodies outside the specified area that may be fed by rivers and streams lying within the radius of interest. The length of the reach of river or stream (or extent of a lake) outside the radius that must be shown will be determined case-by-case based on local data and conditions.

3.3 Emissions from Sources not Quantitatively Evaluated

This section describes how two types of emissions not quantified will be considered in a qualitative review.

3.3.1 Emission increases related to shutdowns or breakdowns

Minnesota’s Notification of Deviations, Shutdowns and Breakdowns rule (Minn. R. 7019.1000) requires the owner or operator of an emission facility to notify the MPCA of shutdowns or breakdowns that cause any increase in emissions.

The MPCA maintains a log of these notifications. In addition, a permit may require the facility to maintain records of start-up, shutdown, breakdown or malfunctions of operating units and/or control equipment. The MPCA will generate a report from the Incident Management System that logs shutdown and breakdown reports for the previous five years. Quantification of non-routine emission releases and associated risk is not expected initially and may never be requested.

Knowledge of a facility’s non-routine releases may be especially important if the chemicals released have acute effects. The release of developmental toxicants with ceiling concentrations from even a one-time release may be an important consideration about whether the facility presents a risk to its community. If a facility has frequent releases, this could become a risk concern for the local population. Facilities with a high frequency of accidental releases may need to amend their permits to account for the additional impact.

Additionally, if the facility is undergoing modifications, the MPCA will seek to understand the extent to which the modifications will improve the facility so that such releases are eliminated or significantly reduced.

3.3.2 Internal Combustion Engine Generators

Generators powered by internal combustion (IC) engines negatively impact local and regional air quality significantly.

In an AERA the project proposal is asked to describe the number and expected operation hours of all IC engines. If the IC engine is associated with an "emergency generator" or fire pump, the emissions and associated risk estimate of the engine is not quantified in AERA. All other engines are included if not exempted as an insignificant source. "Emergency generator" is a generator that is operated when unforeseen conditions result in disruption of electrical power to the stationary source. Emergency generators are used for orderly evacuation and shutdown of a process or a facility, and not for maintaining production, even at reduced levels.

Maintaining emergency generators as a backup power source is recognized by the MPCA as being essential; however, there is the potential for adverse health impacts to people living near a facility during the hours the equipment is being tested or operated. Testing regimens can be frequent, (e.g., weekly) and if there are many generators to test, the duration can be within a period of several hours. This results in very high localized concentrations of pollution which can represent significant risk. The MPCA therefore requests a project proposer to inventory and characterize emergency generators and fire pumps at the facility separately from the inventory of emission sources included in the risk estimate. AERA-04 form is used to describe the number, type and testing regimen of the engines. The form also requires that the facility owner certify that the engines are emergency-use only.

3.4 Chemicals and Emissions

Chemicals not assessed quantitatively need to be considered qualitatively to consider how well quantitative results might represent the facility's air pollution risks to the community.

3.4.1. Percent of Emissions Assessed

Percent mass quantitatively assessed at a facility is a qualitative consideration directly related to available IHBs. In the RASS the percent of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) assessed is calculated and presented on the *Summary* page. In many cases a project proposer will be unable to quantitatively assess a large portion of mass emitted. The MPCA recognizes that this is due to lack of substantial scientific knowledge on the majority of chemicals used in industry. Until additional chemicals can be added to MPCA's hierarchy, large percentages of mass emitted may not be assessed quantitatively. However, the remaining mass can at least be considered in a qualitative manner.

The MPCA is also aware that some projects may emit chemicals of potential interest that are not VOCs. In some cases these chemicals may be the primary risk drivers. If this is the case, this calculation should still be completed, however, the extent to which the information is considered will be relative to the type of chemicals that are of primary interest with regard to risk.

3.4.2 Mixtures and Surrogate Values

Chemical emissions are key pieces of information in conducting a risk analysis at a facility. Emissions for a certain chemical or compound may be reported in several different ways depending on the source. For example, emissions may be reported as mixtures, which can pose a challenge when assessing risk from specific chemicals at a facility. Other factors support the analysis, but without a comprehensive list of the individual chemicals emitted, and an IHB for each chemical, a risk analysis will underestimate the risk by some unknown amount. Many chemicals known to be emitted from facilities lack IHBs.

To improve the "completeness" of a risk assessment, common practice by risk assessors is to apply one IHB to a group of chemicals. Most frequently, the established IHB for a chemical contained in the group is applied to the entire mixture. The IHB for this group is then referred to as a "surrogate value". Surrogate values allow a project proposer to assess a greater quantity of mass emitted.

Surrogates may best be described through an example. For instance, when a project proposer reports selenium compounds, it's likely that the mixture contains selenium. Thus, the selenium IHB, or other worst case IHB, has been applied to the selenium mixture.

Calculating risks using surrogate IHBs to represent chemical mixtures introduces some uncertainty to the risk estimation. With a goal of not under-predicting risk, all available IHBs for chemicals in a given mixture are considered, and a chemical is selected because its toxicity relative to the other chemicals in the mixture is greater. There may, however, be instances in which the mixture contains chemicals with higher toxicity than the surrogate, in which case the potential exists for risks from the mixture to be under-predicted.

Chemical mixtures assigned with surrogate values are identified within the RASS to aid the project proposer and MPCA to identify those chemical emissions that might be further speciated, or where the MDH might be requested to develop a separate health benchmark value (HBV).

3.4.3 Sensitizers

Chemical sensitizers are of concern because these chemicals can cause severe adverse reactions sometimes at minute concentrations for persons who have been previously sensitized to the chemical. A person's initial exposure to a sensitizer may not result in an adverse response, yet that exposure may have resulted in a non-observable immune response. Subsequent exposures may then result in a much more severe response. A person's sensitized response may be from an exposure to a chemical that is only structurally similar. Sensitization reactions are sometimes very severe and can be fatal.

The qualitative analysis should identify those chemical "sensitizers" that are emitted from a facility. A number of these chemicals lack IHBs in the current hierarchy, or are included in the current hierarchy but with IHBs not specifically designed to be protective for sensitized individuals. Sensitizers are noted in the *RiskCalcs* and *Chem wo IHB* pages of the RASS. The MPCA staff note these chemicals in the qualitative summary.

If a project proposer knows of additional sensitizers not on these lists that are emitted, those chemicals should be noted also. Providing information on chemical sensitizers emitted will provide a more comprehensive picture of emissions from a facility and may also provide valuable information to the public.

3.4.4 Developmental Toxicants/Chemicals with Ceiling Values

Pregnant women are a sensitive subgroup who must be given special consideration in a risk analysis. Although many chemical exposures can have adverse effects to a pregnant woman and her fetus, chemicals that are developmental toxicants may directly harm a fetus. Unfortunately, most chemicals have not been tested for developmental effects; many chemicals have uncertainty regarding time of exposure and mass of a chemical necessary to generate developmental effects. Those chemicals for which sufficient scientific evidence was available to develop an IHB for developmental effects have been noted in the *RiskCalcs* worksheet of the RASS.

Of special import are chemicals with HRVs and California Reference Exposure Levels (RELs) that are known to be developmental toxicants. Acute HRVs with developmental endpoints are considered ceiling values which should not be exceeded, and have been identified in the RASS as chemicals with "ceiling values". The acute exposure, that is the resulting maximum estimated hourly concentration from a facility, is compared to the ceiling value to determine whether the ceiling value has been exceeded. Like chronic chemicals and other exposure scenarios, ceiling value chemicals with ratios of 0.1 of the acute threshold can be excluded from further analysis. Ceiling values do not apply to surrogate values.

The MPCA will review RASS worksheets to note whether ceiling value chemicals are emitted, and note if the predicted ambient concentration exceeds the ceiling value.

3.4.5 Identifying PBTs without multimedia factors

PBTs are noted in the *RiskCalcs* and the *Chem wo IHB* pages of the RASS. Given the limited number of PBTs with IHBs and multimedia factors in MPCA's hierarchy, it's possible that a facility may emit PBTs that are not assessed in the quantitative analysis. When this condition exists, the additional PBTs are noted in the AERA for consideration in the qualitative assessment. The PBTs without a multimedia factor, but for which an average annual emissions rate has been estimated can also be included to describe in a qualitative manner expected impacts from PBTs.

3.4.6 Mercury

Risks from the inhalation of mercury from a facility are evaluated in the RASS. Impacts from ingesting mercury-contaminated fish are not easily assessed because the magnitude of the risk depends on the presence and nature of surrounding water bodies. The MPCA may request or conduct a separate analysis of this exposure pathway based on the nature of the land and the presence of waterbodies in the project area. A model for this analysis has been developed by the MPCA as discussed in this document and is available on the MPCA website. Project proposers for sources identified in the MPCA's guidelines for new and expanding sources of mercury air emissions should be prepared to discuss with the MPCA the likelihood of mercury emissions' impacts on local waterbodies. These guidelines, provided on form Hg-01 on the MPCA's website[6], require that taconite production, secondary metal processors, the combustion of fuels in

[6] http://www.pca.state.mn.us/publications/forms/hg-2003.doc

electricity generating stations and industrial boilers (except when burning only natural gas), and sewage sludge, municipal or other incineration must identify mercury inputs and environmental releases.

3.4.7 Criteria Pollutants

Like many toxics, several criteria pollutants are respiratory irritants. While the risks computed in the RASS are just those of the toxics, the ratios of the criteria pollutant concentrations to their respective ambient air quality standards (AAQS) may be an important consideration, especially when there are a number of irritant ‘toxics’ emitted at relatively high levels. Dispersion factors developed for the 1-hour, 3-hour, 8-hour, 24-hour, monthly and annual averaging times will be automatically used from the lookup tables in the RASS (*DispTables*) to predict air concentrations for the pollutants’ various AAQS averaging time.

3.4.8 $PM2._5$

$PM_{2.5}$ is considered an important pollutant because it is associated with a range of potential health effects. $PM_{2.5}$ is a criteria pollutant, and is not assessed using the IHBs commonly used for air toxics. $PM_{2.5}$ is emitted directly from a source’s stack (“direct” or “primary” emissions), and is also formed in the atmosphere downstream from a stack (“secondary” emissions, which form from precursor gas emissions secondarily in the atmosphere, at some distance from the emission source).

In addition to qualitative assessment, direct emission estimates of PM2.5 are required for the quantitative portion on an AERA. The quantitative part will focus on direct PM 2.5 emissions entered into the Risk Assessment Spreadsheet (RASS) for a screening-level dispersion analysis and comparison to ambient standards. The MPCA expects emission sources that emit PM from external combustion boilers and internal combustion engines, and other processes (SCC codes greater that 30000000) that do not generate direct PM from material handling, screening, transfer and conveying, loading, unloading, grinding, crushing, and storage, to examine their emissions in the AERA. The simplest and most conservative way to estimate direct PM2.5 emissions is to assume PM2.5 emissions are equal to PM10 emissions. In this case, PM10 emissions should be entered into the PM2.5 row in the RASS. Predicted concentrations will be compared to the PM2.5 NAAQS.

Although uncertainties remain in estimating the formation of secondary $PM_{2.5}$ from precursor gas emissions, the U.S. Environmental Protection Agency (EPA) now requires the states to report $PM_{2.5}$ emissions from point sources to EPA. On June 20, 2003, EPA published notice in the Federal Register (68 FR 36982) that the Consolidated Emissions Reporting Rule would take effect requiring the States to report $PM_{2.5}$ emissions from point sources to EPA beginning with the 2002 inventory year. This report was due to EPA in June 2004.

$PM_{2.5}$ emissions primarily result from combustion sources, and so for these sources estimates of filterable $PM_{2.5}$ emissions are included in the risk analysis summary information. The MPCA has developed a guidance entitled *Estimating PM2.5 Emissions for an AERA* available at http://www.pca.state.mn.us/publications/aq9-12.pdf. Information regarding the reliability of emission factors will be included in the summary of $PM_{2.5}$ emissions.

3.5 Additivity by Toxicity Endpoint

One conservative feature built into the RASS is that hazard indices for non carcinogens are summed regardless of toxic endpoint. The RASS automatically adds all individual chemical hazard quotients to determine one total hazard index when in reality, the individual chemicals in the sum likely impact several different organs or systems. A refined analysis would allow for summing the chemical hazard quotients to several hazard indices, one for each organ or system. If a project proposer undergoes a reasonable amount of refinement focusing in other areas and is still unable to calculate a noncancer hazard index below the risk management threshold, chemicals may need to be broken into toxicity endpoints. This would need to be done in a more refined and focused analysis because using target endpoints requires a greater level of MPCA staff input and review (the different sources in MPCA's hierarchy of IHBs list target endpoints in different ways). Project proposers must seek guidance from the MPCA's assigned risk assessor before starting this process.

3.6 Conservativeness of the Quantitative Analysis

In the impact analysis summary, MPCA staff provides an analysis using professional judgment as to the conservativeness of the quantitative analysis. A number of the important factors which may play a role in understanding the degree to which the quantitative RASS results are (or are not) conservative include, along with any other considerations:

- Completeness and accuracy of the emission inventory:
- Possible receptor locations at elevations above ground level or other situations which may lead to the modeled ground level concentrations to underestimate ambient exposures;
- Availability of inhalation health benchmarks and multimedia factors to assess emitted pollutants;
- Adequacy of the available toxicity measures.

3.7 Ambient air concentrations of toxic chemicals

Minnesota has multiple monitoring stations throughout the state collecting samples of ambient air to record air quality data. Most stations are in the metro area. These stations provide an indication of ambient air concentrations in a particular area or region. Information on pre-existing ambient air concentrations of pollutants that may also be emitted from the project is considered by the risk managers in their preliminary determinations regarding the project.

In preparing the risk analysis summary of an AERA, MPCA staff includes a summary of representative ambient air monitoring results. The MPCA has ambient monitoring information available through its website and the MPCA may request a project proposer to summarize such information.

3.8 Additional Chemicals with Evidence of Risk

In some cases, there may be strong evidence of toxicity or health impacts associated with an emitted chemical based on information from sources of toxicity information beyond the MPCA's standard sources. In other cases, a chemical without a hierarchy IHB may be emitted in large quantities. Either case may be an indication that a specific chemical or chemical mixture may pose a substantial health concern, and it is possible that this additional chemical or mixture would be considered along with the qualitative and quantitative information. If it is concluded that development of an IHB is warranted, the MPCA will request a value from MDH. The MDH's development process will continue concurrently with the AERA process, and will not otherwise delay the project proposers' development of an AERA or the permitting process.

3.9 What state or federal control requirements apply?

EPA has promulgated National Emission Standards for Hazardous Air Pollutants (NESHAPs) to control releases of the 187 HAPs identified in the Clean Air Act, which subjects certain types of emission units to common, industry-wide control requirements. Additionally, the use of air pollution control equipment or process changes to reduce criteria pollutant emissions will also have some benefit in controlling toxics emissions.

The MPCA impact analysis summary for an AERA includes a description of whether an emissions unit has an applicable standard, especially for emission sources that are emitting significant quantities of toxics. The summary may describe whether existing regulatory controls provide control or reductions of toxics.

Project proposers should present risk estimates to the MPCA that have been refined to the best of their ability. If estimates are greater than acceptable risk management thresholds, a project proposer must then demonstrate that no additional or effective means of lowering toxic emissions are reasonably available. This demonstration should show that both technical and economic feasibility have been considered.

The MPCA may also direct a project proposer to consider additional controls when the qualitative analysis under the AERA process indicates there may be a risk of adverse effects upon public health, even if that risk cannot be precisely quantified.

3.9.1 Is there a reasonable level of emissions control?

A demonstration that reasonable levels of control are used by a project proposer is prepared by the project proposer when the AERA's estimated risks are above risk threshold goals. Demonstration of reasonable control should be conducted in a "top-down" approach, similar to the methods used in best available control technology and lowest achievable emissions rate (BACT/LAER) analyses.

The applicability of federal NESHAPs may not be assumed to represent reasonable levels of control until EPA completes the residual risk analysis for the NESHAP. NESHAPs do not necessarily reflect an adequate level of control because their risk reduction potential has not been assessed. Emission limits within NESHAPs were often set at the "MACT floor" suggesting that other means were available that achieved higher degrees of toxics control. Background Information Documents (BIDs) prepared during the development of NESHAPs describe various control methods, and potentially related costs. BIDs should be reviewed as a part of an analysis of additional control devices.

3.9.2 Demonstrating technical feasibility when a risk estimate is greater than a threshold

When considering whether a source is reasonably controlled, all feasible alternatives for controlling emissions must be identified and described. Several issues related to toxics controls are highlighted here:

1. Consider how well pollutants are captured (e.g. hood capture efficiency, ventilation/control VOC losses during equipment transfer). The chemicals *not* captured but released as fugitive emissions may have significant impact on estimated risk levels. Also, being able to direct pollutants to a stack where they might be released with some buoyancy would improve dispersion and lower ambient concentrations.

2. A list of air pollution control technologies that may be applied to the source should be identified and evaluated. The control alternatives should not be limited to existing controls for the source category. The list should include controls applied to similar types of sources, innovative control technologies, modification of the process or process equipment, pollution prevention measures, and a combination of these measures. Measures must be listed in descending order of air pollution control effectiveness. If the most effective measure was not selected for use in the project, then the following should be demonstrated:

    a. The more effective measure is not technically feasible, and
    b. The economic feasibility in terms of total and incremental costs for the more effective and selected measure.
3. In addition to add-on control devices, the project proposer should also describe whether inherently less-emitting processes could be substituted.

Project proposers may choose any method to identify control technologies. Information sources to check are databases or guidance maintained by other states. California maintains a BACT clearinghouse that can be accessed to identify control techniques for various emission sources. New Jersey has guidance referred to as "State of the Art" (SOTA) guidance.[7]
A demonstration of the economic feasibility of the level of control used is required if the most effective measure of controlling air emissions was not selected for a project or emissions unit. The project proposer must show whether the total and incremental costs are higher with the more effective measure than the proposed measure, and that the extra costs would make the more effective measure unreasonable.

The total and incremental costs should be calculated using the methods found in EPA Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual[8].

"Total cost" means the total annualized cost of the control measure. This means that costs should include both capital and annual operation and maintenance costs, and should be reported as the annual cost of installing and operating the control measure.

"Incremental cost" means the difference in the total annualized costs between each control measure within the hierarchy developed in the demonstration of technical feasibility.

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[7] California's BACT page: http://www.arb.ca.gov/bact/bact This page also has links to the California air districts' individual BACT clearinghouses. New Jersey State of the Art guidance: http://www.state.nj.us/dep/aqpp/sota.html

[8]U.S. EPA Office of Air Quality Planning and Standards Control Cost Manual. Available on EPA's website at http://www.epa.gov/ttn/catc/products.html#cccinfo

3.9.3 Using BACT/LAER determinations to show reasonable level of control

BACT/LAER analyses conducted during new source review (NSR) permitting may be used to support making a technical and economic feasibility demonstration for toxics controls, provided the analysis considered the degree of control of such air emissions. In order to use a BACT analysis for describing toxics control, the effectiveness of the various control alternatives in the hierarchy developed for controlling NSR air pollutants should also describe the device's effectiveness at controlling air toxics. The EPA new source review guidance also suggests that risk assessment techniques can be used within a BACT analysis when considering environmental impacts, and may become a critical component of the overall BACT analysis. The screening process defined within this guide may be used to estimate risk from various control options.

Table 3.1
Qualitative Issues to Consider in an Air Emissions Risk Analysis

Qualitative Section	Who Does It?	How it is done	Rationale and Resources
Site Setting	Project Proposer	Provide information such as population, and population density available. Maps or general description information can be provided. Can provide an estimate of the number of people who live in the vicinity of the facility, which is necessary to estimate population exposures.	U.S. Census Bureau MN Census Quick Facts U.S. Census Quick Facts
Receptors and Sensitive Populations	Project proposer	Map showing residences, schools, daycares, recreation centers/playgrounds, nursing homes, hospitals within appropriate distance from the facility. Lists may be needed for supplemental information.	This information could help demonstrate that a facility with a borderline risk estimate is not a significant threat, e.g., few receptors, no apparent sensitive receptors. Alternately, the presence of more sensitive receptors would lead to relatively greater potential impacts.
Land Use	Project Proposer	Map showing "current and reasonable potential" land use surrounding facility. Supplement with relevant ordinances that would inform potential exposures, e.g. raising chickens in town. Land use includes, but is not limited to farming, forests, residential and industrial areas. It is recommended to verify information with a site visit.	If no map is provided, MPCA will assume the most restrictive land use. MN County Land Use Maps MN Land Use and Cover USGS
Zoning	Project Proposer	Map and/or description of zoning.	Zoning maps are searchable on the internet for most counties in Minnesota – use your preferred search engine to find "MN zoning maps"
Nearby Facilities	Project	Map and/or list of facilities with air emissions within	Provides general awareness of potential impact from

	Proposer	appropriate radius of the facility. This is not limited to facilities with air permits.	nearby contributing sources. MN Environmental Data Access What's In My Neighborhood?
Fishable Water Bodies	Project Proposer	Map with labels of fishable water bodies. Information on accessibility to water body should be provided when available.	Lake Finder
Farming Locations	Project Proposer	Map showing farming locations surrounding facility. Additional information regarding crop types, animals raised, number of animals, farm size, and other qualitative information about the farm can be provided when available.	MN County Land Use Maps

Qualitative Section	Who Does It?	How it is done	Rationale and Resources
Criteria Pollutants	Project Proposer	Spreadsheet compares AAQS to "High first High" modeled concentrations. This has typically been required for air toxics evaluations.	Provides additional information when hazard indexes are near one.
PM2.5	Project proposer	Updated guidance on PM2.5 is now available allowing for direct PM2.5 emissions to be considered in the AERA.	Estimating $PM_{2.5}$ Emissions for AERAs http://www.pca.state.mn.us/publications/aq9-12.pdf
Mercury	Project proposer, MPCA EAO staff, MPCA mercury	Project proposers for sources identified in MPCA's guidelines for new expanding sources of mercury air emissions must identify mercury inputs to and environmental releases from their facility/processes. If fishable water bodies are within a 3 km radius of the facility (when stacks are < 100	Over 80% of lakes assessed in Minnesota are considered impaired due to mercury contamination; consumption of mercury-contaminated fish can be harmful to people and wildlife.

	coordinator	meters), information submitted by proposer will be weighed to decide whether a focused analysis should be conducted to assess risks from consuming fish.	
Surrogate health benchmarks as Risk Drivers	Project proposer, MPCA EAO, MDH	Surrogates are labeled in the RASS. Project proposer may seek to further refine or speciated composition of mixtures with surrogates to apply IHB more selectively. MDH may develop IHB for the mixture (e.g., MDH may recommend using IHBs for other petroleum mixtures in Total Petroleum Hydrocarbon guide).	Use of surrogates to evaluate mixtures provides a rapid method of assessing emissions, and allows resources to be focused where necessary (only on potential risk drivers). Use of surrogates may help identify chemicals for which MDH could develop new IHBs.
Sensitizers	MPCA EAO staff	Chemicals in this category are noted in the RASS (RiskCalcs and Chem wo IHB pages). May be considered along with quantitative information.	Provides potentially important information to public (previously sensitized individuals may benefit from this information).
Developmental Toxicants	MPCA EAO staff	Chemicals are labeled in RASS if they are developmental toxicants. The acute IHB for these chemicals are “ceiling values”, and EO staff note if these chemicals are predicted to exceed its IHB in the analysis.	Developmental effects are serious and irreversible; acute benchmarks should be considered not-to-be exceeded ceiling concentrations since exposures to concentrations above the HRV/REL will increase the likelihood of damage.
Chemicals lacking health benchmarks	MPCA EAO staff, MDH	EO staff review list of chemicals emitted (emissions not quantified). Using professional judgment/new information, EO and /or MDH staff may indicate a significant issue.	MPCA is responsible for environmental protection, and needs to leave open the door for unforeseen chemical issues that may arise. These chemicals will have evidence of potentially significant risk.

Qualitative Section	Who Does It?	How it is done	Rationale and Resources
Emergency Internal	Project proposer	Project proposer provides information on AERA-04 (AERA Emergency Internal Combustion Engines).	NOx emissions can show elevated acute hazard indices from internal combustion engines (including natural gas);

Combustion Engines			short-term exposure to NOx at high concentrations can trigger asthma attacks in pre-disposed individuals.
Percent Mass Assessed	Project proposer	Project proposer inputs mass of HAPs and VOCs emitted from the facility into RASS, which automatically calculates percent of VOCs assessed.	Aids in elucidating completeness of quantitative risk estimates. If a very small percent of toxics mass emitted is assessed, qualitative factors may become more important to MPCA's preliminary determination. Project proposer may seek MPCA guidance on what additional effort may be needed to further evaluate toxics, or more effort to reduce exposure may be appropriate.
Accidental Releases	MPCA EAO Staff	MPCA staff query the Incident Management System to generate a list of facility reports of startup, shutdown and malfunction events from last 5 years. This is merely a report of incidence, not a quantification of emissions. If applicable, this will be answered in the AERA Impact Analysis Form	Release represents exposure to some unknown level of risk. Frequent releases indicate an operation that may be more likely to have future releases that are not being considered in the risk evaluation. Especially important if developmental toxicants with ceiling concentrations are emitted. Frequent breakdowns could be brought to the attention of the project proposer for explanation, and whether it's being fixed in project proposal.
State and federal requirements	Project proposer, MPCA permitting staff	MPCA reviews project proposer's analysis of whether emissions unit has an applicable standard. MPCA permitting staff may also provide guidance on whether more effective control measures are available.	If an emissions unit does not have an applicable standard, or the standard appears to be insufficient, the project proposer prepares an analysis of technical, economic feasibility of additional pollution control equipment.

Qualitative Section	**Who Does it?**	**How it is done**	**Rationale and Resources**
Toxicity Endpoints	Project proposer, MPCA	If HI is above one, MPCA may consider if the HI should be divided into target organ-specific Hazard Indexes. Project proposer must seek guidance from MPCA EAO before staff will accept and review	Calculating hazard indices by endpoint is appropriate but is a more refined analysis than initial screening

	EAO staff	endpoint derivation. Future guidance documents will provide more direct instruction.	
Conservativeness of Quantitative Assessment	MPCA EAO staff	Environmental Outcomes staff will prepare a subjective assessment as to the overall conservativeness of the submittal. Factors considered can include emissions estimates, dispersion modeling, toxicity assessment, other.	Provides for interpreting the meaning of results and potential for impacts.
Monitored Ambient Air	MPCA EAO staff	Environmental Outcomes staff will be notified and asked for: maximum and average criteria pollutant and air toxic concentrations from monitors. A standard report will be produced of all pollutant concentrations monitored at representative station(s). Some professional judgment will be used.	This information may be requested by the public (or perhaps already known by the public if the pollutant is a common one, e.g., benzene). Important information for MPCA to consider if pre-existing concentrations of chemicals proposed to be emitted are already at levels of concern.

Using the AERA Results

This section describes how MPCA staff considers information gathered through the AERA process, the MPCA's review, and the recommendations that may be made as a result. The MPCA expects that the project proposer will consider conducting a reasonable level of refinement as described in this guidance before submitting the AERA and related permit applications to the Agency. If it appears that the project proposer has not taken steps to refine the analysis, the MPCA may ask a project proposer to do so or to consider further emissions reductions methods prior to the MPCA making any preliminary determinations that would be included in an environmental review or permit.

At the conclusion of their AERA review, MPCA staff summarizes the quantitative and qualitative information submitted for a proposed project in a written memorandum. The risk summary memorandum is used in supporting decisions related to environmental review or a permit.

If quantitative analysis indicates that the sum of the individual chemical screening level cancer risks is less than 1E-05 *and* the sum of the individual chemical screening level hazard quotients (i.e., screening hazard index) is less than 1, *and* qualitative factors do not appear to depreciate this, then, generally, the project should not need further analysis and a project proposer can complete the environmental review and/or permitting process.

Sometimes after using the refinements to the quantitative analysis described by this guide, the sum of the individual chemical screening level cancer risks may be greater than 1E-05 or the sum of the individual chemical screening level hazard quotients (i.e., screening hazard index) may be greater than 1. Alternatively, the quantitative analysis may show risk estimates below these values, but qualitative factors may suggest that environmental or human health issues remain. In those cases, the MPCA will discuss the analysis with the project proposer to consider appropriate courses of action. The risk summary memorandum will be prepared for this discussion, so that issues identified can be described as:

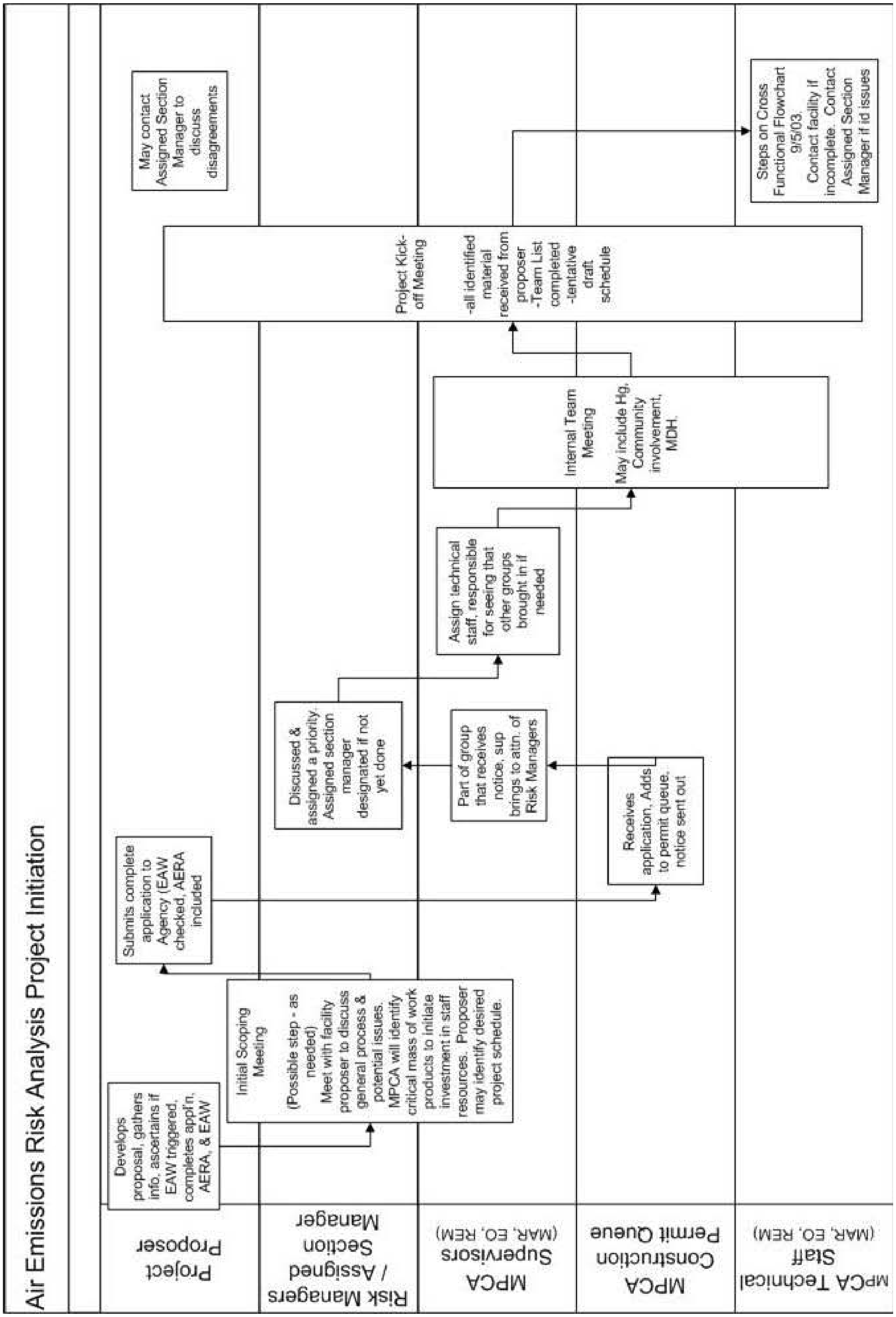
- Issues that might be further clarified or resolved using a more refined, focused risk analysis, or
- Issues exist for which a refined analysis would not provide more useful information for decision-making.

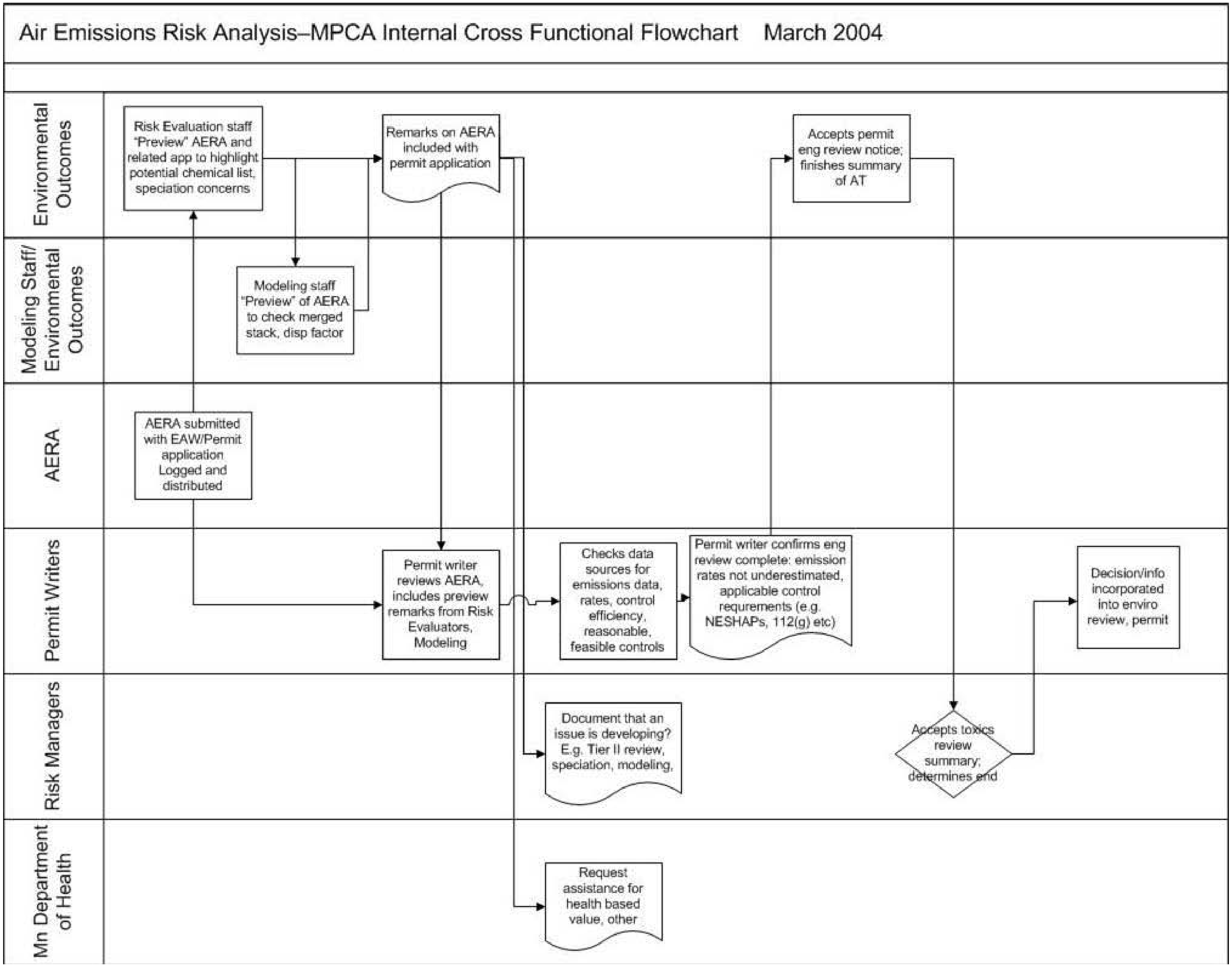
It is as this time that, in addition to discussing further risk analysis, the MPCA will discuss other options with the project proposer. The options may include implementing additional ambient air or stack testing g, additional permit limits, or other mitigative measures, e.g., using additional pollution prevention or pollution control equipment or changes in stack parameters.

If an AERA analysis that shows an unacceptable level of risk is part of an EAW, it may become necessary to recommend that the issue of risk be evaluated within an environmental impact statement. This recommendation would be considered if it appears that alternatives to the project itself exist.

The public has an opportunity to comment on the MPCA's preliminary decisions that incorporate the results of the AERA. This opportunity is made available through the public notice period for a project's environmental review and/or on the air emissions permit.

Appendix A: Initiating the AERA Review




Air Emissions Risk Analysis–MPCA Internal Cross Functional Flowchart March 2004
Environmental Outcomes
Modeling Staff/ Environmental Outcomes
AERA
Permit Writers
Risk Managers
Mn Department of Health
Risk Evaluation staff "Preview" AERA and related app to highlight potential chemical list, speciation concerns
Remarks on AERA included with permit application
Accepts permit eng review notice; finishes summary of AT
Modeling staff "Preview" of AERA to check merged stack, disp factor
AERA submitted with EAW/Permit application Logged and distributed
Permit writer reviews AERA, includes preview remarks from Risk Evaluators, Modeling
Checks data sources for emissions data, rates, control efficiency, reasonable, feasible controls
Permit writer confirms eng review complete: emission rates not underestimated, applicable control requrements (e.g. NESHAPs, 112(g) etc)
Decision/info incorporated into enviro review, permit
Document that an issue is developing? E.g. Tier II review, speciation, modeling,
Accepts toxics review summary; determines end
Request assistance for health based value, other

Appendix B: Installing, Running and Interpreting Disperse Output

This section acts a quick reference for new users when installing and running DISPERSE, specifically the DISPERSE Batch Program. For more specific information, please refer to the DISPERSE Guidance found on MPCA's air toxics webpage.

The MPCA has developed an Excel spreadsheet tool for use in the Air Emissions Risk Analysis (AERA) process titled the Risk Analysis Screening Spreadsheet (RASS). The RASS has several components used to determine screening risk of air emissions from a particular facility. The RASS uses a MPCA modeling program called DISPERSE to develop dispersion factors that are used emissions data to generate air concentrations and risk estimates. DISPERSE uses U.S. Environmental Protection Agency's (EPA) new AERMOD dispersion model to generate dispersion factors that are used in the DISPERSE lookup tables and in the DISPERSE Batch Program. The DISPERSE outputs are next entered into the RASS to compute risk estimates from dispersion factors, inhalation health benchmarks (IHB), multimedia factors, and emission rates.

Overview of the process: How is DISPERSE used?

The DISPERSE lookup table can be found in the *DispTables* worksheet in the RASS. If the user chooses to do a quick and (usually) conservative first-pass analysis, they would enter stack height and receptor distance information in the *StkDisp* worksheet of the RASS, and a dispersion factor is automatically selected from the *DispTables* worksheet. If results from this analysis, found in the *Summary* page of the RASS, are unacceptable and the default modeling assumptions are likely to over predict air concentrations for the facility, the facility may run the DISPERSE Batch Program, which allows the user to enter more facility-specific information.

DISPERSE Look-Up Tables

The DISPERSE look-up tables in worksheet *DispTables* were generated as rapid screening tools to determine a facility's potential to impact the surrounding environment and population. The tables provide 1-hr, 3-hr, 8-hr, 24-hr, monthly, and annual dispersion factors in units of $\mu g/m^3$ per g/s. The look-up tables were generated so that the user may automatically extract the dispersion factors corresponding to the stack height and receptor distances entered in the *StkDisp* page.

Because the look-up tables lack detailed site-specific information (i.e., temperature, velocity, building size and location, and land use), they use worst-case values for these parameters. Each stack is centered on a square building to reasonably maximize building downwash[9]. For facilities with multiple stacks, a preliminary and conservative evaluation might be to group similar stacks and evaluate the group at the lowest stack height. Combining stacks and maximizing building downwash generally yields relatively high predicted concentrations. Guidance on combining stacks is provided in Section VI below. Depending on the results of the preliminary analysis, the user may wish to analyze each stack separately and then combine the results with other stacks so that a facility's total risk is estimated.

The program conservatively addresses different distances to maximum impact for different stack heights via its "at & beyond" algorithm which selects the maximum impact at and beyond some

[9]Downwash is enhanced turbulence near buildings.

appropriate distance from the stack (e.g., stack-to-building edge distance, or stack-to-fence line distance).

Assumptions used for the DISPERSE lookup table:

The following combinations of land uses, building sizes, and stack parameters were used to determine dispersion factors.

- Meteorological data from 1986-1990
- Stack height (1m, 2m, 3m, …, 99m)
- Stack diameter (1 percent of stack height)
- Exit temperature (293K)
- Exit velocity (1m/second)
- Building height (1m less than stack height)
- Building length (twice the building height)
- Building width (twice the building height)
- Land use (cropland; deciduous forest, and a 50/50 mix of cropland and deciduous forest)

How to Run the DISPERSE Batch Program

Overview:

A facility may choose to start directly with the DISPERSE Batch Program, skipping the look-up tables in lieu of a somewhat more facility specific screen. The batch procedure runs a MPCA FORTRAN program which prompts the user for modeling information, similar to EPA's SCREEN3 model. The program asks for several specific pieces of information:

- stack information (stack height, stack diameter, exit velocity, and exit temperature);
- appropriate Land Use Land Cover (LULC) option,
- Building Profile Input Program (BPIP) option,
- meteorology option (1986-1990);
- stack location relative to the building center (if applicable).

MPCA default values are offered for cases where values are not readily available or known to the user.

The batch procedure generates two types of files. The summary report provides dispersion factors for various receptor distances. The summary figures visually depict dispersion factors surrounding the facility for 1-hour, 3-hour, 8-hour, 24-hour, monthly, and annual averages for maximum values[10].

Installation:

Before starting, be sure that the disk that will hold this file has sufficient space. Once extracted, DISPERSE requires about 35 MB of storage. Note, the internal working files in the DISPERSE batch programs are called CAPTAPSA (Criteria Air Pollutant and Toxic Air Pollutant Screening with AERMOD).

To install DISPERSE, please do the following tasks in order:

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[10] Additional information on the summary figures can be found in DISPERSE Guidance.

1. Create a sub-directory (folder) named DISPERSE (this can be on any drive, the results will be written to this same folder);
2. Copy the zip file (DISPERSE1.ZIP[11]) to the sub-directory
   a. From the web, double click on the zipped file, you'll get a message box asking whether you want save to a disk or you want to cancel
   b. Click on save to disk and save to the DISPERSE folder created in Step 1;
3. Unzip the zip file to extract the executable programs, batch files, meteorological data, and FORTRAN source code.
   a. To extract the files, go to your DISPERSE folder;
   b. Double click on the zipped file DISPERSE1.ZIP
   c. A WinZip – DISPERSE1.ZIP window will appear
   d. Click on Extract on the tool bar
   e. A message box that identifies your designated folder should pop up, click on extract

How to Run:

From file manager or Windows Explorer, double-click one of the batch files (BATCH1.BAT or BATCH2.BAT) in the DISPERSE sub-directory. Both batch files perform similar tasks; however BATCH2 has more intermediate displays.

1. The first prompt asks the user if they want to do a test run. A first-time user may choose to run one of four **test runs** in the program. These four options have fewer prompts for information and will acquaint the user with the program.
   a. Tests 1 and 2 will take the least amount of time. Tests 3 and 4 become progressively more complex and will therefore increase the amount of time the program will run.
   b. A user may simply type **N** for no and hit **enter** to skip the four test runs.
2. After choosing **N**, to skip to the non-test program, the user must devise a title and hit **enter**.
3. Type **stack height (**in meters), enter **0** if unknown. Default value is stack height = 1 meter.
4. Type **stack exit temperature** (in degrees Kelvin), enter **0** if unknown. Default value is stack temperature = 293K.
5. Type **stack exit velocity** (in meters per second) enter **0** if unknown. Default value is 1 meter per second.
6. Type **stack diameter** (in meters), enter **0** if unknown. Default value is 1% of stack height.
7. Is **building downwash**[12] possible? Type **Y** for yes and if unknown. Type **N** for no.
   a. If user chooses **Y**, a BPIP[13] option must be selected.
      i. Type **1** for MPCA default values: a simple one-tiered square building scenario with a building height one meter below the stack height.
      ii. Type **2** for user defined values: a simple one-tiered rectangular structure with user defined building parameters. This option requires some facility-specific information.
         1. User will be prompted for information on building height, east-west length, and north-south length.

[11] DISPERSE1.ZIP is ~5MB. Its unzipped files require ~35MB.

[12] To see parameters explaining when building downwash is possible, see DISPERSE Guidance.

[13] Additional information on BPIP can be found in DISPERSE Guidance.

2. Default values can be entered for any of these parameters.

iii. Type **3** for facilities that have a pre-existing BPIP file in standard EPA format.

8. The default **building center location** is the stack, unless the user indicates otherwise. If user wants a different building center location, hit **Y** to specify building center. **N** will provide default values.
   a. If **Y** is typed, user will be prompted to enter the stack east-west distance, in meters, from the building center. Positive numbers are east and negative numbers are west.
   b. The north-south distance must also be specified. Positive numbers are north and negative numbers are south.
9. Type in the year of **meteorology data** that will be used, type **0** for unknown. Default value will run all five years of data between 1986 and 1990. MPCA expects users to use this value unless running a pre-screen trial.
10. A **land use land cover** (LULC[14]) option must be selected.
    a. Type **0** to select all three LULC types or if the LULC is unknown.
    b. Type **1** for cropland or an area with a roughness height of approximately 0.01m to 0.2m. This option resembles an isolated farmstead.
    c. Type **2** for a 50/50 mix of cropland and deciduous forest. The roughness height of this LULC would be ~ 0.3m to 0.8m. This option resembles most towns and suburban areas.
    d. Type **3** for deciduous forests or an area with a roughness height of 0.5m to 1.3m. This option is similar to the downtown core areas of the Twin Cities.
11. Before running the program, the user has an opportunity to check the input information for accuracy. If the information is not correct, type **N** and you will return to the beginning of the program. Type **Y** and hit **enter** to continue.
12. The '**run time**' of the program will be estimated and then the user must hit any key to continue.
13. It ends with: "CAPTAPS RUN COMPLETED SUCCESSFULLY!" Hit any key to continue. The DOS window will 'disappear'.
14. Use Windows Explorer or open a word processing program (such as Microsoft Word) to access the summary report[15] and figures.
15. The summary report is in SUMMARYR.TXT. The six figures are in SUMMARYn.TXT ("n" is 1, 3, 8, D, M, A) for n-hour averages, daily averages, monthly averages, and annual averages. Note these summary files will be overwritten each time the program is run. If user wants to save any of this output, please save in a different directory (folder).

How to View/Print:

1. For best viewing/printing of the summary report (SUMMARYR.TXT), select portrait mode.
2. For best viewing/printing of the summary figures, select landscape or portrait mode, set font size to 8 (CONTROL-A selects the entire file contents), and set margins to 0.5.

[14] Additional information on LULC can be found in DISPERSE Guidance.

[15] Additional information on summary reports can be found in DISPERSE Guidance.

Interpreting the DISPERSE Batch Program Output

Most users will refer to page 1 and 2 of the summary report (SUMMARYR.TXT) generated by the batch process. Page 1 (level 1) provides a look-up table that includes dispersion factors that fall on and off buildings. As it is often not appropriate to evaluate receptors on the building, page 2 excludes those values. The user will use a dispersion factor at an appropriate receptor distance from one of these two tables. The top line in each of the tables, labeled “NOT APP”, is the maximum value for each exposure time. Page 3 shows the user the facility-specific information inputted into the program to formulate the dispersion factors. The pages following contain modeling information that may not be necessary for all users.

Summary figures generated by the program as SUMMARY*n*.TXT are a visual depiction of dispersion factors surrounding the facility. A key to these illustrations is found at the top of each page. Additional information can be found in the DISPERSE Guidance.

Fugitive Emissions

Air emissions not emitted through stacks or vents are considered fugitive emissions, and will need to be accounted for in AERA. Examples of fugitive emission sources include volatile organic compound emissions from outdoor leaking valves, hydrogen sulfide from uncovered wastewater treatment plants, and particulates blowing from outdoor stockpiles. “Fugitives” released within a building should be assumed to be released to the outdoor air—most commonly assumed to discharge through the building’s heating and ventilating system.

For non-stack releases (e.g. windows, doors, or fugitive emission sources), run SCREEN3 or a more refined dispersion model to estimate dispersion factors for the Risk Analysis Screening Spreadsheet (RASS). See attachment B of DISPERSE User’s Guide.

Appendix C: Draft Multimedia Factors

The Risk Analysis Screening Spreadsheet (RASS) incorporates multimedia factors to efficiently differentiate emissions that may or may not lead to ingestion pathway exposures of concern. Multimedia factors for selected persistent, bioaccumulative toxic chemicals are designed to be ratios of the maximum risk from the indirect exposure pathway to the maximum risk from the inhalation exposure pathway.

The multimedia factors currently in the RASS should be considered draft, interim values, and are subject to change upon completion of a state-wide multimedia risk analysis and review of the results. The factors were developed using the Industrial Risk Assessment Program (IRAP) software, incorporating algorithms contained in USEPA's OSW "Human Health Risk Assessment Protocol for Hazardous Waste Combustors."[16] Factors were developed for both cancer and noncancer endpoints for farming and residential scenarios. Factors were **not** developed for the fish consumption pathway due to the great number of variables inherent in estimating fish concentrations, e.g., watershed size relative to the water body, flow rate and depth of the water body, and other factors. However, it is commonly understood that the fish consumption pathway should be considered when mercury is a chemical of potential concern and the MPCA model should be used to estimate a hazard quotient for this pathway. Risk analyses performed using IRAP have also shown that dioxins and furans, PAHs, some metals and other chemicals can have higher risks via the fish consumption pathway than from inhalation. This means that the fish consumption pathway should be considered on a project-specific basis until state-wide risk analysis results have been reviewed, or until another screening approach can be developed. As of the date of this revised guidance, the MPCA is developing a model for evaluating risk from non-mercury pollutants via the fish consumption pathway. This model is under development with the assistance of an external contractor and will be made available on the MPCA website upon completion.

Dispersion modeling files used for this exercise were originally developed for use with the IRAP model and were reviewed by MPCA staff. One emissions source was selected and an emission rate of 1 g/s was entered for most non-volatile chemicals listed in IRAP. Risks from indirect (non-inhalation) pathways for farmers and residents were estimated at the location of maximum concentration. Multimedia factors were then estimated in the following way:

Maximum air concentrations were extracted from the IRAP model to estimate inhalation chronic noncancer hazard quotients and cancer risks by comparing modeled air concentrations with noncancer inhalation health benchmarks (IHB) and by multiplying the air concentrations by inhalation unit risks from the MPCA's current IHB hierarchy of values for use in AERAs. To find chemical-specific multimedia factors, each chemical's IRAP-computed total indirect pathway risk (hazard quotient and cancer risk) was divided by the chemical's inhalation risk. Only those chemicals with a ratio of one (rounded values) or higher were assigned factors. These factors represent the number of times greater the risk could be from indirect pathway

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[16] http://www.epa.gov/epaoswes/hazwaste/combust/risk.htm

exposures than from the inhalation exposures. Multimedia factors have been rounded to one significant digit and can be viewed on the *MMFactors* page of the RASS.

Appendix D: MPCA Air Identification Numbers

ID #	Chemical Name
00-07-9	Aldehydes
0-00-1	Antimony Compounds
0-00-2	Arsenic Compounds
00-03-0	Barium Compounds
0-00-3	Beryllium Compounds
0-00-4	Cadmium Compounds
0-00-5	Chromium Compounds
0-00-6	Cobalt Compounds
0-00-7	Coke Oven Emissions
00-03-1	Copper Compounds
0-00-8	Cyanide Compounds
0-02-4	Diesel exhaust particulate
0-01-2	Glycol ethers
00-08-5	Heptachlorodibenzodioxin, All Isomers
00-08-4	Heptachlorodibenzofuran, All Isomers
00-08-3	Hexachlorodibenzodioxins, All Isomers
00-08-2	Hexachlorodibenzofurans, All Isomers
0-01-3	Lead Compounds
00-07-8	m- and p-Xylenes
0-01-4	Manganese Compounds
0-02-3	Mercury Compounds
0-01-5	Nickel Compounds
0-02-5	Nickel refinery dust from the pyrometallurgical process
00-08-1	Pentachlorodibenzodioxins, All Isomers
00-09-0	Pentachlorodibenzofurans, All Isomers
00-07-7	Petroleum Hydrocarbons, Aliphatic (C7 - C11)
00-05-0	Polychlorinated Dibenzodioxins, Total
00-05-1	Polychlorinated Dibenzofurans, Total
00-08-0	Polychlorinated Dibenzo-P-Dioxins And Furans, Total
00-01-7	Polycyclic Organic Matter (POM)
0-01-9	Selenium Compounds
00-03-2	Silver Compounds
00-09-1	TCDD Equivalents, 2,3,7,8-
00-08-8	Tetrachlorodibenzodioxins, All Isomers
00-08-9	Tetrachlorodibenzodioxins,Other (Excluding 2,3,7,8)
00-08-6	Tetrachlorodibenzofurans, All Isomers
00-08-7	Tetrachlorodibenzofurans, Other (Excluding 2,3,7,8)
00-03-3	Zinc Compounds

Appendix E: MPCA Chemical Groups

Group	CAS # or ID #	Chemical Name
Ag	00-03-2	Silver Compounds
Ag	7440-22-4	Silver
ALD	00-07-9	Aldehydes
ALD	111-30-8	Glutaraldehyde
ALD	50-00-0	Formaldehyde
ALD	75-07-0	Acetaldehyde
As	0-00-2	Arsenic Compounds
As	1327-53-3	Arsenic Trioxide
As	7440-38-2	Arsenic
As	7784-42-1	Arsine
Be	0-00-3	Beryllium Compounds
Be	7440-41-7	Beryllium
Bo	7440-42-8	Boron
Bo	7637-07-2	Boron trifluoride
Cd	0-00-4	Cadmium Compounds
Cd	7440-43-9	Cadmium
CN	0-00-8	Cyanide Compounds
CN	57-12-5	Cyanide (Cyanide ion, Inorganic cyanides, Isocyanide)
CN	74-90-8	Hydrogen cyanide
Co	0-00-6	Cobalt Compounds
Co	7440-48-4	Cobalt
Cr	0-00-5	Chromium Compounds
Cr	18540-29-9	Chromic acid mists and dissolved Cr(VI) aerosols
Cr	18540-29-9	Chromium (Hexavalent) (particulate)
Cr	7789-06-2	Strontium chromate
Cr, Pb	7758-97-6	Lead Chromate
Cresol	1319-77-3	Cresols/Cresylic acid (isomers and mixture)
Cresols	106-44-5	Cresol, p-
Cresols	108-39-4	Cresol, m-
Cresols	95-48-7	Cresol, o-
Cu	00-03-1	Copper Compounds
Cu	7440-50-8	Copper
DF	00-05-0	Polychlorinated Dibenzodioxins, Total
DF	00-05-1	Polychlorinated Dibenzofurans, Total
DF	00-08-0	Polychlorinated Dibenzo-P-Dioxins And Furans, Total
DF	00-08-1	Pentachlorodibenzodioxins, All Isomers
DF	00-08-2	Hexachlorodibenzofurans, All Isomers
DF	00-08-3	Hexachlorodibenzodioxins, All Isomers
DF	00-08-4	Heptachlorodibenzofuran, All Isomers
DF	00-08-5	Heptachlorodibenzodioxin, All Isomers
DF	00-08-6	Tetrachlorodibenzofurans, All Isomers
DF	00-08-7	Tetrachlorodibenzofurans, Other (Excluding 2,3,7,8)
DF	00-08-8	Tetrachlorodibenzodioxins, All Isomers
DF	00-08-9	Tetrachlorodibenzodioxins,Other (Excluding 2,3,7,8)
DF	00-09-0	Pentachlorodibenzofurans, All Isomers
DF	00-09-1	TCDD Equivalents, 2,3,7,8-
DF	132-64-9	Dibenzofurans
DF	1746-01-6	Tetrachlorodibenzo-p-dioxin, 2,3,7,8-
DF	19408-74-3	Hexachlorodibenzo-p-dioxin, 1,2,3,7,8,9-

DF	3268-87-9	Octachlorodibenzo-p-dioxin, 1,2,3,4,5,6,7,8-
DF	35822-46-9	Heptachlorodibenzo-p-dioxin, 1,2,3,4,6,7,8-
DF	39001-02-0	Octachlorodibenzofuran, 1,2,3,4,5,6,7,8
DF	39227-28-6	Hexachlorodibenzo-p-dioxin, 1,2,3,4,7,8-
DF	40321-76-4	Pentachlorodibenzo-p-dioxin, 1,2,3,7,8-
DF	51207-31-9	Tetrachlorodibenzofuran, 2,3,7,8-
DF	55673-89-7	Heptachlorodibenzofuran, 1,2,3,4,7,8,9-
DF	57117-31-4	Pentachlorodibenzofuran, 2,3,4,7,8-
DF	57117-41-6	Pentachlorodibenzofuran, 1,2,3,7,8-
DF	57117-44-9	Hexachlorodibenzofuran, 1,2,3,6,7,8-
DF	57653-85-7	Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-
DF	60851-34-5	Hexachlorodibenzofuran, 2,3,4,6,7,8-
DF	67562-39-4	Heptachlorodibenzofuran, 1,2,3,4,6,7,8-
DF	70648-26-9	Hexachlorodibenzofuran, 1,2,3,4,7,8-
DF	72918-21-9	Hexachlorodibenzofuran, 1,2,3,7,8,9-
DIIS	101-68-8	Methylene diphenyl diisocyanate (MDI)
DIIS	26471-62-5	Toluenediisocyanate (mixed isomers)
DIIS	584-84-9	Toluene diisocyanate, 2,4-
DIIS	822-06-0	Hexamethylene-1,6-diisocyanate
DIIS	9016-87-9	Polymeric diphenylmethane diisocyanate
DIIS	91-08-7	Toluene-2,6-diisocyanate
Glycol	0-01-2	Glycol ethers
Glycol	107-98-2	Propylene Glycol Monomethyl Ether
Glycol	109-86-4	Methoxyethanol, 2- (ethylene glycol monomethyl ether EGME)
Glycol	110-49-6	Methyl Cellosolve Acetate
Glycol	110-80-5	Ethoxyethanol, 2- (ethylene glycol monoethyl ether)
Glycol	111-15-9	Cellosolve Acetate (ethylene glycol monoethyle ether acetate)
Glycol	111-76-2	Butyl Cellosolve (ethylene glycol monobutyl ether)
Glycol	112-34-5	Diethylene Glycol Monobutyl Ether
Hg	0-02-3	Mercury Compounds
Hg	7439-97-6	Mercury
ISO	624-83-9	Methyl isocyanate
Mn	0-01-4	Manganese Compounds
Mn	1313-13-9	Manganese Dioxide
Mn	7439-96-5	Manganese
Ni	0-01-5	Nickel Compounds
Ni	0-02-5	Nickel refinery dust from the pyrometallurgical process
Ni	12035-72-2	Nickel sulfide (NI3S2)
Ni	1313-99-1	Nickel oxide
Ni	7440-02-0	Nickel
PAH	00-01-7	Polycyclic Organic Matter (POM)
PAH	130498-29-2	Polycyclic Aromatic Hydrocarbons (PAH)
PAH	189-55-9	Dibenzo[a,i]pyrene
PAH	189-64-0	Dibenzo(a,h)pyrene
PAH	191-30-0	Dibenzo(a,l)pyrene
PAH	192-65-4	Dibenzo(a,e)pyrene
PAH	193-39-5	Indeno(1,2,3-cd)pyrene
PAH	194-59-2	Dibenzo(c,g)carbazole, 7H-
PAH	205-82-3	Benzo(j)fluoranthene
PAH	205-99-2	Benzo[b]fluoranthene
PAH	207-08-9	Benzo(k)fluoranthene
PAH	218-01-9	Chrysene (Benzo(a)phenanthrene)
PAH	224-42-0	Dibenz(a,j)acridine

PAH	226-36-8	Dibenz(a,h)acridine
PAH	3697-24-3	Methylchrysene, 5-
PAH	42397-64-8	Dinitropyrene, 1,6- (BaP)
PAH	42397-65-9	Dinitropyrene, 1,8- (BaP)
PAH	50-32-8	Benzo[a]pyrene
PAH	53-70-3	Dibenz[a,h]anthracene
PAH	5522-43-0	Nitropyrene, 1-
PAH	56-55-3	Benz[a]anthracene
PAH	57835-92-4	Nitropyrene, 4-
PAH	602-87-9	Nitroacenaphthene, 5-
PAH	607-57-8	Nitrofluorene, 2-
PAH	7496-02-8	Nitrochrysene, 6-
PAH:	91-20-3	Naphthalene
Pb	0-01-3	Lead Compounds
Pb	7439-92-1	Lead
PHA9-16	00-07-7	Petroleum Hydrocarbons, Aliphatic (C7 - C11)
Sb	0-00-1	Antimony Compounds
Sb	1309-64-4	Antimony trioxide
Sb	7440-36-0	Antimony
Se	0-01-9	Selenium Compounds
Se	7784-49-2	Selenium
V	1314-62-1	Vanadium oxide, (V_2O_5)
Xylenes	00-07-8	m- and p-Xylenes
Xylenes	106-42-3	Xylenes, p-
Xylenes	108-38-3	Xylenes, m-
Xylenes	1330-20-7	Xylenes
Xylenes	95-47-6	Xylenes, o-
Zn	00-03-3	Zinc Compounds
Zn	7440-66-6	Zinc
Zn, Cr	13530-65-9	Zinc chromate

Appendix F: Web Resources

AERA Guidance Document: http://www.pca.state.mn.us/air/atguide.html

Chemical and Health Benchmarks Web Resources:

OEHHA (California)	http://www.oehha.ca.gov/air/toxic_contaminants/index.html
OEHHA values	http://www.oehha.ca.gov/air/hot_spots/index.html
Michigan	http://www.michigan.gov/deq/0,1607,7-135-3310_4105---,00.html
TPH	http://www.aehs.com/publications/catalog/contents/Volume4.pdf
US EPA IRIS	http://www.epa.gov/iris/
HRVs	http://www.health.state.mn.us/divs/eh/air/hrvbackground.htm
HAPs	http://www.epa.gov/ttn/atw.orig189.html

Emissions Data Web Resources:

EPA OAQPS Control Cost Manual:	http://www.epa.gov/ttn/catc/products.html#cccinfo
AP 42	http://www.epa.gov/ttn/chief/ap42/index.html
Introduction to AP-42	www.epa.gov/ttn/chief/ap42/c00s00.pdf
California's BACT page	www.arb.ca.gov/bact/bact

Risk Assessment

HHRAP http://www.epa.gov/epaoswer/hazwaste/combust/risk.htm

Mapping References

Minnesota Department of Natural Resources	http://www.dnr.state.mn.us/maps/index.html
USGS:	http://mapping.usgs.gov
Mapquest:	www.mapquest.com
TerraServer USA:	http://www.terraserver-usa.com
Google Earth	http://earth.google.com/

Modeling

MPCA Air Dispersion Modeling Guidance: http://www.pca.state.mn.us/air/modeling.html