Chapter 7 Communicating Results

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7.0 Introduction

The purpose of an air toxics **risk assessment** is to evaluate the magnitude and extent of exposure to air toxics and the potential effects on humans and the environment. Risk assessments aid the process of developing risk management alternatives that minimize risk and maximize environmental benefits.

What is Risk Communication?

Risk communication is the way in which decision-makers communicate with various interested parties about the nature and level of risk, and about the risk reduction strategies to reduce the risk.

The purpose of **risk communication** is to help in the planning of the risk assessment and to convey the results of the risk assessment in a way that effectively supports risk management decisions; this is so that the risk management decisions both meet the goals of the project and provide some comfort level for stakeholders. Good risk communication strategies are a fundamental aspect of developing trust among various stakeholders and the community and are often considered an important first step that can begin even before conducting the risk assessment. Involving the community, establishing and maintaining relationships, and networking with other partners (e.g., agencies, organizations, officials, the media) are key elements in a risk communication strategy. Tailoring communications to the cultural diversity of the community is important because it may help establish the trust necessary to complete a risk assessment that meets all stakeholder and community needs. Risk management rooted in voluntary measures requires effective risk communication to get buy-in.

The subject of risk communication overlaps considerably with related topics discussed in Chapter 6, including EPA's philosophy of transparency, clarity, consistency, and reasonableness (TCCR) as described in its *Policy For Risk Characterization*.[1]

This first part of this chapter (Sections 7.0 through 7.4) provides a general overview of risk communication based on information developed by the Agency for Toxic Substances and Disease Registry (ATSDR)[a] and other authors in order to assist the risk assessment team in communicating the context and results of the risk assessment to the public. The second part of this chapter (Section 7.5 to the end) provides information tailored to communicating about multisource air toxics risks at the local level.

ATSDR has published a handbook on risk communication for its staff.[2] Although directed toward ATSDR staff, this handbook clearly and effectively outlines the detailed steps necessary in order to develop an effective risk communication plan, and is applicable to all risk assessors and risk management teams. The tools and information in the ATSDR handbook (and discussed in this chapter) will help the risk assessment team:

Why is Risk Communication Important?

1. Provides an opportunity to communicate health risks in a caring, concerned, and well-planned manner
2. Involves the community in the risk management process
3. Helps alleviate fear or anger and establish trust

[a] ATSDR also has an excellent website on risk communication resources (see http://www.atsdr.cdc.gov/HEC/primer.html).

- Develop a communication strategy;
- Conduct community outreach and evaluation;
- Develop communication messages; and
- Interact effectively with the news media.

Effective Risk Communication:

- Can determine and respond to community concerns;
- Can reduce tension between concerned communities and agency staff; and
- Can explain health risk information more effectively to communities.

It is important to keep in mind that many different people can have a role to play in communicating results, and the stakeholder team performing the overall project can be utilized to help develop a communication strategy specific to the community being examined. This is especially true if there are members of the community taking part in the stakeholder group process. For example, if the stakeholder group includes community residents, it may be useful to have them help communicate results to the community as a whole, particularly if they are trusted by local citizens.

7.1 Risk Perception

If people perceive themselves to be at risk, their perception is unlikely to change even if they are not being exposed or harmed. Elements that affect risk perception include experience, culture, level of education, outrage factors, who is affected/how they are affected (equal treatment), and the level of control exercised on an event or events. People's perceptions of the magnitude of risk also are influenced by factors other than numerical data. According to Covello[3] and other authors:[4]

Two-way risk communication works best. Non-experts want access to information and to gain knowledge. Technical experts and officials also want to learn more about non-experts' interests, values and concerns. The audience includes government, industry, citizens, and both technical and non-technical people. They can all be included in the process as partners.

- Risks perceived to be voluntary are more accepted than risks perceived to be imposed.
- Risks perceived to be under an individual's control are more accepted than risks perceived to be controlled by others.
- Risks perceived to have clear benefits are more accepted than risks perceived to have little or no benefit.
- Risks perceived to be fairly distributed are more accepted than risks perceived to be unfairly distributed.
- Risks perceived to be natural are more accepted than risks perceived to be manmade.
- Risks perceived to be generated by a trusted source are more accepted than risks perceived to be generated by an untrusted source.
- Risks perceived to be familiar are more accepted than risks perceived to be exotic.
- Risks perceived to affect adults are more accepted than risks perceived to affect children.

7.2 Your Risk Communication Strategy - The Overall Plan

In general, planning a risk communication strategy includes the following steps:

- Determine the goals of the communication effort;
- Identify communication restraints;
- Identify the audience(s);
- Identify audience concerns;
- Identify what the audience(s) knows about the issues, both correct information and misinformation;
- Design the message(s) to be sent out to the community;
- Design the "channels"/choose the best methods to reach people;
- Prepare to deliver/present the message;
- Anticipate communication problems;
- Evaluate the program; and
- Modify program as needed.

When working through this process, it is important to know and understand the communication limits and purpose, know your audience, and whenever possible, pretest your message(s). You also should communicate early, often, and fully, and remember that for many of the people in your audience, perception is reality.

A good communication strategy also will use tested principles of good presentation, such as the use of simplified language to present important content and the ability to be objective (not subjective) and balanced. Presentations also should not be limited to just one form or just one medium.

Try to use spokespersons who can communicate knowledgeably, honestly, clearly, and compassionately, and will listen and deal with specific concerns. Finally, it is important to make sure that the information provided in the risk communication strategy is conveyed to all segments of the audience at a level that they can understand and that the communication materials are honest and upfront about uncertainties. It is often better to say "I don't know" than to hedge.

The ability to establish constructive communication will be determined, in large part, by whether or not the audiences perceive the speaker to be trustworthy and believable. Public assessment of how much we can be trusted and believed is based upon four factors:[(1)]

- Empathy and caring;
- Competence and expertise;
- Honesty and openness; and
- Dedication and commitment.

7.3 Risk Comparisons

Many successful risk communication efforts have had one major thing in common – a portrayal that puts the calculated exposure risks from an assessment in perspective, with risk ranges the public can easily relate to and understand.

Risk comparisons can help to put risks into perspective. However, irrelevant or misleading comparisons can harm trust and credibility. Thus, while risk comparisons are commonly used, they should be used with caution, because some kinds of risk comparisons are more likely to be perceived as pre-conceived judgments about the acceptability of risks.[1] Guidelines for risk comparisons have been published[5] and provide rankings of risk comparisons in terms of their acceptability to the community. The highest-ranking comparisons are those that presume a level of trust between the risk communicator and the public, and that consider the factors that people use in their perception of risk. Exhibit 7-1 describes several example risk comparison rankings.

The general rule of thumb is to select from the highest-ranking risk comparisons whenever possible. When there is no choice but to use a low-ranking risk comparison, do so cautiously, being aware that it could backfire. The fifth rank, which risk assessors rarely use, consists of comparisons of unrelated risks (e.g., involuntary vs. voluntary risks). These comparisons have

Exhibit 7-1. Relative Acceptability of Risk Comparisons

- **First-rank risk comparisons (most acceptable)**
  - Of the same risk at two different times
  - With a standard
  - With different estimates of the same risk
- **Second-rank comparisons (less desirable)**
  - Of the risk of doing something versus not doing it
  - Of alternative solutions to the same problem
  - With the same risk experienced in other places
- **Third-rank comparisons (even less desirable)**
  - Of average risk with peak risk at a particular time or location
  - Of the risk from one source of an adverse effect with the risk from all sources of the same effect
- **Fourth-rank comparisons (marginally acceptable)**
  - With cost; or one cost/risk ratio with another
  - Of risk with benefit
  - Of occupational risk with environmental risk
  - With other risks from the same source
  - With other specific causes of the same disease, illness, or injury
- **Fifth-rank comparisons (rarely acceptable – use with caution)**
  - Of risks that may seem unrelated to community members (e.g., smoking, driving a car, lightning)

been found to be very problematic. For example, the risk of driving without a seat belt is a voluntary risk, while exposure to air toxics is generally considered involuntary by community members. Covello et al. [5] provide specific examples of each of the comparison ranks, as associated with a manufacturing facility (http://www.psandman.com/articles/cma-4.htm). Risk comparison charts are also provided in Appendix B of that document (http://www.psandman.com/articles/cma-appb.htm), although the authors do not recommend their use in public presentations.

EPA has included risk comparisons in some air toxics analyses. For example, the EPA's NATA National-Scale Risk Characterization (http://www.epa.gov/ttn/atw/natamain) discusses general estimated U.S. background concentrations and risks from air toxics. Additional information on dealing with background risks is provided in Section 5.2.4.

7.4 Implementing Risk Communication Strategies

In order to implement risk communication strategies, agencies may need to plan their messages, approaches to public presentations, and working with the media. The purpose of communication with the public is to inform, educate, and enhance cooperative problem solving and conflict resolution. The strategies for communicating effectively with the public should be written down in a communication plan. This plan should be developed early in the Planning and Scoping process (Chapter 4) and then implemented throughout the process. Communicating early and often with external stakeholders will be key to the overall assessment and risk reduction efforts.

7.4.1 Key Messages and Communication Opportunities

Risk communication strategies also consider the meaning of the information (e.g., will the listener understand how to use the information in forming opinions, making decisions, and taking actions). When risks are calculated for air toxics and the risk results are presented to the public, the community may not be familiar with quantitative risk data and what it means for them. In order to prevent panic and to encourage participation in and buy-in of risk management decisions, risk communication strategies are developed that not only reassure the community, but also explain the potential risks and uncertainties in an understandable, clear, and honest way. Effective communications also provide information in a community-compatible language or form. For example, if the community speaks Spanish, then the communications could be in Spanish as well as English. Similarly, if the community includes Native Americans, the communications could be in the appropriate language and employ appropriate symbolism. The effective communication of risks will allow stakeholders to better participate in management decisions that weigh the benefits of different alternatives against the costs of achieving "acceptable" levels of risks and the costs of disruptions associated with implementation.

When developing messages, it is important to consider the following questions:

- What does the community already know?
- Is this information factual?
- What does the community want to know?
- What does the community need to know?
- Can the information be misunderstood?

When developing a public education campaign, it is generally most effective if the campaign highlights no more than three primary messages. More than three primary messages may convolute the focus of the education campaign. Those developing public education campaigns may wish to test their risk communication messages with trusted audience members before releasing them to the public. This can ensure that the messages are on-target and help avoid community objections that decision-makers may not have anticipated. It also is important to ensure that the message is culturally attuned and fits the language needs of the audience. "Outrage reducers" are outlined by risk communication specialist Peter Sandman (www.petersandman.com).

When developing risk-communication messages, decision-makers should (1) review the concerns and worries of their audience; (2) cover WHO, WHAT, HOW, WHEN, WHERE and WHY; and (3) develop messages that are consistent with their actions.

Different messages and channels may be needed for different audiences. To communicate effectively, the risk communicator should try to understand the audience's values, concerns, and perceptions. Credibility is enhanced by the degree to which the risk communicator correctly identifies, anticipates, and empathizes with the specific concerns of his or her audience(s), which may include:

- Health concerns;
- Safety concerns;
- Environmental concerns;
- Economic concerns;
- Aesthetic concerns;
- Lifestyle/cultural concerns;
- Data and information concerns;
- Fairness/Equity concerns;
- Trust and credibility concerns;
- Process/value concerns (e.g., who makes decisions and how); and
- Risk management concerns.

Audiences May Include:

- Environmental groups;
- Civic organizations;
- Professional and trade organizations;
- Educational and academic groups;
- Religious groups;
- Other government agencies;
- Neighborhood/school organizations;
- Industries; and
- Other organizations.

It may be worthwhile to develop audience profiles for key audiences. Profiles describe the members of the audience, whom they trust and go to for information (decision-makers can seek these people out for advice on communicating with the community), what their prevailing attitudes and perceptions are, and what concerns and worries motivate their actions.

It is important to clearly communicate scientific information and uncertainty:

- Provide all information possible, as soon as possible;
- Communicate when there is progress being made;
- Maintain your relationship with the community;
- Be honest about what you do not know;
- Explain how you will work together to find the answers;
- Help the audience understand the process behind your findings;
- Avoid acronyms and jargon;

- Carefully consider what information is necessary; and
- Use familiar frames of reference to which the audience can relate.

Public interactions may also include availability sessions, informal discussions, or poster sessions. Presentations can occur in a variety of venues some of which are better suited than others to different situations. Determining the best channels for your message depends on understanding when to use which tool and knowing how the community prefers to receive information. Message delivery channels include:

- **Presentations**: Speeches to public groups. Benefit: offers the audience a chance to ask questions; reaches many people at one time. Limitations: if poorly presented, can distort community perception; cannot sufficiently address individual concerns; can become argumentative or confrontational.

- **Open Houses/Availability Sessions**: Informal meeting where public can talk to staff on a one-to-one basis. Benefit: allows for one-to-one conversation; helps build trust and rapport. Limitations: can become argumentative or confrontational.

- **Small Group Meetings**: Sharing information with interested community members and government officials. Benefit: allows two-way interaction with the community. Limitations: may require more time to reach only a few people; may be perceived by community groups as an effort to limit attendance; be sure your information is identical or you may be accused of telling different stories to different groups; can become argumentative or confrontational.

- **Briefings**: Can be held with key officials, media representatives, and community leaders; generally not open to the public. Benefit: allows key individuals to question risk assessment staff before release of public information. Limitations: should not be the only form of community communication; bad feelings may arise if someone feels that they were left off the invite list.

- **Community mailings**: Sends information by mail to key contacts and concerned/involved members of the community. Benefit: delivery of information quickly; may require less planning than a meeting. Limitation: no opportunity for feedback.

- **Exhibits**: Visual displays to illustrate health issues and proposed actions. Benefits: creates visual impact. Limitations: one-way communication tool, no opportunity for community feedback.

- **Fact Sheets**: To introduce new information. Benefit: brief summary of facts and issues; provides background for information discussed during a meeting. Limitations: one-way communication tool; needs to be well-written and understandable.

- **Newsletters**: To inform community of ongoing activities and findings. Benefit: explains findings; provides background information. Limitations: can backfire if community members do not understand or misinterpret contents.

- **News Release**: Statement for the news media to disseminate information to large numbers of community members. Benefit: reaches large audience quickly and inexpensively. Limitations: may exclude details of possible interest to the public; can focus unneeded attention on a subject.

- **Public Meetings**: Large meeting open to the public where experts present information and answer questions, and community members ask questions and offer comments. Benefit: allows community to express concerns and agency to present information. Limitations: can intensify conflicts, rather than resolve controversies.

Presentations require a careful balancing act between effectively conveying key messages and avoiding a range of pitfalls. Important "Dos" and "Don'ts" to avoid presentation pitfalls are outlined in Exhibit 7-2.

7.4.2 Working With the Media

The media can be a primary source of information on risks to the public. Effective news media relations have many benefits, complementing other communication efforts. What people read, see, or hear in news coverage can lend credibility to agencies associated with air toxics risk assessment, and can help to make it a familiar topic for public discussion. News coverage can inform people about air toxics issues and help them ask appropriate questions. Skill in media relations can help risk communications avoid or dispel rumors, respond to criticism, defuse controversy, and even turn adversity to advantage.

News coverage is crucial to engaging the attention of decision-makers and earning the support of opinion leaders. Also, because the news media pay distribution costs, helping journalists cover the issues is a cost-effective way to communicate.

The best approach to the media, as with the public, is to be open and honest, provide information tailored to the needs of each type of media, such as graphics and other visual aids, and provide background material. Journalists also should welcome such materials as fact sheets, press kits, and lists of experts. Establishing an information center also can be an effective way to make materials available to the news media (and to the general public). It also is very important that the material and discussions you have with the media clearly articulate the messages that you want to find their way into print or onto the TV or radio.

Like other communication efforts, working with the news media is done best when it is based on a strategy and follows a systematic process. A good strategy seeks opportunities to match the goals and objectives of the organization with the interests of journalists. As in other communication strategies, assessing the needs of the audience – journalists – is important to reaching them effectively.

After you determine that the rules of your organization concerning contacts with the media have been met, here are a few suggestions on how to deal with news reporters:

- When a reporter calls, be sure to get a name and media affiliation; if what the reporter wants is not clear to you, ask for a clear explanation; if you are uneasy with a reporter's query, decline in a friendly way to continue the conversation.

Exhibit 7-2. Presentation Dos and Don'ts

- **Pitfall**: **Jargon**
  Do: Define all technical terms and acronyms.
  Don't: Use language that may not be understood by even a portion of your audience.

- **Pitfall**: **Humor**
  Do: Direct it at yourself, if used.
  Don't: Use it in relation to safety, health, or environmental issues.

- **Pitfall**: **Negative Allegations**
  Do: Refute the allegation without repeating it.
  Don't: Repeat or refer to them.

- **Pitfall**: **Negative Words and Phrases**
  Do: Use positive or neutral terms.
  Don't: Refer to national problems (problems unrelated to the issue at hand), i.e., "This is not Love Canal."

- **Pitfall**: **Reliance on Words**
  Do: Use visuals to emphasize key points, but be culturally correct for the audience.
  Don't: Rely entirely on words.

- **Pitfall**: **Temper**
  Do: Remain calm. Use a question or allegation as a springboard to say something positive.
  Don't: Let your feelings interfere with your ability to communicate positively.

- **Pitfall**: **Clarity**
  Do: Ask whether you have made yourself clear.
  Don't: Assume you have been understood.

- **Pitfall**: **Abstractions**
  Do: Use examples, stories, and analogies to establish a common understanding, but test them out first to make sure they are clear, make your point, and are culturally acceptable.

- **Pitfall**: **Nonverbal Messages**
  Do: Be sensitive to nonverbal messages you are communicating. Make them consistent with what you are saying.
  Don't: Allow your body language, your position in the room, or your dress to be inconsistent with your message.

- **Pitfall**: **Attacks**
  Do: Attack the issue.
  Don't: Attack the person or organization.

- **Pitfall**: **Promises**
  Do: Promise only what you can deliver. Set and follow strict orders.
  Don't: Make promises you can't keep or fail to follow up.

- **Pitfall**: **Numbers**
  Do: Emphasize performance, trends, and achievements.
  Don't: Focus on or emphasize large negative numbers.

Exhibit 7-2. Presentation Dos and Don'ts (continued)

Pitfall: **Guarantees**
Do: Emphasize achievements made and ongoing efforts.
Don't: Say there are no guarantees.

Pitfall: **Speculation**
Do: Provide information on what is being done.
Don't: Speculate about worst cases.

Pitfall: **Money**
Do: Refer to the importance you attach to health, safety, and environmental issues; your first obligation is to public health.
Don't: Refer to the amount of money spent as a representation of your concern.

Pitfall: **Organizational Identity**
Do: Use personal pronouns ("I," "we").
Don't: Take on the identity of a large organization.

Pitfall: **Blame**
Do: Take responsibility for your share of the problem.
Don't: Try to shift blame or responsibility to others.

Pitfall: **"Off the Record"**
Do: Assume everything you say and do is part of the public record.
Don't: Make side comments or "confidential" remarks.

Pitfall: **Risk/Benefit/Cost Comparisons**
Do: Discuss risks and benefits carefully (consider putting them in separate communications).

Pitfall: **Risk Comparison**
Do: Use them to help put risks in perspective.
Don't: Compare unrelated risks.

Pitfall: **Health Risk Numbers**
Do: Stress that true risk is between zero and the worst-case estimate. Base actions on federal and state standards, when possible, rather than risk numbers.
Don't: State absolutes or expect the lay public to understand risk numbers.

Pitfall: **Technical Details and Debates**
Do: Focus your remarks on empathy, competence, honesty, and dedication.
Don't: Provide too much detail or take part in protracted technical debates.

Pitfall: **Length of Presentations**
Do: Limit presentations to 15 minutes.
Don't: Ramble or fail to plan the time well.

Source: ATSDR Risk Communication Primer[2]

- Reporters are often under deadline pressure, but you can take enough time to respond effectively; don't get pressured into hasty comments that might backfire.

- Do not hesitate to ask for more information about a story before responding to a request for an interview.

In working with journalists, it is vital to develop good interpersonal relationships. How can you do that? One rule of thumb followed by experienced practitioners is to adhere to the "Five Fs" – Fast, Factual, Frank, Fair, and Friendly (Exhibit 7-3).[6]

Other issues to keep in mind include:

- **Interviews**. Frequently, the best way to get a message out is through an in-person interview. You should generally assume that all statements you make are "on the record." Exhibit 7-4 outlines some techniques to prevent poor transmittal of your message.

- **Press Releases**. Press releases may not be an effective way to transmit a message. However, in some cases, releases that are targeted to particular media outlets and purposes can be useful. For example, the publication of a report on air toxics risk might be newsworthy and of concern to the community, and thus would be sent to local community newspapers. Remember that your press release should emphasize, upfront, the messages that you want to get out to the public.

- **Other Platforms**. You may have the opportunity to communicate your message through other platforms such as:

  – Letters to the Editor. Keep them short, to the point, and prompt.
  – Commentaries. Radio broadcasts and newspapers print a number of opinion pieces each day. Bear in mind that submissions are numerous, acceptances rare.
  – Talk Radio (and TV). Talk shows may request experts to address various environmental issues.

Exhibit 7-3. The "Five Fs" of Media Relations

Fast. Respect journalists' deadlines. If a journalist telephones for information, return the call immediately, even if it is past normal office hours. A phone message returned the next day is often too late. By then, the story already may have been aired or printed.

Factual. Be factual, and make the facts interesting. Stories are to be based on facts. Journalists also appreciate a dramatic statement, creative slogan, or personal anecdote to help illustrate your point. Give the source of any facts and statistics provided.

Frank. Be candid. Never mislead journalists. Be as open as possible and respond frankly to their questions. As long as there is an explanation of the reason, most journalists will understand and respect a source even if he or she is not able to answer a question completely or at all.

Fair. Organizations should be fair to journalists if they expect journalists to be fair to them. Favoring one news outlet consistently, for example, will lose the confidence of the others.

Friendly. Like everyone else, journalists appreciate courtesy. Remember their names; read what they write; listen to what they say; know their interests; thank them when they cover the issues in a factual, unbiased way.

Exhibit 7-4. Interviewing Techniques

- Always think carefully before you answer a question. People often ramble - and say something they wish they hadn't if they answer too quickly. Take a moment to consider what you want to say. If you need more time, ask for the question to be repeated.
- Don't talk just to keep a conversation going with a reporter. Experienced reporters will be silent because often people they interview will talk to fill awkward voids and then say something they don't mean to say.
- Ask the reporter to make your affiliation clear in the story.
- Listen carefully to questions and respond clearly. Avoid jargon. If you have a key idea that you want to get across, repeat it several times, perhaps using different words. This is especially useful for broadcast: no matter how the tape is edited, you will make your point.
- Don't hurry: speak slowly, and in short, concise sentences. State your position in simple, easy-to-understand language. Use everyday examples and analogies, when possible.
- Never talk down to a reporter. You are partners in getting your message across. Arrogance will come across negatively to an audience. An "attitude" can turn an interview into a confrontation.
- Don't lose your temper! No matter how antagonized you feel, recognize that this can be a tactic to get you to say something you do not wish to say.
- If you don't know the answer to a reporter's question, or cannot answer, just refrain from answering. A lie or bad guess will return to haunt you. You will lose credibility.
- Some reporters may ask to tape an interview over the telephone. This is a common practice for radio reporters to obtain "sound bites" and to get accurate quotes. The reporter should inform you of the taping before it begins. Do not repeat an allegation – it could be taken out of context.

Additional Suggested References

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For an additional list of risk communication references, see http://www.psandman.com/articles/cma-bibl.htm.

7.5 Presenting Basic Information About Multisource Cumulative Risk and Hazard

Depending on the purposes for the assessment, different outputs of the risk assessment process will be the focus of communication. The basic information to be presented to the community and other interested stakeholders may include:

- The range of hazard and/or risk estimated for the study area;
- An estimate of the number of people associated with different hazard and/or risk levels (this may be for the community at large and/or for each exposure area evaluated);
- The chemicals and sources that account for the majority of hazard or risk, or a presentation of chemical or source-specific hazard or risk ordered from highest to lowest;
- A comparison of the hazard or risk estimates to other risks, such as background risk (if evaluated);
- The major assumptions, limitations, and uncertainties associated with the above information (see Section 7.5.2); and
- The community-based expectations of acceptable risk and hazard, and those areas where the expectations are exceeded.

Note that risk assessors acting as risk communicators should be careful to avoid making inferences about whether the results for a particular chemical or source should be the target for risk reduction (that is the realm of the risk manager). One way to do this is to simply provide summary information on all chemicals and all sources, and the percentage they all contribute to overall risks. In subsequent risk communication about the findings of the risk assessment, this information may be focused on those chemicals that "account for the majority of hazard and risk;" however, the risk managers should provide input on how to identify those risk factors that are significant and those that are not (from a risk management perspective).

It should also be noted that negative findings may be as important as positive findings. For example, it may be necessary to contrast specific concerns about elevated exposure and health impacts from a local industry identified during planning and scoping with assessment results that indicate exposure and/or risk levels associated with that industry are likely to be low.

7.5.1 Presentation Formats for Multisource Risk Outputs

Risk characterization results for a multisource assessment can be presented in a wide variety of ways, including tables, bar or pie charts, and maps such as GIS overlays. Chapter 6 provides several general examples of ways to depict multisource risk across a study area. Several additional example presentation formats are provided below and in the RAIMI Case Study provided in Appendix A.

- **Exhibit 7-5** presents an example risk summary table. In this example, the risk or hazard posed by all evaluated carcinogens from all known sources impacting two different neighborhoods is first calculated at each modeling point and then averaged for all the modeling points in a given neighborhood (either Happy Land or Big City neighborhood). For example, Happy Land neighborhood has an overlay of 500 modeling points. The estimated chemical-specific cancer risks posed by all sources impacting the neighborhood at each of these points is determined by multiplying the multisource modeled annual average chemical-specific concentration at each point times the associated chemical-specific IURs

(see Chapter 6). In Happy Land, there are a total of 8 carcinogens impacting the neighborhood that are emitted from a mix of local stationary and mobile sources. The annual average concentrations of each of these 8 chemicals is modeled at each of the 500 modeling points. The upper bound cancer risk at each point is then estimated by combining with the appropriate toxicity value. The *average* upper bound cancer risk *across the Happy Land neighborhood* is, for each chemical, the sum of the 500 individual census block risk estimates divided by 500. For example, the average upper bound benzene risk estimate of 9 x 10^{-6} shown in Exhibit 7-5 is the average of the 500 individual benzene risk estimates for the 500 different modeling points within the Happy Land neighborhood. The sum of the chemical-specific average upper bound risk estimates (on a chemical-by-chemical basis) is the average cumulative upper bound cancer risk for this neighborhood (all chemicals, all sources). A similar exercise could be performed for hazard quotients to determine average chemical-specific hazard quotients and an average cumulative hazard index (all chemicals, all sources). Another way to effectively present some of the information in Exhibit 7-5 might be a pie chart, with different wedges representing individual chemicals and wedge sizes corresponding to the fraction of the cumulative cancer risk or hazard index they pose.

- **Exhibit 7-6** presents an example qualitative approach for displaying information. In this example, the chronic hazard posed by each evaluated chemicals with RfCs from all known sources impacting four different neighborhoods is first calculated at each modeling point and then averaged (by chemical) across all the modeling points in a given neighborhood. The result is then compared to some predetermined decision criteria established by the partnership team during the planning and scoping phase of the assessment. In this example, the partnership team decided that if the chemical-specific neighborhood average hazard was, on a chemical-by-chemical basis, less than HQ = 0.1, the chemical would not be considered further (either for higher levels of analysis or for potential risk mitigation).

  For example, the Mitchell Hill neighborhood has an overlay of 250 modeling points. The estimated chemical-specific hazards posed by all sources impacting the neighborhood at each of the 250 points was determined by dividing the multisource modeled annual average chemical-specific concentration for each chemical at each internal point by the associated chemical-specific RfCs (see Chapter 6). In Mitchell Hill, there are a total of 7 RfC chemicals impacting the neighborhood that are emitted from a mix of local stationary and mobile sources. The annual average concentrations of each of these chemicals is modeled at each of the 250 modeling points. The hazard at each modeling point is then determined by combining the modeled concentration with the appropriate toxicity value. The *average* hazard *across the Mitchell Hill neighborhood* is, for each chemical, the sum of the 250 hazard estimates divided by 250. The average value is then compared to the pre-established decision criteria and the chemical specific hazard labeled appropriately. For this table, the analysts decide to label chemical-specific hazard quotients that are less than 0.1 as "LOW" and chemical-specific hazard quotients that are greater than or equal to 0.1 as "Needs more information," indicating that the chemical will be the subject of additional evaluation or, perhaps, more immediate risk reduction.

  Also note that the focus of this particular table was to provide qualitative information regarding hazard. The table authors also used footnotes to provide information about the chemicals that are carcinogens. In addition, also note that this analysis team has not limited

itself to only the federal HAPs (the planning and scoping group expanded their list of chemical for consideration to include ammonia and hydrogen sulfide).

(Also note in this exhibit that color and bolding have been used to emphasize certain elements. This can be a useful technique to help emphasize specific information.)

- In addition to providing information on risks posed by specific chemicals in a particular area, it will also be helpful to display information that shows which sources are responsible for those risks (communicating information about source apportionment). Several examples of how to display source apportionment are provided in Appendix A (RAIMI case study). An additional example is provided in **Exhibit 7-7**.

  In this example, the average cancer risk for the Johnson Creek neighborhood study area (3×10^{-5}) has been apportioned among the various modeled local sources contributing to that average value. Here, the analysts have broken out the sources into only four categories. Alternatively, they could have listed each source individually along with the risk posed by the individual chemicals associated with each.

- Another important communication tool is to provide a graphical presentation that provides the "big picture" of what was done and what was found in the analysis (see **Exhibit 7-8**).

- Finally, GIS overlays and other types of maps can be used to visually communicate information in a wide variety of ways (see **Exhibit 7-9** and additional examples in Appendix B). In the Exhibit 7-9 example, GIS has been used to highlight a specific geographic area within a larger study are (the dots are the modeling grid) and highlights specific risk and demographic information about that area. This approach can be modified in a wide variety of ways to help focus attention to one or more aspects of the area in question.

7.5.2 Communicating Uncertainty

Recognizing and explaining the concept of uncertainty is a critical component of risk communication. Scientific uncertainty can complicate communications when officials attempt to satisfy public demand for reliable, accurate, and meaningful information pertaining to the evaluation of risk. Communication with the public regarding uncertainty in risk estimates can also be complicated by the complexity of the information, a lack of understanding of difficult scientific concepts and analyses, and a public perception that correlation and association are equivalent to causation. Ultimately, persons responsible for communicating risk will have the difficult task of explaining the limitations and uncertainties associated with a risk assessment's findings.

That having been said, audiences should be given as much information as possible, so that they can understand that uncertainty is not unexpected and that "answers" may evolve with the availability of new information and science. If stakeholders are making demands of "total certainty," one issue the risk communicator may try to identify is whether they are questioning the scientific process itself, or rather, if their underlying doubts are related to the input values or assumptions used in the assessment process.

Recommendations from government agencies familiar with risk communication, including the Nuclear Regulatory Commission (NRC), suggest using a variety of methods, such as diagrams, outlines, and analogies, when explaining the potentially complex topic of uncertainty. For more information on effective communication of risk results, refer to Chapter 29 of ATRA, Volume 1, as well as the following resources:

- *A Primer on Health Risk Communication Principles and Practices*, published by the Agency for Toxic Substances and Disease Registry (see http://www.atsdr.cdc.gov/HEC/primer.html);

- *The Technical Basis for the NRC's Guidelines for External Risk Communication*, published by the U.S. Nuclear Regulatory Commission (see http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6840/cr6840.pdf);

- EPA's Risk Assessment Guidelines (see http://cfpub.epa.gov/ncea/raf/recordisplay.cfm?deid=55907); and

- *Communicating in a Crisis: Risk Communication Guidelines for Public Officials*, compiled by the U.S. Department of Health and Human Services (see http://www.riskcommunication.samhsa.gov/RiskComm.pdf).

7.6 Risk Trends

Developing trends or projections in risk over time is one approach for putting the assessment results in perspective and is a representation of risks that the public can easily relate to and understand. The presentation of risk trends for a community, however, will usually require multiple years of data and multiple analyses of risk to track the trends. When using a methodology such as RAIMI, the process is simplified since the method's computer tools allow the processing of "what if" scenarios. This means that analysts can also perform trend analyses rather quickly (assuming no major changes other than emissions in the study area from year to year). The reason for this has to do with the use of unit emission rates for the various pollutants (see Section 5.2.3.2). As future years of emissions data are developed, they can be converted into unit emission rates, compared to previous year data and changes to the original risk analysis can be calculated. Risk trends are most easily communicated by a simple bar chart that shows the change in risk estimates to people in a particular geographic area from year to year (Exhibit 7-10).

Exhibit 7-5. Example Risk Summary Presentation								
Contaminant	**Neighborhood Cumulative Individual Risk and Chronic Hazard Values (All chemicals, all sources; averaged across all neighborhood census block internal points) Lifetime constant exposure scenario**							
	Happy Land Neighborhood				**Big City Neighborhood**			
	Estimated Cancer Risk	**Percent Contribution[a]**	**Hazard**	**Percent Contribution[a]**	**Estimated Cancer Risk**	**Percent Contribution[a]**	**Hazard**	**Percent Contribution[a]**
Benzene	**9×10^{-6}**	2	0.1	9	**3×10^{-5}**	11	0.1	23
1,3-Butadiene	**5×10^{-4}**	86	**1**	90	**1×10^{-4}**	36	0.3	68
Ethylene oxide	**2×10^{-5}**	3	0.01	1	**2×10^{-5}**	7	0.03	7
Formaldehyde	**2×10^{-6}**	<1	0.003	<1	**2×10^{-5}**	7	0.01	2
Benzo(a)anthracene	**9×10^{-6}**	2	NC	-	**2×10^{-5}**	7	NC	-
Benzo(a)pyrene	**3×10^{-5}**	5	NC	-	**7×10^{-5}**	25	NC	-
Benzo(b)fluor-anthene	**9×10^{-6}**	2	NC	-	**2×10^{-5}**	7	NC	-
TOTALS	**6×10^{-4}**	100	**1**	100	**3×10^{-4}**	100	0.4	100

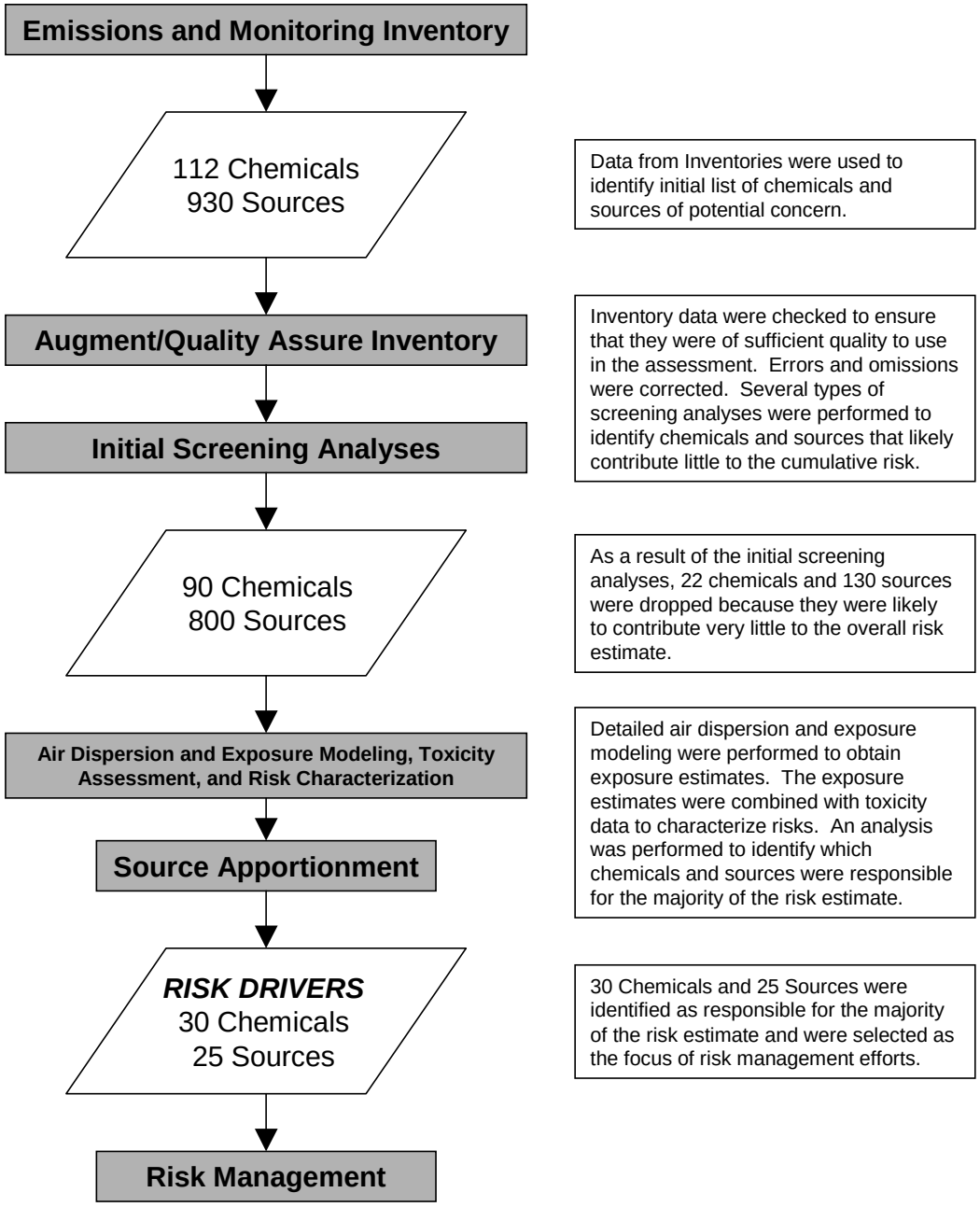
NC Not calculated (RfC not available)
[a] Percent contribution to cumulative cancer risk or hazard for that neighborhood.

Exhibit 7-6. Example Qualitative Presentation of Chronic Hazard Results				
Chemical	**Average Neighborhood Chemical-Specific Hazard (all sources)**			
	Mitchell Hill	**Kramer Heights**	**Manning Acres**	**Wagner's Point**
Ammonia	**Low**[a]	**Low**	**Low**	**Low**
Arsenic[b]	**Low**	**Low**	**Low**	**Low**
Benzene[b]	**Low**	**Low**	**Low**	**Needs more information**[c]
Cadmium[b]	**Low**	**Low**	**Low**	**Low**
Hydrogen sulfide	**Low**	**Low**	**Low**	**Low**
Carbon tetrachloride[b]	**Low**	**Low**	**Low**	**Low**
Chromium (hexavalent)[b]	**Needs more information**[c]	**Needs more information**[c]	**Needs more information**[c]	**Needs more information**[c]

[a] Low means HQ < 0.1
[b] This chemical is also a carcinogen
[c] Areas marked as "needs more information" had a HQ $\geq$ 0.1. These chemicals are candidates for further analysis and possible risk reduction.

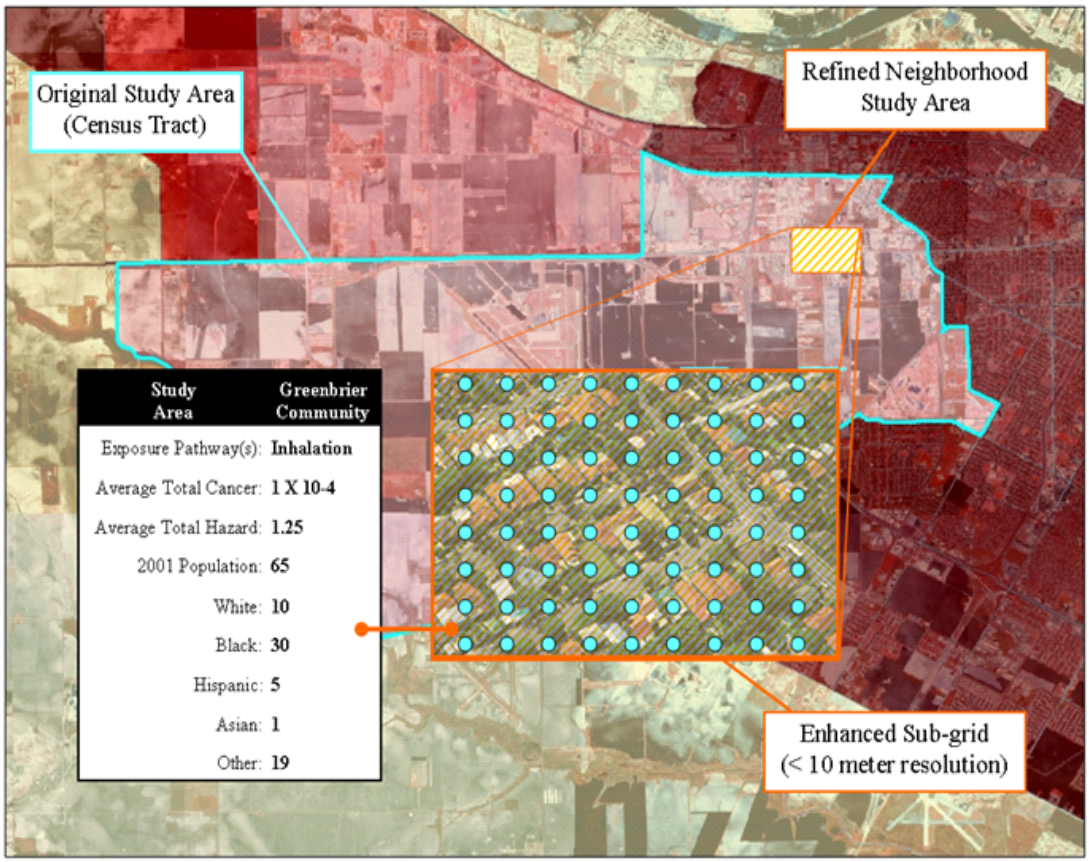
Exhibit 7-7: Example Presentation of Source Apportionment of Average Cancer Risk Johnson Creek Neighborhood			
	Source Description	**Estimated Average Cancer Risk for Lifetime Continuous Exposure**	**Source-Specific Percentage of Inhalation Risk**
1	All On-Road Gasoline Vehicles Surrogate: On-Road Mobile	1×10^{-5}	32%
2	Gasoline Distribution Stage 1 Surrogate: Commercial Land Use and Industrial Land Use	1×10^{-5}	32%
3	All Major Stationary Sources	8×10^{-6}	26%
4	All Other Modeled Sources (36 Individual and 25 Grouped Sources)	3×10^{-6}	10%
	TOTALS	3×10^{-5}	100%

Exhibit 7-8. Example Graphical Representation of the Overall Assessment Methodology and Results



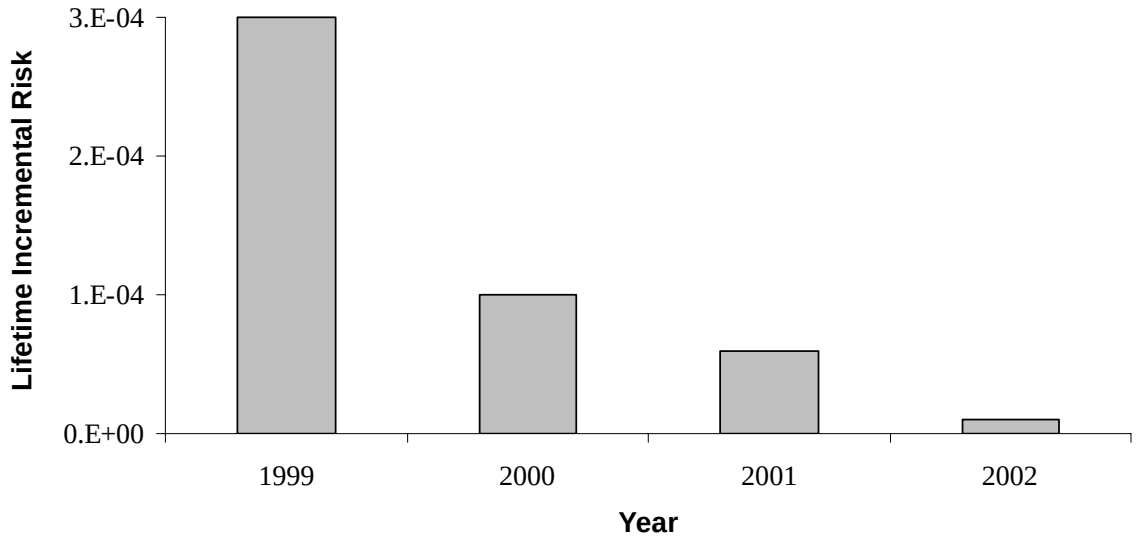
This graphic illustrates each step of a sample multisource cumulative assessment and describes the role each plays in developing the ultimate result – identifying the chemicals and sources responsible for the majority of the risk estimate. This sample assessment also illustrates a tiered or phased approach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

Exhibit 7-9. Example Use of Maps/GIS Overlays to Communicate Assessment Results (Average Total Cancer Risk, All Sources, All Chemicals)



Source: EPA's *Regional Air Impact Modeling Initiative* (see: http://www.epa.gov/Arkansas/6pd/rcra_c/raimi/raimi.htm).

Exhibit 7-10. Example Risk Trend Bar Chart
All Sources, All Chemicals Impacting Study Area



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